Ref. Ares(2019)2416825 - 05/04/2019

EUROPEAN COMMISSION
Directorate-General for Research and Innovation

Open Innovation and Open Science
Director

AMENDMENT Reference No AMD-654002-43

Grant Agreement number: 654002 — European Nuclear Science and Application Research 2 (ENSAR2)

The parties agree to amend the Grant Agreement as follows ('**Amendment**'):

1. Change of Annex 1 (description of the action)

Annex 1 is changed and replaced by the Annex 1 attached to this Amendment.

2 . Changes of Annex 2 (estimated budget)

Annex 2 is changed and replaced by the Annex 2 attached to this Amendment.

All other provisions of the Grant Agreement and its Annexes remain unchanged.

This Amendment **enters into force** on the day of the last signature.

This Amendment **takes effect** on the date on which the amendment enters into force, except where a different date has been agreed by the parties (for one or more changes).

Please inform the other members of the consortium of the Amendment.

SIGNATURES

For the coordinator

For the Commission

Enclosures:

Annex 1
Annex 2

EUROPEAN COMMISSION
Directorate-General for Research and Innovation
Research infrastructures

ANNEX 1 (part A)

Research and Innovation action

NUMBER — 654002 — ENSAR2

Table of Contents

1.1. The project summary

Project Number [1]	654002	Project Acronym [2]	ENSAR2

One form per project

General information	
Project title [3]	European Nuclear Science and Application Research 2
Starting date [4]	The first day of the month after the signature by the Commission
Duration in months [5]	48
Call (part) identifier [6]	H2020-INFRAIA-2014-2015
Topic	INFRAIA-1-2014-2015 Integrating and opening existing national and regional research infrastructures of European interest
Fixed EC Keywords	NATURAL SCIENCES, ENGINEERING AND TECHNOLOGY
Free keywords	nuclear structure, nuclear dynamics, nuclear astrophysics, applications, innovation

Abstract [7]

ENSAR2 is the integrating activity for European nuclear scientists who are performing research in three of the major subfields defined by NuPECC: Nuclear Structure and Dynamics, Nuclear Astrophysics and Nuclear Physics Tools and Applications. It proposes an optimised ensemble of Networking (NAs), Joint Research (JRAs) and Transnational Access Activities (TAs), which will ensure qualitative and quantitative improvement of the access provided by the current ten infrastructures, which are at the core of this proposal. The novel and innovative developments that will be achieved by the RTD activities will also assure state-of-the-art technology needed for the new large-scale projects.Our community of nuclear scientists profits from the diverse range of world-class research infrastructures all over Europe that can supply different ion beams and energies and, with ELI-NP, high-intensity gamma-ray beams up to 20 MeV. We have made great effort to make the most efficient use of these facilities by developing the most advanced and novel equipment needed to pursue their excellent scientific programmes and applying state-of-the-art developments to other fields and to benefit humanity (e.g. archaeology, medical imaging). Together with multidisciplinary and application-oriented research at the facilities, these activities ensure a high-level socio-economic impact.To enhance the access to these facilities, the community has defined a number of JRAs, using as main criterion scientific and technical promise. These activities deal with novel and innovative technologies to improve the operation of the facilities.The NAs of ENSAR2 have been set-up with specific actions to strengthen the communities' coherence around certain resarch topics and to ensure a broad dissemination of results and stimulate multidisciplinary, application-oriented research and innovation at the Research Infrastructures.

1.2. List of Beneficiaries

Project Number [1]	654002	Project Acronym [2]	ENSAR2

List of Beneficiaries

No	Name	Short name	Country	Project entry date[8]	Project exit date
1	GRAND ACCELERATEUR NATIONAL D'IONS LOURDS	GANIL	France		
2	ISTITUTO NAZIONALE DI FISICA NUCLEARE	INFN	Italy		
3	EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH	CERN	Switzerland		
4	JYVASKYLAN YLIOPISTO	JYU	Finland		
5	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	CNRS	France		
6	GSI HELMHOLTZZENTRUM FUER SCHWERIONENFORSCHUNG GMBH	GSI	Germany		
7	RIJKSUNIVERSITEIT GRONINGEN	RUG	Netherlands		
8	THE HENRYK NIEWODNICZANSKI INSTITUTE OF NUCLEAR PHYSICS, POLISH ACADEMY OF SCIENCES	IFJ PAN	Poland		
9	UNIWERSYTET WARSZAWSKI	UNIWARSAW	Poland		
10	INSTITUTUL NATIONAL DE CERCETARE -DEZVOLTARE PENTRU FIZICA SI INGINERIE NUCLEARA "HORIA HULUBEI" (IFIN-HH)	IFIN-HH	Romania		
11	FONDAZIONE BRUNO KESSLER	FBK	Italy		
12	EBG (Entwicklungs- und Betriebsgesellschaft) MedAustron GmbH	EBG MedAustron	Austria		
13	KATHOLIEKE UNIVERSITEIT LEUVEN	KU Leuven	Belgium		
14	UNIVERSITE LIBRE DE BRUXELLES	ULB	Belgium		
15	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	CEA	France		
16	GROUPEMENT INTERET PUBLIC ARRONAX	GIP ARRONAX	France		
17	JUSTUS-LIEBIG-UNIVERSITAET GIESSEN	JLU	Germany		
18	JOHANNES GUTENBERG-UNIVERSITAT MAINZ	JGU Mainz	Germany		

1.2. List of Beneficiaries

No	Name	Short name	Country	Project entry date[8]	Project exit date
19	LUDWIG-MAXIMILIANS-UNIVERSITAET MUENCHEN	LMU	Germany		
20	UNIVERSITAET ZU KOELN	UCO	Germany		
21	NATIONAL CENTER FOR SCIENTIFIC RESEARCH "DEMOKRITOS"	NCSRD	Greece		
22	UNIVERSITA DEGLI STUDI DI MILANO	UMIL	Italy		
23	FUNDACAO DA FACULDADE DE CIENCIAS DA UNIVERSIDADE DE LISBOA FP	FFCUL	Portugal		30/06/2017
24	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT	CIEMAT	Spain		
25	AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS	CSIC	Spain		
26	UNIVERSIDAD DE SANTIAGO DE COMPOSTELA	USC	Spain		
27	UNIVERSIDAD DE SEVILLA	USE	Spain		
28	THE UNIVERSITY OF LIVERPOOL	ULIV	United Kingdom		
29	UNIVERSITY OF YORK	UoY	United Kingdom		
30	Magyar Tudomanyos Akademia Atommagkutato Intezete	ATOMKI-HAS	Hungary		
31	FCIENCIAS.ID - ASSOCIACAO PARA A INVESTIGACAO E DESENVOLVIMENTO DE CIENCIAS	FCIENCIAS.ID	Portugal	01/07/2017	

1.3. Workplan Tables - Detailed implementation

1.3.1. WT1 List of work packages

WP Number[9]	WP Title	Lead beneficiary[10]	Person-months[11]	Start month[12]	End month[13]
WP1	NA1 - FISCO2: FInancial and SCientific Organisation	1 - GANIL	12.10	1	48
WP2	NA2 - NUSPRASEN: Nuclear Structure Physics, Reactions, Astrophysics and Superheavy Elements Network	17 - JLU	0.40	1	48
WP3	NA3 – MIDAS: MInimisation of Destructive plASma processes in ECRIS	4 - JYU	0.60	1	48
WP4	NA4 – NUSPIN: NUclear SPectroscopy INstrumentation	2 - INFN	0.60	1	48
WP5	NA5 – MediNet: Medical Network	12 - EBG MedAustron	1.00	1	48
WP6	NA6 – GDS: Gas-Filled Detectors and Systems	1 - GANIL	0.60	1	48
WP7	NA7- ENSAF: European Network of Small-scale Accelerator Facilities	21 - NCSRD	0.20	1	48
WP8	NA8 – NuPIA: Nuclear Physics InnovAtion	1 - GANIL	2.30	1	48
WP9	JRA1 – PASPAG: Phoswich scintillator assemblies: Application to the Simultaneous detection of PArticle and Gamma radiation	25 - CSIC	81.30	1	48
WP10	JRA2 - PSeGe: R&D on Position-Sensitive Germanium Detectors for Nuclear Structure and Applications	25 - CSIC	77.20	1	48
WP11	JRA3 - TheoS: Theoretical Support for Nuclear Facilities in Europe	5 - CNRS	120.00	1	48
WP12	JRA4 - RESIST : RESonance laser Ionisation Techniques for separators	4 - JYU	129.00	1	48
WP13	JRA5 - SATNuRSE: Simulations and Analysis Tools for Nuclear Reactions and Structure in Europe	7 - RUG	85.00	1	48
WP14	JRA6 - EURISOL	5 - CNRS	78.20	1	48
WP15	JRA7 – TecHIBA: Technologies for High Intensity Beams and Applications	5 - CNRS	98.40	1	48
WP16	TA1 – GANIL-SPIRAL2	1 - GANIL	0.10	1	48
WP17	TA2 - LNL-LNS	2 - INFN	0.10	1	48
WP18	TA3 – ISOLDE	3 - CERN	0.10	1	48
WP19	TA4 - JYFL	4 - JYU	0.10	1	48
WP20	TA5 – ALTO	5 - CNRS	0.10	1	48
WP21	TA6 – GSI	6 - GSI	0.10	1	48

1.3. Workplan Tables - Detailed implementation

WP Number[9]	WP Title	Lead beneficiary[10]	Person-months[11]	Start month[12]	End month[13]
WP22	TA7 – KVI-CART	7 - RUG	0.10	1	48
WP23	TA8 - NLC (SLCJ Warsaw, IFJ PAN Krakow)	8 - IFJ PAN	0.20	1	48
WP24	TA9 - IFIN-HH / ELI-NP	10 - IFIN-HH	0.10	1	48
WP25	TA10 - ECT*	11 - FBK	0.10	1	48
		Total	688.00		

1.3.2. WT2 list of deliverables

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D1.1	Dissemination	WP1	1 - GANIL	Report	Public	12
D1.2	Facility Coordination Group	WP1	1 - GANIL	Report	Public	24
D1.3	Impact studies	WP1	1 - GANIL	Report	Public	36
D1.4	Nuclear Physics in European Research Area	WP1	1 - GANIL	Report	Public	48
D2.1	Report on workshops in months 1-12	WP2	17 - JLU	Report	Public	15
D2.2	Mid-term report: Status and needs - synthesis of results of first workshops	WP2	17 - JLU	Report	Public	27
D2.3	Report on EURISOL Town Meeting	WP2	17 - JLU	Report	Public	36
D2.4	Report on the workshops in months 25-34	WP2	17 - JLU	Report	Public	37
D2.5	Final report: Future directions – synthesis of NUSPRASEN activities	WP2	17 - JLU	Report	Public	48
D3.1	Report on setup of common database	WP3	4 - JYU	Report	Public	12
D3.2	Report on the networking activities	WP3	4 - JYU	Report	Public	48
D3.3	Report on a series of workshops	WP3	4 - JYU	Report	Public	42
D3.4	Report on hands-on-training	WP3	4 - JYU	Report	Public	33
D4.1	Report on the setup of the website, members and chairs of the Scientific Committee and Working Groups	WP4	2 - INFN	Report	Public	12
D4.2	Midterm report on the activity of the Scientific Committee and Working Groups	WP4	2 - INFN	Report	Public	24
D4.3	Intermediate report on the activity of the Scientific Committee and Working Groups	WP4	2 - INFN	Report	Public	36

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D4.4	Final Report on the activity of the Scientific Committee and Working Groups	WP4	2 - INFN	Report	Public	48
D4.5	Midterm report on the Collaboration Workshops and training activities	WP4	2 - INFN	Report	Public	24
D4.6	Intermediate report on the Collaboration Workshops and training activities	WP4	2 - INFN	Report	Public	36
D4.7	Final Report on the Collaboration Workshops and training activities	WP4	2 - INFN	Report	Public	48
D4.8	Final Report on the exchange of key technical personnel	WP4	2 - INFN	Report	Public	48
D5.1	Specific need and proposed solutions of nuclear tools for medicine	WP5	12 - EBG MedAustron	Report	Public	9
D5.2	Clarifying/adapting nuclear concepts to the medical field	WP5	12 - EBG MedAustron	Report	Public	21
D5.3	Nuclear physics instrumentation for medicine	WP5	12 - EBG MedAustron	Report	Public	36
D5.4	Use of nuclear physics tools to support biological effectiveness assessment in ion-beam therapy	WP5	12 - EBG MedAustron	Report	Public	45
D6.1	Web Site	WP6	1 - GANIL	Report	Public	6
D6.2	GDS Topical Meeting “GDS in strong and non-uniform magnetic fields”	WP6	1 - GANIL	Report	Public	48
D6.3	GDS Topical Meeting “GDS for high-intensity and heavy-ion beams”	WP6	1 - GANIL	Report	Public	48
D6.4	GDS Topical Meeting “GDS with rare gas targets: handling and recycling”	WP6	1 - GANIL	Report	Public	48

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D6.5	GDS Topical Meeting "GDS coupling to auxiliary detection systems"	WP6	1 - GANIL	Report	Public	13
D7.1	Strategy Report "Physics Opportunities and Innovation at European Small-Scale Accelerators"	WP7	21 - NCSRD	Report	Public	36
D7.2	Overview on the "International Workshop on Accelerator Operation and Management"	WP7	21 - NCSRD	Report	Public	21
D7.3	Strategy Report "Training Opportunities at European Small-Scale Accelerators"	WP7	21 - NCSRD	Report	Public	36
D7.4	Strategy Report "Integration of the ENSAF labs with the European TA Accelerator Facilities"	WP7	21 - NCSRD	Report	Public	48
D8.1	Intermediate report on Innovation Survey	WP8	1 - GANIL	Report	Public	24
D8.2	Report to be distributed to stakeholders, end-users and funding agencies	WP8	1 - GANIL	Report	Public	48
D8.3	Intermediate report on the identified industrial network	WP8	1 - GANIL	Report	Public	24
D8.4	Report on Industry days, workshops	WP8	1 - GANIL	Report	Public	48
D8.5	Dissemination kit	WP8	1 - GANIL	Other	Public	14
D8.6	Report on the survey of available courses in European countries and on the description of the courses proposed by the various laboratories	WP8	1 - GANIL	Report	Public	12
D8.7	Intermediate Report on the provided courses	WP8	1 - GANIL	Report	Public	36
D8.8	Report on Courses in Nuclear Techniques for industrial partners	WP8	1 - GANIL	Report	Public	48

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D9.1	Report: present status of New Scintillator Materials and their basic characterisation (energy & time response)	WP9	25 - CSIC	Report	Public	12
D9.2	Report: Sensor characterization and Base design of hybrid detectors	WP9	25 - CSIC	Report	Public	18
D9.3	Report: Scintillator response to gamma and particle radiation	WP9	25 - CSIC	Report	Public	24
D9.4	Report: Digital pre-processing at frontend	WP9	25 - CSIC	Report	Public	30
D9.5	Report: Design Phoswich Assemblies for homeland security	WP9	25 - CSIC	Report	Public	36
D9.6	Report: Summary of test results	WP9	25 - CSIC	Report	Public	48
D10.1	Results of the JRA2 kick-off meeting	WP10	25 - CSIC	Report	Public	12
D10.2	Advancement report for the Segmentation and Geometry tasks	WP10	25 - CSIC	Report	Public	30
D10.3	Advancement report for the p-type task	WP10	25 - CSIC	Report	Public	30
D10.4	Advancement report for the Imaging task	WP10	25 - CSIC	Report	Public	30
D10.5	Final report for the Segmentation and Geometry tasks	WP10	25 - CSIC	Report	Public	48
D10.6	Final report for the p-type task	WP10	25 - CSIC	Report	Public	48
D10.7	Final report for the Imaging task	WP10	25 - CSIC	Report	Public	48
D11.1	New effective interaction for beyond-mean-field calculations	WP11	5 - CNRS	Other	Public	24
D11.2	Codes for transfer and CDCC calculations with core excitation	WP11	5 - CNRS	Other	Public	24
D11.3	Eikonal-based code to describe dynamical effects in scattering,	WP11	5 - CNRS	Other	Public	36

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	breakup and knockout reactions					
D11.4	Report and package of the TDHF+BCS and QRPA codes	WP11	5 - CNRS	Report	Public	48
D12.1	Report on Task developments from RESIST	WP12	4 - JYU	Report	Public	12
D12.2	Mid-term report on new techniques to enhance ion beam purity prior to the LIST multipole	WP12	4 - JYU	Report	Public	24
D12.3	Mid-term report on new methods to improve the efficiency, selectivity and spectral resolution	WP12	4 - JYU	Report	Public	24
D12.4	Mid-term report on new concepts and developments related to laser technologies	WP12	4 - JYU	Report	Public	24
D12.5	Final report on new techniques to enhance ion beam purity prior to the LIST multipole	WP12	4 - JYU	Report	Public	48
D12.6	Final report on new methods to improve the efficiency, selectivity and spectral resolution	WP12	4 - JYU	Report	Public	48
D12.7	Final report on new concepts and developments related to laser technologies	WP12	4 - JYU	Report	Public	48
D13.1	Creation and validation of improved data libraries and models and implementation into GEANT4	WP13	7 - RUG	Other	Public	48
D13.2	Code ENSARRoot with generic codes with specific reactions and tracking	WP13	7 - RUG	Other	Public	48
D13.3	Inventory and protocol for data management	WP13	7 - RUG	Report	Public	48
D13.4	Report on workshop on developments of the nuclear-physics	WP13	7 - RUG	Report	Public	40

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	community for GEANT4					
D14.1	Report on performances of the EBIS debuncher	WP14	5 - CNRS	Report	Public	24
D14.2	Report on R&D on radioactive plasma ion sources	WP14	5 - CNRS	Report	Public	36
D14.3	Conceptual design report of a new generation charge breeder	WP14	5 - CNRS	Report	Public	44
D14.4	New targets, ion sources and beams	WP14	5 - CNRS	Report	Public	48
D14.5	Chart of Beams	WP14	5 - CNRS	Report	Public	48
D15.1	Report on the characterization of a Niobium disk under RF	WP15	5 - CNRS	Report	Public	36
D15.2	Report on the polishing results on an accelerating cavity	WP15	5 - CNRS	Report	Public	48
D15.3	Report on 1 kW high power target station	WP15	5 - CNRS	Report	Public	48
D15.4	Report and publication on yields, radioisotopic purity and disturbing impurities achievable	WP15	5 - CNRS	Report	Public	36
D15.5	Plastic scintillator prototype	WP15	5 - CNRS	Demonstrator	Public	24
D15.6	Report of experimental results of the tests of the prototype	WP15	5 - CNRS	Report	Public	45
D15.7	Report on R&D on studies on X-ray emission and detector material	WP15	5 - CNRS	Report	Public	37
D15.8	Report on R&D on characterization and optimization of detector design	WP15	5 - CNRS	Report	Public	36
D15.9	Report on Detector test (source and In-beam)	WP15	5 - CNRS	Report	Public	48
D15.10	Report on Chip Design	WP15	5 - CNRS	Report	Public	12
D15.11	Report on silicon detector and ASIC tests	WP15	5 - CNRS	Report	Public	48

1.3.3. WT3 Work package descriptions

Work package number [9]	WP1	**Lead beneficiary** [10]	1 - GANIL
Work package title	NA1 - FISCO2: FInancial and SCientific Organisation		
Start month	1	**End month**	48

Objectives

The FISCO2 network constitutes the effective consortium management. It will coordinate all technical, scientific, financial, administrative, contractual and legal activities of the ENSAR2 Integrating Activity. It will oversee issues concerning science and society issues, and all other issues related to the research activities conducted within the project. It will also contribute to further integration of all the research activities of the participating infrastructures. An appropriate management framework linking together all the project components will be implemented. Due to the size and complexity of the ENSAR2 Integrating Activity, this requires a specially constituted FISCO2 management team with dedicated staff having the necessary skills.

Description of work and role of partners

WP1 - NA1 - FISCO2: FInancial and SCientific Organisation [Months: 1-48]
GANIL, CEA
Leader: GANIL
Participant: CEA

FISCO2 will coordinate the actions, organise meetings/workshops, and handle administrative, legal, financial matters in order to ensure a smooth functioning of the collaboration. These tasks will be:
Task 1 - Management
• Propose a framework in order to ensure consistency and efficiency in administration and financial management.
• Prepare the Grant Agreement/ Consortium Agreement/ ENRI Agreement.
• Establish an overarching Facility Coordination Group: mutual information, coordination, harmonisation and exchange of best practices between the ENSAR2 research infrastructures.
• Organise meetings of the consortium.
• Represent the project.
Task 2 - Studies and reporting
• Perform impact studies.
• Coordinate the reporting work.
Impacts of ENSAR2 and its research infrastructures
FISCO2 will hire a dedicated person to carry out research on impacts of the ENSAR2 research infrastructures (direct and indirect, on social, environmental and economic levels) and beyond of ENSAR2 itself. These studies will start during the 2nd year of the project in order to benefit from its first results and developments. The research studies on ENSAR2 impacts will be performed in close collaboration with the work package dedicated to innovation.
Task 3 - Dissemination and Exploitation of results
• Web Site: participate in development and translation of nupex.eu in collaboration with NuPECC.
• Capitalise knowledge, and diffuse scientific knowledge.
• Communicate results.
• Exploit results.
• Promote ENSAR2 training activities:

WP3-MIDAS (MInimisation of Destructive plASma processes in ECRIS): The hands-on training in MIDAS activities will promote the transfer of the optimised and the most useful methods among the partners. Training activities will be defined and organised by the Steering Committee. On-site training offers an inspiring environment for experts, young physicists and engineers to improve their expertise by the courses offered by the partner institutes.

WP4-NUSPIN (NUclear SPectroscopy INstrumentation): The transfer of knowledge to new users, with particular regard to young researchers, and from one community to the other constitutes a very important goal of the Network. The exchange of key technical personnel is another important
goal.
1. Organisation of on-site training courses for scientists, engineers and new users will be done annually. The courses will cover the most important and useful subjects and techniques.

2. Exchange of technical experts between infrastructures and research institutions will help to spread the expertise and ensure a widespread knowledge base.

WP5-MediNet (Medical Network): Mobility programme – network exchange of (young) researchers in the field of Detector Instrumentation for Radiation Therapy

WP7-ENSAF (European Network of Small-scale Accelerator Facilities): Training of students and young researchers at small facilities
A working group will be setup to discuss and evaluate best ways to use small accelerators and the installed instrumentation for training young researchers at the beginning of their careers. Mobility of post-docs will be supported.

WP8 - NuPIA (Nuclear Physics InnovAtion): Training in nuclear techniques : Schools for employees of industrial companies
Industrial companies, European research and industrial organisations will be able to send their employees on one-week long training courses to develop their practical skills and gain an understanding of different aspects of radiation detection and safety, imaging, ion-beam analysis techniques and the effects of radiation on electronics component.

Expected Outcome
A plan for the dissemination and exploitation of results will be updated regularly and completed at the end of the project. As additional action for dissemination, there will be a report on completed and planned communication actions. Both plan and report will be inserted in periodic and final reports.
Dissemination on access opportunities are supported by infrastructures through special web pages and advertisements during conferences. FISCO2 will supervise these dissemination actions. To disseminate and promote the knowledge derived from the various activities of ENSAR2 within and beyond the consortium, a special website, where all the scientific periodic reports will be published, will be established and updated.
This website will also be used for the internal communication.
Two workshops, one 30 month after the start of the contract and one at its end, will be organised for the community at large in the format of "Town Meetings".
In order to optimise the meeting budget and ensure a large attendance to scientific events, FISCO2 will encourage the ENSAR2 work package teams to organise their own meetings and workshops jointly with the Town Meetings.
On the basis of a consortium agreement between all participants, questions arising from the assignment of Intellectual Property Rights (IPR) will be settled.
The activity reports planned as milestones include the minutes of PCC (Project Coordination Committee), FCG (Facility Coordination Group) and GA (General Assembly) meetings and the update of the plan for dissemination of results.

Participation per Partner

Partner number and short name	WP1 effort
1 - GANIL	0.10
15 - CEA	12.00
Total	12.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D1.1	Dissemination	1 - GANIL	Report	Public	12
D1.2	Facility Coordination Group	1 - GANIL	Report	Public	24
D1.3	Impact studies	1 - GANIL	Report	Public	36
D1.4	Nuclear Physics in European Research Area	1 - GANIL	Report	Public	48

Description of deliverables

D1.1 : Dissemination [12]

Plan for dissemination within and beyond ENSAR2 consortium

D1.2 : Facility Coordination Group [24]

Plan for harmonisation and best practices in ENSAR2 infrastructures

D1.3 : Impact studies [36]

Impact studies of infrastructures on direct and indirect influence on social, environmental and economic levels. It will start during the 2nd year of the ENSAR2 project.

D1.4 : Nuclear Physics in European Research Area [48]

Study of the integration of nuclear physics research community: status and perspectives

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Start of impact studies	1 - GANIL	18	Report

Work package number [9]	WP2	Lead beneficiary [10]	17 - JLU
Work package title	NA2 - NUSPRASEN: Nuclear Structure Physics, Reactions, Astrophysics and Superheavy Elements Network		
Start month	1	End month	48

Objectives

The pillars of current research in low- and intermediate-energy nuclear physics are
• studies of nuclear structure,
• investigation and proper description of nuclear reactions,
• synthesis of new isotopes and new elements as well as study of their physical and chemical properties
• nuclear astrophysics with its interdisciplinary character.
Progress in the field comes from several factors:
- Increase of intensity of stable and exotic nuclear beams by several orders of magnitude, and significant improvement of quality of these ion beams
- Broadening of the spectrum of nuclei available for study away from the valley of stability towards the proton and neutron drip lines and superheavy elements.
- Advances in many-body theory and in computing power.
- New experimental facilities already existing or under construction like FAIR, SPIRAL2, HIE-ISOLDE (second phase to be finished in Spring 2017) and ELI-NP, and of no less importance new, complex items of experimental and data-acquisition equipment which offer richer experimental information.
Long-term development and goals:
- The advancement of the EURISOL concept with the long-term goal to build a dedicated facility needs special attention and requires activities to continuously update the scientific case, shape the community, and strengthen the synergies with other facilities
All these items are expected to broaden our knowledge horizon in the coming years. As such, networking and exchange between scientists working in the field become mandatory to make better, more efficient use of the experimental facilities, devices, theories and computing codes. Combining outstanding technologies with unique physics expertise can only be achieved at this scale at the European level.
This networking activity will provide platforms for the community to bring up, discuss, plan and coordinate research topics, experimental methods and pieces of equipment that are, through their novelty, complexity or financial demands, beyond the reach of individuals or small groups. In order to cope with the new opportunities mentioned above; it will create exchange between the TNA user groups, the JRA participants of ENSAR2 and theoreticians of the field. The NUSPRASEN network will push forward an idea to organise an Integrated User Group for all TAs, including the EURISOL User Group, which will allow better communication and coherent actions of the user community in Europe. A link to the ESFRI process and to NuPECC will help to prepare the ground towards the next NuPECC Long-Range Plan.

Description of work and role of partners

WP2 - NA2 - NUSPRASEN: Nuclear Structure Physics, Reactions, Astrophysics and Superheavy Elements Network [Months: 1-48]
JLU, INFN, IFIN-HH, ATOMKI-HAS
Total person.months (EU/own): INFN (0/6) - IFIN-HH (0/6) - JLU (0/25) - ATOMKI-HAS (0/16)

Task 1. Coordination of activities and dissemination
A steering committee to be formed will establish contacts to other ENSAR2 activities with fundamental science connection (like PASPAG, PSeGe, RESIST, SATNuRSE, EURISOL, TecHIBA, MIDAS, NUSPIN, GDS, and ENSAF) and will manage the activities of this NA. In particular, it will coordinate Task 2: a) decide on the annual workshops (topical focus, key participants, expected outcome, etc.) and allocate the necessary funds, and b) promote the information exchange in the scientific community, guide the scientific discussions, and inspire the development of new physics directions and instrumental methods. Close consultations and interactions with TA coordinators, user-group representatives (including EURISOL), researchers and facility management will be implemented. Contacts to NuPECC, ESFRI and possibly to other relevant groups will be enhanced and/or established. The steering committee will also organise the WWW-presentations of this activity.

Task 2. Physics goals, synergies, future directions

The steering committee will organise the discussion and exchange forums for the major activities of the field (see subtasks below). The NUSPRASEN workshops will be organised in synergies with the European EURORIB conference series and the regular user meetings of the ENSAR2 access facilities, such as the GANIL/SPIRAL2 Week, ISOLDE Collaboration Meeting, NUSTAR Week, and ELI-NP User Meeting. In the second half of the project, a dedicated EURISOL Town Meeting is planned, where recent progress, the ongoing physics and instrumentation developments, and the specific needs and future plans of the EURISOL community will be discussed and disseminated.
Subtask 2.1: Nuclear structure
The ENSAR2 access facilities provide beams of exotic nuclei for forefront research opportunities in nuclear-structure physics. The complexities of nuclear many-body problems, in which the interactions between constituents are still not fully settled, have made nuclear physics a phenomena-driven field. Progress is achieved by the close interplay of theory and experiment. The objective of this task is to develop new complementary and specific profiles for the development of theory-driven experiments and instrumentation. This will be based on the modern key questions of nuclear-structure physics with radioactive ions and lead to new experimental campaigns at accelerator laboratories offering unique new physics opportunities. The network will facilitate novel programmes in nuclear-structure physics of nuclei under extreme conditions.

Subtask 2.2: Nuclear reactions
The interplay between nuclear structure and reactions is now attracting increasing attention and the important content in increasingly more exclusive observables is a future challenge. Experimental studies of reactions on nuclear systems that exhibit exotic structural features, such as di-neutron configurations or so-called “halos”, are well established. The influence of the continuum also makes reactions with loosely bound nuclei a tool for advancing fundamental reaction theory. Experimental data using energies ranging from MeV/u to GeV/u are needed if we want to describe these exotic systems in terms of fundamental theories, such as ab initio microscopic calculations of structure and reaction. They are or will be provided by the new experimental facilities and instruments being planned or being under construction for the next-generation facilities. In order to achieve such a basic understanding, development of reaction theory and intense mobility of experimental group members and facility representatives.

Subtask 2.3: Nuclear astrophysics
Nuclear astrophysics brings the nuclear reactions, which take place in astrophysical objects, into the laboratory. These reactions are responsible for the synthesis of chemical elements and energy production in stars and cataclysmic events. In order to mimic the environment of the astrophysical objects, we have to measure the probability of nuclear reactions at such low energies where the cross sections are tiny. Another difficult feature of the field is that the reaction partners are exotic (unstable) many times. Our goal is to strengthen the collaboration between the existing groups working in nuclear astrophysics in terms of a) identification, discussion and assessment on the advances of indirect methods, in particular of those using radioactive beams, and b) the formation of new collaborations and user groups, mainly attracting students and young scientists through dedicated workshops. The European Network of Nuclear Astrophysics Schools (ENNAS) will be supported.

Subtask 2.4: Superheavy elements
Because of production cross sections on the picobarn level and (sometimes) very short half-lives, this field, which is at the forefront in nuclear physics, requires extreme performance in terms of beam intensities and target techniques for the production, and highest selectivity, sensitivity and speed in the separation and detection process. In recent years the focus in superheavy element research extended from the pure production and identification towards the study of their atomic, chemical and detailed nuclear-structure properties. This shift is reflected by the recent application of instruments like ion traps, laser spectroscopy or complex gamma-ray spectroscopy setups for superheavy-element research. This subtask aims at the discussion of present achievements, new directions and efficient use of instrumental equipment.

Participation per Partner

Partner number and short name	WP2 effort
2 - INFN	0.10
10 - IFIN-HH	0.10
17 - JLU	0.10
30 - ATOMKI-HAS	0.10
Total	0.40

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D2.1	Report on workshops in months 1-12	17 - JLU	Report	Public	15
D2.2	Mid-term report: Status and needs - synthesis of results of first workshops	17 - JLU	Report	Public	27
D2.3	Report on EURISOL Town Meeting	17 - JLU	Report	Public	36
D2.4	Report on the workshops in months 25-34	17 - JLU	Report	Public	37
D2.5	Final report: Future directions – synthesis of NUSPRASEN activities	17 - JLU	Report	Public	48

Description of deliverables

D2.1 : Report on workshops in months 1-12 [15]
Report on workshops in months 1-12

D2.2 : Mid-term report: Status and needs - synthesis of results of first workshops [27]
Mid-term report: Status and needs - synthesis of results of first workshops

D2.3 : Report on EURISOL Town Meeting [36]
Report on EURISOL Town Meeting

D2.4 : Report on the workshops in months 25-34 [37]
Report on the workshops in months 25-34

D2.5 : Final report: Future directions – synthesis of NUSPRASEN activities [48]
Final report: Future directions – synthesis of NUSPRASEN activities

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS2	Constitution of steering committee	17 - JLU	3	Report
MS3	Workshop on nuclear structure	17 - JLU	6	Report
MS4	Workshop on nuclear reactions	17 - JLU	24	Report
MS5	Workshop on nuclear astrophysics	17 - JLU	24	Report
MS6	Workshop on superheavy elements	17 - JLU	33	Report

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS7	Workshop on cross-combining elements: nuclear theory, instrumentation, computing	17 - JLU	42	Report
MS57	EURISOL Town Meeting	17 - JLU	30	Report

Work package number [9]	WP3	Lead beneficiary [10]	4 - JYU
Work package title	NA3 – MIDAS: MInimisation of Destructive plASma processes in ECRIS		
Start month	1	**End month**	48

Objectives

The research programmes of the European large-scale accelerator facilities tend to set increasing demands on ion beams in terms of their intensity, quality and variety. As an example, high-intensity, high charge-state metallic ions are often requested in projects like FAIR or SPIRAL2. It can be foreseen that the most critical research and development topics in the field of ECR ion sources are:
- technological development to increase plasma density (increases intensity and charge state)
- studies to understand the limitations and processes (both creative and destructive) affecting the volumetric production rate of highly charged ions
- development of plasma and ion-beam diagnostics
- technological development to improve the efficiency and variety of ion beams available for the European nuclear-physics facilities (especially refractory elements).

This networking activity (NA) brings together the participant research teams and those of CERN and IFIN-HH, developing ion sources and beams for the needs of these facilities, and industrial partners (AVS and PANTECHNIK) having wide technological know-how. Maximising the knowledge transfer and efficient dissemination of results will ensure that the latest results are available for all infrastructures participating in MIDAS-NA. Such a networking activity can bring substantial advances in ion-beam development being crucial not only for the large international projects like FAIR and SPIRAL2, but also, for all partner institutes and their scientific programmes. This structure may offer a link for the commercialisation of the scientific developments for benefit of society, and an opportunity to the ECR community to progress toward the use of best practices. An active dialogue with the user community of the accelerator facilities, i.e. other NAs and JRAs, will be also maintained in order to ensure the common knowledge base about the future challenges of the European accelerator infrastructures.

The MIDAS–NA will include the following aspects:
- to promote the collaboration and sharing of expertise between the partners
- to promote and coordinate the pooling and exchanging of different equipment to make their efficient use, new applications and new experimental studies possible
- to explore new applications and technical solutions with the industrial partners

The objective of the MIDAS-NA is to enhance the networking between partner teams in order to further improve the ion beams in terms of their intensity, energy, quality and variety in the most effective way. The exchange of instruments and know-how will be improved in order to perform new and complicated experiments, as an example, to study and eventually to minimise the destructive plasma processes like charge exchange. In addition, this networking combines the know-how of world-class research teams and industrial partners, AVS and PANTECHNIK, to develop technological solutions beyond the present limits. As an example, a new type of ECRIS having an innovative magnetic structure will be developed and tested in collaboration between GANIL and industrial partners. The MIDAS networking can have a strong impact on the future ion-source technology and diagnostics needed for the development of highly charged ion beams.

Description of work and role of partners

WP3 - NA3 – MIDAS: MInimisation of Destructive plASma processes in ECRIS [Months: 1-48]
JYU, GANIL, CNRS, GSI, RUG, ATOMKI-HAS
Total person.months (EU/Own): GANIL (0/5) - JYU (0/8) - CNRS (0/2) - GSI (0/5) - RUG (0/5) - ATOMKI-HAS (0/8)

Task 1: Coordination of scientific activities and dissemination (JYU)
The Steering Committee to coordinate and organise Task 2 and Task 3 will be formed by the representatives of the partner teams. The Committee will organise the web site including the references to all manuscripts published during the NA, and prepare an ion-beam table with necessary information regarding the production techniques/methods and database of different ion-beam related requirements to optimise the use of resources. The Steering Committee will also promote the pooling of resources and equipment to use new experimental setups in an efficient and innovative way. The Steering Committee will also behave as a link between the MIDAS-NA and ENSAR JRAs to guarantee the interaction and exchange of information.
Task 2: Collaboration workshops (GANIL)

The annual workshops will be organised in order to present the most important results and new requirements regarding the research and development of ECR ion sources and their beams. It is an open forum for fruitful discussions and brainstorming. The workshops can also promote an open discussion with the users of nuclear-physics large-scale facilities. This can be done, for example, by inviting the representative of the institute organising the workshop to give a dedicated seminar focusing on the future requirements of the ion beams and to participate in discussions. The workshop makes also the optimisation of different research resources possible and will improve the transfer of new technology and instrumentation.
Task 3: Hands-on-training (GSI)
The hands-on training will promote the transfer of the optimised and the most useful methods among the partners. Training activities will be defined and organised by the Steering Committee. On-site training offers an inspiring environment for experts, young physicists and engineers to improve their expertise by the courses offered by the partner institutes. As an example, the training regarding the ion-beam and plasma diagnostics and metal ion-beam production can be offered.

Associated partner: UCLM (Spain)

Participation per Partner

Partner number and short name	WP3 effort
1 - GANIL	0.10
4 - JYU	0.10
5 - CNRS	0.10
6 - GSI	0.10
7 - RUG	0.10
30 - ATOMKI-HAS	0.10
Total	0.60

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D3.1	Report on setup of common database	4 - JYU	Report	Public	12
D3.2	Report on the networking activities	4 - JYU	Report	Public	48
D3.3	Report on a series of workshops	4 - JYU	Report	Public	42
D3.4	Report on hands-on-training	4 - JYU	Report	Public	33

Description of deliverables

D3.1 : Report on setup of common database [12]
Report on setup of common database

D3.2 : Report on the networking activities [48]
Report on the networking activities

D3.3 : Report on a series of workshops [42]

Report on a series of workshops

D3.4 : Report on hands-on-training [33]

Report on hands-on-training

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS8	Steering committee established	4 - JYU	3	Report
MS9	Website established for database	4 - JYU	9	Report
MS10	Program for hands-on training	4 - JYU	6	Report

Work package number [9]	WP4	Lead beneficiary [10]	2 - INFN
Work package title	NA4 – NUSPIN: NUclear SPectroscopy INstrumentation		
Start month	1	End month	48

Objectives

The main goal of the NUSPIN network is to strengthen the nuclear-structure community by the exchange and transfer of knowledge and the enhancement of synergies between the different collaborations active in the European Infrastructure Facilities.

The research in nuclear structure constitutes a very important part of the scientific programmes of the infrastructures in ENSAR2. The high-resolution γ-ray spectroscopy is the most powerful technique to understand the behaviour of the nucleus at the extreme conditions of excitation energy and angular momentum, as well as to study the properties of exotic nuclei far from the valley of stability at the frontline of the experimental research and applications. The sensitivity of these devices increases dramatically if combined with ancillary detectors such as high-efficiency fast-timing gamma-ray detectors, calorimeters, neutron detectors, devices for lifetimes and nuclear moments measurements. Highly complex experiments require joint employment of different types of these detectors.

The gamma-spectroscopy research community is involved in the development of the most powerful Ge-detector array, AGATA, based on the innovative gamma-ray tracking technique. The AGATA research community has invested and continues to invest important resources in the R&D of different new techniques to cope with the complexity of the array and the specific challenges of experimental campaigns at the radioactive-beam facilities and ELI-NP, under construction in Europe, which will highly benefit from this kind of activities. The collaborations in nuclear structure operating at the different infrastructures are also investing much efforts and resources in developing new instrumentation, experimental methods and techniques for frontline research. Most of these techniques are of common interest and the exchange of information as well as the development of synergies will be of great benefit to the whole research community.

For example, in the case of AGATA, the data acquisition (DAQ) and processing requires specific skills that need to be developed and transferred among the experts and to new users. These techniques (in particular digital electronics, pulse-shape analysis simulations, data acquisition, etc.) can be extended to other types of devices, such as particle detectors and high-efficiency scintillator detectors.
Within NUSPIN, the nuclear-structure community will address:
• The coordination of the preparation and analysis of the AGATA data, the optimisation of the algorithms for pulse-shape analysis. The boost of the performance of each actor in the DAQ flow.
• The cooperation in the development, design and construction of ancillary detectors.
• The integration of Ge detectors with large complementary instrumentation such as scintillator detectors for fast timing and high-energy photon detectors, arrays of charged-particle telescope detectors, devices for nuclear moments and transition amplitudes measurements, etc.
NUSPIN will also promote:
• The efficient and innovative use of the valuable European gamma-ray spectroscopy resources at the different ENSAR2 infrastructures, each with its specificity in beam species and energy ranges and the coordination of the experimental campaigns at the different infrastructures providing and exchanging information on their potential opportunities.
• The collaboration and sharing of expertise between different research domains.
• The encouragement and organisation of the pooling of distributed equipment in order to enhance synergies between complementary resources for common large-scale projects.
• The exploration of new applications of well-established gamma-detection techniques in other fields, as for example the extension of the total-absorption technique to in-beam studies of astrophysical interest.
• The building of bridges between the scientific developments and the applications for the society.
This cooperation will give an added value to the resources and therefore to the hosting infrastructures, also in view of the present and future investments.

Description of work and role of partners

WP4 - NA4 – NUSPIN: NUclear SPectroscopy INstrumentation [Months: 1-48]
INFN, CNRS, GSI, CIEMAT, CSIC, ULIV
Total person.months (EU/Own): INFN (0/18) - CNRS (0/15,5) - GSI (0/14) - CIEMAT (0/3) - CSIC (0/8) - ULIV (0/19)

The objectives will be achieved through the following tasks:

Task 1: Coordination, promotion and dissemination (INFN)
Subtask 1.1: Steering Committee: to coordinate and organise the different activities and tasks. To administrate the funds at the different nodes. To guarantee the communication and facilitate the interaction and exchange of information between the Working Groups and the Scientific Committee.
Subtask 1.2: Scientific Committee: to promote collaborative ventures for the optimisation of the use of the resources and to encourage the pooling of distributed equipment at the different infrastructures; to enhance synergies between complementary resources for common large-scale projects; to promote the research on new detection methods and techniques.
Subtask 1.3: Coordination between the Infrastructures: to organise annual meetings between the Management of the gamma-spectroscopy collaborations and the directorates of the hosting infrastructures to ensure the best exploitation of the opportunities provided by the different laboratories; to define timelines and coordinate the distribution of the resources for physics campaigns.
Task 2: Working groups for the different types of detectors (INFN)
The activity of the WG will be to cooperate on the use, research and development of the detectors and to improve the performance and compatibility of the devices. To collaborate on the simulation tools, the design and construction of the electronics and data acquisition. To cooperate on the optimisation of the data acquisition flow, the data processing and related algorithms. To promote the R&D on detection techniques. To optimise the mechanical integration of the different actors in dedicated experimental campaigns.
Subtask 2.1: Working Group 1: High-resolution gamma-ray spectroscopy.
Subtask 2.2: Working Group 2: Particle detectors.
Subtask 2.3: Working Group 3: High-efficiency and fast-timing scintillator detectors.
Subtask 2.4: Working Group 4: Devices for nuclear moments and transition probabilities.

Task 3: Collaboration Workshops (All)
The Steering Committee will organise annually the NUSPIN Workshop where the most important achievements in gamma-spectroscopy research will be presented and discussed. These workshops will serve not only for the exchange of information but also to strengthen the community, to start new ventures, to discuss the perspectives with theoreticians and with colleagues involved in nuclear-structure research outside Europe. They will host the annual AGATA Collaboration Open meeting.
Mini-Workshops dedicated to specific issues of interest of the different Working Groups will be also organised by the conveners.

Task 4: Training of new users and exchange of experts (All)
The transfer of knowledge to new users, with particular regard to young researchers, and from one community to the other constitutes a very important goal of the Network. The exchange of key technical personnel is another important goal.
Subtask 4.1: Organisation of on-site training courses for scientists, engineers and new users will be done annually. The courses will cover the most important and useful subjects and techniques.
Subtask 4. 2: Exchange of technical experts between infrastructures and research institutions will help to spread the expertise and ensure a widespread knowledge base.

The associated institutions involved in this network are:
CEA, GANIL, UCO, TUD, STFC, UMAN, Univ. Birmingam, UNIS, UoY, UWS, Univ. Lund, KTH, Univ. Uppsala, JYU, UNIWARSAW, IFJ-PAN, IFIN-HH, NCSRD, UHU, UAM, USC, UCM, CIEMAT, Univ. Salamanca, MTA Atomki, RBI, Univ. Zagreb.

Participation per Partner

Partner number and short name	WP4 effort
2 - INFN	0.10
5 - CNRS	0.10
6 - GSI	0.10
24 - CIEMAT	0.10
25 - CSIC	0.10
28 - ULIV	0.10

Partner number and short name	WP4 effort
Total	0.60

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D4.1	Report on the setup of the website, members and chairs of the Scientific Committee and Working Groups	2 - INFN	Report	Public	12
D4.2	Midterm report on the activity of the Scientific Committee and Working Groups	2 - INFN	Report	Public	24
D4.3	Intermediate report on the activity of the Scientific Committee and Working Groups	2 - INFN	Report	Public	36
D4.4	Final Report on the activity of the Scientific Committee and Working Groups	2 - INFN	Report	Public	48
D4.5	Midterm report on the Collaboration Workshops and training activities	2 - INFN	Report	Public	24
D4.6	Intermediate report on the Collaboration Workshops and training activities	2 - INFN	Report	Public	36
D4.7	Final Report on the Collaboration Workshops and training activities	2 - INFN	Report	Public	48
D4.8	Final Report on the exchange of key technical personnel	2 - INFN	Report	Public	48

Description of deliverables

D4.1 : Report on the setup of the website, members and chairs of the Scientific Committee and Working Groups [12]
Report on the setup of the website, members and chairs of the Scientific Committee and Working Groups

D4.2 : Midterm report on the activity of the Scientific Committee and Working Groups [24]
Report on the activity of the Scientific Committee and Working Groups

D4.3 : Intermediate report on the activity of the Scientific Committee and Working Groups [36]
Report on the activity of the Scientific Committee and Working Groups

D4.4 : Final Report on the activity of the Scientific Committee and Working Groups [48]

Final Report on the activity of the Scientific Committee and Working Groups

D4.5 : Midterm report on the Collaboration Workshops and training activities [24]
Report on the Collaboration Workshops and training activities

D4.6 : Intermediate report on the Collaboration Workshops and training activities [36]
Report on the Collaboration Workshops and training activities

D4.7 : Final Report on the Collaboration Workshops and training activities [48]
Final Report on the Collaboration Workshops and training activities

D4.8 : Final Report on the exchange of key technical personnel [48]
Final Report on the exchange of key technical personnel

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS11	Setup of the website, Scientific Committee and Working groups	2 - INFN	12	Report
MS12	Scientific and Working groups meetings	2 - INFN	20	Report
MS13	Collaboration Workshops	2 - INFN	32	Report
MS14	Training Courses and exchange of personnel	2 - INFN	44	Report

Work package number [9]	WP5	Lead beneficiary [10]	12 - EBG MedAustron
Work package title	NA5 – MediNet: Medical Network		
Start month	1	**End month**	48

Objectives

Cancer ranges amongst the most severe challenges to modern society, rendering the development of effective tumour treatment of highest societal significance. Nuclear-Physics-related knowledge, technology and expertise are highly relevant to improve tumour diagnostics as well as therapy, thus contributing importantly to the advancement of public healthcare. Particle therapy has undergone major technological developments in the last two decades and has been shown to be effective especially for the treatment of tumours in the vicinity of sensitive organs at risk. The increasing importance of particle therapy manifests itself in the increasing number of proton and carbon-ion therapy facilities worldwide, e.g. more than ten facilities are operational in Europe, while a similar number is under construction or in the planning stage. Noteworthy in this context is the interest expressed by the US Department of Energy (DOE) and the National Cancer Institute (NCI) to learn from the experience and perspectives of modern particle-therapy technologies in Europe. At the same time, also the more widespread forms of radiotherapy, such as those based on intensity modulated photon beams (IMRT), are continuously being optimised. The optimisation of radiation therapy in general and particle therapy in particular requires research on a variety of topics such as beam delivery optimisation, in-vivo monitoring of the delivered dose, dosimetry, radiobiology and radiation quality. Expertise in nuclear techniques for the detection and characterisation of charged particles and photons is crucial to each of these objectives. Large efforts are therefore devoted to the development of innovative detector technologies and modelling by several European research groups, focusing on both clinical and pre-clinical applications of particle therapy.
Under the common topical umbrella of nuclear tools applied to the medical environment, two distinct but complementary pillars (Task 1 and Task 2) are jointly pursued within the MediNet NA:
Task 1 comprises research on beam-delivery methods, large-area transmission detectors, non-destructive beam-intensity measurements, improved imaging technology (proton and ion radiography and tomography, in-situ PET systems, prompt-γ imaging detectors, vertex imaging), and reliable online dosimetry. It is noted that several of these activities are expected to contribute to the development of novel instrumentation for IMRT as well. The groups participating in this proposal carry world-renowned expertise and cutting-edge technologies in the pertinent research fields, including a strong connection to operating or planned particle-therapy facilities for the clinical translation of the pursued developments. Potential involvement of industrial partners may be considered, and could be effectuated utilising existing contacts and collaborations of the core group partner institutions.
Task 2 focuses in one of the most critical fields of ion-beam therapy, that is the forecast of the biological effects to the radiation used in therapy (today proton and carbon-ions are the particles selected). The objective in this task is the response to the outcomes of separate projects financed by the EC during the previous Seventh Framework Programme, (in particular ULICE and Bio-QuaRT). The researchers and experts from ion-beam therapy centres, from European metrology institutes, and from industries in the field, recommend the development of specific instruments and, in general, of a new multidisciplinary approach to the estimation of the biological weighted dose. This second pillar of MediNet will focus on the study of soft and hard tools from nuclear physics - as Monte-Carlo codes, tissue equivalent proportional counters, solid-state micro-dosimeters - to be integrated with the studies on cell signalling, biological dosimetry (VINS Belgrade), and bio-compatibility (BMC_Basel University) and obtain new insights for the biological characterisation of the radiation. Valuable members of this initiative are scientists from national and international networks (ENLIGHT and NuPECC) to guarantee the widest visibility and the continuity of this plan with previous actions in ion-beam therapy.
Common goals of NA MediNet:
- to disseminate results within the community, thus avoiding costly parallel developments
- to exchange knowledge and technology
- to coordinate detector developments in order to achieve more efficient progress
- to provide a forum for discussion and stimulation of novel ideas especially with clinicians to provide solutions to therapeutics' requirements more efficiently
- to define clinical feasibility of the development
- to organise communication via network and working group meetings; maintain a joint website
Specific goals of Task 1:
- to establish working groups for specific project tasks to provide a training ground for students (Master and PhD level) by mutual exchange within a mobility programme

- to act as a forum for establishing new collaborations between ENSAR2 groups and preparing joint projects of ENSAR2 laboratories and high-tech companies involved in detector R&D
- to foster the liaison and shared knowledge with US and Japanese communities
Specific goals of Task 2:
- to establish working groups for specific project tasks
- to promote further research and development projects based on the outcomes of this NA
- to coordinate the discussion with the ion-beam therapy experts to develop a common language and guarantee applicability of the tools in the clinical environment.

Description of work and role of partners

WP5 - NA5 – MediNet: Medical Network [Months: 1-48]
EBG MedAustron, INFN, CERN, CNRS, GSI, RUG, IFJ PAN, UNIWARSAW, LMU, CSIC
Total person.months (EU/Own): INFN (0/20) - CERN (0/4) - CNRS (0/8) - GSI (0/4) - RUG (0/4) - IFJ PAN (0/4) - UNIWARSAW (0/4) - EBG MedAustron (0/8) - LMU (0/8) - CSIC (0/4)

Task 1 (LMU)
Subtask 1.1: Working Group Activities
The following working groups (WG) will be established. According to their expertise and scientific interests, the partner institutions have expressed their interest to contribute to the WGs.
WG1: Detector developments for photon detection
WG2: Detector developments for charged-particle detection
WG3: Novel scintillators and their application
WG4: Development of new photosensors (MCP-PMTs, SiPMs, dSiPMs, radiation hardness)
WG5: Development of efficient data-acquisition electronics
The mission of Task 1 within MediNet is to promote the information exchange of ongoing R&D work in the general field of radiation detection instrumentation, pursued in the participating institutions of Task 1.
The Working Groups are designed to structure the realization of this goal along the topics of the corresponding technological fields.
The 5 WGs cover the spectrum of relevant R&D activities, where in each case different institutions contribute/participate, some exclusively active in one of the 5 fields, some involved in research of several sub-fields.
In each WG, a convener from one of the participating institutions will be responsible to coordinate the activities, which comprise classical networking activities by initiating information flow either via modern virtual communication (e.g. video meetings, website) or by direct meetings, either at the occasion of the annual network meetings or especially by the temporary exchange of young investigators, co-financed from NA5/Task 1 funds that participate temporarily in the R&D work of partner institutes, thus becoming human information carriers across the boundaries of the individual institutions. The role and the time committed by each group for the different WGs varies depending on group expertise and research priorities. It will be the responsibility of the Task 1 coordinator to ensure the lively exploitation of this envisaged activity scheme.

Subtask 1.2: Mobility programme – network exchange of (young) researchers in the field of Detector Instrumentation for Radiation Therapy
Exchange of knowledge and expertise on detector developments will be a central goal within Task 1, to be realised via presentations and discussions at the periodical network meetings. Moreover, direct contact of young researchers involved in the various R&D projects at the partner institutions or other laboratories with their colleagues at other labs is regarded as an equally efficient manner to achieve this goal. The networking effects of mutual lab visits and joint research work will not only enable a direct flow of information, but will also greatly widen the horizon of all involved young scientists, thus enhancing their physical understanding, practical skills as well as forming a basis for future collaborations and paving the way for new ideas and projects. Both the involved researchers as well as their host and home laboratories will benefit from such a lively exchange culture that is envisaged to be seeded within Task 1. All partner institutions contributing to Task 1 have agreed to temporarily host young scientists from network member groups sponsored within Task 1 for internships or research visits within their on-going R&D projects on detector developments at their respective facilities.
Part of the working group activities will include coordinated experimental efforts, e.g., via comparative studies of complementary (or alternative) detector approaches, pursued by joint experimental campaigns.
The network task could also play a role in coordinating experimental efforts, which could be helpful to (i) avoid duplicate work, (ii) have an easier/fairer comparison of different detector systems by (a) agreeing on common experimental

protocols and (b) possibly agreeing to test different systems at the same time in one location, and (iii) generally enable progress in a more efficient way.

Task 2 (EBG MedAustron)
Subtask 2.1: Working Group Activities
The following working groups (WGs) will be established. According to their expertise and scientific interests, the partner institutions have expressed their interest to contribute to the WGs.
WG6: Development of Monte-Carlo modelling of physical and biological parameters for ion-beam therapy
WG7: Cellular signalling and biological studies for biological dosimetry
WG8: Development of micro-dosimeters for ion-beam therapy and comparative studies
WG9: Study of biological and imaging compatibility of detectors for in vivo applications
Task 2 focuses on correlating the physical description of the radiation and biological outcomes (using nuclear physics tool).
The Working Groups are designed to structure the realization of this goal along the topics of the corresponding scientific and technological fields. The 4 WGs cover the spectrum of relevant R&D activities, where in each case different institutions contribute/participate, some exclusively active in one of the 4 fields, some involved in research of several sub-fields.
In each WG, a convener from one of the participating institutions will be responsible to coordinate the activities, which comprise classical networking activities by initiating information flow either via modern virtual communication (e.g. video meetings, website) or by direct meetings, either at the occasion of the annual network meetings or especially by the temporary exchange of young investigators, co-financed from NA5/Task 2 funds that participate temporarily in the R&D work of partner institutes, thus becoming human information carriers across the boundaries of the individual institutions. The role and the time committed by each group for the different WGs varies depending on group expertise and research priorities. It will be the responsibility of the Task 2 coordinator to ensure the lively exploitation of this envisaged activity scheme.

Subtask 2.2: Advisory Committee Meetings
Task 2 promotes the discussion between the two communities of experts, the specialists in ion-beam therapy and the physicists. A selected group of scientists operating in European ion-beam therapy centres will be asked to take part in the Advisory Committee, which will meet two times during the MediNet programme. Its main role will be to maintain the focus of the network activity on the needs of the users and to assess the feasibility of the tools developed.
Task 3: Network Meetings (LMU, EBG MedAustron)
This task includes the organisation of the annual meetings of the networking institutions, held at varying, well accessible locations in Europe and locally organised by partner institutions. These meetings serve as a platform for working group summaries as well as for discussions on topics of general interest across the working groups. They foster the relationships between the participating groups and offer the possibility to include also contributions from distinguished external experts working on comparable scientific issues.

The associated partners involved in MediNet activities are: Univ. Pisa, Univ. Roma, UMIL, VINS Belgrade, ENLIGHT(CERN), NuPECC, Univ. Basel.

The time used by beneficiary and associated partners in Research Activities and propaedeutic activities, which are directly linked to the topics of this Network Activity, can be estimated as a total of 300 person-months equivalent for the four years. This considerable amount of time guarantees that the deliverables produced by the Network will be based on strong background and will be up to date in each complementary disciplines.

Participation per Partner

Partner number and short name	WP5 effort
2 - INFN	0.10
3 - CERN	0.10
5 - CNRS	0.10
6 - GSI	0.10
7 - RUG	0.10
8 - IFJ PAN	0.10

Partner number and short name	WP5 effort
9 - UNIWARSAW	0.10
12 - EBG MedAustron	0.10
19 - LMU	0.10
25 - CSIC	0.10
Total	1.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D5.1	Specific need and proposed solutions of nuclear tools for medicine	12 - EBG MedAustron	Report	Public	9
D5.2	Clarifying/adapting nuclear concepts to the medical field	12 - EBG MedAustron	Report	Public	21
D5.3	Nuclear physics instrumentation for medicine	12 - EBG MedAustron	Report	Public	36
D5.4	Use of nuclear physics tools to support biological effectiveness assessment in ion-beam therapy	12 - EBG MedAustron	Report	Public	45

Description of deliverables

D5.1 : Specific need and proposed solutions of nuclear tools for medicine [9]
Specific need and proposed solutions of nuclear tools for medicine

D5.2 : Clarifying/adapting nuclear concepts to the medical field [21]
Clarifying/adapting nuclear concepts to the medical field

D5.3 : Nuclear physics instrumentation for medicine [36]
Nuclear physics instrumentation for medicine

D5.4 : Use of nuclear physics tools to support biological effectiveness assessment in ion-beam therapy [45]
Use of nuclear physics tools to support biological effectiveness assessment in ion-beam therapy

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS15	Kickoff-Meeting	12 - EBG MedAustron	3	Report
MS16	Website	12 - EBG MedAustron	4	Report

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS17	Mid-term meeting	12 - EBG MedAustron	27	Report
MS18	Final meeting	12 - EBG MedAustron	48	Report

Work package number [9]	WP6	**Lead beneficiary** [10]	1 - GANIL
Work package title	NA6 – GDS: Gas-Filled Detectors and Systems		
Start month	1	**End month**	48

Objectives

The aim of the present network activity is to assemble and coordinate a large group of research collaborations that are in the process of developing new capabilities with gas-filled detection and active-target systems in the field of nuclear physics. Gas-filled time-projection chambers and active-target detection systems have found profitable applications in nuclear physics due to their high efficiency and ability to detect low-energy particles. Examples include the CENBG TPC, designed for studying 2-proton radioactivity and the active targets IKAR at GSI, MAYA at GANIL, and TACTIC at York/TRIUMF that are used for scattering and reaction studies over a wide range of energies. While these detectors have each been extremely successful, recent advances in high-density front-end electronics now permit very large numbers of channels to be read and processed. Smaller pixel sizes, higher data rate throughput, the ability to change gains and thresholds on a channel-by-channel basis, and software-level fully numeric triggering are some of the main advantages that next-generation detectors will have over previous ones. Between 2010 and 2013, new detector projects including MINOS, ACTAR TPC, and SpecMAT have all been funded through competitive grants awarded by the European Research Council (ERC) and together represent a total EU investment of nearly 4.4M€. These projects highlight the potential for these types of detection systems in nuclear physics and imply that the demand for a networking activity between these collaborations, and several others interested in using these technologies, is both essential and timely.

This network activity will encompass all applications of gas-filled detectors and systems in the nuclear-physics community such as position-sensitive beam tracking and monitoring detectors, continuous-flow gas targets, high-rate gas counters, and gas-filled magnets and spectrometers. It aims to coordinate solutions towards several of the long-standing challenges that must be overcome before gas-filled detector systems can achieve their full potential. High-intensity beams in excess of 106 ion/s, large energy losses associated with heavy-ion beams, and large dynamic ranges are some examples. Requirements for new types of gases and mixtures will be coordinated including conceptual designs for integrated gas chambers and ultra-pure gas-handling and recycling systems for rare and expensive gases (such as 3He). Organisation of the needs for auxiliary detectors, such as scintillating materials and semi-conductor devices, that need to be operated inside the gas volume or within large magnetic fields will be studied.
The GDS network will exchange information through dedicated workshops and topical meetings between physicists and engineers already working on these projects across Europe. It will assist and promote collaborations and personnel working on similar projects and will encourage the support and training of highly qualified personnel in this rapidly evolving field.

Description of work and role of partners

WP6 - NA6 – GDS: Gas-Filled Detectors and Systems [Months: 1-48]
GANIL, INFN, CNRS, KU Leuven, CEA, USC
Total person.months (EU/Own): GANIL (0/20) - INFN (0/18) - CNRS (0/18) - KULeuven (0/18) - CEA (0/16) - USC (0/18)

The work package will be divided into 5 tasks:

Task 1: Management/GDS Coordination (GANIL)
The main objectives of this task are to harmonise the various activities described in the tasks of the GDS network (see below), assist with the dissemination of information and knowledge gained to the broader community, and suggest ways to combine the existing resources of the various collaborations in order to maximise the efficiency and potential of these projects. This task will provide the platform for these activities through the organisation of workshops between all of the EU communities working on GDS projects.

Task 2: GDS in strong and non-uniform magnetic fields (CEA, KU Leuven)
To reach particle identification and energy resolution over an extended dynamic range several detector projects require magnetic fields. However, access to magnets with strong fields of 2-5 Tesla and with "volumes" that can house an active target or time projection chamber of around 0.5 m3 with their auxiliary detector arrays is non-existent in Europe. The role of this task is to combine the available knowledge and expertise to support and assist existing projects and to develop new ideas and capabilities for future ones.

Task 3: Novel detection systems for high-intensity and heavy-ion beams (USC, GANIL)

The large number of ionisation electrons produced from unreacted high-intensity (>106 ions/s) or heavy-ion beams (i.e., Ni, Sn, Pb, U) creates significant space charge that degrades the homogeneity of the drift electric field in gas-filled detection systems. Experiments suffer from poorer resolution, or in some cases, cannot be performed at all. New solutions to operate an active-target detection system at the highest possible beam intensities, exploring different possibilities and investigating new detection capabilities for auxiliary detection systems will be coordinated in this task.

Task 4: Rare-gas target handling and recycling systems (CNRS, CEA)
This task aims to propose solutions towards the realisation of a gas-handling system for rare-gaseous targets for use in rare-isotope beam experiments. Among the most important is 3He as it provides several unique probes such as one-proton transfer (3He,d) reactions or charge-exchange (3He,t) reactions. Rare gases are essential for certain types of experiments but the cost of obtaining such gases in useable quantities is often a major deterrent. It is therefore imperative to recirculate a limited volume of gas, while retaining its quality for long-term operation. This task will collect the available data on what handling and recycling systems are already in existence, assess their main limitations, and propose how they could be improved. Data on the operational characteristics of new gas mixtures will also be collected in this task.

Task 5: Auxiliary detectors (INFN, KU Leuven)
Depending on the physics goals of each experiment, different types of auxiliary detectors such as neutron and γ-ray detectors must be coupled to GDS to complement the identification and track reconstruction in the gas volume. Silicon detectors, inorganic and organic scintillators need to be used in various compact geometries around the gas volume (or even operating inside it) and in the vicinity of strong magnetic fields. Despite the obvious improvements in overall sensitivity, the actual realisation of coupling a GDS to an array of auxiliary detectors is far from trivial. This task will be devoted to sharing the available information on new types of detector materials and their operational characteristics as it pertains to the joint use of different types of auxiliary detectors with the next generation GDS.

Participation per Partner

Partner number and short name	WP6 effort
1 - GANIL	0.10
2 - INFN	0.10
5 - CNRS	0.10
13 - KU Leuven	0.10
15 - CEA	0.10
26 - USC	0.10
Total	0.60

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D6.1	Web Site	1 - GANIL	Report	Public	6
D6.2	GDS Topical Meeting “GDS in strong and non-uniform magnetic fields”	1 - GANIL	Report	Public	48
D6.3	GDS Topical Meeting “GDS for high-intensity and heavy-ion beams”	1 - GANIL	Report	Public	48
D6.4	GDS Topical Meeting “GDS with rare gas	1 - GANIL	Report	Public	48

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	targets: handling and recycling"				
D6.5	GDS Topical Meeting "GDS coupling to auxiliary detection systems"	1 - GANIL	Report	Public	13

Description of deliverables

D6.1 : Web Site [6]

Creation of a dedicated GDS website to help facilitate communication between the GDS community and disseminate information amongst all interested parties

D6.2 : GDS Topical Meeting "GDS in strong and non-uniform magnetic fields" [48]

The GDS annual Topical Meetings will bring together expertise from the European community to confront some of the primary challenges associated with modern-day gas-filled detectors and systems (GDS). Each annual meeting will be oriented towards one of these four main challenges that we regard as being essential to overcome in the next 4 years.

D6.3 : GDS Topical Meeting "GDS for high-intensity and heavy-ion beams" [48]

The GDS annual Topical Meetings will bring together expertise from the European community to confront some of the primary challenges associated with modern-day gas-filled detectors and systems (GDS). Each annual meeting will be oriented towards one of these four main challenges that we regard as being essential to overcome in the next 4 years.

D6.4 : GDS Topical Meeting "GDS with rare gas targets: handling and recycling" [48]

The GDS annual Topical Meetings will bring together expertise from the European community to confront some of the primary challenges associated with modern-day gas-filled detectors and systems (GDS). Each annual meeting will be oriented towards one of these four main challenges that we regard as being essential to overcome in the next 4 years.

D6.5 : GDS Topical Meeting "GDS coupling to auxiliary detection systems" [13]

The GDS annual Topical Meetings will bring together expertise from the European community to confront some of the primary challenges associated with modern-day gas-filled detectors and systems (GDS). Each annual meeting will be oriented towards one of these four main challenges that we regard as being essential to overcome in the next 4 years.

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS19	GDS coordination committee	1 - GANIL	3	Report
MS20	Creation of the GDS community	1 - GANIL	6	Report
MS21	News Feed	1 - GANIL	6	Report

Work package number [9]	WP7	**Lead beneficiary** [10]	21 - NCSRD
Work package title	NA7- ENSAF: European Network of Small-scale Accelerator Facilities		
Start month	1	**End month**	48

Objectives

Low-energy stable-beam facilities will continue to contribute to our understanding of nuclei through research in nuclear structure, reactions and nuclear astrophysics, and will be important in high-level education of students and training of young researchers in nuclear physics. Small-scale national facilities played, and still do so, a crucial role in providing expertise in developing experimental techniques and equipment for the flagship facilities from the ESFRI Roadmap. The role of small-scale national facilities was highlighted in the last NuPECC Long-Range Plan of 2010, where one reads among the recommendations: Fully exploit smaller scale national and university Nuclear Physics laboratories across Europe dedicated to nuclear structure and astrophysics experiments, fundamental interactions and nuclear applications. ENSAF is in line with these recommendations as its primary objective is to strengthen the role of small-scale facilities in the European Research Area by bringing together scientists from many European small-scale accelerator facilities to:
1. Organise extended data bases of resources available at small-scale accelerator facilities, and increase the community awareness of the capabilities of these facilities and identify niches for scientific research.
2. Develop good practices and exchange know-how related to a) the operation of accelerators and ion sources, b) target preparation and recycling, c) detector and instrumentation maintenance, and d) laboratory management and coordination of users.
3. Develop and coordinate common scientific efforts with emphasis on projects around the Transnational Access facilities of ENSAR2 and furthermore around the upcoming ESFRI infrastructures.
4. Elaborate and formulate action plans aiming at an effective use of small-scale accelerator facilities for training young scientists. This becomes particularly important as our field concentrates top research in large-scale facilities with complex detection and data-acquisition systems accessed through highly competitive research proposals and procedures. In this context, small-scale facilities should complement the early stages of the formation of future generations of experimentalists and serve, when necessary, as introductory laboratories to TA facilities.
ENSAF will be coordinated by NCSRD and CNA Sevilla (on behalf of USE). ENSAF gathers a large collaboration of accelerator facilities: CMAM, Madrid (Spain), UCO, Cologne (Germany), MPI, Rez (Czech Republic), University of Oslo (Norway), University of Bochum (Germany) and TUD (Germany).

Description of work and role of partners

WP7 - NA7- ENSAF: European Network of Small-scale Accelerator Facilities [Months: 1-48]
NCSRD, USE
Total person.months (EU/Own): NCSRD (0/12) - USE (0/12)

Task 1: Awareness (NCSRD)
This task aims at producing a survey of resources available at the ENSAF accelerator facilities (scientific instrumentation, analytical facilities, services provided, etc.). Collaboration with NuPECC, the IAEA and other Integrating Activity projects is envisaged within this task. A workshop dedicated to Task 1 will be organised around project-month 12 with the tentative title “Physics Opportunities and Innovation at European Small-Scale Accelerators” that will result also in a corresponding strategy report.

Task 2: Exchange of know-how and best practices (USE)
Reliable operation of an accelerator requires specific maintenance works and skills from the operating and scientific personnel. Ion sources, up-charging systems, remote control software, etc. are often causing failures due to numerous technical problems. For addressing these problems and finding solutions, different groups have often applied different approaches, gaining this way valuable experience. In addition, all nuclear-physics experimentalists have to provide independently of the goal of their measurements a “target” to perform an experiment. The production of a target is often a demanding procedure and the personnel performing this acquire with time increased skills and an extended knowledge of physical properties of different target materials and their behaviour. It is of utmost importance to train accordingly the scientific personnel in target-preparation techniques. Moreover, small-scale accelerator laboratories are increasingly receiving beam-time requests for experiments of interdisciplinary character. Hence, groups of users from other disciplines are gradually forming around these laboratories setting specific conditions to their management. Best practices in this respect are not widespread. A review and evaluation of management approaches in small labs would therefore be very useful to perform. To achieve the goals of Task 2, ENSAF foresees some financial support

for mobility of experts between the participating laboratories. The corresponding requests will be forwarded to the ENSAF Coordinator and will be evaluated centrally, i.e., by the Facility Coordination Group (FCG) of ENSAR2. For this purpose, the ENSAF Coordinator will participate in the FCG meetings to report on ENSAF progress and present these applications. Within Task 2, an International Workshop of experts in Accelerator Operation and Management will be organised by project month 30 under the auspices of ENSAR2.

Task 3: Linking ENSAF and TA facilities (NCSRD)
TA facilities within ENSAR2 are expected to provide beam time for forefront research. Hereby, a strong competition between excellent proposals is expected. The preparation of these proposals often requires time demanding preparatory measurements for, e.g., instrument calibration, radiation-hardness tests (especially with secondary neutron beams) or feasibility studies, notably off-beam tests of unique setups. As TA labs are often overloaded by running PAC (programme advisory committee) approved experiments, the time offered for preparatory work is very limited. Small-scale facilities can therefore serve, whenever this is technically feasible, to contribute indirectly to the "access" TA labs offer. Hence, Task 3 aims at partially supporting such activities, i.e. preparatory work at an ENSAF lab with the primary aim to subsequently setup a research proposal to be submitted to the PAC of a TA laboratory, or feasibility studies at a TA facility by ENSAF scientists, in general. Activities to be implemented within Task 3, should be in line with the scientific goals of ENSAR2, i.e. nuclear structure, nuclear astrophysics and related applications and will have to be scheduled twice a year (on a six-month cycle) before being presented to the ENSAR2 FCG. As in Task 2, applications for mobility support will be forwarded to the ENSAF Coordinator who will participate in the FCG meetings to report on the ENSAF progress and present these applications. Support will be decided by the FCG.

Task 4. Training of students and young researchers at small facilities (UCO)
A working group will be setup to discuss and evaluate best ways to use small accelerators and the installed instrumentation for training young researchers at the beginning of their careers. This will be in connection with Task 3 about linking ENSAF and TA facilities, but will be treated with special emphasis on using smaller accelerators for training. Mobility of post-docs will be supported, in line with the procedures set for Task 3. The working group will have two collaboration meetings and will deliver by project month 36 a corresponding strategy report.

Participation per Partner

Partner number and short name	WP7 effort
21 - NCSRD	0.10
27 - USE	0.10
Total	0.20

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D7.1	Strategy Report "Physics Opportunities and Innovation at European Small-Scale Accelerators"	21 - NCSRD	Report	Public	36
D7.2	Overview on the "International Workshop on Accelerator Operation and Management"	21 - NCSRD	Report	Public	21
D7.3	Strategy Report "Training Opportunities	21 - NCSRD	Report	Public	36

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	at European Small-Scale Accelerators”				
D7.4	Strategy Report “Integration of the ENSAF labs with the European TA Accelerator Facilities”	21 - NCSRD	Report	Public	48

Description of deliverables

D7.1 : Strategy Report “Physics Opportunities and Innovation at European Small-Scale Accelerators” [36]

Strategy Report “Physics Opportunities and Innovation at European Small-Scale Accelerators”

D7.2 : Overview on the “International Workshop on Accelerator Operation and Management” [21]

Overview on the “International Workshop on Accelerator Operation and Management” with link to electronic proceedings

D7.3 : Strategy Report “Training Opportunities at European Small-Scale Accelerators” [36]

Strategy Report “Training Opportunities at European Small-Scale Accelerators”

D7.4 : Strategy Report “Integration of the ENSAF labs with the European TA Accelerator Facilities” [48]

Strategy Report “Integration of the ENSAF labs with the European TA Accelerator Facilities”

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS22	ENSAF webpages	21 - NCSRD	3	Report
MS23	2nd ENSAF Workshop held	21 - NCSRD	30	Report
MS24	International Workshop on Accelerator Operation and Management	21 - NCSRD	15	Report
MS25	Meetings on Training at Small-Scale Accelerator	21 - NCSRD	12	Report

Work package number [9]	WP8	**Lead beneficiary [10]**	1 - GANIL
Work package title	NA8 – NuPIA: Nuclear Physics InnovAtion		
Start month	1	**End month**	48

Objectives

The Network Activity NuPIA (Nuclear Physics InnovAtion) is a transversal activity meant to reinforce the links between ENSAR2 institutions and industry and to promote the use of the ENSAR2 facilities by industrial partners.

NuPIA will be a network gathering innovation and technology transfer officers within the ENSAR2 institutions, research groups in ENSAR2 Work Packages and industry.
In particular, innovative developments at short- and/or mid-term are already foreseen:
• in NA MIDAS about ion sources, with AVS and PANTECHNIC SMEs as associated partners
• in NA MediNet about medicine
• in JRA TecHIBA about radioisotopes
• in JRA PASPAG about scintillator materials
• in JRA PSeGe about 3D position-sensitive Ge detectors in cooperation with industrial partner SEMIKON

NuPIA will enhance the exchange of good practices between scientists involved in these work packages, innovation officers in institutions and industry. This will ensure that companies will be aware of the potentialities offered by the ENSAR2 facilities and partners and that companies will be in a position to build long-term relationships with ENSAR2 partners.

The NuPIA network will be coordinated by GANIL with a collaboration gathering all ENSAR2 institutions.
As a new community, we need to structure the WP during the project: a NUPIA steering committee will be formed by the coordinator, deputy coordinator and task leaders. The committee will meet twice per year in order to perform an efficient and consistent management of the NA. The committee will organise the web site including all documents published during the NA. The committee will also behave as a link between the NA and ENSAR2 Work Packages active in innovation to guarantee the interaction and exchange of information. To fulfil these objectives, NuPIA will be divided into 3 tasks.

Description of work and role of partners

WP8 - NA8 – NuPIA: Nuclear Physics InnovAtion [Months: 1-48]
GANIL, JYU, UNIWARSAW, CEA
Total person.months (EU/Own): GANIL (0/15) - JYU (0/7) - UNIWARSAW (0/48) - CEA (2/4)

Task 1: Survey of innovation within the ENSAR2 WPs (CEA)
The objective of this task is to highlight the innovative capacity of the ENSAR2 partners and quantify the impact in terms of direct and indirect benefits for industry and society. A survey of the innovative developments of possible interest for industry or for other scientific domains will be carried out. The impact in terms of direct and indirect benefits for industry and society will be assessed. Direct benefit assessment will include services to industry, such as providing beam or technical expertise, innovation transferred to industry, start-up creation, etc. Indirect benefit will be estimated through regional impact, job creation, skill transfer to industry, etc. The results of this impact study will complement the more general impact study done in WP Management (FISC02). This task will be conducted by persons/departments in charge of innovation/industrial partnership in each ENSAR2 partner laboratories.
The work will begin by a definition of the methodology and choice of the impact indicators (12 months). The innovative developments achieved or expected during the ENSAR2 project and the impact indicators obtained from the ENSAR2 partners will be collected (18 months). The results will then be compiled and analysed. In particular, the opportunity to create a technology transfer network specific to nuclear physics, or to join the existing network HEPTECH, will be discussed and the decision will be taken at the end of the 2nd year (organisation of a dedicated meeting). A report to be largely distributed among stakeholders, end-users and funding agencies will be issued at the end of the project.

Task 2: Bridging and dissemination (UNIWARSAW, GANIL)
The ENSAR2 facilities have often established links with their national industry and some local SMEs. The goal of this task is to create a strong European network of SMEs and industrial partners in close relation with all the ENSAR2 facilities and partners. This, for instance, will enable industry and SMEs necessitating beam time to be aware of all the offered possibilities and access to the most appropriate facility. In case of technology transfer, this will allow them

to select the best suited European company and for the company to access a wider market. This task will be achieved through the following subtasks:
Subtask 2.1: Bridging (UNIWARSAW)
The innovation work within the various ENSAR2 work packages will be presented through direct and indirect contacts to industrial users, small and medium enterprises, and the European Atomic Energy Community. For this purpose, project participants will organise a European workshop, for people from nuclear physics industry in main activities: research and development, design and development, and production. The first step of the workshop preparation will be for each ENSAR2 partner, to identify the industries among its various industrial networks, to be invited to the workshop. The Subtask 2.1 leader will coordinate the actions: organisation of the workshop for end-users industries and industrial partners, website creation with information about the workshop and various links, and reporting work.
The main innovative areas as a result of cooperation between research facilities and industrial partners involve medicine and pharmaceutical industry, nuclear power and energy industry, defence industry, environmental protection industry. Cooperation with related industries will lead to a European network for technology transfer and knowledge of innovative results.
Subtask 2.2: Dissemination and communication activities (GANIL)
The purpose of this subtask is to create a teaching package with different tools in order to present the most important result on innovation of ENSAR2 research activities. The kit will promote innovation in all TAs of ENSAR2 and will be distributed to all partners (NAs, JRAs and TAs) who need to organise or participate in an event (exhibition, meetings) during the period of the grant. The working group will collect information about innovation from each infrastructure and develop various items. This kit will include for instance: a film about ENSAR2 innovation, posters, and kakemonos.

Task 3: Training in nuclear techniques : Schools for employees of industrial companies (JYU, ULIV)
This task will be carried out mainly at the Accelerator Laboratory of the University of Jyväskylä, Finland and the University of Liverpool in the UK.
Other ENSAR2 institutions may be involved, for topics in which they are able to offer specific and high-level training. The Task 3 leader will conduct a survey of the courses available in different European countries and contact the various institutions during the first year in order to establish synergies of these specific courses.
Industrial companies, European research and industrial organisations will be able to send their employees on one-week long training courses to develop their practical skills and gain an understanding of different aspects of radiation detection and safety, imaging, ion-beam analysis techniques and the effects of radiation on electronics component.
In Liverpool courses will be provided based on the Radiometrics, Instrumentation and Modelling MSc course.
http://www.liv.ac.uk/study/postgraduate/taught/faculty-of-science-and-engineering/school-of-physical-sciences/physics/taught/radimetrics-instrumentation-and-modelling-msc/overview/
In Jyväskylä hands-on training will be provided in the Accelerator Laboratory. Courses will combine short lectures and practical experience.
In other laboratories, the descriptions of the various courses will be defined during the first year.

Participation per Partner

Partner number and short name	WP8 effort
1 - GANIL	0.10
4 - JYU	0.10
9 - UNIWARSAW	0.10
15 - CEA	2.00
Total	2.30

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D8.1	Intermediate report on Innovation Survey	1 - GANIL	Report	Public	24
D8.2	Report to be distributed to stakeholders, end-users and funding agencies	1 - GANIL	Report	Public	48
D8.3	Intermediate report on the identified industrial network	1 - GANIL	Report	Public	24
D8.4	Report on Industry days, workshops	1 - GANIL	Report	Public	48
D8.5	Dissemination kit	1 - GANIL	Other	Public	14
D8.6	Report on the survey of available courses in European countries and on the description of the courses proposed by the various laboratories	1 - GANIL	Report	Public	12
D8.7	Intermediate Report on the provided courses	1 - GANIL	Report	Public	36
D8.8	Report on Courses in Nuclear Techniques for industrial partners	1 - GANIL	Report	Public	48

Description of deliverables

D8.1 : Intermediate report on Innovation Survey [24]

Intermediate report on Innovation Survey

D8.2 : Report to be distributed to stakeholders, end-users and funding agencies [48]

Report to be distributed to stakeholders, end-users and funding agencies

D8.3 : Intermediate report on the identified industrial network [24]

Intermediate report on the identified industrial network

D8.4 : Report on Industry days, workshops [48]

Report on Industry days, workshops

D8.5 : Dissemination kit [14]

Dissemination kit

D8.6 : Report on the survey of available courses in European countries and on the description of the courses proposed by the various laboratories [12]

Report on the survey of available courses in European countries and on the description of the courses proposed by the various laboratories

D8.7 : Intermediate Report on the provided courses [36]

Intermediate Report on the provided courses

D8.8 : Report on Courses in Nuclear Techniques for industrial partners [48]

Report on Courses in Nuclear Techniques for industrial partners

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS26	Decision for technology transfer network	1 - GANIL	24	Report
MS27	End of the collection of impact data	1 - GANIL	40	Report
MS28	Website and workshop	1 - GANIL	18	Report
MS29	Summary of courses	1 - GANIL	24	Report

Work package number [9]	WP9	Lead beneficiary [10]	25 - CSIC
Work package title	JRA1 – PASPAG: Phoswich scintillator assemblies: Application to the Simultaneous detection of PArticle and Gamma radiation		
Start month	1	End month	48

Objectives

The PASPAG JRA aims to improve the infrastructure for European large-scale facilities such as FAIR, SPIRAL2 & ELI-NP to make best use of the high investment into delivering radioactive ion beams. Efficient gamma-ray and charged-particle detection systems are key tools for experimental nuclear physics. Future nuclear-physics facilities will make strong demands on the capability and performance of such detector systems. For example, the optimum gamma-ray spectrometer would combine a maximum of solid angle with good rate capability and energy resolution. New scintillator materials and photon detector technologies in combination with high granularity will help to tackle the challenges associated with extreme Doppler shifts at relativistic energies.

Description of work and role of partners

WP9 - JRA1 – PASPAG: Phoswich scintillator assemblies: Application to the Simultaneous detection of PArticle and Gamma radiation [Months: 1-48]
CSIC, INFN, CNRS, GSI, IFJ PAN, UNIWARSAW, IFIN-HH, USC, UoY
Total person.months (EU/Own): INFN (18/18) - (CNRS (0/36) - GSI (0/3) - IFJ PAN (18/18) - UNIWARSAW (0/12) - IFIN-HH (6/6) - CSIC (18/18) - USC (15/21) - UoY (6/42)
In this JRA, we will exploit novel scintillator materials and explore new techniques and concepts such as phoswich detectors and segmented or hybrid scintillators. We will focus on developing the capability to detect high-energy gamma rays, neutrons and charged particles with the same type of detectors thus making it possible to detect them simultaneously with the same detector array. The emphasis will be on a modular approach both for the scintillator crystals and photosensors as well as for the electronics where improved throughput and effective data processing will allow for compact scalable devices. This JRA will also prepare the ground for taking this technology out of basic science so that it can be exploited for societal applications, for example, within the areas of nuclear medicine and homeland security. Depending on the applications, features like energy resolution, position sensitivity, high-rate capability and insensitivity to magnetic fields or radiation hardness are of varying importance.
The work of this JRA serves to broaden the physics cases which can be addressed by gamma-ray spectroscopy. There are important synergies with other work packages within this overall project, e.g.: NA NUSPIN, JRAs PSeGe and TecHIBA (particularly detection at high-rate conditions) and TAs as NLC for detector tests.
The JRA is organised into different tasks, strongly connected with each other which range from the identification and characterisation of new materials (Task 1) to the construction of small-size phoswich prototypes (Task 2) and hybrid detectors (Task 3) to be used in applications.

Task 1: Novel Scintillator Materials (INFN)
A wide range of promising new scintillators are becoming commercially available, such as CeBr3, CLYC and GAGG. Others, such as GYGAG:Ce, CLLB and CLLC will be available in the near future. It has also recently been discovered that co-doping inorganic scintillators might increase the crystal proportionality and significantly improve the energy resolution. It is not clear, however, how these developments in scintillator performance might translate into practical applications for nuclear physics and the new materials need to be characterised in this regard.
Subtask 1.1(CNRS): Basic R&D on developing new scintillators is outside the scope of this project. Instead, we will obtain commercially available scintillators and work closely with industry, using our contacts to obtain small samples of new materials not yet on the market. The project will focus on characterising such materials and exploring their combination with different photosensors in order to identify their usefulness in basic research and societal applications. Key parameters to be explored are energy resolution, timing resolution, particle identification via pulse-shape discrimination, radiation hardness and efficiency.
Subtask 1.2 (USC): Thin crystals of high light-yield scintillators such as LaBr3:Ce could potentially provide position sensitivity due to the effective localisation of the scintillation light. This feature could be used to tackle the challenge of Doppler broadening in nuclear physics but would also be extremely useful in several societal applications, e.g., homeland security, medical imaging or radiotherapy. We will construct an ‘imager’ using scintillators with one or two transparent windows. The system will be optimised in terms of choice of photosensor and geometry. Algorithms will be designed and tested to determine the position resolution.

The output of this Task will be two-fold: firstly, a report on the performance of various novel scintillators for nuclear-physics applications in terms of response to gamma rays, thermal and fast neutrons; the second deliverable will be the prototype ‘imager’.

Task 2: Phoswich detectors (IFJ PAN)
Phoswich detectors use two different scintillators which are optically coupled. Typically, the scintillators are chosen so that the light output of the two materials has very different timing properties so that the energy deposited in the two parts of the phoswich can be extracted. Phoswich solutions are attractive for discriminating high-energy charged particles and gamma rays. They can also be a good solution for making economic use of novel scintillators to produce detectors which have high energy resolution for low-energy gamma rays and high efficiency at the expense of resolution for high-energy gamma rays.
Subtask 2.1(CSIC): As the peak wavelength of emission from novel scintillators can vary strongly, it will be necessary to explore the optimum coupling to high-performing photosensors including ultra-bright PMTs and solid-state replacements such as silicon drift detectors (SDD) and silicon photomultipliers (SiPM).
Subtask 2.2 (TUM): To separate the different components in the light emission, digital systems based on flash ADCs may be the most flexible solution. The amount of data has to be reduced by digital pre-processing at the frontend. Optimised algorithms have to be developed to deliver sufficient performance and throughput. Dedicated in-beam tests are foreseen at the proton-beam facility in Krakow and heavy-ion facilities in Orsay and Warsaw.
The output of Task 2 will be a report on the construction and evaluation of various prototype phoswich designs.

Task 3: Hybrid arrays and their applications (UoY)
A third task of this project will be to investigate hybrid detector arrays. By hybrid arrays we mean highly-segmented assemblies of different scintillator materials as well as the
combined use of photosensors in the same detector package, e.g., position sensitivity achieved with SiPMs on one side and a PMT on the other to obtain the best energy or timing resolution. This task will also address societal applications outside of fundamental research. Such applications span a broad range from medical imaging to homeland security.
Subtask 3.1 (UoY): Novel scintillators with improved energy resolution, coupled to silicon photomultipliers or APDs in combination with digital pulse processing will provide a route forward for various applications requiring good timing properties or high-rate capability. Timing resolutions of hundreds of ps for some silicon photomultipliers mean that this technology is very relevant to applications like PET imaging. We will exploit the Compton camera technique to construct hybrid detector systems (phoswich) with layers of different scintillators and semiconductors boasting high timing and energy resolutions in order to improve SPECT imaging by removing physical collimation.
Subtask 3.2 (CSIC): Applications in the area of homeland security, where the illicit movement of fissile material and dirty bombs are of particular concern. Radioactive material should be localised and identified from drones or other mobile vehicles. Advances in signal processing and digital electronics offer considerable scope for development and improvements for these applications. Greater sensitivity can be envisaged in radionuclide identification and characterisation. We will use the phoswich technique in combination with digital pulse identification to build segmented detectors that can be carried by drones, and thus will be able to help to localise and to identify hidden radioactivity.
Subtask 3.3 (GSI): New scintillator materials are of particular interest in nuclear structure applications with radioactive beams. Excellent timing and energy resolution is needed in order to discriminate rare events of interest from dominant background. A test setup, combining particle-tracking detectors with high-resolution scintillators, will be realised and employed at GSI.
The output of Task 3 will be a report summarising the achievements.

The associated partners involved in PASPAG activities are: CTH, Univ. Rzeszow, TUM, TUD and UCO.

Participation per Partner

Partner number and short name	WP9 effort
2 - INFN	18.00
5 - CNRS	0.10
6 - GSI	0.10
8 - IFJ PAN	18.00
9 - UNIWARSAW	0.10
10 - IFIN-HH	6.00

Partner number and short name	WP9 effort
25 - CSIC	18.00
26 - USC	15.00
29 - UoY	6.00
Total	81.30

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D9.1	Report: present status of New Scintillator Materials and their basic characterisation (energy & time response)	25 - CSIC	Report	Public	12
D9.2	Report: Sensor characterization and Base design of hybrid detectors	25 - CSIC	Report	Public	18
D9.3	Report: Scintillator response to gamma and particle radiation	25 - CSIC	Report	Public	24
D9.4	Report: Digital pre-processing at frontend	25 - CSIC	Report	Public	30
D9.5	Report: Design Phoswich Assemblies for homeland security	25 - CSIC	Report	Public	36
D9.6	Report: Summary of test results	25 - CSIC	Report	Public	48

Description of deliverables

D9.1 : Report: present status of New Scintillator Materials and their basic characterisation (energy & time response) [12]

Report: present status of New Scintillator Materials and their basic characterisation (energy & time response)

D9.2 : Report: Sensor characterization and Base design of hybrid detectors [18]

Report: Sensor characterization and Base design of hybrid detectors

D9.3 : Report: Scintillator response to gamma and particle radiation [24]

Report: Scintillator response to gamma and particle radiation

D9.4 : Report: Digital pre-processing at frontend [30]

Report: Digital pre-processing at frontend

D9.5 : Report: Design Phoswich Assemblies for homeland security [36]

Report: Design Phoswich Assemblies for homeland security

D9.6 : Report: Summary of test results [48]

Report: Summary of test results

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS30	Crystal characterisation	25 - CSIC	12	Report
MS31	Scintillator readout Test-bench	25 - CSIC	18	Report
MS32	Hybrid readout	25 - CSIC	24	Report
MS33	Data processing	25 - CSIC	24	Report
MS34	Imaging using segmented detector	25 - CSIC	36	Report

Work package number [9]	WP10	**Lead beneficiary** [10]	25 - CSIC
Work package title	JRA2 - PSeGe: R&D on Position-Sensitive Germanium Detectors for Nuclear Structure and Applications		
Start month	1	**End month**	48

Objectives

The European experimental gamma-ray spectroscopy community has a long-standing tradition of coordinated efforts. Since the early nineties it has been joining forces to build instruments with the highest possible sensitivity, e.g., the escape-suppressed spectrometer EUROBALL (1995-2004), which contributed in a significant way to the impressive progress of nuclear-structure research achieved in the last decades. In recent years, new important technical developments, namely HPGe detector segmentation, pulse-shape analysis and gamma-ray tracking, opened the possibility to obtain unprecedented detection efficiencies and at the same time improved energy resolution under the extreme experimental conditions expected for the new generation of facilities for intense radioactive-ion beams (FAIR, SPIRAL2 and SPES) and high-intensity stable-ion beams (ECOS facilities), requiring unprecedented levels of sensitivity and count-rate capabilities.
The present project will contribute to the R&D of detector technology for position-sensitive HPGe detector arrays. While the first developments were applied successfully and new devices have already been put into operation it is obvious that several aspects still require basic research and ongoing development. Key areas are detector production technology, the basic characteristics of the novel detectors, electronic instrumentation and software developments.
Our collaboration will be strongly committed to the development of new applications especially in the field of high-resolution gamma-ray imaging. In this respect, the exchange of technologies and know-how is crucial to advance the expertise within our community. The networking activity associated with this JRA will be an important tool to reach these goals, as several European institutions will contribute with their specific expertise. In this way, the best resources already existing will be available for this work package and will be combined in pursuit of the ambitious future goals in a timely and efficient manner.

Description of work and role of partners

WP10 - JRA2 - PSeGe: R&D on Position-Sensitive Germanium Detectors for Nuclear Structure and Applications [Months: 1-48]
CSIC, INFN, CNRS, GSI, UCO, ULIV
Total person.months (EU/Own): INFN (28/4) - CNRS (0/4) - GSI (13/15) - UCO (13/15) - CSIC (23/5) - ULIV (0/4)

This Work package will be divided into the management and 4 tasks:
Management (CSIC, INFN, UCO)
There will be one coordinator and two deputies for this work package. In addition, a Steering Committee will be installed at the start of the work package. The list of Steering Committee members will be posted on the web page of the work package soon after the start.

Task 1: New technologies on passivation and segmentation (INFN)
The technology used for production of standard coaxial detectors is well established and reliable. The situation is quite different for the new generation of highly segmented detectors for gamma tracking.
The aim of this task is the improvement of the present technologies for passivation and segmentation in HPGe detectors, to solve the problem of the intrinsic instabilities of the Ge surface. The intrinsic surface between the segments can become unstable and lead to an increase of the leakage current and noise and/or to a reduction of the isolation between the segments. It is then necessary to find passivation methods that could be applied on the segments boundaries or on the whole surface of the detector without affecting the performance of the contacts in the segments: passivation and segmentation techniques need to be developed together. It may also be possible to investigate the benefits of coating or other surface treatments.
Careful 2D scans of the full Ge volume at a 2-mm pitch (in effect 3D scans) will enable us to properly determine the charge collection and deduce the electric field in the prototype crystals in order to quantify the benefit of the different surface-treatment techniques tested. Detailed studies in selected parts of the crystal volume can be performed with much better spatial resolution down to 0.5 mm.
At INFN, the work will be done at the Materials Laboratory of the LNL where an interdisciplinary group will study chemical and physical methods of passivation of the inter-segment area.

The goals of this task include: R&D of segmented contacts in HPGe detectors and of the passivation of the boundary regions between contacts, charge collection and electric-field exploration via 2D scans.

Task 2: R&D on novel Ge-detector geometries for ultimate position resolution and efficiency (GSI)
In "planar" detectors with high position resolution, the detector geometry design and contacts are still an issue. The structure of the detector requires a guard ring forming a dead region which uses about 20% of the Ge volume. The high position resolution of a planar Ge detector is important for future arrays with imaging capabilities as well as for the applications based on gamma-ray imaging.
The aim of this task is to develop a prototype of a 3D position-sensitive Ge gamma-detector with 1-2 mm position resolution and maximal active/total volume ratio. For that purpose, novel contact technologies for planar and quasi-planar "point contact" detectors will be investigated. Ge-crystal processing is to be done by a specialised industrial company.
The goals include: modelling and simulation of electrical-field distributions aiming to maximise the active volume, evaluation of the 3D position resolution obtainable, production of a prototype detector in cooperation with the industrial partner SEMIKON and the experimental determination of the position resolution; other performance figures with the produced prototype will also be determined.

Task 3: R&D on segmented p-type coaxial detectors (CSIC)
A dilemma faced when making contacts on Ge crystals is that most materials available for contacts form an electron barrier. Amorphous germanium produces a barrier of about 0.35 eV on average at 90-95 K. The hole barrier is fundamental to reach the high resolution required for Ge detectors but it is not possible to obtain a long-term stable segmentation in a lithium contact subject to several annealing cycles. Therefore, the use of n-type Ge detectors, the only available alternative, has consequences on the quality of the segment signals in detectors with neutron damage.
In position-sensitive detectors for tracking arrays, the most important signals are the ones from the segments. Thus, a development focused on the possibility to use p-type HPGe detectors will greatly benefit present and future detector arrays.
The goals of this task include: R&D on basic properties of the material producing high hole-barrier n-contacts, evaluation of the barrier and stability of amorphous germanium and yttrium contacts, alternative materials for n-contacts and a feasibility study of segmentation with these materials.

Task 4: Network activity: Demonstration of imaging applications and associated detector technologies (ULIV)
Subtask 4.1: Demonstration of imaging applications
Compton Imaging using segmented germanium detectors is a key technological goal. Its realisation relies on research on highly segmented germanium detectors and on the complex analysis of the pulse shape needed to reach the necessary position resolution of the point of interaction. In most medical-imaging applications, a conventional gamma camera (Anger camera) or a Single-Photon Emission Computerised Tomography (SPECT) is used. An alternative solution is Compton imaging. Thanks to position-sensitive photon detectors, the collimator can be removed and the physical properties of the interactions between gamma-rays and matter can be used to reconstruct the path of individual photons from the source, thus retrieving information on the source location. Compton cameras have been extensively used in nuclear medicine and astrophysics. Medical imaging faces markedly different challenges than those in astronomy. The commonly used radioactive isotope 99mTc, which emits low-energy gamma rays, is well-suited for mechanically collimated systems.
This task aims to contribute to the dissemination of imaging techniques for applications through the organisation of schools and conferences
Subtask 4.2: Detector encapsulation techniques
The costs of the encapsulation process in the AGATA capsules are significant due to the complexity of the mechanics (low yield in the production) and the electron-beam welding. Additionally the possibility to reuse the capsule in case of repairing is limited to a few times. Therefore, the actual complex and elaborate encapsulation technique should be replaced by a cost effective and reusable mechanical solution.
Subtask 4.3: Low-power pre-amplifiers & cryostat R&D / BSD, HV, LV distribution
We propose to enhance collaboration to revise the design of the complex cryostats to improve their reliability, in particular that of the clusters of highly segmented AGATA detectors. A collaborative exploration of ways to reduce the power consumption will help the integration of future digital preamplifiers. One of the most promising lines to explore is the integration of the reset pre-amplifier in an ASIC design.
We will collaborate on Pulse-Shape Analysis (PSA) to produce pulse-shape databases that are of paramount importance for the tracking technology. The position resolution depends primarily on a thorough understanding of the phenomena that shape the electronic pulses coming from the detectors.
Subtask 4.4: Pulse-Shape Analysis and neutron-gamma discrimination

This task aims to understand how pulse-shape analysis can discriminate between the interaction of gammas and neutrons. If the discrimination becomes feasible the latter transforms from being a source of background for the tracking processes into a sensitive source of reaction channel information.
The polarisation sensitivity of position-sensitive, electronically segmented HPGe detectors has been demonstrated. Both Compton and Rayleigh scattering polarimetry techniques can be applied for the purpose of measuring the polarisation of X-ray and γ-ray photons. It has been shown that the use of pulse-shape analysis greatly improves the polarisation sensitivity relative to that obtainable using the electronic segmentation alone. The ELI facility is an important representative of the type of facility where polarimeters will need to be developed for beam diagnostics and physics.

The associated partners involved in PSeGe activities are: CEA, Univ. Uppsala, UMIL, STFC, Univ. Valencia, Univ. Salamanca, IFIN-HH, KTH.

Participation per Partner

Partner number and short name	WP10 effort
2 - INFN	28.00
5 - CNRS	0.10
6 - GSI	13.00
20 - UCO	13.00
25 - CSIC	23.00
28 - ULIV	0.10
Total	77.20

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D10.1	Results of the JRA2 kick-off meeting	25 - CSIC	Report	Public	12
D10.2	Advancement report for the Segmentation and Geometry tasks	25 - CSIC	Report	Public	30
D10.3	Advancement report for the p-type task	25 - CSIC	Report	Public	30
D10.4	Advancement report for the Imaging task	25 - CSIC	Report	Public	30
D10.5	Final report for the Segmentation and Geometry tasks	25 - CSIC	Report	Public	48
D10.6	Final report for the p-type task	25 - CSIC	Report	Public	48
D10.7	Final report for the Imaging task	25 - CSIC	Report	Public	48

Description of deliverables

D10.1 : Results of the JRA2 kick-off meeting [12]
Results of the JRA2 kick-off meeting

D10.2 : Advancement report for the Segmentation and Geometry tasks [30]
Advancement report for the Segmentation and Geometry tasks

D10.3 : Advancement report for the p-type task [30]
Advancement report for the p-type task

D10.4 : Advancement report for the Imaging task [30]
Advancement report for the Imaging task

D10.5 : Final report for the Segmentation and Geometry tasks [48]
Final report for the Segmentation and Geometry tasks

D10.6 : Final report for the p-type task [48]
Final report for the p-type task

D10.7 : Final report for the Imaging task [48]
Final report for the Imaging task

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS35	Kick-off R&D	25 - CSIC	6	Report
MS36	Detector R&D Application / associated technologies Workshop	25 - CSIC	12	Report
MS37	Detector R&D Application / associated technologies Workshop - 2	25 - CSIC	24	Report
MS38	Completed R&D Detector R&D Application / associated technologies Workshop	25 - CSIC	48	Report

Work package number [9]	WP11	Lead beneficiary [10]	5 - CNRS
Work package title	JRA3 - TheoS: Theoretical Support for Nuclear Facilities in Europe		
Start month	1	End month	48

Objectives

The main objective of TheoS is to provide a strong and reliable theoretical support to the experiments that will be performed at the TAs of ENSAR2, including the ESFRI projects FAIR, SPIRAL2 and ELI-NP. This goal will be reached by improving our knowledge of nuclei both starting from first principles and by improving existing phenomenological models in nuclear structure and reactions. Links with other areas of physics, like hadron physics and astrophysics, will be emphasised within TheoS. In addition, this JRA will build a community to coordinate the research in nuclear theory within Europe. To do so, a new impetus will be given to the theoretical modelling of nuclear structure and dynamics along two main areas of research:
1. The improvement of microscopic theories of nuclear structure by using, among other inputs, the recent progresses in Effective Field Theory (EFT) for low-energy nuclear physics. The purpose is to increase the predictive power for unstable nuclei of the models based on the mean-field approximation or going beyond mean-field (BMF).
2. The development of new reaction models able to describe accurately the processes through which nuclei are studied away from stability, and those that lead to the formation of chemical elements in astrophysical environments.

We will focus on developing tools to relate measurable observables to theoretical inputs. In the first area of research, this translates into clarifying the link between spectroscopic data and mean-field, or BMF, ingredients. This will help interpreting the experiments conducted within the TAs of ENSAR2. A particular focus will be put on gamma-ray experiments and on the measurement of nuclear electromagnetic moments far from stability. The improvements planned in the Radioactive-Ion Beam (RIB) facilities of ENSAR2 will help us set foot in still unexplored areas of the nuclear landscape. TheoS will work in close collaboration with experimentalists for the search of new features in nuclear structure, such as new collective modes.

In addition to these direct applications to experiment, the link between measurements and theoretical inputs will provide a stringent test of the nuclear interactions used in nuclear structure. We will take advantage of these developments to improve the effective interactions used in BMF approaches. The connection with EFT in the nucleonic sector will be used to provide less empirical mean-field and BMF theories. A bottom-up approach will be applied to relate sub-nucleonic degrees of freedom to nucleon-nucleon forces. EFT will also be used to properly define the hierarchy of terms in BMF theories.

The study of exotic nuclei is usually performed through reactions like (in-)elastic scattering, nucleon or cluster transfer, breakup, knockout etc. To infer reliable structure information from such data, accurate reaction models are needed. The second area of research aims mostly at improving the way reaction analyses are performed at RIB facilities. This goal will not only be reached by developing more precise reaction models, but also by improving the interface between structure and reaction. For example, two-particle correlations are expected to be observed in two-particle transfer, breakup or knockout. We will develop accurate models for these reactions and analyse their sensitivity to structure inputs. We will also improve our understanding of the physics of fusion, fission and fragmentation reactions by developing a dynamical BMF theory. Using these new models, we hope to suggest new reaction observables that will be more sensitive to the structure of the exotic nuclei that are studied at RIB facilities. To reach these objectives the following tasks are planned.

Description of work and role of partners

WP11 - JRA3 - TheoS: Theoretical Support for Nuclear Facilities in Europe [Months: 1-48]
CNRS, INFN, ULB, UMIL, USE
Total person.months (EU/Own): INFN (24/44) - CNRS (24/61) - ULB (24/76) - UMIL (24/56) - USE (24/144)

Task 1: Description of the structure of stable and exotic nuclei with beyond-mean-field (BMF) approaches (INFN)
Subtask 1.1: Development of suitable effective interactions in mean-field and BMF theories (CNRS)
We plan to develop new effective interactions specifically tailored for BMF approaches using most recent advances in EFT. The power-counting analysis and the proper treatment of ultraviolet divergence will allow us to better control and possibly introduce in the interactions new terms that may have different relevance at the mean-field and the BMF levels. We also aim at a better understanding of specific interaction channels, like the neutron-proton asymmetry terms. Deliverables of this subtask (new less-empirical effective interaction) will be obtained as a priority since they are crucial for Subtasks 1.2 and 1.3.

Subtask 1.2: Fingerprint of correlations in BMF approaches (UMIL)
Using Subtask 1.1, we aim at describing effects beyond the independent-particle picture, including nuclei with odd particle number, and exploring different ways to deal with correlations such as particle-vibration coupling, many particle-many hole couplings or configuration-mixing. Outcome of this Subtask will serve as structure inputs for Subtasks 1.3 and 2.2.
Subtask 1.3: Improvement of BMF theory for small- and large-amplitude collective motion and dissipative aspects of nuclear dynamics (INFN)
BMF will be improved to include effects of Subtasks 1.1 and 1.2. Collective motion, either at low or medium energy, will be used to benchmark different approaches, to understand the appearance of new modes in exotic nuclei and provide new constraints on the nuclear effective interaction away from the beta stability line. This analysis, in parallel with the development of new, less empirical interactions based on EFT (Subtask 1.1), will also provide stringent constraints on the nuclear equation of state (EOS), that are crucial for the understanding of some important features of compact stellar objects. Outcome of this subtask will serve as structure inputs for Subtask 2.2.

Task 2: Calculate reaction observables to compare state-of-the-art structure models with novel experimental data in exotic nuclei (USE)
Subtask 2.1: Development of new reaction formalisms (ULB)
To develop models suited to the needs and particularities of reactions involving exotic nuclei we will proceed in three steps: (i) validate approximations made in state-of-the-art reaction models; (ii) when necessary, suggest corrections and improvements, such as the development of suitable polarisation potentials for elastic and transfer processes, or the inclusion of cluster collective degrees of freedom in few-body reaction models (CDCC, Eikonal, Faddeev, etc.); and (iii) develop new reliable reaction models, such as formalisms for quasi-free scattering processes or reactions involving three-body projectiles. Emphasis will be made on the interplay between the various reaction channels (elastic scattering, breakup, knock-out and transfer). Applications of these developments to reactions of astrophysical interest will also be studied, such as the calculation of production rates in two- and three-body capture reactions.
Deliverables of this subtask will be used in Subtask 2.2.
Subtask 2.2: Improvement of the interface between nuclear structure and nuclear reactions (USE)
This subtask is a crucial step to properly analyse experiments made in new and future RIB facilities. Its goal is to develop proper interfaces between structure models, such as those mentioned in Task 1, and reaction models, like those developed in Subtask 2.1. This will provide clear signatures within reaction observables of the structure properties of exotic nuclei. In particular, the effect of correlation in nuclei will be studied through this Subtask. This includes inferring information on the structure of three-body nuclei from the analysis of breakup observables, such as fragment distributions. In connection with Subtask 2.1, we will study the influence of the collective degrees of freedom of the projectile clusters on reaction observables.
The accurate analysis of the data collected in future RIB facilities will also benefit from the development of new reaction observables that are less sensitive to the reaction process, such as the ratio method developed in Brussels, Surrey and MSU. We plan to explore this method in more detail and to extend it to other reactions like three-body breakup and transfer reactions.
TheoS will also serve as a core for a wider platform for nuclear theory in Europe. Although the present JRA is built on five main nodes, this ambitious research programme will be realised in close collaboration with associate partners: Univ. Surrey, Univ. Warsaw, Univ. Zagreb, IST-Univ. Lisboa, Univ. Padova, CEA, CENBG Bordeaux, Univ. Bucharest, Univ. Autonoma Madrid, Univ. Granada, INFN-Pisa, Univ. Erlangen, LM-Univ. München, Mines-Nantes, Univ. Frankfurt, TU München, Univ. Barcelona, Univ. and INFN-Catania, IFIN-HH Bucharest.
To foster exchanges between these different groups, we plan to have annual meetings at ECT*, the ENSAR2 TA, which provides the perfect forum for organising workshops in this area of research. These meetings will be set up to present new achievements in nuclear theory and report on the progresses made by the different groups in the aforementioned tasks. To discuss relevant new experiments made with RIBs and to improve our support to experiments, members of other ENSAR2 activities will be invited to these meetings. In such workshops, a special emphasis will be set on the synergies with both high-energy nuclear physics and nuclear astrophysics. With the aim of enlarging our collaboration to other nuclear-theory groups within and outside Europe, these meetings will be advertised internationally.

Participation per Partner

Partner number and short name	WP11 effort
2 - INFN	24.00
5 - CNRS	24.00

Partner number and short name	WP11 effort
14 - ULB	24.00
22 - UMIL	24.00
27 - USE	24.00
Total	120.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D11.1	New effective interaction for beyond-mean-field calculations	5 - CNRS	Other	Public	24
D11.2	Codes for transfer and CDCC calculations with core excitation	5 - CNRS	Other	Public	24
D11.3	Eikonal-based code to describe dynamical effects in scattering, breakup and knockout reactions	5 - CNRS	Other	Public	36
D11.4	Report and package of the TDHF+BCS and QRPA codes	5 - CNRS	Report	Public	48

Description of deliverables

D11.1 : New effective interaction for beyond-mean-field calculations [24]
New effective interaction for beyond-mean-field calculations

D11.2 : Codes for transfer and CDCC calculations with core excitation [24]
Codes for transfer and CDCC calculations with core excitation

D11.3 : Eikonal-based code to describe dynamical effects in scattering, breakup and knockout reactions [36]
Eikonal-based code to describe dynamical effects in scattering, breakup and knockout reactions

D11.4 : Report and package of the TDHF+BCS and QRPA codes [48]
Report and package of the TDHF+BCS and QRPA codes

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS39	Definition of an appropriate power counting	5 - CNRS	24	Report
MS40	Inclusion of quantum fluctuations	5 - CNRS	48	Report

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS41	Definition of appropriate reaction observables	5 - CNRS	24	Report
MS42	Understanding the dynamical effects	5 - CNRS	48	Report

Work package number [9]	WP12	Lead beneficiary [10]	4 - JYU
Work package title	JRA4 - RESIST : RESonance laser Ionisation Techniques for separators		
Start month	1	End month	48

Objectives

The Joint Research Activity (JRA), RESIST, aims to refine the highly successful Resonance Ionization Laser Ion Source (RILIS), In-Gas Laser Ionization and Spectroscopy (IGLIS) and Laser Ion Source Trap (LIST) technologies, coupled to hot cavity or to gas cells at on-line facilities for the production and study of radioactive ion beams (RIBs). In this manner, RIBs of the highest purity regarding selection of isobaric as well as isomeric species will be obtained, which are indistinguishable for conventional mass spectrometers. The research will, for the first time, jointly address both ISOL AND In-Flight facilities. Through this approach, dedicated studies on the shortest-lived exotic and refractory isotopes far from stability become possible. Laser spectroscopic studies of exceptional sensitivity are anticipated using carefully optimized experimental environments. Radionuclides produced in the rarest quantities will thus be accessed, extending and complementing earlier nuclear and laser spectroscopic techniques.
The participants reflect the variety of facilities which utilize three main mechanisms for the production of radioactive atoms, namely:
• Thick hot target approach (ISOL): Radioactive atoms are thermalized within a catcher or target material and are transferred to a hot cavity for ionization;
• Low-energy projectile thin target approach: Recoil release is followed by thermalization and neutralization within a buffer gas cell with subsequent in-cell or in-jet ionization;
• High-energy projectile thin target approach: Recoil release directly into an in-flight pre-separator followed by thermalization and neutralization within a large volume buffer gas cell followed by in-cell or in-jet ionization.
The laser ionization source RILIS enjoys a dominant position as the most fruitful and in-demand ionization mechanism for RIB production worldwide. The LIST approach is a particular upgrade of RILIS. At ISOLDE, the hot cavity LIST has recently demonstrated outstanding advantages for the improvement of ion beam purity. A plume of radioactive atoms, stemming from either the RILIS hot cavity or within a supersonic jet ejected from the gas cell, are resonantly excited and ionized in a multi-step process. The photo-ions are captured, guided and possibly even trapped and cooled in a rf multipole structure and are subsequently injected into the mass analyser. The technique has the potential to generate RIBs of ultimate purity, including complete suppression of isobaric interferences, enhancement of isotopic abundance sensitivity and even selection of isomeric states.
By utilizing the unique environments, highly attractive opportunities are within reach for sensitive in-source laser spectroscopy on the shortest-lived exotic isotopes far from stability, in regions such as very heavy species which so far have been inaccessible to on-line experiments using, for example, high-resolution collinear laser spectroscopy.
For the first time, RESIST exclusively aims to address the state-of-the-art research in the fields of laser physics and spectroscopy, ion manipulation, materials research and isotope separation, as provided by the different partners. The need to suppress contamination and to enhance the radioactive ion beam of interest is an issue which will grow even more acute with the next-generation facilities. This JRA will therefore have a direct impact on the search for the answers of key questions to be found within the nuclear landscape, covering evolution of nuclear structure, nuclear astrophysics, fundamental physics as well as applied research in the fields of material, life and bio-medical sciences and, after post-acceleration, the JRA will impact on the field of nuclear reaction studies.
RESIST will provide support and added value to the TecHIBA JRA, specifically in the optimization of the production of α emitters at ISOLDE for targeted alpha therapy. Within a more international context, participants within RESIST are directly involved in the REGLIS (Rare Elements in-Gas Laser Ion Source and Spectroscopy) project at GANIL, recently funded through the French National Agency. Furthermore, the international network IGLIS-NET (In-Gas Laser Ionization and Spectroscopy NETwork, http://kekrnb.kek.jp/iglis-net) exchanges regular information on developmental research between 14 participating research groups and institutes including four members of RESIST. The investigation of new concepts for solid-state laser technology links RESIST with industrial partners.

Description of work and role of partners

WP12 - JRA4 - RESIST : RESonance laser Ionisation Techniques for separators [Months: 1-48]
JYU, GANIL, INFN, CERN, CNRS, GSI, KU Leuven, JGU Mainz
Total person.months (EU/Own): GANIL (9/6) - INFN (15/6) - CERN (18/18) - JYU (11/14) - CNRS (13/3) - GSI (26/6) - KULeuven (11/11) - JGU Mainz (26/18)

Three key research areas have been identified within this JRA forming the Tasks, each with a set of reachable milestones. For each task, a coordinating institute is indicated in parentheses. Sub-tasks are also presented. Person months from each institute are given (both EU supported and own contribution).

Task 1: Pre-LIST techniques to enhance ion beam purity (CERN)
Person months (EU/own): CERN (6/6) - JGU Mainz (12/3) - KU Leuven (3/3) - JYU (3/3) - GANIL (3/3) - INFN (9/3)
Placing the LIST between the target and mass separator extractor electrode enables an electrostatic suppression of ions created in non-laser ionization processes which take place in a hot cavity and gas cell. However the presence of the electric field can generate fast electrons which produce impact ionization of unwanted species and reduce the purity of produced ion beams. Solutions for optimal configuration of electric fields when coupling the LIST with the target are to be investigated.
The geometry of the laser-atom interaction is of highest importance both for selectivity and efficiency. Optimization of the LIST geometry with the goal of reducing the contribution of non-laser ionization processes in the hot cavities, LIST and in the gas cell volume is required. Linked to this effort is the development of low work-function materials resistive to the high temperature conditions.
- Subtask 1.1 (JGU Mainz, CERN): Reduction of secondary electron ionization processes pre-RF structure. Minimization of radioisotope deposition on rf structure leading to isotope-dependent ionization mechanisms.
- Subtask 1.2 (KU Leuven, JYU): Optimization of laser-ionization geometry in the gas jet to minimize or even preclude photo-ion creation in the gas cell volume and minimizing the deposition of radioisotopes on the rf structure.
- Subtask 1.3 (GANIL, INFN): High temperature materials research for transfer line and laser ionization cavity for surface ion suppression.

Task 2: Advancements in efficiency, selectivity and spectral resolution (KU Leuven)
Person months (EU/own): CERN (6/6), JGU Mainz (6/2), KU Leuven (5/5), JYU (3/6), GANIL (6/3), GSI (13/3)
RILIS, IGLIS and LIST techniques are already used in combination with hot cavity targets or gas cell systems to selectively generate intense radioactive ion beams. To meet the expectations for experiments at active and planned In-Flight and ISOL facilities the method needs to be refined in efficiency, selectivity and especially spectral resolution. Efficiency plays a significant role in laser spectroscopy of isotopes far from stability, becoming a limiting factor in the region of trans-einsteinium elements due to the limited amount of sample atoms or the low production rates at in-flight facilities.
As a complementary approach to gas-cell techniques, in-cell spectroscopy will be optimized using catcher filaments, which promises higher efficiencies when used in conjunction with buffer gas cells for low intensity radioactive beams behind recoil separators.
Extensive laser spectroscopy on atomic spectra and excitation ladders all over the periodic table of elements will be used to optimize ionization parameters and isobaric, isotopic and isomeric selectivity. The optimisation of the ionisation process will also involve the intercomparison between non-resonant and resonant laser ionization via bound Rydberg-states or auto-ionizing resonances.
The development of well-collimated gas jets with high Mach numbers will improve both efficiency and selectivity in the gas cell system by better laser-atom overlap and will substantially increase the spectral resolution to linewidths below ~200 MHz. This will ensure isomeric selectivity for beams with mass number $A \geq 80$ but also allow for laser spectroscopy combining high resolution and highest sensitivity. Gas jet diagnostics, nozzle design and spectroscopy on gas jets with optimum spatial overlap between the gas jet and laser beams and optimized injection into the RF ion guide will ensure efficiency.
- Subtask 2.1 (GSI, KU Leuven, JYU, GANIL): Optimization of gas-cell coupling to a mass separator to target selectivity improvements of the future IGLIS technique at in-flight facilities.
- Subtask 2.2 (KU Leuven, JYU): Development of well-collimated, high Mach number gas jets.
- Subtask 2.3 (JGU Mainz, CERN): Extensive excitation scheme development to optimize isobaric, isotopic and isomeric selectivity.

Task 3: New concepts and development of laser technologies (JGU Mainz)
Person months (EU/own): CERN (6/6) - JGU Mainz (8/3) - KU Leuven (3/3) - JYU (5/5) - INFN (6/3) - CNRS (13/3)
In the last years, major advances have been made in the laser systems used for the selective and efficient production of RIBs, as well as in sensitive in-source spectroscopy for the extraction of fundamental nuclear structure parameters of rare isotopes. In order to exploit the promising environments for spectroscopy, for example the gas jet, it has been recognized that the next step must be taken in terms of considerably narrowed linewidth using state-of-the-art concepts. In order to match the spectral broadening of gas cell-based ion sources with the current solid-state Ti:sapphire technology, laser linewidths of <1 GHz provide the optimal overlap. This may be achieved using dual-etalon resonators, operating in an automated manner. For gas-jet spectroscopy, ultra-narrow linewidth pulsed lasers are needed, requiring amplification techniques or injection-locking of cw lasers. Both approaches promise Fourier-limited laser radiation.

New technologies aim to close the visible gaps in the wavelength spectrum of Ti:sapphire lasers require difference frequency mixing or Raman shifting. This would open up access to greater coverage of selective and efficient ionization schemes for RIB production.
- Subtask 3.1 (JGU Mainz, CERN): Optimization of automated wide range tunability of solid-state laser systems for atomic spectroscopy and scheme development.
- Subtask 3.2 (JYU, KU Leuven, CNRS): Generation of high power Fourier-limited laser radiation using injection-locking techniques with a narrow bandwidth cw laser and pulsed dye amplification of a cw-diode laser radiation for in-jet spectroscopy.
- Subtask 3.3 (JGU Mainz, JYU, CERN, INFN): Investigation of new laser concepts for future RIB facilities as well as difference frequency mixing and Raman shifting to provide visible radiation from Ti:sapphire lasers.

Participation per Partner

Partner number and short name	WP12 effort
1 - GANIL	9.00
2 - INFN	15.00
3 - CERN	18.00
4 - JYU	11.00
5 - CNRS	13.00
6 - GSI	26.00
13 - KU Leuven	11.00
18 - JGU Mainz	26.00
Total	129.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D12.1	Report on Task developments from RESIST	4 - JYU	Report	Public	12
D12.2	Mid-term report on new techniques to enhance ion beam purity prior to the LIST multipole	4 - JYU	Report	Public	24
D12.3	Mid-term report on new methods to improve the efficiency, selectivity and spectral resolution	4 - JYU	Report	Public	24
D12.4	Mid-term report on new concepts and developments related to laser technologies	4 - JYU	Report	Public	24
D12.5	Final report on new techniques to enhance ion	4 - JYU	Report	Public	48

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	beam purity prior to the LIST multipole				
D12.6	Final report on new methods to improve the efficiency, selectivity and spectral resolution	4 - JYU	Report	Public	48
D12.7	Final report on new concepts and developments related to laser technologies	4 - JYU	Report	Public	48

Description of deliverables

D12.1 : Report on Task developments from RESIST [12]
Report on Task developments from RESIST

D12.2 : Mid-term report on new techniques to enhance ion beam purity prior to the LIST multipole [24]
Mid-term report on new techniques to enhance ion beam purity prior to the LIST multipole

D12.3 : Mid-term report on new methods to improve the efficiency, selectivity and spectral resolution [24]
Mid-term report on new methods to improve the efficiency, selectivity and spectral resolution

D12.4 : Mid-term report on new concepts and developments related to laser technologies [24]
Mid-term report on new concepts and developments related to laser technologies

D12.5 : Final report on new techniques to enhance ion beam purity prior to the LIST multipole [48]
Final report on new techniques to enhance ion beam purity prior to the LIST multipole

D12.6 : Final report on new methods to improve the efficiency, selectivity and spectral resolution [48]
Final report on new methods to improve the efficiency, selectivity and spectral resolution

D12.7 : Final report on new concepts and developments related to laser technologies [48]
Final report on new concepts and developments related to laser technologies

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS43	Reduction of hot cavity and gas jet radioisotope deposition	4 - JYU	48	Clean RIBS produced with LIST (hot cavity and gas jet coupling) - report
MS44	Supersonic, high Mach number gas jet produced	4 - JYU	48	Laser probing of jet velocity - report
MS45	Ionization scheme development	4 - JYU	24	Report at Annual Meeting
MS46	Pulsed dye amplifier seeded by CW diode laser and injection-locked Ti:sapphire	4 - JYU	36	Off-line experiment using the new laser - report

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
	laser used in both off-line and on-line gas jet spectroscopy			
MS58	New high temperature transfer line material utilized for surface ion suppression	4 - JYU	36	On-line and off-line demonstration of surface ion reduction - report
MS59	Automated wide-range wavelength tunability for scheme development	4 - JYU	24	Demonstration on a new element - report

Work package number [9]	WP13	Lead beneficiary [10]	7 - RUG
Work package title	JRA5 - SATNuRSE: Simulations and Analysis Tools for Nuclear Reactions and Structure in Europe		
Start month	1	End month	48

Objectives

The nuclear structure and reaction community is at a stage where a substantial amount of R&D work has been performed for various emerging experimental facilities but a lot still needs to be done before we are ready for the next generation experiments at medium and large-scale facilities. At the same time, one needs to prepare for the analysis of the obtained data as they become available in the coming years. We have achieved a number of goals in this direction within the SiNuRSE work package of ENSAR as is evident from the milestones and the deliverables. A platform based on the GEANT4 simulation code has been developed and can now be used for experiments foreseen at the ENSAR2 facilities. New event generators and improved physics models relevant in the energy domain of ENSAR2 facilities have now been implemented in GEANT4 and specific "physicslists" created. Expert members of the community know how to deal with databases and working examples have been developed to show how all this would work. Some members of SiNuRSE have become members of the GEANT4 collaboration, which is very important to make sure that the needs of the nuclear-physics community will be taken into consideration. We now need to take further steps to advance our simulation tools, in particular in the domains defined further in this project and also to come up with new tools which are essential for the analysis of the events. These developments have to be done within ENSAR2 to maximise the output of the efforts which will be spent on these issues as the developers are also members of the experimental collaborations within ENSAR2.

Description of work and role of partners

WP13 - JRA5 - SATNuRSE: Simulations and Analysis Tools for Nuclear Reactions and Structure in Europe
[Months: 1-48]
RUG, CEA, JLU, FFCUL, CIEMAT, CSIC, USC
Total person.months (EU/Own): RUG (15/15) - CEA (12/12) - JLU (7/15) - FFCUL (18/12) - CIEMAT (12/12) - CSIC (9/9) - USC (12/18)

The work-package is divided into four tasks, which are described below.

Task 1: Development, benchmarking and validation of physics models and event generators (CEA)
The objective of this task is to provide, benchmark and validate physics models and event generators usable in GEANT4 so that the code can be used to simulate the experiments foreseen at the ENSAR2 facilities. Emphasis will be put on domains of nuclear reactions which have a limited implementation in GEANT4, are also relevant for facilities of ENSAR2 which were not included in ENSAR, or are important for specific key experiments. In the following, the different subtasks and the responsible partners are listed:
Subtask 1.1: Improvement and validation of neutron transport models in GEANT4 at neutron energies below 20 MeV (CIEMAT)
In the framework of the ENSAR/SiNuRSE project, the CIEMAT group has made available (https://www-nds.iaea.org/geant4/) a complete set of evaluated neutron-data libraries for GEANT4 and performed a systematic comparison between the GEANT4 and MCNPX codes. Within SATNuRSE, new evaluated nuclear-data libraries for neutrons and charged particles (ENDF, JEFF, JENDL, TENDL…) will be made available for GEANT4 and validated by comparing GEANT4 with MCNPX. In addition, a correlated particle-production model for breakup reactions described in the ENDF format will be developed. Lastly, the model for the transport of thermal neutrons in GEANT4, relevant for the simulation of very low-energy neutrons, will be revised and benchmarked.
Subtask 1.2: Extension/improvement of the INCL physics models (CEA)
The intra-nuclear cascade model, INCL, modelling nucleon and, thanks to ENSAR/SiNuRSE, light-ion induced reactions in the 100 MeV-3 GeV energy domain, has become a reference in the field, and is available in GEANT4. However, further improvements and extensions are still needed, which will allow the code to be universally used in the simulations of experiments or to address specific reaction channels that will be studied in the community of ENSAR2. This will concern in particular: introducing strange-particle production channels that will allow the model to be used for simulations of experiments studying hypernuclei, which could be a key domain of R3B and Super-FRS at the future FAIR facility; and improving the predictive power of the model in light-ion induced reactions in the domain of few-particle

removal channels which are important for both simulation of nuclear-structure experiments and medical applications for prediction of the production of β+-emitter 11C used in carbon therapy.

Subtask 1.3: Inclusion of modern atomic-interaction routines in GEANT4 (JLU)

The passage of heavy ions through matter exhibits several peculiarities, which are absent for light particles like electrons or protons. Most obvious is charge-exchange (ionisation and electron capture) and contributions from higher orders in projectile atomic number to the stopping power of relativistic heavy ions. Measurements of stopping powers, charge-changing cross sections and charge-state distributions have been performed at GSI, GANIL, Berkeley, and elsewhere in the last decades. These experiments prompted theoretical developments and codes, which are available at Giessen and GSI and which are able to reproduce accurately the data over the energy range up to 1 GeV/u. These codes, specific for heavy ions, ought to be available to the global nuclear-physics community, by incorporation into GEANT4 and used for experiment simulation and analysis within the present project.

Subtask 1.4: Electromagnetic cascade model and evaporation of protons and alphas (CSIC)

In the framework of the SiNuRSE project, the CSIC group has developed an event generator for beta-decay studies that goes beyond what is presently available in GEANT4, which is dependent on the available nuclear data. The idea was to allow the user to override this limitation by using the available information of lower-lying levels in the daughter nucleus from databases and complementing the upper part of the level scheme with a statistical model based on level densities and gamma-strength functions. This event generator implemented de-excitation of the levels populated in the beta decay by gamma cascades and for levels above the neutron-separation energy by the emission of beta-delayed neutrons. Within the SATNuRSE project, we plan to further develop the electromagnetic cascade model in such a way that it can be complementary to other models and event generators, and also implement the evaporation of other particles like protons and alphas. Discussion will take place to implement these developments in GEANT4.

Task 2: Development of analysis tools (USC)

ENSARRoot has been developed during the working period of the ENSAR project as a platform for the simulation and analysis of nuclear-physics experimental setups. The code is functional but it lacks of a proper set of example cases that allow the users to select and copy from applications or detector implementations similar to their own utilisation. The specific tasks we plan to perform are:

Subtask 2.1: Implementation of physical applications (USC, FFCUL)

a) PIGE: We plan to include a PIGE (Proton-Induced Gamma-ray Emission, based on the detection of the prompt gamma rays emitted from nuclei that are in an excited state following a proton-induced nuclear reaction) simulation and data-analysis application in ENSARRoot, linked to the Tandem accelerator of the CTN/IST (Lisbon).

b) (p,gamma) reactions: Simulation and analysis code for a set of reactions for the detailed analysis of the gamma cascades from the decay of unbound systems in the nuclei 56Fe and 60Ni, near or at the shell closer Z=28, providing very valuable insights in the understanding of the nuclear continuum just above the particle threshold.

Subtask 2.2: Further development of ENSARRoot code (USC, FFCUL)

The package ENSARRoot offers a basic platform for constructing simulation and analysis applications for nuclear-physics experiments. Further development of the code includes the modularisation and increase of the different applications and examples; the general maintenance of the code, including the update to newer library versions and the enhancement of documentation, user forums and support.

Subtask 2.3: Track-reconstruction routines and pattern recognition (RUG, USC, FFCUL)

Smart and generic track finding and rough track-reconstruction algorithms will be designed for several cases utilised by the community. The purpose of these methods is to analyse large numbers of events on a very short time scale, reducing computational complexity using pattern-recognition and morphological techniques, and thereby reducing the number of potential events to a level at which more precise methods can be utilised effectively. The project will also include Support for ANN (Artificial Neural Networks) algorithms for the pattern recognition of intermediate- (Compton dominated) and high-energy (Pair Production) events in the energy range between 100 keV and 30 MeV.

Task 3: Data management protocol (RUG)

The general trend towards open access to data and how the community should deal with experimental data is an issue that will be tackled in this task. The work will include:

- an inventory of the efforts at facilities involved in ENSAR2, and
- a proposal of a protocol specific for the community using ion beams, which various partners can use for the management of data obtained in the near future.

Task 4: Dissemination of knowledge and workshop organisation (RUG)

The main objective of this task is to inform the community at large and interested groups in particular about the achievements of the work package and the usefulness of its results for the whole community. This will be done in the form of setting up a site which includes all the work done in the work package, by setting up a discussion platform,

and by organising workshops with participants from the community as well as from outside the community who work on these subjects.
Subtask 4.1: Organisation of workshops between the GEANT4 code developers and advanced users from the nuclear-physics community (CIEMAT, CSIC, USC, FFCUL, RUG, JLU)
Goals:
• To identify the priorities of the Nuclear-Physics community in different fields and inform the code developers.
• To facilitate the porting of code developed by advanced GEANT4 users inside/outside the ENSAR2 community to the GEANT4 framework.

Participation per Partner

Partner number and short name	WP13 effort
7 - RUG	15.00
15 - CEA	12.00
17 - JLU	7.00
23 - FFCUL	18.00
24 - CIEMAT	12.00
25 - CSIC	9.00
26 - USC	12.00
Total	85.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D13.1	Creation and validation of improved data libraries and models and implementation into GEANT4	7 - RUG	Other	Public	48
D13.2	Code ENSARRoot with generic codes with specific reactions and tracking	7 - RUG	Other	Public	48
D13.3	Inventory and protocol for data management	7 - RUG	Report	Public	48
D13.4	Report on workshop on developments of the nuclear-physics community for GEANT4	7 - RUG	Report	Public	40

Description of deliverables

D13.1 : Creation and validation of improved data libraries and models and implementation into GEANT4 [48]
Creation and validation of improved data libraries and models and implementation into GEANT4

D13.2 : Code ENSARRoot with generic codes with specific reactions and tracking [48]

Code ENSARRoot with generic codes with specific reactions and tracking

D13.3 : Inventory and protocol for data management [48]
Inventory and protocol for data management

D13.4 : Report on workshop on developments of the nuclear-physics community for GEANT4 [40]
Report on workshop on developments of the nuclear-physics community for GEANT4

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS47	New nuclear data libraries for GEANT4	7 - RUG	24	Report
MS48	Heavy-ion penetration in GEANT4	7 - RUG	24	Report
MS49	Algorithms for specific analysis and tracking	7 - RUG	24	Report
MS50	Inventory finished	7 - RUG	36	Report

Work package number [9]	WP14	**Lead beneficiary [10]**	5 - CNRS
Work package title	JRA6 - EURISOL		
Start month	1	**End month**	48

Objectives

The EURISOL concept was defined during the EURISOL Design Study in the Sixth Framework Programme. This JRA builds on that work and includes Research and Development activities necessary for the future EURISOL facility which is one of the priorities of the NuPECC long-range plan. It will also contribute to enhance the performances and output of the ISOL facilities which are participants in ENSAR2, mainly SPIRAL and SPIRAL2 at GANIL, HIE-ISOLDE at CERN and the future SPES at Legnaro. The JRA EURISOL consists of three activities: Improvement of electron-beam ion-charge breeding (EBIB), development of chemically reactive ISOL beams (BEAMLAB), and development of a chart of ISOL beam intensities available through a website (CRIBE). The activity leader will be Yorick Blumenfeld from CNRS. Activity will be closely coordinated with the NUSPRASEN network within which the science case for EURISOL will be updated and which will organize a EURISOL Town Meeting.

Description of work and role of partners

WP14 - JRA6 - EURISOL [Months: 1-48]
CNRS, GANIL, INFN, CERN, IFJ PAN, UNIWARSAW
Total person.months (EU/Own): GANIL (42/18) - INFN (12/7) - CERN (12/12) - CNRS (18/24) - IFJ PAN (0/10) - UNIWARSAW (12/44)

Task 1: Innovative Charge Breeding Techniques (ICBT) (CERN)
Person.months (EU/Own): GANIL (30/5) - CERN (0/6) - UNIWARSAW (12/44)

During the last decade the Electron-Beam Ion-Source (EBIS) technology has established itself as a key method for preparation of radioactive beams for further post-acceleration, and Europe has been the world-leader in the field. Now several oversea laboratories are either commissioning (ReA at NSCL-MSU and CARIBU at ANL, both US), designing (ARIEL at TRIUMF, Canada) or considering using (iThemba, South Africa and IBS-RISP, Korea) EBIS devices as charge breeders. Two of the tasks described below would reinforce our position and increase the EBIS-based charge-breeder knowledge. The future challenges for these breeders lie in the higher beam intensities delivered by the primary target, the request for curbed breeding times and the demand for fully stripped heavy ions (or few-electron systems) to be injected into consecutive storage rings. In addition, the experiments would profit from a CW extracted beam structure. This work package will address the important issues related to the achievement of these goals and to validate the feasibility of an EBIS/T type charge breeder for EURISOL. It should be based on recent developments related to the most crucial items, i.e. the production of a very high current, high energy and compression electron beam needed for such a charge breeder and the CW-preparation Paul trap. The first tests of an electron gun partially fulfilling these specifications will take place during 2014. The path to the successful production of CW EBIS beams has been paved within the EMILIE-NUPNET project during which an EBIS debuncher prototype was built.
Furthermore, charge breeders of ECR ion-source type are of interest for several facilities within Europe and elsewhere. Its high breeding throughput and relative simplicity are especially appealing. Experiments have indicated that the injection conditions into the plasma are very critical for the overall efficiency. Task 3 will optimise the capture and ionisation efficiency inside the ECR cavity through study of the impact of the injection electrode configuration, of the ion scattering on the support gas, and of the injection beam energy.

Task 2: Development of chemically reactive nuclear beams - BEAMLAB (CNRS)
Person.months (EU/Own): GANIL (0/3) - INFN (12/7) - CERN (12/6) - CNRS (18/18) - IFJ PAN (0/6)

The ongoing development of isotope separation on-line (ISOL) facilities illustrates the power of the technique to produce radioactive nuclear beams. In Europe two major existing facilities are on an upgrade path: ISOLDE towards HIE-ISOLDE and SPIRAL towards SPIRAL2. In addition, ALTO recently became a running TA facility and SPES is in the construction phase. Such developments go hand in hand with R&D on the target and ion-source system (TIS) at the heart of the ISOL technique. With recent collaborative work on targets and ion sources, new nuclear beams of interest have been produced. The ActILab JRA in ENSAR has brought together common efforts and has provided a major step forward in the development of UCX targets, as well as for delivering more intense light beams such as 30Na or neutron-rich Be beams.

Because of the use of thick targets, the efficiency of the ISOL technique strongly depends on the physicochemical properties of the nucleus of interest, as well as those of the TIS material. However, this sensitive dependence can be turned into an advantage by a clever combination of material and chemical products. Various approaches have already been tried and tested to selectively extract nuclei of a particular chemical species or to improve the beam purity. In particular, the use of a chemical vapour to form a volatile molecule containing the nuclei of interest has proved its feasibility. Developing such devices would lead to the production of completely new nuclear beams using the ISOL technique and open the way to unexplored fields and applications. This approach has also been a cornerstone for Super-Heavy Elements research, a fast evolving research field at GSI, GANIL and JYFL.
The objective of this task is to address the required developments to produce nuclear beams for isotopes which are challenging because of the chemical reactivity of the element. These efforts will focus on the development of molecular beams exploiting gas-phase chemical reactions obtained by controlling the gas phase in the target volume. This requires an evaluation of the different physicochemical interactions which occur in the rest of the unit, from the target container, the transfer line to the plasma of the ion source itself. This task will be organised in four main subtasks:

• Subtask 2.1: Efficient ion sources for difficult ISOL beams

Different ion sources will be characterised in physicochemical conditions favouring the production of the ion species of interest. Computer calculations are also planned to optimise key parameters.

• Subtask 2.2: Material compatibility in reactive gas atmospheres

Because of the importance of the physicochemical interactions at the material surface, such a study will supply invaluable data to optimise chemically selective devices and to improve beam purity.

• Subtask 2.3: New molecular beams

Based on the chemical properties of the nuclei to be produced, suitable chemical products will be used to create volatile compounds containing the nucleus of interest.

• Subtask 2.4: Specific target designs for non-volatile elements

Key target parameters will be investigated to best release the nuclei of interest produced: target configuration, thickness and target material.
These subtasks are related and the work will focus on nuclei of interest such as rare-earth or non-volatile transition metals. Thus, the results of this R&D programme are expected to directly benefit existing ISOL facilities. Furthermore, the produced experimental data will directly serve for the forthcoming 2nd generation ISOL facilities.

Task 3: Chart of Radioactive Ion Beams in Europe – CRIBE (GANIL)
Person.months (EU/Own): GANIL (12/10) - IFJ PAN (0/4)

A huge volume of data concerning produced or predictable radioactive-ion beams (RIBs) available at different nuclear facilities in Europe exists in principle. Access to these data, which is of great interest for researchers in many fields of science, is quite complicated today. A unique, homogeneous and easily accessible database for all European RIB facilities, present and future, is not available.
The main idea of this activity is to collect available data (essentially intensities and energies) of radioactive-ion beams produced in the existing European nuclear facilities dedicated to the production and the acceleration of RIBs. Both low-energy (at the exit of a mass separator) and post-accelerated RIBs will be taken into account. These data will be accessible and visualised through a nuclear chart. The experience already gained at GANIL in this type of project will be used to carry out this project successfully. This chart will present beams that are already available in the nuclear facilities (ALTO, GANIL, GSI, ISOLDE, Jyväskylä University, LNL, LNS, SLCJ, CCB) or that will become available during the ENSAR2 period 2015 – 2019).
The chart will be publicly accessible via a website and will be distributed to interested industrial partners.

Participation per Partner

Partner number and short name	WP14 effort
1 - GANIL	0.10
2 - INFN	12.00
3 - CERN	12.00

Partner number and short name	WP14 effort
5 - CNRS	42.00
8 - IFJ PAN	0.10
9 - UNIWARSAW	12.00
Total	78.20

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D14.1	Report on performances of the EBIS debuncher	5 - CNRS	Report	Public	24
D14.2	Report on R&D on radioactive plasma ion sources	5 - CNRS	Report	Public	36
D14.3	Conceptual design report of a new generation charge breeder	5 - CNRS	Report	Public	44
D14.4	New targets, ion sources and beams	5 - CNRS	Report	Public	48
D14.5	Chart of Beams	5 - CNRS	Report	Public	48

Description of deliverables

D14.1 : Report on performances of the EBIS debuncher [24]
Report on performances of the EBIS debuncher

D14.2 : Report on R&D on radioactive plasma ion sources [36]
Report on R&D on radioactive plasma ion sources

D14.3 : Conceptual design report of a new generation charge breeder [44]
Conceptual design report of a new generation charge breeder

D14.4 : New targets, ion sources and beams [48]
New targets, ion sources and beams

D14.5 : Chart of Beams [48]
Chart of Beams

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS51	Experiments for the optimal breeder configuration	5 - CNRS	24	Report
MS52	Nuclear data of produced beams	5 - CNRS	36	Report

Work package number [9]	WP15	Lead beneficiary [10]	5 - CNRS
Work package title	JRA7 – TecHIBA: Technologies for High Intensity Beams and Applications		
Start month	1	End month	48

Objectives

This proposal is based on a large initiative called ECOS endorsed by NuPECC. This initiative accessed the capability offered today in Europe of stable-ion beam facilities and their high-intensity upgrades to cope with the needs of scientists to fully exploit unique physics cases in nuclear structure, reactions, astrophysics and applications. Within ENSAR2, a number of the foreseen TAs will be delivering stable-ion beams. The TecHIBA-JRA proposal joins efforts among the large European scientific community in order to provide support to these TAs both in fundamental research and activities related to accelerators and applications. The TecHIBA-JRA will ensure a breakthrough in all aspects related to the production and use of high-intensity heavy-ion beams. It is also of full benefit to future projects of high-intensity stable-ion beams such as at GANIL, Huelva and GSI. The TecHIBA-JRA consists of 6 tasks presented below.

Description of work and role of partners

WP15 - JRA7 – TecHIBA: Technologies for High Intensity Beams and Applications [Months: 1-48]
CNRS, GANIL, INFN, CERN, UNIWARSAW, CEA, GIP ARRONAX
Total person.months (EU/Own): GANIL (18/3) - INFN (24/3) - CERN (0/4) - CNRS (24/3) - UNIWARSAW (12/3) - CEA (12/12) - GIP ARRONAX (12/3)

Task 1: Improvement of Superconducting Accelerating Cavities – ISACA (CNRS)
Contributing institutes: CEA
The aim of ISACA is to study and build an innovative set-up to improve, quality-wise and safety-wise, the surface polishing of superconducting cavities. The current surface treatments typically used are either a buffered chemical polishing or an electro-polishing in a concentrated acid mixture containing highly concentrated hydrofluoric acid which is extremely delicate and expensive. Mechanical polishing techniques have now been used for decades achieving unsurpassed surface quality with a surface roughness below a few nanometres. Metallographic techniques allow preparing the surface with reduced crystallographic damage. Combining and transferring this knowledge and adapting the techniques to the needs of the superconducting-RF community would be a major step. The real challenge would be to achieve defect-free, non-polluted mirror-like surfaces on complex, closed geometries. Moreover, the development of this process combined with advanced surface studies and RF testing should allow to better understand the effect of surface structure on a superconducting material subjected to an intense radio frequency (RF) wave.

Task 2: Radio-Isotopes for Therapy and Medical Imaging – RITMI (CERN, ILL)
Contributing Institutes: GANIL, UNIWARSAW, GIP ARRONAX, CNRS
RITMI focuses on new production technologies for medical radioisotopes that cannot be produced with conventional methods at medical cyclotrons. The ENSAR2 facilities provide unique technologies, such as intense alpha and light-ion beams, high-energy proton beams, high neutron flux, and efficient mass separation methods. RITMI will demonstrate how these technologies can be applied to provide radioisotopes that are in high demand for preclinical and clinical research, namely alpha emitters and “matched pairs” of Sc isotopes.
Subtask 2.1: Dedicated collection chamber to improve 149Tb, 211At and 225Ac supply from ISOLDE
Spallation production at ISOLDE gives access to promising alpha emitters, but at present the activities of alpha emitters are seriously constrained by the Swiss authorisation limit of the ISOLDE hall. Full use of the ISOLDE capability requires a dedicated collection chamber certified as local “class A” area. We propose to develop a collection chamber for higher activities of alpha emitters and other radionuclides that are presently facing administrative limitations. It will also constitute a base for similar chambers of other RIB facilities.
Subtask 2.2: Improved 211At production
211At production is usually performed batch-wise by irradiating solid Bi targets with alpha beams and extracting by dry distillation. An alternative method is based on irradiation of liquid Bi with continuous on-line extraction of 211At collected on cold catchers. This method has the potential for upscaling to higher activities thanks to the convective cooling of the liquid metal target. When irradiated with 6,7Li beams a molten Bi target gives also access to 211Rn that may serve as longer-lived generator for remote 211At supply.

Subtask 2.3: Matched pair of scandium isotopes for Theranostics (therapeutic-diagnostic)

For certain applications 43Sc can be a viable alternative to the emerging PET isotope 44Sc. It has a similar half-life, a shorter positron range and less disturbing high-energy gamma rays. Production via 43Ca(p,n) requires rare and expensive enriched targets. We propose alternative production by 40Ca(α,n) reaction on cheap natural Ca targets. The therapeutic match 47Sc can be produced from Ti targets but the resulting product has limited radionuclide purity. Alternatively, we propose to explore the routes 46Ca(n,γ)47Ca or 48Ca(γ,n)47Ca which lead to the generator isotope 47Ca from which the daughter 47Sc can be separated.

Task 3: NEW Detection Opportunities for Magnetic Spectrometers – NEWDOMS (INFN)
Contributing institutes: CNRS, IFIN-HH, Univ. Valencia
In recent years, large-acceptance and high-resolution magnetic spectrometers have been installed in leading European laboratories for nuclear physics, with a major impact in several branches of nuclear structure and reaction mechanisms. Important upgrading of the existing facilities is foreseen, especially in view of emerging detection technologies and the availability of stable intense beams. The improvement of the exclusive measurement capability is one of the main directions that should be considered with higher priority in this field. NEWDOMS proposes to investigate the use of new scintillator materials to detect neutrons and gamma-rays in coincidence with charged particles measured by spectrometers to be adapted to the scientific opportunities offered by the European laboratories. This will be performed in close collaboration with PASPAG JRA, which is investigating use of phoswich scintillators for gamma and charged particle detection. The possibility of manufacturing plastic scintillators with efficient neutron/gamma pulse-shape discrimination (PSD) has been recently demonstrated by a system of a PVT polymer matrix over-loaded with a PPO scintillating dye. First characterisation results show that PSD in plastic scintillators can be of similar quality to standard commercial liquid scintillators. Another recent result is the implementation of a compact PSD electronic for liquid scintillators based on fast-stretcher generating highly performing signals for PSD and timing purposes. These two seminal technologies open the door to a massive use of plastic scintillators in applications where neutrons and gamma-rays have to be detected and identified. The purpose of NEWDOMS is to develop a prototype of a PVT+PPO scintillator, interface it with the fast stretcher and install it in coincidence with a magnetic spectrometer.

Task4: Identification of Low-Energy Radioactive Ions – ILERI (CEA)
Contributing institutes: GANIL, CSIC, CNRS, UNIWARSAW, MTA Atomki, Univ. Uppsala, USE
Fusion-evaporation are paramount reactions to produce exotic nuclei in the neutron-deficient side of the stability valley, from the N=Z nuclei up to the superheavy elements. But those nuclei are produced at very low recoil energy, and many reaction channels may be open. It is then very complex to unambiguously identify those nuclei. One possibility is to measure their decay properties, either atomic (X rays, electrons) or nuclear ones (proton, alpha, electron or gamma emission). In this activity, we propose to focus on the use of silicon detectors to detect and measure the decay particles. The first task aims at the design of a detection set-up for the atomic signature through X-ray detection, while the second one aims at identification of the nuclear decays, notably through an analysis of signal shapes.

Task 5: Generic Electronics Systems – GES (CEA)
Contributing institutes: GANIL, CNRS
Modern semiconductor detectors used in nuclear-physics experiments are increasingly more segmented, so that they require massively multi-channel readout electronics. Readout solutions based on ASIC are very attractive as they are compact, have highly reduced power consumption and are cost effective. The design of generic ASICs suitable for several experiments has been demonstrated by MUST2 and presently the success of the GET project (a project funded by French National Research Agency, on electronics) for gaseous detectors overcomes the large initial investment required of ASIC development. This task, performed within the skilled team which has designed the MATE and AGET chips, aims at the design of a multi-channel very front-end ASIC optimised for silicon detectors, including the preamplifier and shaper stages with configurable parameters, and with a dynamic-range capability of 14-15 bits to be split on two 12 bits sub-ranges. It will be compatible with standard ADC or the existing AGET chip. As with the GET development this development will be deployed also for gaseous and scintillator devices.

Task 6: TecHIBA coordination – TecHIBA-COOR (CNRS)
Contributing institutes: GANIL, INFN, JYU, GSI, IFJ PAN, UNIWARSAW, UHU
Coordination of the new JRA activities and continuation of some of the activities within the ECOS network that has been launched within ENSAR.

Participation per Partner

Partner number and short name	WP15 effort
1 - GANIL	0.10

Partner number and short name	WP15 effort
2 - INFN	24.00
3 - CERN	0.10
5 - CNRS	36.00
9 - UNIWARSAW	12.00
15 - CEA	14.20
16 - GIP ARRONAX	12.00
Total	98.40

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D15.1	Report on the characterization of a Niobium disk under RF	5 - CNRS	Report	Public	36
D15.2	Report on the polishing results on an accelerating cavity	5 - CNRS	Report	Public	48
D15.3	Report on 1 kW high power target station	5 - CNRS	Report	Public	48
D15.4	Report and publication on yields, radioisotopic purity and disturbing impurities achievable	5 - CNRS	Report	Public	36
D15.5	Plastic scintillator prototype	5 - CNRS	Demonstrator	Public	24
D15.6	Report of experimental results of the tests of the prototype	5 - CNRS	Report	Public	45
D15.7	Report on R&D on studies on X-ray emission and detector material	5 - CNRS	Report	Public	37
D15.8	Report on R&D on characterization and optimization of detector design	5 - CNRS	Report	Public	36
D15.9	Report on Detector test (source and In-beam)	5 - CNRS	Report	Public	48
D15.10	Report on Chip Design	5 - CNRS	Report	Public	12
D15.11	Report on silicon detector and ASIC tests	5 - CNRS	Report	Public	48

Description of deliverables

D15.1 : Report on the characterization of a Niobium disk under RF [36]
Report on the characterization of a Niobium disk under RF

D15.2 : Report on the polishing results on an accelerating cavity [48]
Report on the polishing results on an accelerating cavity

D15.3 : Report on 1 kW high power target station [48]
Report on 1 kW high power target station

D15.4 : Report and publication on yields, radioisotopic purity and disturbing impurities achievable [36]
Report and publication on yields, radioisotopic purity and disturbing impurities achievable

D15.5 : Plastic scintillator prototype [24]
Plastic scintillator prototype

D15.6 : Report of experimental results of the tests of the prototype [45]
Report of experimental results of the tests of the prototype

D15.7 : Report on R&D on studies on X-ray emission and detector material [37]
Report on R&D on studies on X-ray emission and detector material

D15.8 : Report on R&D on characterization and optimization of detector design [36]
Report on R&D on characterization and optimization of detector design

D15.9 : Report on Detector test (source and In-beam) [48]
Report on Detector test (source and In-beam)

D15.10 : Report on Chip Design [12]
Report on Chip Design

D15.11 : Report on silicon detector and ASIC tests [48]
Report on silicon detector and ASIC tests

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS53	Construction of polishing device	5 - CNRS	12	Report
MS54	Prototype of a PVT + PPO plastic scintillator	5 - CNRS	24	Report
MS55	Detector design and construction	5 - CNRS	36	Report
MS56	Asic prototype	5 - CNRS	30	Report
MS60	Test of the prototype with radioactive source and in beam in coincidence measurements	5 - CNRS	33	Report
MS61	Simulated and real signal database for Pulse shape analysis	5 - CNRS	24	Report
MS62	Approval of chamber design by CERN health physics	5 - CNRS	24	Report

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS63	Delivery of a 1 kW irradiation station	5 - CNRS	42	Report

Work package number [9]	WP16	Lead beneficiary [10]	1 - GANIL
Work package title	TA1 – GANIL-SPIRAL2		
Start month	1	**End month**	48

Objectives

Name of the infrastructure: Grand Accélérateur National d'Ions Lourds
Location of the infrastructure: Caen, FRANCE
Web site address: http://www.ganil-spiral2.eu/
Annual operating costs: 8,000,000 € (without manpower), 22,300,000 € (including manpower)
Description of the infrastructure: GANIL/SPIRAL2 is one of the major nuclear-physics facilities in the world with SPIRAL2 selected on the ESFRI list. The accelerator complex delivers:
• High-intensity light- and heavy-ion beams, ranging from protons up to 238U, including a unique-in-Europe pallet of rare stable-isotope beams like 36S, 48Ca, 50Ti, 64Ni and 70Zn, in the energy range between a few keV to 95 MeV/u.
• Wide range of high-intensity exotic beams produced either in flight with the LISE and S3 (from 2016) fragment separators or with the ISOL method at the SPIRAL 1 facility.
• Up to four different beams for users simultaneously.
The infrastructure consists of the following parts:
• Two injector cyclotrons right after two ECR ion sources, which can be operated in parallel.
• The IRRSUD beam line which allows to use low-energy beams from any of these injectors in a dedicated experimental area.
• CSS1: separated-sector cyclotron number 1 (delivers beams in the experimental area labelled SME in the energy range 5-15 MeV/u).
• CSS2: separated-sector cyclotron number 2, which is fed by CSS1, to reach the maximum beam acceleration (E = 30-100 MeV/u) and delivery to any experimental area.
• SPIRAL 1: Low-energy radioactive beams (30 keV) are available for decay spectroscopy and fundamental symmetries research at the LIRAT facility. These radioactive beams can also be injected into the CIME cyclotron and accelerated in the energy domain 2-25 MeV/u. This facility is unique in Europe.
• SPIRAL 2 Phase 1 (to be operational from 2015): SC LINAC accelerating beams from protons to heavy-ions with A/Q=3 in the energy range from 0.75 MeV/u to 20 MeV/u (up to 33 MeV for protons, up 14.5 MeV/u for heavy ions). The LINAC will deliver beams with the highest intensities in the world for this energy range (up to 5 mA for deuterons and up to 1 mA for heavy-ions).
In the GANIL experimental halls, a diverse array of experimental infrastructure is fully available to all users with technical support provided by local physicists, engineers, and technicians. In particular, GANIL runs two large magnetic spectrometers:
• VAMOS is a large-acceptance spectrometer and is used for various types of experiments: direct and deep-inelastic reactions for new spectroscopy studies of exotic nuclei, fusion-evaporation reactions, etc. The focal-plane detection system will undergo a significant upgrade in the coming years.
• The LISE III spectrometer, which separates projectile fragments from an enormous flux of incident unreacted beam, focuses and unambiguously identifies these fragments using several types of detectors. LISE is also used for Atomic Physics experiments.
• Two new experimental halls with corresponding instrumentation are currently under construction at SPIRAL 2 Phase 1: Neutrons For Science (NFS) facility and Super Separator Spectrometer (S3) that will be operational in 2015 and 2016, respectively. These new experimental areas will open completely new opportunities in the study of nuclei far from stability, neutron science and applications.
• Other detectors on the GANIL research site are designed and exploited for investigations on exotic nuclei and highly excited nuclei:
• The EXOGAM device is a large solid angle, high-efficiency germanium gamma array, well adapted to low-spin spectroscopy.
• MUST2/TIARA: modular set-ups consisting of solid-state detector telescopes dedicated to the study of direct reactions induced by radioactive beams on light particles.
• ACTAR TPC: an active target and time projection chamber is presently under construction at GANIL with funds awarded via an ERC starting grant (2013). This detector will be essential for experimental studies of nuclear structure and rare-decay modes. It is expected to be available in 2016/17.
• The period covered by HORIZON2020 will see the first campaign with the AGATA -ray tracking array at GANIL, starting in 2015. The AGATA campaigns are already scheduled in 2015 and 2016. GANIL has requested to extend the

AGATA campaigns at GANIL into 2017 and 2018. The combination of AGATA with the VAMOS spectrometer and other auxiliary detectors (plungers, a high-energy -ray spectrometer PARIS, a neutron-wall NEDA and others) will, together, provide a world unique facility for in-beam nuclear spectroscopy studies.
GANIL experimental areas offer to the users a variety of equipment for the detection of particles and rays: INDRA and FAZIA (by 2016/2017) 4 multi-detectors for charged particles, the Chateau de crystal scintillator array for rays, and the Neutron wall. In addition, three beam lines with dedicated equipment are now available for Atomic and Condensed-Matter Physics, at low energy (around 1 MeV/u), at medium energy (after CSS1) and at high energy (95 MeV/u). A dedicated beam line is devoted to industrial beam applications, and to biological research. The activity on this line has been increased considerably over the last few years, with the creation of a new laboratory dedicated to radiobiology on the GANIL campus (LARIA) and with a special effort to attract new industrial partners. In total (including low- and medium-energy beams), between 50 and 60% of GANIL beam time is allocated to interdisciplinary and applied research to tackle major societal challenges including cancer therapy, medical radioisotopes and safe/clean carbon-less energy.
The laboratory has access to the major computer centres of the CNRS (CC IN2P3 in Lyon) and the CEA. It is also in an active academic environment with a large campus dedicated to Sciences across the street: Université de Caen, ENSICAEN and other engineering schools, IUT (University Technology Institute).

Services currently offered by the infrastructure: All stable and rare isotope beams and all experimental areas at GANIL/SPIRAL2 are open to external users. Each area has both a technical and a scientific coordinator, who act as liaisons with the outside users. They provide assistance to the users with regards to setting up and performing the experiment.
GANIL presently provides around 5000 hours of beam time per year. This corresponds to 40-50 experiments on average. From 2016, SPIRAL2 will provide an additional 2500-3000 hours approximately of beam time per year for users. Around 700 scientists come regularly to the facility, with about 300 physicists from the EU (non-national) and associated countries. International users contribute actively to funding and construction of all major experimental devices and new halls of GANIL/SPIRAL2 with an overall budget exceeding 2 M€.
The average number of scientific publications related to GANIL experiments is around 130 per year.

Description of work and role of partners

WP16 - TA1 – GANIL-SPIRAL2 [Months: 1-48]
GANIL
Modality of access under this proposal:
GANIL/SPIRAL2 fully meets the requirements for open access to the facility for the international community. All proposed experiments are evaluated and prioritised as a function of their scientific merit, by an International Programme Advisory Committee (PAC). Once an experiment has been recommended by the PAC and approved for scheduling by the directorate of GANIL, the beam coordinator contacts the spokesperson(s) to define a possible schedule. The final beam schedule is finalised around 3 months before the experiment. The duration of a user’s stay can range between a few days for the short solid-state physics experiments to several weeks for long nuclear physics experiments or campaigns of experiments. The users have to follow a specific procedure for any experiment, after it has been included in the GANIL/SPIRAL2 beam schedule. The spokespersons receive several documents which will be used as a basis to define more precisely the conditions of the experiment: beam optics, beam quality, detection systems, list of targets, expected data-acquisition support, specific needs (cryogenics needs, use of explosive gases…) and the corresponding safety, security and radioprotection requirements. Allocation of beam time implies that the users group will benefit from all the laboratory infrastructures and equipment during its stay. The unit cost is determined taking into account consumables, energy and maintenance costs necessary to provide heavy-ion beams during one hour. The output of the experiments are the experimental data stored on disks that the research teams take back to their home laboratories for analysis. Deliverables include PhD theses, published articles in major international journals and talks/seminars in workshops/meetings/international conferences.

Support offered under this proposal:
- Scientific and technical assistance is routinely provided to GANIL/SPIRAL2 users, in the experimental halls where scientific and technical coordinators take part in the set-up of the experiments including the electronics and associated data-acquisition systems. The beam is tuned to the user's experimental setup by beam operators and liaison scientists. The facilities user support provides access to the computers and networks, to data-storage devices, to workshops, to electronics laboratories, etc.
- The GANIL/SPIRAL2 Users Board specifically ensures that user teams receive maximal support; it oversees the adequacy of the physics equipment for experimental programmes.
- GANIL/SPIRAL2 users can also benefit from the local logistical infrastructure: a guest house, cafeteria, library and a general store for materials, components, and supplies.

- GANIL/SPIRAL2 covers from its own budget all additional expenses not covered by the unit cost (that means more than 90% of the full cost) of all fundamental research experiments performed at the facility.

Outreach to new users:
- Information about GANIL/SPIRAL2 facilities (technical and scientific information, calls for proposals, European support) is available online: pro.ganil-spiral2.eu/users-guide/ and widely announced via extended mailing lists. Within Integrating Activities (under FP6, FP7 and HORIZON2020), the priority for the financial and logistic support is given to young scientists, PhD students and postdoctoral fellows.
- All workshops and conferences organised by GANIL/SPIRAL2 are also widely advertised by email distribution, and information posted on the GANIL/SPIRAL2 website.
- For industrial applications, outreach is achieved via an active participation in the RADECS association that gathers companies and beam providers, and also through participation in related conferences.
- The number of users will increase with the new facility SPIRAL2 Phase 1 by about 200, as it will provide an additional 2500-3000 hours of beam time per year to current and new users. All GANIL/SPIRAL2 users are registered which allows for an easy monitoring of their number on a year-by-year basis.

Review procedure under this proposal:
When a group of physicists submit a written proposal to conduct an experiment at GANIL/SPIRAL2, the proposal is directed to the Nuclear Physics or Interdisciplinary Research Programme Advisory Committees (PAC consisting of 12 members and iPAC, respectively). For information on submitting proposals and procedure for evaluation and granting access see “Review procedures for Transnational Access to experimental infrastructures” in Section 3.2.

Participation per Partner

Partner number and short name	WP16 effort
1 - GANIL	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP17	Lead beneficiary [10]	2 - INFN
Work package title	TA2 - LNL-LNS		
Start month	1	**End month**	48

Objectives

Name of the infrastructure : LNL-LNS of INFN
Location (town, country) of the infrastructure: “Laboratori Nazionali di Legnaro” (LNL, at Legnaro, Padua) and “Laboratori Nazionali del Sud” (LNS at Catania) are both property of Istituto Nazionale di Fisica Nucleare (INFN) and are devoted to Fundamental and Applied Nuclear Physics.
The research activities in the two laboratories are strictly coordinated and complementary, due to the different beams and experimental apparatuses offered to the users.
Web site address: http://www.lnl.infn.it, http://www.lns.infn.it
Annual operating costs: 5,756,896.56 €

Description of the infrastructure:

Accelerator Facilities
The LNL and LNS laboratories have different accelerators providing light- and heavy-ion beams up to 80 MeV/u (NSDBF = Nuclear Structure and Dynamics Based Facilities + AIPF = Applied and Interdisciplinary Physics Facilities). In particular, the accelerators in use are:
• the PIAVE/ALPI accelerator complex at LNL, equipped with an ECR source and the superconducting RFQ injector PIAVE, delivering ion beams with A>90 up to approximately 15 MeV/u;
• the Tandem/ALPI accelerator complex at LNL, hosting the 16 MV XTU-Tandem accelerator (for beams with A<90) coupled to the ALPI superconducting Linac delivering heavy-ion beams with energies up to 10 MeV/u;
• the Superconducting Cyclotron at LNS providing a wide variety of heavy-ion beams with energies up to 80 MeV/u;
• the 15 MV SMP Tandem accelerator at LNS providing heavy-ion beams with energies of a few MeV/u.
The FRIBs (in Flight Radioactive Ion Beams) facility at LNS produces light- and heavy-ion RIBs at intermediate energy by using the In-Flight technique.
During the period of the offered Transnational Access the ISOL-type SPES facility for radioactive beams will be installed and commissioned at LNL and the first low-energy rare beams will be available for the experimentalists. The building that will host the driver is presently under construction.
Both Laboratories host accelerator-based facilities devoted to applied, interdisciplinary and biomedical physics (AIPF) centred on:
• the SIRAD facility dedicated to bulk damage and Single-Event Effects studies in semiconductor detectors and associated electronics
• thanks to the presence of two exit ports, the SPES driver (a cyclotron accelerating protons up to 70 MeV energy, 700 mA intensity) will be also available for research studies on the production of new radioisotopes for medicine and neutrons for applied physics (e.g., radiation-damage studies)
• the CATANA facility at LNS where, besides the proton-therapy, biomedical physics experiments using proton and carbon beams from the cyclotron are performed.

The associated research instrumentation
The two laboratories LNL and LNS have several detection equipment installed at dedicated beam lines (see web pages). A brief description is given only for those which, due to the fact that they are either new or recently upgraded, have a major impact in increasing the number of users.
• The new 4π GALILEO spectrometer at LNL is an advanced device in the field of nuclear-structure studies through gamma-ray spectroscopy. GALILEO will be easily integrated with different ancillary detectors such as light charged-particle detectors (EUCLIDES, TRACE), heavy-fragment detectors (DANTE, RFD), neutron detectors (NW, NEDA), plunger devices, etc.
• The large acceptance magnetic spectrometer PRISMA at LNL for the study of grazing reactions is being upgraded with the installation of a second arm to perform kinematic coincidence measurements
• The EXOTIC beam line at LNL for the production of light RIBs 7Be, 8B, 17F and 15O beams are available in the energy range of a few MeV/u with intensities between 103 and 105 pps
• For the study of nuclear structure at finite temperature, the GARFIELD + RCo (Ring Counter) array at LNL and the MEDEA + SOLE array at LNS are used.

• The RIPEN multi-detector system for neutron spectroscopy at LNL is now available for coupling with different charged-particle detectors for reaction mechanism studies.
• The MAGNEX + EDEN (a time-of-flight neutron array) facility at LNS represents a unique instrument worldwide opening a very wide range of possibilities in the field of nuclear physics.
• The CHIMERA array at LNS has been upgraded to be used with new fragmentation beams of the FRIBS separator. In addition, new measurements will be performed together with the FARCOS detector (Femtoscope ARray for COrrelations and Spectroscopy).
• The first block of the FAZIA array for charged-ion identification is now in the commissioning phase at LNS. An experimental campaign with four blocks is foreseen during 2014-2015.
• Among the main instrumentation devoted to applied and interdisciplinary research there is:
• the new detector STARTRACK for nano-dosimetry studies
• the LANDIS equipment for non-destructive in situ analysis of archaeological samples.

Services currently offered by the infrastructure:
Outside users receive support by the local teams and have access to well-equipped laboratories and services with quality expertise. The main services offered to users are the following: 1) Detector Laboratory at LNL, for testing and repairing large-volume HPGe detectors; 2) Target laboratories at LNL and LNS; 3) Experimental Hall services at LNS and LNL providing technical assistance to users; 4) Computer centres and Data-Acquisition Services at LNL and LNS; 5) Cellular and molecular biology laboratories at LNL and LNS; 6) Superconductivity laboratory at LNL.
An indicator of the global quality of the research performed at LNL and LNS, which well represents the exciting scientific environment offered to users, is the number and high quality of the peer-reviewed published papers (around 200 per year). The complete list of publications is available in the Annual Reports (www.lnl.infn.it/~annrep/index.htm, www.lns.infn.it/index.php?option=com_docman&Itemid=164).
Among the scientific highlights we can mention:
• for nuclear structure and reactions: Lifetime measurements in neutron-rich 63,65Co isotopes using the AGATA demonstrator (Phys. Rev. C 88, 044326 –2013); The RGB and AGB star nucleosynthesis in light of the recent O-17(p, alpha)N-14 and O-18(p, alpha)N-15 reaction-rate determinations (Astrophysical Journal 764, 128 – 2013); Non-statistical decay and α-correlations in the 12C+12C fusion–evaporation reaction at 95 MeV (J. Phys. G: Nucl. Part. Phys. 41 075108-2014); Study of the rainbow-like pattern in the elastic scattering of 16O on 27Al at Elab. = 100 MeV (J. Phys. G: Nucl. Part. Phys. 40 105101- 2013)
• for interdisciplinary research: Track structure of light ions: experiments and simulations (New J. Phys. 14 093010 -2012); Conversion from dose-to-graphite to dose-to-water in an 80 MeV/A carbon ion beam (Physics in medicine and biology 58 (2013)5363)
The broad international interest to conduct research (nuclear and interdisciplinary physics and related applications) at the LNL-LNS research infrastructure and use its services is testified by the number of users per year (approximately 1200). Among them, about 40% are foreigner. In addition, contacts and fellowship programmes currently exist with Russia, India, China and developing African countries.
The expertise of LNL-LNS finds application in several fields such as the hadron-therapy (CATANA facility), the safeguard of Cultural Heritage masterpieces (LANDIS laboratory – patent nr. 9807435 and nr. 2885370), the development of advanced composite materials (patent nr. EP 0826434 (A1), and patent nr. RM2007A000522), the development of new techniques for the fabrication of resonant cavities, and the making of maps of the natural radioactivity of the territory (agreement with the Toscana and Veneto regions). Moreover, both laboratories have irradiation facilities and offer beam time to industries.

Description of work and role of partners

WP17 - TA2 - LNL-LNS [Months: 1-48]
INFN
Modality of access under this proposal:
All the above mentioned facilities (accelerators and/or experimental set-ups) are open for access. For information on submitting proposals and procedure for evaluation and granting access see “Review procedures for Transnational Access to experimental infrastructures” in Section 3.2.
Support offered under this proposal:
A number of main services with internal support are offered, including: 1) engineering project service and mechanical machine shops; 2) vacuum laboratories; 3) cryogenics and superconductivity laboratory; 4) laboratory for sputtering and composite materials; 5) laboratory for treatment of materials; 6) Nuclear Analytical Laboratory and 7) Micro and Nano-dosimetry Test laboratory.

Important logistics support includes: 1) General store for goods and components; 2) Canteen and cafeteria service for LNL employees and users; 3) Guest-house for guests and users; 4) Library and documentation service.
Outreach to new users:
Calls for proposal at LNL-LNS are advertised on the web pages (http://www.lnl.infn.it, http://www.lns.infn.it) and distributed through an e-mail list including PhD students and post-doctoral fellows. In addition, the minutes of the meeting of the Laboratory user groups (every 6-12 months) are distributed to inform the community on practical questions such as the time schedules related to work (maintenance, upgrade or new implementation) at the installation.
Review procedure under this proposal:
Scientific proposals requiring access to both laboratories undergo a peer review evaluation based on scientific merit and carried out by the local PACs, instituted by INFN, whose composition is available on the lab web sites. The final decisions about the selection of projects which can benefit of TA funds is left to a unique User Selection Panel. See also "Review procedures for Transnational Access to experimental infrastructures" in Section 3.2.

Participation per Partner

Partner number and short name	**WP17 effort**
2 - INFN	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	**Deliverable Title**	**Lead beneficiary**	**Type**[15]	**Dissemination level**[16]	**Due Date (in months)**[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	**Milestone title**	**Lead beneficiary**	**Due Date (in months)**	**Means of verification**

Work package number [9]	WP18	Lead beneficiary [10]	3 - CERN
Work package title	TA3 – ISOLDE		
Start month	1	End month	48

Objectives

Description of the infrastructure
Name of the infrastructure: ISOLDE
Location (town, country) of the infrastructure: European Organisation for Nuclear Research (CERN), Geneva, Switzerland
Web site address: www.cern.ch/isolde
Annual operating costs: 7,820,000 €
Description of the infrastructure:
ISOLDE is the radioactive beam facility at CERN. The 1.4 GeV proton beam with average intensity of 2 μA from the PS-Booster accelerator impinges on thick targets producing a large variety of radioactive isotopes. The high proton energy and the accumulated target and ion-source knowledge allow for the extraction and separation of about 1000 different isotopes of more than 70 elements; this number of isotopes available for users is by far the highest at any ISOL-facility worldwide.
The facility provides low energy 30-60 keV and post-accelerated radioactive beams. The energy of the latter will increase with a new superconducting linac to 4.3 MeV/u in 2015 and later to 10 MeV/u in 2017 within the HIE-ISOLDE upgrade programme. This linac will build on the success of REX-ISOLDE and be able to accelerate nuclei of various masses, lifetimes and production rates. The new energy regime will allow a new class of experiments to be performed, thus increasing the physics reach of the installation even further. Future plans include the coupling to HIE-ISOLDE of the test storage ring, TSR, from MPIK Heidelberg, making ISOLDE the only ISOL-type facility worldwide coupled to a storage ring. The TSR will further open the physics domains of research at ISOLDE.
The ISOLDE Facility consists of the following parts:
-Two target and ion source units. There are 20 different types of targets including neutron converter that are combined with three types of ion sources to chemically select ions of the different elements. When no chemical selection is possible lasers are used for selectivity.
- Two mass separators with resolving power of 2000 and 6000 unit of mass, used for isobaric separation.
- A radiofrequency cooler and buncher, ISCOOL, to bunch the ion beam, used especially for laser-based experiments.
-Three beam lines, which can simultaneously deliver radioactive beams: the central beam line connects to the main experimental devices through many different branches, the other two can deliver simultaneously beams differing 15 % in mass from the central one.
As part of the HIE-ISOLDE project a design study to improve further the purity and beam quality is presently on-going, which will attract new users.
Present experiments mainly deal with nuclear structure questions, explored via measurements of ground state properties (mass, radii, moments) and decay studies or Coulomb excitation and transfer reaction studies. Part of the programme is devoted to nuclear astrophysics and fundamental physics. Close to 20% of the beam time is given to solid state physics and life sciences with broad societal benefits.

The Associated Research Instrumentation:
Appropriate experimental and laboratory infrastructure is provided for external users, including electronics, radiation detectors, multi-parameter data acquisition systems, laser installations, chemistry and radioactive laboratories.
The ISOLDE hall connects the central beam line through different switchyards with more than a dozen beam lines. Shielded collection points and laboratories for the handling of radioactive samples are also available. Two beam lines for post-accelerated beams will be operational in 2015.
The presently existing fixed experimental setups are listed below:
• MINIBALL is a highly efficient germanium array placed after the post-accelerator for Coulomb excitation and transfer studies together with a Si-Array called T-REX. In 2015 an electron conversion spectrometer, SPEDE, will be added for spectroscopy studies on actinides.
• A versatile scattering chamber is available behind the post-accelerator for reaction studies.
• The Collinear laser spectroscopy (COLLAPS) and resonance ionisation laser spectroscopy (CRIS) set-ups are used to determine ground-state and isomer charge radii, spin and magnetic and quadrupole moments. In addition COLLAPS can be used for beta-detected NMR while CRIS for decay studies on isomeric pure samples.
• The ISOLTRAP setup with its Penning traps and MR-TOF spectrometer is devoted to high-precision mass measurements.

• Low-temperature dilution refrigerator for nuclear orientation (NICOLE).
• Total Absorption Spectrometer (TAS) for beta decay studies.
• New fixed setup dedicated to decay studies (IDS).
• UHV experimental chambers for surface and interface studies (ASPIC).
• Several angular-correlation spectrometers for perturbed angular-correlation studies, online and offline emission-channelling apparatus and a photoluminescence system for solid-state physics.
• A new line for studies with polarised beams (VITO) applied to material science and biology. The line will accommodate UHV experimental chambers for surface and interface studies (ASPIC).
Due to the increasing number of ISOLDE users and experiments a new class C laboratory will become operational in August 2014. It will host an extended laboratory for condensed-matter and bio-physics with a separate chemistry laboratory, as well as 3 enlarged laser laboratories, a mechanical workshop, and a new detector laboratory.

Services currently offered by the infrastructure:
• The 700 different nuclei produced at ISOLDE in quantities high enough for spectroscopic studies are available for the users. Approved experiments (see below) have access to all common installations at ISOLDE. The ISOLDE physics and technical groups provide advice and assistance to the users with regards to setting up and performing the experiment.
• All ISOLDE users have access to the standard CERN services, including computing, library 24h, magazine store, electronics pool, restaurants, housing service, etc.
• ISOLDE presently provides about 3500 hours of beam time per year for about 50 experiments realised with the leading and participation of more than 400 external users.
An overview of the outcome of the scientific programme at ISOLDE can be found through the publication lists on the web (www.cern.ch/isolde/publications) with an average of 80-100 publications per year. To illustrate the quality of research one should mention the recent publications in Nature:
• The first determination of the ionisation potential of astatine (Nature Communications 4 (2013)1835)
• The mass measurement of calcium-54, providing evidence for a new neutron shell closure N=32 and being a test-ground for ab-initio calculations in this middle mass region (F. Wienholtz et al, Nature 498 (2013) 346)
• The study of pear shape (octupole deformation) in radon-220 and radium-224, with impact on nuclear models and searches for the permanent electric dipole moment in atoms (P.L. Gaffney et al, Nature 497 (2013) 199)

Description of work and role of partners

WP18 - TA3 – ISOLDE [Months: 1-48]
CERN
Modality of access under this proposal:
ISOLDE fully meets the requirements for open access to the facility for the international community.
• ISOLDE users are registered at CERN's Users' Office as associates and have full access to the services offered by this international research centre. To be given access to the experimental hall they must pass a safety course and obtain a personal dosimeter.
• The access to the radioactive beams is given according to the operational schedule whereas other infrastructures of the ISOLDE facility are continuously available for all users. The work is normally done on-site during 1-15 days depending on the project, typically accompanied by further measurements and/or data analysis performed in the users' home institutes.
• The beam scheduling of approved experiments is done to maximise the overall facility efficiency, scientific output and quality. The ISOLDE physics coordinator schedules approved experiments according to the users' request and technical constraints.

Support offered under this proposal:
• More than 95% of ISOLDE users are external, and the support offered to external users will also be provided to users covered by this proposal.
• New users are invited to participate in regular training courses on machine operation to run their experiments efficiently and responsibly. A support office(r) is available to ISOLDE users for administrative and organisational problems. General assistance and information is provided as well by the CERN's Users Office and on the official CERN website.
• All new users are fully integrated into the scientific environment via seminars, lectures, etc. and access to libraries and computing facilities.
• Both internal and external transport services for material exist. The so-called "team accounts" are provided to assist users in managing their finances at CERN.
• The ISOLDE physics group and the technical teams comprised of some of the world-leading technical experts in radioactivity handling, high-temperature target technologies, ion sources, and radioactive beam production.

• Due to the increasing number of users we will have to provide a larger support within the proposal. This will be achieved through the presence of the transnational access project coordinator who also acts as administrative liaison through extended secretarial services.

Outreach of new users:
• Information for new users is published through the web page (http://www.cern.ch/isolde), where calls for TA support are also announced. E-mail lists of experiment spokespersons and of all users are employed as well to ensure efficient communication.
• Yearly user workshops are held where new experimental possibilities are presented. The ISOLDE facility and the possibilities it provides for new users are presented frequently at international meetings.
• Community funding of transnational access will help new users to establish their own scientific programmes at ISOLDE. The funding is crucial to give to young researchers access to international scientific environment at an early stage of their career.

Review procedure under this proposal:
Proposed experiments requesting access to ISOLDE beams are evaluated scientifically by the ISOLDE and nTOF Committee, INTC, with scientific members from outside CERN. The INTC committee is advised on the feasibility of the experiments by the Technical Advisory Committee. For information on submitting proposals and procedure for evaluation and granting access see "Review procedures for Transnational Access to experimental infrastructures" in Section 3.2.
The procedure is also described online: www.cern.ch/isolde/financial-support

Participation per Partner

Partner number and short name	WP18 effort
3 - CERN	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP19	Lead beneficiary [10]	4 - JYU
Work package title	TA4 - JYFL		
Start month	1	**End month**	48

Objectives

Name of the infrastructure : Accelerator Laboratory, Department of Physics, University of Jyväskylä (JYFL)
Location (town, country) of the infrastructure: Jyväskylä, Finland
Web site address: http://www.jyu.fi/accelerator
Annual operating costs : 2,920,000 €

Accelerator facilities:
• A K=130 MeV heavy-ion cyclotron with two ECR ion sources and a multi-cusp ion source delivers one of the largest varieties of stable-ion beams (from p to Xe) suitable for modern nuclear-physics research and applications. Its annual operation time has been close to 7000 hours during the last years. Laboratory has got the funding for the construction of a third ECR ion source in 2014-2017. It will increase the intensity and energy range of the beams delivered by K130.
• A new 800 m2 extension of the JYFL target hall has been equipped with an additional new K=30 MeV light-ion cyclotron, which enables long difficult experiments and development work at both cyclotrons. Beam time for applications will be doubled.

Associated research instrumentation:
One third of the K=130 cyclotron beam time is dedicated to tagging studies of exotic nuclei at the proton drip line and of super-heavy elements. The RITU gas-filled recoil separator with detector arrays at the target area (JUROGAM Ge-detector array) and the focal plane (GREAT spectrometer) is the most efficient system in the world for such studies. Optionally, a new SAGE spectrometer composed of a JUROGAM II array of Ge clover detectors and a novel in-beam electron spectrometer will be available at the RITU target. A new vacuum recoil-separator will enable detailed studies of nuclei close to the N=Z line in 2015.
A large amount of beam time is used for comprehensive studies of nuclear ground state and exotic decay modes at the IGISOL ion-guide facility. It delivers various species of cooled and bunched radioactive ion beams to beam lines equipped with ion traps for accurate nuclear-mass measurements, detector systems for exotic decay modes and laser-spectroscopy systems for hyperfine-structure studies. A new laser-ion-source will be commissioned in 2014 to generate new low-energy radioactive species. Radioactive beams from IGISOL are also used for applications, such as studies of atomistic transport processes in nanoscale solids.
There is a designated beam line, equipped with a RADiation Effects Facility (RADEF), for studies of single-event effects (SEE) in electronics. The RADEF facility is also available for various radiation hardness tests of materials, sensors and detectors with light ions and heavy-ion beam cocktails delivered by the K=130 cyclotron.
Two beam lines are available for nuclear-reaction studies and test experiments. One of them is equipped with a scattering chamber of 1.5 meters in diameter.
Scientific environment:
The JYFL Accelerator Laboratory is attached to the Department of Physics of the University of Jyväskylä. Services of all the laboratories at the Department, including the new Nanoscience Centre (http://www.jyu.fi/nsc/en/) are available to all users. The Accelerator Laboratory also has close contacts with the experts of experimental and theoretical high-energy and materials physics at the Department of Physics.

Services currently offered by the infrastructure:
All the accelerators and associated instrumentation are available for the users. In addition, JYFL has well-equipped mechanical and electronics workshops ready for fast deliveries. The requested beams are delivered by the JYFL staff. Each experiment proposed by the users has a local liaison and is typically carried out in collaboration with one of the six in-house research teams.
The international exchange programmes have led to a significant transfer of foreign users (around 200 foreign visitors annually) and equipment (value of 10 M€) to JYFL.
Among the recent highlights obtained by the users:
• RITU:
o Shell-Structure and Pairing Interaction in Superheavy Nuclei: Rotational Properties of the Z=104 Nucleus 256Rf: Phys. Rev. Lett. 109 (2012) 012501
o Spectroscopy of proton-rich 66Se up to J = 6+: Isospin-breaking effect in the A = 66 isobaric triplet: Phys. Rev. C 88 (2013) 041308(R)
o Blurring the Boundaries: Decays of Multiparticle Isomers at the Proton Drip Line, Phys. Rev. Lett. 112 (2014) 092501

• IGISOL:
o Precision mass measurements beyond 132Sn: Anomalous behaviour of odd-even staggering of binding energies: Phys. Rev. Lett. 109 (2012) 032501
o Reactor decay heat in 239Pu: Solving the gamma discrepancy in the 4-3000 s cooling period: Phys. Rev. Lett. 105 (2010) 201501
• Applications:
o Depth profiling of Al2O3 + TiO2 nano-laminates by means of a time-of-flight energy spectrometer: Nucl. Instrum. Meth. B 269 (2011) 3021
o Ultra-high resolution mass separator - Application to detection of nuclear weapons tests; Applied Radiation and Isotopes 68 (2010) 450

Since 2005, the JYFL Accelerator Laboratory with the RADEF facility is recognised by the European Space Agency (ESA) as an official radiation test facility for space electronics. Among the RADEF users there are more than 30 international companies.
As a university laboratory, the JYFL Accelerator Laboratory provides a unique environment for graduate students and young scientists for active participation in experiments as well as in the design and construction of instrumentation.
There is a strong national support for the research activities at JYFL: the JYFL Accelerator Laboratory was awarded by the Academy of Finland a status of a Finnish Centre of Excellence (CoE) in Nuclear and Accelerator-Based Physics for 2012-2017. It also has a special task given by the Ministry of Education as a centre of expertise in radiation and ion-beam applications in general.

Description of work and role of partners

WP19 - TA4 - JYFL [Months: 1-48]
JYU
Modality of access under this proposal:
Beam times of typically one week are allocated for the user groups based on the proposals approved by the Programme Advisory Committee. Users are encouraged to contact local scientists at JYFL already when preparing the scientific proposal to discuss the available equipment and beams as well as feasibility of the proposed experiment and its scheduling. The users' experiments can employ the JYFL research instrumentation (see above), their own instrumentation or combinations of the two. The user group is responsible for the analysis of the collected data and has its proprietary right. Deliverables are typically scientific publications.

Support offered under this proposal:
In preparing and running the experiment one of the local research teams offers all the scientific, technical and logistic support needed to perform a successful experiment. Help is offered in setting up the instrumentation, running the data-acquisition systems and analysis of the data. The accelerator team is responsible for delivering of the ion beams and stable running conditions through the entire experiment. Theory support is also available by the strong nuclear physics theory team of JYFL. Accommodation for the users is organised by the JYFL staff on request.

Outreach to new users:
JYFL are published in JYFL Accelerator News biannually, which is posted to nuclear physicists all over the world and published at http://www.jyu.fi/accelerator/anews.
Access is also advertised via NuPECC Nuclear Physics News.
An announcement of the Annual Users Meeting is published well in advance.
Results and achievements are also published in JYFL Annual Report posted to nuclear physicists all over the world and published at https://www.jyu.fi/fysiikka/en/info/ann_reports/
For the industrial applications, JYFL Accelerator Laboratory is a partner in the RADECS association. Thanks to the EU access support, the JYFL Accelerator Laboratory is today one of the leading stable-ion beam facilities in nuclear physics in Europe. Possible EU support in the future will further guarantee the high number of European users. Today, practically all the outside users of JYFL are foreign users.
Due to the new developments and improved collaboration with the new EU countries, the number of new international users is expected to increase from the present annual share of 40%.

Review procedure under this proposal: Proposals for the experiments (projects) are evaluated by the Programme Advisory Committee comprised of 6 international scientists. The criterion of new users is taken into account in awarding the financial support. For information on submitting proposals and procedure for evaluation and granting access see "Review procedures for Transnational Access to experimental infrastructures" in Section 3.2.

Participation per Partner

Partner number and short name	WP19 effort
4 - JYU	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP20	**Lead beneficiary [10]**	5 - CNRS
Work package title	TA5 – ALTO		
Start month	1	**End month**	48

Objectives

Name of the infrastructure : ALTO (Accélérateur Linéaire et Tandem à Orsay)
Location (town, country) of the infrastructure: Orsay, France
Web site address: https://ipnwww.in2p3.fr/Installation-ALTO
Annual operating costs : 1,551,229 €

Description of the infrastructure: The ALTO facility consists of two accelerators in the same area. A Tandem accelerator dedicated to stable (ions and cluster) beam physics and a linear electron accelerator dedicated to the production of radioactive beams. This gives a unique opportunity to have in the same place cluster beams for interdisciplinary physics and stable and radioactive beams for astrophysics and nuclear physics.
Tandem Accelerator:
The Orsay Tandem Van de Graaff accelerator is of the MP type. Its nominal voltage is 15 MV and it is usually operated up to 14.6 MV. Stable ion beams ranging from protons to gold can be delivered. Cluster beams and micro-droplets are also routinely delivered, but at lower voltage (10 MV). The ion sources of the Tandem accelerator have been recently improved in order to deliver 5 times more beam intensity. Intense cluster beams (C60 and gold droplets) and rare ion beams (14C, 48Ca ...) are now available.
e-LINAC:
The e-LINAC accelerator is an electron accelerator (50 MeV 10 µA) used as a driver to induce fission in a thick heated uranium-carbide target. The number of fissions reached in the target is 1011 fissions per second. Separated beams of neutron-rich nuclei are available for studies in nuclear structure, decay heat in reactors and solid-state physics.

The Associated research instrumentation
Six beam lines are available for experiments for stable beams. One beam line is devoted to industrial irradiation and two others to cluster physics which are equipped with dedicated setups for irradiation and new generation of detection apparatus. One separator and two spectrometers are available for nuclear-physics experiments as well as state-of-the-art Ge multi-detector arrays. LICORNE, a new neutron source producing intense, kinematically focused, mono-energetic beams of neutrons with energies between 0.5 and 4 MeV, is also available for the users.

Services currently offered by the infrastructure:
All the above-mentioned experimental setups are open for access. Other services are offered by the infrastructure such as a detector laboratory, a target laboratory, an experimental hall service, a computer centre and data-acquisition service, a radioprotection and security service and a laser laboratory.
The ALTO facility has a long tradition to work with different research communities such as: atomic physics, solid-state physics, accelerator physics, nuclear physics, particle physics, nanotechnology, interaction of ion with matter, and biology with around 250 external users (150 international).

Description of work and role of partners

WP20 - TA5 – ALTO [Months: 1-48]
CNRS
Modality of access under this proposal:
To apply for access to the accelerator and experimental facilities, a written project proposal has to be submitted. The call for proposals at ALTO is advertised on the web pages (http://ipnwww.in2p3.fr). An additional application form has to be submitted by the users interested in the EC support. Preliminary contacts with the manager of the facility of interest must be established in advance in order to ascertain the feasibility of the experiment and/or obtain information about the characteristics and the use of the facility. To comply with the scientific scheduling and safety rules, preliminary contacts must be made with the Technical Division and with the Scientific Coordinator of the facility. Local research groups are in charge of the above-mentioned experimental facilities and the users are independent in all the activities allowed by safety rules. See also “Review procedures for Transnational Access to experimental infrastructures” in Section 3.2.

Support offered under this proposal: A number of main services are offered, including :
1) Engineering project service and mechanical machine shops, 2) vacuum laboratories; 3) cryogenics and superconductivity laboratory; 4) target laboratory 5) detector laboratory 6) accelerator division. Important logistics

support includes: 1) Canteen and cafeteria service for employees and ALTO users; 2) Rooms for guests and users 4) Library and documentation service. These supports are routinely used by the 250 external users at ALTO every year.

Outreach to new users:
Since 2010 and the first consideration of ALTO as a TA, the number of transnational users has increased by a factor 2 and is still increasing. The call for proposals at ALTO is advertised on the web pages (http://ipnwww.in2p3.fr). In addition, there is an e-mail list which is rather complete as it includes also PhD students and post-doctoral fellows and is distributed to the users. Furthermore, the minutes of the meeting of the Laboratory user groups (every 6-12 months) are distributed to inform the community on practical questions such as the time schedules related to work (maintenance, upgrade or new implementation) at the installation. In addition, surveys are made when decisions have to be taken involving the time scheduling of beam time or developing of new beams.

Review procedure under this proposal:
To apply for access to the accelerator and experimental facilities, a written project proposal has to be submitted. The proposals are reviewed by an international Programme Advisory Committee (PAC). The PAC presently has 11 members (10 external), with 7 of them coming from universities or research institutes outside France. For information on submitting proposals and procedure for evaluation and granting access see "Review procedures for Transnational Access to experimental infrastructures" in Section 3.2.

Participation per Partner

Partner number and short name	WP20 effort
5 - CNRS	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP21	Lead beneficiary [10]	6 - GSI
Work package title	TA6 – GSI		
Start month	1	End month	48

Objectives

Name of the infrastructure: GSI Helmholtzzentrum für Schwerionenforschung GmbH
Location (town, country) of the infrastructure: Planckstr. 1, 64291 Darmstadt, Germany
Web site address: www.gsi.de
Annual operating costs: UNILAC operating cost: 12,843,000 € (2011), 10,844,000 € (2012)

Description of the infrastructure:
GSI is operating a large accelerator complex consisting of the linear accelerator UNILAC, the heavy-ion synchrotron SIS and the experimental storage-cooler ring ESR. With the UNILAC, ions from p to U can be accelerated up to 11 AMeV, at SIS up to 2 AGeV and in ESR stable or radioactive ion beams can be stored and cooled at energies up to 0,56 AGeV (for U).
As a new facility which will come into operation in 2015, the storage ring CRYRING will offer cooled beams in the energy range between 10 AkeV and 4 AMeV. CRYRING will be equipped with a 1.44 Tm beam line to the ESR and will open a new window for atomic and nuclear-physics experiments with highly charged and radioactive heavy ions at GSI. The CRYRING is equipped with an ion source and an injection system which can be operated independently of the main accelerators of GSI.
GSI, together with national and international partner institutions, has started the construction of a new large accelerator and research complex – the Facility for Antiproton and Ion research (FAIR), which was on the first and subsequent ESFRI list. Following an upgrade in intensity the GSI accelerators UNILAC and SIS18 will serve as injectors. The substantial upgrade works necessary to enable the two accelerators to deliver the high intensities needed at FAIR will have serious impact on the amount of beam time which can be offered to the GSI users. For this reason, no beam time was offered to the users in 2013 and starting from end 2014 the SIS18 accelerator (and the ESR) will not be available for two years. For these reasons the present proposal is focused on access to the UNILAC experimental facilities, the CRYRING and the infrastructures of GSI, i.e. the research laboratories and the experimental sites for integration and testing of detectors built for the FAIR experiments. Access to SIS18 and ESR will be possible again around the end of this funding period and will be supported – if possible - within this project.
Various equipment and experimental setups for broad fields of ENSAR2-related physics are available, in particular nuclear-structure and astrophysics, but also atomic, bio- and plasma physics and material science:
Equipment dedicated to nuclear structure and nuclear astrophysics research:
• The velocity filters SHIP and the gas-filled separator TASCA for the separation and detection of super-heavy elements.
• SHIPTRAP, a Penning trap behind SHIP for nuclear-structure and atomic-physics studies on (heavy) nuclei/atoms.
• Laser and decay spectroscopy setups and chemistry apparatus for nuclear, atomic physics and chemistry studies of (super-)heavy elements.
New opportunities for nuclear-structure and astrophysics studies in the next 4 years
• The development of a 28 GHz ECR ion source providing intense ion beams for, e.g., the heavy-element programme at the UNILAC will be completed;
• The low-energy storage ring CRYRING for highly charged heavy-ion beams in the energy range between 10 AkeV 4 AMeV will come in operation.

Equipment/Projects dedicated to other/multidisciplinary research:
• High-power-density beam bunches and various equipment for plasma-physics research
• The Kilojoule/Petawatt-Laser PHELIX, which started operation in 2008 and will be fully available allowing combined ion- and laser-beam experiments in plasma physics;
• Experimental stations and a cell-biology laboratory for research into the radio-biological effects of ion beams;
• Experimental stations and various instrumentations for applications of high- and low-energy heavy-ion beams in materials research and modification (e.g., a heavy-ion microprobe, a diamond anvil cell for irradiating samples under high pressure, diagnostic tools like raster tunnel and raster scanning microscopy, etc.).
• New opportunities for other/multidisciplinary studies in the next 4 years
• Storage ring for highly charged ions CRYRING as a facility for atomic-physics research;
• Access to the GSI detector and target laboratories with – amongst others - a lithography station for electrode structuring of diamond detectors, an ageing test stand of gaseous detectors and the clean rooms for detector mounting.

Services currently offered by the infrastructure:

In 2012 about 1,300 scientists from over 150 institutes in more than 30 countries made use of the accelerator facilities at GSI – about 260 scientists were coming from GSI, 540 from German universities and national research centres and 500 from foreign countries, of which half were originating from European institutions and/or universities. Prominent research highlights obtained by the scientific users comprise: a) Identification of the first candidates for Z fingerprinting of the Meitnerium-decay by means of characteristic K-X ray detection. There is clearly potential for direct determination of the atomic number of the descendants of super-heavy elements. b) For the first time a measurement of nuclear reactions with radioactive beams with high statistical accuracies in a storage ring environment have been performed by studying the elastic scattering of radioactive 56Ni off protons. c) The anti-analogue of the Giant Dipole Resonance (AGDR) was successfully used to study neutron skins of rare isotopes. d) Sixty new neutron-rich isotopes in the region $60 \leq Z \leq 78$ have been identified with the fragment separator. One of the main experimental achievements has been the installation of the AGATA detector at GSI and the experimental campaigns in 2012 and 2014 which was strongly supported by the past FP7 ENSAR activity.
The scientific results are published in peer-reviewed journals and in the GSI Annual Report (http://repository.gsi.de/collection/ScientificReports?ln=en). In 2013, about 380 reviewed articles resulted from research and development activities at GSI.
Under the past FP7 ENSAR activity, 24 user groups with 150 users visited the facility so far spending on the average 7.2 days at the facility. About 15 articles were published by the user groups; many more publications are expected when the analyses of all experiments are completed.

Description of work and role of partners

WP21 - TA6 – GSI [Months: 1-48]
GSI
Modality of access under this proposal:
Being a user facility, GSI is open to all national and international user groups.
To apply for access to the accelerator and experimental facilities, a written project proposal has to be submitted to the international General G-PAC comprising 12 members (all external), with more than half of them coming from non-national universities/institutes. For information on submitting proposals and procedure for evaluation and granting access see "Review procedures for Transnational Access to experimental infrastructures" in Section 3.2. For further information on the proposal procedure and the respective committees see https://www.gsi.de/de/work/user/beam_time/applying_for_beamtime.htm.
Access is being offered in hours of beam time. The costs calculations have been done on the basis of historical data for unit costs in 2011 and 2012, since there was no beam time in 2013 caused by preparatory work for FAIR. As usual approximately 2% of the actual operating costs are charged as unit costs. Operation costs for the CRYRING are not available at the moment.
It was estimated that 15 user groups with a total of 120 users will participate in the experimental campaigns at GSI in the framework of ENSAR2.

Support offered under this proposal:
For any research group all experimental facilities including electronics, computing, etc. are provided free of charge. Moreover, a GSI contact person is assigned to each experimental project that gives and/or organises the scientific, technical and logistical support to set-up and perform the experiment.
Beyond free access to the experimental facilities the services and support provided by GSI include:
• office space and access to the GSI computing facilities;
• training courses and briefings on the general safety regulations at GSI and on the specific regulations at the experimental facilities;
• access to the GSI detector and target laboratories, as well as access to a maintained workshop for experimentalists and assistance from the GSI general mechanical shops;
• a Guest Office providing logistic support with regard to accommodation, travel and payments;
• on-site guest house with 28 bed/office rooms, partly equipped with terminals for connection to the GSI computing facilities and to international data networks;
• guest house with 9 fully-furnished apartments for long-term visitors.
Specific services offered under this Transnational Access Programme are a web-based submission of applications for experiment proposals, financial support under the EC access programme and, after allocation of experiment time and access funding, web-based application for scheduling, for registration as access user, etc.

Outreach to new users:

The information about the EC funding possibilities for access to GSI is made available to the research community via a dedicated GSI webpage (see for example the present ENSAR access activity http://www.gsi.de/user/funding/ensar.htm), but also via targeted actions, e.g., on the occasion of workshops at and outside GSI. Following the practice under the past contracts, there will be one call for proposals every year. These calls will be announced in the GSI Kurier, through a mailing list of GSI users and via the GSI webpage. The required application forms can be downloaded from the ENSAR2 web page.
In the past ENSAR programme, 24 users projects with more than 150 users have been supported under the ENSAR Transnational Access programme, many of which could not have afforded the travel and subsistence costs.

Review procedure under this proposal:
User groups applying for funding under the EC Access Activity submit a separate application to the TA managing director, if possible in parallel with their experiment proposal. See also “Review procedures for Transnational Access to experimental infrastructures” in Section 3.2.

Participation per Partner

Partner number and short name	WP21 effort
6 - GSI	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP22	Lead beneficiary [10]	7 - RUG
Work package title	TA7 – KVI-CART		
Start month	1	End month	48

Objectives

Name of the infrastructure : KVI-CART (formerly known as KVI), AGOR facility
Location (town, country) of the infrastructure: Groningen, the Netherlands
Web site address: http://www.rug.nl/kvi-cart
Annual operating costs : 5,722,500 € of which for the AGOR infrastructure and associated instrumentation: 1,467,000 €
Description of the infrastructure:
Accelerator facility
The laboratory KVI-CART is funded by Groningen University as a Centre for Advanced Radiation Technology since 2014. The central facility of the KVI-CART is AGOR, a superconducting K=600 MeV cyclotron equipped with three external ion sources:
- a cusp source for the production of intense beams of protons, deuterons and alpha particles,
- two ECR ion sources for the production of light and heavy ions: an AECR type source for high charge states and a Supernanogan for beams from gasses.

AGOR is capable of accelerating protons and deuterons up to 190 and 180 MeV, respectively. Alpha particles and all other ions with a q/A=1/2, where q is the charge of the ion with mass A, can be accelerated up to 90 MeV/u. Heavier nuclei can be accelerated to an energy of 600(q/A)2 MeV/u. Minimum energy of the primary beam is approximately 6 MeV/u. The recently developed setup for irradiations in air with heavy-ion beams up to xenon with primary energy of 30 MeV/u is unique in Europe.
Associated research instrumentation
Two multipurpose beam-lines with associated equipment are available at the AGOR facility:
• Experimental setup in air. This flexible set-up is used for many different types of experiments such as radiobiology experiments with high-energy protons, -particles and 12C, radiation hardness tests with simulated solar spectrum, as well as detector tests with very low intensity beams. Recently the set-up has been expanded with equipment to facilitate heavy-ion experiments. Due to the modular nature of the set-up, many different types of experiments can be accommodated, including end-stages in vacuum provided by the user. The first irradiations with a cocktail of heavy ions, ranging from neon to xenon, with an energy of 30 MeV/u, were conducted successfully in April 2014. Based on the experiences with these irradiations and user feedback the facility will be further improved and expanded.
• An experimental setup in vacuum for heavy ions (Ne – Pb) with energies in the range 10 – 40 MeV/u is currently under construction and is expected to be operational by the end of 2014. The main component of this set-up is the former BIBER irradiation chamber from HMI, Berlin. The large vacuum chamber contains a 4D, translation and rotation, movable platform as well as many different types of vacuum throughputs.
In addition a large magnetic fragment separator is available, which is operated by staff from the physics department.
• The TRIP-facility (Trapped Radioactive Ions: μicro-laboratory for fundamental Physics) consists of a production target and a dual-mode magnetic separator. Radioactive atoms or ions can be produced through reactions of the primary stable ions that have been accelerated with AGOR. User-provided end stages can be placed after the separator to study the radioactive species of interest. When planning to use this separator, users should contact the fundamental-interactions group of the University of Groningen physics department.
Further, ancillary equipment like two large Germanium Clover detectors is available. Local scientists and engineers can provide information to visitors about equipment available to meet their needs.
Services currently offered by the infrastructure:
The two irradiation setups described above are offered to external users. Our staff will help with the design of experimental equipment to be used at this multipurpose beam-line. They also have a broad experience in solving wide-ranging technical problems which will help in running the experiments smoothly and efficiently.
For experiments with the magnetic fragment separator, support for the design of experimental setups will have to be arranged with the fundamental-interactions group of the University of Groningen physics department. KVI-CART will provide technical support to install user end stations.
In addition to this technical support the external users will be offered the following services:
• Well-equipped and very modern mechanical and electronics workshops which can handle and help solving any problems that can arise during the set-up or running of the experiments.
• Internet access and computer expertise, e.g., for solving communication issues between experimental equipment.
• Access to KVI-CART and university libraries and free access to journals via internet.

The equipment described combined with the beams offered by the superconducting cyclotron AGOR form an infrastructure that can be used by a large variety of users. This multiformity is illustrated by the many different areas for which the users of past European support have used their beam time:

• Tests of optical glues for the PANDA electromagnetic calorimeter, Nucl. Instrum. And Meth. In Phys. Res. A722(2013)82 (http://www.sciencedirect.com/science/article/pii/S0168900213004786)
• Vector analyzing powers of the deuteron-proton elastic scattering and breakup at 100 MeV, Eur. Phys. J. A 49 (2013) 36 (http://link.springer.com/article/10.1140/epja/i2013-13036-5)
• Precise determination of the unperturbed 8B neutrino spectrum, Phys. Rev. Lett. 108 (2012) 162502 (http://dx.doi.org/10.1103/PhysRevLett.108.162502)
• Volume dependent expression of in and out-of-field effects in the proton irradiated rat lung, Int. Journal of Radiation Oncology, Biology, Physics 81(2011) 8620 (http://www.redjournal.org/article/S0360-3016%2811%2900479-2/abstract)
• Solar proton event damage in space-borne Ge detectors, Nucl. Instr. Meth. A610(2009)354 (http://www.sciencedirect.com/science/article/pii/S0168900209011206)

Highlights of the ENSAR-supported experiments
In the domain of nuclear astrophysics, experiment P20, β-delayed α-decay study of 16N using the implantation method, managed to lower the statistical uncertainty in the branching ratio for α-decay significantly, down to 2%. This will improve the understanding of oxygen production in stars as well as stellar evolution in general. Experiment S58, Study of electric dipole strength below the particle threshold in (p,p'γ) experiments, has allowed a detailed study of the structure of Pygmy Dipole Resonance states in 140Ce, relevant for the understanding of nuclear structure as well as for nucleosynthesis in explosive stellar-burning phases. A precise determination of cross sections for d-p and d-d systems was obtained in experiment F18 "Dynamics of three- and four-nucleon systems studied in the elastic scattering and breakup reactions". Crucial information needed for the development of the PANDA experiment at FAIR was obtained through radiation hardness tests performed in experiment T29, "Radiation hardness of Avalanche Photodiodes", radiation damage and defect studies in PWO crystals, and hadron response of inorganic scintillating fibres. In the field of proton beam radiation therapy, experiment T30, "Experiments for real time in-vivo dosimetry for ion therapy", investigated the production of prompt gamma rays on the main elements constituting human tissue and the imaging of these gamma rays using a Compton camera. It also led to the proposition of a novel particle-range assessment technique based on prompt gamma-ray timing measurements.
The widespread interest from users from other countries is demonstrated by the fact that the beam time promised for TA in four years under FP7 was delivered in the first three years of the contract. Some further requests of high scientific quality could be accommodated via other financing mechanisms. An on-going call for proposals will provide additional beam time, above the initial 800 hours, to some of these experiments.
In 2012, we had 48 international users, 12 national users (outside of KVI) and 15 local users. Of the international users, about 12 were involved in more than one experiment.
In 2013, we had 33 international users, 10 national users and 12 local users. Of the international users, about 8 were involved in more than one experiment.

Description of work and role of partners

WP22 - TA7 – KVI-CART [Months: 1-48]
RUG
Modality of access under this proposal
Users are completely free and independent in formulating their scientific objectives. See also "Review procedures for Transnational Access to experimental infrastructures" in Section 3.2.
A liaison physicist from the KVI-CART scientific staff, who is well acquainted with the facility and the technical specifications, will be assigned to external groups to help with preparing proposals, getting equipment ready and arranging for technical help when needed.
Support offered under this proposal
As a rule, users from outside the KVI-CART will get the necessary help, scientific and technical, in using the equipment of the facility. For each user group, a contact person is assigned. In many cases the experiments are performed in collaboration with KVI-CART staff members who will then also act as contact between the outside users and the KVI-CART technical staff.
User groups will get access to various resources of the facility, such as experimental equipment, computing facilities, technical assistance, office space, etc. (see also above).

KVI and its visitors can make good use of the extensive facilities of the University of Groningen and the high-tech know-how present in the Zernike Science park at a walking distance from the laboratory.
Accommodation facilities for visiting scientists are available at a short driving distance. The KVI-CART offers ample free parking spaces next to the lab.
Outreach to new users
Calls for proposals will be published at the KVI-CART website and, collectively with the other ENSAR2/TA-institutes, in the NuPECC journal Nuclear Physics News. New users are also made aware of the facility and its capabilities through presence at specialised conferences and workshops. Scientists that have previously used the facility will be alerted by e-mail.
KVI has been an institute with an international orientation since its early days. The number of international scientists using the facility has increased over the years, but made a large jump in the mid-nineties of the previous century, after the installation of the superconducting cyclotron AGOR. The support of KVI from the European Commission as TA-institute under FP4, FP5, FP6 and FP7 together with the number of EC-supported networks and JRA projects have increased the number of international users.
KVI-CART will maintain this international orientation.

Review procedure under this proposal
For information on submitting proposals and procedure for evaluation and granting access see “Review procedures for Transnational Access to experimental infrastructures” in Section 3.2.The KVI PAC members can be found at: http://www.rug.nl/kvi-cart/research/facilities/agor/pac

Participation per Partner

Partner number and short name	WP22 effort
7 - RUG	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP23	**Lead beneficiary** [10]	8 - IFJ PAN
Work package title	TA8 - NLC (SLCJ Warsaw, IFJ PAN Krakow)		
Start month	1	**End month**	48

Objectives

Name of the infrastructure: Narodowe Laboratorium Cyklotronowe (National Cyclotron Laboratory – a consortium of Institute of Nuclear Physics Polish Academy of Sciences in Kraków and Heavy Ion Laboratory in Warsaw)
Location of the infrastructure: Kraków and Warsaw, Poland
Web site address: http://www.nlc.edu.pl
Annual operating costs: SLCJ Warsaw: 1,250,000 M€, CCB - IFJ PAN Kraków 2,500,000 €
Description of the infrastructure:
The National Cyclotron Laboratory (NLC) is a unique cyclotron facility in Poland operating a double site infrastructure: at the Heavy-Ion Laboratory (SLCJ) of the University of Warsaw and at the Cyclotron Centre Bronowice (CCB), the proton-therapy and basic research facility of the Institute of Nuclear Physics Polish Academy of Sciences (IFJ PAN) in Kraków. NLC is a consortium formed to conduct basic research and applications on 4 cyclotrons: two at SLCJ (the K=160 MeV isochronous heavy-ion cyclotron and the high-intensity proton-deuteron PET K=16.5 MeV cyclotron), and two at CCB (the K=60 MeV light-ion cyclotron AIC-144 and the new Proteus-235 proton cyclotron). The nuclear-physics research programme is complementary to the programmes of large-scale European RIBs. The investigations carried out in Warsaw and Kraków are also in many aspects complementary - at IFJ PAN a high-energy proton beam is available while at SLCJ beams of heavier nuclei from boron to argon can be accelerated.
Main accelerator facilities to be offered for ENSAR2 transnational access by NLC are:
1) Isochronous heavy-ion cyclotron (K=160) at SLCJ Warsaw, equipped with two ECR sources, accelerating beams from He up to Ar (soon up to Xe) up to energy of 10 MeV/u.
2) The IBA Proteus C-235 proton cyclotron at IFJ PAN in Krakow, where the energy of the proton beam can be varied continuously over the energy range 70-230 MeV.

The two laboratories IFJ PAN and SLCJ UW have several detection systems installed at dedicated beam lines. The instrumentation is primarily associated with a specified cyclotron, but part of it can be moved and temporarily installed at another site of the NLC for specific experimental campaign.

The main instrumentation at SLCJ Warsaw consists of:
• the HPGe gamma-ray array EAGLE designed as a multi-configuration detector setup equipped with 20 ACS HPGe detectors and, depending on type of measurements performed, coupled to ancillary detectors;
• the multidetector system JANOSIK, consisting of large NaI detector (a 25 cm x 29 cm NaI(Tl) crystal surrounded by an active plastic shield) and NaI multiplicity filter (32 small scintillator detectors) designed for giant dipole resonance (GDR) studies;
• the charged-particle array ICARE, consisting of the 1-m diameter reaction chamber with up to 48 E-ΔE gas and semiconductor telescopes. ICARE is used for the study of properties of isotopes far from stability line produced in heavy-ion reactions;
• the on-line mass separator IGISOL equipped with the ion source of the Ion-Guide type. The detection setup consists of a tape station, an advanced time-delay system (beta, gamma-gamma, Ge, Si(Li), BaF2 detectors) and a mini-orange spectrometer. The system is designed to study short-lived isotopes produced in heavy-ion reactions;
• the universal scattering chamber CUDAC equipped with 32 PIN-diodes (1x1 cm2)
• the experimental setup for irradiation of biological samples and nano-dosimetry studies;
The list of publications with the data obtained at SLCJ using listed above instrumentation is available in the Annual Reports (www.slcj.uw.edu.pl/en/39.html).
The main instrumentation at IFJ PAN Krakow consists of:
• Big Instrument for Nuclear Data Analysis (BINA) detection setup, which includes a liquid-target assembly, multi-wire chamber and scintillation hodoscope. BINA will be used for in-beam experimental investigations of the dynamics of few-nucleon systems: systematic studies of three-nucleon force (3NF), Coulomb and relativistic effects, as well as their mutual interplay in the proton-deuteron system;
• High-energy gamma-ray detection system consisting of an array of eight large-volume BaF2 detectors (HECTOR array), which can be complemented with a few clusters of the PARIS array. It will be used for studies of the structure of high-lying resonance states by inelastic scattering or fusion-evaporation reactions induced by protons;
• KRATTA (Kraków Triple Telescope Array): 35 multi-module telescopes for charged-particle detection;

• a detector testing bench, offering possibility of testing the response functions in the wide proton energy range (70-230 MeV) of various detectors, which are the components of large detection systems being installed in other TA facilities and European infrastructures under construction like FAIR, SPIRAL2, SPES or HIE-ISOLDE.
Scientific highlights:
• Barrier heights distributions were studied for many scattering systems. The results demonstrated the influence of transfer reactions and non-collective excitations on the shapes of the distributions (E. Piasecki et al., Phys. Rev. C85, 054604 and C85, 054608).
• Spontaneous chiral symmetry breaking was observed in 126,128Cs nuclei as a presence of specific gamma selection rules, following from the picosecond life-time measurements (E. Grodner et al., Phys. Rev. Lett. 97, 172501, E. Grodner et al., Phys. Lett. B703, 46).
• Research on Targeted Alpha Therapy is performed using 211At radioisotope produced with the internal α-beam of K=160 heavy-ion cyclotron (M. Łyczko et al., Nucl. Med. Rev. 15B, 1, and E. Leszczuk et al., submitted to Journal of Nanoparticles Research).

Services currently offered by the infrastructure: All experimental areas at IFJ PAN Krakow and SLCJ Warsaw are open to external users and have technical and scientific coordinators, who are the liaison with these outside users. At present, the total number of users of both facilities is of about 110/year. The coordinators provide assistance in their respective domains of competence, to the groups for the setting up of the experiment and eventually to insert the ancillary detectors brought by these groups into the existing equipment.
SLCJ has at its disposal: mechanical and electronics workshops, target laboratory, detector laboratory, library, two conference rooms, hostel for experimental teams (9 rooms), 15 scientists and 38 technicians ready to help an external user. IFJ PAN Krakow offers guesthouse rooms, library and a conference room. IFJ PAN has at its disposal mechanical and electronics workshops. In addition 7 scientists and 6 technicians can help the external users.
Both centres, SLCJ and IFJ PAN, have international programme advisory committees; for names of PAC members see http://www.slcj.uw.edu.pl and http://experimentsccb.ifj.edu.pl/?static=5, respectively. See also “Review procedures for Transnational Access to experimental infrastructures” in Section 3.2.
SLCJ Warsaw provides for TA access in the areas of nuclear physics, biology, nano-dosimetry and medical applications, including isotope production.
Since Cyclotron Center Bronowice at IFJ PAN Krakow is also a medical facility, the nuclear-physics experiments will have to be conducted during the time free of patients’ treatment. This will be mainly at nights and during the weekends. Altogether NCL provides for TA 1360 hours of beam time within 4 years duration of the ENSAR2 project.

Description of work and role of partners

WP23 - TA8 - NLC (SLCJ Warsaw, IFJ PAN Krakow) [Months: 1-48]
IFJ PAN, UNIWARSAW
Modality of access under this proposal:
Call for proposals of experiments is announced twice a year in SLCJ and once a year at IFJ PAN on the web pages and distributed via mailing lists. For information on submitting proposals and procedure for evaluation and granting access see “Review procedures for Transnational Access to experimental infrastructures” in Section 3.2.

Support offered under this proposal:
Technical assistance of all kinds is provided by the SLCJ and IFJ PAN technical staff. Mechanical and electronic workshops are available for the users. Both might help in manufacturing and setting up equipment for use in experiments. A target laboratory can produce targets and a detector laboratory will help with handling/repairing detectors. The beam is tuned to the user's target, after discussion with beam engineers to define the experimentalist's goals.
Apart from the scientific and technical support, both the IFJ PAN and SLCJ users can also benefit from the local logistic infrastructure: guest house, cafeteria, library, general store for materials, components, and supplies.
Outreach to new users:
Information about NLC facilities (technical and scientific information, calls for proposals, European support) is available online: http://www.ifj.edu.pl and http://www.slcj.uw.edu.pl/en/.
All workshops and conferences organised by IFJ PAN and HIL Warsaw are also widely advertised by email distribution, and information posted on the website.

Review procedure under this proposal:
For information on submitting proposals and procedure for evaluation and granting access see “Review procedures for Transnational Access to experimental infrastructures” in Section 3.2. Once an experiment has been recommended by the appropriate committee, IAC at IFJ PAN and PAC at SLCJ, and approved for scheduling by the director of the respective facility, the user liaison contacts the project spokesperson to define a possible schedule. Final planning is established

around 3 months before the experiment. The users have to follow a specific procedure for any experiment, after it has been included in the beam schedule:
• The spokespersons receive several documents which will be used as a basis to define more precisely the conditions of the experiment: beam optics, detection systems, targets, etc.
• Each member of the working team must provide a medical certificate stating that he/she is allowed to work with ionising radiations;
• Each participant of the experiment needs a personal dosimeter in order to have access to the experimental areas;
• The output of the experiments is the data while the deliverables are the published articles and talks/seminars in workshops/meetings/international conferences.

Participation per Partner

Partner number and short name	WP23 effort
8 - IFJ PAN	0.10
9 - UNIWARSAW	0.10
Total	0.20

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP24	Lead beneficiary [10]	10 - IFIN-HH
Work package title	TA9 - IFIN-HH / ELI-NP		
Start month	1	**End month**	48

Objectives

Provision of access to the following infrastructure(s):
ELI-NP high-power lasers and gamma beam and Tandem Accelerator Complex of IFIN-HH
Description of the infrastructure
Name of the infrastructure: ELI-NP and Tandem Accelerator Complex @IFIN-HH
Location (town, country) of the infrastructure: Bucharest-Magurele, Romania
Web site address: www.ifin.ro , www.eli-np.ro
Annual operating costs : TANDEM complex: 1,600,000 € (without manpower), 2,000,000 € (including manpower); ELI-NP: expected ~30,000,000 €
Description of the infrastructure:
Extreme Light Infrastructure Nuclear Physics (ELI-NP) facility is a European Research Infrastructure Centre primarily dedicated to nuclear science but also to ultra-high intensity lasers, laser-matter interactions, and material science, using laser-driven radiation sources. The ESFRI committee selected this facility on the basis of its uniqueness and complementarity with other big nuclear physics infrastructures in Europe. This multidisciplinary facility will provide new opportunities to study fundamental processes that occur in ultra-intense laser fields during laser-matter interactions. It will also open new dimensions in nuclear research with intense beams. The facility will be available for users in 2017. Two research systems with parameters beyond the state-of-the-art will be exploited, namely a high-power laser system with two amplification arms to deliver every minute 10 PW and intensities on the target in the range of 1023 W/cm2 and a brilliant beam system to deliver 1013 photons/s with energies up to 20 MeV. More specifically for the low-energy nuclear physics an important tool is the brilliant -ray beam, produced in Compton backscattering of laser light of an accelerated electron beam. One of the most stringent parameters of the -beam, determining its high quality, is a very narrow bandwidth, which combined with its high brilliance, results in a high spectral density of ≥ 104 photons/s/eV, about two orders of magnitude higher as compared to existing beams. Several dedicated experimental setups are foreseen to be constructed inside the on-going European ELI-NP construction project and will be available for the user community. Presently, the definition of these setups is already at the Technical Design Report (TDR) level and is being done within large international collaborations that will turn into a large user community when the facility will start operating. There will be several representative items for low-energy nuclear physics among this experimental instrumentation, like:

• ELIADE - a high-resolution spectrometer; a spectrometer with large LaBr3 detectors; a tape station and a close-geometry spectrometer for high-resolution β-decay studies; a 4 neutron array; a 4 charged-particle array of segmented DSSSD detectors; a position-sensitive Bragg spectrometer; a time-projection chamber (TPC) for reaction studies, etc.

The IFIN-HH tandem accelerator complex consists of a 9-MV FN Pelletron and two smaller tandem accelerators:

1. The 9-MV FN Pelletron Tandem accelerator has been completely upgraded in the last five years. The accelerator can provide beams from hydrogen to gold from the two types of ion sources and can deliver currents up to the range of microamperes. The accelerator has two beam pulsing systems, one in the millisecond range and the other one in the nanosecond range. The accelerator comes with 7 beam-lines, each one with its dedicated experimental setup:
• The ROSPHERE multi-detection array, used mainly for nuclear structure experiments, consists of 25 high-purity germanium detectors with anti-Compton shields. The setup can accommodate up to 15 LaBr3:Ce fast scintillators for fast-timing measurements and the plunger reaction chamber also used for timing measurements;
• The tape station for beta-decay experiments, using three clover detectors with 120% relative detection efficiency and anti-Compton shields and fast lanthanum bromide scintillators;
• The setup dedicated to nuclear reaction and nuclear astrophysics studies consisting of multi-strip silicon detectors for particle detection with the possibility of radial and longitudinal movement around the target;
• Low-background measurements setup;
• A Rutherford backscattering (RBS) and elastic recoil-detection analysis (ERDA) set-up;
• A dedicated beam-line for accelerator mass spectrometry (AMS) measurements.
All these experimental setups make use of few digital and analogue acquisition systems in various standards (CAMAC, VME, etc.).

2. Two additional low-energy electrostatic accelerators complete the existing facility. A 3-MV HVEE Tandetron accelerator has two ion sources capable of delivering a wide range of negative-ion beams in the range of tens of microamperes and 1-MV HVEE Tandetron accelerator installed in 2012 in IFIN-HH is dedicated for AMS experiments. No supported access is offered for these facilities.

From the total number of experiments in one year at one tandem accelerator (around 60 experiments per year) about 50% of the experiment proposals are from international users.

Services currently offered by the infrastructure:
The entire research infrastructure described above, e.g. the ELI-NP facility and the Tandem accelerator complex, is open for external users around the world. The research activities are coordinated in collaboration with our research and development staff. The R&D personnel participate in the experiments, starting from the setting up of the experiments to data analysis and publication of the results. The average beam time per year for each accelerator is around 5000 hours of beam on target.

Description of work and role of partners

WP24 - TA9 - IFIN-HH / ELI-NP [Months: 1-48]
IFIN-HH
Modality of access under this proposal:
In 2009, an international PAC has been established for the access to the TANDEM research facilities. For information on submitting proposals and procedure for evaluation and granting access see "Review procedures for Transnational Access to experimental infrastructures" in Section 3.2. The spokesperson for each experimental proposal has to establish the required experimental conditions with the scientific and technical staff in IFIN-HH, few months before the experiment is scheduled. The results of the experiments are usually published and presented at international conferences.
An international Programme Advisory Committee following the same procedure will be established at ELI-NP. Additionally, a representative User Committee will be formed when ELI-NP facility will start regular operation.

Support offered under this proposal:
Local scientific and technical support is provided during the whole progress of the experiment. The external users have access to the entire research infrastructure available at the facilities (detectors, electronics, data-acquisition systems, computer infrastructure) only under the supervision of the responsible personnel in the laboratory. They also have access to the mechanical workshop, electronics and chemistry laboratories and will have full support from the specialised personnel in the laboratories/workshops. The technical assistance is available 24 hours a day and 7 days of week during the normal run of an experiment. Within this proposal selected external users will be supported for travel, accommodation and per diem.

Outreach to new users:
The call for proposals is widely announced to the user community using web pages and large e-mail lists few months before the PAC meeting. The activity at the TANDEM complex and ELI-NP facilities is presented at international conferences and other types of outreach events. All the events, such as conferences and workshops organised by IFIN-HH are widely announced. For ELI-NP, there are plans to organise regular biannual user meetings.

Review procedure under this proposal:
The TANDEM PAC has currently 8 members, 6 of them being external and coming from international facilities. ELI-NP PAC will have a similar structure in terms of representatives. The official PAC language is English. See further "Review procedures for Transnational Access to experimental infrastructures" in Section 3.2.

Participation per Partner

Partner number and short name	WP24 effort
10 - IFIN-HH	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

Work package number [9]	WP25	**Lead beneficiary** [10]	11 - FBK
Work package title	TA10 - ECT*		
Start month	1	**End month**	48

Objectives

Name of the infrastructure: European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*)
Legal name of organisation operating the infrastructure: Fondazione Bruno Kessler (FBK)-Trento, Italy Location (town, country) of the infrastructure: Villazzano (Trento), Italy
Web site address: http://www.ectstar.eu
Annual operating costs :1,200,000 €
Description of the infrastructure:
The European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*) in Trento (Italy) offers a unique combination of projects in high-level scientific exchange, dedicated research and advanced training to the international community working in modern Nuclear Physics. The goals of the Centre, as stipulated in its Statute, are: performing in-depth research on topical problems at the forefront of theoretical nuclear physics; fostering interdisciplinary exchange between nuclear physics and neighbouring fields such as particle physics, astrophysics, condensed-matter physics and the quantal physics of small systems; promoting talented young physicists through training projects and networks of active young researchers; strengthening interactions between theoretical and experimental research.
ECT* is unique and the only centre of its kind in Europe. It operates in the context of European Universities and Laboratories. It has been recognised within previous EC Programmes as a “Major Research Infrastructure”. ECT* received EC funding within the FP7 projects HadronPhysics2 (2009-2011), ENSAR - JRA07-THEXO (2010-2014) and as TA facility through HadronPhysics3 (2012-2014). The Centre is operated and sponsored by the Fondazione Bruno Kessler (FBK) in Trento from which it receives about half of its annual budget. Major funding agencies in France, Germany and Italy plus other institutions, from altogether 11 European countries, provide the other half.
The Centre is based in Villazzano (Trento, Italy) in a property called Villa Tambosi. The total user space available is about 2500 m2. This includes office space, a lecture hall (80/90 seats) equipped with high-tech multimedia facilities, a conference room (45 seats), three seminar and meeting spaces (15-20 seats each), six computer rooms (about 60 seats), a library and a canteen. The computing facilities of the Centre include arrays of workstations and PCs, and access to High Performance Computing (HPC) through the Interdisciplinary Laboratory for Scientific Computing (LISC) of FBK. It is planned that the LISC research group will become part of ECT* starting from 2015.
The scientific activities of ECT* are carried out under the responsibility of the international Scientific Board and with the supervision of the Director. The acting director is Prof. Wolfram Weise (TU Munich, Germany). The ECT* research group includes at present the Director, seven Postdoctoral Researchers (3 Senior Research Associates, 4 Junior Postdocs) holding positions at the Centre, and several short- and long-term visiting scientists. These researchers are also partly involved in providing expertise to the projects related to the TA. Starting from 2015 the ECT* group is foreseen to be expanded by the addition of five LISC researchers and one postdoctoral position provided by INFN within the framework of TIFPA (the Trento Institute of Fundamental Physics and Applications).
Services currently offered by the infrastructure:
Unique research capabilities and European added value. The importance of ECT* for European research derives from its mission: to create the necessary conditions for excellence and state-of-the-art research by foreign collaborations and bringing together specialists from all over Europe; to offer to European research teams a natural forum of competition and exchange with teams elsewhere in Europe and in the world; to promote coordination of European research efforts preventing isolation of smaller research groups, particularly in the peripheral and less-favoured regions of the Community, strengthening the mobility of European researchers and putting them in a strong worldwide competitive environment.
Specific benefits for users result from the unique opportunities provided by the ECT* International Projects series (workshops, collaboration meetings, training programmes) to transfer and update information on theoretical and experimental research at the frontiers of the field; its excellent computing facilities links to European computing networks; international collaborations of the ECT* research group in Nuclear Physics and related areas; cooperation agreements conducted by ECT* with major research centres abroad, such as RIKEN and the National Astronomical Observatory of Japan, and the Technical University of Munich in Germany; active contacts between ECT* and the Faculty of Science at the University of Trento in nuclear physics and related fields of research (many-body theory, Bose-Einstein condensation, etc.), and the perspectives offered by ECT*’s association with TIFPA, the new Trento Institute for Fundamental Physics and Applications supported by INFN.

Scientific highlights. On average, about 800 users per year participate in the scientific projects of the Centre. Visits to ECT* inspire work leading to a multitude of publications in peer-reviewed high-impact journals. Altogether 39 user-projects (workshops) were successfully conducted in the period 2012-2013 (see the ECT* Annual Reports at www.ectstar.eu). These include the previous TA of HadronPhysics3 and the THEXO activity within ENSAR. About 20 projects are scheduled for 2014 and we foresee similar developments from 2015 onward, with possible further expansions.
The projects submitted to ECT* and approved by its selection panel cover a broad scientific spectrum of nuclear physics at large. About 1/3 of the projects in 2012-2013 had a strong content of nuclear physics topics related to the foreseen ENSAR2 scientific programme. In 2014, the share of projects focused on ENSAR2-related themes has increased to about 40%.
Community interest in the infrastructure. Since its opening in 1993, ECT* has hosted about 14.000 visitors from over 50 different countries. In 2013, the pattern of visitor-days was as follows: of the 860 visitors about 62% came from EC member states, with 44% from France, Germany and Italy, 20% from the USA, 6% from Japan and 12% from the rest of the world.
ECT* is playing a continuously important role in providing a forum for planning and shaping nuclear physics research in Europe. The NuPECC Long Range Plan of 2010 on Perspectives for Nuclear Physics Research in Europe emphasises, in particular, the strong necessity for increased support for ECT* which has been acknowledged by the EC as the theoretical research infrastructure in Europe. The accomplishments of the Centre have been widely recognised within the European Nuclear Physics community. Financial support comes from several national funding agencies and research institutions, presently from France, Germany, Italy - the three biggest supporters – and from Belgium, Czech Republic, Finland, Hungary, The Netherlands, Poland, Romania, and the UK. An updated MoU has been signed in September 2013, coordinating financial contributions from 2014 onward. The Centre promotes a strategy to increase transnational access for "smaller" EC member communities and associated countries.
The worldwide interest in ECT* programmes is further underlined by recently signed cooperation agreements with Japan and preparations for similar agreements with centres in China and Korea. The international visibility of ECT* also shows up prominently in documents such as the recent Nuclear Physics Assessment and Outlook Report of the US National Research Council.

Description of work and role of partners

WP25 - TA10 - ECT* [Months: 1-48]
FBK
Modality of access under this proposal:
The scientific infrastructure of the Centre provides services for its users throughout most of the year. Once accepted through a peer reviewing procedure, the user is given access to ongoing ECT* projects and to the Centre's computational facilities, library, seminar and discussion rooms. The typical number of participants in each one of the projects is about 40, a size that encourages a strong interaction among the users. The typical duration of a project is a week. In addition, dedicated scientific programmes extending over longer periods are occasionally organised for broad physics user communities. All users of the infrastructure are external. They are all treated equally and enjoy without restrictions all of the Centre's facilities.
Support offered under this proposal:
The scientific and logistic support routinely provided to external users and offered under this proposal comprises office space, computing facilities and assistance by the ECT* staff. Each user of ECT* has a working place. About 150 users can be accommodated at one time for activities of the Centre. ECT* users are connected through a dedicated fast workshop network and through Wi-Fi with LAN speed of several Gigabits per sec. Further computing facilities open to users: 43 DELL Workstations; virtual machines for users and system management hosted by FBK in a data centre; HPC facilities of LISC at FBK. Users also enjoy scientific support from resident researchers with whom they can interact and develop collaborations.
Outreach to new users:
As in previous activities under FP7, TA at ECT* under the Horizon 2020 framework will be publicised to research teams throughout Europe through the ECT* web page (www.ectstar.eu). Additional information and calls for proposals are sent directly to the large body of ECT* Associates (ca. 300 scientists worldwide) for further distribution, including members from less favoured countries. The extensive list of ECT* Associates is steadily increasing. Given the history and statistics of TA and other activities at ECT* over the past few years, as well as the foreseen expansion of nuclear physics research facilities in Europe and elsewhere, a further increase of TA users can be expected and will be monitored continuously by ECT* staff.
Review procedure under this proposal:

The selection of projects (Workshops and Collaboration Meetings) and users are decided by the ECT* Scientific Board. This internationally composed User Selection Panel has an excellent record of working efficiently and in accordance with top quality requirements. It is planned to pursue this scheme for the TA within ENSAR2. The composition of the Board is listed on the ECT* webpage (http://www.ectstar.eu).
As pointed out on the ECT* web page the actual selection process is as follows. The Scientific Board acting as User Selection Panel has three meetings per year during which it carries out project selection and nomination of project group leaders. Selection criteria are: scientific quality; timely features and forefront subjects; topicality; balance between theoretical and experimental research; link to major experimental programmes; interdisciplinary context; professional status and organisational skills of project leader; balance between nationalities and senior/junior participants. Selected projects, once approved by the Panel, are announced on the web.

Participation per Partner

Partner number and short name	WP25 effort
11 - FBK	0.10
Total	0.10

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]

Description of deliverables

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

1.3.4. WT4 List of milestones

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
MS1	Start of impact studies	WP1	1 - GANIL	18	Report
MS2	Constitution of steering committee	WP2	17 - JLU	3	Report
MS3	Workshop on nuclear structure	WP2	17 - JLU	6	Report
MS4	Workshop on nuclear reactions	WP2	17 - JLU	24	Report
MS5	Workshop on nuclear astrophysics	WP2	17 - JLU	24	Report
MS6	Workshop on superheavy elements	WP2	17 - JLU	33	Report
MS7	Workshop on cross-combining elements: nuclear theory, instrumentation, computing	WP2	17 - JLU	42	Report
MS8	Steering committee established	WP3	4 - JYU	3	Report
MS9	Website established for database	WP3	4 - JYU	9	Report
MS10	Program for hands-on training	WP3	4 - JYU	6	Report
MS11	Setup of the website, Scientific Committee and Working groups	WP4	2 - INFN	12	Report
MS12	Scientific and Working groups meetings	WP4	2 - INFN	20	Report
MS13	Collaboration Workshops	WP4	2 - INFN	32	Report
MS14	Training Courses and exchange of personnel	WP4	2 - INFN	44	Report
MS15	Kickoff-Meeting	WP5	12 - EBG MedAustron	3	Report
MS16	Website	WP5	12 - EBG MedAustron	4	Report
MS17	Mid-term meeting	WP5	12 - EBG MedAustron	27	Report
MS18	Final meeting	WP5	12 - EBG MedAustron	48	Report
MS19	GDS coordination committee	WP6	1 - GANIL	3	Report
MS20	Creation of the GDS community	WP6	1 - GANIL	6	Report
MS21	News Feed	WP6	1 - GANIL	6	Report

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
MS22	ENSAF webpages	WP7	21 - NCSRD	3	Report
MS23	2nd ENSAF Workshop held	WP7	21 - NCSRD	30	Report
MS24	International Workshop on Accelerator Operation and Management	WP7	21 - NCSRD	15	Report
MS25	Meetings on Training at Small-Scale Accelerator	WP7	21 - NCSRD	12	Report
MS26	Decision for technology transfer network	WP8	1 - GANIL	24	Report
MS27	End of the collection of impact data	WP8	1 - GANIL	40	Report
MS28	Website and workshop	WP8	1 - GANIL	18	Report
MS29	Summary of courses	WP8	1 - GANIL	24	Report
MS30	Crystal characterisation	WP9	25 - CSIC	12	Report
MS31	Scintillator readout Test-bench	WP9	25 - CSIC	18	Report
MS32	Hybrid readout	WP9	25 - CSIC	24	Report
MS33	Data processing	WP9	25 - CSIC	24	Report
MS34	Imaging using segmented detector	WP9	25 - CSIC	36	Report
MS35	Kick-off R&D	WP10	25 - CSIC	6	Report
MS36	Detector R&D Application / associated technologies Workshop	WP10	25 - CSIC	12	Report
MS37	Detector R&D Application / associated technologies Workshop - 2	WP10	25 - CSIC	24	Report
MS38	Completed R&D Detector R&D Application / associated technologies Workshop	WP10	25 - CSIC	48	Report
MS39	Definition of an appropriate power counting	WP11	5 - CNRS	24	Report
MS40	Inclusion of quantum fluctuations	WP11	5 - CNRS	48	Report

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
MS41	Definition of appropriate reaction observables	WP11	5 - CNRS	24	Report
MS42	Understanding the dynamical effects	WP11	5 - CNRS	48	Report
MS43	Reduction of hot cavity and gas jet radioisotope deposition	WP12	4 - JYU	48	Clean RIBS produced with LIST (hot cavity and gas jet coupling) - report
MS44	Supersonic, high Mach number gas jet produced	WP12	4 - JYU	48	Laser probing of jet velocity - report
MS45	Ionization scheme development	WP12	4 - JYU	24	Report at Annual Meeting
MS46	Pulsed dye amplifier seeded by CW diode laser and injection-locked Ti:sapphire laser used in both off-line and on-line gas jet spectroscopy	WP12	4 - JYU	36	Off-line experiment using the new laser - report
MS47	New nuclear data libraries for GEANT4	WP13	7 - RUG	24	Report
MS48	Heavy-ion penetration in GEANT4	WP13	7 - RUG	24	Report
MS49	Algorithms for specific analysis and tracking	WP13	7 - RUG	24	Report
MS50	Inventory finished	WP13	7 - RUG	36	Report
MS51	Experiments for the optimal breeder configuration	WP14	5 - CNRS	24	Report
MS52	Nuclear data of produced beams	WP14	5 - CNRS	36	Report
MS53	Construction of polishing device	WP15	5 - CNRS	12	Report
MS54	Prototype of a PVT + PPO plastic scintillator	WP15	5 - CNRS	24	Report
MS55	Detector design and construction	WP15	5 - CNRS	36	Report
MS56	Asic prototype	WP15	5 - CNRS	30	Report
MS57	EURISOL Town Meeting	WP2	17 - JLU	30	Report
MS58	New high temperature transfer line material	WP12	4 - JYU	36	On-line and off-line demonstration of surface ion reduction - report

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
	utilized for surface ion suppression				
MS59	Automated wide-range wavelength tunability for scheme development	WP12	4 - JYU	24	Demonstration on a new element - report
MS60	Test of the prototype with radioactive source and in beam in coincidence measurements	WP15	5 - CNRS	33	Report
MS61	Simulated and real signal database for Pulse shape analysis	WP15	5 - CNRS	24	Report
MS62	Approval of chamber design by CERN health physics	WP15	5 - CNRS	24	Report
MS63	Delivery of a 1 kW irradiation station	WP15	5 - CNRS	42	Report

1.3.5. WT5 Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
1	Financial	WP1, WP10, WP11, WP12, WP13, WP14, WP15, WP16, WP17, WP18, WP19, WP2, WP20, WP21, WP22, WP23, WP24, WP25, WP3, WP4, WP5, WP6, WP7, WP8, WP9	Planning and regular monitoring of spending by coordinator and steering committee
2	Financial: Limited financial resource for prototyping the radioactive plasma ion source at ALTO	WP14	Adjusting the budget distribution.
3	Financial: difficulties to reach the goal of ECOS-Network activities	WP15	Using contributions from the Stable ion beam facilities in Europe
4	Human	WP1, WP10, WP11, WP12, WP13, WP14, WP15, WP16, WP17, WP18, WP19, WP2, WP20, WP21, WP22, WP23, WP24, WP25, WP3, WP4, WP5, WP6, WP7, WP8, WP9	Identify a deputy to the work package leader
5	Human: lack of personnel per task	WP1, WP10, WP11, WP12, WP13, WP14, WP15, WP16, WP17, WP18, WP19, WP2, WP20, WP21, WP22, WP23, WP24, WP25, WP3, WP4, WP5, WP6, WP7, WP8, WP9	EU funding for personnel is supported where possible with realistic own contributions. Overall manpower situation is closely monitored within the WP and by each task leader.
6	Human: inability to find proper candidates for Post-doc positions	WP10, WP11, WP12, WP13, WP14, WP15, WP9	The call for position will be communicated as widely as possible, on an international scale
7	Human lack of specific skills	WP10, WP11, WP12, WP13, WP14, WP15, WP9	Mitigation through network of engineers in the domain.
8	Human: learning curve for using the superconducting Linac	WP18	Longer commission time is foreseen
9	Human risk at GSI infrastructure	WP21	Intensive project planning to ensure availability of accelerator operating personnel, hiring of additional personnel
10	Human risk at ECT* infrastructure	WP25	Regular monitoring of administrative workload by work package leader and ECT* Board
11	Human: unavailability of manpower at BNL	WP14	Engage additional students from CERN. CERN team is always constituted of a very large number

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
			of PhD students who are eager to learn to work at various facilities.
12	Human: Shortage of labor for numerical calculations.	WP14	Intensive training of one of the young employees.
13	Human: no local student for one or more tasks defined in the work package	WP14	Enlarge the proposals for students to the partners universities
14	Human : following of post-doc activity	WP15	Regular meetings with the laboratory team, periodic status report and daily survey
15	Human: reduction or lack of ALTO support for the running of the facility that may occur during the contract period	WP20	Internal resources in other laboratories of CNRS will be identified and allocated to the running of the facility
16	Technical: delay of the SPIRAL2, SPES, HIE-ISOLDE, ELI-NP facility installation	WP16, WP17, WP18, WP24	Increase the supply of beam time for others accelerators in the infrastructure
17	Technical: failure of accelerator/experiment components	WP16, WP17, WP18, WP19, WP20, WP21, WP22, WP23, WP24	Regular maintenance and upgrade of critical components
18	Technical: accelerators failure	WP17	Increase the supply of beam time for others accelerators in the two laboratories
19	Technical: hardware issues	WP9	Coordinate the available hardware between the collaborating institutes
20	Technical: passivation stability issues	WP10	Few passivation techniques will be followed
21	Technical: charge collection issues	WP10	Alternative geometries and synergies with task 3 will be used.
22	Technical: non optimal contact material / stability of contacts	WP10	Check the possible use of already known non-optimal contact materials as amorphous Ge or Yttrium
23	Technical: unavailability of test-bench at BNL later on in the programme	WP14	Concentrate the tests to 2015 and 2016
24	Technical: limited availability of the LIRAT beam line for the EMILIE debuncher test	WP14	Early scheduling of the tests, taking into account the SPIRAL schedule constraints
25	Technical: limited availability of the LPCtrap setup for the EMILIE debuncher test	WP14	Coordination of the tests with CNRS teams as early as possible
26	Technical: new target materials (other than 12C) in SPIRAL are subject to ASN authorization (early 2015)	WP14	Relying on tests at the other facilities: ALTO / CERN/ SPES

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
27	Technical: limited accessibility of on-line and offline test bench due to the commissioning and early operation of the upgraded SPIRAL	WP14	Planning of BeamLab tests as early as possible.
28	Technical: in beam test of the prototype is subjected to the approval of the LNS	WP15	Ask for beam time at CNRS/ALTO or alternatively in other laboratories
29	Technical: difficulties in reaching all objectives in the foreseen time	WP15	Regular follow-up by the task leaders and project management
30	Technical: authorities refuse approval of chamber design RITMI-Task 1	WP15	Close contact with authorities during the design phase.
31	Technical: at the midterm of the contract, the renewal of the authorization should be obtained, the risk will be the non renewal of the authorization	WP20	Special care will be taken in priority by the management of the Institute in order to produce (as for the first authorization) a well documented and motivated application form
32	Scientific	WP1, WP10, WP11, WP12, WP13, WP14, WP15, WP16, WP17, WP18, WP19, WP2, WP20, WP21, WP22, WP23, WP24, WP25, WP3, WP4, WP5, WP6, WP7, WP8, WP9	Regular monitoring of the activities by a project collaboration committee
33	Scientific: missing milestones & deliverables	WP1, WP10, WP11, WP12, WP13, WP14, WP15, WP16, WP17, WP18, WP19, WP2, WP20, WP21, WP22, WP23, WP24, WP25, WP3, WP4, WP5, WP6, WP7, WP8, WP9	Deliverables and milestones are realistic. Tasks involve appropriate institutes. Task leaders closely monitor progress on annual basis.
34	Scientific	WP5	Progress and activity reports by all participant groups during annual meetings; exchange of knowledge through young researcher exchange.
35	Scientific: industrial involvement. Sharing information between small and major companies	WP9	Case by case study, single out the open access infromation
36	Scientific risks: some subtasks depend on the deliverables of other subtasks. A delay in one subtask might induce a global delay in the project.	WP11	Critical Subtasks will be treated in priority. Regular monitoring of the activities by the JRA leaders (meetings). In addition various subtasks will be worked in parallel, using all available intermediate results.

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
37	Scientific: availability of facilities for in-beam tests	WP15	Several facilities will be considered for the tests: Ganil, Orsay Tandem, CNA Accelerator…

1.3.6. WT6 Summary of project effort in person-months

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	WP11	WP12	WP13	WP14	WP15	WP16	WP17	WP18	WP19
1 - GANIL	0.10	0	0.10	0	0	0.10	0	0.10	0	0	0	9	0	0.10	0.10	0.10	0	0	0
2 - INFN	0	0.10	0	0.10	0.10	0.10	0	0	18	28	24	15	0	12	24	0	0.10	0	0
3 - CERN	0	0	0	0	0.10	0	0	0	0	0	0	18	0	12	0.10	0	0	0.10	0
4 - JYU	0	0	0.10	0	0	0	0	0.10	0	0	0	11	0	0	0	0	0	0	0.10
5 - CNRS	0	0	0.10	0.10	0.10	0.10	0	0	0.10	0.10	24	13	0	42	36	0	0	0	0
6 - GSI	0	0	0.10	0.10	0.10	0	0	0	0.10	13	0	26	0	0	0	0	0	0	0
7 - RUG	0	0	0.10	0	0.10	0	0	0	0	0	0	0	15	0	0	0	0	0	0
8 - IFJ PAN	0	0	0	0	0.10	0	0	0	18	0	0	0	0	0.10	0	0	0	0	0
9 - UNIWARSAW	0	0	0	0	0.10	0	0	0.10	0.10	0	0	0	0	12	12	0	0	0	0
10 - IFIN-HH	0	0.10	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
11 - FBK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 - EBG MedAustron	0	0	0	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 - KU Leuven	0	0	0	0	0	0.10	0	0	0	0	0	11	0	0	0	0	0	0	0
14 - ULB	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0
15 - CEA	12	0	0	0	0	0.10	0	2	0	0	0	0	12	0	14.20	0	0	0	0
16 - GIP ARRONAX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0
17 - JLU	0	0.10	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0
18 - JGU Mainz	0	0	0	0	0	0	0	0	0	0	0	26	0	0	0	0	0	0	0
19 - LMU	0	0	0	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20 - UCO	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0
21 - NCSRD	0	0	0	0	0	0	0.10	0	0	0	0	0	0	0	0	0	0	0	0
22 - UMIL	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	0	0	0	0
23 - FFCUL	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	WP9	WP10	WP11	WP12	WP13	WP14	WP15	WP16	WP17	WP18	WP19
24 - CIEMAT	0	0	0	0.10	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0
25 - CSIC	0	0	0	0.10	0.10	0	0	0	18	23	0	0	9	0	0	0	0	0	0
26 - USC	0	0	0	0	0	0.10	0	0	15	0	0	0	12	0	0	0	0	0	0
27 - USE	0	0	0	0	0	0	0.10	0	0	0	24	0	0	0	0	0	0	0	0
28 - ULIV	0	0	0	0.10	0	0	0	0	0	0.10	0	0	0	0	0	0	0	0	0
29 - UoY	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0
30 - ATOMKI-HAS	0	0.10	0.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31 - FCIENCIAS.ID	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Person/ Months	12.10	0.40	0.60	0.60	1	0.60	0.20	2.30	81.30	77.20	120	129	85	78.20	98.40	0.10	0.10	0.10	0.10

	WP20	WP21	WP22	WP23	WP24	WP25	Total Person/Months per Participant
1 - GANIL	0	0	0	0	0	0	9.70
2 - INFN	0	0	0	0	0	0	121.50
3 - CERN	0	0	0	0	0	0	30.30
4 - JYU	0	0	0	0	0	0	11.30
5 - CNRS	0.10	0	0	0	0	0	115.70
6 - GSI	0	0.10	0	0	0	0	39.50
7 - RUG	0	0	0.10	0	0	0	15.30
8 - IFJ PAN	0	0	0	0.10	0	0	18.30
9 - UNIWARSAW	0	0	0	0.10	0	0	24.40
10 - IFIN-HH	0	0	0	0	0.10	0	6.20
11 - FBK	0	0	0	0	0	0.10	0.10
12 - EBG MedAustron	0	0	0	0	0	0	0.10
13 - KU Leuven	0	0	0	0	0	0	11.10
14 - ULB	0	0	0	0	0	0	24
15 - CEA	0	0	0	0	0	0	40.30
16 - GIP ARRONAX	0	0	0	0	0	0	12
17 - JLU	0	0	0	0	0	0	7.10
18 - JGU Mainz	0	0	0	0	0	0	26
19 - LMU	0	0	0	0	0	0	0.10
20 - UCO	0	0	0	0	0	0	13
21 - NCSRD	0	0	0	0	0	0	0.10
22 - UMIL	0	0	0	0	0	0	24
23 - FFCUL	0	0	0	0	0	0	18
24 - CIEMAT	0	0	0	0	0	0	12.10
25 - CSIC	0	0	0	0	0	0	50.20
26 - USC	0	0	0	0	0	0	27.10

	WP20	WP21	WP22	WP23	WP24	WP25	Total Person/Months per Participant
27 - USE	0	0	0	0	0	0	24.10
28 - ULIV	0	0	0	0	0	0	0.20
29 - UoY	0	0	0	0	0	0	6
30 - ATOMKI-HAS	0	0	0	0	0	0	0.20
31 - FCIENCIAS.ID	0	0	0	0	0	0	0
Total Person/Months	0.10	0.10	0.10	0.20	0.10	0.10	688.00

1.3.7. WT7 Tentative schedule of project reviews

Review number [19]	**Tentative timing**	**Planned venue of review**	**Comments, if any**
RV1	22	tbd	Mid-term Review
RV2	48	tbd	Final Review

1.3.8. WT8 Summary of transnational / virtual access provision per installation

Access provider short name	Short name of infrastructure	Installation		Installation country code[21]	Type of access[22]	Unit of access	Unit cost (€)	Min. quantity of access to be provided	Access costs[23]		Estimated number of users	Estimated number of projects
		number[20]	Short name						On the basis of UC	As actual costs		
1 - GANIL	GANIL-SPIRAL2	1	GANIL-SPIRAL2	FR	TA-uc	beam hour	130.48	3750.0	489300		200	48
2 - INFN	LNL-LNS	1	NSDBF +AIPF	IT	TA-uc	beam hour	91.85	4480.0	411488		176	52
3 - CERN	ISOLDE	1	ISOLDE	IO	TA-uc	beam hour	74.52	5200.0	387504		1800	70
4 - JYU	JYFL	1	JYFL	FI	TA-uc	beam hour	105	3000.0	315000		280	60
5 - CNRS	ALTO	1	ALTO	FR	TA-uc	beam hour	103.4	2539.0	262532.6		108	30
6 - GSI	GSI	1	UNILAC	DE	TA-uc	beam hour	54.48	1920.0	104601.6		120	15
7 - RUG	KVI-CART	1	AGOR	NL	TA-uc	beam hour	322.07	700.0	225449		68	40
8 - IFJ PAN	NLC/IFJ PAN	1	NLC-IFJ PAN	PL	TA-uc	beam hour	116.37	480.0	55857.6		25	5
9 - UNIWARSAW	NLC/ UNIWARSAW	1	NLC-SLCJ	PL	TA-uc	beam hour	121.98	1000.0	121980		50	10
10 - IFIN-HH	IFIN-HH/ ELI-NP	2	ELI-NP	RO	TA-ac	beam hour		1000.0		35000	60	9
10 - IFIN-HH	IFIN-HH/ ELI-NP	1	TANDEM Complex	RO	TA-uc	beam hour	35	1150.0	40250		100	20
11 - FBK	FBK	1	ECT*	IT	TA-uc	visitor day	94	1080.0	101520		216	32

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It can generally not be changed. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry into force of the Grant Agreement (NB : entry into force = signature by the Commission). Please note that if a fixed starting date is used, you will be required to provide a written justification.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Abstract

8. Project Entry Month

The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

9. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

10. Lead beneficiary

This must be one of the beneficiaries in the grant (not a third party) - Number of the beneficiary leading the work in this work package

11. Person-months per work package

The total number of person-months allocated to each work package.

12. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

13. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

14. Deliverable number

Deliverable numbers: D1 - Dn

15. Type

Please indicate the type of the deliverable using one of the following codes:

R	Document, report
DEM	Demonstrator, pilot, prototype
DEC	Websites, patent fillings, videos, etc.
OTHER	
ETHICS	Ethics requirement
ORDP	Open Research Data Pilot
DATA	data sets, microdata, etc.

16. Dissemination level

Please indicate the dissemination level using one of the following codes:

PU	Public
CO	Confidential, only for members of the consortium (including the Commission Services)
EU-RES	Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)
EU-CON	Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)
EU-SEC	Classified Information: SECRET UE (Commission Decision 2005/444/EC)

17. Delivery date for Deliverable

Month in which the deliverables will be available, month 1 marking the start date of the project, and all delivery dates being relative to this start date.

18. Milestone number

Milestone number:MS1, MS2, ..., MSn

19. Review number

Review number: RV1, RV2, ..., RVn

20. Installation Number

Number progressively the installations of a same infrastructure. An installation is a part of an infrastructure that could be used independently from the rest.

21. Installation country

Code of the country where the installation is located or IO if the access provider (the beneficiary or linked third party) is an international organization, an ERIC or a similar legal entity.

22. Type of access

VA	if virtual access,
TA-uc	if trans-national access with access costs declared on the basis of unit cost,
TA-ac	if trans-national access with access costs declared as actual costs, and
TA-cb	if trans-national access with access costs declared as a combination of actual costs and costs on the basis of unit cost.

23. Access costs

Cost of the access provided under the project. For virtual access fill only the second column. For trans-national access fill one of the two columns or both according to the way access costs are declared. Trans-national access costs on the basis of unit cost will result from the unit cost by the quantity of access to be provided.

HORIZON2020
Call: H2020-INFRAIA-2014-2015
Topic: INFRAIA-1-2014-2015
Type of action: RIA

European Nuclear Science and Application Research 2

Acronym: ENSAR2
Number: 654002

History of Changes

Amendment n°2

Part A WP1	Addition of CEA as partner
Part A	Modification of budget: personnel costs of GANIL, CNRS and CEA
Part A	Modification of deadlines of deliverables
Part B 3.1.2	Modification of Timing of the different work packages and their components
Part B 4.2	Modification of GANIL personnel description

Amendment n°1

Part A Beneficiaries	Partial takeover from beneficiary FFCUL to new beneficiary FCiências.ID
Part A Financial information	Modification of financial information for Partners 1, 2, 3, 5, 8 and 17
Part A Work Packages	Modification of the title of work-package 2
Part A Work Packages	Modification of description of work-packages 2, 5 14, 23
Part A Work Packages	Modification of effort in work-pages 1, 2, 3, 4, 6, 7, 8, 9
Part A Work Packages	Addition of associated partners in work-package 5
Part A Work Packages	Modification of effort presentation in all work packages
Part A Work Packages	Modification of task title in work package 14
Part A Deliverables	Modification of deliverables
Part A Milestones	Modification of milestones
Part A Risks	Completion of risks 11 and 15
Part B	Completion of section 1.3.5 Sex and/or gender analysis + modification of its title
Part B	Addition of section 1.4.3 Strategic vision for the future
Part B	Completion of section 2.2.3 Research data management
Part B	Modification of section 3.1.2 Timing of the different work packages and their components
Part B	Modification of section 3.1.3 Graphical representation...
Part B	Modification of section 3.2.1 Organisational structure...
Part B	Modification of section 3.2.2 Innovation management
Part B	Modification of section 3.2.3 Trans-national Access to be provided
Part B	Modification of section 3.3 Consortium as a whole
Part B	Modification of section 3.4b Other direct costs
Part B	Addition of CV
Part B	Suppression of section 4.1.32 Associated partners
Part B	Addition of third parties
Part B	Addition of subcontracting activity

Part B	Modification of Ethics section
Part B	Modification of Milestones MS4 and MS18
Part B	Modification of Deliverables D6.2 to D6.5, D8.5, and D14.3
Part B	Addition of a participant to section 4.1
Part B	Modification of section 4.2 Subcontracting
Part B	Suppression of section 4.3 Financial support to third parties

Table of Contents

1. Excellence

1.1 Objectives

In order to carry out research at the forefront of fundamental nuclear science, our community of nuclear scientists profits from the diverse range of large research infrastructures (RIs) existing in Europe. **These RIs can supply different species of ion beams and energies but are complementary in their provision of beams and address different aspects of nuclear structure, nuclear reactions and nuclear astrophysics**. In this way, we can learn how the nuclear forces arising from the interaction between the building blocks of neutrons and protons manifest themselves in the rich structure of nuclei, and how different isotopes of elements are synthesised in primeval stellar processes.
These European nuclear-physics facilities are world-class and excel in comparison with facilities elsewhere in the world. Furthermore, the vibrant European nuclear-physics community has made great efforts in the past to make the most efficient and effective use of these facilities by developing the most advanced and novel equipment needed to pursue the excellent scientific programmes proposed at them. Our **community also has a long tradition of applying state-of-the-art developments in nuclear instrumentation to other research fields (e.g. archaeology) and to benefit humanity (e.g. medical imaging).** Together with multidisciplinary and application-oriented research at these facilities, these activities ensure a high-level of socioeconomic impact. This has been done under the auspices of NuPECC (Nuclear Physics European Collaboration Committee) and drawing support from previous EC framework programmes. This community strives to do the same in the future and has delineated the steps needed to pursue coherent research programmes at these facilities. This was done within the framework of the Roadmap and Long-Range Plan (LRP) of NuPECC which has been published in 2010. In this LRP, NuPECC addressed future perspectives in six major subfields of research in nuclear physics and re-emphasised the role of the European Network of complementary large-scale facilities where past achievements and future perspectives for research in nuclear physics are excellent. In this LRP, recommendations for future Pan-European facilities are also given.

ENSAR2 is the integrating activity (IA) for European nuclear scientists who are performing research in three of the major subfields defined by NuPECC: Nuclear Structure and Dynamics, Nuclear Astrophysics and Nuclear Physics Tools and Applications. Its core aim is to provide access to nine of the complementary world-class large-scale facilities: **GANIL (F), GSI (D), joint LNL-LNS (I), JYFL (FI), KVI-CART (NL), CERN-ISOLDE (CH), ALTO (F), joint IFIN-HH/ELI-NP (RO) and NLC (PL).** These facilities provide stable and radioactive ion beams of excellent qualities ranging in energies from tens of keV/u to a few GeV/u and intense photon beams up to 20 MeV energy. The stable-ion beams range from protons to uranium. Radioactive ion beams are produced using the two complementary methods of in-flight fragmentation (IFF) and isotope separation on-line (ISOL), so that several hundred isotopes are available for the users. The high-intensity, high-energy photon beams are produced by laser back-scattering from high-energy electron beams. In addition, the **infrastructure ECT* (I)** will provide a unique place for meetings, seminars and workshops to the community.
These infrastructures will be offering access to a very large, wide and diverse user community. The size of this community of physicists in nuclear structure, nuclear astrophysics, and applications of nuclear science in addition to the staff that is involved in accelerator and detector development and in running the facilities ranges between 2700-3000 scientists and highly qualified engineers according to a survey by NuPECC (http://www.nupecc.org/pub/) and a more recent one by NuPNET (Nuclear Physics ERA-NET), which was published as brochure. The facilities will also provide an increased amount of beam time for applications of nuclear techniques.

To enhance the access to these facilities, the community has defined a number of **Joint Research Activities (JRAs**), using as main criterion scientific and technical promise. These activities deal with novel and innovative technologies to improve the operation of the facilities. They are in general relevant to more than one facility and rely on strong participation of the European university groups. These activities involve all facets of operation of an accelerator facility starting with the improvement of laser techniques for the production and study of Rare Ion Beams (**RESIST**) and various developments for ISOL beam production and use (**EURISOL**). In parallel, technological developments on accelerators, spectrometers and electronics will be performed for stable-ion beam facilities with the direct applications of the production of radioisotopes for medicine and the improvement of identification of reaction products at low energies (**TecHIBA**). Complementary activities will develop new technologies and methods for the simultaneous detection of particles and gamma rays with same type of detectors (**PASPAG**) and 3-dimensional gamma-ray tracking with high-resolution germanium detectors (**PSeGe**). In addition, general platforms for physics models, event generators and analysis tools will be created and a study on data management will be performed (**SATNuRSE**). The development of modern theoretical tools for describing, interpreting, and predicting experimental results will support the work in nuclear-physics facilities (**TheoS**). Particular importance is attributed to all RTD work, which will or might lead to industrial applications, as radioisotopes in TecHIBA, scintillators in PASPAG, 3-dimensional position-sensitive detectors in PSeGe or new concepts for solid-state laser technology in RESIST.

The network activities of ENSAR2 have been set-up with specific actions to strengthen the community work in TAs and JRAs. In this vein, the scientific interests of the nuclear structure and nuclear astrophysics communities are discussed within **NUSPRASEN** to optimise use of the large RIs. Furthermore, cooperation about ECR ion sources (**MIDAS**) completes beam developments in JRAs. Dissemination on nuclear spectroscopy instrumentation (**NUSPIN**) and gas-filled detectors and systems (**GDS**) ensures an efficient transfer of knowledge between scientists. Enhancement of collaboration between large-scale and small-scale facilities improves the development and tests of high-level equipment and enhances training of young researchers (**ENSAF**). Networks stimulate also innovation, relationships with industry (**NuPIA**) and application-oriented research, in particular about technologies for nuclear medicine and studies of radiation biological effects (**MediNet**). In addition to these networks, the managing network **FISCO2** will insure a smooth running of the integrating activity as a whole in all aspects of technical, scientific, financial, administrative, contractual and legal activities. It will supervise an impact study on TA infrastructures and on ENSAR2 itself. FISCO2 will also stimulate dissemination of knowledge and outreach activities.

All of the activities proposed by **ENSAR2** have objectives which can be achieved within the project lifetime as indicated by the milestones and deliverables that have been marked for each of the activities. These milestones and the deliverables of the activities are well defined and measurable in timing and content.

1.2 Relation to the work programme

ENSAR2 is dedicated to the work programme topic: "**Research infrastructures for nuclear physics. This activity aims at furthering the integration of, and access to, the key research infrastructures in Europe for studying the properties of exotic nuclei or of nuclear matter at extreme conditions."**
ENSAR2 proposes indeed open access to the top-level European infrastructures in this field, all of them among the world-class facilities. **For the first time**, IA support will be offered for the joint **IFIN-HH/ELI-NP (RO) infrastructure in Romania and the NLC (PL) infrastructure in Poland. This is in fulfilment of the plan made in the Integrating Activity ENSAR under FP7 and in accordance with the spirit of enlarging the ERA (European Research Area) as stipulated by the EC.** Moreover, basically in all the other seven IA infrastructures upgraded instrumentation and novel beams from new accelerator systems will be available for the users. Most prominent are the **new Radioactive Ion Beams to be available from SPIRAL2 at GANIL, HIE-ISOLDE at CERN and SPES at LNL**. These facilities bridge the technological gap between the present-day ISOL facilities and EURISOL, the next generation ISOL facility (ESFRI) for the nuclear-physics community.
Three of the nine infrastructures are involved in ESFRI projects: Beams from SPIRAL2 at GANIL will be available for the users in 2015. High-quality and high-intensity energetic gamma-ray beams will open up a new era for nuclear physicists at ELI-NP. In addition many of the activities at GSI will focus on developments for FAIR.

1.3 Concept and approach

1.3.1 Overall concept

The user community of ion-beam infrastructures for nuclear physics is currently in a transition phase going from the current accelerators to a new generation of facilities: SPIRAL2 at GANIL (F), ELI-NP at IFIN-HH (RO), FAIR at GSI (G), HIE-ISOLDE at CERN (CH) and SPES at LNL (I). ENSAR2 is meant to support this important change.
It is ENSAR2's top priority:

- to ensure that the European communities of Nuclear Structure, Nuclear Reactions, Nuclear Astrophysics and Applications of Nuclear Science concentrate on the most prominent Joint Research Activities, for further improvements and extensions of the RI facilities,
- to stimulate multidisciplinary and application-oriented research,
- to promote the most needed R&D, as identified by the community, using as main criterion scientific and technical promise, combined with a rather rapid applicability,
- to focus on activities that are in general relevant to more than one facility, and
- to benefit from the R&D potential of the European university groups, often in leading positions.

To fulfil these objectives, **ENSAR2 strategy** is addressing various aspects that cover all current topics of interest for this community:

- Access to existing large RIs that have proven to provide high level quality services to users.
- Access to new and/or upgraded infrastructures, facilities and instruments

- R&D for the benefit of experimental studies:
  - Production and acceleration of new beams at higher intensity and purity
  - Development of detectors for both gammas and particles with higher position sensitivity allowing for simultaneous detection with same detector array and with adapted state-of-the-art electronics
  - Theoretical support to experimentalists for nuclear structure and reaction studies
  - Simulations, event generators and data management
- Networking and dissemination actions to strengthen the community's knowledge and know-how regarding:
  - Developments for accelerators and detectors
  - Small-scale facilities to reinforce and complement large-scale facilities
  - Progress in the ENSAR2 fundamental research subfields and optimising use of large RIs towards strengthening nuclear structure and nuclear astrophysics research.
- Broadening of fundamental research towards innovation and applications:
  - Networking on innovation actions between ENSAR2 consortium and industry
  - Nuclear physics for medicine: developments of dedicated detectors, ion-beam therapy, production of radioisotopes.
  - Applications of specific R&D works: ion sources for industry, homeland security, imaging techniques.

1.3.2 Integration of participating Research Infrastructures

ENSAR2 proposes access to infrastructures located in western and eastern European countries – from France to Romania– as in northern and southern member states – from Finland to Italy. These European Research Infrastructures in Nuclear Physics have in the recent past fostered a culture of cooperation between them at all levels under the guidance of NuPECC and through activities in earlier EC framework programmes. As observed in the former EC framework programmes, such an integrated activity project enhances participation of European researchers in experiments, especially participation of young researchers. New users from non-beneficiary countries, as Ireland, received also EC support. More generally, the ENSAR2 infrastructures are highly international as they have users coming for a large part from other European countries and also from abroad.

Each infrastructure has a **Programme Advisory Committee (PAC)**, constituted of international experts, for the selection of the experimental proposals based on scientific merits and feasibility. In addition, ENSAR2 will have a **Facility Coordination Group (FCG),** comprising directors of infrastructures and chairpersons of PACs. The FCG is meant for exchange of good practices and harmonisation of scientific policies. Therefore, ENSAR2 will propose a very large choice of infrastructures and instruments to users through a common structured organisation with a high-level selection system, taking into account characteristic features of each infrastructure.

1.3.3 National or international research and innovation activities

Outside Europe, ENSAR2 infrastructures have special links with Japan (RIKEN, Tokyo & RCNP, Osaka), China (IMP, Lanzhou), United States (NSCL, East Lansing, MI & ANL, Argonne, IL), Canada (TRIUMF, Vancouver), South Africa (iThemba, Cape Town). European researchers collaborate with researchers from these institutes to perform joint experiments at ENSAR2 infrastructures in Europe or at one of the above-mentioned research infrastructures abroad taking advantage of the complementarity of the facilities. In several cases these collaborations involve moving detectors from Europe to these international infrastructures and vice versa. A recent shining example is the deployment of the European advanced gamma-detection array EURICA for a prolonged experimental campaign at RIKEN. The current approach of global cooperation is up to now mainly organised case by case. FCG will also propose a harmonisation of cooperation of all transnational access infrastructures including the international sister institutes.
In ENSAR2, a special work package, NuPIA, will be devoted to innovation activities. This network will be a transverse action involving innovation officers of infrastructures and all beneficiaries of ENSAR2. Each of them being involved in national or international initiatives, ENSAR2 will benefit directly from the outputs of these initiatives.

1.3.4 Overall approach, methodology and associated work plan

ENSAR2 infrastructures constitute the backbone of the proposal. The European nuclear-physics community proposes in a bottom-up approach an integrating activity with a coherent and complementary ensemble of Networking, Transnational Access and Joint Research Activities based on these infrastructures.

The proposed JRAs and NAs will improve the access provided by the current infrastructures, within the funding period, both qualitatively and quantitatively. In particular, the novel and innovative developments that will be achieved by the R&D activities will **improve the quality of the facilities in terms of a rich palette of beam varieties** of both stable and exotic type and excellent beam characteristics in terms of emittance, intensity and energy. This will be achieved by the JRAs RESIST, EURISOL and TecHIBA, which have clearly also interconnections among each other, as developments in one may benefit the other. In that respect, the NA MIDAS will concentrate the academic and industrial expertise available in Europe on the developments of ion sources to work together towards the goal of enhancing the JRAs and improving the infrastructures.

The other JRAs will **improve the performance, characterisation and understanding through simulation of the equipment** with which the experimental programmes at the infrastructures are carried out. This concerns the work package SATNuRSE. Detector development is essential to obtain state-of-the-art equipment that will have the technological edge compared to the competition in performing cutting-edge research. This will be performed by the JRAs PASPAG, PSeGe and TecHIBA, and the GDS NA.

Inter- and multidisciplinary applications of these detector technologies will also benefit other fields and the society at large. It is also the aim of ENSAR2 to enhance the use of the infrastructures for multidisciplinary use and industry. These JRAs have also interconnections with NUSPIN NA, which will concentrate on development and pooling of high-resolution γ-ray and neutron detection systems.

TAs have strong connections with TheoS JRA in developing theoretical formalisms for a better understanding of the experimental results.

ENSAF NA will develop a network of small-scale facilities improving the technical support to large-scale infrastructures providing transnational access.

NuPIA NA will **strengthen innovation actions** using stable and radioactive beam facilities of ENSAR2. NuPIA will have special links with MediNet NA dedicated to nuclear physics for medicine, with MIDAS NA for ion sources, PSeGe JRA for imaging techniques, PASPAG JRA for homeland security, and TecHIBA for the production of radioisotopes.

The overarching **management network** activity FISCO2 will not only deal with management of the whole consortium but will undertake impact studies and dissemination of knowledge and outreach activities. It will also oversee the full integration of the various work packages of ENSAR2.

1.3.5 Gender Action Plan

The ENSAR2 communities using ion-beam facilities take sex and/or gender issues very seriously into account. ENSAR2 will ensure that gender equality means giving equal consideration to the needs and interests of both women and men. ENSAR2 has encouraged and will, whenever possible, encourage women’s participation in the tasks and the management structure, and will ensure that, in general, women are represented in ENSAR2 with roughly the same fraction as in the overall ENSAR2 community. In particular, ENSAR2 has women in responsible positions as activity coordinators. Furthermore, the access to infrastructures and any other equipment or code is strictly the same for all genders, within the limits of radioprotection rules. All scientists have the same work and employment conditions.

ENSAR2 beneficiaries make important efforts to attract women to science, through:

- science festivals as Fête de la Science in France, Vlaamse Wetenschapsweek in Belgium, Science Picnic in Poland, Night of Science and University for Children in Germany, Researcher’s nights in Italy, Germany and Romania.
- specific exhibitions on women in physics as “Physique de Femmes” in France, “Lise Meitner und ihre ‘Töchter’: Physikerinnen stellen sich vor”, “Von der Antike bis zur Neuzeit – der verleugnete Anteil der Frauen an der Physik” in Germany, “Donne alla guida della più grande macchina mai costruita dall'Uomo” Italian contribution to CERN celebration for International Women’s Day,
- visits to schools to explain research and how to become a researcher.
- visits of research infrastructures by school students on a weekly basis, and also by families as Portes Ouvertes in France, Open Dag in the Netherlands.
- training periods for school students.

With these different actions, the goal is to convince young women to choose science, to realise what is behind schoolbooks, what is research in laboratories and all the various professions that can participate in research. It is crucial to communicate this simple message: “science is possible, science is fascinating” to young women and their entourage in order to initiate interest before University and the first choices of career.

1.4 Ambition

1.4.1 Beyond the state-of-the-art

ENSAR2 is the Integrating Activity of nuclear scientists from almost all European countries reflecting the community at large and within an equal opportunity structure. It **has been established through a bottom-up approach under the auspices of NuPECC, which assured a global view on the needs for development of Nuclear Physics within Europe**. It proposes a coherent and complementary ensemble of Networking, Transnational Access and Joint Research Activities, which will ensure a qualitative and quantitative improvement of the services and access provided within the funding period by the ten infrastructures, which are at the core of this proposal. The novel and innovative developments that will be achieved by the R&D activities will also assure state-of-the-art technology needed for the new European large-scale projects.

ENSAR2 builds on a successful and rich tradition which already was initiated and recognised during preceding framework programmes. This optimisation of European Resources will not only maintain, but even **enhance the historical lead of European scientists in nuclear-physics research.**
ENSAR2 will foster international collaboration for the benefit of progress in this research area. It will also significantly **contribute to develop the next generation of European researchers**.
ENSAR2 infrastructures are at the heart of the proposal. These European Research Infrastructures in Nuclear Physics have a culture of cooperation between them at all levels. This has been fostered by activities in earlier framework programmes. The integration of the feedback from the users has been a second important accomplishment. This has triggered **coherent European plans for the development of the different Research Infrastructures, particularly in the field of Radioactive Ion Beams,** and of Scientific Instrumentations around them. This is in accordance with the long-range plan for the field, which has been published by NuPECC in 2010.

Networking activities
The networking activities will gather communities around themes related to improvement of the services provided by the RIs to the community of users whether in fundamental science or in the applications of nuclear science. These NAs will organise regular meetings where the participants in the project will discuss scientific and technological matters of importance for improving and enhancing access to ENSAR2 RIs. The community at large that will benefit from the RIs will be invited to participate and will be consecutively informed of all steps impacting services of and transnational access to ENSAR2 RIs.
Therefore, ENSAR2 will make use of the possibilities of networking to foster a culture of cooperation between the participants and the European nuclear-physics community, which will benefit from the research infrastructures. Furthermore, the following activities will be emphasised:

- pooling of resources, (including human capital where possible), and
- stimulating complementarity and ensuring broad dissemination of results.

The managing network **FISCO2** is organised to fulfil the requirements of the EC for the administrative handling of an Integrating Activity. It will stimulate outreach activities and broad dissemination of knowledge resulting from the other activities. It will help develop and maintain databases for the benefit of the whole community. It will take in charge impact studies for the ENSAR2 infrastructures and the whole project. The seven other networking activities have been identified by the community for fostering of future collaborations on research topics, pooling of resources, stimulating multidisciplinary and application-oriented research and dissemination of results. They can be grouped into several classes of objectives.

- **MIDAS** supports developments of ion sources by academic and industrial experts and organise trainings and workshops on this topic for the community.
- **NUSPRASEN** provides a forum to discuss the scientific interests of the nuclear structure and nuclear astrophysics communities, the progress in these subfields and the optimisation of the use of the large RIs for that purpose.
- **NUSPIN** aims at pooling and optimising the use of the valuable resources for high resolution gamma-ray and spectroscopy and coordinating their use at the facilities. Instruction courses for young scientists and engineers to get them acquainted with these techniques are part of this activity.

- **MediNet** is devoted to nuclear physics for medicine through the developments of beam and detection techniques and of ion-beam therapy.
- **GDS** gathers experts of gas-filled detectors and systems to develop new techniques to overcome constraints such as high-intensity beams and strong non-uniform magnetic fields.
- **ENSAF** is a network of small-scale accelerators to support technical developments and tests for experiments at large-scale infrastructures
- **NuPIA** is a transversal activity to support innovation through bridging between academic research and industry, impact study and training of industrial personnel in research institutions.

Transnational access activities

ENSAR2, representing the communities of Nuclear Physics and Applications of Nuclear Science, identifies 10 facilities of prime interest for HORIZON2020. They are: ALTO (F), CERN-ISOLDE (CH), GANIL-SPIRAL2 (F), GSI (D), JYFL (FI), KVI-CART (NL), joint LNL-LNS (I), ECT* (I), joint NLC (PL), and joint IFIN-HH/ELI-NP (RO). These world-class facilities are prominent with regard to:

- Accelerator specifications. These facilities provide stable and radioactive ion beams of excellent qualities ranging in energies from tens of keV/u to a few GeV/u. The stable-ion beams range from protons to uranium. Radioactive ion beams are produced using the two complementary methods of In-Flight Fragmentation (IFF) and Isotope Separation On-Line (ISOL), so that several hundred isotopes are available for the user as beams.
- Available instrumentation. These include a variety of ancillary equipment to detect gamma rays, neutrons and light and heavy ions. Unique detectors include arrays of scintillators, solid-state detectors and magnetic spectrometers, etc.

Of course, most paramount is the interest of the user communities in being offered access. These facilities belong to the European Network of Complementary Large-scale Facilities which is supported by NuPECC. The facilities are monitored by the community via NuPECC. Certain experimental proposals use the same unique equipment at different facilities to take advantage of the complementarity in available beams and energies. These equipment are constructed to be moved to different facilities.

The research infrastructures of ENSAR2 allow forefront and worldwide mostly unique research opportunities for nuclear structure, nuclear reactions and nuclear astrophysics studies and also for inter-/multi-disciplinary research exploiting nuclear beams. For example, **the European physicists have the highest energy fragment and post-accelerated beams, the highest intensities for enriched isotope beams, the smallest-emittance proton beams, the largest-range and the short-lived ISOL beams.** Similarly, at all facilities one can single out unique instrumentation for a wide range of experiments with stable- and unstable-ion beams. Prominent examples are storage-cooler rings (unique in Europe) and high-performance spectrometers and high-resolution tracking arrays for particle and gamma-ray detection, respectively. An important goal of ENSAR2 will be to identify, realise, and coordinate the improvements and extensions of the instrumentation and the experimental programme of the facilities for increasing the quality and quantity of access. Specific measures for achieving these goals will include:

- Mutual information on exchange of best practices, coordination of scientific programmes, instruction courses, and services offered to users,
- harmonising/coordination of organisational aspects for users (common proposal, procedure, joint deadlines, joint advertisements for Programme Advisory Committee (PAC) meetings, and Facility Coordination Group (FCG) meant for exchange of good practices and harmonisation of scientific policies, etc.), and
- identifying future needs, e.g., by long-term prospecting of the field and the need for new infrastructures.

The above points should be strongly emphasised also in view of the strong international competition from other labs (RIBF, Tokyo; NSCL/MSU, East Lansing, MI; TRIUMF, Vancouver) and future large-scale facilities (FRIB, East Lansing; ROAN, Daejeon, Korea, …) outside of Europe. This will require additional important efforts in investment and coordination to preserve the current level of excellence in the European nuclear-physics research area. ENSAR2 will go a long way to accomplish these objectives.

Joint Research Activities for facility improvement

The Joint Research Activities of ENSAR2 are a direct consequence of the strategy described in the preceding section. These activities deal with novel and innovative technologies to improve the operation of the facilities and enhance their access. They are in general relevant to more than one facility. These activities involve all facets of operation of an accelerator facility for an experiment, i.e. from the ion source to gamma-ray and particle detection systems, theoretical developments and platforms for simulations of detector systems to optimise experimental setups:

- **PASPAG** studies detection of particles and gamma rays with phoswich scintillators allowing for simultaneous detection with same detector array. PASPAG will also develop applications of detection systems for homeland security.
- **PSeGe** is focused on 3-dimensional position-sensitive Ge detectors dedicated to nuclear structure and applications in imaging.
- **TheoS** is a theory support activity to experiments in nuclear structure and reactions.
- **RESIST** develops resonance laser ionisation techniques for the production of high-purity beams of radioactive ions.
- **SATNuRSE** is devoted to simulations, developments of analysis tools and data management.
- **EURISOL** develops techniques and tools for current and future ISOL facilities, such as charge breeders, beam production and a dissemination tool to inform the community on available beams and intensities.
- **TecHIBA** aims at accelerator and instrumentation developments in the framework of high-intensity beams.

1.4.2 Innovation potential

Innovation is an activity present in all beneficiary institutions of ENSAR2. In most of them, innovation offices are active for several years. Infrastructures devote a part of their beam time to industrial activities and applications as irradiation of electronic components for space (JYU, GANIL, KVI) or production of radioisotopes (ARRONAX, CERN-ISOLDE).
ENSAR2 emphasises this **innovation activity through the network NuPIA** that is a transverse activity aiming at bridging between academic and industry through dedicated workshop, impact study, dissemination actions, and training of industrial personnel in ENSAR2 infrastructures.
In addition, ENSAR2 will perform developments for innovation at short- and/or mid-term:

- in NA MIDAS about ion sources, with AVS and PANTECHNIC SMEs as associated partners
- in NA MediNet about medicine
- in JRA TecHIBA about radioisotopes, with ARRONAX company as beneficiary participant in this JRA
- in JRA PASPAG about scintillator materials
- in JRA PSeGe about 3D position-sensitive Ge detectors in cooperation with industrial partner SEMIKON

1.4.3 Strategic vision for the future

The community of nuclear physicists using stable and radioactive ion beams is represented by NuPECC at European and International levels. NuPECC (Nuclear Physics European Collaboration Committee) is the overarching committee for nuclear and hadron physics and their applications in Europe. NuPECC formulates on a regular basis the strategic plans for the overall community including that of ENSAR2. These strategic plans are meant to give a clear vision of the future of this scientific domain. These regular strategic plans are distributed widely through important documents: the Long-Range Plans (LRPs). The last LRP dates from 2010, and NuPECC is now preparing a new LRP, which will be published in 2016 after wide and deep discussions with all the concerned scientists. It will give strategic advices for the future developments of Nuclear Physics in Europe.

2. Impact

2.1 Expected impact

2.1.1 Project contribution

In this integrating activity the strongest and most immediately felt impact is the one on the users of the infrastructures. ENSAR2 infrastructures have been chosen to provide the largest palette of stable and radioactive beams worldwide with the best beam qualities considering aspects as purity, intensity, emittance, etc. to users. This clearly requires a European approach rather than a national or local one, because none of the European countries has infrastructures that provide the full palette but rather only a part of it. In addition, the uniqueness of some of the instrumentation available at ENSAR2 infrastructures gives these an edge in comparison to infrastructures elsewhere in the world. Clearly, by having such a broad and excellent network of research infrastructures that is unparalleled in the world the European user will also have an edge on the competitors internationally. However, in the spirit of healthy competition between European centres of research and international ones, fruitful collaborations emerge where joint international efforts benefit from complementarity of the excellent facilities worldwide.

Impacts of the transnational access activities

The impact of access on users from nuclear structure and nuclear astrophysics is enormous, in particular if this is taken in combination with the R&D planned to improve the quality of the research infrastructures and the equipment with which the experiments will be performed. This will be enhanced with the update of the ENRI (ENSAR Research Infrastructures) agreement in which it is foreseen to enlarge the Facility Coordination Group (FCG) to include representatives from the new ENSAR2 research infrastructures and a representative of the small-scale facilities that are partners in ENSAF NA. This FCG will activate and promote access to the joint ENSAR2 facilities and coordinate and harmonise between them in regard to scientific programmes and proposals for access. Furthermore, the ENSAR2 research infrastructures have an excellent track record for operating smoothly and efficiently providing the users with the beams of the wanted specifications and in the foreseen time windows. This does not concern users in nuclear structure, nuclear reactions and nuclear astrophysics only, but also in multidisciplinary research and industrial applications using light- and heavy-ion beams. In addition, ENSAR2 infrastructures comprise new and upgraded facilities (including ESFRI facilities) that will attract even more users.

Impacts of the networking activities

The impacts of the networking activities are also large since they will bring together experts of the fields with the aim to improve the facilities and increase their use. For example, **MIDAS** NA will bring together and coordinate the academic and industrial expertise in Europe related to ion sources. It will have impact on the production of ion beams in terms of plasma density, production rate, efficiency and variety of ion beams.

NUSPRASEN NA will impact the scientific progress in the subfields of nuclear structure and reactions and nuclear astrophysics through providing a forum for discussing present status and developments in the field and future perspectives within Europe and worldwide.

NUSPIN NA will coordinate and optimise the use of valuable European resources, such as Ge-detector arrays and neutron detectors, in ENSAR2-TA laboratories. It will also enhance synergies among researchers on a broad European scale to ensure the sharing, design, construction and maintenance of detectors and associated equipment in a coordinated approach.

MediNet NA will be dedicated to nuclear-physics applications to medicine, coordinating expertise on accelerator and instrumentation techniques and on ion-beam therapy, especially biological effects of radiation during therapy.

GDS NA will gather the community working on gas-filled detectors and systems, this community being already successful at the European level with two ERC grants.

ENSAF NA will coordinate the European small-scale facilities to support large-scale infrastructures on target production and test measurements before experiments. This activity will integrate a large number of facilities spread all over Europe, with ENSAR2-TA infrastructures. It will provide training opportunities for young scientists in less complex environments than at large RIs.

NuPIA NA will be a transversal activity for innovation, gathering innovation officers acting in ENSAR2 institutions and bridging academic and industrial work through workshops, dissemination actions and trainings for industry personnel.

Impacts of the joint research activities

The Joint Research Activities will have direct influence on the quality of the European ion-beam infrastructures and the experiments performed at these infrastructures.

PASPAG JRA will broaden the physics case of gamma-ray spectroscopy by developing phoswich scintillators for detection of particles and gamma rays allowing for simultaneous detection of both with the same detector array.

PSeGe JRA will contribute to nuclear structure and applications with 3-dimensional position-sensitive Ge detectors.

TheoS JRA will bring strong theoretical support to experiments through studies on nuclear structure and reactions.

RESIST JRA will improve the production of Radioactive Ion Beams, especially the beam purity, with resonance laser ionisation techniques.

SATNuRSE JRA will support the data analysis with simulations, analysis tools, and data-management studies.

EURISOL JRA will coordinate R&D activities towards ISOL facilities. It will have impact on the operational efficiency of these facilities through improvement of electron-beam charge breeding, development of chemically reactive ISOL beams and dissemination by developing a chart of available radioactive ion beam intensities.

TecHIBA JRA will contribute to studies with high-intensity stable beams, through the improvement of superconducting cavities, the production of radioisotopes, the developments of detectors for magnetic spectrometers, the identification of low-energy radioactive ions, and the development of generic electronics systems.

Innovation capacity

ENSAR2 institutions have their own innovation programmes including beam lines for industries, developments of applications, and transfer of knowledge to industry among many other actions.

In order to improve and coordinate these actions within ENSAR2, NuPIA NA will be the main link between innovation officers within the ENSAR2 institutions, research groups in ENSAR2 work packages and industry. Especially, ENSAR2 will perform developments for innovation at short- and/or mid-term:

- in NA MIDAS about ion sources, with AVS (ES) and PANTECHNIC (F) SMEs as associated partners,
- in NA MediNet about medicine: accelerator and instrumentation techniques and radiotherapy,
- in JRA TecHIBA about radioisotope production,
- in JRA PASPAG about scintillator materials for homeland security, and
- in JRA PSeGe about 3D position-sensitive Ge detectors for medical imaging in cooperation with industrial partner SEMIKON.

NuPIA will enhance exchange of good practices between scientists involved in these work packages, innovation officers in institutions and industry. To achieve these objectives, NuPIA will organise bridging actions such as common workshops, trainings for industry personnel and dissemination actions, specifically in dedicated conferences. In addition, NuPIA will prepare future actions with a dedicated impact study.

Socioeconomic impacts

The socioeconomic impacts of the ENSAR2 research infrastructures span impacts on multidisciplinary research and industrial applications through granting access (free of charge or at partial/full operational cost) to communities of other scientific disciplines and industry. **More than 20% of the beam time at the ENSAR2 research infrastructures is devoted to solid-state physics and life sciences with broad societal benefits**. The range of use of beams, stable or radioactive, is indeed broad spanning research on and/or production of nano- and micro-scale porous films and membranes or microstructures, increasing capacity of battery storage, semiconductors and electronics radiation hardness, materials science, atomic physics, condensed-matter physics, biophysics, radiobiology and radiotherapy, collaboration with ESA and EADS 'European Aeronautic Defence and Space' company for testing electronic components for space applications and space research, and last but not least the safeguard of Cultural Heritage masterpieces and archaeological artefacts.

The ENSAR2 research infrastructures are all located in regions where they **have large impact on training engineers and scientists for industry, and have strong impact on employment of highly-qualified personnel**. They also collaborate with local industry increasing the capacity of these to compete with national and international ones. They fulfil the role of breeding grounds for spin-off businesses and industries which invigorate high-tech activities in their regions. Examples abound, e.g. two spin-offs from KVI-RUG (Groningen), companies for applying nuclear science techniques in environmental, agricultural and industrial problems (Medusa and The Soil Company); two from JYFL-JYU (Jyväskylä), a leading NanoScience Centre in Finland and an X-ray tomography facility; two from GANIL (Caen), PANTECHNIK - the world-leading ion-source company - and Quertech Ingenierie - expert in the innovative techniques increasing hardness of aluminium; two from ALTO-CNRS, ISITECH - a company dedicated to the development of electronic cards – and ACS - a company specialised in cryogenic acceleration and more for LNL/LNS-INFN and GSI, in particular regarding medical applications related to ion-beam therapy. Patents that are produced through research at these infrastructures are usually shared with the industries for the benefit of both; a number of examples exist for GANIL, GSI, KVI-RUG, and LNL/LNS-INFN.

The ENSAR2 infrastructures participate, with local research institutions and industries, in consortia whose aim is to promote the transfer of knowledge, technological innovation and, more in general, the **development of the regions**. For example, GANIL is one of the three members of "Normandie Incubation" whose main mission is to help the creation of new start-ups for the valorisation of activities of public laboratories in Normandy. Since its creation, nearly 50 projects started, generating the creation of more than 140 new jobs in the region.

Another application of nuclear science of strong **impact is the use of radioactive isotopes** such as produced at the ENSAR2 laboratories. These have been used for condensed-matter investigations (e.g. diffusion processes) for a long time. Nuclei are now being routinely used as probes of their environment in metals and semiconductors via various methods. These techniques have also been applied to the study of complex bio-molecules, surfaces, and interfaces. With the routine availability of high-purity radioactive ion beams from isotope separators the possibilities for such investigations have been greatly expanded, permitting technologically ever more demanding experiments. In particular, the use of on-line isotope separation at, *e.g.*, ISOLDE-CERN, IGISOL at JYFL-JYU and SPIRAL at GANIL facilities, has demonstrated the great potential of nuclear probes for solid-state physics research and in biophysics research. Furthermore, research is continuing at ENSAR2 laboratories to produce new radioactive isotopes that could be used in imaging and therapy (e.g., alpha emitters for cancer therapy).

There are further applications pursued at ENSAR2 research infrastructures with major potential implications for society, *e.g.*,

- **nuclear waste management** and methodological developments useful for theoretical evaluation of waste incineration and
- development of **nuclear technology through material research** necessitated by ageing of structure materials of fission/fusion reactors due to nuclear reactions. This goes hand in hand with education and training of young nuclear physicists, which is relevant not only for health-related applications, but also for the development of novel nuclear technologies, one alternative currently discussed to face the problem of emission of greenhouse gases.

Another aspect of the socioeconomic impact is exemplified by the interesting results of a study on the impact of GANIL on the region. This showed that GANIL generated more than 250 direct jobs and 350 indirect jobs, and injects more than 32 M€ in the local economy each year, through its running costs and the salaries of its employees and those of associated laboratories. It was estimated that each € that is invested by the Region Basse Normandie for GANIL is reimbursed locally within 3 years.

2.1.2 Barriers/obstacles to the impact achievements

Today the European situation in terms of regulations and standards for the use of ion-beam infrastructures allows achieving scientific, technical, innovation and socio-economic impacts of research activities with these infrastructures as described in the previous section without any foreseen obstacles.

2.2 Measures to maximise impact

a) Dissemination and exploitation of results

2.2.1 Draft 'plan for the dissemination and exploitation of the project's results'

Institutions participating in ENSAR2 have as their ultimate objective **publication of their scientific results** in renowned international journals, and, where applicable, dissemination of these results to other scientific communities and the public as well. For each NA or JRA work package, its Steering Committee (SC) will discuss the scientific results and the best possible way of publishing them with general consensus among the participants in that activity. The reports of the activities that will be produced for the EC will be placed on the website of ENSAR2. In case of results of possible exploitation by the industry, the matter will be discussed in the Steering Committee. The best possible way of achieving this will be followed taking into full consideration the rules regarding the intellectual property of each of the participants, and where the final owner of the patent, whether it is one of the institutions or industry, would consent to its free use by the participants.

In addition to management of the complex consortium, **FISCO2 will be responsible for the dissemination** of knowledge and outreach activities to society in general. The NA **NuPIA will help with the outreach activities** to disseminate ENSAR2 innovation actions to industry. FISCO2 will act in this respect for all participants in this Integrated Activity. Education and training of young nuclear physicists is foreseen in several JRAs and NAs, and in particular, ENSAF NA will provide hands-on experience at the small-scale facilities where it is easier to get beam time.

The participants in ENSAR2 deem the publication of results of importance not only for the scientific community, but also for **reaching out to society and industry**. This is clearly a main objective of this IA. The multidisciplinary applications and some of the work packages have direct benefit to society. In case of major discoveries of importance for the wide scientific community and the public, press releases will be made to ensure a strong and appropriate impact.

The coordinator and management of ENSAR2 will actively encourage and monitor the broad implementation of the techniques developed by the participants in the various activities. The ENSAR2 website will be set up to record and disseminate the technical advances and a Web page could be devoted to each of the activities with links to the participating institutes and university groups. The deliverables will be largely distributed within the community.

The dissemination of knowledge within the community will take place also via **specific workshops and collaboration meetings** organised by several JRAs and NAs. Two **town meetings** will be organised by FISCO2 for the whole community, first time thirty months after the start of ENSAR2 and a second time at its end. In these meetings, the achievements and highlights of each work package will be presented and discussed. These workshops and meetings will be very useful for the community members, in particular the large number of PhD students and young researchers, who benefit from access to ENSAR2 RIs and use of their facilities not only informing them on achieved results but also about the impact on improvement of access to RIs.

2.2.2 Achievement of the expected impacts

Scientific and technical impacts of ENSAR2 integrating activity will be ensured by scientific publications in international journals, in addition to workshops, collaboration meetings and participation to conferences.
Innovation impacts will be achieved with the support of the specific work package NuPIA that will enhance links between academic research and industry.
Socio-economic impacts will be favoured by the broad distribution of the Transnational Access infrastructures of ENSAR2 all over Europe. ENSAR2 will increase the scientific activity in all participating institutions and will enhance mobility of scientists, especially young researchers. This will have a large impact on economics of cities and regions hosting ion-beam infrastructures, as shown for GANIL in Basse-Normandie, France.

2.2.3 Research data management

Types of generated/collected data
ENSAR2 infrastructures will generate **multi-parameter data** which result from electronic signals obtained in singles or coincidence modes from gamma-rays, neutrons or charged particles traversing detectors that are especially designed for detecting the particles in question and determining their energies. Tracking information is often also stored for later analysis to determine the particle path.
With the SATNuRSE JRA, **simulated data** will be collected through event generators.
In FISCO2 and NuPIA NA, **socio-economic, environmental and innovation data** (number of visitors, radioactive releases, patents, etc.) will be collected **for impact studies**.

Standards
The usual standards for nuclear-physics experiments that have been developed over the years and often harmonised between ENSAR2 infrastructures as far as data-storage formats are concerned will be used.

Data exploitation
The data described above will be available to working groups during their exploitation. **Once published, the data will be available on request to all interested**, with the condition of collaboration with the working group. This condition is today necessary due to the quality/complexity of the raw data, i.e. electronic signals that cannot be analysed without specific codes developed by the working group.

Data curation and preservation
The scientific data are preserved during a certain time at the infrastructures where the experiments were performed. The data are copied to disks by the experimental groups for further analysis.
Each of the participating institutions owns its computing systems for data taking and analysis. These computing systems are also connected to computing grids or farms. In France, e.g., the calculation centre of IN2P3 specialises in the provision of IT services required for the analysis and interpretation of data obtained in the subfields of the fundamental processes of subatomic physics. In the same way, at CERN, the CASTOR system is available for physics data management. In Germany, JOIN[2] is a joint repository infrastructure. The FBK institution uses the joint cluster system Kore of Trentino region. This ensures strong engagement of ENSAR2 infrastructures with national and pan-European e-infrastructure.
The goal of the SATNuRSE work package in matter of data management will be to address the question of wider access to the data from outside the ENSAR2 institutions and collaborations. The idea is to first make an inventory of the existing facilities and to propose a protocol for data access and management.

Open source software
No open source software will be used or developed by the project.

Strategy for knowledge management and protection
ENSAR2 Management will implement a consortium agreement at the start of the project in order to settle questions arising from the assignment of Intellectual Property Rights (**IPR**).

ENSAR2 partners will follow the 'green' model to provide free on-line access to peer-reviewed scientific publications produced by the project in order to favour dissemination of ENSAR2 results. Where possible, the participants will be encouraged to publish in **open-access** journals and to deposit their papers prior to publication in open-access archives. For certain important publications that deserve immediate dissemination, ENSAR2 management may consider using the “gold” open access by approving the publication costs by the groups involved.

b) Communication activities

2.2.4 Communication measures for promoting the project and its findings

Communication towards scientists

As presented above, the internal communication will be ensured by **workshops, collaboration meetings, town meetings and scientific publications** in all JRAs and NAs. ENSAR2 scientists will be strongly encouraged to present their results in international conferences. For a broader impact, the ENSAR2 web site will communicate about all scientific events and publications.
Several work packages of ENSAR2 will organise **trainings and schools**, as NAs MIDAS, NUSPIN, and NuPIA and JRAs PSeGe, and SATNuRSE.
In EURISOL JRA, a chart of intensities of available radioactive ion beams will be created to improve the distribution of information to users.
In addition, the NuPIA NA will organise specific communication actions for innovation, creating a communication kit to present ENSAR2 innovation activities in specific booth during international conferences.

Communication towards the layman

Information and promotion of Science towards the public are necessary to transmit the passion for Science and explain the importance of Research. There is a great interest of the public for new information about the structure of matter and how it has been generated. The layman has often a negative view of Nuclear Physics due to nuclear weapons and to problems with nuclear waste connected with nuclear energy. **The European excellent nuclear science and its positive application aspects should be emphasised**, especially applications dedicated to health, and innovations resulting from research.

In order to promote and communicate about the project, many activities are planned during ENSAR2 reaching a wide public of students, and laymen in European countries.

Actions:

- **Website for layman:**
  Nupex.eu: this website developed by NuPECC promotes Nuclear Structure, Nuclear Astrophysics and Applications of Nuclear Science for the layman. The translation of the website will be pursued and expanded in order to provide a site available in 15 European languages.

- **Wikipedia, Scholarpedia**:
  Update of the information about Nuclear Structure, Nuclear Astrophysics and Applications of Nuclear Science.

- **Public events:**
  Participation to public events celebrating Science (e.g., Fête de la Science in France) every year.

2.2.5 Impact of communication activities

The communication activities will be organised from the very start of the project in order to maximise their impact. In order to improve the distribution of information, regular meetings will be organised between the work package steering-committee members and the project-coordination committee members.
Participants in ENSAR2 projects will take part in international conferences in order to diffuse information about results. They will also participate in science festivals and other local/national initiatives for public. ENSAR2 infrastructures will organise regularly ‘open doors’ actions.

3. Implementation

3.1 Work plan — Work packages, deliverables and milestones

3.1.1 Brief presentation of the overall structure of the work plan

ENSAR2 work plan is focused on the **Transnational Access activities**. They **are the central part of the project**, being supported by Joint Research Activities and Networking Activities, which aim at improving the access both in quality and quantity. Therefore, these latter activities are dedicated to developments ranging from ion-beam production, detector techniques, experimental studies, theoretical models, simulations to innovation actions with industry. The work plan reflects this approach that encompasses the whole process of research with ion beams. Deliverables and milestones indicate the major actions for each activity.

Special attention is paid to innovation potential of infrastructures, user projects, and developments in other work packages, **through the Networking Activity NuPIA** that will study the innovation impact of the whole ENSAR2 consortium and implement measures for information exchange, training and communication between innovation officers, researchers and industries.

3.1.2 Timing of the different work packages and their components

	1st year				2nd year				3rd year				4th year			
Work Package NA1 - FISCO2	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
D1.1: Dissemination				**D**												
MS1.1: Start of impact studies						**M**										
D1.2: Facility Coordination Group								**D**								
D1.3: Impact studies												**D**				
D1.4: Nuclear Physics in European Research Area																**D**
Work Package NA2 - NuSPRASEN	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS2.1: Constitution of steering committee, schedule and budget distribution	**M**															
MS2.2: Workshop on nuclear structure		**M**														
MS2.3: Workshop on nuclear reactions								**M**								
D2.1: Report on workshops in months 1-12					**D**											
MS2.4: Workshop on nuclear astrophysics								**M**								
D2.2: Mid-term report									**D**							
MS2.5: Workshop on superheavy elements											**M**					
D2.3 Report on EURISOL Town Meeting												**D**				
D2.4 Report on workshops in months 25-34													**D**			
MS2.6: Workshop on cross-combining elements														**M**		
D2.5: Final report: future directions																**D**
Work Package NA3 - MIDAS	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS3.1: Steering committee established	**M**															
MS3.3: Program for hands-on training		**M**														
MS3.2: Website established for database			**M**													
D3.1: Report on setup of common database				**D**												
D3.4: Report on hands-on-training											**D**					
D3.3: Report on a series of workshops														**D**		
D3.2: Report on the networking activities																**D**

Work Package NA4 - NUSPIN	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS4.1: Setup of the website, Scientific Committee and Working groups				**M**												
D4.1: Setup of the website, Scientific Committee and Working groups				**D**												
MS4.2: Scientific and Working groups meetings							**M**									
D4.2: Midterm report on the activity of the Scientific Committee and Working Groups									**D**							
D4.5 Midterm report on the Collaboration Workshops and training activities									**D**							
MS4.3: Collaboration Workshops											**M**					
D4.3: Intermediate report on the activity of the Scientific Committe and Working Group												**D**				
D4.6 Intermediate report on the Collaboration Workshops and training activities												**D**				
MS4.4: Training courses and exchange of personnel															**M**	
D4.4: Final report on the activity of the Scientific Committee and Working Groups																**D**
D4.7 Final report on the Collaboration Workshops and training activities																**D**
Work Package NA5 - MEDINET	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS5.1: Kickoff-Meeting	**M**															
MS5.2: Website		**M**														
D5.1: Specific need and proposed solutions of nuclear tools for medecine			**D**													
D5.2: Clarifying/adapting nuclear concepts to the medical field							**D**									
MS5.3: Mid-term meeting									**M**							
D5.3: Nuclear physics instrumentation for medicine												**D**				
MS5.4: Final meeting																**M**
D5.4: Use of nuclear tools to support biological effectiveness assessment in ion-beam therapy															**D**	

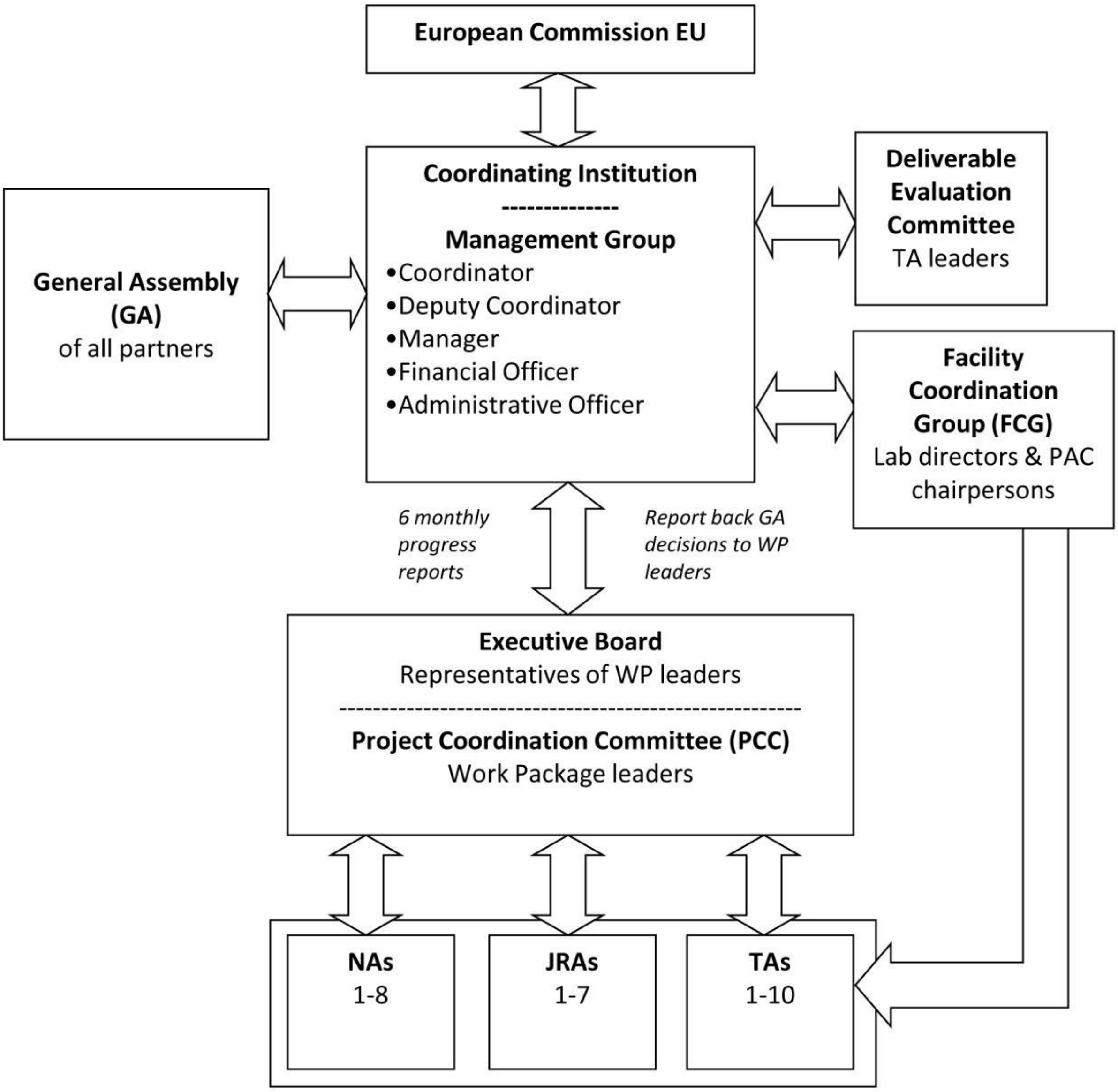
Work Package NA6 - GDS	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS19: Creation of the GDS coordination committee	**M**															
MS20: Creation of the GDS community		**M**														
MS21: News Feed		**M**														
D6.1: Web site		**D**														
D6.2: GDS Topical Meeting "GDS in strong and non-uniform magnetic fields"																**D**
D6.3: GDS Topical Meeting "GDS for high-intensity and heavy-ion beams"																**D**
D6.4: GDS Topical Meeting "GDS with rare gas targets: handling and recycling"																**D**
D6.5: GDS Topical Meeting "GDS coupling to auxiliary detection systems"					**D**											
Work Package NA7 - ENSAF	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS22: ENSAF webpages	**M**															
MS25: Meetings on Training at Small-Scale Accelerator				**M**												
MS24: International Workshop on Accelerator Operation and Management					**M**											
D7.2: Overview on "International Workshop"							**D**									
MS23: 2nd ENSAF Workshop										**M**						
D7.1: Strategy "Physics Opportunities"												**D**				
D7.3: Strategy "Training Opportunities"												**D**				
D7.4: Strategy "Integration"																**D**
Work Package NA8 - NUPIA	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
D8.5 Dissemination kit					**D**											
D8.6 Report on the survey of available courses in European countries…				**D**												
MS28: Report – website and workshop						**M**										
MS26: Decision for technology transfer network								**M**								
MS29: Report - summary of courses								**M**								
D8.1: Intermediate report on innovation survey								**D**								
D8.3: Intermediate report on the identified industrial network								**D**								
MS27: End of the collection of impact data														**M**		
D8.7 Intermediate report on the provided courses												**D**				
D8.2: Report ready to be distributed to stakeholders, end-users and funding agencies																**D**
D8.4 Report on Industry Day, workshops																**D**
D8.8 Report on courses in nuclear techniques for industrial partners																**D**

Work Package JRA1 - PASPAG	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS9.1: Crystal characterisation				**M**												
D9.1: Report: present status of new Scintillator Materials and their basic characterisation				**D**												
MS9.2: Scintillator readout Test-bench						**M**										
D9.2: Report: Sensor characterisation and base design of hybrid detectors						**D**										
MS9.3: Hybrid readout								**M**								
MS9.4: Data processing								**M**								
D9.3: Report: Scintillator response to gamma and particle radiation								**D**								
D9.4: Report: Digital pre-processing at frontend										**D**						
MS9.5: Imaging using Segmented detector												**M**				
D9.5: Report: Design Phoswich Assemblies for homeland security												**D**				
D9.6: Report: Summary of test results																**D**
Work Package JRA2 - PSeGe	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS10.1: Kick-off R&D		**M**														
MS10.2: Detector R&D Application / associated technologies workshop				**M**												
D10.1: Completion of the JRA2 kick-off meeting				**D**												
MS10.3: Detector R&D Application / associated technologies workshop								**M**								
D10.2: Advancement report for the Segmentation and Geometry tasks										**D**						
D10.3: Advancement report for the p-type task										**D**						
D10.4: Advancement report for the Imaging task										**D**						
MS10.4: Completed R&D Detector R&D Application workshop																**M**
D10.5: Final report for the Segmentation and Geometry tasks																**D**
D10.6: Final report for the p-type task																**D**
D10.7: Final report for the Imaging task																**D**
Work Package JRA3 - THEOS	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS11.1: Definition of an appropriate power counting								**M**								
MS11.3: Definition of appropriate reaction observables								**M**								
D11.1: New effective interaction for beyond mean-field calculations								**D**								
D11.2: Codes for transfer and CDCC calculations								**D**								
D11.3: Eikonal-based code to describe dynamical effects…												**D**				
MS11.2: Inclusion of quantum fluctuations																**M**
MS11.4: Understanding the dynamical effects																**M**
D11.4: Report and package of the TDHF+BCS and QRPA codes																**D**

Work Package JRA4 - RESIST	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
D12.1: Report on Task developments from RESIST				D												
MS45: Ionization scheme development								M								
MS59: Automated wide-range wavelength tunability for scheme development								M								
D12.2: Mid-term report on new techniques to enhance ion beam purity prior to the LIST multipole								D								
D12.3: Mid-term report on new methods to improve the efficiency, selectivity and spectral resolution								D								
D12.4: Mid-term report on new concepts and developments related to laser technologies								D								
MS46: Pulsed dye amplifier												M				
MS58: New high temperature transfer line material utilized for surface ion suppression												M				
MS43: Reduction of hot cavity and gas jet radioisotope deposition																M
MS44: Supersonic, high Mach number gas jet produced																M
D12.5: Final report on new techniques to enhance ion beam purity prior to the LIST multipole																D
D12.6: Final report on new methods to improve the efficiency, selectivity and spectral resolution																D
D12.7: Final report on new concepts and developments related to laser technologies																D
Work Package JRA5 - SATNuRSE	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS47: New nuclear data libraries for GEANT4								M								
MS48 : Heavy-ion penetration in GEANT4								M								
MS49: Algorithms for specific analysis and tracking								M								
MS50: Inventory finished												M				
D13.3: Inventory and protocol for data management																D
D13.4: Workshop														D		
D13.1: Improved data libraries																D
D13.2: Code ENSARRoot																D

Work Package JRA6 - EURISOL	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS51 Experiments for the optimal breeder configuration								**M**								
D14.1: Report on performances of the EBIS debuncher								**D**								
MS52: Nuclear data of produced beams												**M**				
D14.2: Report on R&D on radioactive plasma ion sources												**D**				
D14.3: Conceptual design report of a new generation charge breeder															**D**	
D14.4: New targets, ion sources and beams																**D**
D14.5: Chart of beams																**D**
Work Package JRA7 - TECHIBA	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
MS53: Construction of polishing device				**M**												
D15.10: Report on Chip design				**D**												
MS54: Prototype of a PVT + PPO plastic scintillator								**M**								
MS61: Simulated and real signal database for pulse shape analysis								**M**								
MS62: Approval of chamber design by CERN health physics								**M**								
D15.1: Report on the characterization of a Niobium disk under RF												**D**				
D15.5: Plastic scintillator prototype								**D**								
D15.7: Report on R&D on studies on X-ray emission and detector material													**D**			
MS56: Asic prototype										**M**						
MS60: Test of the prototype with radioactive source…											**M**					
MS55: Detector design and construction												**M**				
MS63: Design of molten Bi target prototype for use at ARRONAX or SPIRAL2												**M**				
D15.3: Report on 1 kW high power target station																**D**
D15.4: Report and publication on yields, radioisotopic purity and disturbing impurities achievable												**D**				
D15.6: Report of experimental results of the tests of the prototype																**D**
D15.8: Report on R&D on characterization and optimization of detector design												**D**				
D15.2: Report on the polishing results on an accelerating cavity																**D**
D15.9: Report on detector test (source and in-beam)																**D**
D15.11: Report on silicon detector and ASIC tests																**D**

3.1.3 Graphical presentation of the components showing how they inter-relate



3.2 Management structure and procedures

3.2.1 Organisational structure and decision-making mechanisms

Coordination bodies

The main scheme describing the communication flow within the consortium, the distribution of rights and responsibilities, etc. contains the following elements:

- **General Assembly (GA):** The general assembly is constituted by one representative of each participating laboratory/institution. The GA will insure the feedback to the community at large and monitor the overall progress of ENSAR2. The GA (each contractor having one vote) approves the working plan, matters relevant to the overall budget, changes in the structure of the project (including the involvement of new partners or the withdrawal of participants), changes in the consortium agreement, and final termination of the project. The GA will elect its chairperson in the first meeting.

  Planned ordinary meetings are: yearly meetings at "T0 + 9 month", "T0 + 20 month", "T0 + 38 month" and towards the end of the project. T0 denotes the legal starting date of the project. Extraordinary meetings can be called upon request of the coordinator, of 1/3 of the Contractors or of any Contractor in case of an emergency situation.

- **Work package Coordinator/Steering Committees (SC):** Each work package has its own Steering Committee and a work package coordinator, who manages the work package and represents the work package in the PCC. For TA activities, there is no need for a Steering Committee. In this case, the RI appoints a facility coordinator.

  The SC meets when the need arises to set technical requirements and/or when demanded by progress of the work packages (milestones, deliverables, etc.).

  Meetings of a SC are scheduled by the respective work-package coordinator.

- **Project Coordination Committee (PCC):** It is constituted of all work-package coordinators and the ENSAR2 coordinator/managing team and it supports the ENSAR2 coordinator in all management issues. The PCC prepares the topics to be decided by the GA. It will meet twice per year and survey the overall coherence of the activities within ENSAR2. The PCC will also elect an executive board with 6 members (3x2 from the research infrastructures, the networks and the joint research projects). The executive board is for rapid interaction with the ENSAR2 coordinator and its managing team on pressing issues. These procedures allow an efficient project management and control both scientifically and administratively.

- **Project Coordinator/Managing Institution:** The coordinator is the sole contact person with the European Commission; (s)he has the full responsibility for all scientific and administrative coordination of the whole project. (S)He is the chair of the PCC. The chosen coordinator will be assisted by the managing institution (GANIL) and is head of the project office. (S)He will receive a 25%-contract with GANIL. To help with this task, the project office is constituted of a manager, a financial officer and an administrative assistant based at GANIL. GANIL will handle all financial transactions and accounting as well as all organisational matters.

- **Deliverable Evaluation Committee**: it is constituted of Transnational Access leaders or their representative. Its role is to control the quality of deliverable reports written by ENSAR2 participants before submission to the European Commission.

- **Facility Coordination Group (FCG)**: A facility coordination group will be set up through ENSAR2, consisting of the directors of the infrastructures providing transnational access, the chairmen of the local Programme Advisory Committees (PACs), the representative of the ENSAF network of small-scale facilities and the coordinator of ENSAR2. This FCG activates and promotes access to the joint facilities. Furthermore, the FCG will meet once a year to review the working procedures of the various PACs and will participate in the definition and the improvement of the criteria for access. Beyond the confidentiality aspect of the proposals submitted to the various PACs, which has to be respected, the FCG will give advice on the strategic coordination of the scientific programmes and proposals after their evaluation by the local PACs. Based on the reports of the local PAC chairs, the FCG discusses and makes recommendations on common policies for the proposed experimental programmes, for allocation of the appropriate infrastructure, for allocation of financial support for transnational access in the framework of ENSAR2, for the eligibility criteria applied and for exchange of best practices. Therefore, the mission of this overarching Facility Coordination Group would be to do the coordination and harmonisation between the ENSAR2 infrastructures and also their PACs and thus go a long way in the spirit of the 'Integrating activity' programme through integration of the transnational access.

The organisational structure and decision mechanisms of ENSAR2 favour the involvement of all actors of the project through their corresponding decision body. With regular meetings and daily contact with the management team, an up-to-date overview of the project progress and a rapid decision process are possible.

The innovation management will be performed through the dedicated work package NuPIA for the whole ENSAR2 project. Innovation officers of partner institutions will be involved in this work package and will put together their expertise in order to optimise the innovation management for the ENSAR2 consortium.

Review procedures for Transnational Access to experimental infrastructures

When a group of physicists submit a written proposal to conduct an experiment at an ENSAR2 infrastructure, the proposal is directed to the Programme Advisory Committee (PAC) of the infrastructure. The PACs consist of several experts from laboratories of the host country and of countries in Europe and outside Europe. The PACs meet approximately twice a year each to evaluate and rank proposals, and to make recommendations to the laboratory management.

In most infrastructures, all proposals for new experiments and continuations of experiments are presented by their spokespersons during the public session of these committees. During the closed session, the committee ranks the proposals in a secret-vote procedure and formulates written recommendations for the beam-time allocation sent to the spokesperson of each proposal. The evaluation process is based entirely on the criteria of scientific excellence and feasibility. The evaluation can also be performed remotely by PAC members. Following or simultaneously with the PAC meeting, a Selection Panel comprising members of the PAC considers the request for TA support by proposed experiments which fulfil the TA criteria for support. However, the support for TA grant has to be asked at the submission of a scientific proposal. The following points should be stressed:

- The selection of international users who benefit from the TA support is based solely on the scientific merit of the proposals.
- All the experiments fulfilling TA criteria can benefit from the TA funds, with a special attention to new users and users from countries where such infrastructure is not available.

Beam times are typically one week and are allocated to the user group on the basis of the proposals approved by the PAC. The unit of access offered is beam hour. As a rule, outside users will be spending a few extra days per user on top of the experiment time, to set up the experiment and potentially perform a first analysis of the data. Contacts with local research groups can be established to have detailed information about beams and experimental facilities available at RIs. Access costs will be declared on the basis of unit cost, a unit cost being the total cost incurred to provide one hour of beam on target.

3.2.2 Innovation management

The innovation management will be performed through the dedicated work package NuPIA for the whole ENSAR2 project. It is described in details in that section and there is no need to expand on here.

Innovation officers of partner institutions will be involved in this work package and will put together their expertise in order to optimise the innovation management for the ENSAR2 consortium.

ENSAR2 Management will implement a consortium agreement at the start of the project in order to settle questions arising from the assignment of Intellectual Property Rights (**IPR**).

3.2.3 Table 3.2c: Trans-national access to be provided

Access provider short name	*Short name of infrastructure*	*Installation*		*Installation Country code*	*Type of access*	*Unit of access*	*Unit cost (UC) (€)*	*Min. quantity of access to be provided*	*Access costs*		*Estimated number of users**	*Estimated number of user projects*
		Nr	*Short name*						*On the basis of UC*	*As actual costs*		
GANIL	GANIL-SPIRAL2	1	GANIL-SPIRAL2	FR	TA-uc	Beam hour	130.48	3750	489,300.00		200	48
INFN	LNL-LNS	1	NSDBF+ AIPF	IT	TA-uc	Beam hour	91.85	4480	411,488.00		176	52
CERN	ISOLDE	1	ISOLDE	CH	TA-uc	Beam hour	74.52	5200	387,504.00		1800	70
JYU	JYFL	1	JYFL	FI	TA-uc	Beam hour	105.00	3000	315,000.00		280	60
CNRS	ALTO	1	ALTO	FR	TA-uc	Beam hour	103.40	2539	262,532.60		108	30
GSI	GSI	1	UNILAC	DE	TA-uc	Beam hour	54,48	1920	104,601.60		120	15
RUG	KVI-CART	1	AGOR	NL	TA-uc	Beam hour	322.07	700	225,449.00		68	40
IFJ PAN	NLC	1	NLC-IFJ PAN	PL	TA-uc	Beam hour	116.37	480	55,857.60		25	5
UNIWARSAW	NLC	2	NLC-SLCJ	PL	TA-uc	Beam hour	121.98	1000	121,980.00		50	10
IFIN-HH	IFIN-HH/ELI-NP	1	TANDEM Complex	RO	TA-uc	Beam hour	35.00	1150	40,250.00		100	20
IFIN-HH	IFIN-HH/ELI-NP	2	ELI-NP	RO	TA-ac	Beam hour		1000		35,000.00	20 in 2017 40 in 2018	3 in 2017 6 in 2018
FBK	FBK	1	ECT*	IT		Visitor day	94.00	1080	101,520.00		216	32

3.3 Consortium as a whole

3.3.1 Description of the consortium

ENSAR2 is the integrating activity (IA) for European nuclear scientists who are performing research in three of the major subfields defined by NuPECC: Nuclear Structure and Dynamics, Nuclear Astrophysics and Nuclear Physics Tools and Applications. It provides access to nine of the complementary world-class large-scale facilities: GANIL (F), GSI (D), joint LNL-LNS (I), JYFL (FI), KVI-CART (NL), CERN-ISOLDE (CH), ALTO (F), joint IFIN-HH/ELI-NP (RO) and NLC (PL), which together provide unique opportunities to perform research in the three above-mentioned domains because of the variety of available beams and state-of-the-art instrumentation. These facilities provide stable and radioactive ion beams of excellent qualities ranging in energies from tens of keV/u to a few GeV/u and intense photon beams up to 20 MeV energy. The stable-ion beams range from protons to uranium. Radioactive ion beams are produced using the two complementary methods of in-flight fragmentation (IFF) and isotope separation on-line (ISOL), so that several hundred isotopes are available for the users. The high-intensity, high-energy photon beams are produced by laser back-scattering from high-energy electron beams. In addition, the infrastructure ECT* (I) will provide a unique place for meetings, seminars and workshops to the community and an excellent forum for theorists and experimentalists to discuss progress in the field and point to forward directions of research.
These infrastructures will be offering access to a very large, wide and diverse user community. The size of this community of physicists in nuclear structure, nuclear astrophysics, and applications of nuclear science in addition to the staff that is involved in accelerator and detector development and in running the facilities ranges between 2700-3000 scientists and highly qualified engineers. The facilities will also provide an increased amount of beam time for applications of nuclear techniques in which industries may be involved.

To enhance the access to these facilities, the community has defined a number of Joint Research Activities (JRAs), using as main criterion scientific and technical promise. These activities deal with novel and innovative technologies to improve the operation of the facilities. They are in general relevant to more than one facility and rely on strong participation of the European university groups. These activities involve all facets of operation of an accelerator facility.

The network activities of ENSAR2 have been set-up with specific actions to strengthen the community work in TNAs and JRAs. In this vein, the scientific interests of the nuclear structure, nuclear reactions and nuclear astrophysics communities are discussed in several NAs that deal with different aspects of research and technical developments at ENSAR2 research infrastructures. Enhancement of collaboration between large-scale and small-scale facilities, stimulation of innovation, relationships with industry and application-oriented research, in particular about technologies for nuclear medicine and studies of radiation biological effects, are also foreseen in a few NAs.

Steps undertaken to establish this consortium and to choose the different activities are described here below.

Setting up the Scientific Steering Committee (SSC)/bottom-up approach

The large community of nuclear physics has chosen the ENSAR2 activities in a self-organised and transparent way. A call for ideas was launched end of 2012 to the whole community to come up with ideas for Transnational Access, Joint Research and Networking Activities. In parallel, major European infrastructures were asked to nominate a RI representative and an outside expert to be members of the ENSAR2 Scientific Steering Committee (SSC). The SSC is composed of 18 representatives and experts from different European countries, with two additional members: the ENSAR coordinator and manager. The SSC members have a good overview of the existing activities, and the potential for successful collaborative research and innovation at the present ENSAR2 research infrastructures. In May 2013, the SSC performed a first selection from the more than forty work-package proposals (JRAs and NAs) submitted by scientists.

Following the ENSAR Town Meeting in Warsaw in June 2013, a day was devoted for the presentation of the first-phase selected work packages by the spokespersons of their collaborations. The SSC could then perform a second selection to define the optimal and novel work packages of ENSAR2. A number of criteria was set out following the rules, set also by the EC, of excellence, quick applicability and ultimately benefiting the infrastructures. This would in turn reflect positively on the community and its scientific projects as a whole. The SSC suggested in a top-down approach ideas, mechanisms and possibilities for merging and improvement of the work packages to make them complementary but coherent and to satisfy the needs set out by the community. This process was repeated after the publication of the call for the Integrating Activity instrument at the end of 2013.

Setting up the consortium/ mixed bottom-up and top-down approaches resulting in unique research opportunities for the European nuclear physics community

Selection of research infrastructures for Transnational Access Activities

The choice of the ENSAR2 research infrastructures was made judicially. These infrastructures allow forefront and for a large part unique worldwide research opportunities for nuclear-physics studies, and also for inter-/multidisciplinary research exploiting nuclear beams. Concerning this last aspect all ENSAR2 ion-beam infrastructures have a successful track record. Yet, **these infrastructures are complementary through the diversity of accelerated beams offered. The complementarities also arise because of the existence of unique instrumentation in each laboratory** making it possible to address certain aspects of physics that cannot be done elsewhere. The composition of the infrastructures in relation to the objective of providing the users with the best quality beams and the best major and/or ancillary equipment has been realised. In totality, ENSAR2 infrastructures will provide the European user with the highest energy fragment and post-accelerated beams, the highest intensities for enriched isotope beams, the smallest-emittance proton beams, the largest-range and the shortest-lived ISOL beams**. New infrastructures** will be open for access for the first time, **as IFIN-HH/ELI-NP in Romania and NLC in Poland. Three TA infrastructures are involved in ESFRI projects.** In addition, ECT* will provide a unique environment of high-level exchanges of scientific results and knowledge. The commitments of the infrastructures to providing access can also be recognised by the small fraction of the cost of running the infrastructure that is being requested from the EC. Furthermore, the ENSAR2 research infrastructures (ENRI) commit themselves through a formal agreement, so-called ENRI agreement, to set up a Facility Coordination Group (FCG), which will coordinate and harmonise the procedures of the PACs of the RIs and facilitate exchange of information and best practices.

Selection of the Joint Research Activities and Networking Activities

The self-organisation of the community spurred by the SSC ensured perfect matching of expertise within the work packages for JRAs and NAs. Having reduced the number of JRAs and NAs to the minimum required to improve the quality of the infrastructures, the novel ideas presented by the community were structured to address key aspects of running infrastructures for experimental programmes at the cutting-edge of the subfields of nuclear physics. The different excellent expertise from all across Europe were put together to solve advanced technological problems. These different expertise will induce cross-fertilisation that will result in the best and most innovative solutions for the questions at hand. The distribution of the expertise is very well balanced in each JRA in relation to its objective. The objectives of the JRAs and NAs are complementary, but sharing one collective objective, i.e. to improve the quality of the infrastructures and of the scientific results. Therefore, the composition of the consortium is well balanced as a whole in relation to the objective of **improving the quality and quantity of access to the infrastructures** and the optimal use of generated data.

In ENSAR2, particular importance is also attributed to all RTD work that might lead to inter-, multidisciplinary or industrial applications. The commitment of the community is large as can be deduced from the financial and manpower resources committed by the community in addition to those being asked from the EC. With the track record of the excellent university groups partaking in this endeavour the RTD projects are deemed to succeed and yield results within the running period of ENSAR2.

The same is true of the Networking Activities, which have been chosen to enhance the access to the facilities. The experts of the fields in Europe collaborate together with the aim of improving the beam and detector qualities, the experiment preparation and the best applications in terms of innovation, especially for medicine. These NAs comprise dedicated scientists who have committed their resources to the success of these NAs with the ultimate goal to forge collaborations that would use the infrastructures intensively in the future.

3.3.2 Industrial/commercial involvement in the project

The infrastructures will be used in multidisciplinary and industrial approaches. Already, **ESA and** also **commercial companies have signed contracts** with a number of the infrastructures to use beam irradiation for various application purposes. JRAs and NAs will also benefit industry; **SMEs are involved** in MIDAS, for instance. It is clear from the interest shown by the SMEs that they see possible commercial applications of some ENSAR2 studies. The Network NuPIA will be the interface between ENSAR2 scientists and industry, through innovation officers in ENSAR2 institutions.

3.4 Resources to be committed

In ENSAR2, resources are distributed between work packages according to a specific strategy. The ENSAR2 Scientific Steering Committee defined a financial distribution favouring the Transnational Access, with 47% of the total budget (see table 3.1b). This choice reflects the important focus on users in this project, privileging access to ENSAR2 infrastructures. In the same spirit, NAs and JRAs devote a large part of their budgets to workshops, schools and town meetings that are open to the whole community using ion beams and high-intensity γ-ray beams.

The human resources are distributed according to the needs of each NA and JRA. For TAs, the staff effort reflects the calculation method for the access cost. For instance, GANIL and CERN have chosen not to take into account the manpower in the access cost calculation.
In addition to the personnel costs indicated in the ENSAR2 project, numerous research institutions will invest human resources without funding from the European Commission. The contribution of ENSAR2 beneficiaries is estimated to be 1216,5 person.months. A detailed table presents the distribution of this contribution per institution in Section 4 (4.1.31) of the ENSAR2 project.

3.4.1 Table 3.4b: Other direct costs

Participant 1 - GANIL	**Cost (€)**	**Justification**
Travel	~~298600~~381264,00	Travels, meetings, workshops, conferences for NA FISCO2, NA MIDAS, NA GDS, NA NuPIA, JRA RESIST, JRA EURISOL and JRA TecHIBA
Equipment	35000,00	Mechanics for adapting ion sources to GANIL test bench for JRA EURISOL
Other goods and services	12000,00	Communication kit for NA NuPIA and consumables for JRA TecHIBA
Travel and subsistence for trans-national access	391760,00	
Total	~~737360~~820024,00	
Participant 2 - INFN	**Cost (€)**	**Justification**
Travel	85800,00	Travels, meetings, workshops and schools for NA NUSPRASEN, NUSPIN, NA GDS, NA MediNet, JRA PASPAG and JRA EURISOL
Travel and subsistence for trans-national access	275610,40	
Total	361410,40	
Participant 3 - CERN	**Cost (€)**	**Justification**
Travel	36800,00	Travels, meetings, workshops for NA MediNet, JRA RESIST, JRA EURISOL and JRA TecHIBA
Equipment	32000,00	Completion of EBIS test band for JRA EURISOL
Other goods and services	14000,00	Procurement of transition metal polycarbonyl complexes for JRA EURISOL and consumables for JRA TecHIBA
Travel and subsistence for trans-national access	259596,00	
Total	342396,00	
Participant 4 - JYU	**Cost (€)**	**Justification**
Travel	66000,00	Travels, meetings and schools for NA MIDAS, NA NuPIA and JRA RESIST
Travel and subsistence for trans-national access	246400,00	
Total	312400,00	

Participant 5 - CNRS	**Cost (€)**	**Justification**
Travel	187700,00	Travels, meetings, workshops and schools for NA MIDAS, NA NUSPIN, NA GDS, NA MediNet, JRA PSeGe, JRA RESIST, JRA EURISOL, JRA TecHIBA
Other goods and services	25000,00	Sample crystals for JRA PASPAG and consumables for JRA TecHIBA
Travel and subsistence for trans-national access	118773,92	
Total	331473,92	
Participant 6 – GSI	**Cost (€)**	**Justification**
Travel	68700,00	Travels, meetings and schools for NA MIDAS, NA NUSPIN, NA MediNET, JRA PASPAG, JRA PseGe and JRA RESIST
Travel and subsistence for trans-national access	165118,72	
Total	233818,72	
Participant 7 - RUG	**Cost (€)**	**Justification**
Travel	67900,00	Travels, meetings and schools for NA MIDAS, NA MediNet and JRA SATNuRSE
Travel and subsistence for trans-national access	68440,80	
Total	136340,80	
Participant 8 - IFJ PAN	**Cost (€)**	**Justification**
Travel	12200,00	Travels, meetings and workshops for NA MediNet, JRA PASPAG and JRA EURISOL
Equipment	21000,00	Construction of transfer line prototype for JRA EURISOL
Travel and subsistence for trans-national access	31357,92	
Total	64557,92	
Participant 9 - UNIWARSAW	**Cost (€)**	**Justification**
Travel	46400,00	Travels, meetings and workshops for NA MediNet, NA NuPIA, JRA PASPAG, JRA EURISOL and JRA TecHIBA
Equipment	8000,00	Electronics and mechanics for beam tests for JRA PASPAG
Other goods and services	1000,00	Consumables for JRA TecHIBA
Travel and subsistence for trans-national access	46372,00	
Total	101772,00	
Participant 10 - IFIN-HH	**Cost (€)**	**Justification**
Travel	16000,00	Travels, meetings and workshops for NA NUSPRASEN and JRA PASPAG
Other goods and services	9340,00	Electricity, gases and liquids for TA IFIN-HH/ELI-NP = part of ELI-NP actual costs: Personnel costs: 18660,00 € Other direct costs: 9340,00 € Indirect costs: 7000,00 € Total (ELI-NP actual costs): 35000,00 €
Travel and subsistence for trans-national access	59800,00	
Total	85140,00	

Participant 11 – FBK	Cost (€)	Justification
Travel and subsistence for trans-national access	101984,00	
Total	101984,00	
Participant 12 – EBG MedAustron	**Cost (€)**	**Justification**
Travel	32000,00	Travel, meetings and workshops for NA MediNet
Total	32000,00	
Participant 13 - KULeuven	**Cost (€)**	**Justification**
Travel	23000,00	Travel, meetings and workshops for NA GDS and JRA RESIST
Total	23000,00	
Participant 15 - CEA	**Cost (€)**	**Justification**
Travel	32000,00	Travels, meetings and workshops for NA GDS, NA NuPIA and JRA SATNuRSE
Other goods and services	22000,00	Surface quality control and consumables for JRA TecHIBA
Total	54000,00	
Participant 17 - JLU	**Cost (€)**	**Justification**
Travel	103000,00	Travel, meetings and workshops for NA NUSPRASEN
Total	103000,00	
Participant 19 - LMU	**Cost (€)**	**Justification**
Travel	42400,00	Travel, meetings and workshops for NA MediNet
Total	42400,00	
Participant 20 - UCO	**Cost (€)**	**Justification**
Travel	12000,00	Travels, meetings and workshops for JRA PSeGe
Total	12000,00	
Participant 21 - NCSRD	**Cost (€)**	**Justification**
Travel	48000,00	Travel, meetings and workshops for NA ENSAF
Total	48000,00	
Participant 25 - CSIC	**Cost (€)**	**Justification**
Travel	71700,00	Travels, meetings and schools for NA NUSPIN, NA MediNet, JRA PASPAG, JRA PSeGe, and JRA SATNuRSE
Total	71700,00	
Participant 26 - USC	**Cost (€)**	**Justification**
Travel	16400,00	Travels, meetings and workshops for NA GDS, JRA PASPAG and JRA SATNuRSE
Total	16400,00	
Participant 27 - USE	**Cost (€)**	**Justification**
Travel	32000 ,00	Travel, meetings and workshops for NA ENSAF
Total	32000,00	
Participant 28 - ULIV	**Cost (€)**	**Justification**
Travel	73000,00	Travel, meetings and schools for NA NUSPIN and JRA PSeGe
Total	73000,00	
Participant 29 – UoY	**Cost (€)**	**Justification**
Travel	6000,00	Travel and meetings for JRA PASPAG
Total	6000,00	
Participant 30 – MTA Atomki	**Cost (€)**	**Justification**
Travel	38000,00	Travel, meetings and workshops for NA NUSPRASEN and NA MIDAS
Total	38000,00	

4. Members of the consortium

4.1 Participants (applicants)

4.1.1 GANIL

Description

GANIL (Grand Accélérateur National d'Ions Lourds) has been funded at Caen, France since 1983 as an institute for fundamental research to investigate and consolidate knowledge about the atomic nucleus. The laboratory is operated jointly by the National Institute of Nuclear and Particle Physics (IN2P3) belonging to the National Centre for Scientific Research (CNRS) and Direction des Sciences de la Matière (DSM) of the Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA). The relation between GANIL and its third parties CNRS and CEA in the ENSAR2 project, especially in matter of personnel, is further developed in section 4.2.

The quality of beams delivered by its accelerators makes GANIL an outstanding facility used also by other disciplines, via laboratories associated with CIRIL (Centre Interdisciplinaire de Recherche Ions - Lasers) and ENSI Engineer's High School in Caen, gathered in an interdisciplinary research hub. The range of areas explored with GANIL beams extends from astrophysics to radiobiology, including the science of materials (ageing of materials, hardness of electronic components carried into space and of reactor vessels, etc.). With GANIL and its industrial applications department, several specialised companies have been formed in areas ranging from the production of microporous membranes (filters) to the development of new electronic modules and ion sources. The accelerator complex of GANIL comprises Electron Cyclotron Resonance (ECR) ion sources and five cyclotrons: two injectors and two sector-separated cyclotrons put in a cascade delivering stable beams and CIME large-acceptance cyclotron for the acceleration of radioactive ion beams at the SPIRAL facility operating since 2001. Up to 3 simultaneous beams in the energy range from 1 to 100 MeV/nucleon are available. The accelerators provide for users up to 10000 hours per year of heavy-ions beams.

The SPIRAL2 facility, under construction, will extend the GANIL possibilities to heavier radioactive beams, and/or with much higher intensities: it will provide intense beams of neutron-rich exotic nuclei (10^6–10^{11} pps in the mass range 60 to 140), created by the ISOL production method. The layout of the SPIRAL2 driver is based on a superconducting linac driver, which will deliver a high-intensity, 40 MeV deuteron beam as well as a variety of heavy-ion beams with mass-to-charge ratio 3 and energy up to 14.5 MeV/nucleon. The SPIRAL2 accelerator is now under final installation, the beam commissioning should start during the last quarter of 2014.

GANIL pursues high-quality, front-line scientific research and actively participates in education and instruction of (graduate) students and postdocs (about 100 each year) in an international environment. GANIL has 245 full-time employees. About 700 researchers from 30 different countries visit GANIL each year to perform experiments.

The main tasks of GANIL within ENSAR2 are the coordination of TA GANIL-SPIRAL2, providing access to the facility, NA FISCO2, financial and scientific management of ENSAR2, NA GDS on gas-filled detectors and systems, NA NuPIA, the transverse activity on innovation, and the participation in NA MIDAS for the developments of ion sources and beams, in JRA RESIST for resonance laser ionisation techniques, in JRA EURISOL for developments for current and future ISOL facilities, and in JRA TecHIBA for high-intensity stable beams.

GANIL has experience in transnational access to its facilities in the FP3 – FP7 EC framework programmes and in coordination of European contracts (EURISOL, SPIRAL2 Preparatory Phase, ENSAR). In particular, a dedicated GANIL group, "Bureau de la Coopération Scientifique", is specialised in project management. GANIL has several expert groups and services in charge of advanced R&D in basic and applied nuclear, atomic and solid-state physics. The GANIL staff has successful experience in running complex stable- and radioactive-ion accelerator facilities, management of large collaborations and is world expert in techniques relating to ECR ion-source technology, advanced electromagnetic spectrometers, complex particle detectors, electronics and data-acquisition systems. Therefore, the facility is fully prepared to fulfil in an optimal way all tasks attributed to it in ENSAR2, including ENSAR2 coordination and management. For more information: http://www.ganil-spiral2.eu/

Key persons in charge of activities

GANIL works only with personnel from CNRS and CEA. These personnel are listed in section 4.2.

Publications

- Search for Superscreening Effects in a Superconductor, P. Ujic, F. de Oliveira Santos, M. Lewitowicz, et al., Phys. Rev. Lett. 110, 032501 (2013)
- Status of the SPIRAL2 Project, M. Lewitowicz, Acta Phys. Pol. B42, 877 (2011)
- The SPIRAL2 Project and experiments with high-intensity rare isotope beams, M. Lewitowicz, J. Phys.: Conf. Ser. 312 052014 (2011)

- Upgrade of the SPIRAL identification station for high-precision measurements of nuclear β decay, G.F. Grinyer et al., Nucl. Instr. Meth. A 741 18-25 (2014)
- Improved half-life determination and β delayed γ-ray spectroscopy for ^{18}Ne decay, G.F. Grinyer et al., Phys. Rev. C 87 045502 (2013)

Projects

- FP7 SPIRAL2 Preparatory Phase (coordinator)
- FP7 ENSAR Integrating Activity (coordinator)
- FP7 CRISP cluster of research infrastructures
- FP7 ERC-StG-2013 - Active Target and Time Projection Chamber (ACTAR TPC)
- FP6 EURISOL Design Study (coordinator)

4.1.2 INFN

Description

INFN (Istituto Nazionale di Fisica Nucleare) is an Italian public organisation carrying out research activity at four national laboratories and 20 divisions located at university physics departments. INFN conducts experimental and theoretical studies in the fields of subnuclear, nuclear, and astroparticle physics since 1951. Moreover, INFN promotes research applications in medicine, art preservation and environment protection. INFN has approximately 1900 employees divided roughly equally between scientific staff and technical and administrative staff.
In the nuclear physics field, basic and applied research is mainly conducted at LNL (Laboratori Nazionali di Legnaro - Padova; http://www.lnl.infn.it/) and at LNS (Laboratori Nazionali del Sud - Catania; http://www.lns.infn.it/). LNL and LNS avail of state-of-the-art heavy-ion accelerator complexes, the Tandem/PIAVE-ALPI of LNL and the Tandem and the superconducting cyclotron of LNS.
INFN has several expert groups actively working in basic and applied nuclear physics. In particular, there is recognised expertise for design, development and running of advanced accelerators (ECR ion sources, radiofrequency cavities) and large detection systems including electronics, data-acquisition and analysis. For more information see: http://www.infn.it/.
The main tasks of INFN in ENSAR2 are the coordination of TA LNL/LNS, NA NUSPIN and the participation in NA MediNet, NA GDS, JRA PASPAG, JRA PSeGe, JRA TheoS, JRA RESIST, JRA EURISOL and JRA TecHIBA.

Key person in charge of activities

Role in the consortium:	participant of JRA PSeGe work package
Main scientific activity:	experimental research in nuclear structure
Name:	NAPOLI
First Name:	Daniel Ricardo
Date of birth:	October 16, 1955
Place of birth:	Buenos Aires (Argentina)
Nationality:	Italian-Argentinian
Gender:	male

2013 – present	Chair of the GAMMA Collaboration in Italy
2003 – present	Member of the Steering Committee of the GAMMAPOOL
2010 – present	Member of the AGATA Collaboration Council
2007 – 2013	Local Responsible of the GAMMA Collaboration at LNL, Italy
2002 – present	Senior Researcher, Istituto Nazionale di Fisica Nucleare, Italy
1991 – 2002	Researcher, Istituto Nazionale di Fisica Nucleare, Italy
1991 – 1989	Invited Scientist, Istituto Nazionale di Fisica Nucleare, Italy
1987 – 1989	Post-doc fellowship at LNL, INFN
1983 – 1987	Researcher in Physics at the Laboratorio Tandar, CNEA, Argentina
1983 – 1983	Physicist consultant at Vialco SA, Argentina
1982	Researcher in the Physics Group of Plantas Quimicas, CNEA, Argentina
1980 – 1982	Technical consultant at Techint SACI, Argentina

Role in the consortium: leader of NA NUSPIN work package

Main scientific activity: experimental research in nuclear structure
Name: LENZI
First Name: Silvia
Nationality: Italian
Gender: female

2012 – present	Scientific Coordinator (spokesperson) of the AGATA (Advanced Gamma Tracking Array) experimental campaign at the GANIL French National Laboratory.
2008 – present	Member of the Study Group of the SPES project of INFN for the development and construction of a radioactive beam facility at the Legnaro National Laboratory.
2008 – present	Member of the Board of Directors of the Euro-School on Exotic Beams
2010 – present	Member of the AGATA Collaboration Council.
2013 – present	President of the "Commissione Didattica", Department of Physics and Astronomy, University of Padova
2004 – present	Associate Professor at the University of Padova, Italy
1995 – 2003	Researcher at the University of Padova, Italy
1994 – 1995	Assistant Research Professor at the Niels Bohr Institute, Copenhagen University
1987 – 1994	Winner of several fellowships in Argentina and Italy
1987	PhD in Physics, University of Buenos Aires, Argentina

Role in the consortium: leader of TA LNL-LNS work package
Main scientific activity: experimental research in nuclear astrophysics
Name: ROMANO
First Name: Stefano
Date of birth: July 14, 1960
Place of birth: Messina (Italy)
Nationality: Italian
Gender: male

2014	Coordinator of the “Ionising and non-Ionising Radiation” second level Master, University of Catania
2013	Coordinator of the International PhD on Nuclear and Particle Astrophysics, University of Catania
2012 - 2014	Deputy of INFN/LNS Director for the management and organisation
2012 - 2014	Scientific Secretary of the Programme Advisory Committee (PAC) – INFN - LNS
2011	Associate Professor – Experimental Physics – University of Catania
2010	Member of the European Working Group on Nuclear Astrophysics - NuPECC
2007 - 2014	National Responsible of research project of INFN
2007 - 2014	Appointment of research at INFN - LNS
2004 - 2007	Local Responsible of research project of INFN
2002 - 2011	Researcher and Teacher in Experimental Physics – University of Catania
1997	PhD Degree on Experimental Nuclear Physics - University of Catania, Catania, Italy

Publications

- AGATA-Advanced GAmma Tracking Array, S. Akkoyun et al. – Nucl. Instr. Meth. A668, 26 (2012)
- Evidence for a spin-aligned neutron-proton paired phase from the level structure of ^{92}Pd, B. Cederwall et al. - Nature 469, 69 (2011)
- M.A. Bentley and S.M. Lenzi: Review article: Coulomb energy differences between high-spin states in isobaric multiplets, Prog. Part. Nucl. Phys. 59, 497 (2007)
- S. M. Lenzi, F. Nowacki, A. Poves, and K. Sieja: Island of inversion around ^{64}Cr - Phys. Rev. C 82, 054301 (2010)
- On the measurement of the ^{13}C(alpha,n)^{16}O s-factor at negative energies and its influence on the s-process - La Cognata, M et al. Astrophysical journal; Volume: 777 - Issue: 2 Article Number: 143 (2013)

Projects

- FP7 SPIRAL2 Preparatory Phase
- FP7 ENSAR Integrating Activity
- FP6 EURONS Integrating Activity

- Since 2010, member of the AGATA Coordination Committee
- Since 2012, Scientific Coordination of the AGATA Physics Campaign at GANIL.

4.1.3 CERN

Description

CERN (European Organisation for Nuclear Research) is an international public research Organisation (http://home.web.cern.ch) which main area of research is the study of the fundamental constituents of matter and the forces acting between them, ISOLDE is one experimental infrastructure within the CERN complex of nuclear and particle physics experiments that also includes anti-proton experiments, relativistic heavy-ion physics, neutrino beams and, as the dominant activity, the LHC colliding beam programme. ISOLDE itself is a multidisciplinary activity where radioactive beams of up to 700different isotopes produced via the ISOL method (Isotope Separation On-Line) are delivered at low energy (60 keV) and post-accelerated beams that will start with 4.3 MeV/u in 2015 and be upgraded up to 10 MeV/u in the period of 2015-2017 as part of the HIE-ISOLDE project that contemplate both an upgrade of the energy as well a design study addressing improvement of beam quality and purity has finished in 2014 and the improvements will be implemented along the duration of this project.
The major part of the physics programme is within nuclear structure, but there are substantial activities within solid-state physics and biophysics as well as within fundamental physics and nuclear astrophysics.
CERN has close to 2500 employees out of which effectively about 40 FTE work on ISOLDE; most employees are technical and supportive staff.
The main tasks of CERN within ENSAR2 are: TA ISOLDE (coordinator), NA MediNet (participant), JRA RESIST (participant), JRA EURISOL (participant) and JRA TecHIBA (participant). ISOLDE/CERN has had experience in transnational access to its facility in earlier EU framework programmes. Furthermore, CERN has many years of experience with running advanced accelerator facilities, management of large collaborations and have world experts within accelerator techniques, data-acquisition systems, and detector set-ups, and ISOLDE is a world leader within the radioactive beam production and manipulation. Therefore, they can optimally fulfil the tasks they have been attributed within ENSAR. For more information see: http://isolde.web.cern.ch

Key person in charge of activities

Role in the consortium:	leader of TA ISOLDE work package
Main scientific activity:	experimental research on nuclear structure
Name:	GARCIA BORGE
First Name:	Maria Jose
Nationality:	Spanish
Gender:	female

2012 – 2016	ISOLDE leader and spokesperson of ISOLDE @CERN
2003 – 2011	Head of department
1996 – present	Leader of research group
1986 – present	Researcher at CSIC, Spain
1984 – 1986	Post-Doc fellow at ISOLDE@CERN
1982 – 1983	Post-Doc at the University of Arizona, USA
May 1982	PhD in Physics, Univ. Complutense de Madrid

Publications

- Spins, Electromagnetic Moments and Isomers of $^{107-109}$Cd, D. T. Yordanov et al., Phys. Rev. Lett. 110 (2013) 192501
- Studies of pear-shaped nuclei using accelerated radioactive beams, L. P. Gaffney et al., Nature 497 (2013) 199
- Masses of exotic calcium isotopes pin down nuclear forces, F. Wienholtz et al., Nature 498 (2013) 346
- Collinear Resonance Ionization Spectroscopy of Neutron deficient Francium Isotopes, K.T. Flanagan et al., Phys. Rev. Lett 111 (2013) 212501
- ^{11}Be(βp), a quasi-free neutron decay?, K. Riisager et al., Phys. Lett. B 732 (2014) 305-308

Projects

- FP7 ENSAR Integrating Activity
- FP7 CRISP
- FP6 EURONS

4.1.4 JYU

The University of Jyväskylä (JYU) with its 7 faculties is one of the largest universities in Finland. The Department of Physics (JYFL) belongs to the Faculty of Mathematics and Science. Its research and education areas cover theoretical and experimental subatomic and materials physics and applications. The JYFL Accelerator Laboratory is a part of the Department of Physics. It offers broad range of instrumentation and a large variety of light and heavy-ion beams for basic research and applications. As a university laboratory, it provides an ideal environment for graduate students and young scientists for active participation in international experiments as well as in the design and construction of instrumentation. The JYFL Accelerator Laboratory has acted as a Marie Curie Training Site. It was awarded by the Academy of Finland a status of a Finnish Centre of Excellence (CoE) in Nuclear and Accelerator Based Physics for 2006-2011 and 2012-2017. Since 2005, it is recognised by the European Space Agency (ESA) as an official radiation test facility for space electronics. Its main task in ENSAR is to offer access within TA JYFL. It will coordinate JRA RESIST, where the IGISOL at JYFL will play a key role. JYFL's experience in ECR ion source developments is needed in WP NA MIDAS, which is led by JYFL. It is a partner in NA NuPIA in charge of organising training in nuclear techniques. The JYFL teams involved in the ENSAR Access, RTD and Net Working activities consist of around 70 employees including technicians, academic staff and 25 PhD students. For more information see: http://www.jyu.fi/accelerator.

Key persons in charge of activities

Role in the consortium: leader of TA JYFL work package
Main scientific activity: experimental research on nuclear structure
Name: JOKINEN
First Name: Ari
Nationality: Finnish
Gender: male

2014 – present	Nuclear Matter Programme leader, Helsinki Institute of Physics, Finland
2012 – present	FAIR project leader, Helsinki Institute of Physics, Finland
2011 – present	professor, University of Jyväskylä, Finland
2006 – 2011	lecturer, University of Jyväskylä, Finland
2005 – 2006	senior researcher, University of Jyväskylä, Finland
2003 – 2005	senior assistant, University of Jyväskylä, Finland
2002 – 2011	ISOLDE project leader, Helsinki Institute of Physics, Finland
2001 – 2003	project associate, CERN
1996 – 1999	senior researcher, University of Jyväskylä, Finland
1994 – 1996	fellow physicist, CERN
1994	PhD in Nuclear Physics, University of Jyväskylä, Finland

Role in the consortium: leader of NA MIDAS work package
Main scientific activity: experimental research on ion sources
Name: KOIVISTO
First Name: Hannu
Nationality: Finnish
Gender: male

2002 – present	Senior research assistant, Ion source group leader, University of Jyväskylä, Finland
1999 – 2002	Scientist at the Academy of Finland
1998 – 1999	Post-Doc at National Superconducting Cyclotron Laboratory/Michigan State University, USA
1998	PhD in Nuclear Physics, University of Jyväskylä, Finland

Role in the consortium: leader of JRA RESIST work package
Main scientific activity: experimental research on nuclear structure and ion beams
Name: MOORE
First Name: Iain

Nationality:	British
Gender:	male

2012 – present	University Lecturer, University of Jyväskylä, Finland
2008 – present	Deputy Spokesperson of the laser spectroscopy project, LaSpec, for NuSTAR, FAIR, Germany
2006 – 2013	Cyclotron beam time co-ordinator for JYFL-ACCLAB, Jyväskylä, Finland
2006 – 2013	Scientific Secretary to the Programme Advisory Committee of the JYFL Accelerator Laboratory (JYFL-ACCLAB), University of Jyväskylä, Finland
2006 – 2011	Senior researcher, University of Jyväskylä, Finland
2004 – 2006	Researcher, University of Jyväskylä, Finland
2001 – 2003	Post-Doc at Argonne National Laboratory, USA
2002	PhD in nuclear physics, University of Manchester, UK

Publications

- Accurate Q-value for the ^{112}Sn decay and its implication for the search of the neutrino mass, S. Rahaman, et al., Phys. Rev. Lett. 103 (2009) 042501
- Precision mass measurements beyond ^{132}Sn: Anomalous behaviour of odd-even staggering of binding energies, J. Hakala, et al., Phys. Rev. Lett. 109 (2012) 032501
- H. Koivisto et al., Ionization Efficiency Studies with Charge Breeder and Conventional ECRIS Rev. Sci. Instr. 85, (2014), 02B917.
- H. Koivisto et al. , The electron cyclotron resonance ion source with arc-shaped coils concept (Invited), Rev of Sci. Instr. 83, 02A312 (2012).
- M. Reponen, I.D. Moore et al., Gas jet studies towards an optimization of the IGISOL LIST method, Nucl. Instr. and Meth. A 635 (2011) 24

Projects

- FP7 ENSAR Integrating Activity
- ANDES (EURATOM)
- FP7 NuPNET ERA-NET
- FP6 EURISOL Design Study
- FP6 EURONS Integrating Activity

4.1.5 CNRS

Description

The Centre National de la Recherche Scientifique (National Centre for Scientific Research), CNRS is a government-funded research organisation, under the administrative authority of France's Ministry of Research. As the largest fundamental research organisation in Europe with an annual budget representing a quarter of French public spending on civil research, CNRS carries out research in all fields of knowledge and, in particular, in nuclear physics through one of its institutes: the National Institute of Nuclear and Particle Physics (IN2P3). IN2P3/CNRS's mission is to promote and coordinate the research activities in nuclear physics, high-energy physics and their applications. It coordinates programmes in these areas on behalf of CNRS and universities, in partnership with CEA. IN2P3/CNRS pursues front-line scientific research and participates in the education and instruction of (graduate) students and post-docs in preparing them for future careers in industry and academia. The 20 IN2P3 laboratories actively stimulate and participate in interdisciplinary fields of research, both within and outside of France. CNRS operates the state-of-the-art accelerator facilities GANIL (together with CEA/DSM) and ALTO.
CNRS has had experience with trans-national access to its facilities in earlier EC framework programmes. Furthermore, each participating CNRS laboratory has several specialised services that do research in basic and applied nuclear science. The members of these groups have successful experience with running advanced accelerator facilities, management of large collaborations and are recognised experts in techniques related to exotic beam production targets and ion-source technology, innovative accelerator techniques, microelectronics, data-acquisition systems including fast sampling methods, simulation and construction of large detector set-ups. Therefore, they can optimally fulfil all tasks they have been attributed within ENSAR2, i.e. the coordination of TA ALTO, JRA TheoS, JRA EURISOL and JRA TecHIBA, and the participation in NA MIDAS, NA NUSPIN, NA MediNet, NA GDS, JRA PASPAG, JRA PSeGe and JRA RESIST.

Key persons in charge of activities

Role in the consortium: leader of JRA TecHIBA work package
Main scientific activity: experimental research on nuclear structure
Name: AZAIEZ
First Name: Faiçal
Nationality: French
Gender: male

2010 – present	Laboratory director at CNRS
2010 – present	Coordinator of the ECOS network activity within ENSAR
2009 – present	Member of the Nuclear Physics European Coordination Committee (NuPECC)
2005 – 2010	Chairman of the European working group ECOS
2006 – present	Member of the international steering Committee of the AGATA
May 1999	Habilitation à diriger des recherches (habilitation to supervise PhD research work)
May 1984	PhD, Université d'Orsay, France

Role in the consortium: leader of JRA EURISOL work package
Main scientific activity: experimental research on nuclear reactions
Name: BLUMENFELD
First Name: Yorick
Nationality: French
Gender: male

2011	Promoted to Directeur de Recherche classe exceptionnelle, CNRS
2008-2012	ISOLDE Physics Group Leader and Collaboration spokesperson at CERN
2006	Promoted to Directeur de Recherche 1st class
2002	Joliot Curie award of the French Physical Society
1998-1999	Visiting Scientist, NSCL-Michigan State University
1997	Promoted to Directeur de Recherche, CNRS.
1989-1990	Visiting scientist, Lawrence Berkeley Lab.
1988	Médaille de Bronze du CNRS (medal for best PhD thesis)
1987	Thèse d'état (PhD), Université d'Orsay, France: Peripheral reactions induced by 40Ar at intermediate energy: Giant resonances, High excitation energy structures and projectile fragmentation; advisor: Pr. J.C. Roynette
1982	Attaché de Recherche, CNRS
1981	Thèse de troisième cycle, Université d'Orsay, France: Coincidences between Light Charged Particles and Heavy Fragments in the 40Ca + 40Ca reaction at 10 MeV/nucleon.
1978	Masters Degree in Physics, Université d'Orsay, France

Role in the consortium: leader of JRA TheoS work package
Main scientific activity: theoretical research on nuclear structure
Name: LACROIX
First Name: Denis
Nationality: French
Gender: male

Oct 2013 – present	Member of the physics department (Theory Group), CNRS, France
December 2010	"Habilitation à Diriger les Recherches" (habilitation to supervise PhD research work) on "Quantum nuclear many-body dynamics and related aspects"
May 2007 – Oct 2013	Member of the physics department, GANIL, France
2006 – 2007	Visiting Scientist, NSCL-Michigan State University
1999	Promoted to Chargé de Recherche CNRS
1999 – Mars 2006	Scientist in theory group of LPC-Caen, CNRS-ENSICAEN, France.
1999	PhD of Caen University on "Quantum and dissipative aspects for nuclear structure and reactions"

Role in the consortium: leader of TA ALTO work package
Main scientific activity: experimental research on nuclear structure and beam production
Name: IBRAHIM
First Name: Fadi
Nationality: French
Gender: male

2012 – present	Director of Research Department at CNRS
2010	Promoted to Director of Research at CNRS (equivalent to Professor)
2007 – 2012	Member of the scientific council of GANIL (France)
2005 – present	SPIRAL2 Contact Person at CNRS, France
2005	"Habilitation à Diriger les Recherches" (habilitation to supervise PhD research work) : "Etude et production des fragments de fission, de LOHENGRIN à ALTO"
2002	Beam Coordinator of the Tandem Facility Scientific coordinator of the ALTO project
1999	Responsable of the PARRNe programme for the production of neutron rich exotic nuclei at the Tandem Facility
1995 – 1998	Researcher, CNRS, Grenoble, France
1995	Promoted to Chargé de Recherche CNRS
1994 – 1995	Assistant professor at University Paris XI, France
1994	PhD in Nuclear Physics, University of Paris XI, France

Publications

- High Intensity Stable Ions beams in Europe: the ECOS report (edited by NuPECC; http://www.nupecc.org/ecos/ECOS-Final.pdf)
- Stochastic dynamic beyond mean-field, Denis Lacroix and Sakir Ayik, Eur. Phys. J. A 50, 95 (2014). (Review Article)
- Radioactive Ion Beam Facilities in Europe, Y. Blumenfeld; Nucl. Instr. Meth. B 266 (2008) 4074
- EURISOL Design Study: Towards an ultimate ISOL facility for Europe, Y. Blumenfeld, P. Butler, J. Cornell, G. Fortuna and M. Lindroos; Int. Journal of Mod. Phys. E 18 (2009) 1960
- Probing nuclear structures in the vicinity of ^{78}Ni with β- and βn-decay spectroscopy of ^{84}Ga, K. Kolos, D. Verney, F. Ibrahim, et al., Phys. Rev. C 88, 047301

Projects

- FP7 SPIRAL2 Preparatory Phase
- FP7 ENSAR Integrating Activity
- FP7 NuPNET ERA-net
- FP6 EURISOL Design Study
- FP6 EURONS Integrating Activity

4.1.6 GSI

Description

GSI (GSI Helmholtzzentrum fuer Schwerionenforschung Gmbh) operates a large accelerator complex consisting of the linear accelerator UNILAC, the heavy-ion synchrotron SIS and the experiment storage-cooler ring ESR. Ions of all elements, from hydrogen to uranium, can be accelerated up to energies of 1-2 A.GeV, highly ionised up to bare uranium, also secondary beams of unstable nuclei or secondary pions are available. The accelerators are complemented by technically advanced experimental facilities as well as a high-energy (kJ), high power (PW) laser system Phelix, which altogether offer outstanding opportunities for current and future research in the fields of hadron and nuclear physics, atomic physics, dense plasma research, material science, biophysics and radiation medicine.
Accelerators: The GSI accelerator complex provides ion beams of all stable elements up to uranium with energies from the Coulomb barrier up to 2 A.GeV. In addition, secondary beams of unstable nuclei are available as well as beams of highly ionised atoms up to bare uranium and beams of secondary pions. As a further option, secondary pion beams can be delivered at momenta of 0.5 GeV/c to 2.5 GeV/c. Several experiments can be performed in parallel, using different ions.
UNILAC, a 120m linear accelerator, provides intense ion beams (p to U) at energies up to 11.4 A.MeV. The UNILAC serves as an injector to the synchrotron SIS.

SIS, the heavy-ion synchrotron with 216 m circumference and a maximum bending power of 18 Tm accelerates particles of p to U up to 2 A.GeV.
FRS, a 75m Projectile Fragment Separator, provides unstable isotopes of all elements up to uranium.
In the ESR (Experimental Storage Ring), stable or radioactive ion beams can be stored and cooled at energies up to 0.56 A.GeV (for U).
The pion-beam facility provides pion-beams in the momentum range of 0.5 to 2.5 GeV/c.
Experimental facilities: GSI offers various stations for nuclear, atomic, plasma physics and material science experiments at the UNILAC and the SIS accelerators or the Experimental Storage Ring ESR of interest for the ENSAR community

- FRS – large in-flight projectile fragment separator for production and in-beam separation of nuclei far off stability
- R3B - Relativistic Radioactive Reaction Experiment to study high-lying collective states and complete kinematics break-up reactions of exotic nuclei
- SHIP spectrometer - velocity filter for separation and detection of super-heavy elements
- SHIPTRAP - Penning trap for nuclear structure and atomic physics studies on very heavy nuclei/atoms
- HITRAP - ion trap for atomic physics and nuclear structure studies on heavy, highly-charged ions at rest
- TASCA - Transactinide separator and chemistry apparatus to study single ion chemistry of super heavy ions
- In-Beam experiments at the ESR - equipped with: Schottky mass spectroscopy; time-of-flight mass spectroscopy using the isochronous operation mode of the ring; internal gas-jet target and detector system; various X-ray and position sensitive particle detectors; collinear laser spectroscopy system,
- PHELIX - high power, high energy laser for plasma physics experiments
- Two experimental stations for dense plasma research allowing the combined application of intense ion and PHELIX laser beams for plasma generation and diagnosis
- M-branch - three beam lines for materials research with in situ characterisation of irradiated samples (SEM, XRD, FTIR, UV-Vis, RGA, etc.)
- Various experimental stations for UNILAC or SIS experiments

Nature of user facility: With about 1300 users (approx. 1100 external), GSI is a user facility for the international science community.
Since the 3rd Framework Programme of the European Union, GSI has been recognised as a large scale European research infrastructure and has received EC funding respectively.
Future: GSI, together with national and international partner institutions, is planning the construction of the FAIR Facility for Antiproton and Ion Research. A superconducting double-synchrotron SIS100/300 with a circumference of about 1,100 meters and with magnetic rigidities of 100 and 300 Tm, respectively, is at the heart of the FAIR accelerator facility. Following an upgrade for high intensities, the existing GSI accelerators UNILAC and SIS18 will serve as injectors. Attached to the large double-synchrotron SIS100/300 is a complex system of storage-cooler rings and experiment stations including a superconducting nuclear fragment separator (Super FRS) and an antiproton production target. FAIR will supply radioactive ion beams and antiproton beams with unprecedented intensity and quality. Moreover, the facility is designed to provide particle energies 20-fold higher compared to those achieved so far at GSI (up to 35AGeV for U92+). A further important feature of the FAIR accelerator facility is that, due to the intrinsic cycle times of the accelerator and storage-cooler rings, up to four research programmes can be run in a truly parallel mode. This allows, in a very efficient and cost-effective way, a rich and multidisciplinary research programme to be conducted covering a broad spectrum of research fields such as: QCD studies with cooled beams of antiprotons; QCD-Matter and QCD-Phase Diagram at highest baryon density; nuclear structure and nuclear astrophysics investigations with nuclei far off stability; precision studies on fundamental interactions and symmetries; high density plasma physics; atomic and material science studies; radio-biological investigations and other application oriented studies. First operation of the FAIR facility is scheduled for 2019.
Until 2017 user operation at GSI is strongly reduced to allow for accelerator upgrades and re-building of the facility.
The main tasks of GSI within ENSAR are to coordinate TA GSI, NA NUSPRASEN, and to participate in NA MIDAS, NA NUSPIN, NA MediNet, JRA PSeGe, JRA PASPAG and JRA RESIST.

Key persons in charge of activities

Role in the consortium: Leader of NA NUSPRASEN, main contact of GSI for the ENSAR2 project
Main scientific activity: Experimental research on nuclear structure
Name: SCHEIDENBERGER
First Name: Christoph
Nationality: German

Gender: male

2007 – present Leading Scientist at GSI, Germany
2007 – present Deputy Research Director, NUSTAR, GSI, Germany
2007 – present Full professor (W3) for Experimental Nuclear Physics, head of IONAS group, JLU Giessen, Germany
2011 Master of Management
2007 – 2010 Helmholtz-Akademie für Führungskräfte
2005 Habilitation, JLU Giessen, Germany
1994 PhD, JLU Giessen, Germany

Role in the consortium: leader of TA GSI work package
Main scientific activity: experimental research on relativistic nuclear collisions
Name: LEIFELS
First Name: Yvonne
Nationality: German
Gender: female

2001 – present Staff Scientist, Gesellschaft für Schwerionenforschung (GSI), Darmstadt
1997 – 2001 Research Stipend of the Margarete-von-Wrangell Stiftung at the University of Heidelberg
1995 – 1997 Scientific Employee, University of Heidelberg
1993 – 1995 Scientific Employee, Gesellschaft für Schwerionenforschung (GSI), Darmstadt
1993 Doctoral degree in physics, University of Bochum, Germany
1993 Prize of the University of Bochum for doctoral thesis
1989 – 1993 Employment as doctoral student, University of Bochum
1988 – 1989 Scientific Employee, University of Bochum
1988 Diploma, Physics Faculty, University Bochum, Germany

Publications

- Spectroscopy of Element 115 Decay Chain, D. Rudolph et al., Phys. Rev. Lett. 111, 112502 (2013).
- Anti-analog giant dipole resonances and the neutron skin of nuclei, Krasznahorkay et al., Phys. Lett. B 720 (2013) 428.
- First experimental results of a cryogenic stopping cell with short-lived, heavy uranium fragments produced at 1000 MeV/u, S. Purushothaman et al., Euro. Phys. Lett. A 104 42001 (2013)
- Few body quantum dynamics of high-Z ions studied at the future relativistic HESR storage ring, S. Hagman et al., Phys. Scr. 2013 (2013) 014086
- The FIRST experiment at GSI, R. Pleskac et al., Nucl. Instr. Meth. A 678 (2012) 130

Projects

- FP7 FAIR Preparatory Phase
- FP7 SPIRAL2 Preparatory Phase
- FP7 ENSAR Integrating Activity
- FP7 CRISP cluster of research infrastructures
- FP7 NuPNET ERA-net

4.1.7 RUG

Description

The KVI - Centre for Advanced Radiation Technology is a research institute reporting directly to the Executive Board of the University of Groningen. The mission of the KVI - Centre for Advanced Radiation Technology (KVI-CART) is to perform basic research on subatomic and astroparticle physics and application-driven research on accelerator physics and physics in medicine. We work, in close collaboration with the scientific community, healthcare and industry, on long-term solutions for science and society. Through the development of state-of-the-art detection techniques, KVI-CART fosters the cross-fertilisation between basic and application-driven research. KVI-CART educates young researchers in physics and medical technology at BSc, M.Sc. and Ph.D. level. KVI-CART possesses a cyclotron for intermediate-energy physics and applied-physics research, and technical departments ranging from mechanical to electronics to computer technology.
The main tasks of KVI in ENSAR2 are the coordination of TA KVI-CART and JRA SATNuRSE and the participation in NA MIDAS and NA MediNet.

Key persons in charge of activities

Role in the consortium: coordinator of ENSAR2
Main scientific activity: nuclear structure, nuclear astrophysics, few-body physics and astroparticle physics.
Name: HARAKEH
First Name: Muhsin N.
Nationality: Dutch
Gender: male

Mohsen (Muhsin) N. Harakeh was born on December 14, 1947. He graduated from State University of New York at Stony Brook in 1974 in experimental nuclear physics. After two postdoc periods in the Netherlands and Denmark, he was appointed in 1978 assistant professor at KVI (Nuclear Physics Accelerator Institute) of University of Groningen, and associate professor in 1982. In 1985, he was appointed full professor at Free University of Amsterdam. In January 1993, he returned to KVI as full professor and Deputy Director. In January 1996, he was appointed Director of KVI. At the end of December 2008, he retired as Director of KVI and took a sabbatical leave of two years: one year at GANIL, Caen and another year at GSI, Darmstadt. His research interests are in nuclear structure, nuclear astrophysics, few-body physics and astroparticle physics. He has served on many programme advisory committees of international facilities, scientific advisory committees of institutes and evaluation committees of institutes, physics departments, etc., and a large number of times as chairman. He was the first director of the International Research School FANTOM. He has been chairman of the Editorial Board of Nuclear Physics News International, and is associate editor of two international nuclear physics journals. He has been a member of NuPECC (Nuclear Physics European Collaboration Committee), a committee that sets policy decisions for the nuclear physics community in Europe, from beginning of 1996 till end of 2008 and has been chair of this committee for three years 2003-2005. He is a fellow of the American Physical Society since 1994 and member of the Academy of Europe (Academia Europaea) since 2008. He has been elected chair of Physics and Engineering Section of Academia Europaea in September 2012. He has been decorated in 2008 as Officer in the order of Oranje-Nassau for his achievements. He has received several honours. He has been chairman and member of several organising committees of international conferences, summer schools, and also member of many international advisory committees of international conferences, symposia, workshops, etc.

M. N. Harakeh is Professor Emeritus for RUG, which means that he is retired and does not get salary from RUG anymore. For ENSAR2 coordination, he has a part-time temporary CEA employment contract to work at GANIL. Please see section 4.2 for details about temporary employment at GANIL.

Role in the consortium: scientific representative of RUG
Main scientific activity: experimental research on nuclear physics applications for medicine
Name: DENDOOVEN
First Name: Peter
Nationality: Belgian
Gender: male

2011 – present KVI-CART representative on the board of the FANTOM international research school for Fundamental and Applied Nuclear and aTOMic physics

2011 – present	Associate professor, KVI–CART, University of Groningen, the Netherlands
2007 – 2011	Assistant professor, KVI–CART, University of Groningen, the Netherlands
2001 – 2006	Senior technical-scientific researcher, KVI–CART, University of Groningen, the Netherlands
1994 – 2001	Senior researcher, University of Jyväskylä, Finland
1992 – 1994	Post-Doc at Lawrence Livermore National Laboratory, USA
1992	Ph.D. in Physics, University of Leuven, Belgium

Role in the consortium: leader of the JRA SATNuRSE
Main scientific activity: experimental research on nuclear physics
Name: KALANTAR-NAYESTANAKI
First Name: Nasser
Nationality: Dutch
Gender: male

1993 – present	Kernfysisch Versneller Instituut (KVI), the Netherlands Assistant Professor in the Physics department (1993-2000), Associate Professor in the Physics department (2000-2004), Professor in the Physics department (2004-present), Programme leader of the GSI-KVI activities (2006-present), Group leader of the Nuclear Structure group at KVI (2007-2008), Group leader of the Nuclear and Hadron Physics group at KVI (2008-present)
1989 – 1992	Free University, Amsterdam, the Netherlands Staff member (tenured) of the experimental nuclear physics group, In charge of Monte Carlo simulations for Hadron detectors, Member of computer committees in the department and at NIKHEF-K.
1986 – 1989	NIKHEF-K, the Netherlands Post-doctoral Research Associate in the electron-scattering group
1987	PhD in Physics, Massachusetts Institute of Technology (MIT), USA

Role in the consortium: leader of the TA KVI-CART
Main scientific activity: accelerator physics and technology
Name: BRANDENBURG
First Name: Sytze
Nationality: Dutch
Gender: male

2014 – present	member management team KVI-Centre for Advanced Radiation Technology
2010 – present	head medical physics research group
2007 – present	extraordinary professor in accelerator physics, Faculty of Mathematics and Natural Sciences, University of Groningen, the Netherlands
1999 – 2007	member management team KVI
1999 – present	head accelerator operations and research group
1999 – present	senior research scientist / programme leader, Kernfysisch Versneller Instituut (KVI), Groningen, the Netherlands
1996 – 1998	deputy head accelerator operations and research group coordinator application directed research
1994 – 1996	deputy head installation and commissioning team AGOR cyclotron
1986 – 1994	secondment at CNRS, France in the framework of the construction of the super-conducting cyclotron AGOR
1985 – 1998	research scientist, Kernfysisch Versneller Instituut (KVI), Groningen, the Netherlands
1985	PhD in Mathematics and Natural Science, University of Groningen, the Netherlands

Publications

- First experimental results of a cryogenic stopping cell with short-lived, heavy uranium fragments produced at 1000 MeV/u, S. Purushothaman, et al., Europhys. Lett. 104 (2013) 42001

- New stopping cell capabilities: RF carpet performance at high gas density and cryogenic operation, M. Ranjan, et al., Europhys. Lett. 96 (2011) 52001
- LaBr3:Ce and SiPMs for time-of-flight PET: achieving 100 ps coincidence resolving time, D.R. Schaart, S. Seifert, R. Vinke, H.T. van Dam, P. Dendooven, H. Löhner, F.J. Beekman, Phys. Med. Biol. 55 (2010) N179-N189
- Optimizing the timing resolution of SiPM sensors for use in TOF-PET detectors, R. Vinke, H. Löhner, D.R. Schaart, H.T. van Dam, S. Seifert, F.J. Beekman and P. Dendooven, Nucl. Instr. Meth. A 610 (2009) 188-191
- Extraction of radioactive positive ions across the surface of superfluid helium: A new method to produce cold radioactive nuclear beams, W.X. Huang, P. Dendooven, K. Gloos, N. Takahashi, J.P. Pekola, J. Äystö, Europhys. Lett. 63 (2003) 687–693

Projects

- FP7 SPIRAL2 Preparatory Phase
- FP7 ENSAR Integrating Activity
- NUSTAR: collaboration of GSI-FAIR on nuclear structure, astrophysics and reactions
- EXL: collaboration of ring experiments at GSI-FAIR
- ESA Office of Science Payloads and Advanced Concepts: “Radiation damage studies of active sensors and components”

4.1.8 IFJ PAN

Description

The Niewodniczanski Institute of Nuclear Physics of the Polish Academy of Sciences (Instytut Fizyki Jądrowej im. H. Niewodniczańskiego Polskiej Akademii Nauk - IFJ PAN), established in 1955, is a public research institute. The pursued research is aimed at explaining the structure of matter from microscopic to cosmic scales, through experiments and/or application of theoretical methods. The activity extends from both theoretical and experimental research, concerning the fields of particle physics and astrophysics, nuclear and strong-interactions physics, via condensed-matter physics, to interdisciplinary and applied research. The Institute has a staff of over 400 persons, including 40 full professors, 30 associate professors and over 100 post-docs. The International Post-Graduate Course at IFJ PAN has at present 50 students from universities of several countries. The Institute is pursuing an active cooperation with Polish universities which concerns research as well as education processes, and with leading institutes worldwide. Each year the Institute hosts international and national scientific conferences.

The National Cyclotron Laboratory (NLC) is unique cyclotron facility in Poland operating a double site infrastructure: at the Heavy Ion Laboratory (SLCJ) of the University of Warsaw and at the Cyclotron Centre Bronowice (CCB), the proton-therapy and basic research facility of the Institute of Nuclear Physics Polish Academy of Sciences in Kraków. NLC is a consortium formed to conduct basic research and applications on 4 cyclotrons: two at SLCJ (the K=160 isochronous heavy-ion cyclotron and the high-intensity proton-deuteron PET K=16.5 cyclotron), and two at CCB (the 60 MeV light-ion cyclotron AIC-144 and the new Proteus-235 proton cyclotron). The consortium agreement was signed on the 4th of April 2010 by the Rector of the University of Warsaw and the Director General of the Institute of Nuclear Physics of the Polish Academy of Sciences. The nuclear physics research programme is complementary to the programmes of large-scale European RIBs. The investigations carried out in Warsaw and Kraków are also in many aspects complementary - at CCB high-energy proton beam is available while at SLCJ beams of heavier nuclei from boron to argon can be accelerated.

The main tasks of IFJ PAN in ENSAR2 are the co-coordination of TA NLC and the participation in NA MediNet, JRA PASPAG and JRA EURISOL.

Key person in charge of activities

Role in the consortium:	co-leader of TA NLC
Main scientific activity:	Experimental research on nuclear structure and reactions
Name:	MAJ
First Name:	Adam
Nationality:	Polish
Gender:	male

2013	Scientific Director of the Niewodniczanski Institute of Nuclear Physics, Kraków, Poland
2010 – 2012	Technical Director of the Niewodniczanski Institute of Nuclear Physics, Kraków, Poland
2009 – 2013	Head of the Division of Nuclear Physics and Strong Interactions at the Institute of Nuclear

	Physics, Kraków, Poland
2006	State nominated Professor, Warsaw, Poland
2003 – 2009	Head of the Department of the Structure of Nucleus at the Institute of Nuclear Physics, Kraków
2001 – 2006	Associated professor the Inst. of Nuclear Physics, Krakow, Poland
2001	Habilitation: Niewodniczanski Institute of Nuclear Physics, Krakow, Poland
1996	Visiting Professor in the Niels Bohr Institute, Copenhagen, Denmark
1989 – 1990	Post-doc position in the Niels Bohr Institute, Copenhagen, Denmark
1988 - 2001	Lecturer (adjunct) at the Institute of Nuclear Physics, Krakow
1988	Ph. D.: Institute of Nuclear Physics, Kraków, Poland

Publications

- Gamma-decay of the GDR in the GEMINI++, M. Ciemala, M. Kmiecik, M. Krzysiek, A. Maj, K. Mazurek, R. Charity, D. Mancusi, Acta Phys. Pol. B44, 611 (2013)
- Lifetime Measurements of Short Lived States in ^{69}As, M. Matejska-Minda et al., Acta Phys. Pol. B45, 235 (2014)
- Study of the soft dipole modes in ^{140}Ce via inelastic scattering of ^{17}O, M. Krzysiek et al., Phys. Scr. 89, 054016 (2014)
- Gamma Spectroscopy of Neutron-rich Nuclei with A = 100 Produced by Cluster Transfer Reactions at REX-ISOLDE, S. Bottoni et al., Acta Phys. Pol. B45, 343 (2014)
- Isospin Character of Low-Lying Pygmy Dipole States in ^{208}Pb via Inelastic Scattering of ^{17}O Ions F.C.L. Crespi et al., Phys. Rev. Lett. 13, 012501 (2014)

Projects

- FP7 ENSAR Integrating Activity
- FP7 SPIRAL2PP
- Member of the NUSTAR Council in GSI, Darmstadt, Germany;
- PARIS project leader
- Member of NUPECC

4.1.9 UNIWARSAW

Description

University of Warsaw is a leading public research and education organisation in Poland. It comprises 19 faculties spanning a wide range of science and humanities. The Faculty of Physics is composed of four Institutes: Experimental and Theoretical Physics as well as Astronomy and Geophysics. The Faculty teaches about 600 B.Sc. and M.Sc. students and has the graduate (Ph.D.) School attended by about 100 students.

Several branches of physics are very strongly represented in the Faculty, such as particle, nuclear, condensed matter, and solid-state physics. The University also manages the Heavy Ion Laboratory (HIL), which operates the K=160 heavy-ion cyclotron, which is a unique device not only in Poland, but also in Central Europe.

At the University of Warsaw there are several important experimental groups conducting research in nuclear structure and heavy-ion physics. They have large and successful experience in nuclear spectroscopy, especially in the domain of exotic nuclei. Life-time Coulex measurements are a trademark of the experimental group at HIL, which also developed the world-standard numerical code GOSIA used in such experiments. Nuclear structure theory group at the University of Warsaw constitutes one of the most active and experienced centres of research specialising in predicting properties of nuclei far from stability.

The National Cyclotron Laboratory (NLC) is unique cyclotron facility in Poland operating a double site infrastructure: at the Heavy Ion Laboratory (SLCJ) of the University of Warsaw and at the Cyclotron Centre Bronowice (CCB), the proton-therapy and basic research facility of the Institute of Nuclear Physics Polish Academy of Sciences in Kraków. NLC is a consortium formed to conduct basic research and applications on 4 cyclotrons: two at SLCJ (the K=160 isochronous heavy-ion cyclotron and the high-intensity proton-deuteron PET K=16.5 cyclotron), and two at CCB (the 60 MeV light-ion cyclotron AIC-144 and the new Proteus-235 proton cyclotron). The consortium agreement was signed on the 4th of April 2010 by the Rector of the University of Warsaw and the Director General of the Institute of Nuclear Physics of the Polish Academy of Sciences. The nuclear physics research programme is complementary to the programmes of large-scale European RIBs. The investigations carried out in Warsaw and Kraków are also in many aspects complementary - at CCB high-energy proton beam is available while at SLCJ beams of heavier nuclei from boron to argon can be accelerated.

The main tasks of UNIWARSAW in ENSAR2 are the co-coordination of TA NLC and the participation in NA MediNet, NA NuPIA, JRA PASPAG, JRA EURISOL and JRA TecHIBA.

Key person in charge of activities

Role in the consortium: co-leader of TA NLC
Main scientific activity: experimental research on nuclear reactions
Name: RUSEK
First Name: Krzysztof
Nationality: Polish
Gender: male

2009 – present	Director, Heavy Ion Lab. University of Warsaw, Warsaw, Poland
2004 – 2005	Visiting professor, Universidad de Huelva, Huelva, Spain
1999 – 2009	Associate professor, The Andrzej Sołtan Institute for Nuclear Studies, Warsaw, Poland
1992 – 1993	Research fellow, The University of Birmingham, Birmingham, UK,
1987 – 1988	Scientific collaborator, Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany
1983 – 1999	Adiunkt, the Andrzej Sołtan Institute for Nuclear Studies, Warsaw, Poland,
1982	Adiunkt, Institute of Nuclear Research, Warsaw, Poland,
1980 – 1981	Scientific collaborator, Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany
1980	PhD in Nuclear Physics, University of Warsaw, Poland

Publications

- Elastic and inelastic scattering of ^{6}Li + ^{18}O versus ^{7}Li + ^{18}O and ^{6}Li + ^{16}O, Rudchik, A.T., et al. Nucl. Phys. A 922, pp. 71-83 (2014)
- GLORIA: A compact detector system for studying ion reactions using radioactive beams, G. Marquinez-Duran, L. Acosta, R. Berjillos, J.A. Duenas, J.A. Labrador, K. Rusek, A.M. Sanchez-Benitez, I. Martel. Nucl. Instr. Meth. A 755,pp 69-77 (2014)
- Weak channels in backscattering of ^{20}Ne on ^{nat}Ni, ^{118}Sn, and ^{208}Pb, E. Piasecki et al., Phys. Rev. C85, 054604
- ^{128}Cs as the Best Example Revealing Chiral Symmetry Breaking, E. Grodner et al., Phys. Rev. Lett. 97, 172501
- M. Łyczko et al. Nucl. Med. Rev. 15B, 1

Projects

- FP7 SPIRAL2 Preparatory Phase
- FP7 ENSAR Integrating Activity

4.1.10 IFIN-HH

Description

IFIN-HH, or the National Institute for Physics and Nuclear Engineering, located in Bucharest-Magurele, is a public institution funded from public funds, "dedicated to the research and development in physical and natural sciences, mainly Nuclear Physics and Nuclear Engineering, and in related areas including Astrophysics and Particle Physics, Field Theory, Mathematical and Computational Physics, Atomic Physics and Physics of Condensed Matter, Life and Environmental Physics. In all these fields, IFIN-HH conducts theoretical and experimental research" (according to its mission statement; see http://nipne.ro). It is recognised as one of the visible research institutions for research in low and intermediate energy nuclear physics in Europe. With its staff over 700 and a budget of about 35M euros (2013), is the largest research institute in Romania, as personnel, assets, publications, results and international prestige.
The main tasks of IFIN-HH in ENSAR2 are the coordination of TA IFIN/ELI and the participation in JRA PASPAG.

Key persons in charge of activities

Role in the consortium: leader of TA IFIN/ELI
Main scientific activity: Experimental research on nuclear astrophysics
Name: TRACHE
First Name: Livius Marian
Nationality: Romanian
Date of birth: December 10, 1952

Place of birth:	Padureti, Romania
Gender:	male

2012 – present	Scientific Director and Research Scientist gr. I, IFIN-HH, Romania
1993 – present	Research scientist, Texas A&M University, USA
1982 – 1983	Research fellow of the Bundesministerium fuer Forschung und Technologie Bonn, Germany
1978 – 1998	Physicist and Research Scientist gr. III, then II, IFIN-HH, Romania
1987	PhD in physics, University of Bucharest, Romania
1976 – 1978	Physicist, Institute for Research in Electrotechnics (ICPE) Bucharest, Romania

A versatile physicist with over 35 years experience of work in several nuclear physics laboratories in Romania and abroad in Germany, Russia, The Netherlands and United States for over half of his career. Research in experimental nuclear physics, with contributions in *nuclear structure*, in *nuclear astrophysics*, and in reactions between heavy ions, including reactions with *radioactive nuclear beams*. Has developed theoretical models needed to describe the nuclear structure studied, and for new indirect methods for nuclear astrophysics. Experienced in equipment design and construction and also in applied nuclear physics, ranging from the analysis of macro elements (at percent level) and trace elements (at or under part per million level) in archaeological material and in semiconductors using atomic and nuclear methods (XRF, PIXE, neutron activation, proton or deuteron activation), to the detection of nuclear radiation. Lead a nuclear structure group in the Institute for Physics and Nuclear Engineering (IFIN) in Bucharest, Romania from 1983 to 1998. Had in the past and has currently approved experiments in laboratories in Germany, The Netherlands, Czech Republic, Italy, France and Japan. Experienced working with large experimental devices or arrangements, like magnetic spectrometers and multi-detectors.

Publications

- Asymptotic normalization coefficient of ^{8}B from breakup reactions and the S_{17} astrophysical factor, L. Trache, F. Carstoiu, C.A. Gagliardi, R.E. Tribble, Phys. Rev. Lett. 87, 271102 (2001).
- Breakup of ^{8}B and the S_{17} astrophysical factor re-examined, L. Trache, F. Carstoiu, C.A. Gagliardi and R. E. Tribble, Phys. Rev. C 69, 032802(R) (2004).
- Asymptotic normalization coefficients for ^{8}B -> ^{7}Be+p from a study of ^{8}Li -> ^{7}Li+n , Trache L et al., Phys. Rev. C 67, 062801 (2003).
- Experimental study of beta-delayed proton decay of ^{23}Al for nucleosynthesis in novae, A Saastamoinen, L. Trache et al., Phys. Rev. C 83, 045808 (2011).
- Livius Trache and Paula Gina Isar (eds.), Proceedings of the Carpathian Summer School of Physics 2012, Sinaia, Romania, 24 June – 7 July 2012. American Institute of Physics Conference Proceedings, vol. 1498, Melville, NY, Dec. 2012.

Projects

- FP7 ENSAR Integrating Activity
- FP7 SPIRAL2 PP
- FP7 CRISP
- FP6 EURONS

4.1.11 <u>FBK</u>

Description

The legal entity for this work package is Fondazione Bruno Kessler (FBK). Its legal headquarter is located in Trento, Via S. Croce, no. 77 – tax code and VAT reg. no. 02003000227. The Secretary General of the Foundation is Eng. Andrea Simoni, authorised pursuant to the power of attorney, authenticated by notary public Paolo Piccoli in Trento on January 18th, 2013, file no. 67.701 / 17.508 registered in Trento on January 22nd, 2013 under no. 910, S. 1T.
FBK is an internationally recognised Research Foundation, conducting research in the areas of Information Technologies, Advanced Materials and Microsystems and Frontiers of Physics. The focus is on applied and basic research aimed at resolving real-world problems, driven by the need for technological innovation in society and industry. In addition, FBK carries out its mission by disseminating and publishing results, and transferring technology to companies and public entities. FBK carries out basic research in co-operation with universities and research centres, and applied research in cooperation with major companies, as well as with small to medium-sized enterprises. ECT*, the European Centre for Theoretical Studies in Nuclear Physics and Related Areas, is an institutional part of FBK and operates within the administrational frame of FBK.

The main task of ECT* in ENSAR2 is the coordination of TA ECT*.

Key person in charge of activities

Role in the consortium:	leader of TA ECT*
Main scientific activity:	theoretical research on nuclear and hadronic matter
Name:	WEISE
First Name:	Wolfram
Nationality:	German
Gender:	male

2012 - present	Director, European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*), Trento, Italy
2012 – present	Professor Emeritus, Technical University of Munich
2012 – present	Visiting Senior Scientist, RIKEN, Japan
2010	Emilio Segre Distinguished Lecturer, University of Tel Aviv, Israel
2007 – 2009	Vice Chair (Prodekan), Faculty of Physics, Technical University of Munich
2007	Giulio Racah Memorial Lecturer, the Hebrew University of Jerusalem, Israel
2001 – 2004	Director, European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*), Trento, Italy
2002	JSPS Research Fellow Award, Japan Society for the Promotion of Science
2000 – 2001	Dean of Studies (Studiendekan), Faculty of Physics, Technical University of Munich
1995	A.v. Humboldt - J.C. Mutis Award for Scientific cooperation with Spain
1994 – present	Professor of Theoretical Physics, Chair for Applied Quantum Field Theory, Technical University of Munich
1991 – 1996	Adjunct Professor, NORDITA, Copenhagen
1987 – 1989	Chair (Dekan), Faculty of Physics, University of Regensburg
1976 – 1994	Professor of Physics, Chair of Theoretical Physics, University of Regensburg
1975 – 1976	Scientific Associate, CERN, Geneva
1973 – 1975	Research Associate, Department of Physics, State University of New York at Stony Brook
1974	Habilitation, University of Erlangen
1970 – 1972	Research Associate, University of Erlangen
1970	PhD (Dr. rer. nat), University of Erlangen

Publications

- Chiral Fermi liquid approach to neutron matter, J. W. Holt, N. Kaiser, W. Weise, Phys. Rev. C 87 (2013) 014338
- Role of the cluster structure of ^{7}Li in the dynamics of fragment capture, Shrivastava, A. Navin, A. Diaz-Torres et al., Phys. Lett. B 718 (2013) 931
- Monte Carlo simulations on the Lefschetz thimble: taming the sign problem, M. Cristoforetti, F. Di Renzo, A. Mukherjee, L. Scorzaton, Phys. Rev. D 88 (2013) 051501(R)
- Gluon mass generation in the presence of dynamical quarks, C. Aguilar, D. Binosi, J. Papavassiliou, Phys. Rev. D 88 (2013) 074010
- The Boltzmann equation in classical Yang-Mills theory, V. Mathieu, A.H. Mueller, D.N. Triantafyllopoulos, Eur. Physical Journal C 74 (2014) 2873

Projects

- FP7 ENSAR Integrating Activity
- FP7 HadronPhysics 3 Integrating Activity
- FP7 HadronPhysics 2 Integrating Activity
- FP7 QUROPE Coordination Action

4.1.12 EBG MedAustron

Description

EBG MedAustron is the Austrian centre for ion-beam therapy specialised in cancer treatment with protons and carbon ions, and in the research and development of this new therapy. The first proton therapy patient is expected to be treated in 2015. After the centre's completion, which includes two rooms for proton and carbon ions –one with horizontal fix-beam and one with horizontal and vertical beams-- and one room with a proton

gantry, up to 1400 patients will be treated annually. Currently only three centres worldwide offer these two radiation treatment options at the same location.
EBG MedAustron has a staff of 140, approximately half of them employed in research and development. MedAustron activity focuses, in particular, in medical technology, software development, clinical research, accelerator technology, innovative tools for ion-beam therapy. 200M€ are being invested in cutting-edge research.
Since 2011 MedAustron is supporting a research for the development and the optimisation of microdosimetry tools for ion-beam therapy. MedAustron is collaborating with several European Institutes including Austrian Institute of Technology, ENEA, Tor Vergata University, INFN Legnaro, Institut Ruđer Bošković, and ETH Zurich, performing Monte Carlo simulation and collecting experimental data for the optimisation of microdosimeters in the field of ion-beam therapy. MedAustron is promoting international discussions and exchanges in the field. It hosted the workshop "Challenges in micro- and nanodosimetry for ion beam cancer therapy" on May 7-9, 2014, in the framework of the European Union funded COST Action Nanoscale Insights into Ion Beam Cancer Therapy (NanoIBCT), and Joint Research Project Biologically Weighted Quantities in Radiotherapy (BioQuaRT).
The main task of EBG MedAustron in ENSAR2 is the co-coordination of NA MediNet.

Key person in charge of activities

Role in the consortium: co-leader of NA MediNet work package
Main scientific activity: research in microdosimetry and ion-beam therapy
Name: MAGRIN
First Name: Giulio
Nationality: Italian
Gender: male

Giulio Magrin, physicist, will take the responsibilities of task 2 –ENSAR2 network activity MediNet— coordinating the innovative studies on soft and hard nuclear physics tool for the biological characterisation of the ion-therapy radiation.
Three complementary experiences qualify him for the co-ordination of this pillar activity
The expertise in development of radiation detectors for medical purposes gained at the Italian Institute of Nuclear Physics (INFN), at the Radiological Research Centre of Columbia University in New York, at the Italian National Institute of Health (ISS), at MedAustron;
Carrying out networking activities for the promotion and development of ion-beam therapy with the Foundation for Hadron Therapy (TERA), European Network for LIGht ion Hadron Therapy (ENLIGHT), the European Organisation for Nuclear Research (CERN), and EBG MedAustron.
The study and realisation of proton accelerators for radiotherapy in Geneva first with TERA, and then with the company Application of Detectors and Accelerators to Medicine (ADAM).

Giulio Magrin got his degree at University of Padua (Italy) and worked for since 1991 in the field of microdosimetry and ion-beam therapy.

2011	Researcher, EBG MedAustron, Austria
2008 – 2010	Researcher, Applications of Detectors and Accelerators to Medicine, ADAM sa, Geneva, Switzerland
2003 – 2007	Researcher, Foundation for Hadron Therapy, TERA, CERN, Switzerland
1998 – 1999	Researcher, Italian National Institute of Health ISS
1995 – 1997	Researcher, Centre for Radiological Research Columbia University, New York, USA
1991 – 2002	Researcher, INFN, Italy

Publications

- Radiation quality and ion-beam therapy: Understanding the users need, Magrin G, Mayer R, Grevillot L, Radiat Prot Dosimetry; in press.
- Introduction to the EC's Marie Curie Initial Training Network (MC-ITN) project: Particle Training Network for European Radiotherapy (PARTNER), Dosanjh M, Magrin G, J Radiat Res, 54 1 (2013) i1-5.
- A novel microdosimeter based upon artificial single crystal diamond, Rollet S, Angelone M, Magrin G, Nuclear Science, IEEE Transactions on, 59-5 (2012) 2409-2415

- Mini-TEPCs for radiation therapy, De Nardo L, Cesari V, Donà G, Magrin G, Colautti P, Conte V, Tornielli G, Radiat Prot Dosimetry. 108-4 (2004) 345-52.
- Variance-covariance technique for monitoring the TOP proton beam quality, Magrin G, Colautti P, Tornielli G, LNL-INFN Report 156 (2000)

Projects

- ENLIGHT: network of sixty Institutions from seventeen countries for promoting ion-beam therapy. G. Magrin was scientific secretary of ENLIGHT in the period 2006-2008
- Marie Curie Action PARTNER

4.1.13 KU Leuven

Description

The University of Leuven (KU Leuven) is a public research and education organisation and is a charter member of LERU. KU Leuven employs 7,018 researchers on its academic staff (2013). 39% of its graduate students and 36% of its postdoctoral researchers are international scholars (2011-2012). To strengthen international collaboration, KU Leuven has its own international research fellowship programme and supports international scholars in international funding applications. KU Leuven participates in over 540 highly competitive European research projects (FP7, 2007-2013), ranking sixth in the league of HES institutions participating in FP7 and takes up the 8th place of European institutions hosting ERC grants (as first legal signatories of the grant agreement). To date, the 69 ERC Grantees (including affiliates with VIB and IMEC) in our midst confirm that KU Leuven is a breeding ground (49 Starting Grants) and attractive destination for the world's best researchers.
KU Leuven conducts fundamental and applied research in all academic disciplines with a clear international orientation. It has 13 faculties organised in three groups (Science, Engineering and Technology, Biomedical Sciences, and Humanities) and a number of institutes pursuing research in various fields of science. Among these is the "Instituut voor Kern en Stralingsfysica – IKS" which has around 80 employees: about 60 scientific staff and 20 technical and supportive staff. At IKS three research teams are active in experimental subatomic physics research performing experiments at several of the infrastructures in this Integrating Activity, i.e. at GANIL, GSI, ISOLDE-CERN, JYFL and KVI.
The main research topics are nuclear spectroscopy and nuclear reaction studies with post-accelerated radioactive beams, nuclear moment studies through laser spectroscopy techniques, and fundamental weak interaction studies in nuclear decay. The main task of KU Leuven within ENSAR2 is in JRA RESIST (task coordinator). KULeuven is also participating in NA GDS.
The teams at KUL have track records in research with exotic nuclei and have pioneered or been closely involved in the development of many of the recently developed new techniques for research of such nuclei. They are key players in radioactive ion beam research, laser ion source and gas-catcher techniques, new methods for nuclear moment determinations, and new techniques (including Penning traps) for low-energy weak-interaction studies. A new laser laboratory for the "Heavy-Element Laser IOnisation Spectroscopy – HELIOS" project is being commissioned and will be a key instrumentation for the JRA activity. They have ample experience in managing this type of activities in earlier EC framework programmes. For more information see: http://www.fys.kuleuven.be/iks/.

Key person in charge of activities

Role in the consortium:	participant in JRA RESIST and NA GDS work packages
Main scientific activity:	Experimental research on nuclear structure
Name:	RAABE
First Name:	Riccardo
Nationality:	Italian
Gender:	male

2009 - present	Associate Professor, Instituut voor Kern- en Stralingsfysica, KU Leuven (Belgium)
2008 - 2009	Researcher (permanent position), Commissariat à l'Energie Atomique, Grand Accélérateur National d'Ions Lourds, Caen (France)
2003 - 2007	Postdoctoral Fellow of the Research Foundation - Flanders (FWO), Instituut voor Kern- en Stralingsfysica, KU Leuven (Belgium)
2001 - 2003	Post-Doc Researcher, Commissariat à l'Energie Atomique, CEA/DAPNIA/Service de Physique Nucléaire, Saclay (France)
2001	PhD, KULeuven, Belgium

Publications

- Measurement of the isoscalar monopole response in the neutron-rich nucleus ^{68}Ni, M. Vandebrouck et al., Phys. Rev. Lett. 113 (2014), p. 032504
- Experimental Study of the Two-Body Spin-Orbit Force in Nuclei, G. Burgunder et al., Phys. Rev. Lett. 112 (2014), p. 042502
- Limited Asymmetry Dependence of Correlations from Single Nucleon Transfer, F. Flavigny et al., Phys. Rev. Lett. 110 (2013), p. 122503
- Precise Determination of the Unperturbed ^{8}B Neutrino Spectrum, T. Roger et al., Phys. Rev. Lett. 108 (2012), p. 162502
- Elastic Scattering and Reaction Mechanisms of the Halo Nucleus ^{11}Be around the Coulomb Barrier, A. Di Pietro et al., Phys. Rev. Lett. 105 (2010), p. 022701

Projects

- Principal Investigator of the project "Spectroscopy of exotic nuclei in a Magnetic Active Target - SpecMAT", awarded with an ERC Consolidator Grant (2013)
- Principal Investigator of the project "Transfer reaction studies at HIE-ISOLDE", awarded with a grant of the Research Foundation - Flanders (2012)
- Principal Investigator of the project "An active target detector for the study of the most exotic nuclei: the auxiliary charged-particle detectors", awarded with a grant of the Research Foundation - Flanders (2011)
- Co-spokesperson of the ACTAR TPC collaboration (2010-present)

4.1.14 ULB

Description

The Université Libre de Bruxelles (ULB; http://www.ulb.ac.be) is one of the largest and best research universities in Belgium, with a student population of 24,000 and more than 1,800 PhDs in progress. Founded in 1834, ULB has a long tradition of excellence in research with four scientific Nobel Prizes, one Fields Medal, three Wolf Prizes and two Marie Curie Excellence Awards. ULB has a considerable experience with European funding programmes and participates actively to the Framework Programmes. It also provides its researchers with a free access to a well-equipped computer centre.
The ULB research team in theoretical nuclear physics has a world reputation in different domains of low-energy nuclear theory. In particular, this team has a recognised expertise in the description of reactions involving light exotic nuclei, such as the reactions used to study nuclear structure far from stability or reactions of astrophysical interest. On the heavier side of the nuclear landscape, it is developing new methods based on the mean-field approach to study the structure of exotic nuclei. In particular, it has developed the best available mass formula based on a microscopic mean-field approach.
This group has a continuous collaboration with several other European teams working in nuclear theory. One of its main contracts is an "Interuniversity Attraction Pole" of the Belgian federal government which links all the groups active in low energy nuclear physics in Belgium. Thanks to this contract, the Brussels team has a strong collaboration with the groups of experimentalists of the KU Leuven.
However, this kind of collaboration is not exclusive: the group is also working frequently with several research teams performing experiments at the TAs of ENSAR.
For more information see: http://pntpm4.ulb.ac.be/pntpm/Default.aspx.
ULB will ensure that the project ENSAR2 receives all necessary administrative, legal & financial support and adequate space and facilities for its implementation.
The main task of ULB in ENSAR2 is its participation in JRA TheoS.

Key person in charge of activities

Role in the consortium: Participation in JRA TheoS
Main scientific activity: Theoretical research on nuclear structure
Name: CAPEL
First Name: Pierre
Nationality: Belgian
Gender: male

2011 – present Assistant Professor at the ULB (Brussels, Belgium)
2011 Research Associate at HIM (Mainz, Germany)

2009 – 2010	Research Associate at the NSCL (East Lansing, USA)
2006 – 2009	Postdoctoral Researcher of the F.R.S-FNRS at the ULB (Fund for Scientific Research, Belgium)
2004 – 2006	Research Associate at TRIUMF (Vancouver, Canada)
2000 – 2004	PhD thesis: “Coulomb breakup of halo nuclei by a time-dependent method", Université Libre de Bruxelles (ULB), Brussels (Belgium)

Publications

- P. Capel, Focus section of the J. Phys. G, Eds. R. C. Johnson and F. M. Nunes, J. Phys. G 41, 094002 (2014).
- Systematics of low-lying states of even-even nuclei in the neutron-deficient lead region from a beyond-mean-field calculation, J. M. Yao, M. Bender, P.-H. Heenen, Phys. Rev. C 87 034322 (2013).
- Comparing nonperturbative models of the breakup of neutron-halo nuclei, P. Capel, H. Esbensen, and F. M. Nunes, Phys. Rev. C 85, 044604 (2012).
- One-neutron halo structure by the ratio method, P. Capel, R. C. Johnson, and F. M. Nunes, Phys. Lett. B705, 112 (2011).
- Collision of halo nuclei within a dynamical Eikonal approximation, D. Baye, P. Capel, and G. Goldstein, Phys. Rev. Lett. 95, 082502 (2005).

Projects

- Direct Reactions Involving Exotic Nuclei (2014-2015). Pierre Capel is the principal investigator for this grant.
- Belgian Research Initiative on eXotic nuclei for atomic, nuclear and astrophysics studies (BRIX) (2012-2017).
- FP7 ENSAR Integrating Activity
- Production and use of radioactive-ion beams (yearly). The “Institut Interuniversitaire des Sciences Nucléaires" (IISN), is a Belgian scientific fund that finances research in nuclear physics.
- Theoretical and experimental analysis of the Coulombian and nuclear breakup of 17F (2009-2010). Pierre Capel was the principal investigator for this project.

4.1.15 CEA

Description

The CEA (Commissariat à l’Énergie Atomique et aux Énergies Alternatives), and specifically the IRFU (Insitut de Recherche sur les Lois Fondamentales de l’Univers) is a scientific institute with a leading role in all the major programmes in fundamental physics and with a top-level expertise in the development of instruments for this programme. Then it has all the skills required to progress in the field of detection set-up, combining knowledge and know-how in detector physics, associated electronics and signal processing. It has already involved in similar, successful programmes like Musett (silicon detector for the detection of heavy ions) or GET (General electronics for TCP) and consequently possesses the expertise and the equipment to pursue a high-level research and development task in detector technology.
The main tasks of CEA in ENSAR2 are participating in NA GDS, NA NuPIA, JRA SATNuRSE and JRA TecHIBA.

Key persons in charge of activity

Role in the consortium:	deputy coordinator of NuPIA
Main scientific activity:	high-energy nuclear reactions and their applications
Name:	LERAY
First Name:	Sylvie
Nationality:	French
Gender:	female

PhD in nuclear physics, Directeur de Recherche CEA, up to 2013 staff of the SPhN (Service de Physique Nucléaire) of CEA/DSM/Irfu, leader of the SPALLATION group which is working on experiments, modelling and validation in spallation physics and more generally on high-energy nuclear reactions and their applications. 140 publications in refereed journals. From 2103 in charge of European Affairs and External Funding at Irfu. She has participated into several EURATOM founded projects: the FP5 HINDAS project, was leader of work packages devoted to high energy data in FP6 EUROTRANS/NUDATRA and FP7 ANDES and CHANDA projects. She was also responsible for a

Task devoted to the improvement of event generators for simulations in ENSAR/SiNuRSE. She has conducted in 2010 the chapter on applications in the NuPECC Long Range Plan 2010: Perspectives of Nuclear Physics in Europe and took part to ENSAR/EFINION work package.

Role in the consortium: task leader in TecHIBA
Main scientific activity: experimental studies of super-heavy nuclei, nuclear instrumentation
Name: DROUART
First Name: Antoine
Nationality: French
Gender: male

2013 – present Head of the Laboratory for the Study of the Atomic Nucleus
2000 – present Permanent Position Researcher in Nuclear Physics (CEA – French Atomic Energy Commission – Saclay, Institute of Research into the Fundamental Laws of the Universe, Nuclear Physics Service)
2000 Ph.D. in Nuclear Physics (CEA Saclay, Nuclear Physics Service)

Publications

- The Super Separator Spectrometer (S^3) for SPIRAL2 stable beams, A. Drouart & al., Nucl. Phys. A834, (2010) 747
- X-ray fluorescence from the element with atomic number Z = 120, M.O. Frégeau & al., Phys. Rev. Lett. 108 (2012) 122701
- Very large emissive foil detectors for the tracking of low-energy heavy ions, A. Drouart & al., Nucl. Instr. Meth. A 579 (2007) 1090
- New potentialities of the Liège intranuclear cascade (INCL) model for reactions induced by nucleons and light charged particles, Boudard, A., et al., Phys. Rev. C, 2013. 87: p. 014606
- Improved modelling of helium and tritium production for spallation targets, Leray, S., et al., Nucl. Instr. Meth. B, 2010. 268(6): p. 581-586.

Projects

- FP7 ENSAR
- FP7 CHANDA
- FP7 ANDES
- Design of the Super Separator Spectrometer for SPIRAL2 at GANIL
- Design of the VAMOS spectrometer at GANIL

4.1.16 GIP ARRONAX

Description

The GIP ARRONAX hosts a multiparticle (protons, deuterons and alpha particles) high energy (up to 70 MeV) and high intensity (up to 2*350 µA for protons) cyclotron. ARRONAX activities are mainly connected to research in nuclear medicine especially by producing innovative radionuclides for imaging and radionuclide therapy in oncology. A special attention has been devoted to theranostic isotopes and to generator produced radionuclides. Research programmes are conducted on innovative isotopes like Copper-64, Copper-67, Astatine-211 and Scandium-44.
The GIP ARRONAX R&D team has developed targets for strontium-82, copper-64, scandium-44 and astatine-211 production. Several techniques are mastered from electroplating to deposition under vacuum as well extraction and separation techniques and radiolabelling. Thermal calculations as well as nuclear physic calculations are also performed on a regular basis.
ARRONAX is one of the few facilities in the world able to produce Curie quantities of Strontium-82.

The ARRONAX facility possesses six different experimental vaults available for experiments. The facility has several sets of hot cells for target processing (one is in a sterile environment) and laboratories (radiochemistry, radiolabelling, nuclear metrology and quality control).
All the nuclear techniques (γ spectrometry, α spectrometry, liquid scintillation) are present on site as well as all the techniques necessary for the final product quality control (HPLC, IT-TOF, CGMS, ...)

GIP ARRONAX staff (30 FTE) is divided in different groups. The R&D group gathers together physicists, radiochemists, radiopharmacists and technical staff.
The main task of ARRONAX in ENSAR2 is the participation in JRA TecHIBA.

Key person in charge of activities

Role in the consortium: participant in JRA TecHIBA work package
Main scientific activity: medical physics
Name: HADDAD
First Name: Ferid
Nationality: French
Gender: male

2014	Director (CEO), ARRONAX GIP
2014	Professor, Science Faculty of the University of Nantes.
2010	Habilitation à diriger les recherché (habilitation to supervise PhD research work)
2009	Deputy Director, ARRONAX GIP
2008	Head of the R&D group, ARRONAX GIP.
1995	Assistant professor, Science Faculty of the University of Nantes.
1995	Post-doctoral fellowship at SUBATECH (Bourse Régionale).
1993-1995	Post-doctoral fellowship at the Cyclotron Institute of Texas A&M University (USA).
1991-1993	PhD in Physics: Dynamics and collective motions in heavy ion collisions.

Publications

- Arronax, a high energy and high intensity cyclotron for nuclear medicine, Haddad F. et al., Eur. J. Med. Mol. Imaging (2008) 35 :1377-1387.
- Optimization of strontium-82 purification parameters using Chelex-100 resin, Alliot C et al., Applied Radiation and Isotopes 74 (2013), 74, 56-60.
- ^{232}Th(d,4n)^{230}Pa cross-section measurements, Duchemin C, Guertin A, Haddad F, Michel M and Métivier V, Nuclear Medicine and Biology 41 (2014) e19- e22.
- A new route for polonium-210 production from alpha irradiated bismuth-209 target, Younes AM et al., Radiochimica acta Ref. : RACT-D-13-2171R3 (2014)

Projects

- ArronaxPlus (2012-2019): 4 platforms around the nuclear medicine department to promote clinical and preclinical studies using innovative radionuclides.
- IRON (2012- 2019): network of French laboratory involved in nuclear medicine and working in oncology or neurology
- Strontium (2006/2014): implementation of production of Strontium-82 at GIP ARRONAX
- TheraneaM (2014-2019- Partnership with the Advanced Accelerator Applications company)
- COST action BM0607

4.1.17 JLU

Description

JLU is one of Germany's top research universities featuring an extraordinarily broad range of subjects. Both rich in tradition and highly innovative, JLU is host to a number of projects which are beacons of German research. What is more, its unique range of subjects and its high-profile international cooperation programmes in the areas of research, teaching and study ensure JLU's competitiveness at both national and international level. The university is dedicated to excellent research and teaching with a distinct profile in cultural studies and the life sciences. In keeping with Justus von Liebig's principle of "research training through research", JLU is highly committed to excellent interdisciplinary postgraduate education in all disciplines. The university's especially diverse climate, so fertile for interdisciplinary research and discussion, is further enriched by almost 30 percent international doctoral students.
The university was founded in 1607. The Liebig tradition of interdisciplinary synergies, excellence in research training and broad international networking continues to figure very prominently. Today the university is characterised by the following facts and figures:

- 11 faculties and 6 research centres
- 24,000 students

- 340 professors
- 1,700 teaching and research staff
- 2,390 administrative and technical staff

As it enters its fifth century, JLU is involved in international networks far beyond the bounds of its excellent research areas, having over the past ten years successfully pressed ahead with the process of internationalisation. High-quality bilateral cooperation agreements and the university's membership in selected networks of higher education institutions provide the basis for high-level international research and exchange. A wide range of initiatives have made JLU an internationally attractive university with a clear commitment to sustainability: at JLU, internationalisation is being pursued as a long-term process, a concept applied universally, across the fields of teaching, research and management. JLU's remarkable achievements in the context of Germany's nationwide "Excellence Initiative" prove JLU's top-class university research in its profile areas. Since 2006, the university has received funding of 25 million euros for two renowned international projects, the Excellence Cluster Cardio-Pulmonary System (ECCPS, in cooperation with the Max Planck Institute Bad Nauheim and Goethe University Frankfurt) as well as the International Graduate Centre for the Study of Culture (GCSC) in the humanities.
The main task of JLU in ENSAR2 is the participation in JRA SATNuRSE.

Key person in charge of activities

Main scientific activity: experimental hadron physics with one major focus on detector physics
Name: BRINKMANN
First Name: Kai-Thomas
Nationality: German
Gender: male

Current activity: Professor at JLU, head of workgroup Brinkmann.

4.1.18 JGU Mainz

Description

Mainz University (JGU Mainz) is a public full-scale scientific and educational establishment, comprising the complete range of study topics with an outstandingly strong appearance in natural sciences. E.g. in physics the BMBF excellence cluster PRISMA has been established in 2012. The number of students exceeds 35 000, being instructed and supervised by more than 500 professors and lecturers. Mainz University has the highest ERASMUS mobility within all German Universities, its third party funding amounts to about 80 Mio. Euro per year, which is raised basically from national resources (DFG, BMBF) through presently 4 research units, 13 collaborative research centres and additional 8 research training programmes for graduate students. EU funding amounts to about 5 % with an increasing trend. Apart from the medical institutions, a major share of the externally funded research and teaching projects are operated by the natural science departments, dominantly the department of chemistry, pharmacy and geosciences and the department of physics, mathematics and computer science. In the field of physics, the latter is scientifically well established with strong and solid research projects in the domains of elementary- and astroparticle physics, solid state physics and quantum optics & laser physics, each supported by a strong theory division. Involvements in the leading European large-scale facilities CERN, GSI, GANIL, ILL and ESRF, as well as the recent foundation of the Helmholtz-Institute Mainz HIM confirm this fortunate situation.
The researchers involved in the present project have a long-standing worldwide reputation in the development and application of modern state-of-the art solid state laser systems to online laser ion sources and all related spectroscopic activities up to analytical applications requiring highest sensitivity and selectivity. Numerous world leading on-line facilities for production of exotic nuclei use a Mainz university solid-state laser system, operated often by present or former members of the Mainz University working group, (i.e. CERN/ISOLDE, TRIUMF, JYFL, ORNL, GANIL, RIKEN, RISP, University of Nagoya). The group was already actively involved in different EU framework programmes (Osteodiet, EURONS LASER, ENSAR/PREMAS), the unique expertise will be most helpful for the majority of proposed WPs. For further information see http://www.larissa.physik.uni-mainz.de/
The main task of JGU Mainz in ENSAR2 is the participation in JRA RESIST.

Key person in charge of activity

Role in the consortium: participant in JRA RESIST work package
Main scientific activity: laser spectroscopy and mass spectrometry for isotope sciences
Name: WENDT
First Name: Klaus
Nationality: German

Gender:	male

2007 – present	Promotion to extraordinary Professor, University of Mainz
2000 – present	Group Leader of the Working Groups RISIKO / LARISSA
1999 – present	Senior Researcher & Lecturer, Universität, Mainz,
1999	Habilitation, Universität, Mainz,
1986 – present	Staff Scientist, Institut für Physik, Universität, Mainz,
1985	PhD in physics, CERN, Geneva, Switzerland
1984 – 1986	CERN-Fellowship
1981 – 1984	Research Scientist, CERN, Geneva, Switzerland

Publications

- Measurement of the first ionization potential of astatine by laser ionization spectroscopy, S. Rothe et al., Nature Communication 4,1835 (2013)
- Resonance ionization mass spectrometry for trace analysis of long-lived radionuclides, N. Erdmann, G. Passler, N. Trautmann, K. Wendt, Radioactivity in the environment 11, 331 – 354 (2008)
- Counting individual ^{41}Ca atoms with a Magneto-Optical Trap, I.D. Moore et al., Phys. Rev. Lett. 92, 153002 (2004)
- Trace Analysis of the Radionuclides ^{90}Sr and ^{89}Sr in Environmental Samples I: Laser Mass Spectrometry, J. Lantzsch et al., Angew. Chem. Int. Ed. Engl. 34, 181-183 (1995)
- Mean Square Charge Radii of Radium Isotopes and Octupole Deformation in the $^{220-228}$Ra Region, S.A. Ahmad et al., Nucl. Phys. A 483, 244-268 (1988)

Projects

- CERN/ISOLDE Kernstrukturuntersuchung mit atomphysikalischen Methoden 2006-2009, funding by the German BMBF
- CERN/ISOLDE Steigerung von Selektivität und Effizienz, 2009-2012, funding by the German BMBF
- CERN/ISOLDE In source Spektroskopie an der ISOLDE RILIS, 2012 – 2015, funding by the German BMBF
- FP6 EURONS
- FP7 ENSAR

4.1.19 LMU

Description

LMU (Munich, Germany) is one of the largest research universities in Germany, regularly ranked in the top group of German universities (2013 Times Higher Education World Reputation Ranking: no. 1 in Germany, no. 2 in continental Europe, no. 44 worldwide) and since 2006 earned the distinction of an elite university in Germany. As of 16.10.2013, within its 18 faculties LMU Munich hosts 50542 students (30844 female, 19698 male) and employs 737 professors and 5221 (scientific and non-scientific) staff members, operating on a budget of about 489 MEUR (2013). The Faculty of Physics (51 professors) is top-ranked in Germany, providing both world-class higher education as well as forefront research opportunities.
LMU Munich has gained experience with EC-funded Integrating Initiatives both as participants and activity coordinators in previous EC framework programmes. In the work package NA MediNet LMU has the task to coordinate the networking activities on applications of nuclear science and technologies for the advancement of radiation therapy detectors, besides contributing to the scientific goals of the NA. Here, LMU is participating via its expert group at the Chair of Medical Physics with recognised and long-term experience in detector development and treatment planning and verification for hadron therapy.
For more information see: http://www.uni-muenchen.de/
The main task of LMU in ENSAR2 is the co-coordination of NA MediNet.

Key person in charge of activities

Role in the consortium:	co-leader of NA MediNet work package
Main scientific activity:	instrumentation for medical applications, nuclear structure
Name:	THIROLF
First Name:	Peter
Nationality:	German
Gender:	male

2014 – present	Member of the Scientific Council of the Institut Laue-Langevin, Grenoble, France
2012 – present	Council Member of the NUSTAR collaboration at FAIR (Darmstadt/Germany)
2012 – present	Deputy project leader of the ‘Centre for Advanced Laser Applications (CALA), Garching, Germany
2010 – present	Member of the Collaboration Committee of the DESIR facility at SPIRAL2
2010 – 2011	Deputy Research Area Coordinator: 'Fundamental Physics and Nuclear Transitions' (substituting Prof. T.W. Hänsch)
2006 – present	Project leader in the DFG Cluster of Excellence ‘Munich-Centre for Advanced Photonics (MAP)’
2006 – present	Principal Investigator and project leader in the DFG Cluster of Excellence 'Origin and Structure of the Universe’
2006 – present	Principal Investigator and project leader in the DFG Cluster of Excellence 'Origin and Structure of the Universe’
2006 – 2011	Board Member of the DFG Cluster of Excellence MAP
2006 – 2009	Research Area Coordinator: 'Fundamental Physics and Nuclear Transitions' in the DFG Cluster of Excellence MAP
2006	Promotion to ‘Akademischer Oberrat’ at LMU Munich
2004 – present	Project leader in the DFG-funded Transregional Collaborative Research Centre TR18 ‘Relativistic Laser-Plasma Dynamics’
2004 – present	‘Privatdozent’, LMU München
2004	Habilitation, Ludwig-Maximilians-University (LMU) München
2002	Appointment as ‘Akademischer Rat’ at LMU Munich
1996 – 2004	Scientific Assistant, LMU München
1995 – 1996	Research Associate at National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, MI, USA
1992 – 1994	Scientific employee, Max-Planck-Institute (MPI) for Nuclear Physics, Heidelberg
1992	PhD in Physics, University of Heidelberg

Publications

- Submillimeter nuclear medical imaging with a Compton Camera using triple coincidences of collinear β^+-annihilation photons and γ rays, C. Lang, D. Habs, P.G. Thirolf, A. Zoglauer, Radiotherapy and Oncology 102, s1 (2012), S29.
- Development of a Compton Camera for Online Range Monitoring of Laser-Accelerated Proton Beams, P. Thirolf, S. Aldawood, C. Lang, K. Parodi, Med. Phys. 40, 144 (2013)
- Submillimeter nuclear medical imaging with increased sensitivity in positron emission tomography using $\beta\gamma$ coincidences, C. Lang, D. Habs, K. Parodi, P.G. Thirolf, Jour. of Instrumentation 9 (2014) P01008.

Projects

- Member of the Executive Board of the EU funded Research Infrastructure: ELI-Nuclear Physics, Bucharest, Romania
- FP6 SAFERIB
- FP6 EURISOL Design Study
- FP5 IonCatcher

4.1.20 UCO

Description

The University of Cologne, Germany, (UCO) has six Faculties covering a broad spectrum of disciplines and has developed internationally outstanding research profile areas on this basis.
The life and natural sciences are represented by the Faculty of Medicine and the Faculty of Mathematics and Natural Sciences comprising biology, chemistry, geography, geosciences, mathematics and physics. These two Faculties have greatly benefited from long-standing excellent collaborations. Cutting-edge, internationally competitive research is currently being performed in many fields including research on aging-associated diseases, molecular evolutionary biology and plant sciences, quaternary research, and statistical physics. In addition, three interdisciplinary centres, the Centre of Molecular Medicine Cologne, the Cologne Centre for Genomics and the Centre for Integrated Oncology directly link basic with translational research.
The Nuclear physics institute of University of Cologne educates and trains physicists from under graduate level of students up to post-doctoral level for scientists. Researches on Ge detector technology and electronics developments are pursued since the 1970's. Encapsulated HPGe detectors were invented together with industrial partners at University of Cologne.
The main task of UCO in ENSAR2 is the participation in JRA PSeGe.

Key person in charge of activities

Role in the consortium:	participant in JRA PASPAG work package
Main scientific activity:	research in detector development
Name:	REITER
First Name:	Peter
Nationality:	German
Gender:	male

2002 – present	professor experimental physics, University of Cologne
1998 – 2002	assistant professor LMU University of Munich, Germany
1996 – 1998	postdoctoral Appointee Argonne National Laboratory, USA
1993 – 1996	researcher, MPI für Kernphysik, Heidelberg, Germany
1993	PhD, MPI für Kernphysik, Heidelberg, Germany

Publications

- Improved energy resolution of highly segmented HPGe detectors by noise reduction – A. Wiens et al., Eur. Phys. J. A (2013) 49: 47
- Space Charge Distributions in highly segmented HPGe–Detectors – B. Birkenbach et al., Nucl. Instr. and Meth. A 640 (2011) 176
- The AGATA triple cluster detector - A. Wiens et al., Nucl. Instr. and Meth. A 618 223(2010)
- Crosstalk properties of 36-fold segmented symmetric hexagonal HPGe detectors - B. Bruyneel et al., Nucl. Instr. and Meth. A 599, (2009) 196
- Characterization of Large Volume HPGe Detectors. Part I: Electron and Hole Parameterization - B. Bruyneel, P. Reiter, G. Pascovici, Nucl. Instr. and Meth. A (2006) 569, Issue 3, 764-773

Projects

- Member of AGATA management board
- Head of MINIBALL steering committee
- Convener of Fast beam RISING campaign at GSI
- Spokesperson of several experiments at ANL, GSI, CERN

4.1.21 NCSRD

Description

The *National Centre for Scientific Research "Demokritos" (NCSRD)* is the largest multidisciplinary research centre in Greece, with critical mass of expertise and significant infrastructure in the fields of New Materials, Microelectronics and Nanotechnology, Nuclear Physics and Particle Physics, Nuclear Technology and Radiation Protection, Life Sciences, Biology and Biotechnology, Environment, Energy and Sustainable Development, Informatics and Telecommunications as well as technologies for studying the Cultural Heritage. Research in these fields is conducted by the five independent NCSRD institutes. "Demokritos" conducts world-class basic and applied research, for advancing scientific knowledge and promoting technological development in selected areas of national socio-economic interest. It also plays a pivotal role in postgraduate education and professional training, provides customised high-technology services to the public and private sectors, operates a Technology Park and an Exhibition of the research achievements of the local research centres, and recently initiated the implementation of a plan to establish an Innovation and Entrepreneurship hub, the Metropolitan Innovation Campus of Attica, by integrating the local research and industrial stakeholders. In 2013, the total number of employees was 837 people from which 539 were scientists, 137 technical personnel, 89 administrators and 71 auxiliary personnel. In 2013, the total income was almost 34 M€, with the percentage from EU Programmes & Services 51% and 49% that from public grants. Through the period 2005-2012 NCSRD scientists attracted more than 120M€ from the EU Framework Programmes and from sales of products and services. In the period 2005-2012 (the most recently peer-evaluated period), the impact of the research conducted at "Demokritos" has increased significantly, as documented by the 5.237 papers in refereed journals and proceedings of International Conferences, 103.847 non self-cited citations, 92 Books and Monographs. In the same period, Demokritos' researchers received 154 awards and/or prizes or other distinctions and supervised more than 100 PhD theses.

The research activities of *the Institute of Nuclear and Particle Physics (INPP)* focus on three major scientific areas, i.e. Astroparticle Physics (APP), High-Energy Physics (HEP), and Nuclear Physics and Applications (NPA). INPP is mainly oriented towards basic research but is also engaged in the development of numerous novel applications and hardware development programmes. The INPP applications programme contributes decisively to the country's capacity building, and the solution of problems of societal importance. Moreover, INPP hosts two unique research infrastructures (RI) in Greece, i.e. the Tandem Accelerator Laboratory (TAL) at the NCSR "Demokritos" premises in Athens and NESTOR, the facilities to build a deep-see neutrino telescope, in Pylos, Peloponnese. These RI are the flagships of the Greek Nuclear and Astroparticle Physics scientific communities.

The main task of NCSRD in ENSAR2 is the coordination of NA ENSAF.

Key person in charge of activities

Role in the consortium:	leader of NA ENSAF work package
Main scientific activity:	Experimental research on nuclear astrophysics
Name:	HARISSOPULOS
First Name:	Sotirios
Nationality:	Greek
Gender:	male

Dr. Sotirios Harissopulos is the Director of the Institute of Nuclear and Particle Physics (INPP) of the National Centre for Scientific Research "Demokritos" (NCSRD) and member of the Governing Board of NCSRD. He studied physics at the University of Thessaloniki, Greece and received his PhD in June 1989 from the University of Cologne, Germany. For his PhD, he was granted a scholarship from the German Academic Exchange Service (DAAD) and carried out research in nuclear structure at the Institute of Nuclear Physics (IKP) of the University of Cologne, focusing on lifetime measurements with the plunger method. After his return to Greece, he started as Assistant Professor at the Technological-Educational Institute of Athens and in December 1995 he was elected as a tenure-track research scientist at "Demokritos". In Feb. 1999, he promoted to senior researcher ("Principal Investigator") and in Dec. 2006 to "Director of Research", a position equivalent to that of a University Professor. In the period from June 2003 to May 2004, he was on sabbatical at the University of Bochum, Germany, working with Prof. Claus Rolfs on the study of nuclear reactions relevant to stellar nucleosynthesis and the detection of geo-neutrinos. He has received a number of research grants either as visiting scientist or scientist in charge. Within the FP7/CAPACITIES programme he was granted a REGPOT project (Grant 230123; 1.5 M€; acronym LIBRA) that led to a full upgrade of a small-scale accelerator facility. Dr. Harissopulos acted as the WP-leader of the EFINION Networking Activity within the FP7/ENSAR Integrating Activity. He has additionally been convener of two workshops funded by the European Science Foundation (ESF), the first one entitled "ESF Exploratory Workshop in p-process nucleosynthesis" (2002) and the second one "ESF Workshop on the future of stable beams in nuclear astrophysics" (Dec. 2007).

S. Harissopulos was the Greek delegate for the FP7/EURATOM/Fission programme and has represented the Greek funding agency (GSRT) in the FP7/ERA-NET in Nuclear Physics in Europe (NuPNET). He is currently a member of NuPECC (for Greece), a member of the ISOLDE Steering Committee and member of the Greek National Committee for CERN. From 2003 to 2005, he served as (elected) member of the Governing Board of the Hellenic Researchers Association. He is member of the European Physical Society and the German Physical Society (DPG). His research activities include experimental nuclear astrophysics, nuclear structure, and applications of nuclear methods. He was chair and/or member of a number of International Conferences and Workshops, invited speaker and lecturer in many conferences and schools and referee in several scientific journals. He has served as an Independent External Evaluator of a number of PhD theses abroad as well as of research proposals on behalf of various funding agencies from abroad. He has more than 100 publications in referred journals and peer-reviewed conference proceedings with more than 2000 citations. So far has supervised 10 PhD theses. S. Harissopulos is one of the members of NuPECC's working group on "Small-scale facilities", and main organiser of the 1st European Workshop on European Small-Scale Accelerator Facilities (see in http://www.inp.demokritos.gr/~ssfw/ and in http://www.nupecc.org/index.php?display=ssf/survey).

Publications

- Cross section measurements of proton capture reactions relevant to the p process: The case of $^{89}Y(p,\gamma)^{90}Zr$ and $^{121,123}Sb(p,\gamma)^{122,124}Te$; S. Harissopulos et al., Phys. Rev. C 87, 025806 (2013)
- Investigation of the reaction $^{74}Ge(p,\gamma)^{75}As$ using the in-beam method to improve reaction network predictions for p nuclei; A. Sauerwein et al., Phys. Rev. C 86, 035802 (2012).
- Astrophysical Reaction Rates and the Low-energy Enhancement in the γ Strength; A.C. Larsen et al., Acta Phys. Pol. B 44, 563 (2013)]
- Radionuclides for nuclear medicine: a nuclear physicists' view; M. Cantone et al., European Jour. Nucl. Med. 40, S257, Suppl.: 2, Oct. 2013.
- The FIDIAS project: Development of a MicroMegas TPC for the detection of low-energy heavy ions; F. J. Iguaz et al., Nucl. Instr. Meth. A 735, 399 (2014).

Projects

- FP7 LIBRA (coordinator)
- FP7 ENSAR (participant)
- FP7 NuPNET (participant)
- FP6 EURONS (participant)
- Convener of the workshop funded by the European Science Foundation (ESF) entitled "ESF Workshop on the future of stable beams in nuclear astrophysics" in Athens, Greece, in December 2007.

4.1.22 UMIL

Description

The University of Milan (UMIL), established in 1924, is a public teaching and research-intensive university, the only Italian among the 21 prestigious members of LERU (League of European Research Universities), and an internationally high-ranked university.
With a teaching staff of about 2.200 tenured professors and with almost 60.000 students, the University of Milan is the largest university in Lombardy, one of the most dynamic and internationally-oriented EU regions and leader in the Italian economy. The University of Milan's Faculties offer a number of study programmes, which can be grouped into three macro-disciplinary areas: Humanities, Social Sciences and Law; Medicine and Healthcare; and Natural Sciences.
The broad range of subjects taught, which currently consists of 79 Undergraduate programmes, 57 Master programmes, 9 Single-cycle programmes, 21 Doctoral Schools, and several Advanced Vocational programmes, attracts students from Italy and the whole world.
The University of Milan has a deserved reputation as one of the European universities that is most seriously committed to research, of both a basic and applied nature and its research activities are undertaken across the entire range of scientific and disciplinary fields present in the institution. Research activities are conducted in 31 Departments and 29 Inter-departmental Research Centres and their results are attested by a significant quantity of scientific publications (more than 24.000 in the last three years) and international patent applications, while 5 scientists from the University have been ranked as highly cited by the ISI – Institute for Scientific Information (USA). The University's researchers occupy leading positions in numerous research programmes conducted both at a national and international level.
Moreover, since years, the University of Milan is focused in the protection and exploitation of the scientific productivity. To this aim it has developed a policy aimed to facilitating and shortening the time and mode of transfer of results from research to market and it has built relationships with different third party (Industry; not profit organisation, institutional entity; SME) that it necessary to fill the gap exists between research and market.
With its wide spectrum of basic and applied research activities, covering scientific areas such as pharmacology, life sciences and biotechnologies, chemistry, agriculture and veterinary science, nanotechnologies, computer science and communication science as well as law, socio-economic and human sciences, the institution is constantly developing projects in cooperation with the most relevant international research groups, often acting as coordinator of activities. Several patent applications, in co ownership with partners, have been filed to protect results developed within European Project.
The Department of Physics hosts research activities in various domains of fundamental and applied Physics such as

Astrophysics, Theoretical Physics, Nanotechnologies, Optics, Particle Physics, Nuclear Physics, Condensed Matter Physics, Physics of Plasmas, Accelerator Physics, Physics of Complex Systems, Environmental and Cultural Heritage Physics, and Medical Physics. The Department hosts a research unit of the National Institute of Nuclear Physics (INFN). Research is also performed in collaboration with other national research agencies: the National Institute of Astrophysics (INAF), the National Consortium of Universities for the Physics of Matter (CNISM), and the National Research Council (CNR). The Department partly hosts the activity of the Interdisciplinary Centre of Excellence (CIMAINA) in the field of nanotechnologies, which involves several research groups across the University. The national and international excellence of the research performed in the Department, are demonstrated by the award of substantial national and international grants, The graduate School also involves several national and international institutions. The Department also performs basic and applied research in collaboration with private companies and government agencies. The Department employs about 80 research staff members, and 40 administrative and technical staff units. Several Italian and foreign students of the PhD School and Post-Docs contribute to the research activities of the Department.
The main tasks of UMIL in ENSAR2 are the participation in NA MediNet and in JRA TheoS.

Key person in charge of activities

Role in the consortium:	participant in JRA TheoS work package
Main scientific activity:	theoretical research on nuclear structure
Name:	COLÒ
First Name:	Gianluca
Nationality:	Italian
Gender:	male

2012 – present	Member of the PAC of LNL, INFN, Italy
2008 – present	Member of the SPES project study group
2011 – present	Member of the Department direction board, Università degli Studi di Milano, Italy
2006 – present	Associate professor, Università degli Studi di Milano, Italy
2001 – 2004	Member of the Department direction board, Università degli Studi di Milano, Italy
1995 – 2006	Assistant professor, Università degli Studi di Milano, Italy
1995	Post-Doc, Università degli Studi di Milano, Italy
1994	Post-Doc, CNRS, France
1993	Post-Doc, ECT*, Trento, Italy
1992	PhD in Physics, Università degli Studi di Milano, Italy

Publications

- Beyond-mean-field theories with zero-range effective interactions. A way to handle the ultraviolet divergence, K. Moghrabi, M. Grasso, G. Colò, N. Van Giai, Phys. Rev. Lett. 105, 262501 (2010).
- Self-consistent RPA calculations with Skyrme-type interactions: the skyrme_rpa program, G. Colò, L. Cao, N. Van Giai, L. Capelli, Comp. Phys. Comm.184, 142 (2013).
- A new Skyrme interaction with improved spin-isospin properties, X. Roca-Maza, G. Colò, and H. Sagawa, Phys. Rev. C86, 031306(R) (2012).
- Tensor interaction and nuclear structure, H. Sagawa and G. Colò, Prog. Part. Nucl. Phys. 76 (2014) 76.
- Measurement of the isoscalar monopole response in the neutron-rich 68Ni nucleus, M. Vandebrouck, et al., Phys. Rev. Lett. 113, 032504 (2014).

Projects

- Member of the PAC of the Legnaro National Laboratories (INFN).
- Previous member of the PAC of RCNP, Osaka.
- Member of national research initiative "STRENGTH", granted by INFN
- Deputy coordinator of the national research project "Many-Body Theory of Nuclear Systems and Implications on the Physics of Neutron Stars" (PRIN 2008)"
- Local coordinator of the UE project "Asia-Europe Link in Nuclear Physics and Astrophysics"

4.1.23 FFCUL (date of termination: June 30th, 2017)

Description

The Fundação da Faculdade de Ciências da Universidade de Lisboa (FFCUL) is a non-profit organisation, recently reclassified as a public institution. FFCUL was created in 1993 as an initiative of the Faculdade de Ciências da Universidade de Lisboa (FCUL) to promote and facilitate scientific research, technology and development services to society, and to organise qualified human resources training and consulting expertise and knowledge dissemination. FFCUL acts as the legal front institution of multiple research units, from different scientific fields, carrying out research work and managing financial and administratively R&D projects. Currently, FFCUL manages over 400 projects and implements a professional (and constantly audited) management of around 30 research units, in the fields of Mathematics, Statistics and Operational Research, Physics, Chemistry and Biochemistry, Geology, Geophysics, Space, Astronomy, Biology, Computer Science and Informatics, Education Sciences and Philosophy and History of Sciences.

Many of these R&D activities are developed together with international teams and are funded both at National and European levels. At European level FFCUL has the experience of managing circa one hundred EU FP6 and FP7 projects.

FCUL acts as a third party in those R&D projects based on a scientific agreement in force since the FFCUL establishment. The third party carries out part of the work directly and FFCUL is responsible for part of the scientific and technical work as well.

All the research work is carried out by the research unit staff and by staff hired by FFCUL specifically for the R&D Projects. The largest FFCUL clients are associated to the FCUL research units (which integrate researchers from more than 20 other Portuguese faculties and universities), but FFCUL also supports other universities and laboratories directly.

The main task of FFCUL in ENSAR2 is the participation in JRA SATNuRSE

Key person in charge of activities

Role in the consortium:	participant in JRA SATNuRSE work package
Main scientific activity:	Experimental research on nuclear structure
Name:	GALAVIZ REDONDO
First Name:	Daniel
Nationality:	Spanish
Gender:	male

2008 – present	Research Associate. Programme Ciencia 2007. FFCUL, Lisboa, Portugal
2007 – 2008	Research Associate, Juan de la Cierva Fellow. CSIC, Madrid, Spain
2004 – 2006	Research Associate, NSCL, Michigan State University, USA
2004	PhD on Nuclear Physics, Technische Universität Darmstadt, Germany

Publications

- Performance analysis for the CALIFA Barrel calorimeter of the R3B experiment, H. Alvarez-Pol et al., Submitted to Nucl. Instr. Meth. A.
- Simulations of a new detection concept for high-energy neutrons based on timing RPCs, J. Machado et al., Journal of Instrumentation 8, P07020 (2013).
- Beyond the neutron drip line: The unbound oxygen isotopes ^{25}O and ^{26}O, C. Caesaret al., Phys. Rev. C 88, 034313 (2013)
- Golden glazes analysis by PIGE and PIXE techniques, M. Fonseca et al., Nucl. Instr. Meth. B 269, 3060 (2011)

Projects

- Simulations and analysis of direct reactions in neutron rich nuclei (S393) and the CALIFA detector
- FP7 ENSAR
- Moving towards FAIR: Complete study of halo nuclei in breakup reactions under quasi-free scattering conditions and simulations on the R3B experiment

4.1.24 CIEMAT

Description

CIEMAT (Centro De Investigaciones Energeticas, Medioambientales Y Tecnologicas), an Organism of the Ministry of Economy and Competitiveness, is a Public Research Agency for excellence in energy and environment, as well as in many vanguard technologies and in various areas of fundamental research.

The group involved in the project is the Nuclear Innovation Unit of the Nuclear Division, belonging to the Energy Department. The group works in nuclear data research since its formation in 1997, participating in the EU projects NTOF-ND-ADS of FP5 and the CANDIDE network of FP6 and coordinating the NUDATRA Domain of IP-EUROTRANS and the ANDES project. It has also participated in the nuclear data experiments n_TOF at CERN, at the JRC-IRMM and the preparation of experiments at FAIR. The nuclear data activity is part of a wider research programme on Monte Carlo simulation for nuclear technologies: advanced nuclear cycles, including the nuclear waste transmutation and advanced reactors for sustainable nuclear energy. The group has contributed to FEAT and TARC FP4 projects at CERN, the MUSE4, PDS-XADS y ADOPT of FP5; in EUROTRANS, PATEROS, RED-IMPACT, JHR-CA, MTR-I3 and SNF-TP of FP6; ANDES (as coordinator), CP-ESFR, CDT, MAXSIMA, FAIRFUELS and ENSAR of FP7 as well as several ISTC projects. The Nuclear innovation group also participates in the NEA Working Party on scientific issues of Advanced Fuel Cycles, WPFC previously WPPT, and in several expert groups of IAEA. Finally CIEMAT is member of the GEANT4 collaboration and is responsible for the validation of the high precision neutron transport models which use evaluated nuclear data and the production of the corresponding GEANT4 nuclear data libraries. CIEMAT has developed as well a new physics package for the transport of charged particles driven by nuclear data libraries and maintains, in collaboration with the IAEA, a website where all these results have become public.

CIEMAT will contribute to ENSAR2 JRA SATNURSE work package with the experience in nuclear data measurements at n_TOF, nuclear data libraries and Monte Carlo simulation with GEANT4 and MCNPX.

Key persons in charge of activities

Dr. D. Cano-Ott, head of the Nuclear Innovation Unit, responsible for the actinide capture measurements at n_TOF and expert in Monte Carlo simulation and nuclear instrumentation. He has participated in FP6 and FP7 nuclear data projects and supervises various PhD and Master theses.

Dr. E. Mendoza, researcher. He is participating in ANDES and ENSAR FP7 projects. He is responsible of the recent developments in GEANT4 related to the use of evaluated nuclear data libraries.

Dr. D. Cano-Ott and Dr. E. Mendoza work for the same unit of CIEMAT “Nuclear Innovation Unit”.

Publications

- New Standard Evaluated Neutron Cross Section Libraries for the GEANT4 Code and First Verification, E. Mendoza, D. Cano-Ott, T. Koi and C. Guerrero (on behalf of the GEANT4 collaboration), IEEE Trans. Nucl. Sci. 61, 2357 (2004).
- MONSTER: a TOF Spectrometer for β-delayed Neutron Spectroscopy, T. Martínez, D. Cano-Ott, J. Castilla, A.R. Garcia, J. Marin, G. Martinez, E. Mendoza et al., Nuclear Data Sheets 120, 78 (2014).
- Simultaneous measurement of neutron-induced capture and fission reactions at CERN, C. Guerrero, E. Berthoumieux, D. Cano-Ott, E. Mendoza et al., Eur. Phys. J. A 48: 29 (2012)
- Monte Carlo simulation of the n_TOF Total Absorption Calorimeter, C. Guerrero, D. Cano-Ott, E. Mendoza et al., Nucl. Instr. Meth. A 671, 108 (2012).
- Measurement and resonance analysis of the ^{237}Np neutron capture cross section, C. Guerrero, D. Cano-Ott, E. Mendoza et al., Phys. Rev. C 85, 044616 (2012).

Projects

- FP7 ANDES (coordinator)
- FP7 ENSAR Integrating Activity
- FP7 SPIRAL2 PP
- FP6 EUROTRANS

4.1.25 CSIC

Description

The Spanish National Research Council (CSIC) is the largest public institution dedicated to research in Spain and the third largest in Europe. Belonging to the Spanish Ministry of Economy and Competitiveness through the Secretary of State for Research, Development and Innovation, its main objective is to develop and promote research that will help bring about scientific and technological progress, and it is prepared to collaborate with Spanish and foreign entities in order to achieve this aim. According to its Statute (article 4), its mission is to foster, coordinate, develop and promote scientific and technological research, of a multidisciplinary nature, in order to contribute to advancing knowledge and economic, social and cultural development, as well as to train staff and advise public and private entities on this matter.

It has a staff of more than 13,000 employees, among these about 3,300 are permanent researchers and about 4,300 are pre- and post-doctoral researchers.

The CSIC has 71 institutes or centres distributed throughout Spain. In addition, it has 54 Joint Research Units with universities or other research institutions. There is also a delegation in Brussels.

CSIC provides services to the entire scientific community through management of the Singular Scientific and Technological Infrastructures (ICTS) such as Calar Alto Astronomical Observatory, Doñana Biological Station, European Synchrotron Radiation Facility, Hesperides Ocean Research Vessel, Integrated Micro and Nanoelectronics Clean Room, Juan Carlos I Antarctic Base, Max Von Laue-Paul Langevin Institute and Sarmiento de Gamboa Ocean Research Vessel

CSIC has considerable experience in both participating and managing R&D projects and training of research personnel.

Under the 7th Framework Programme CSIC has signed 724 actions (including 62 coordinated by CSIC and 45 ERC projects). Funding wise, CSIC is listed the 6th organisation in Europe in the 7th Framework Programme. As to the number of projects signed by CSIC within each programme, the distributions is People 36,4%, Cooperation 32,1%, Capacities 25,2% and Ideas 6,3%. If we take into account funding, the ranking would be different: Cooperation 45%, IDEAS 28%, People 19%, and Capacities 8%.

In addition, CSIC presents a large participation in other European programmes as LIFE+, INTERREG, EMRP, RFCS, ERANET, etc.

The main tasks of CSIC in ENSAR2 are the coordination of JRA PSeGe, the coordination of JRA PASPAG and the participation in NA NUSPIN, NA MediNet and JRA SATNuRSE.

Key persons in charge of activities

Role in the consortium:	leader of JRA PSeGe work package
Main scientific activity:	Experimental research on nuclear structure
Name:	GADEA RAGA
First Name:	Andres
Nationality:	Spanish
Gender:	male

2010 – present	'Project Manager' of AGATA (350 participants of about 40 institutes in 12 countries
2008 – present	Member of the Steering Committee of NEDA (Neutron Detector Array)
2007 – 2011	Co-Spokesperson of the AGATA Demonstrator Scientific Campaign at INFN-LNL
2007 – 2010	Coordinator of the High – Resolution gamma-Spectroscopy Working group for the project SPIRAL2
2007 – 2008	Spokesperson and coordinator of the AGATA-Demonstrator installation, coupled to the Magnetic Spectrometer PRISMA, at INFN-LNL
2007 – present	Investigador, CSIC, Spain
2006 – 2008	National Responsible (National Coordination) of the GAMMA INFN (with 58 researchers)
2006 – 2007	Senior researcher, INFN- Legnaro National Laboratories (LNL) Italy
2003 – 2004	Coordinator of the Ancillary Detectors Group in EUROBALL IV
2002 – 2010	Member of the 'Management Board' of AGATA (Advance Gamma Tracking Array)
2001 – 2006	Spokesperson and responsible of the Ge-detector Array CLARA INFN
2001 – 2006	Researcher, INFN- Legnaro National Laboratories (LNL) Italy
1997 – 1998	Local Responsible for the Ancillary Detectors in EUROBALL III, INFN-LNL, Italy
1994	PhD in nuclear physics, University of Valencia, Spain

Role in the consortium: leader of JRA PASPAG work package
Main scientific activity: Experimental research on exotic nuclei
Name: TENGBLAD
First Name: Olof
Nationality: Swedish
Gender: male

Prof. Olof Tengblad is a nuclear physicist. He started his scientific carrier at Chalmers University of Technology in Göteborg, Sweden, studying neutron detectors, especially the ^{3}He spectrometer and 4π n-longcounters. He was the Physics Coordinator of ISOLDE during 1992-1996. Since 1999 he has held a permanent research position at the Spanish Governmental research body CSIC (Agencia Estatal Consejo Superior de Investigaciones Cientificas). His main activity is related to the experimental study of exotic nuclei. He is presently Technical Manager for the R3B project at GSI/FAIR and he is part of the Physics Coordination Committee of the HIE-ISOLDE project. His publication record includes some 200 refereed articles with an H-index = 34. The group webpage: http://www.iem.cfmac.csic.es/departamentos/nuclear/fnexp/index_en.html).
He is project leader of the ERAnet-NuPNET project GANAS:
http://www.iem.cfmac.csic.es/departamentos/nuclear/GANASwebpage/html/index.html
He is member of the thematic group for "Radiological and Nuclear Threats to Critical Infrastructure" within ERNCIP the European Reference Network for Critical Infrastructure Protection
http://ipsc.jrc.ec.europa.eu/index.php?id=827 .

Publications

- Design and Test of a High-Speed Flash ADC Mezzanine Card for High-Resolution and Timing Performance in Nuclear Structure Experiments; Egea, X., Sanchis, E., Gonzalez, V., Gadea, A. et al., IEEE Trans. Nucl. Sci. 60, 3526 (2013)
- Coupling a CLOVER detector array with the PRISMA magnetic spectrometer Investigation of moderately neutron-rich nuclei populated by multinucleon transfer and deep inelastic collisions; A. Gadea et al., Eur. Phys. J. A 20, 193 (2004)
- AGATA—Advanced GAmma Tracking Array; the AGATA Collaboration, Nucl. Instr. Meth. Phys. Res. A668, 26 (2012)
- $LaBr_3$(Ce):$LaCl_3$(Ce) Phoswich with Pulse Shape Analysis for High Energy Gamma-ray and Proton Identification, O. Tengblad et.al. Nucl. Instr. and Meth. A704, 19-26, (2013)
- Beta-delayed (multi-)particle decay studies, O. Tengblad, and C. Aa. Diget , Hyperfine Interaction online 05.04.2012 , (2012)

Projects

- FP5 TARGISOL
- FP6 EURONS
- RABBIT - http://sites.fct.unl.pt/rabbit/pages/affiliated-research-groups
- ERA-NET - NuPNET – GANA: http://www.iem.cfmac.csic.es/departamentos/nuclear/GANASwebpage/html/
- R3B – https://www.gsi.de/work/forschung/nustarenna/kernreaktionen/activities/r3b.htm

4.1.26 USC

Description

The University of Santiago de Compostela (USC) is a public research and education organisation with a great European tradition (founded in 1495). USC offers up to 63 specialisations in humanities, social and law sciences, experimental and health sciences, and in technical studies. USC also offers a significant number of doctoral programmes (74) and a wide of master degrees (74) and specialisation courses. In addition USC is collaborating in Erasmus Mundus programmes as part of its interest of improving the teaching and studies in European Universities. In terms of human resources, the university has more than 2,000 professional and research personnel (about 38% female) involved in education and research involved in study and research, over 30,000 students each year, and more than 1,000 people working in administration and services (about 8% supporting research activities). The University's yearly total budget is about €230 million. Research and Technology Development is one of the most important activities in the USC with more than 250 research teams, belonging to the different departments and research Institutes of the university. These R&D activities were supported with an average of €65 million/year (20%

corresponding to contracts with private companies and 60% to competitive public funds) during the period 2008-2012.
In addition different research groups have participated (and work) actively in more than 100 projects under the various European Union RTD Framework Programmes and Initiatives including Training Networks of Marie-Curie fellowships, and more than 30 MC grant holders have been hosted by USC. These figures show the activities and expertise of the research teams from the USC which are supported by the different units under the Area of Management and Valuation of Research, Development and Innovation which in charge of the R&D management, and hold more than 15-years' expertise in the financial and administrative management of EU projects and subsidies from other Entities, and responsible for USC' Knowledge Transfer management
As a result of the education, research and social commitment of USC, a main project called Campus Vida (http://www.campusvida.info) has been awarded by the Spanish Ministries of Education and of Science and Innovation with the International Campus of Excellence recognition. Campus Vida defines and contributes to the development of a new model of sustainable economic and social growth based on talent, innovation and internationalisation.
The Experimental Nuclear Physics group, associated to the Particle Physics Department (with more than 100 members), is very active. The group has expertise in the field of nuclear structure and dynamics, where we develop our main activity in an international context. We also develop an important activity in R&D of particle detectors and simulation-related topics. The group has experience from participation in earlier EC framework programmes (FP5, FP6 and FP7, in which we have acted as Work Package and Task coordinator.)
Main tasks of USC in ENSAR2 are participating in NA GDS, JRA PASPAG and JRA SATNuRSE.
For more information see: http://www.usc.es/genp

Key persons in charge of activities

Role in the consortium:	Task leader in JRA PASPAG
Main scientific activity:	Experimental research on nuclear structure
Name:	ÁLVAREZ POL
First Name:	Héctor
Nationality:	Spanish
Gender:	male

2012 – present	Professor at USC, Spain
2010 – 2012	Professor (temporary position) at USC, Spain
2001 – 2010	Researcher (temporary position) at USC, Spain
December 2002	PhD in nuclear physics, at USC, Spain

Publications

- Particle identification using clustering algorithms, R. Wirth et al., Nucl. Instr. Meth. A 717, pp. 77 - 82. 2013.
- Gamma-ray measurements in the one-neutron knockout of ^{17}C, ^{19}N, ^{21}O and ^{25}F, C. Rodriguez-Tajes, D. Cortina-Gil, H. Alvarez-Pol, et al., Eur. Phys. J. A. 48 - 7, 2012.
- Production of new neutron-rich isotopes of heavy elements in fragmentation reactions of ^{238}U projectiles at 1A GeV, H. Alvarez-Pol et al., Phys. Rev. C. 82 - 4, 2010.
- Test of LAAPDs Coupled to CsI(Tl) Crystals for the CALIFA R3B/FAIR Calorimeter, Martin Gascón, Hector Alvarez-Pol, et al., IEEE Transactions on Nuclear Science. 57 - 3, pp. 1465 - 1469. 2010.
- Design studies and first crystal tests for the R3B calorimeter, H. Alvarez-Pol et al., Nucl. Instr. Meth. B 266 - 19-20, pp. 4616 - 4620. 2008

Projects

- FP7 ENSAR Integrating Activity
- FP6 EUROTRANS
- FP6 EURISOL Design Study
- FP6 EURONS

4.1.27 USE

Description

The University of Seville (USE), with more than 70000 students, and 6700 staff, is the third largest university in Spain. More than 10000 students are following postgraduate courses, enrolled into 86 master programmes and 152 doctoral programmes. The University of Seville is strong in research. Apart from its 4300 academic staff, it has 1600 researchers under different contracts. Research is carried out in the university departments, and especially in 6 research centres, and 9 university research institutes. The University of Seville has several academic agreements with different European and international universities. In particular, the faculty of Physics has a successful double degree agreement with the University of Munster in Germany

The Department of Atomic, Molecular and Nuclear Physics has more than 30 members, including academic staff, researchers, PhD students and Master Degree students. It has a long-standing tradition in nuclear physics studies, with two main research areas: applied nuclear physics (including environmental radioactivity and mass spectrometry, ion beam analysis, and archeometry) and fundamental nuclear physics, devoted to basic research in both nuclear structure and reactions. The members of the group enrolled in the TheoS proposal develop their research activity in this area, with emphasis in the study of light and medium-mass nuclei far from the stability valley. Moreover, the group has many ongoing collaborations with leading experimental facilities, collaborating actively in the interpretation of nuclear reaction experiments using state-of-the-art reaction frameworks. The group is also very active in the development of novel descriptions of the structure and reactions of few-body systems. These skills will be useful to achieve the proposed objectives within the TheoS Work Package for ENSAR2. Finally, the department is fully committed to the training of new researchers, coordinating the Interuniversity Master in Nuclear Physics, which involves 8 national institutions.

The University of Seville, as well as the Junta de Andalucia and the Spanish Research council, participate in the Centro Nacional de Aceleradores (CNA). CNA is a research centre, dedicated to the development and applications of accelerators in cross- disciplinary fields, is recognised of one of the main national users facilities (ICTS) in Spain. CNA maintains several international collaborations, including an association agreement of with the International Agency of Atomic Energy (IAEA), as well as several joint European projects. CNA has stable collaborations, contracts and covenants with private companies, hospitals, and other research centres. CNA is involved in NA ENSAF work package.

Key person in charge of activities

Role in the consortium:	Task leader in JRA TheoS work package
Main scientific activity:	Theoretical research on nuclear structure
Name:	MORO
First Name:	Antonio
Nationality:	Spanish
Gender:	male

2011 – present	Associate professor, University of Seville, Spain.
2009 – 2010	Assistant professor, University of Seville, Spain.
2004 – 2009	Research contract funded by Junta de Andalucia, University of Seville, Spain.
2001 – 2004	Post-doctoral fellow at the Instituto Superior Tecnico (IST), Lisbon
2001	PhD in Physics, University of Seville, Spain

Publications

- Continuum-discretized coupled-channels calculations with core excitation, R. de Diego, J. M. Arias, J. A. Lay, and A. M. Moro, Phys. Rev. C 89, 064609 (2014).
- Interplay Between Valence and Core Excitation Mechanisms in the Breakup of Halo Nuclei, A. M. Moro and J. A. Lay, Phys. Rev. Lett. 109, 232502 (2012).
- Do Halo Nuclei Follow Rutherford Elastic Scattering at Energies Below the Barrier? The Case of ^{11}Li, M. Cubero et al., Phys. Rev. Lett. 109, 262701 (2012).
- Three-body description of direct nuclear reactions : Comparison with the continuum discretized coupled channels method, A. Deltuva, A. M. Moro, E. Cravo, F. M. Nunes, and A. C. Fonseca, Phys. Rev. C 76, 064602 (2007).
- Study of ^{10}Li via the ^{9}Li(2H,p) reaction at REX-ISOLDE, H.B. Jeppesen et al., Phys. Lett. B642, 449 (2006).

Projects

- Calculations for the interpretation of reactions with exotic nuclei, Funded by the Spanish Ministry of Science and Innovation, Role: coordinator, Scope: national. Duration : 4 years (1/1/10–31/12/13)
- Theory and scattering experiments with exotic and stable nuclei, Funded by the Spanish Ministry of Science and Education, Role: coordinator. Duration : 3 years (1/10/07–30/9/10)
- Few-body approaches applied to nuclear reactions with exotic nuclei, Funded by the Spanish Ministry of Science and Education, Role: coordinator. Duration : 2 years (1/7/08–30/6/10)
- Scattering, structure and tracking of exotic nuclei, Funded by the Spanish Ministry of Science and Education, Role: participant. Duration : 4 years (1/10/06–30/3/10)
- Physics outside the valley of stability: implications in astrophysics, Funded by the Regional Government of Junta de Andalucia, Role: participant. Duration : 4 years (26/3/13–1/9/17)

4.1.28 ULIV

Description

The University of Liverpool is a research and teaching organisation. It is a member of the Russell group of 24 UK research led Universities and is ranked in the top 1% of higher education institutions worldwide.
The University has a wide range of research activities with over 1300 leading researchers. The research includes nuclear physics and its applications. The nuclear physics research is carried out within international collaborations working at a range of facilities across Europe and the rest of the world. Liverpool researchers lead many activities in these collaborations.
The University has excellent teaching facilities at undergraduate and graduate student level with over 30,000 students at the University. The University has recently established a state of the art radiation laboratory with modern detector systems and digital electronics which acts as an excellent training facility for a wide range of students and for industry training.
The nuclear physics researchers have experience in managing large collaborations and are recognised experts in techniques related to the design and construction of detector set-ups, data-acquisition systems, simulations and data-analysis techniques.
The main tasks of ULIV are the participations in NA NUSPIN and JRA PSeGe.

Key person in charge of activities

Role in the consortium:	participant in JRA PSeGe work package
Main scientific activity:	nuclear spectroscopy, development of nuclear instrumentation and applications of nuclear physics
Name:	BOSTON
First Name:	Andrew
Nationality:	British
Gender:	male

2012 – present	Reader in Physics, University of Liverpool. UK representative on AGATA management board, chair of the detector characterisation working group in AGATA collaboration.
2008 – 2012	Senior Lecturer in Physics, University of Liverpool
2001 – 2008	Lecturer in Physics, University of Liverpool
1999 – 2001	Senior Research Assistant, Nuclear physics group, University of Liverpool
1998 – 1999	Research Assistant, Nuclear physics group, University of Liverpool.

Publications

- Compton imaging with the PorGamRays spectrometer, Judson, D. S., A. J. Boston, et al. (2011). Nucl. Instr. Meth. A 652(1): 587-590.
- Compton imaging with AGATA and SmartPET for DESPEC, Moon, S., B. Q. Arnes, A. Boston, et al. (2011). Journal of Instrumentation 6.
- AGATA-Advanced GAmma Tracking Array, Akkoyun, S., A. Algora, A. Boston, et al. (2012). Nucl. Instr. Meth. A 668: 26-58.
- A Compton camera application for the GAMOS GEANT4-based framework, Harkness, L. J., P. Arce, A. Boston, et al. (2012). Nucl. Instr. Meth. A 671: 29-39.

- Semiconductor detectors for Compton imaging in nuclear medicine, Harkness, L. J., D. S. Judson, A. Boston, et al. (2012). Journal of Instrumentation 7.

Projects

- AGATA : European Gamma Detector Array
- ProsPECTuS : Compton Camera for diagnostic nuclear medicine
- GammaKEV: academy-industry project for gamma-ray detector systems for submarines
- Project of gamma-ray sensor with the National Nuclear Laboratory (NNL)
- Project on threat reduction of instrumentation with the Atomic Weapons Establishment (AWE)

4.1.29 UoY

Description

The University of York is a research-intensive university located in the city of York, UK. Established in 1963, the campus university has expanded to more than thirty departments and centres, covering a wide range of subjects. York has been named the eighth best university under 50 years old in the world (and first within the UK). The university also ranks among the top 10 in the UK, top 20 universities in Europe, and ranked 96th in the world, according to the 2011 QS World University Rankings.

The Nuclear Physics Group, part of the Department of Physics, is one of the largest nuclear physics groups in the UK with 8 academics, 6 postdocs and 12 PhD students. The group leads efforts in experimental nuclear physics at leading facilities worldwide. The group has three well-equipped laboratories for detector development. Increasingly, the group is becoming involved with work on societal applications and has built links with a variety of relevant industries and detector companies. The highlight of this work in the last year or so has been the development of a hand-held gamma-ray spectrometer for Kromek, a company based in the NE of England. This product is already enjoying significant sales.

The main task of UoY in ENSAR2 is the participation in JRA PASPAG.

Key person in charge of activities

Role in the consortium:	task leader in JRA PASPAG work package
Main scientific activity:	experimental nuclear physics
Name:	JENKINS
First Name:	David
Nationality:	British
Gender:	male

Dr David Jenkins is an experimental nuclear physicist based at the Department of Physics, University of York, UK. His research focuses on the study of exotic proton-rich nuclei both with stable beams at facilities such as the University of Jyvaskyla in Finland and radioactive beams, for example at the REX-ISOLDE facility in CERN. David presently holds a Fellowship from the Institute of Advanced Studies of the University of Strasbourg where he is working on clustering in nuclei. David also leads the Applications Laboratory in the Nuclear Physics Group at York. He has more than 100 refereed articles and an h-index of 24. He will participate in the JRA PASPAG work package.

Publications

- L.P. Gaffney et al. Studies of pear-shaped nuclei using accelerated radioactive beams, Nature 497, 199 (2013)
- J. Henderson, P. Ruotsalainen, D.G. Jenkins et al., Enhancing the sensitivity of recoil-beta tagging, J. Inst. 8, P04025 (2013).
- D.G. Jenkins et al., γ-ray spectroscopy of the A=23 T=1/2 nuclei ^{23}Na and ^{23}Mg: High-spin states, mirror symmetry, and applications to nuclear astrophysical reaction rates, Phys. Rev. C 87, 064301 (2013)
- D.G. Jenkins, “Electromagnetic transitions as a probe of clustering in nuclei” in C. Beck (ed.), “Clusters in Nuclei, Vol. III”, Lecture Notes in Physics 875, pp 25-49 (2013)
- D. G. Jenkins et al., Candidate superdeformed band in ^{28}Si, Phys. Rev. C 86, 064308 (2012)

Projects

- Short-KTP (knowledge transfer partnership) with Kromek PLC (http://www.kromek.com)
- PARIS collaboration - http://paris.ifj.edu.pl
- ERA-NET - NuPNET – GANAS

- Mini-IPS grant from STFC to develop hand-held gamma ray spectrometer using novel scintillators e.g. lanthanum bromide
- CLASP grant from STFC to produce novel sensors for well logging in oil and gas exploration

4.1.30 MTA Atomki

Description

The Institute for Nuclear Research, Hungarian Academy of Sciences (MTA Atomki) is the leading institution in nuclear physics and nuclear astrophysics in Hungary.
Its laboratories provide service for external (national and international) and internal users and contribute to higher education, as well. It is an associated member of the University of Debrecen since 2000, training numerous master and PhD students every year. MTA Atomki has the largest accelerator centre in the country. One of the main activities at the accelerators is nuclear astrophysics. Based on the wide range of beam energies, various processes of astrophysical interest have been successfully studied. Experimental low energy nuclear physics is also a key task that is performed at the institute. The major areas investigated are nuclear structure, nuclear reactions. Nuclear physicists of MTA Atomki are also extensive users of large scale facilities in Europe and overseas. Therefore, the activities also include radioactive ion beams which are available at these institutes. The form of collaborations incorporates not only joint research proposals but also detector hardware and software developments and their testing at the local accelerators. MTA Atomki is also an evaluation centre for nuclear physics data providing invaluable help to run the basic service of the National Nuclear Data Centre at Brookhaven. The major partners of MTA Atomki in nuclear physics and nuclear astrophysics are GSI (Darmstadt, Germany), GANIL (Caen, France), RIKEN (Wako, Japan), LNGS (Gran Sasso, Italy).
The main task of MTA Atomki in ENSAR2 is the participation in NA NUSPRASEN and NA MIDAS.

Key person in charge of activities

Role in the consortium: participant in NA NUSPRASEN work package
Main scientific activity: nuclear physics and nuclear astrophysics
Name: ELEKES
First Name: Zoltán
Nationality: Hungarian
Gender: male

Zoltán Elekes is a senior researcher studying fundamental questions of nuclear physics and nuclear astrophysics. He is involved in low energy and high energy measurements at the local accelerators at MTA Atomki as well as at large scale facilities. He has lead several experiments using radioactive ion beams which is his main expertise. He has published about 200 refereed, scientific papers and received distinguished awards and scholarships.

Publications

- Multiple Chiral Doublet Bands of Identical Configuration in ^{103}Rh, I. Kuti et al., Phys. Rev. Lett. 113, 032501 (2014)
- Coulomb Suppression of the Stellar Enhancement Factor, G. G. Kiss et al., Phys. Rev. Lett. 101, 191101 (2008)
- Spectroscopic Study of Neutron Shell Closures via Nucleon Transfer in the Near-Dripline Nucleus ^{23}O, Z. Elekes et al., Phys. Rev. Lett. 98, 102502 (2007)
- Vanishing N=20 Shell Gap: Study of Excited States in ^{27,28}Ne, Zs. Dombrádi et al., Phys. Rev. Lett. 96, 182501 (2006)
- Excitation of Isovector Spin-Dipole Resonances and Neutron Skin of Nuclei, A. Krasznahorkay et al., Phys. Rev. Lett. 82, 163216 (1999)

Projects

- ERC Starting Grant on experimental nuclear astrophysics
- Nuclei in the Cosmos 2014 conference, Debrecen, 7-11 July 2014
- Eurocores programme of the European Physical Society “EuroGENESIS: Origin of the Elements and Nuclear History of the Universe”
- FP7 ENSAR project
- International Symposium on Exotic Nuclear Systems ENS'05, Debrecen, June 20-25, 2005

4.1.31 FCiências.ID (date of addition to the project: July 1st, 2017)

FCiências.ID – Associação para a Investigação e Desenvolvimento de Ciências, is a Non-Profit Private Association, endowed with legal personality. It was created in 2017 as an common initiative of Faculdade de Ciências da Universidade de Lisboa (FCUL) - a Higher Education institution - and 6 private companies, in order to support, potentiate and develop Research and Development (R&D) and innovation activities of its seven associates, while, simultaneously enhancing FCUL strategic partnerships with market and services companies, therefore creating a more challenging environment for research and innovation.
FCiências.ID is the legal representative of 20 research centres, in the fields of Mathematics, Statistics and Operational Research, Physics, Space and Astrophysics, Chemistry and Biochemistry, Geology, Geophysics, Biology, Computer Science and Informatics and Philosophy and History of Sciences.
FCiências.ID responsibilities are related to the administrative, financial and scientific management of the research centres R&D projects, and also to performing research work. Many of these R&D activities are developed together with international teams and are funded both at National and European levels.
FCiências.ID is progressively taking on the responsibilities related to the management of the R&D projects hosted by FCUL and initially contracted to FCUL Foundation. FCiências.ID heritage is the Fundacao da Faculdade de Ciencias da Universidade de Lisboa, FP (FFCUL), its projects but also its human resources and management knowledge.
At European level, FCiências.ID will inherit the experience of managing circa one hundred EU FP6 and FP7 projects, eight H2020 projects one COST Action as Grant Holder and will initiate two ERC projects as Host Institution.

Key person in charge of activities

Role in the consortium:	participant in JRA SATNuRSE work package
Main scientific activity:	Experimental research on nuclear structure
Name:	GALAVIZ REDONDO
First Name:	Daniel
Nationality:	Spanish
Gender:	male

2008 – present	Research Associate. Programme Ciencia 2007. FFCUL, Lisboa, Portugal
2007 – 2008	Research Associate, Juan de la Cierva Fellow. CSIC, Madrid, Spain
2004 – 2006	Research Associate, NSCL, Michigan State University, USA
2004	PhD on Nuclear Physics, Technische Universität Darmstadt, Germany

Publications

- Performance analysis for the CALIFA Barrel calorimeter of the R3B experiment, H. Alvarez-Pol et al., Submitted to Nucl. Instr. Meth. A.
- Simulations of a new detection concept for high-energy neutrons based on timing RPCs, J. Machado et al., Journal of Instrumentation 8, P07020 (2013).
- Beyond the neutron drip line: The unbound oxygen isotopes 25O and 26O, C. Caesar et al., Phys. Rev. C 88, 034313 (2013)
- Golden glazes analysis by PIGE and PIXE techniques, M. Fonseca et al., Nucl. Instr. Meth. B 269, 3060 (2011)

Projects

- Simulations and analysis of direct reactions in neutron rich nuclei (S393) and the CALIFA detector
- FP7 ENSAR
- Moving towards FAIR: Complete study of halo nuclei in breakup reactions under quasi-free scattering conditions and simulations on the R3B experiment

4.1.32 Commitment of participants

This table shows the in-kind contribution of the participants in ENSAR2, and summarizes the person months involved in the project for which participants do not request funds.

Short name of participant	Person-months per participant	Work Packages
GANIL	115	NA1-FISCO2, NA3-MIDAS, NA6-GDS, NA8-NuPIA, JRA4-RESIST, JRA7-TecHIBA
INFN	144	NA2-NUSPRASEN, NA4-NUSPIN, NA5-MediNet, NA6-GDS, JRA1-PASPAG, JRA2-PSeGe, JRA3-TheoS, JRA4-RESIST, JRA6-EURISOL
CERN	38	JRA4-RESIST, JRA6-EURISOL, JRA7-TecHIBA
JYU	29	NA3-MIDAS, NA8-NuPIA
CNRS	174,5	NA3-MIDAS, NA4-NUSPIN, NA5-MediNet, NA6-GDS, JRA1-PASPAG, JRA2-PSeGe, JRA3-TheoS, JRA4-RESIST, JRA7-TecHIBA
GSI	47	NA3-MIDAS, NA4-NUSPIN, NA5-MediNet, JRA2-PSeGe, JRA4-RESIST, JRA7-TecHIBA
RUG	24	NA3-MIDAS, NA5-MediNet, JRA5-SATNuRSE
IFJ PAN	32	NA5-MediNet, JRA1-PASPAG, JRA6-EURISOL
UNIWARSAW	111	NA5-MediNet, NA8-NuPIA, JRA1-PASPAG, JRA6-EURISOL
IFIN-HH	12	NA2-NUSPRASEN, JRA1-PASPAG
EBG MedAustron	8	NA5-MediNet
KU Leuven	29	NA6-GDS, JRA4-RESIST
ULB	76	JRA3-TheoS
CEA	44	NA6-GDS, JRA5-SATNuRSE
GIP ARRONAX	3	JRA7-TecHIBA
JLU	40	NA2-NUSPRASEN, JRA5-SATNuRSE
JGU Mainz	18	JRA4-RESIST
LMU	8	NA5-MediNet
UCO	15	JRA2-PSeGe
NCSRD	12	NA7-ENSAF
UMIL	56	JRA3-TheoS
FFCUL/FCiências.ID	12	JRA5-SATNuRSE
CIEMAT	15	JRA5-SATNuRSE
CSIC	44	NA3-NUSPIN, NA5-MediNet, JRA1-PASPAG, JRA2-PSeGe, JRA5-SATNuRSE
USC	57	NA6-GDS, JRA1-PASPAG, JRA5-SATNuRSE
USE	156	NA7-ENSAF, JRA3-TheoS
ULIV	23	NA3-NUSPIN, JRA2-PSeGe
UoY	42	JRA1-PASPAG
MTA Atomki	24	NA8-NUSPRASEN, NA3-MIDAS
Total	**1408,5**	

4.2 Third parties involved in the project (including use of third party resources)

~~Third parties~~

GANIL (beneficiary n°1) will work with personnel of ~~with two Third Parties in the framework of the ENSAR2 project:~~

- ~~These Third Parties are:~~
  - CNRS (Centre National de Recherche Scientifique) – beneficiary n°5
  - CEA (Commissariat à l'Energie Atomique et aux Energies Alternatives) – beneficiary n°15

The personnel seconded by CNRS and CEA to GANIL ~~and refunded by GANIL~~ in the framework of ENSAR2 are of three categories:

1. Permanent personnel, not funded by EC:

Role in the consortium: deputy coordinator of ENSAR2
Main scientific activity: experimental research on nuclear structure
Name: LEWITOWICZ
First Name: Marek
Nationality: Polish
Gender: male

2016 – present Coordinator of International Affairs at GANIL
2012 – ~~present~~ 2016 Deputy Director of GANIL
February 2008 Promoted as Directeur de Recherche 1ère Classe at CNRS
2005 – 2011 Scientific Director of SPIRAL2
2000 – 2005 Deputy Director of GANIL
September 1997 Promoted as Directeur de Recherche 2ème Classe at CNRS
October 1991 Employee as Chargé de Recherche 1ère Classe at CNRS at GANIL
July 1989 PhD in nuclear physics

Role in the consortium: manager of ENSAR2
Main activity: international cooperation
Name: TURZÓ
First Name: Ketel
Nationality: French
Gender: female

2012 – present Employee as Ingénieure de Recherche 2e classe at CNRS (GANIL), Officer of international cooperation
2008 – 2012 European Project Manager at GANIL
2006 – 2008 Scientific communication officer
2004 – 2005 Assistant professor at the University of Bordeaux, France
2003 – 2004 Post-Doc at KULeuven, Belgium
2002 PhD in nuclear physics, University of Lyon, France

Role in the consortium: leader of NuPIA work package
Main scientific activity: accelerator research
Name: MOSCATELLO
First Name: Marie-Hélène
Nationality: French
Gender: female

2015 – present Officer in charge of innovation, applications and relations with industry (CEA)
2012 – 2015 GANIL Vice-Director in charge of safety-security-radioprotection-environment
2010 – 2012 Responsible for Technical Audits of the SPIRAL2 project (50%)
Responsible for the Machine Protection System of the SPIRAL2 facility (50%)
2009 – 2010 Accelerator Project leader for the ARCHADE hadron-therapy centre in Caen, France
2005 – 2009 Interim Project leader of the SPIRAL2 project, from January to July 2005
Responsible for the Radioactive Beam Production and Acceleration of the SPIRAL2 project

2001 – 2004	Responsible of GANIL Accelerator Development Group
1998 – 2000	Head of the Operation of the GANIL accelerators
1992 – 1998	Head of the "Theory and Parameters" Group in the Accelerator Division
1991 – 1992	Design of the central region of the superconducting cyclotron K800, Catania, Italy
1989 – 1991	Cyclotron studies – Design of the injection and extraction systems of a separated-sector superconducting cyclotron
1989 – present	Engineer, Commissariat à l'Énergie Atomique et aux Énergies Alternatives (CEA), GANIL, France
1987 – 1989	Nuclear engineer – Design of nuclear fuel reloads for nuclear plants, Västerås, Sweden
1985 – 1987	Nuclear engineer in the nuclear fuel reprocessing plant in La Hague, France
July 1985	Engineering Diploma (M.Sc.) of l'Ecole Nationale Supérieure d'Ingénieurs Electriciens de Grenoble (today PHELMA-Grenoble INP) in Energy and Nuclear Engineering

2. Muhsin N. Harakeh, additional temporary personnel, already identified:

Role in the consortium: coordinator of ENSAR2
Main scientific activity: nuclear structure, nuclear astrophysics, few-body physics and astroparticle physics.

Name:	HARAKEH
First Name:	Muhsin N.
Nationality:	Dutch
Gender:	male

Mohsen (Muhsin) N. Harakeh was born on December 14, 1947. He graduated from State University of New York at Stony Brook in 1974 in experimental nuclear physics. After two postdoc periods in the Netherlands and Denmark, he was appointed in 1978 assistant professor at KVI (Nuclear Physics Accelerator Institute) of University of Groningen, and associate professor in 1982. In 1985, he was appointed full professor at Free University of Amsterdam. In January 1993, he returned to KVI as full professor and Deputy Director. In January 1996, he was appointed Director of KVI. At the end of December 2008, he retired as Director of KVI and took a sabbatical leave of two years: one year at GANIL, Caen and another year at GSI, Darmstadt. His research interests are in nuclear structure, nuclear astrophysics, few-body physics and astroparticle physics. He has served on many programme advisory committees of international facilities, scientific advisory committees of institutes and evaluation committees of institutes, physics departments, etc., and a large number of times as chairman. He was the first director of the International Research School FANTOM. He has been chairman of the Editorial Board of Nuclear Physics News International, and is associate editor of two international nuclear physics journals. He has been a member of NuPECC (Nuclear Physics European Collaboration Committee), a committee that sets policy decisions for the nuclear physics community in Europe, from beginning of 1996 till end of 2008 and has been chair of this committee for three years 2003-2005. He is a fellow of the American Physical Society since 1994 and member of the Academy of Europe (Academia Europaea) since 2008. He has been elected chair of Physics and Engineering Section of Academia Europaea in September 2012. He has been decorated in 2008 as Officer in the order of Oranje-Nassau for his achievements. He has received several honours. He has been chairman and member of several organising committees of international conferences, summer schools, and also member of many international advisory committees of international conferences, symposia, workshops, etc.

M. N. Harakeh is Professor Emeritus for RUG, which means that he is retired and does not get salary from RUG anymore. For ENSAR2 coordination, he has a part-time temporary CEA employment contract to work at GANIL.

Estimated budget for the duration of ENSAR2: ~~201 264~~187 000 euros (CEA contract)

3. Additional temporary personnel to be hired. Therefore, their names and CV's are not available yet.

- In GANIL, CNRS personnel and CEA personnel work both under GANIL's control and at GANIL premises. The personnel working at GANIL are paid by CNRS and CEA.
- ~~The costs related to CNRS and CEA seconded personnel are refunded on a yearly basis by GANIL to CNRS and CEA.~~
- The ~~estimation of costs~~corresponding cost ~~for each Third Party~~ is estimated to:
  - CNRS: ~~124 900~~168 500 euros
  - CEA: ~~331 264~~201 000 euros

Third parties

FBK (partner n°11) will work with a third party in the framework of the ENSAR2 project:

- This third party (PAT - Provincia Autonoma di Trento) does not implement any action in ENSAR2 project.
- This will be accomplished at the premises of FBK. In FBK, FBK personnel and PAT personnel work both under FBK's control and at FBK premises, according to Provincial Law (Legge Provinciale) n. 14 of the 14th August 2005, art.28.4, and by an ad-hoc Agreement between PAT and FBK. The personnel seconded to FBK are paid by PAT and PAT has no control on such personnel. The costs related to PAT seconded personnel are refunded on a monthly basis by FBK to the PAT.
- The personnel seconded by PAT to FBK are Tiziana Ingrassia and Mauro Meneghini.

  - Tiziana Ingrassia: accounting assistant
    Nationality: Italian
    Gender: female
    Main activity in ENSAR2: administration (contracts, travels, purchases)

1989 – Today	administrative officer at FBK, Trento, Italy
1988 – 1989	employee in Studio Legale Stefenelli law office
1987 – 1988	employee in General Leasing Company
1987	high school diploma, awarded by the Institute for Trade of Trento, Italy

Estimated budget for the duration of ENSAR2, charged to the EC (included in access costs of TA ECT*): 11 069,50 euros

  - Mauro Meneghini: maintenance assistant
    Nationality: Italian
    Gender: male
    Main activity in ENSAR2: maintenance of the infrastructure

1983 – Today	maintenance and administrative assistant / driver at FBK, Trento, Italy
1982 – 1983	sales agent at FIAT Dealership, Trento, Italy
1980 – 1981	driver for wholesale supermarkets Vege, Trento, Italy
1979 – 1980	kitchen help at Archdiocesan Deaf Institute, Trento, Italy
1971 – 1978	engraver in his own company
1970	school diploma

Estimated budget for the duration of ENSAR2, charged to the EC (included in access costs of TA ECT*): 15 050,64 euros

Subcontracting

The subcontracting activities at GANIL (beneficiary n°1) correspond to:

- The study of socio-economic impacts foreseen in WP1. The estimated costs are 50 000 euros.

For this action, GANIL will hire a specialized consulting firm to carry out research on impacts of the ENSAR2 research infrastructures (direct and indirect, on social, environmental and economic levels) and beyond of ENSAR2 itself. GANIL team participating in WP1 – FISCO2 will ensure the interface between the consulting firm and the beneficiaries of ENSAR2 project.
Only one subcontract will be implemented in this work package. The subcontractor is not known yet. A competitive call will be held in order to award the subcontractor.

- The technical realisation of the chart of radioactive ion beams in WP14. The estimated costs are 5 000 euros. For this action, GANIL will hire junior engineers, students at ENSICAEN (engineer school in France). GANIL team participating in WP14 – EURISOL will ensure the supervision of this action. This subcontracting is in line with Article 11, with regards to the principle of best value for money.

5. Ethics and Security

5.1 Ethics

The fundamental and applied research with heavy ion beams proposed here does not present ethic issues.
During the ENSAR2 project, the ENSAR2 consortium will rigorously apply the ethical standards and guidelines of Horizon2020 regardless of the country in which the research is carried out.

5.2 Security

Please indicate if your project will involve:

- activities or results raising security issues: NO
- 'EU-classified information' as background or results: NO

ESTIMATED BUDGET FOR THE ACTION

	Estimated eligible[1] costs (per budget category)											EU contribution			Additional information		
	A. Direct personnel costs				B. Direct costs of subcontracting	[C. Direct costs of fin. support]	D. Other direct costs		E. Indirect costs[2]	F. Special unit costs	Total costs	Reimbursement rate %	Maximum EU contribution[3]	Maximum grant amount[4]	Information for indirect costs	Information for auditors	Other information
	A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons [A.6 Personnel for providing access to research infrastructure]		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary				D.1 Travel D.2 Equipment D.3 Other goods and services D.4 Costs of large research infrastructure	D.5 Costs of internally invoiced goods and services		F.1 Costs for providing trans-national access to research infrastructure[5]					Estimated costs of in-kind contributions not used on premises	Declaration of costs under Point D.4	Estimated costs of beneficiaries/ linked third parties not receiving funding/ international partners
Form of costs[6]	Actual	Unit[7]	Unit[8]		Actual	Actual	Actual	Unit[9]	Flat-rate[10] 25%	Unit[12]							
	a	Total b	No hours	Total c	d	e	f	Total g	h = 0,25 x (a +b+c+f+g +[i1][13]+[i2][13]-n)	Total i1	j = a+b+c +d+[e]+f+g +h+[i1]+[i2]	k	l	m	n	Yes/No	
1. GANIL	0.00	0.00	0.00	0.00	55 000.00	0.00	820 024.00	0.00	205 006.00	489 300.00	1 569 330.00	100.00	1 569 330.00	1 569 330.00	0.00	No	n/a
2. INFN	337 800.00	0.00	0.00	0.00	0.00	0.00	361 410.40	0.00	174 802.60	411 488.00	1 285 501.00	100.00	1 285 501.00	1 285 501.00	0.00	No	n/a
3. CERN	134 000.00	0.00	0.00	0.00	0.00	0.00	342 396.00	0.00	119 099.00	387 504.00	982 999.00	100.00	982 999.00	982 999.00	0.00	No	n/a
4. JYU	53 900.00	0.00	0.00	0.00	0.00	0.00	312 400.00	0.00	91 575.00	315 000.00	772 875.00	100.00	772 875.00	772 875.00	0.00	No	n/a
5. CNRS	459 236.00	0.00	0.00	0.00	0.00	0.00	331 473.92	0.00	197 677.48	262 532.60	1 250 920.00	100.00	1 250 920.00	1 250 920.00	0.00	No	n/a
6. GSI	96 000.00	0.00	0.00	0.00	0.00	0.00	233 818.72	0.00	82 454.68	104 601.60	516 875.00	100.00	516 875.00	516 875.00	0.00	No	n/a
7. RUG	70 000.00	0.00	0.00	0.00	0.00	0.00	136 340.80	0.00	51 585.20	225 449.00	483 375.00	100.00	483 375.00	483 375.00	0.00	No	n/a
8. IFJ PAN	40 000.00	0.00	0.00	0.00	0.00	0.00	64 557.92	0.00	26 139.48	55 857.60	186 555.00	100.00	186 555.00	186 555.00	0.00	No	n/a
9. UNIWARSAW	71 000.00	0.00	0.00	0.00	0.00	0.00	101 772.00	0.00	43 193.00	121 980.00	337 945.00	100.00	337 945.00	337 945.00	0.00	No	n/a
10. IFIN-HH	30 660.00	0.00	0.00	0.00	0.00	0.00	85 140.00	0.00	28 950.00	40 250.00	185 000.00	100.00	185 000.00	185 000.00	0.00	No	n/a
11. FBK	0.00	0.00	0.00	0.00	0.00	0.00	101 984.00	0.00	25 496.00	101 520.00	229 000.00	100.00	229 000.00	229 000.00	0.00	No	n/a
12. EBG MedAustron	0.00	0.00	0.00	0.00	0.00	0.00	32 000.00	0.00	8 000.00	0.00	40 000.00	100.00	40 000.00	40 000.00	0.00	No	n/a
13. KU Leuven	53 900.00	0.00	0.00	0.00	0.00	0.00	23 000.00	0.00	19 225.00	0.00	96 125.00	100.00	96 125.00	96 125.00	0.00	No	n/a
14. ULB	100 000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25 000.00	0.00	125 000.00	100.00	125 000.00	125 000.00	0.00	No	n/a
15. CEA	201 000.00	144 400.00	0.00	0.00	0.00	0.00	54 000.00	0.00	99 850.00	0.00	499 250.00	100.00	499 250.00	499 250.00	0.00	No	n/a
16. GIP ARRONAX	47 000.00	0.00	0.00	0.00	0.00	0.00	3 000.00	0.00	12 500.00	0.00	62 500.00	100.00	62 500.00	62 500.00	0.00	No	n/a
17. JLU	37 000.00	0.00	0.00	0.00	0.00	0.00	103 000.00	0.00	35 000.00	0.00	175 000.00	100.00	175 000.00	175 000.00	0.00	No	n/a
18. JGU Mainz	58 500.00	0.00	0.00	0.00	0.00	0.00	1 000.00	0.00	14 875.00	0.00	74 375.00	100.00	74 375.00	74 375.00	0.00	No	n/a
19. LMU	0.00	0.00	0.00	0.00	0.00	0.00	42 400.00	0.00	10 600.00	0.00	53 000.00	100.00	53 000.00	53 000.00	0.00	No	n/a
20. UCO	70 000.00	0.00	0.00	0.00	0.00	0.00	12 000.00	0.00	20 500.00	0.00	102 500.00	100.00	102 500.00	102 500.00	0.00	No	n/a
21. NCSRD	0.00	0.00	0.00	0.00	0.00	0.00	48 000.00	0.00	12 000.00	0.00	60 000.00	100.00	60 000.00	60 000.00	0.00	No	n/a
22. UMIL	72 000.00	0.00	0.00	0.00	0.00	0.00	6 000.00	0.00	19 500.00	0.00	97 500.00	100.00	97 500.00	97 500.00	0.00	No	n/a
23. FFCUL	0.00	0.00	0.00	0.00	0.00	0.00	580.33	0.00	145.08	0.00	725.41	100.00	725.41	725.41	0.00	No	n/a
24. CIEMAT	37 000.00	0.00	0.00	0.00	0.00	0.00	3 000.00	0.00	10 000.00	0.00	50 000.00	100.00	50 000.00	50 000.00	0.00	No	n/a
25. CSIC	136 000.00	0.00	0.00	0.00	0.00	0.00	71 700.00	0.00	51 925.00	0.00	259 625.00	100.00	259 625.00	259 625.00	0.00	No	n/a
26. USC	68 000.00	0.00	0.00	0.00	0.00	0.00	16 400.00	0.00	21 100.00	0.00	105 500.00	100.00	105 500.00	105 500.00	0.00	No	n/a
27. USE	100 000.00	0.00	0.00	0.00	0.00	0.00	32 000.00	0.00	33 000.00	0.00	165 000.00	100.00	165 000.00	165 000.00	0.00	No	n/a
28. ULIV	0.00	0.00	0.00	0.00	0.00	0.00	73 000.00	0.00	18 250.00	0.00	91 250.00	100.00	91 250.00	91 250.00	0.00	No	n/a
29. UoY	40 000.00	0.00	0.00	0.00	0.00	0.00	6 000.00	0.00	11 500.00	0.00	57 500.00	100.00	57 500.00	57 500.00	0.00	No	n/a
30. ATOMKI-HAS	0.00	0.00	0.00	0.00	0.00	0.00	38 000.00	0.00	9 500.00	0.00	47 500.00	100.00	47 500.00	47 500.00	0.00	No	n/a

ESTIMATED BUDGET FOR THE ACTION

	Estimated eligible[1] costs (per budget category)											EU contribution			Additional information		
	A. Direct personnel costs				B. Direct costs of subcontracting	[C. Direct costs of fin. support]	D. Other direct costs		E. Indirect costs[2]	F. Special unit costs	Total costs	Reimbursement rate %	Maximum EU contribution[3]	Maximum grant amount[4]	Information for indirect costs	Information for auditors	Other information
	A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons [A.6 Personnel for providing access to research infrastructure]		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary				D.1 Travel D.2 Equipment D.3 Other goods and services D.4 Costs of large research infrastructure	D.5 Costs of internally invoiced goods and services		F.1 Costs for providing trans-national access to research infrastructure[5]					Estimated costs of in-kind contributions not used on premises	Declaration of costs under Point D.4	Estimated costs of beneficiaries/ linked third parties not receiving funding/ international partners
Form of costs[6]	Actual	Unit[7]	Unit[8]		Actual	Actual	Actual	Unit[9]	Flat-rate[10] 25%	Unit[12]							
	a	Total b	No hours	Total c	d	e	f	Total g	h = 0,25 x (a +b+c+f+g +[i1][13]+[i2][13]-n)	Total i1	j = a+b+c +d+[e]+f+g +h+[i1]+[i2]	k	l	m	n	Yes/No	
31. FCIENCIAS.ID	28 000.00	0.00	0.00	0.00	0.00	0.00	1 819.67	0.00	7 454.92	0.00	37 274.59	100.00	37 274.59	37 274.59	0.00	No	n/a
Σ consortium	2 340 996.00	144 400.00		0.00	55 000.00	0.00	3 458 217.76	0.00	1 485 903.44	2 515 482.80	10 000 000.00		10 000 000.00	10 000 000.00			0.00

1 See Article 6 for the eligibility conditions.
2 Indirect costs already covered by an operating grant (received under any EU or Euratom funding programme; see Article 6.5.(b)) are ineligible under the GA. Therefore, a beneficiary/linked third party that receives an operating grant during the action's duration cannot declare indirect costs for the year(s)/reporting period(s) covered by the operating grant, unless it can demonstrate that the operating grant does not cover any costs of the action (see Article 6.2.E).
3 This is the theoretical amount of EU contribution that the system calculates automatically (by multiplying all the budgeted costs by the reimbursement rate). This theoretical amount is capped by the 'maximum grant amount' (that the Commission/Agency decided to grant for the action) (see Article 5.1).
4 The 'maximum grant amount' is the maximum grant amount decided by the Commission/Agency. It normally corresponds to the requested grant, but may be lower.
5 Depending on its type, this specific cost category will or will not cover indirect costs. Specific unit costs that include indirect costs are: costs for energy efficiency measures in buildings, access costs for providing trans-national access to research infrastructure and costs for clinical studies.
6 See Article 5 for the forms of costs.
7 Unit : hours worked on the action; costs per unit (hourly rate) : calculated according to the beneficiary's usual accounting practice.
8 See Annex 2a 'Additional information on the estimated budget' for the details (costs per hour (hourly rate)).
9 Unit and costs per unit : calculated according to the beneficiary's usual accounting practice.
10 Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs.
11 See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit).
12 See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit, estimated number of units, etc).
13 Only specific unit costs that do not include indirect costs.
14 See Article 9 for beneficiaries not receiving funding.
15 Only for linked third parties that receive funding.