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Authorship	Written by:	Sotirios V. Harissopoulos
	Contributors:	
	Reviewed by:	M.N. Harakeh, KVI Cart
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REFERENCES AND APPLICABLE DOCUMENTS

- [1] EURONS, The EUROpean Nuclear Structure integrated infrastructure initiative (Grant agreement ID: 506065) <https://cordis.europa.eu/project/id/506065>
- [2] EWON, The East-West-Outreach Nuclear Physics Network; <http://www-old.inp.demokritos.gr/EWON/>
- [3] East-West Integrated Research Activities (EWIRA): <http://www.ensarfp7.eu/what-is-ensar/deliverables/jira06-ewira>
- [4] <http://slcj.uw.edu.pl/en/home-page/>
- [5] <https://ccb.ifj.edu.pl/en.home.html>
- [6] <https://www.ifj.edu.pl/en/index.php>
- [7] <http://www.nipne.ro/>
- [8] ENSAR2 Deliverable D7.1 entitled Strategy Report “Physics Opportunities and Innovation at European Small-Scale Accelerators”
- [9] ERINS (European Research Infrastructures for Nuclear Science: Nuclear Structure, Astrophysics and Applications); Integrating Activity proposed within the H2020-INFRAIA-2018-2020 call (follow-up of ENSAR2)
- [10] RADIATE (Research And Development with Ion beams– Advancing Technology in Europe) Integrating Activity: <https://cordis.europa.eu/project/id/824096>
- [11] SANDA (Supplying Accurate Nuclear Data for energy and non-energy Applications) Integrating Activity; <https://cordis.europa.eu/project/id/847552>
- [12] ARIEL (Accelerator and Research reactor Infrastructures for Education and Learning); A EURATOM coordination and support project: <https://www.ariel-h2020.eu/index.php/en/>

LIST OF ACRONYMS AND ABBREVIATIONS

EURONS	EUROpean Nuclear Structure
EWIRA	East-West Integrated Research Activities
EWON	East-West Outreach Network
TA	Transnational Access

EXECUTIVE SUMMARY

D7.4 reports on synergies of eight ENSAF laboratories with various European TA facilities within EC-funded projects. The relevant information summarised in the tables below was provided by representatives of these ENSAF labs during the first and/or the second ENSAF Workshops. According to the tables, the level of integration of the listed facilities into the European Research Area is successful. It is expected that through further upgrades assisted through structural funds in the coming years, small-scale facilities will be able to play a key role in education, research and innovation across Europe.

INTRODUCTION

ENSAF, the European Network of Small-scale Accelerator Facilities has as primary objective to strengthen the role of small-scale accelerator laboratories within the European Research Area by developing collaborations between these labs and promoting synergies and helping integration of the ENSAF labs with other European TA facilities. The optimum way to achieve the latter goal goes through participation of ENSAF labs in various EC-funded projects with partners from European countries hosting TA facilities with leading roles.

As already presented in some detail in Deliverable D7.1, small-scale accelerator facilities provide a variety of beams that can be employed to develop and test important scientific instruments, such as detectors and sensors used not only for scientific research but also in a variety of applications with technological importance. Hence, ENSAF labs provide not only charged-particle beams for understanding physical processes in materials relevant to, e.g., energy production via fusion or the shielding of devices in space exploration, but also secondary neutron beams allowing for nuclear-waste transmutation studies and other industrial applications.

The first coordinated effort to integrate nuclear physics research groups from small-scale labs in TA accelerator facilities was made through the EURONS Integrated Infrastructure Initiative [1], when the EWON Networking Activity [2] was implemented. In the subsequent FP7, these efforts were decisively strengthened through the implementation of the EWIRA Joint Research Activity [3] of the ENSAR IA. As a result of EWIRA’s success, the Warsaw’s Heavy Ion Laboratory [4], the Cyclotron Centre [5] of Krakow’s Nuclear Physics Institute (IFJ PAN Kraków) [6] and the Tandem Accelerator Laboratory of Bucharest’s National Institute of Physics and Nuclear Engineering (IFIN-HH) [7] have been included in the group of TA facilities of the currently running ENSAR2 IA.

In deliverable D7.1 [8], 15 European small-scale accelerator facilities were listed. From those, 11 facilities were represented in the first and/or the second workshop of ENSAF. Eight of the latter facilities provided detailed information on their integration and synergies with other TA European facilities. Based on their presentations following activities were documented.

<i>Croatia: Ruđer Bošković Institute, Laboratory for Ion-Beam Interactions, Zagreb</i>	
<i>Number of accelerators:</i>	2
<i>Type of Accelerators:</i>	<ul style="list-style-type: none"> • 1 MV Tandetron • 6.0 MV EN Tandem Van de Graaff
<i>Integrated in</i>	<ul style="list-style-type: none"> • RADIATE [10] (TA facility), <i>and</i> • EU H2020 project AIDA - Advanced European Infrastructures for Detectors at Accelerators, 2015-2019

<i>Czech Republic: Nuclear Physics Institute – CAS, Řež near Prague,</i>	
<i>Number of accelerators:</i>	3
<i>Type of Accelerators:</i>	<ul style="list-style-type: none"> • U-120M isochronous cyclotron, • TR-24 cyclotron • 3 MV Tandetron accelerator.
<i>Integrated in</i>	<ul style="list-style-type: none"> • SANDA [11] (TA facility) • ARIEL [12] (TA facility)

<i>Greece: Tandem Accelerator Laboratory, NCSR “Demokritos”, Athens</i>	
<i>Number of accelerators:</i>	2
<i>Type of Accelerators:</i>	<ul style="list-style-type: none"> • 5.5 MV Tandem accelerator • 250 kV single-stage high-current accelerator (PAPAP)
<i>Integrated in</i>	ERINS [9]; Proposed as TA facility jointly with CNA (Sevilla, Spain), and ATOMKI (Debrecen, Hungary).

<i>Hungary: ATOMKI, Debrecen</i>	
<i>Number of accelerators:</i>	5
<i>Type of Accelerators:</i>	<ul style="list-style-type: none"> • 1 MV single-ended Van de Graaff accelerator • 5 MV single-ended Van de Graaff accelerator • 20 MeV MGC-20E cyclotron • 2 MV Tandetron accelerator • 200 kV AMS accelerator for radiocarbon dating.
<i>Integrated in</i>	<ul style="list-style-type: none"> • ERINS [9]; Proposed as TA facility jointly with CNA (Sevilla, Spain), and NCSR “Demokritos” (Athens, Greece). • RADIATE [10] (JRA participant) • SANDA [11] (JRA participant)

<i>Norway: The Oslo Cyclotron Laboratory (OCL), University of Oslo, Oslo</i>	
<i>Number of accelerators:</i>	1
<i>Type of Accelerators:</i>	35 MeV Scanditronix MC35 Cyclotron
<i>Integrated in</i>	ARIEL [12] (JRA participant)

Portugal: Instituto Superior Tecnico - Universidade de Lisboa, Lisboa	
<i>Number of accelerators:</i>	2
<i>Type of Accelerators:</i>	<ul style="list-style-type: none"> • 2.5 MV single-ended Van de Graaff accelerator • 3 MV Tandetron accelerator
<i>Integrated in</i>	<ul style="list-style-type: none"> • RADIATE [10] (TA facility) • SANDA [11] (NA participant)

Slovenia: Jožef Stefan Institute (JSI), Ljubljana	
<i>Number of accelerators:</i>	1
<i>Type of Accelerators:</i>	<ul style="list-style-type: none"> • 2 MV Tandetron accelerator
<i>Integrated in</i>	<ul style="list-style-type: none"> • RADIATE [10] (TA facility) • SANDA [11] (JRA participant)

Spain: CNA: Centro Nacional de Aceleradores, Sevilla	
<i>Number of accelerators:</i>	4
<i>Type of Accelerators:</i>	<ul style="list-style-type: none"> • 3 MV Tandem Pelletron accelerator, • 18 MeV Cyclotron, • 1 MV accelerator for Accelerator Mass Spectrometry • 200 kV radiocarbon dating system (MiCaDaS).
<i>Integrated in</i>	<ul style="list-style-type: none"> • ERINS [9]; Proposed as TA facility jointly with ATOMKI (Debrecen, Hungary) and NCSR "Demokritos" (Athens, Greece). • ARIEL [12] (TA facility)

CONCLUSION

The information provided by eight ENSAF facilities demonstrates a very good level of their integration into the European Research Area. Currently, most of these facilities implement medium-term upgrades funded mostly via EC structural/regional funds. It is expected that through these upgrades, small-scale facilities will be able to play a key role in education, research and innovation across Europe.