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D3.1 – MIDAS-REPORT ON SETUP OF COMMON DATABASE

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Disclaimer

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LIST OF ACRONYMS AND ABBREVIATIONS

MIDAS	Minimisation of Destructive plASma processes in ECRIS
SC	Steering Committee
ECRIS	Electron Cyclotron Resonance Ion Source
NA	Networking Activity

EXECUTIVE SUMMARY

This deliverable report describes the status of the common database created among the MIDAS-NA participants to serve ENSAR2 consortium. Its main objective was to setup a website including all necessary information to prepare highly charged ion beams requested by the users of ENSAR2 infrastructures. In addition, the database includes the description of research and development projects of MIDAS partners for the ECR ion sources and their beams. The work for the common database has progressed in accordance with the plans and the objectives have successfully been accomplished.

INTRODUCTION

MIDAS networking activity (NA) consists of teams developing ECR ion sources and beams for the needs of the ENSAR2 facilities. The participating teams are: JYFL, GSI, GANIL, LPSC, RUG-KVI, ATOMKI, UCLM and CERN. In addition, the networking includes two industrial partners: AVS and PANTECHNIK. The objective of the MIDAS-NA is to enhance the networking and dissemination of best practices between partner teams. It offers a fruitful and inspiring environment for new inventions and discoveries building a solid ground for further improvements of ECR ion sources and ion beams in terms of their intensity, energy, quality and variety in the most effective way. This objective will be realised and met by three tasks of MIDAS-NA:

Task 1: Coordination of scientific activities and dissemination

Task 2: Collaboration workshops

Task 3: Hands-on-training

The Steering Committee (SC) of MIDAS-NA coordinates and organises Task 1 to advance the networking and dissemination of good practices and know-how between the partner laboratories. The main tools to achieve the goals are annual workshops (Task 2), hands-on-training (Task 3) and website including all relevant information for the use of partner teams. The annual workshops will be organised in order to present the most important results, status of ongoing projects, and new ion source related requirements. 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, which improves the transfer of new technology and instrumentation. The hands-on training promotes the transfer of the optimised and the most useful methods among the partners. Training activities and programmes have been defined and organised by the SC. The first three trainings have already been realised and they have received very positive feedback. Consequently, it has already been demonstrated that the on-site training offers an inspiring environment for experts, young physicists and engineers to improve their expertise by the training offered by the partner institutes.

The common database is a website including a vast amount of information needed in day-to-day ion beam production and operation of Electron Cyclotron Resonance Ion Sources (ECRIS). It also includes the most relevant information about the coordination of MIDAS-NA and its tasks. The platform and the format for the realisation of the database have been fixed and input of data has been started. In this deliverable report the status of the common database is given.

SETUP OF COMMON DATABASE

An important objective of MIDAS-NA was to organise and maintain the ECRIS related web site where the most

relevant information about the ECR ion sources and their beams can easily be shared between the partner teams. It was decided that the information about the MIDAS-NA will be integrated with the database. This part can be modified or omitted later after the completion of the ENSAR2 consortium programme. As a result of planning and considerations a commercial Wiki server *Confluence* was selected for the realisation of the database. Confluence enables open and closed access to the data and management of users with selectable editing permissions. At the beginning, the wiki database will be created and maintained by the JYFL ion source group but this responsibility shall be shared later. The write access has been and will be given to other MIDAS participants upon requests.

The Wiki database includes the following items:

1) *Meetings:* the page contains dates, agenda, minutes, presentations and other related information about the annual meetings of MIDAS-NA.
2) *Hands-on-training:* Several hands-on-trainings will be organised during the ENSAR2 collaboration project to disseminate best practices and important know-how of the European ECRIS community. This link describes each training and reveals the schedules.
3) *Pooling of equipment*: This page contains information about equipment, which can be used for research collaborations as proposed by the MIDAS-NA. The list was defined during the first annual meeting.
4) *Requirements*: This page contains requirements and wishes for new beams and features in different laboratories. The list has generated and will guide discussion about the collaboration projects.
5) *Laboratory projects*: describes the most important projects of different laboratories.
6) *Publications*: This section will include the publications of the participants of MIDAS-NA.
7) *Database on beams*: This page contains information about the beams produced by partner institutions using ECR ion sources. It describes the method used for each element, ion source parameters and other relevant details. The table will be completed during the course of MIDAS-NA.

The MIDAS website can be found from: https://webapps.jyu.fi/wiki/display/ensar2. The layout of the main page is shown in ANNEX 1. The database is accessible also via the official website of ENSAR2 consortium by clicking the MIDAS link shown in: http://www.ensarfp7.eu/activities/networking-activities. As an example the “Hands-on-training”-link reveals the subjects and full programme for the first round of hands-on-training (see ANNEX 3). Each link includes the description and schedule of training. The first GANIL and JYFL trainings have been completed and their lecture notes and final reports are available via the links. The corresponding GANIL page is shown in ANNEX 4 as an example.

The content of the database has briefly been described above. The most relevant and important part of the database is the section “Database on beams”. This section can be considered as a cooking book for ion beams. The objective is to guarantee that all relevant know-how and information to produce different ion beams can be find easily and will be shared between the partners. The information is accessible by clicking the link “Database on beams” shown in ANNEX 1. The link opens the table of elements shown in Figure 1. The record ion beam intensities produced by each partner can be found by clicking the element of interest. This can be demonstrated by clicking the element Fe, which opens a new table shown in Figure 2. In this table the record Fe ion beam intensities of GANIL, GSI and JYFL are presented. The detailed information about the production of Fe ion beams can be found by clicking the name of institution on the left-side column of the table (see Figure 2). In the case of JYFL this action opens the page shown in ANNEX 2. The page should describe the ECRIS and its extraction used for producing the ion beams. It presents the evaporation method in the case of solid element and reveals the operation parameters. The page shall include the ion beam spectrum, safety instructions, references and all

notes, which might be beneficial to the MIDAS partners. Similar information will be given for all ion beams available in partner institutions.

Database on beams

Created by Taneli Kalvas, last modified by Hannu Koivisto 18 minutes ago

This page contains information about beams produced by ECR ion sources.

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra		Rf	Db	Sg	Bh	Hs	Mt									
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	

Figure 1: Table of elements.

	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+
ATOMKI												
GANIL	15	39	72	94	91	73	55	29	16	6		
GSI	19	30	95	42	22	8	2					
JYFL						115	101	58		31.2		3.2
KVI												
LPSC												

Figure 2: Table for Fe ion beams produced by the partner institutions.

CONCLUSION

The format of the MIDAS database has been completed and the work for adding the ion beam data of partner institutes can be started. The writing access has already been granted to a team member of ATOMKI, GANIL, GSI and KVI. Their responsibility is to add the ion beam data produced by their institute. As a result, each laboratory will have a dedicated page for all ion beams produced by their ECR ion sources. The page will be similar to one shown in ANNEX 2.

The MIDAS database will include a vast amount of beneficial information for the experts producing the ion beams for the European nuclear physics community. The pages can be used to find the best possible production method for each ion beam and to optimally meet the given requirements. The information will be added to the database and its format will be developed upon the requests of partners to maximise the interaction and the exchange of know-how. This will ensure that the latest results and the best practices are available to all infrastructures participating in MIDAS-NA.

ANNEX 1: MAIN PAGE OF MIDAS-NA WEBSITE

Website for European collaboration on ECR ion sources, MIDAS-NA

Created by Wiki Admin, last modified by Hannu Koivisto just a moment ago

MIDAS-NA brings together the participant research teams developing ion sources and beams for the needs of ENSAR2 facilities, and industrial partners (AVS and PANTECHNIK) having wide technological know-how. The transfer and dissemination of knowhow will ensure that the latest results are available for all infrastructures participating in MIDAS-NA. 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

The afore-mentioned objectives will be achieved through the following tasks:

Task 1: Coordination of scientific activities and dissemination*. Steering Committee will organize an open database for the most relevant information of highly charged ion beam production by ECR ion source. The committee will also organize and promote the collaboration and pooling of equipment.*

Task 2: Collaboration workshops *to present the most important results and to promote open discussion*

Task 3: Hands-on-training to promote *the transfer of most useful methods and practices among the partners*

This Wiki space contains information about the MIDAS Networking Activity, which is part of the ENSAR2 project.

- Meetings
- Hands-on-training
- Pooling of equipment
- Requirements
- Laboratory projects
- Publications
- Database on beams
- Facilities

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ANNEX 2:

Iron at JYFL

Created by Taneli Kalvas, last modified by Hannu Koivisto just a moment ago

14 GHz ECRIS, MIVOC method

Record Fe ion beams, shown in the table, were produced with the JYFL 14 GHz ECRIS using MIVOC method with commercially available $^{nat}Fe(C_5H_5)_2$ (Ferrocene). Ion source was optimised for Fe^{11+}. Material Safety Data Sheets for safe use of Ferrocene can be found from here .

Mixing gas: No mixing gas was used in this run. Typically oxygen is used to maximise the intensities and to minimise the material consumption and carbon contamination.

Microwave power: 350 W

Acceleration voltage: 10 kV (JYFL extraction system)

Material consumption: The material consumption was not measured in the experiment resulting in record intensities. Couple of months later the consumption rate of 1 mg/h for the enriched ^{54}Fe was measured. In this experiment the intensity of 52 μA ($^{54}Fe^{11+}$) was extracted from the JYFL 14 GHz ECRIS. The intensity was not maximised. The main goal was to meet the intensity requirement, with minimum material consumption, and to produce a stable beam. The enriched MIVOC compound ($^{54}Fe(C_5H_5)_2$) was synthesised at JYFL for the experiment.

11+	115
12+	101
13+	58
14+	-
15+	31.2
16+	-
17+	3.2

An iron spectrum produced by MIVOC can be found from here.

For more information see:

H. Koivisto, et.al., Nucl. Instr. and Meth. in Phys. Res., B174, (2001), p. 379

H. Koivisto, J. Ärje and M. Nurmia, Metal ion beams from an ECR ion source using volatile compounds, Nucl. Instr. and Meth. in Phys. Res., B94, (1994), p.291.

ANNEX 3

Hands on training section: main view

Hands-on-training

Created by Taneli Kalvas, last modified by BARUE Christophe on Nov 21, 2016

Several hands-on training workshops will be organized within the MIDAS-NA project in several laboratories:

- Low temperature plasma diagnostics (UCLM) **First training 27 - 29.6.2017 (Full)**
- ECR charge breeder techniques (LPSC)
- Low-energy beam transport design and emittance measurements (KVI)
- MIVOC method and/or Highly charged plasma diagnostics (JYFL) **First training 5 - 7. 12. 2016 (Full) and second 7 - 9. 2016 (Full)**
- Microwave-based techniques to improve the performances of the ECRISs (GSI) **First training 12 - 14. 12.2017 (Full)**
- Iron beam production with ECR4 ion source using oven technique (GANIL) **First training 15 - 17.11.2016 (Full)**
- Measurements of ECR plasma parameters by Langmuir-probe (ATOMKI) **First training 8 - 12. 5.2017 (Full)**

ANNEX 4

Hands on training section: view of GANIL hands-on-training

Training workshop on iron beam production with ECR4 Ion source using oven technique

Created by Tuomo Kalvas, last modified by Hannu Koivisto 4 days ago

Initial proposal of Hands-on-Training

Nickel beam production with Phoenix V2 ion source at GANIL

Place: GANIL, Boulevard Henri Becquerel, BP 55027, F-14076 CAEN Cedex 05

Duration: 3 days, Maximum participants: 4

ıds-on-training

Description:

The ion source Phoenix V2 is being commissioning for the SPIRAL 2 facility. The nominal intensity of 50 µA $^{40}Ar^{14+}$ at 60 kV is expected in the next few months coming. Then, the first metallic beam $^{58}Ni^{19+}$ at 61 kV will be optimized and validated by producing a stable beam intensity of 19 µA (1 pµA). This beam should be available for LINAC tests in June 2016.

The participants will gain practical knowledge in a resistive oven (1600°C) mounting and nickel load preparation. The start-up and the optimization of the ion source for nickel will be practiced as well.

If for some planning reasons the training could not be done with Phoenix V2, the GANIL ion source ECR4 working at 100 kV will be used ($^{58}Ni^{9+}$).

Plan of Activities:

First day: After an introduction on the techniques used at GANIL to produce the different metallic ions, the oven technique will be presented. Then the participants will attend the 1600°C resistive oven mounting and learn about the nickel sample preparation.

Second day: The oven loaded with nickel will be introduced into the ion source. The ion source will be started until the nickel beam apparition. The oven temperature will be increased above the Curie temperature of Ni without the axial magnetic field of the ion source, in order to avoid the Nickel sample escapes from the oven. Then the ion source parameters (buffer gaz, P_{RF}) will be progressively increased to avoid metal over-evaporation.

Third day: The participants will switch on the ion source optimization for charge state 19+ of Ni. The buffer gaz, the micro-wave power, and the oven temperature will be investigated to reach the maximum intensity on this charge state. A debriefing will take place at the end of the day to summarize the behaviors observed during the Ni^{19+} optimization and to identify the main points the users have to take into consideration to implement effciently the oven technique.

Hands-on 1st session 15-17 November 2016:

Place: GANIL, Boulevard Henri Becquerel, BP 55027, F-14076 CAEN Cedex 05

Participants: D. Cortazar (UCLM), M. Gigliore (LPSC), P. Hajdu (ATOMKI), H. Koïvisto (JYFL), R. Lang (GSI), V. Toivanen (GANIL).

Below is the presentation "introduction to the hands-on training Fe production at GANIL":

> GPI-2016-064 Hands-on training Fe Production at GANIL.pdf

Below is the report on this first hands-on training:

> GPI-2016-065 Report hands-on training at GANIL - Iron production with oven method.docx