



## **ENSAR2/MIDAS Meeting**

**Toledo 23-24 May, 2018**

Notes (all presentations on MIDAS website)

The third annual MIDAS-meeting was held at Campus Fabrica de Armas of UCLM in Toledo, Spain, 23-24<sup>th</sup> May, 2018. The UCLM ion source team organized the meeting where 13 attendees gathered from nine partner institutes in 6 EU countries. The agenda of the meeting, all presentations and reports can be found from (<https://webapps.jyu.fi/wiki/display/ensar2/Meetings>). The first day of the meeting focused on the status of MIDAS-NA and progress reports of each partner. The second day was reserved for problem solving, collaboration discussions and planning.

### **Participants:**

Rob Kremers, KVI-CART, The Netherlands,  
Hannu Koivisto, JYFL, Finland  
Christophe Barué, Pascal Jardin, GANIL, France,  
Thomas Thuillier, LPSC, France,  
P. Salou, Pantechnik, France,  
A. Garbayo, AVS, Spain/UK  
Fabio Maimone, K. Tinschert, GSI, Germany,  
Sandor Biri, Richard Rácz, ATOMKI, Hungary,  
Daniel Cortazar, Ana Megia Macias, UCLM, Spain,

### **JYFL: H. Koivisto**

Deliverable report on hands-on training expected in November 2018. End of ENSAR 2 in February 2020.

Criticisms regarding the web page: not homogeneous with the other web sites of NAs: can be solved by putting an interface web page.

The web nuclide chart of beam receipts must be completed

The meaning of the intensities given in the tabular “best beam intensity” must be explained: it is not clear if each charge state has been optimized. It could be clarified by adding a comment on the specific line. In the relevant laboratory sub-page, a spectrum optimized on a given charge state would be a useful information together with a footnote about the optimized conditions.

Rapprochement of people within the collaboration has changed the individual mentality regarding the benefit of sharing our “secret” knowledges

Participants and associated partners must express their wishes to eventually add training sessions

We all have to give the budget status of our laboratory

Could it be interesting to add on-going tests on the nuclide chart as information for possible collaboration?



How to give the information necessary to deduce the beam performances on the target of physicist after different post-accelerations? A common method of emittance measurement must be defined to make the different beam performances comparable.

### **GSI (K. Tinschert)**

Not enough funds up to the end of the collaboration (4 Hands-on-training sessions, 2 participants to workshops)

2 ovens for standard operation (1600°C and 2000°C) based on spring filaments

Material protection systems of the source renewed using PLC in place of old electromechanical relay technique. Will that be more reliable?

Looking for collaborations for developing new difficult isotopes. See the list in Klaus' presentation. Several subjects of collaboration.

### **GSI hands on training (F. Maimone)**

Report under writing, some points are still under analysis. Fabio is working on it.

### **GANIL: (P. Jardin)**

On-going R&D, and possible items for collaboration (see presentation).

Carbonyls and other molecules containing metallic atom are sometime very dangerous and their use is therefore restricted (experienced at JYFL and GSI). Their use must be studied closely with the safety services.

The 2000°C oven made with a helicoidal filament works at GSI, without short-circuit between the turns, once the tungsten of the filament has been annealed after the realization of the filament to relax the inner constraints. GANIL should try this solution.

Recall of ENSAR2 objectives and short introduction to the R&D directions, which could be taken within the coming ENSAR3 collaboration. How can we identify common and clear R&D objectives at the European level, which will serve the European community of physicists.

### **LPSC (T. Thuillier)**

Presentation of the on-going R&D, with the liner and the metallic oven for Ca production.

Metis R&D: 50µA Ca<sup>14+</sup>. Leak problem due to welding difficulties still occurs. No reliable oven for Ca evaporation presently. Looking for a technical solution.

Concerning the failure at 600°C of the copper-stainless steel brazing of the low temperature oven, INFN is using a solution withstanding 1000°C (Ni brazing).



Two frequency heating (18 GHz + 14 GHz) tested at LPSC with Phoenix-V3, showing an improvement of 20% for  $\text{Ar}^{14+}$  and 40% for  $\text{Ar}^{16+}$ , respectively, when compared to experiments in optimized single frequency heating mode on a same day (in collaboration with GSI).

Complete disassembly of the Phoenix-V3 beam line for replacement of the analyzing dipole.

Experiments on the LPSC charge breeder with a magnetic plug to boost the injection field dramatically increased high charge state production and improved the charge breeding efficiency of gaseous and condensable ions.

The 60 GHz R&D program is presented and LPSC proposes to open the collaboration to any EU partners interested in.

#### **KVI-CART . (R. Kremer)**

Interesting measurements of the current on the bias disc ask the question of the balance between the different currents within the source. Clear description is needed to clarify a point rarely addressed.

#### **Atomki. Sandor Biri**

Instabilities depend on the balance between powers at each frequency in the case of double frequency injection (see presentation).

#### **GANIL: (C. Barué)**

To make the instabilities observed on the current extracted from the different sources comparable, a spectra of the standard deviation at different frequencies should be extracted from the measurements.

High intensities have been obtained with Phoenix-V2 installed at SPIRAL 2 (4.0 mA  $\text{He}^{2+}$ ) mainly by optimizing the medium coil current (lowering  $B_{\text{min}}$ ).

The excellent stability ( $\pm 2\%$ ) measured can be reproduced on a short period but nevertheless with significantly different ion source parameters. The long-term stability has to be proved.

The  $\text{O}^{6+}$  beam (0.9 mA) is much less stable than  $\text{He}^{2+}$  ( $\pm 10\%$ ). No explanation.

#### **UCLM : Ana. See presentation**

Interesting considerations about the plasma behavior: we are waiting for the publication of the results!

#### **JYFL (H. Koivisto). See presentation**



Nice analysis of the visible light emission from  $\text{Ar}^{9+,13+}$  ions versus the extraction of the ions out of the source. More information can be found from the ICIS2017 proceedings.

Promising results obtained with the HIISI ECRIS at JYFL. Under active testing up to the beginning of august. GANIL interested in participating.

**INFN : D. Mascali. See presentation**

PANDORA : Study of beta absorbants versus charge state, as it can change by several orders of magnitude their half-lives (Be, 85Kr, 176Lu, 187Re, 87Rb...) . David is interested in the possibility to inject some of the element of interest in ECR ion sources using high vapor pressure molecules. The supplying or synthesis ways of molecules enriched with particular isotopes could be evaluated (GANIL, Catania, JYFL)

Production of radioactive isotopes of interest using SPIRAL1 facility could be studied to perform a test of feasibility (Catania, GANIL).

**Pantechnik: P. Salou**

Different demands of industrial companies for metallic beams. (Al, B, C, Si, Ge, As ...). See the list given in the presentation

For Al, possible production with Aluminium nitride. Few  $\mu\text{A}$  obtained at Catania. "Triméthyl" of aluminium suggested by Thomas. Could Al simply be produced using standard method, oven or sputtering ? Test of Al production by sputtering proposed by GANIL.

Recycling time ((10min)) of  $^{14}\text{C}$  deposited on the chamber wall. Where is deposited the C. Are there solutions to limit the deposition or the recycling time? All suggestions are welcome.

**Discussion about the technical problems and failures (H. Koivisto)**

- Put on the web site the different questions
- Put the presentation on the website, removing information which must not be spread at that time
- Let difficulties appear to let our hierarchy know them, and what is the status of their solving
- How to maintain the website beyond ENSAR2, in a way beneficial for our community? Cost is not a pb (400€/year)
- AVS needs more information about molecular plasmas and interaction cross sections between electrons and moving atoms up to 2keV of kinetic energy. Meeting at Legnaro scheduled by July 2018, where people of astrophysics and plasma ion-sources communities can meet, and where information about such data should be available. A plasma model is needed to determine the improvement ways. Ongoing R&D: 22cm Xe ECR gridded ion engine



with ECR neutralizer. LPSC must study the possibility to collaborate. See link for Academia-Industry meeting: <https://www.ensar2-nupia.eu/workshop>

- D. Mascali: ask for the participation of Legnaro students to some hands-on-training sessions. Possible, must be managed directly with laboratories where hands on trainings remain.
- C. Barué: technical pbs mentioned during the debriefing session of the GANIL hands on trainings. 1600°C oven for Fe production: Condensation of Fe at the exit of the crucible. GSI has also had to face similar pb and solved it partially by placing an alumina ring inside the crucible and by using extra filament turns at the front-end of the oven. INFN ECR4 injection has been refurbished to host a 22mm oven. Could that transformation be transferred to GANIL. And Ana has started a thermal simulation of the oven to help its evolution towards a more homogeneous temperature: a molybdenum crucible should be use. Pb and studies to be addressed in collaboration.
- KVI-CART: R. Kremer. Transmission through the beam line. Adaptation of beam elements, electrostatic lens of solenoid upstream the magnetic separator for an extracted current of ~4mA.
- ATOMKI, S. Biri: Extraction of the source including two consecutive electrostatic lens. Current ranges from 1 to 3 mA. Transmission limited to 22% in the case of  $O^{6+}$  as the first lens cannot be properly polarized, due to a Penning discharge between electrodes of the lens. The source do not include any iron yoke, which could help reducing the penning pb and also help getting a better mirror ratio. Advices are required to choose the best and simplest solution.
- T. Thuillier: Difficulty to braze the coaxial heater, having an inconel envelope, on a Ta chamber. There are at GSI specialists for specific welding. There are also welding institution in Netherland (ref R. Kremer) and in France (ref P. Jardin) to which such pb could be submitted. Second problem: How to bond Cu and stainless steel? Same advice as for the coaxial brazing.

### Collaboration planning session

**T. Thuillier: Research activity proposal: 60GHz R&D.** Motivation given in the presentation. Similar R&D are under progress (China FECR, 45 GHz, Mars in USA). Need a lot of deep upstream research on ECR plasma, high beam intensity transport, RF...

Existing prototype (coil) at LPSC+ 60GHz gyrotron+ magnetic separator+ 2 years of PhD

An ERC application for a magnetic structure including an hexapole realized using the same technology is considered.

Program of 5 to 6 years (or more)

Budget 1-2 M€

Proposal of work package on this subject within the ENSAR3/MIDAS JRA

#### Remarks:

Is the long term study sufficient if no facility can host such ECRIS?

Physics cases must be defined to convince the investors



Could a 28 GHz step be considered?

Is there no other direction to improve ECRIS performances which could be explored rather than the one based on the scaling RF rules? Breakthrough technology?

Could that prototype help to progress toward a 60 GHz fully Super conducting ECRIS, and how?

**H. Koivisto: JYFL monochromator.** See presentation

High resolution spectrometer available at JYFL (<10pm). Doppler effect Atomic speed of the N+ in the source extractable from the measurements, but no Zeeman effect was observed: Why?

Who is interested in collaborating on this subject? D. Mascali

**Inductively heated oven:** already developed and tested at Jyvaskyla. Home made unit, not reliable.

Can be improved. GANIL is interested to collaborate. Do not forget to proposed IPHC (B. Gall) to join the collaboration

**Laboratories interested in the next ENSAR3/MIDAS JRA**

Jyväskylä, GANIL, INFN, ATOMKI, LPSC, GSI

Possible new group: IPHC?

Possible associated group: Nizhny Novgorod? Pantechnik?

**ENSAR3: Guidelines for MIDAS2-JRA**

All agreed to apply for MIDAS-JRA in "ENSAR3"

Hannu will coordinate JRA.

Proposals of Work Packages given by Hannu

**Conclusions (D. Cortazar)**

Narrow work and confidence established between people. Knowledge exchanged, we now know what we have to do.

Home work: proposal for our next objectives within the next MIDAS (dead line march 2019)