



ECOS (European Collaboration On Stable ion beams)

ENSAR NA Report

1. The ENSAR ECOS Network Activity

The ECOS (European Collaboration on Stable ion beams) working group has been appointed by NuPECC in 2004 with the following tasks:

- Describe and access the research perspectives with high intensity stable-ion beams.
- Categorize existing facilities and their possible upgrades.
- Identify the opportunities and specifications for a dedicated new facility in Europe.

The ECOS working group has prepared a report which is available at the NuPECC webpages and which has been published in 2007. One of the important recommendations of the ECOS working group is to ensure a strong support from both the nuclear physics community and the funding agencies for existing stable-ion-beam facilities not only for their accelerator-system development but also for the instrumentation and experimental infrastructure needed to host dedicated research programs. The other important recommendation is that a new dedicated high-intensity stable-ion-beam facility in Europe, with energies at and above the Coulomb barrier, is considered to be one of the important issues to be discussed in the Long-Range Plan of the nuclear physics community. The objectives of the proposed ECOS-Network are related to these two recommendations and they are twofold:

- i. Bring together and coordinate the expertise that is available in the European countries in order to achieve the research and development activities in essential aspects related to the production and use of high-intensity heavy-ion beams (Task 1). The important aspect related to the development of high-power ion sources is the objective of JRA01-ARES with which the NA02-ECOS will have a significant synergy.
- ii. Optimize resources and manpower for the upgrade and development of various stable-ion-beam facilities in Europe in order to optimize their scientific output (Tasks 2 and 3). From this point of view, NA02-ECOS has a direct link to the TNAs delivering stable ion beams to the users community in Europe. These are TNA01-GANIL, TNA02-GSI, TNA03-INFN, TNA04-JYFL and TNA05-RUG. In order to achieve its goals, NA02-ECOS has been broken down into 4 tasks:

Task 1: High power thin-target technology (participants: IN2P3 + GANIL+GSI)

The maximum usable primary beam current with thin targets is among others determined by the long-term stability of the thin targets under irradiation. High beam intensities lead to a considerable heating of the targets, and, hence to thermal stress, possibly phase transitions, oxidation or reduction of the chemical compounds and diffusion into the target backing respectively. We propose to study these phenomena in detail and to compare for example the performance of thin actinide targets as function of the production method (painting, spray-painting, electrolysis, electrode position,



evaporation and sputtering), the used chemical compounds (oxide, carbide, others) and backings/coatings respectively. The way is to bring together labs that use different techniques for target preparation and those that can test the target performance under real conditions. For this task ECOS will have the duty to organize the collaboration and exchange of expertise on the development of high power target technology.

Task 2: Synergies in Superheavy Element Research (participant: GSI + GANIL+JYFL)

The study of Superheavy Elements (SHE) is one of today's most challenging interdisciplinary research fields. It brings together nuclear physics, atomic physics, chemistry and theoretical physics. Over the last years researchers from the different disciplines have continued to strengthen exchange of ideas. The ECOS community proposes to use this Network in order to enhance synergies among the research groups on a European scale. For this task ECOS is aiming for bringing together the groups with research activities on SHE using high intensity ion beams for an exchange of new ideas and techniques related to the use of very high intensity stable beams.

Task 3: Organization of bi-annual ECOS Workshops

In order to optimize resources, two workshops will be organized with parallel sessions dedicated to all aspects of the technical developments and research activities using stable ions beam facilities in Europe. The second workshop will be coupled to the NA town meeting.

Task 4: Coordination of stable ion beam facilities in Europe and organization of the network

In order to achieve the goals of the ECOS NA and to foster synergies, collaboration and scientific exchange, a number of meetings have been organized (task 3).

The activities for task 1 and 2 were mainly consisting of the strategy discussion and in its results performed during the FUSHE 2012 workshop, held in Weilrod, Germany, from May 13th to 16th 2012 (<http://www.ensarfp7.eu/projects/ecos/workshops-meetings/fushe2012>), and follow up activities initiated by it.

Concerning task 1 a dedicated conference was held during the funding period of the ECOS-NA with the 26th World Conference of the International Nuclear Target Development Society (INTDS 2012) from August 19th to 24th, 2012 at the conference center Erbacher Hof in Mainz, Germany (<http://www.intds.org/>).

Task3 resulted from a number of meeting and workshop that took place during the funding period of ECOS-NA and in which many the steering committee has played a major role: D. Ackermann (GSI), F. Azaiez (Orsay, Chairman), G. De Angelis (LNL), M. Lewitowicz (GANIL), A. Maj (Krakow), I. Martel (Huelva) and R. Julin (Jyvaskyla).

1. The deliverables:



In the following the three reports corresponding to the three deliverables of the ECOS Network Activities are given:

D-NA02-1: Report on the development of high power thin-target technology with special emphasis on new techniques and methods that will allow increasing the primary beam intensity usable with such targets.

D-NA02-2: Report on the research activities related to SHEs and on the achievement made in this research field

D-NA02-3: Report on the collaborations and synergies between facilities providing stable ion beam facilities in Europe initiated and driven by ECOS network

D-NA02-3: Report on the collaboration and synergy between stable ions beam facilities in Europe.

A number of meetings and workshops were organized during the funding period with the main goal of identifying and enhancing synergies between stable ion beam facilities in Europe and possible collaborations both in scientific and technical issues.

Beside a workshop that has been dedicated to the search and study of SuperHeavy elements, two other workshops of few days each have been organized to discuss the physics programs and technical developments that are undertaken at various facilities in Europe. The focus, during these two workshops, was on the use of ion beams with intermediate intensities (up to 100pnA). This includes the following topics:

- i) - Structure of N=Z and Proton-rich nuclei
- ii) - Structure of Neutron-rich Nuclei
- iii) - Nuclear Physics and Astrophysics
- iv) - Facility up-grades and new Facilities
- v) - Accelerator Technologies
- vi) - Synergies and Accelerator Technologies
- vii) - Instrumentation

Physics cases that are currently studied with stable ion beams have been confronted at various facilities to both the possible beam intensity increase and to the enhanced efficiency and sensitivities of future detection systems. As a result, it appeared that facilities such as LNL, GANIL and JYFL are very complementary in the field of gamma and particle spectroscopy and that GANIL and LNS remain among other activities very adapted to the study of nuclear dynamics. Important collaborations have been encouraged to join forces in order to use in the most effective and complementary way various European detection system at several facilities. This concerns among others the AGATA collaboration and the FAZIA collaboration.

The Steering committee of ECOS-NA through many meetings (up to 6 during the ENSAR contract period) have initiated several actions aiming at creating stronger ties between the stable ion beam facilities in Europe. One of these initiatives was the creation a



European chart of stable beams. This chart gathers beam data from eight European infrastructures: ALTO and GANIL in France, GSI in Germany, IFJ and SLCJ in Poland, JYFL in Finland and LNL and LNS in Italy. The chart is interactive. So, the user can choose the isotope of interest as well as its energy and its intensity. It is then possible to see which infrastructure produces the chosen beam. This is now available online: <http://u.ganil-spiral2.eu/chart-ecos/>. The other initiative that turned out to be very successful was the organization of a 'Facilities Meeting' that gathered technical staff from various European stable ion beam facilities in order to exchange information, ideas and experience in technical issues going from optimizing resources to improving and up-grading accelerator components. This meeting gave birth to an internet Forum for engineers and technicians to continue interacting on the same subjects. This 'Facilities meeting' is supposed to continue in the future on the basis of a Bi-annual cycle.

The other initiative that has been undertaken by the community within the ECOS-NA is related to defining a European strategy for the future of Stable Ion beam facilities. This was thought to proceed through two angles:

- The success of ENSAR2 as an application for Integrated Activities within H2020. This will allow the continuation of many of the initiatives and actions that has been started under the umbrella of ENSAR.
- The revision and up-date of the ECOS/NuPECC roadmap of stable ion beams in Europe that has been elaborated more than 7 years ago and that needs, in addition to LINAG at GANIL, the inclusion of new projects such as the CW-LINAC project at GSI or the LINCE initiative in Huelva.