ENSAR2

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.

ENSAR2 is the Horizon-2020 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 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 ENSAR2 infrastructures. 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.

Transnational Access

ENSAR2's 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. At ELI-NP, the high-intensity, high-energy photon beams are produced by laser back-scattering from high-energy electron beams. It is worth noting that IA support will be offered for the first time for the joint IFIN-HH/ELI-NP infrastructure in Romania and the NLC infrastructure in Poland. This is in fulfilment of the plan made in the IA ENSAR under FP7 and in accordance with the spirit of enlarging the ERA (European Research Area) as stipulated by the EC. In addition to nuclear structure and nuclear astrophysics research at these facilities, multidisciplinary and application-oriented research will be pursued ensuring a high-level of socioeconomic impact. Furthermore, the infrastructure ECT* (I) will provide a unique place for meetings, seminars and workshops to the community. ENSAR2 proposes open access to the above-mentioned ten top-level European infrastructures. These infrastructures will be offering access to a very large, wide and diverse user community from the EU and associated countries and for the first time to international users. The facilities will also provide an increased amount of beam time for applications of nuclear techniques.

Joint Research Activities

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 and make the most efficient and effective use of these 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 radioactive-ion beams and various developments for

ISOL beam production and use. 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 technologies and methods for the simultaneous detection of particles and gamma rays with same type of detectors and 3-dimensional gamma-ray tracking with high-resolution germanium detectors. In addition, general platforms for physics models, event generators and analysis tools will be created and a study on data management will be performed. The development of modern theoretical tools for describing, interpreting, and predicting experimental results will support the work in nuclear-physics facilities. Particular importance is attributed to all RTD work, which will or might lead to industrial applications, as radioisotopes, scintillators, 3-dimensional position-sensitive detectors or new concepts for solid-state laser technology. This implies also applying state-of-the-art developments to other fields and to benefit humanity (e.g., archaeology, medical imaging).

Networking Activities

The NAs of ENSAR2 have been set-up with specific actions to strengthen the community's work in TAs and JRAs. They promote foresight studies for new instrumentation and methods, stimulate complementarity, ensure a broad dissemination of results and stimulate multidisciplinary and application-oriented research and innovation at the RIs. They aim to strengthen the communities' coherence regarding particular research topics, to pool resources and to provide instruction courses to users. In this vein, the scientific interests of the nuclear structure and nuclear astrophysics communities are discussed to optimise use of the large RIs.

Specifically, cooperation about ECR ion sources completes beam developments in JRAs. Dissemination on nuclear spectroscopy instrumentation and gas-filled detectors and systems 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. Networks stimulate also relationships with industry and application-oriented research, in particular about technologies for nuclear medicine and studies of radiation biological effects. In addition, the managing network 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, and will also stimulate dissemination of knowledge and outreach activities.