

Large Scale Radioactive Ion Beam Facilities in Nuclear Physics : Science and Society Impact

Sydney GALES

IPN Orsay, France

The advent of intense heavy ion accelerators and of secondary Radioactive Ion Beams (RIB) made possible the exploration of a new territory of nuclei with extreme in Mass and/or N/Z ratios. During the last few decades, RIB has allowed the investigation of a new territory of nuclei with extreme N/Z called “terra incognita”.

To pursue the investigation of this terra incognita several projects, based on second generation high power accelerators producing intense stable and RIB, all aiming at the increase by several orders of magnitude of the RIB intensities, are now under construction and/or planned for the end of this decade worldwide. In Europe NuPECC (Nuclear Physics European Collaboration Committee - an expert committee of the European Science Foundation) and the ESFRI committee have recommended the construction of new-generation of complementary RIB facilities in Europe. Using the in-flight fragmentation (IFF) process, the FAIR facility project at GSI (Darmstadt, Germany), with the new super-FRS fragment-separator and the NUSTAR collaboration is leading the way whereas others RIB proposals are based on the isotope-separation on-line (ISOL) method. Main ISOL facilities under construction or upgrade are SPES@ Legnaro (It), SPIRAL2@GANIL (Fr), ALTO@ Orsay (Fr), MYRRHA@ Mol (Belgium) and HIE-ISOLDE@CERN.

Similar and competitive projects in the emerging field of “exotic nuclei” are also either proposed or under construction in others parts of the world. In Asia RIBF@RIKEN (Tokyo, Japan) is today the world leading RIB facility. New Large scale RIB facilities are under construction in China, HIAF@ Lanzhou, CARIF @Beijing and RISP@ Daejong in Korea which goal is to produce intense Secondary RIB using both ISOL and IFF techniques.

In North America, this “gold rush” towards new large scale facilities for “exotic nuclei” is led by TRIUMF (Canada) with ISACII and ARIEL projects for ISOL and by the USA flagship project FRIB at East-Lansing (Michigan).

Projects of high intensity heavy ion accelerators, and low energy drivers ($< 10 \text{ MeV/n}$) are being built and/or starting operation at Flerov Laboratory @DUBNA, GSI, RILAC@RIKEN and SPIRAL2@GANIL for the physics of SHE nuclei. Last but not least new probes are being developed using high power laser and gamma beams are in development at the new ELI-NP project in Romania. Technical performances, innovative new instrumentation and methods, and keys experiments in connection with these second generation high intensity facilities will be reviewed.

In addition, Large Scale Facilities in Nuclear Science creates an environment where basic research as well as applied research are interacting to generate innovations for our daily life. Nuclear science and technology are central to the most important advancements in medicine, materials, energy, security, climatology to name a few. The social and economic impact of these new projects will be illustrated through some specific examples.