International Nuclear Physics Conference INPC2013: 2-7 June 2013, Firenze, Italy

Nuclear-physics applications of MYRRHA

Lucia Popescu (for the ISOL@MYRRHA and MYRRHA collaborations)

Belgian Nuclear Research Centre SCK•CEN, Mol, Belgium

Contact email: lpopescu@sckcen.be

MYRRHA, (Multi-purpose hYbrid Research Reactor for High-tech Applications), is a hybrid system, that combines a 600-MeV x 4-mA proton linear accelerator and a lead-bismuth eutectic (LBE) cooled fast spectrum research facility. MYRRHA can be operated in both sub-critical (accelerator-driven system (ADS)) and critical modes, allowing fuel developments for innovative reactor systems, material developments for GEN IV systems, material developments for fusion reactors, medical radioisotopes production and industrial applications (e.g. Si-doping). The system will also demonstrate the ADS full concept by coupling the three components (accelerator, spallation target and subcritical reactor) at a reasonable power level to allow operation feedback, scalable to an industrial demonstrator and allow the study of efficient transmutation of high-level nuclear waste.

Moreover, by branching off a small fraction of the proton beam, the ISOL@MYRRHA facility will be operated in parallel to the MYRRHA-ADS. This facility should use up to 200-μA x 600-MeV proton beam for the production of Radioactive Ion Beams (RIBs) via the Isotope Separator On Line (ISOL) method. By combining the high primary-beam intensity with selective ionization and a beam-purification system with high mass-resolving power, it will be possible to produce intense RIBs with high purity. ISOL@MYRRHA aims to be complementary to existing facilities, by focusing on experimental programs requiring long uninterrupted beam times. These are experiments which

- hunt for very rear phenomena,
- need high statistics,
- need many time-consuming systematic measurements,
- have inherent limited detection efficiency.

Measurements with high-intensity beams and extended/regular beam times are an important source of information for quasi all fields in science making use of RIBs, ranging from fundamental-interaction measurements with extremely high precision over systematic measurements for condensed-matter physics and production of medical radio-isotopes. In nuclear physics, e.g. determining precise values of extremely small decay branches (in the order of 10^{-6}) or crystal γ-ray spectrometry with very high resolution can provide crucial experimental input for understanding aspects of nuclear structure. Long beam times could be also of interest for astro-physics, when nuclear reactions with small cross sections are involved, but the absence of a post-accelerator in the present design of ISOL@MYRRHA will prevent such kind of studies. Although higher-energy secondary beams are not discarded for a later phase, only research with low-energy beams (up to 60 keV) is addressed for the moment.