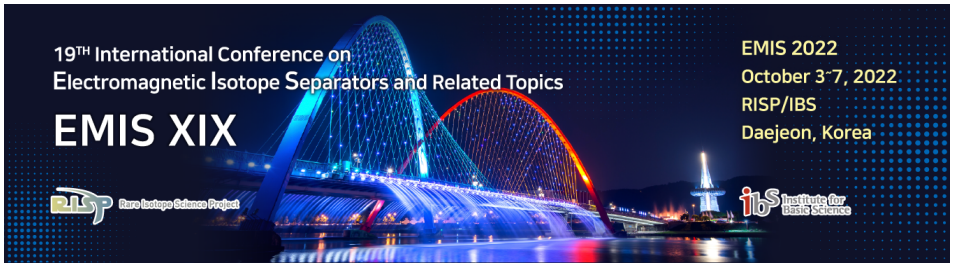

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GPIB & PIPERADE apparatus for the new DESIR hall at GANIL

Monday, 3 October 2022 23:42 (8 minutes)

The DESIR (Désintégration, Excitation et Stockage d'Ions Radioactifs) hall is a part of the new SPIRAL2 facility under construction at GANIL. This hall will be dedicated to the study of nuclear physics at low energy (30-60 keV). Dedicated projects have been proposed and are under construction to study the available rare isotopes, which are of particular interest for nuclear structure, nuclear astrophysics, fundamental interactions and applications.

DESIR experiments will benefit from radioactive ion beams from both SPIRAL1 and SPIRAL2 facilities. Several key regions of the nuclear chart will be accessed through various production mechanism: light exotic nuclei via fragmentation production from the historical SPIRAL1 facility, or neutron deficient and heavy elements beyond uranium from the new SPIRAL2/S3 complex. However, these production methods are non-selective, limiting the purity of the beams of interest and consequently high precision measurements as required for nuclear structure studies. In order to ensure the cleaning and purification as well as the bunching and cooling of the RI beams through DESIR, three devices are under commissioning at the LP2i Bordeaux among which a High Resolution Separator (HRS), a RFQ cooler-Buncher (GPIB) and a double Penning trap (PIPERADE).

Using the same mechanical design as ISCOOL at CERN, the GPIB (General Purpose Ion Buncher) is a radiofrequency quadrupole cooler-buncher. The GPIB aims at reducing the emittance of the RI beams from 80π mm.rad down to 3π mm.rad at 60 keV and bunch the beams on request from the DESIR hall experiments. The RF circuit of the GPIB has been designed to accept masses from m=5u to m=250u and to support RF potentials higher than 4 kV peak to peak. Such high RF power will benefit to DESIR in cooling and bunching ion pulses up to 10^8 ions per bunch. Currently under commissioning, transmission of more than 90% and significant decrease in transverse emittance have already been measured for CW beams.

On its side, PIPERADE is a double-Penning trap, designed either to measure the mass of radionuclides by itself or to deliver large and very pure samples of exotic nuclei to the different experiments in DESIR. PIPERADE show a large inner diameter for the first trap that will mitigate space charge effects. Purification cycles will be performed over milliseconds to separate short-lived nuclei and to extract the ions of interest from the large amount of isobaric contaminants. These latter will be accumulated into the second trap until they constitute a sufficiently pure sample for the measurements. The mass resolving power of PIPERADE is expected to be higher than 10^5 in the case of gas-free measurement techniques (ToF-ICR or PI-ICR) and will allow purification of close isobars and even isomers. Using the TOF-ICR as well as the new PI-ICR techniques, mass precision of 10^{-8} will be reachable for short-lived nuclei.

The combined use of the HRS, the GPIB and PIPERADE will ensure high quality ion samples to all the DESIR experiments. The GPIB and PIPERADE are now fully assembled at LP2i Bordeaux and under commissioning before their transfer to GANIL in 2 or 3 years. Their status will be presented as well as the recent achievements.

Primary author: HUSSON, Audric (LP2i Bordeaux - CNRS/IN2P3/UBx)

Co-authors: Dr GERBAUX, Mathias (Université de Bordeaux/LP2i Bordeaux); Dr ASCHER, Pauline (LP2i Bordeaux); BLANK, Bertram (LP2IB); DAUDIN, Laurent (LP2IB); HUKKANEN, Marjut (University of Jyväskylä); DE

ROUBIN, Antoine (KU LEUVEN); LACHACINSKI, Benoit (LP2IB); Mr FLAYOL, Mathieu (LP2i Bordeaux); ALFAURT, Phillipe (LP2IB); Dr GRÉVY, Stéphane (LP2i Bordeaux); PÉRARD, Sean (LP2i Bordeaux)

Presenter: HUSSON, Audric (LP2i Bordeaux - CNRS/IN2P3/UBx)

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