

PIPERADE: A double-Penning trap isobar separator for the low-energy facility DESIR at SPIRAL2

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The next generation of Rare Isotopes facilities, such as SPIRAL2, HIE-ISOLDE, FAIR, RIBF aims to push further the borders of our knowledge about fundamental properties of exotic nuclei. To do so, these facilities require a production of high quality beam that is adapted to the needs of various experiments.

Besides production mechanisms, mass separation techniques are crucial for the improvement of the beam quality by reducing beam impurities.

At DESIR, the low-energy branch of the future facility SPIRAL2, in addition to the High Resolution Separator, a double Penning trap system, PIPERADE, built at MPIK in Heidelberg in close collaboration with CENBG in Bordeaux and CSNSM in Orsay, will be placed upstream the experimental hall as an alternative mass separator. Apart from its higher resolving power, a Penning trap has a high storage capability. Since DESIR will receive beam from different production lines (SPIRAL1, SPIRAL2 and S3), a large variety of exotic nuclei beams will be available to address various questions. The production of the exotic nuclei far from stability (with very low yield) might be accompanied with large amount of unwanted isobars. To allow high precision measurements, in addition to its high storage capacity, PIPERADE is designed to select ions of interest and distribute pure samples to experimental setups installed at the DESIR hall.

As an example, such intense and pure beam is critical for beta-decay spectroscopy and branching ratios measurements of super-allowed transitions in beta-emitters that will be conducted at DESIR. Another experiment that needs such beam is the high-precision measurement of the beta-neutrino angular-correlation parameter in beta-decays that will be performed with the LPCTrap.

It is also foreseen to perform high-precision mass measurements (with MLLTRAP) and laser spectroscopy (with LUMIERE) for nuclear structure and astrophysical r-process studies.

The main challenge of the PIPERADE double Penning trap system is to keep a high resolving power while dealing with large sample that introduces space charge effects. Thus, the traps are designed according to the simulation and tests of new excitation schemes that allow fast separation of ions of interest among a large amount of isobaric contaminants, which is of important for efficient transmission of low yield and extremely short-lived nuclei very far from stability.

The status of the project as well as first experimental tests that address space charge effects will be presented.

Primary author: Dr NAIMI, Sarah (MPIK)

Co-authors: Mr DE ROUBIN, Antoine (MPIK); Dr BLANK, Bertram (CEN Bordeaux-Gradignan); LUNNEY, David (CSNSM Centre de Spectrometrie Nucleaire et de Spectrometrie de); Mr GUERIN, Hugo (CENBG); BLAUM, Klaus (Max-Planck-Gesellschaft (DE)); Dr GERBAUX, Mathias (CENBG); Dr HECK, Michael (MPIK); ASCHER, Pauline (CENBG); Dr DUPRÉ, Pierre (CSNSM); Dr GRÉVY, Stéphane (CENBG)

Presenter: Dr NAIMI, Sarah (MPIK)

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