MUSETT and the spectroscopy of heavy elements at GANIL

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Over the past years, one of the most fascinating topics in nuclear structure physics research has been the synthesis and spectroscopy of heavy nuclei in the direction of the predicted super-heavy island of stability. Detailed information has been obtained on the collective properties and single-particle structure using both prompt and decay spectroscopy techniques. However, very little data are available for neutron-rich heavy elements. These isotopes can only be populated in very asymmetric reactions using light ion beams and actinide targets. Hence the recoil nuclei produced have a very large angular distribution and very low kinetic energy. The transmission of separators or spectrometers is usually very small for such reactions.

The VAMOS spectrometer has a larger transmission for very asymmetric reactions than any other spectrometer coupled to a Germanium detector array and is therefore the ideal choice for doing in-beam spectroscopy after such reactions. For this purpose VAMOS has been equipped with a new silicon detector array MUSETT ("Mur de Silicium pour l'Etude des Transfermiens par Tagging") which has been developed for implantation and identification of fusion-evaporation residues through alpha-decay tagging. This new detector consists of 4 double-sided silicon strip detectors (128 strips on each side) having a total active area of 40x10 cm^2. The huge number of high-resolution channels requires the use of a new front-end electronics which assures the compactness of the system. An ASIC's chip (36mm^2), known as ATHED and a new data acquisition system have been developed. Recoil-decay tagging was used to unambiguously identify evaporation residues in the dominant backgrounds of unwanted reaction channels, and EXOGAM provided a large efficiency for the detection of prompt gamma-ray cascades.

In this contribution, we will first give an overview of our experimental program on transfermium and transactinides elements studies. We will then describe the new MUSETT silicon wall and the new NARVAL-based data acquisition system. We will then show the results of the first commissioning experiment using very asymmetric reactions and the VAMOS Wien filter mode. A new gas-filled operation mode has been recently implemented at VAMOS. Examples of nuclear structure and reaction dynamics studies using this new mode and MUSETT will be given. In a near future the Super Separator Spectrometer S3 and the ultra-high intensities of the LINAG linear accelerator will provide fantastic opportunities for decay-spectroscopy studies. We will show how the S3 focal plane detection will benefit from the MUSETT developments and give examples of first-day experiments foreseen with S3 in 2013.