

## The X-Array and SATURN: A new decay-spectroscopy station for CARIBU

The CARIBU facility at Argonne National Laboratory provides a unique opportunity for research in nuclear structure, nuclear astrophysics and nuclear applications with neutron-rich exotic nuclei. A new decay-spectroscopy station has been commissioned for experiments with low-energy, fission-fragment radioactive beams from the CARIBU ion source in collaboration between the University of Massachusetts Lowell and the Argonne Physics Division. The new set-up consists of the X-Array of HPGe clover detectors for the detection of  $\gamma$  rays and SATURN (Scintillator And Tape Using Radioactive Nuclei), a plastic scintillator to detect  $\beta$  particles emitted in the decays combined with a tape transport system for the removal of long-lived radiation.

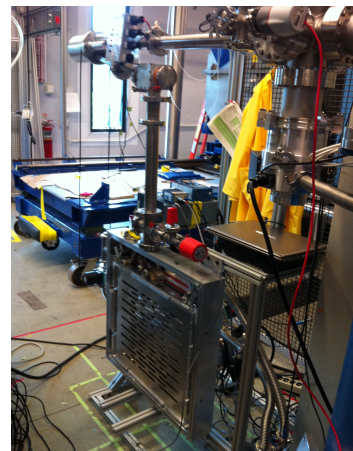


Figure 1: The SATURN system

The X-Array consists of five HPGe clover detectors constructed by Canberra/Eurisys. Four identical clovers made up of four 60 mm  $\times$  60 mm crystals are positioned in the vertical plane. The remaining clover (the ‘Super-Clover’), located in the horizontal plane facing the incoming beam, has 70 mm  $\times$  70 mm crystals. The detectors are mounted on an adjustable 80/20 aluminum frame with wheels to allow it to be easily moved from one location in the laboratory to another. The position of each detector is adjustable to allow for precise alignment with the experimental set-up.

Two versions of the  $\beta$ -particle detector have been constructed: a large-volume ‘well’ detector capable of measuring the full  $\beta$ -particle energies and providing more selectivity for high-energy  $\beta$ -decays; and a series of thin paddle-like structures surrounding the collection point, which provide higher  $\gamma$ -ray efficiency and directional information pertaining to the emitted  $\beta$ -particles. The design of the tape-transport system has been adopted from a prototype diagnostic system currently installed at CARIBU and is based upon a continuous loop of 35-mm aluminized Mylar tape. The data acquisition system is based upon the recently implemented Digital GammSphere system

The modularity of the array will allow for the addition of dedicated neutron detectors to be utilized in  $\beta$ -delayed neutron measurements in the future. Work is currently underway in developing a narrower tape system, probably  $\sim$ 15mm, which will allow for both increased speed of tape movement and use with other detector systems such as the TAGS spectrometer.

The new array has been commissioned, with  $\gamma$ -ray multi-scaled singles,  $\beta$ - $\gamma$  and  $\beta$ - $\gamma$ - $\gamma$  coincidence data collected both with and without use of the tape. A number of detection efficiency measurements were also performed using standard sources. Analyses of these are ongoing. A NIM paper on the system efficiency and performance is about to be submitted.

An extensive research program focusing on  $\beta$ -decay measurements with CARIBU low-energy beams lies on the horizon and we anticipate scheduling of a number of experiments in the summer of 2014.