Novel Recoil Spectrometer for Characterising Nuclei Far From Stability

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For the γ-ray spectroscopy of very neutron-deficient nuclei, highly selective experimental systems and analysis methods are required. In recent years, this has been achieved by using recoil-decay tagging and recoil-gating techniques with Ge-detector arrays at recoil separators, such as RITU (Jyväskylä, Finland) and the FMA (Argonne, USA). These experiments are well suited for the observation of γ rays at the target position, but due to the long flight paths, only isomers with lifetimes longer than about a microsecond survive to be examined at the separator focal plane.

The present project at the Heavy Ion Accelerator Facility located at the Australian National University has been initiated to study the decay of isomeric states with lifetimes starting from a few hundred nanoseconds. The new separator system is based on SOLITAIRE, a 6.5 T superconducting, gas-filled solenoid [1] which has been commissioned recently for reaction studies. The distance from the target to the focal plane is only 1.6 meters, which corresponds to a flight time of about 130 ns (260 ns) for a recoil velocity of $v/c \sim 4\%$ (2%). At the focal plane, recoils will be implanted into a tape, allowing removal of built-up activities, while γ rays de-exciting isomeric states will be observed by Compton-suppressed Ge / LEPS detectors. Conversion electrons will be measured using an array of Si(Li) detectors mounted upstream from the focal plane.

The initial region of interest, the very light Pb isotopes, was chosen due to the rich variety of competing shape-coexisting structures in these nuclei [2], while the experimental data is incomplete despite substantial efforts (see e.g. Refs [3,4] and references therein). Once operational, the system will also be used for studies of isomeric states in other mass regions. In this contribution, the project will be described. Results from first tests with a single Ge detector will also be discussed in the light of computer simulations predicting the separator performance.

[1] T. Kibédi *et al.*, ANU Internal Report, ANU-P/1404 (1999).
[2] J.L. Wood *et al*, Phys. Rep. **215**, 101 (1992).
[3] G.D. Dracoulis *et al.*, Phys. Lett. B **432**, 37 (1998).
[4] G.D. Dracoulis *et al.*, Phys. Rev. C **69**, 054318 (2004).