Free ion hyperfine fields and magnetic moment measurements on radioactive beams

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The magnetic moment, or *g* factor, is an important observable to study nuclear structure. Such measurements on short lived excited nuclear states having lifetimes of the order of picoseconds have always been challenging. In the last decade methods have been developed that allow *g*-factor measurements on short-lived excited states of neutron-rich nuclei produced as radioactive beams. These measurements are even more challenging because radioactive beams are weak, and because the radioactivity of the beam can produce enormous levels of background radiation.

This paper will discuss the Recoil in Vacuum technique, which has been applied to measure the magnetic moments of the first-excited states of several neutron-rich nuclei near double-magic ^{132}Sn [1,2]. Key aspects of the method development and characterization of the necessary free-ion hyperfine fields were performed at the ANU heavy Ion Facility using stable beams [3]. Our progress in experimental studies of the hyperfine fields present at the nuclei of highly charged free ions will be reported, along with our progress in the quest to calculate these fields from first principles based on atomic physics models.

The radioactive beams were produced at the Holifield Radioactive Ion Beam Facility (HRIBF) at Oak Ridge National Laboratory, USA, by proton-induced fission of uranium, isotopic separation of the chosen fission fragment, and acceleration these neutron-rich radioactive ions. Following Coulomb excitation of the beam ions of interest, detailed particle-gamma angular correlations were observed using the CLARION and HYBALL detector arrays. From these angular correlations, the nuclear moments were deduced. Selected results, including the latest measurements performed in February 2012 on semimagic ^{134}Te, will be reported, and their implications for nuclear structure around ^{132}Sn will be discussed.

[1] N.J. Stone et al., *Phys. Rev. Lett.* **100**, 187 (200).
[2] A.E. Stuchbery and N.J. Stone, *Phys. Rev C.* **76**, 034307 (2007).
[3] A.E. Stuchbery et al. , *Phys. Rev C.* **76**, 034306 (2007).