# Magnetic Moments of Short-lived States in Radioactive Nuclei following Coulomb Excitation at Relativistic Energies

**K.–H. Speidel[1], O. Kenn[1], S. Mandal[2], H.–J. Wollersheim[2], P. Maier–Komor[3]**

[1] *Institut für Strahlen– und Kernphysik, Universität Bonn, D–53115 Bonn*
[2] *Gesellschaft für Schwerionenforschung, D–64220 Darmstadt*
[3] *Physik–Dept. Technische Universität München, D–85748 Garching*

Magnetic moments provide highly valuable information on the microscopic structure of nuclei as they are extremely sensitive to single particle components in the wave function and their intricate interplay with collective degrees of freedom. Because of the intrinsically opposite signs of the spin $g$ factors of protons and neutrons $[g_s(\pi) = +5.586, g_s(\nu) = -3.826]$ $g$ factor measurements enable to determine the nucleonic composition of the states in question. In recent experiments on low spin states of neodymium isotopes, it was possible to show for the first time, that the well-established decrease of the $g(2_1^+)$ values with neutron number, approaching the N = 82 shell closure, arises from a strong $f_{7/2}$ neutron component in the wave function [1].
The technique used for nuclear states with *ps* lifetimes is projectile Coulomb excitation in combination with strong transient magnetic hyperfine fields. The latter are of several kTesla strength and are experienced when ions move through a polarized ferromagnetic target layer. The spin precession of the excited nuclear state is observed via the rotation of an anisotropic angular correlation of emitted $\gamma$ rays. Both, precession and the angular correlation can be measured simultaneously with $\gamma$ detectors at fixed polar angles $\Theta_\gamma$ in the reaction plane and using an annular particle detector with azimuthal position sensitivity. In this geometry measurements were succesfully carried out at beam energies of $\sim 15\ MeV/u$ [2]. At relativistic energies of $\sim 100\ MeV/u$, the strong Lorentz boost of the $\gamma$ intensity distribution requires to set the $\gamma$ detectors at forward angles which can be accomplished with the newly designed RISING detector array.
The radioactive projectiles, produced in a fragmentation reaction of a stable beam from the SIS accelerator and separated with the fragment separator, will be focussed onto a target for Coulomb excitation of the first $2^+$ state. Ion tracking of the incoming and the scattered ions is required for Dopplershift correction and well-defined determination of the interaction time of the ions in the ferromagnetic layer. The target will consist mainly of gadolinium for both Coulomb excitation and precession of the radioactive nuclei.
First measurements are planned for nuclei in the mass region A = 70-90 (Kr,Sr,Zr) to study the N = Z class of nuclei, where *pn* pairing correlations play the dominant role, and on the neutron rich side (near the dripline) shell gap quenching predictions which manifest themselves in a strikingly different single particle structure and shell closures as well.

[1] J. Holden et al. , Phys. Lett. B 493 (2000) 7
[2] U. Grabowy et al. , Z. Phys. A 359 (1997) 377