Measurements of magnetic moments of low-lying excited states in nuclei beyond the limits of stability: ^{82}Sr, AND ^{90}Sr

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A new experiment was set up at TAMU to carry out magnetic moment measurements. The setup consists of a removable angular correlation table for four clover detectors and a beam line with target chamber, beam diagnostics, and vacuum pump system. A three layer target (C/GdCu) is held between the pole pieces of an electromagnet, which is incorporated in a Displex Cryocooler. The target temperature is kept below 50K. A Si-particle detector at 0 deg. detects emitted charged particles. Gamma rays were recorded in four clover detectors (from the LLNL array at TAMU). Altogether 17 detector output signals were recorded in a Rutgers owned PIXIE-4 digital pulse processing data-acquisition system. A schematic of the setup is shown in Fig.1.

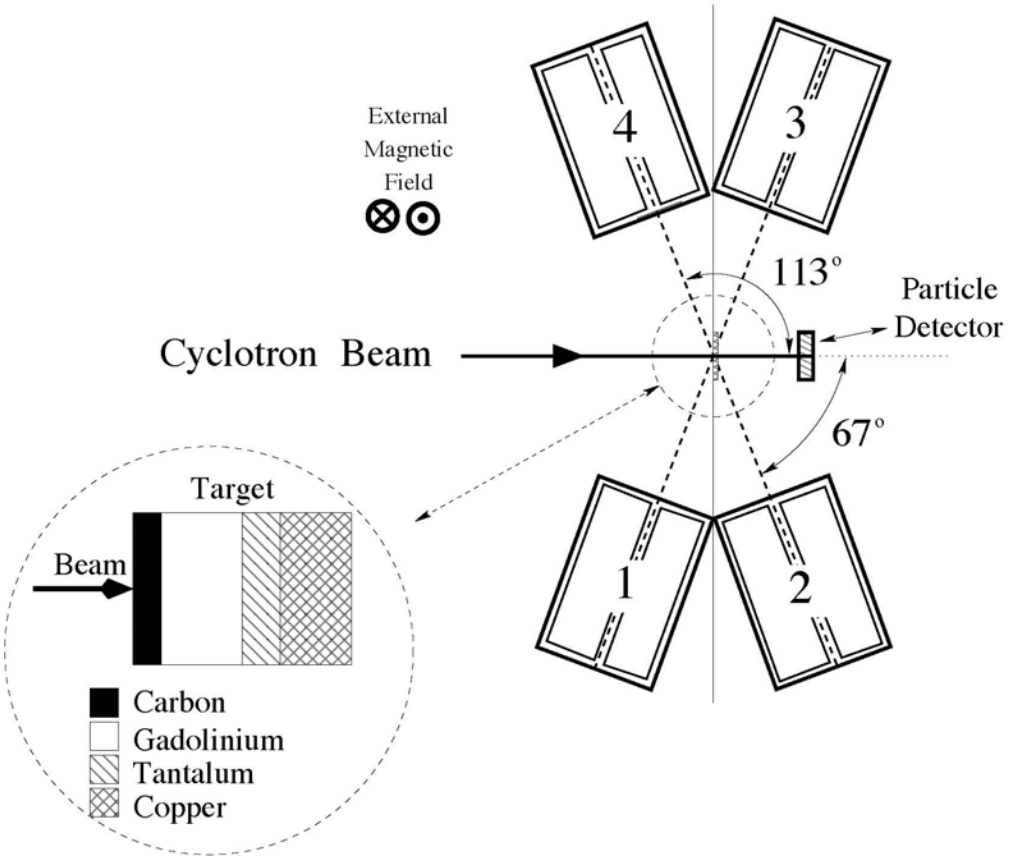

FIG. 1. A schematic of the experimental setup.

Two runs were carried out in the summer and fall of 2013 with beams of ^{78}Kr and ^{86}Kr at 3.0, 3.1 and 3.2 MeV/u. The alpha-transfer reactions from the C layer of the target to a beam of ^{78}Kr of ^{86}Kr ions was used to populating low-lying excited states of the radioactive nuclei ^{82}Sr and ^{90}Sr. The transient field

technique was used to extract the magnetic moment. Simultaneously ^{78}Kr and ^{86}Kr were excited by Coulomb excitation and were used for calibrations as well as for the first measurement of the 4^+ state in ^{86}Kr. A qualitative estimate of the energy dependence of the alpha-capture cross section was obtained.

These experiments were very successful and underscore the high quality of the beams accelerated by the K500 cyclotron, especially their adaptability for magnetic moment measurements. The analysis of these experiments was completed. The structure of ^{82}Sr is clearly that of a collective nucleus while the structure of ^{90}Sr states reflects the dominance of single particles occupying specific shells. Large scale shell model calculations were carried out or ^{90}Sr, ^{86}Kr and ^{92}Zr using a ^{78}Ni core by K. Sieja (Strasbourg). The systematics of the magnetic moments in the region are displayed in Fig. 2 where, in addition, the similarities between Sr and Zr nuclei are highlighted. The newly determined g factors of the first 2^+ and 4^+ in ^{90}Sr together with the same prior measured g factors in ^{92}Zr shed light on the robustness of ^{88}Sr and ^{90}Zr nuclei as closed core nuclei, which are of great interest for shell model calculations.

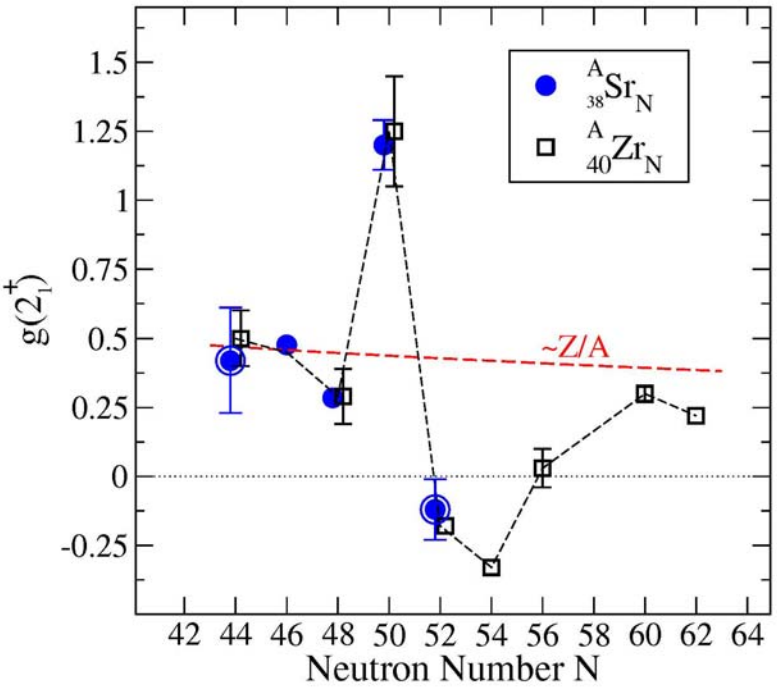

FIG. 2. The systematics of the magnetic moments of Sr and Zr nuclei.