Measurements of Magnetic Moments for Excited States of ^{46,48}Ti and ^{50,52}Cr Nuclei and their Shell Model Interpretation ◇

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Large-scale shell model calculations predict characteristic variations of g-factors for excited states of even-even Ti- and Cr- nuclei which result from the excitation of neutrons and protons in the fp-shell [1,2]. Moreover, the symmetry between particles and holes for the cross-conjugate nuclei ^{46}Ti and ^{50}Cr, with respect to ^{40}Ca and ^{56}Ni as core nuclei, provides simple g-factor relations [2,3].The experimental situation for testing these specific features, however, is rather poor as the data are incomplete and in general of insufficient accuracy [4,5].

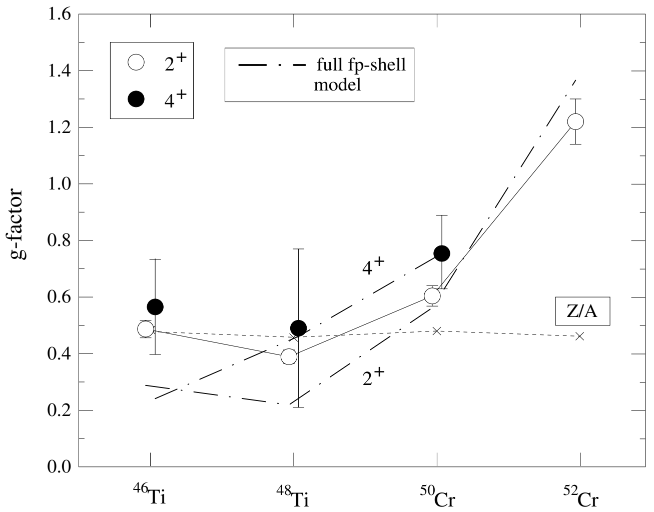

Fig. 1: Experimental g-factor values in comparison to full fp-shell model calculations (dot-dashed lines). Dashed curve refers to Z/A. Solid line is to guide the eye.

We have measured the g-factors of the first 2^+ and 4^+ states of these four nuclei employing the transient field (TF) technique combined with Coulomb excitation (C.E.) in inverse kinematics by scattering the nuclei as beam particles from a carbon target. Details of this technique are described in [6]. The Ti- and Cr- energies were 110 and 120 MeV, respectively. As the carbon recoils were detected in a Si detector at 0° relative to the beam direction, the beam had to be stopped in a Ta foil placed behind the target, which consisted of four well-attached layers: 0.75 mg/cm^2 C, followed by 3.6 mg/cm^2 Gd on a 1 mg/cm^2 Ta layer with 3.6 mg/cm^2 Cu backing. Using carbon for C.E. γ-rays from target excitation ($^{12}C(2^+ \rightarrow 0^+)$: 4.43 MeV) contributed only a very low-intensity background in the region of interest of γ-spectra which were measured in coincidence with the recoiling carbon ions using large volume NaI(Tl) or BaF_2 scintillators. A Ge detector at 0° served as monitor for detecting contaminant lines which was crucial in the case of $^{48}Ti(4^+ \rightarrow 2^+)$ transition.

Beside detailed angular correlations the precession of the 2^+ and the 4^+ states have been measured in the TF of the polarized Gd layer of the target. For the determination of absolute values of g-factors the strength of the TF was calculated with the linear parametrization including a small empirical attenuation due to the interaction of the beam ions with the Gd host. Preliminary data are shown in figs. 1 and 2 compared to results from fp-shell model calculations [2]. Evidently, the very precise values for the first 2^+ states are rather well described in the model space chosen. More specific calculations for ^{50}Cr (see fig. 2) show the effect of the number t of particles excited from the $f_{7/2}$ shell to the $p_{3/2}$, $f_{5/2}$, $p_{1/2}$ orbits. The best agreement is achieved with $t \geq 2$. Moreover, the 4^+ g-factor is in disagreement with the earlier result by Pakou et al. [5].

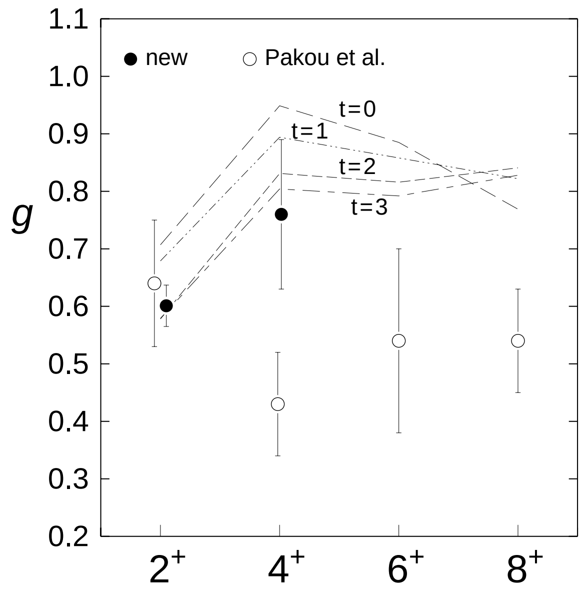

Fig. 2: Exerimental g-factor values for ^{50}Cr in comparison with shell model calculations allowing t valence nucleons to be outside the $1f_{7/2}$ shell [1]. Open symbols refer to former experimental data [5]

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