# Test of Shell Model Calculations for $^{50}$Cr with Magnetic Moments of the First $2^+$ and $4^+$ States ◇

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Shell model calculations predict for the yrast states of $^{50}$Cr, resulting from the excitation of neutrons and protons in the fp- shell, g factors with characteristic variations as shown in fig. 1 [1,2]. This particular feature was also obtained in extensive Cranking Hartree-Fock-Bogoliubov calculations [3] yielding essentially the same result.

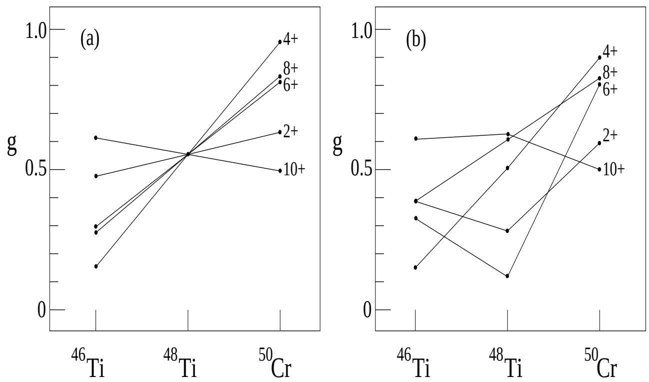


Fig. 1: Theoretical calculations of the spin dependence of the g factors of the low-lying states of $^{46}$Ti,$^{48}$Ti and $^{50}$Cr. (a) All valence nucleons are in the $f_{7/2}$ shell: $(f_{7/2})^n$ (b) One valence nucleon is allowed to occupy the $(p_{3/2}, f_{5/2}, p_{1/2})$ orbits: $(f_{5/2})^{n-1}(p_{3/2}, f_{5/2}, p_{1/2})$.

The experimental situation is somewhat obscure. Magnetic moments have been determined for spins up to $8^+$ employing the transient field technique whereby the states of interest were populated in a heavy ion fusion reaction [2]. The values obtained are consistent with a constant g factor for all states being attributed by the authors to larger collectivity than described by the model calculations. On the other hand, as the feeding pattern following the reaction is rather complex, the experimental data may in fact reflect the magnetic moment of a single state or a certain bunch of states instead of specific individual states. The discrepancy between experiment and theory has motivated us to make another effort by avoiding the feeding problem.

As Coulomb excitation (C.E.) has been considered, our interest was focussed on the first $2^+$ ($\tau = 12.8(7)$ ps) and $4^+$ ($\tau = 3.2(4)$ ps) states, for which, however, the largest change of the g factor is expected (fig. 1).

C.E. of 120 MeV $^{50}$Cr beam ions from the Munich tandem accelerator was accomplished with a carbon target. The ion source was operated with a highly enriched $^{50}$Cr isotope. The targets consisted of 0.45 mg/cm$^2$ $^{nat}$C on 3.8 mg/cm$^2$ Gd deposited on a 1 mg/cm$^2$ Ta layer and a 3.5 mg/cm$^2$ Cu backing. Coincidence requirement between forward scattered C ions and $\gamma$ rays from excited $^{50}$Cr ions provided suffciently clean $\gamma$ spectra showing as prominent lines only the $2^+ \to 0^+$ and the $4^+ \to 2^+$ transitions at energies of 0.784 MeV and 1.098 MeV, respectively (fig. 2). In these conditions rather low background radiation contributed in the energy region of interest. For the cleanliness of the spectra the good timing characteristics of the $BaF_2$ scintillators was essential.

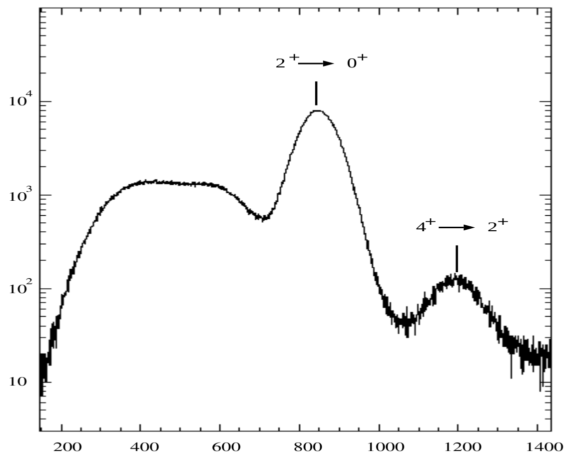


Fig. 2: Typical $\gamma$ spectrum showing the $2^+ \to 0^+$ and the $4^+ \to 2^+$ transitions at energies of 0.784 MeV and 1.098 MeV

Gamma-angular correlations have been measured to determine the logarithmic slopes relevant for the nuclear spin precessions. The latter were obtained from counting rate ratios of four detectors placed symmetric to the beam direction for "up" and "down" directions of the external magnetic field to magnetize the target. Preliminary results of the precessions deduced are:

$$2^+ \text{ state:} \quad \Phi = 20.89(18)\,\text{mrad}$$
$$4^+ \text{ state:} \quad \Phi = 23.8(5.4)\,\text{mrad}$$

Using the linear parametrization of the transient field we obtain for the g factors the following preliminary values:

$$g_{2^+} = 0.591(57) \text{ and } g_{4^+} = 0.73(18)$$

which tend to support the model predictions in contrast to the former measurements. Currently efforts are made to improve the accuracy of the $4^+$ g factor.

## References

[1] L. Zamick, D.C. Zheng, Phys. Rev. **C54** (1996) 956
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[3] G. Matrinez-Pinedo *et al.*, Phys. Rev. **C54** (1996) 2150

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