**g-FACTOR OF THE FIRST EXCITED 4^+ STATES IN $^{156}$Gd AND $^{158}$Gd**

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Relative g-factor of the first 2^+ and 4^+ states have been measured with the transient field technique in $^{156}$Gd and $^{158}$Gd. The precession of gamma rays depopulating the levels under study were observed, after passing through thin polarized gadolinium. The observed values agree with the predictions of the rotational model, i.e. $g(4^+)=g(2^+)$, while contrasting the hypothesis that in $^{156}$Gd the g-factor of the 4^+ is reduced with respect to the 2^+, because of rotational alignment.

1. INTRODUCTION

The influence of the alignment of a $v(1/2)_2$ quasiparticle pair on the g-factors of the g.s. band in even-even rare earths has been extensively investigated both theoretically and experimentally. Hartree-Fock-Bogoliubov Cranked (HFB) calculations predicted /1,2/ a reduction, which depends on the position of the Fermi surface and should be maximum for N=92 and N=98. In this frame the g.s. band g-factors can be described, for low spins, with the expression $g(I)=g_0(I+\alpha I^2)$, while a strong reduction is predicted at excitation energies close to backbending region.

Systematic measurements have been performed in Sm, Gd, Dy and Yb even-even isotopes /3/. Up to $I=10^+$, a smooth reduction (of the order of 10-20% at $I=10^+$) has been observed, in agreement with the theoretical expectations /2/. The strong reduction at backbending has been found for example in the N=92 $^{158}$Dy /4/.

In recent years, some evidence of a strong deviation of the g-factor values from the rotational model predictions has been found also for low lying levels. A reduction of about 20% at $I=6^+$ has been found in the N=98 nucleus $^{166}$Er /5,6/, while the normal behaviour $g(1)=g(2^+)$ has been observed in $^{168}$Er /7/. Updated HFB calculations /8/ have tried to describe this findings and indeed were able to predict the selective reduction in $^{166}$Er. However the calculated effect is, at $I=6^+$, only about 20% of the experimental one.

An even more impressive case has been recently reported in the N=92 $^{156}$Gd /9/. The g-factor of the first 4^+ state has been measured to be $g(4^+)=0.310(19)$, while that of the first 2^+ state is 0.386(4) /10/. The reduction is therefore about 20 percent and, according to the current models, should be at least two times larger for 6^+. On the other hand, in the same work, the normal behaviour has been found for $^{158}$Gd, namely $g(4^+)=g(2^+)$. The situation seems then to resemble that in $^{166}$Er and $^{168}$Er. However, this result is in contrast with previously reported Transient Field (TF) data /11,12/. $^{156}$Gd and $^{158}$Gd were simultaneously populated in three separate Coulomb excitation experiments and similar precessions were measured at various recoil velocities, pointing to similar g-factors for the 4^+ and 6^+ states.

This ambiguous situation motivated us to check again the g-factor of the 4^+ state in $^{156}$Gd. The Transient Field technique after Coulomb excitation appears to be very suitable for this purpose. In fact $^{156}$Gd and $^{158}$Gd can be measured...
simultaneously, thus reducing the possibility of systematic errors. Moreover, one can populate rather selectively the low lying states by choosing proper bombarding energies.

2. EXPERIMENTAL PROCEDURE

A set-up similar to that of ref./13/ has been used, therefore only main details will be given here. $^{156}\text{Gd}$ and $^{158}\text{Gd}$ were Coulomb excited by a 117 MeV $^{58}\text{Ni}$ beam. Two targets have been used. The first one consisted of 0.5 mg/cm$^2$ of Gd$_2$O$_3$ (50% $^{156}\text{Gd}$, 50% $^{158}\text{Gd}$) evaporated on 4.4 mg/cm$^2$ of annealed metallic $^{160}\text{Gd}$ (acting as ferromagnetic host). The second one consisted of 1.3 mg/cm$^2$ of metallic $^{156}\text{Gd}$ glued to a 3.4 mg/cm$^2$ $^{160}\text{Gd}$ foil by means of a 0.3 mg/cm$^2$ indium layer. Both targets were backed with 6 mg/cm$^2$ of Ag. The isotopical enrichment of Gd was bigger than 95% for all the target layers. With the mixed target a short run was also done at 160 MeV. Gadolinium was preferred to iron, even at the expense of using an isotopically enriched ferromagnetic layer, because, in good experimental conditions, it gives rise to bigger precessions.

Fig. 1. Coincidence $\gamma$-spectrum taken at $\theta = 65^\circ$ with the mixed $^{156,158}\text{Gd}$ target.

Four Ge-detectors were positioned at $\pm 65^\circ$ and $\pm 115^\circ$ with respect to beam axis. $\gamma$-rays were taken in coincidence with backscattered projectiles detected by means of an annular 4 cm-$\phi$ cm Parallel Plate Avalanche Counter covering a solid angle of 2 sr. An example of the collected spectra is shown in the figure. Due to the low energies of the observed $\gamma$-rays, $\gamma$-absorption effects were carefully minimized. For such a purpose the target was directly screwed between the pole tips of the electromagnet. The $\gamma$-absorption in the target affected by only some percents the measurement of logarithmic slope S, which was performed by turning the $\gamma$-detector assembly by $\pm 3^\circ$. A selection of experimental data is presented in table 1. The effect $\epsilon$, deduced from the double ratio of the counts taken in the four germanium detectors as described in ref./13/, is related to the angular precession through relation $\epsilon = S \Delta \theta$. The contribution of indirect feeding