JOURNAL OF THE PHYSICAL SOCIETY OF JAPAN VOL. 34, SUPPLEMENT, 1973
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR MOMENTS AND NUCLEAR STRUCTURE, 1972

V–12

Effective g_s Values for a Few Odd Deformed Nuclei

Y. DAR, J. GERBER† and J. P. VIVIEN†

Department of Physics, Technion-Israel Institute of Technology, Haifa, Israel
†Centre de Recherches Nucléaires, Strasbourg-Cronenbourg, France

Following a series of lifetime measurements,[1-3] values of g_K were obtained, with the aid of precise values available for the ground state magnetic moments, in some odd-A deformed nuclei. This was in particular possible since the mixed M1–E2 transition were dominated by magnetic dipole radiation.

Theoretical values for g_K can be obtained from the Nilsson models. We refer to equations 112, 114, 117 in ref. 4 from which one combines the expression:

$$g_K = g_l + \frac{\hat{g}_s - g_l}{K}\langle \alpha K|\tilde{S}_0|\alpha K\rangle \tag{1}$$

where

$$\langle \alpha K|\tilde{S}_0|\alpha K\rangle = \frac{1}{2}\sum_l (|a^{(\alpha)}_{lK-1/2}|^2 - |a^{(\alpha)}_{lK+1/2}|^2)$$

and

$$|\alpha K> = \sum_{l,\Lambda} a^{(\alpha)}_{l,\Lambda}|Nl\Lambda\Sigma>.$$

$|Nl\Lambda\Sigma>$ are the harmonic oscillator functions used in the Nilsson model. g_K can now be expressed in terms of orbital and spin g-factors:

$$g_K = g_l + \frac{\hat{g}_s - g_l}{2K}\sum_l (|a^{(\alpha)}_{l1}|^2 - |a^{(\alpha)}_{l2}|^2).$$

Due to spin polarization effects[5] $\hat{g}_s$ is being treated as an effective parameter, namely:

$$\hat{g}_s = \beta g_s \tag{2}$$

where g_s is the spin g-factor of a free particle. Values for g_K were calculated following the Nilsson model[6] as well as for the extended Nilsson model which incorporates a hexadecapole deformation ε_4.[7] Fixing the parameters κ, μ and ε_4 from level spacings, the wave functions were calculated from a computer code by B. Nilsson.[8]

The question of spin polarization was discussed by Bochnacki and Ogaza.[5] They derived an expression for the effective g_s value:

$$\hat{g}_s = g_l + (g_s - g_l)_{\text{odd}}(1+\alpha) + (g_s - g_l)_{\text{even}}\frac{\alpha^{(1)}_{\text{np}}}{[1-\alpha^{(1)}]^2}$$

which consists of an *odd* dominant contribution and

Table I. Values of β that were adjusted to fit measured g_K values to the theoretical values as predicted by the Nilsson and extended Nilsson models.

Nucleus	Nilsson	Ext. Nilsson
Gd–157	0.74±0.02	1.00±0.02
Tb–159	0.80±0.07	0.77±0.07
Ho–165	0.76±0.08	0.78±0.08
Er–167	0.64±0.04	0.68±0.04
Yb–173	0.81±0.02	0.94±0.03
Lu–175	0.71±0.01	0.71±0.01
Ta–181	0.81±0.02	0.71±0.02

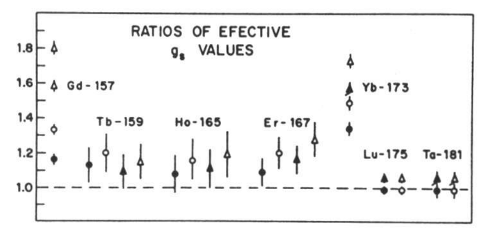

Fig. 1. Ratios of measured and calculated values of β (or of effective g_s values, $\hat{g}_s$). The circles and triangles are related to values deduced from the Nilsson and Extended Nilsson models, respectively. The full and open forms represent ratios with values calculated by Bochnacki and Ogaza, taking into account the *odd* group effect and the *odd* + *even* group polarization, respectively.

an *even* part. The α's are polarizability factors that are connected with nuclear parameters such as the interaction strength. This paper also discusses the dependence and sensitivity of the result on the various parameters.

The meaning of a comparison between the calculated values of $\beta = \hat{g}_s/g^s$ and the adjusted β's from experiment is arbitrary to some extent. This, since the deduction of both the experimental and theoretical g_K is not model independent. The "measured" β's are therefore subject to a comparison with a specific choice of nuclear parameters that are introduced into the theory of Bochnacki and Ogaza.

The experimental results deduced from the Nilsson and extended Nilsson models (Table I) are each compared with the odd group dominant effect and the odd even contribution. The results are presented in Fig. 1. The best agreement is reached by the combination of applying the Nilsson model to the *odd*-group results of Bochnacki and Ogaza. It seems however that a systematic tendency exists towards higher values of β. This may indicate somewhat weaker spin polarization effects than previously expected.

References

1) R. Armbruster, Y. Dar, J. Gerber, A. Macher and J. P. Vivien: Nuclear Phys. **A143** (1970) 315.
2) R. Amrbruster, Y. Dar, J. Gerber, A. Macher and J. P. Vivien: Nuclear Phys. **A153** (1970) 460.
3) Y. Dar, J. Gerber, A. Macher and J. P. Vivien: Nuclear Phys. **A171** (1971) 575.
4) J. M. Eisenberg and W. Greiner: *Nuclear Models,* NHPC, (Amsterdam 1970) Vol. 1, p. 265–266.
5) Z. Bochnacki and S. Ogaza: Nuclear Phys. **69** (1965) 186.
6) S. G. Nilsson: K. Danske Vidensk. Selsk. mat.-fys. Medd. **29** (1955) no. 16.
7) J. L. Lamm: Nuclear Phys. **A125** (1969) 504.
8) private communication.