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III–16 The g Factor of the 12^+ Isomeric State in ^{206}Pb and the Effective Orbital g Factor of the Neutron

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The g factor of the 12^+ $[(\nu i_{13/2})^{-}{}_2]$ isomeric state in ^{206}Pb ($T_{1/2}=0.2$ μsec) has been measured. The state was populated by the ^{204}Hg(α, 2n) ^{206}Pb reaction in liquid mercury target with the 27-MeV pulsed α beam from the NBI Tandem accelerator. The value obtained was;

$$g(^{206}\text{Pb}: 12^+) = -0.155 \pm 0.004.$$

This result gives the g factor of the $i_{13/2}$ neutron. Since the g factor of the $i_{13/2}$ proton can also be deduced from the $g(^{210}\text{Po}: 11^-\ [(\pi i_{13/2})(\pi h_{9/2})])$ and the $g(^{209}\text{Bi}: 9/2^-\ [\pi h_{9/2}])$, we can compare the magnetic moments of the $i_{13/2}$ particles. As shown in the Table I, the comparison indicates that the main deviation of the magnetic moments from the Schmidt values is of isovector charactor.

Using the three available data on g factors of single particle neutron states around the ^{208}Pb core ($p_{1/2}$, $f_{5/2}$ and $i_{13/2}$), we tried to deduce the effective orbital g factor of the neutron. Two different methods were used; (i) the M1-core-polarization model and (ii) the configuration-mixing model.

(i) According to the M1-core-polarization model, the magnetic moment of a single particle state is given by,[1)]

$$\mu = j\left\{(g_l+\delta g_l) \pm \frac{(g_s+\delta g_s)-(g_l+\delta g_l)}{2l+1}\right\} + \delta g_s' \langle (Y_2 s)_1 \rangle \,. \quad (\text{for } j = l \pm 1/2)$$

The three experimental g factors were used to determine the three parameters (δg_l, δg_s, and $\delta g_s'$). In this analysis the state independence of the parameters is assumed. The parameters obtained were; $\delta g_l = -0.036 \pm 0.010$, $\delta g_s = 2.77 \pm 0.15$ and $\delta g_s' = -3.30 \pm 0.22$.

(ii) By use of the configuration-mixing model,[2)] we can estimate the effect of the spin (core) polarization. Nagamiya and Yamazaki have made an evaluation of the δg_l.[3)] Using the present value of the $g(\nu i_{13/2})$, we have reevaluated the δg_l(n). The value obtained was $\delta g_l(\text{n}) = -0.04 \pm 0.03$.

Table I. Magnetic moments of the $i_{13/2}$ particles.

	μ_{exp}	μ_{Schmidt}	$\mu_{\text{exp}} - \mu_{\text{Schmidt}}$
μ_{proton}	8.07 ± 0.19	8.79	-0.72 ± 0.19
μ_{neutron}	-1.01 ± 0.05	-1.91	0.90 ± 0.05
Sum	7.06 ± 0.20	6.88	0.18 ± 0.20
Difference	9.08 ± 0.20	10.70	-1.62 ± 0.20

The good agreement between the values from the two analyses with different assumption leads us to conclude that

$$g_l^{\text{eff}}(\text{neutron}) = \delta g_l(\text{n}) = -0.04 \pm 0.03.$$

References

1) A. Bohr and B. Mottelson: *Nuclear Structure* vol. 1 (Benjamin Inc. 1969, New York).
2) A. Arima and H. Horie: Progr. theor. Phys. **11** (1954) 509.
3) S. Nagamiya and T. Yamazaki: Phys. Rev. **C4** (1971) 1961.

Note added after the Conference—A new measurement of the magnetic moment of the $5/2^-$ state in ^{207}Pb has been reported in this conference by Schroeder and Toschinski.[1)] They used a superconducting magnet to generate magnetic field of 100 kG with good homogeneity. The calibration of the field was done by use of a rotating-coil field meter. The time-integral-PAC method was used to observe the spin-rotation angle. The result was $\mu = 0.79 \pm 0.03$ nm in disagreement with previous value which was used in the present analysis.

A reanalysis based on the new datum yields,

$$g_l^{\text{eff}}(\text{neutron}) = \delta g_l(\text{n}) = -0.02 \pm 0.03.$$

1) presented at this conference III–15.