Spectra of divalent Mn in NaCl ($g=2.0022$, $A=86.6$ gauss) and in KBr ($g=2.0041$, $A=94.96$ gauss), of divalent Eu in KCl, and of trivalent Gd in $CaCl_2$ and in $SrCl_2$ will be reported in a separate paper.

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Possible Method of Measuring Magnetic Moments of V Particles

M. Goldhaber
Brookhaven National Laboratory, Upton, New York*
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It is reasonable to assume that those V particles which have a spin $I>0$ will, as a rule, be produced partially polarized with respect to their line of flight or their production plane. If their decay is observed before they have interacted with other particles or external fields, their "memory" of the polarization should remain intact and should, for V particles with $I>1/2$, lead to angular distributions of the decay products which are not isotropic. In fact, the study of such angular distributions, or some of their characteristic features, e.g., the distribution of dihedral angles between the decay planes and the production planes of V particles, has recently been discussed in detail as a promising method of determining the spins of V particles.[1–3] There are strong indications in the experiments of Fowler, Shutt, Thorndike and Whittemore[4] and of Walker and Shepard[5] that the decay planes of Λ^0's, produced in the reaction $p+\pi^- \rightarrow \Lambda^0+\theta^0$, are oriented in such a way as to form preferentially small dihedral angles with their production planes. Tentatively it thus appears that the Λ^0 has a spin $I\geqslant 3/2$.[6] If this should be confirmed it would seem possible to measure, besides the spin, the sign and magnitude of the magnetic moment of Λ^0 by studying the effect of a magnetic field on the distribution of decay planes. In the nonrelativistic limit ($v/c\ll 1$), we find that in a magnetic field of strength B, a particle with a magnetic moment μ will carry out Larmor precessions around the axis of the field with an angular frequency

$$\omega=\mu B/I\hbar,$$

in a sense determined by the sign of the magnetic moment. Any discernible characteristic of its angular distribution at decay which can be established in field free space (e.g., a plane of symmetry) will precess around the axis of the magnetic field through an angle

$$\varphi=\omega t=2.744\times 10^5\, gBt \text{ (degrees)},$$

where the gyromagnetic ratio $g=\mu/I$ (μ measured in nuclear magnetons), and t is the time (in sec) spent in the magnetic field, e.g., before entering a cloud chamber or inside one. Thus, with the perhaps optimistic, but not completely unrealistic assumptions of a magnetic field $B\approx 18\,000$ gauss, a time of flight in this field of the order of 10^{-9} sec, and a gyromagnetic ratio $g\approx 2$, we should find a precession angle $\varphi\approx 10°$.

Similar methods could be applied to obtain spins and magnetic moments of specific hypernuclei with $I>1/2$, especially if they could be produced in well-defined reactions, such as

$$K^-+\mathrm{He}^4 \rightarrow {}_\Lambda\mathrm{H}^4+\pi^-,$$

or

$$K^-+\mathrm{He}^4 \rightarrow {}_\Lambda\mathrm{H}^3+n, \text{ etc.}$$

Because of the smaller distances involved here, the use of more intense (pulsed[7]) magnetic fields may be considered.

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hfs Separations and hfs Anomaly in the 6 $^2P_{3/2}$ Metastable Level of Tl^{203} and Tl^{205}†

Gordon Gould
Department of Physics, Columbia University, New York, New York
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Precision measurements at weak field of the frequency of the hfs line ($F=2$, $m_F=0 \leftrightarrow F=1$, $m_F=0$) in the metastable 6 $^2P_{\frac{3}{2}}$ level of the thallium isotopes have been made with an atomic beam magnetic resonance apparatus.[1] A qualitative estimate of 0.008 cm^{-1} has previously been given for the hfs splitting of the $6\,^2P_{\frac{3}{2}}$ level of Tl from optical measurements.[2] In order to produce a large enough population in the metastable level to allow observation of the lines, the beam was illuminated between the oven and the "A"-magnet by an "Osram" argon-thallium spectral lamp. The thallium resonance radiation excited the atoms principally to the $7\,^2S_{\frac{1}{2}}$ level from which they decayed, in part, to the $6\,^2P_{\frac{3}{2}}$ level before entering the "A"-field. Details of the experiment and further results will be published later. The transition frequencies at zero field are as follows:

For Tl^{203},

$$\Delta\nu_1 = 2a_1 = 524\,060\,100 \pm 200\ \text{sec}^{-1};$$

for Tl^{205},

$$\Delta\nu_2 = 2a_2 = 530\,076\,600 \pm 200\ \text{sec}^{-1}.$$

The moment ratio measured by the nuclear magnetic resonance technique[3] is $\mu_1/\mu_2 = 0.990258 \pm 0.000001$. From these values the isotopic hyperfine structure anomaly in the $6\,^2P_{\frac{3}{2}}$ level is found to be

$$\Delta_{\frac{3}{2}} = (a_1\mu_2/a_2\mu_1) - 1 = -0.001626 \pm 0.000002.$$

The hyperfine anomaly in Tl is largely due to the Breit-Rosenthal effect[1,4–6] wherein the electron wave functions are altered differentially for the two isotopes from those characteristic of a point nucleus because of the finite nuclear charge distributions. A smaller contribution to the anomaly (Bohr-Weisskopf effect[7]) occurs because of a differential distribution of the nuclear magnetization in a finite volume for the two isotopes. Schwartz[8] has shown that an accurate calculation of these effects for gallium in the $4s^24p\,^2P_j$ term requires inclusion of the perturbation by the $4s4p5s$ configuration. In the present case the effect of the admixture of the $6s6p7s$ configuration into the nominal $6s^26p\,^2P_{\frac{3}{2}}$ level is even more striking. In fact, the anomaly in the $^2P_{\frac{3}{2}}$ level is almost entirely due to the admixed s-electron wave function since the electron density of a pure $^2P_{\frac{3}{2}}$ state is very nearly zero at the nucleus. The quantity b, proportional to the effective electron density at the nucleus and on which both the B-R and B-W contributions to the hfs anomaly depend linearly, may be written[8] in the form

$$b_j(\text{eff}) = (1-\beta_j)b_{pj} + \beta_j b_s,$$

where $\beta_{\frac{1}{2}} = (1-5\theta a_{\frac{3}{2}}/a_{\frac{1}{2}})/(1+5\theta)$ and $\beta_{\frac{3}{2}} = -(a_{\frac{1}{2}}/a_{\frac{3}{2}})\beta_{\frac{1}{2}}$ are the respective fractional s-admixtures to the ^2P_j levels. Taking into consideration shielding of the p-electron from the nucleus, Schwartz[9] has calculated for Tl that $b_s/b_{p\frac{1}{2}} = 3.39$ and that $5\theta = a_{\frac{1}{2}}/a_{\frac{3}{2}}$ (theoretical relativistic value for p-electrons only) $= 12.08$. Experimentally[1,4] $|a_{\frac{1}{2}}/a_{\frac{3}{2}}| = 80.5$, but it is here assumed that the upper hfs is normal and that the ratio is positive. Since $b_{p\frac{3}{2}} \approx 0$, one obtains

$$b_{\frac{1}{2}}(\text{eff}) = 1.155 b_{p\frac{1}{2}},$$
$$b_{\frac{3}{2}}(\text{eff}) = -17.74 b_{p\frac{1}{2}},$$

and

$$b_{\frac{3}{2}}/b_{\frac{1}{2}} = -15.36.$$

This is in excellent agreement with the experimental ratio[4]:

$$\frac{\Delta_{\frac{3}{2}}}{\Delta_{\frac{1}{2}}} = \frac{-0.001626 + 0.000002}{0.000105 \pm 0.0000015} = -15.49 \pm 0.26.$$

These results indicate that the assumption that $a_{\frac{3}{2}}$ is positive is probably correct, but a further experimental check on this point would be desirable.

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Spurious Solutions of a Bethe-Salpeter Equation

D. A. Geffen, *Oak Ridge National Laboratory, Oak Ridge, Tennessee*

AND

F. L. Scarf, *Laboratory for Insulation Research, Massachusetts Institute of Technology, Cambridge, Massachusetts*

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In a recent publication[1] the one-dimensional eigenvalue problem associated with Wick's Bethe-Salpeter equation[2] was investigated in the limit of zero binding energy. In this problem the coupling constant, λ, represents the eigenvalue and the total energy, η $(\eta = E/2M)$, is a parameter. It was shown that the eigenfunctions are those solutions of Heun's equation possessing certain regularity properties and frequently known as Heun's functions. In the limit of zero binding