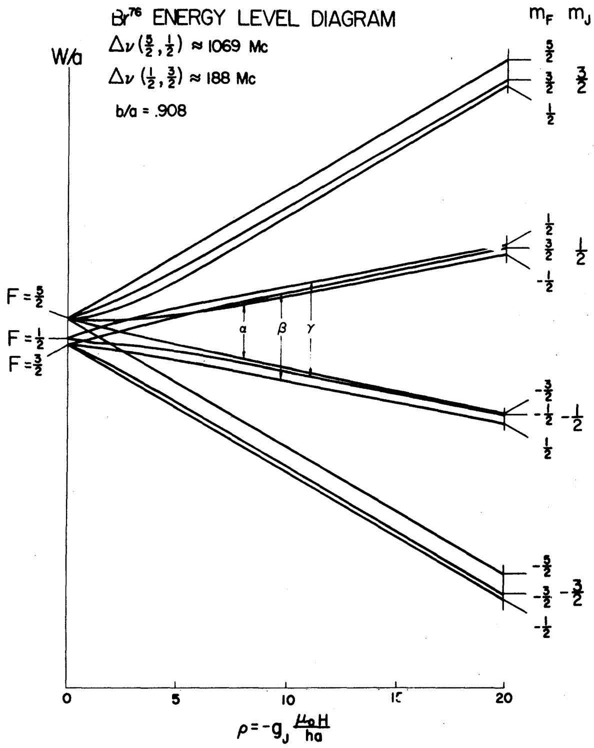

FIG. 2. Br^{76} energy-level diagram. This diagram was calculated with an IBM-650 computer, using a b/a value of 0.908. The hfs separations listed are approximate only.

quadrupole moment and magnetic dipole moment can be obtained simply from b and a by a method due originally to Casimir.[5,6] The results, which are uncorrected for any relativistic, electronic core perturbation, or configuration interaction effects, are

$$|\mu| = 0.55 \pm 0.02 \text{ nuclear magneton,}$$
$$|Q| = 0.27 \pm 0.01 \text{ barn.}$$

The sign of μ is not known, but μ and Q have opposite signs.

Work on Br^{76} is being continued in order to improve these results. A full account will be published later.

The authors wish to acknowledge the wholehearted cooperation of the Radiation Laboratory Chemistry Department and Health Chemistry Division during the course of this work.

† Work done under the auspices of the U. S. Atomic Energy Commission.

[1] Green, Garvin, and Lipworth, Bull. Am. Phys. Soc. Ser. II, 3, 318 (1958).

[2] J. R. Zacharias, Phys. Rev. 61, 270 (1942).

[3] Garvin, Green, and Lipworth, Phys. Rev. 111, 534 (1958).

[4] For a definition of the quadrupole operator Q_{op} see N. F. Ramsey, Molecular Beams (Clarendon Press, Oxford, 1950), Chap. III, p. 66, and Chap. IX, p. 272.

[5] H. B. G. Casimir, On the Interaction Between Atomic Nuclei and Electrons (Teylers Tweede Genootschap, Haarlem, 1936), pp. 57, 58.

[6] Davis, Feld, Zabel, and Zacharias, Phys. Rev. 76, 1076 (1949).

SPIN OF Fe^{57}

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The spin of the stable isotope Fe^{57} has been directly observed to be $\frac{1}{2}$ from the electron spin resonance spectrum of iron-doped silicon. Samples were prepared by alloying several milligrams of iron[1] enriched to contain 84.1% Fe^{57} onto silicon crystals 3 mm × 3 mm × 10 mm. The iron was diffused into the silicon bars by placing them in evacuated quartz tubes held at 1200°C for 24 hours. The samples were quenched by dropping the quartz tubes into water, were chemically etched, and were placed in the reflection cavity of a spectrometer operating at about 14 kMc/sec.

Figure 1 shows the dispersion derivative at approximately 10°K as displayed on the recorder of the spectrometer for the magnetic field in a (111) crystal direction. The central pattern (centered about $g = 2.0699$) is due to the 16% abun-

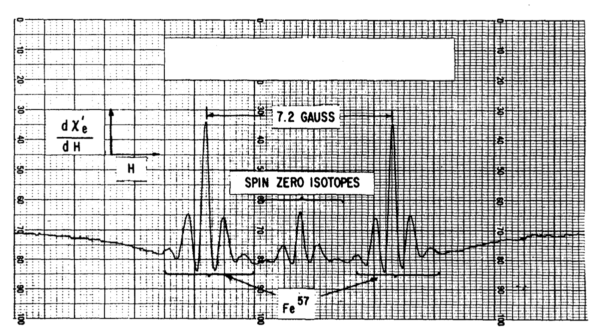

FIG. 1. The derivative of the dispersion at approximately 10°K in a silicon crystal doped with iron enriched to contain 84.1% Fe^{57}. The central pattern is due to the 16% abundant Fe isotopes of spin zero. The two outer patterns represent hyperfine interaction with Fe^{57}.

dant iron isotopes of spin zero. Only this pattern was observed in crystals containing iron of normal isotope abundance. The other two patterns, which are split by 7.2 gauss, are attributed to the Fe^{57} sites. The observation of two sets of lines confirms a spin of $\frac{1}{2}$ for this isotope. The hyperfine interaction constant for this spectrum is 7.0×10^{-4} cm^{-1}.

The value of $\frac{1}{2}$ for the spin of Fe^{57} is in agreement with analysis made by Garif'ianov et al.[2] of their spin resonance data on Fe dissolved in borax. They were unable to resolve the hyperfine structure, but did observe a broadening of their resonance line when they used Fe enriched in Fe^{57}.

The spin of Fe^{57} has also been determined to be $\frac{1}{2}$ by Trumpy[3] who measured the circular polarization of the gamma radiation which followed polarized neutron capture by Fe^{56}. As Trumpy points out, the value $\frac{1}{2}$ contradicts simple shell theory, which predicts a $p_{3/2}$ state for Fe^{57}.

This and other spectra observed in iron-doped silicon are under further study. It may prove possible to estimate the magnetic moment of Fe^{57} by using electron-nuclear double resonance.[4]

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[1]The iron enriched in Fe^{57} was obtained from the Isotope Sales Department, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

[2]Garif'ianov, Zaripov, and Kozyrev, Doklady Akad. Nauk S. S. S. R. 113, 1243 (1957) [translation: Soviet Phys. Doklady 2, 195 (1957)].

[3]G. Trumpy, Nuclear Phys. 2, 664 (1957).

[4]G. Feher, Phys. Rev. 103, 834 (1956).

SPIN AND MAGNETIC DIPOLE MOMENT OF 2.6-hr Mn^{56}†

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Recent studies[1] of the beta- and gamma-ray spectra are providing new insight into the decay systematics of 2.6-hr Mn^{56}. Because of this current interest we feel it advisable to report progress to date on our atomic beam magnetic resonance measurements[2] of the nuclear spin of this isotope.

Many resonances have been observed at various magnetic fields with a corresponding frequency range of 1-276 Mc/sec. At some of these fields all three observable resonances were measured.

All of this data is consistent and can only be reconciled with a nuclear spin $I = 3\hbar$, and a nuclear magnetic dipole moment $|\mu|$=3.53±0.01 nm.

We are still attempting to determine the sign of the magnetic dipole moment. More details of the measurements will be published when this work is complete.

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†Work performed under the auspices of the U. S. Atomic Energy Commission.

[1]C. Sharp Cook, Nuclear Phys. 7, 480, (1958); Ralph E. Segel (private communication).

[2]Preliminary work reported: W. J. Childs and L. S. Goodman, Bull. Am. Phys. Soc. Ser. II, 3, 21 (1958).

STRUCTURE OF MESONS*

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The near equality between the β-decay and μ-decay vector-coupling constants may be explained by assuming the π meson to act as a β-decay source of appropriate strength.[1] This property of the π meson would be automatically insured if it were a composite system[2] composed exclusively of baryons and antibaryons appropriately coupled. An absence of virtual mesons may be achieved by using for the binding agent a direct four-Fermi interaction. This type of interaction is indicated by several other considerations as well. First, it avoids the introduction of an additional meson to bind the original one. Second, it makes the strong interaction similar in form to the weak interaction, which recent arguments indicate is not mediated by mesons.[3]

A model of the π and K mesons based upon a direct point interaction has been examined in the approximation in which radiative corrections are neglected. These corrections are eliminated by modifying the Hamiltonian. The modified problem is then solved exactly. A momentum cutoff is required but this parameter and the coupling constant are determined by the experimental values of the meson mass and the meson-baryon coupling constant.

The interaction Hamiltonian is assumed to have the form

$$H_{\mathrm{int}} = \sum_{i,j,k} g(\overline{N}_i\, i\gamma_5\, \tau_k N_i)(\overline{M}_j\, i\gamma_5\, \tau_k M_j), \quad (1)$$