greater than 1 Mev, then only one parameter remains in the solutions. This parameter is $\langle|k(r)|\rangle/C$, where $k(r)$ is the radial function that determines the effective coupling and C is the surface deformation parameter.[5] The value of this parameter, determined from Eq. (1) and used in Eq. (2), is 0.21 ± 0.04 (R_0 is set equal to $1.41A^{\frac{1}{3}}\times10^{-13}$ cm).

Thus, in O^{17} the straightforward application of the weak-coupling collective model[5] gives consistent results.

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[1] J. Thirion and V. L. Telegdi, Phys. Rev. **92**, 1253 (1953).
[2] A. Bohr and B. R. Mottelson, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. **27**, No. 16 (1953); J. P. Elliott and B. H. Flowers, Proc. Roy. Soc. (London) **A229**, 526 (1955); F. C. Barker, Phil. Mag. **1**, 329 (1956); see also B. J. Raz, thesis, University of Rochester, 1955 (unpublished).
[3] Geschwind, Gunther-Mohr, and Silvey, Phys. Rev. **85**, 474 (1952).
[4] M. J. Stevenson, Bull. Am. Phys. Soc. Ser. II, **2**, 31 (1957); and private communication; M. J. Stevenson and C. H. Townes, Phys. Rev. **107**, 635 (1957).
[5] See Bohr and Mottelson, reference 2.

Magnetic Moment of Ne^{21}†

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NEON-21 is the lightest stable isotope whose magnetic moment has not yet been measured. Furthermore, this isotope is of considerable interest since it is one of the few isotopes whose spin is not correctly predicted by the extreme single-particle model of the nucleus. The nucleons outside of closed shells presumably consist of two $d_{\frac{5}{2}}$ protons and three $d_{\frac{5}{2}}$ neutrons, but the spin of Ne^{21} has been shown[1,2] to be $\frac{3}{2}$ instead of the $\frac{5}{2}$ which would result from the extreme single-particle model. Various conflicting theories[3–11] have developed as to the structure of Ne^{21} and the closely related Na^{23}.

The ratio of g-values of Ne^{21} and deuterium has been measured in a molecular-beam magnetic resonance apparatus[12] employing the separated oscillatory field method.[13] The result of several determinations without shielding corrections is:

$$g(Ne^{21})/g(D_2)=-0.514274\pm0.000004.$$

A thin-walled strainless steel trap inserted in the neck of a liquid helium Dewar was used to clean up the recirculating gas.

The sign of the moment was determined to be negative from the interference pattern obtained between one region of horizontally oscillating rf field and another region of vertically oscillating rf field. The previously measured[1] spin of $\frac{3}{2}$ is consistent with various deflection and optimum oscillatory field measurements in the present experiment. Further details of the measurements will be included in a later paper. Both the sign and the spin agree with the previous results[1,2] of Koch and Rasmussen[2] and Hubbs and Grosof.[1]

These data result in the following value, including shielding corrections,[13] for the magnetic moment of Ne^{21}:

$$\mu(Ne^{21})=-0.661758\pm0.000005 \text{ nuclear magneton.}$$

This result is in excellent agreement with the calculation of Umezawa[3] but in disagreement with the value quoted by Mayer and Jensen.[6]

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[1] T. C. Hubbs and G. M. Grosof, Phys. Rev. **106**, 715 (1956).
[2] J. Koch and E. Rasmussen, Phys. Rev. **76**, 1417 (1949).
[3] M. Umezawa, Progr. Theoret. Phys. Japan **8**, 509 (1952).
[4] A. L. Schawlow and C. H. Townes, Phys. Rev. **82**, 268 (1951).
[5] A. Bohr and B. Mottleson, Kgl. Danske Videnskab. Selskab, Mat.-fys. Medd. **27**, No. 16 (1953).
[6] M. G. Mayer and J. H. D. Jensen, *Elementary Theory of Nuclear Shell Structure* (John Wiley and Sons, Inc., New York, 1955).
[7] B. H. Flowers, Phil. Mag. **43**, 1330 (1952).
[8] I. A. Vaisman, J. Exptl. Theoret. Phys. (U.S.S.R.) **26**, 754 (1954).
[9] J. Filiminov, J. Exptl. Theoret. Phys. (U.S.S.R.) **28**, 753 (1954).
[10] P. L. Sagalyn, Phys. Rev. **94**, 885 (1954).
[11] S. Sengupta, Phys. Rev. **96**, 235 (1954).
[12] Quinn, Baker, LaTourrette, and Ramsey (to be published).
[13] N. F. Ramsey, *Molecular Beams* (Clarendon Press, Oxford, 1956).

β-γ Circular Polarization Correlation in a *J-J* Transition*

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THE study of β-γ circular polarization correlation in β transitions without spin change provides valuable information about β-decay coupling constants.[1,2] In particular, the experimental result will depend on the presence or absence of S,T and V,A interference terms.[2] Recent experiments on aligned Co^{58} nuclei seemed to indicate the absence of such interference terms.[3–5] In order to study this problem with a different experimental approach and using a different β emitter, we have measured Sc^{46} by the method described in reference 1.

Sc^{46} samples obtained from the Oak Ridge National Laboratories were used to prepare sources of about 50 microcuries strength. The activity was deposited on 0.8-mg/cm² Mylar foils. The pulse height discriminators were adjusted to accept the electron spectrum above 170 kev and the γ spectrum above 260 kev. Single counts and coincidence counts were recorded for 20-minute periods with alternating directions of the magnetic field in the analyzer. Averages were taken over runs of about 10 hours. The results of about 20 runs are statistically consistent. The relative difference in coincidence counting rates for opposite magnetic field directions is found to be $(0.73\pm0.09)\%$. The efficiency of our analyzer given in reference 1 has recently been checked over a wide energy region using bremsstrahlung of P^{32} electrons. If the polarization of these electrons is v/c, as indicated by other experiments,[6] the calculated efficiencies are correct within about 5%. The observed coincidence difference corresponds to a value of $+0.33\pm0.04$ for the asymmetry parameter A defined in reference 1.

The Sc^{46} decay scheme is accepted as being $4^+(\beta^-)4^+(\gamma)2^+(\gamma)0^+$ on the basis of precise γ-γ[7] and β-γ[8] angular correlation measurements and ft values.[7,9] The parameter A can then only have values between 0 and 0.08, if there is no interference term as in the case of a pure V,T and a pure S,A interaction. This cannot be reconciled with our large experimental value. Specifically,[2] our experiment shows that

$$\left|\frac{\mathrm{Re}(C_SC_T'^*+C_S'C_T^*-C_VC_A'^*-C_V'C_A^*)}{|C_T|^2+|C_T'|^2+|C_A|^2+|C_A'|^2} +\frac{\alpha Z}{p}\frac{\mathrm{Im}(C_SC_A'^*+C_S'C_A^*-C_VC_T'^*-C_V'C_T^*)}{|C_T|^2+|C_T'|^2+|C_A|^2+|C_A'|^2}\right|>0.5,$$

$$\alpha Z/p\simeq 0.14.$$

The present result therefore indicates that the β interaction contains at least a combination of S and T, or of V and A interactions.

The present experiment together with the longitudinal electron polarization measurement on this isotope by Frauenfelder *et al.*[10] can be explained by the two-component neutrino theory, assuming a mixture of T with comparable amounts of S and V interaction, or by assuming that in Fermi interactions $C'\approx 0$.[2]

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[1] F. Boehm and A. H. Wapstra, Phys. Rev. **106**, 1364 (1957).
[2] Alder, Stech, and Winther, Phys. Rev. **107**, 728 (1957) report, University of Illinois (unpublished).
[3] Ambler, Hayward, Hoppes, Hudson, and Wu, Phys. Rev. **106**, 1361 (1957).
[4] Postma, Huiskamp, Miedema, Steenland, Tolhoek, and Gorter, Physica **13**, 259 (1957).
[5] D. F. Griffing and J. C. Wheatly, Phys. Rev. **104**, 389 (1956).
[6] H. Frauenfelder *et al.* (private communication); H. de Waard *et al.* (private communication).
[7] Nuclear Level Schemes and Nuclear Data Cards, National Research Council, Washington, D. C.
[8] T. B. Novey (private communication).
[9] It may be added that a spin 5 for the Sc^{46} ground state would give a negative value of A,[2,10] as in the case of Co^{60}.[1]
[10] Frauenfelder, Bobone, von Goeler, Levine, Lewis, Peacock, Rossi, and DePasquali, Phys. Rev. **107**, 910 (1957).

Parity in Nuclear Reactions*

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THE failure of parity conservation recently observed in β decay has raised the question of how accurately parity is conserved in nuclear reactions. A quite sensitive test is to be found in certain (p,α) reactions which are rigorously forbidden by angular momentum and parity conservation. The particular case that has been studied is the 340-kev resonance of $F^{19}(p,\alpha)O^{16}$ which proceeds through a $J=1$, even parity state[1] of Ne^{20}. Normally the state decays by the α_1 group to the 6.14-Mev level of O^{16}, but a parity "impurity" in the wave functions of either the Ne^{20} excited state or O^{16} or He^4 ground states would allow a resonant α_0 group to the ground state of O^{16}. This group would appear in the cross-section curve as a resonance superimposed on the nonresonant yield[2,3] from broad states of Ne^{20}. In principle the resonant cross section can have a term proportional to the amplitude of the wave function impurity, due to interference between resonant and nonresonant processes. However, this term is zero if the spin of the proton or F^{19} nucleus is not aligned parallel to the proton momentum. The leading term is then proportional to the square of the impurity amplitude and can be written as $\sigma_{\alpha 0}=(\Gamma_{\alpha 0}/\Gamma_{\alpha 1})\sigma_{\alpha 1}$, where $\sigma_{\alpha 0}$ and $\sigma_{\alpha 1}$ are resonant cross sections for the (p,α_0) and (p,α_1) reactions, and $\Gamma_{\alpha 0}$ and $\Gamma_{\alpha 1}$ are the partial widths for α_0 and α_1 decay of the compound state of Ne^{20}. Both resonant reactions are isotropic as the state of Ne^{20} is formed by s-wave protons.

Measurements have been made of the yield of $F^{19}(p,\alpha_0)O^{16}$ in the region of the 340-kev resonance, using AlF_3 targets of thickness comparable with the resonance width of 3 kev. Counts were taken at both 0° and 90° with a CsI scintillation counter subtending a solid angle of 0.1 of a sphere. Scattered protons and short range α particles were excluded by absorbing foils.

Figure 1 shows a typical yield curve of $F^{19}(p,\alpha_0)O^{16}$, corrected for s-wave barrier penetrability, together with the yield of γ radiation from $F^{19}(p,\alpha_1\gamma)O^{16}$. This curve indicates an upper limit of 2% for a $F^{19}(p,\alpha_0)O^{16}$ resonance relative to the nonresonant yield. A slightly better limit was obtained by a series of counts at the $(p,\alpha_1\gamma)$ resonance energy and 6 kev above and below. The mean of the counts either side of the resonance agreed within the statistical error of 1% with the counts taken at the resonant energy. After correcting for target