greater than 1 Mev, then only one parameter remains in the solutions. This parameter is \(|k(r)|^2/C\), where \(k(r)\) is the radial function that determines the effective coupling and \(C\) is the surface deformation parameter. The value of this parameter, determined from Eq. (1) and used in Eq. (2), is \(0.21 \pm 0.04\) (\(R_6\) is set equal to \(1.44 \times 10^{-18} \text{ cm}\)).

Thus, in \(O\) the straightforward application of the weak-coupling collective model gives consistent results.

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

5 See Bohr and Mottelson, reference 2.

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**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 \(d_1\) protons and three \(d_1\) neutrons, but the spin of Ne\(^{21}\) has been shown to be \(\frac{3}{2}\) instead of the \(\frac{5}{2}\) which would result from the extreme single-particle model. Various conflicting theories\(^{2-11}\) 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.\(^{12}\) The result of several determinations without shielding corrections is:

\[ g(\text{Ne}^{21})/g(\text{D}_2) = -0.514274 \pm 0.000004. \]

A thin-walled stainless 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 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 Grosol.\(^{2}\)

These data result in the following value, including shielding corrections,\(^{13}\) for the magnetic moment of Ne\(^{21}\):\(^{14}\)

\[ \mu(\text{Ne}^{21}) = -0.661758 \pm 0.000005 \text{ nuclear magneton}. \]

This result is in excellent agreement with the calculation of Umezawa\(^{3}\) but in disagreement with the value quoted by Mayer and Jensen.\(^{4}\)

We wish to thank Professor K. Clusius for supplying the generous sample of neon enriched to 20.5% in Ne\(^{21}\) which was used in this experiment. We also wish to thank Mr. F. W. Terman for suggesting the experiment.

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**\(\beta-\gamma\) Circular Polarization Correlation in a J-J Transition**

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**THE study of \(\beta-\gamma\) circular polarization correlation in \(\beta\) transitions without spin change provides valuable information about \(\beta\)-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.\(^{3,4}\) Recent experiments on aligned Co\(^{58}\) nuclei seemed to indicate the absence of such interference terms.\(^{5-7}\) In order to study this problem with a different experimental approach and using a different \(\beta\) emitter, we have measured Sc\(^{48}\) by the method described in reference 1.

Sc\(^{48}\) 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/cm\(^2\) Mylar foils. The pulse height discriminators were adjusted to accept the electron spectrum above 170 kev and the \(\gamma\) 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 $(0.73 \pm 0.09)\%$. The efficiency of our analyzer given in reference 1 has recently been checked over a wide energy region using bremsstrahlung of $P^2$ electrons. If the polarization of these electrons is $\psi / c$, as indicated by other experiments, the calculated efficiencies are correct within about $5\%$. The observed coincidence difference corresponds to a value of $+0.33 \pm 0.04$ 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 $\gamma$-$\gamma^2$ and $\beta$-$\gamma^2$ angular correlation measurements and $f_t$ values. 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, our experiment shows that

$$\text{Re}(C_S C_T^* + C_S C_T^* - C_V C_T^* - C_V C_T^*) \quad \frac{|C_T|^2 + |C_T'|^2 + |C_A|^2 + |C_A'|^2}{|C_T|^2 + |C_T'|^2 + |C_A|^2 + |C_A'|^2}$$

$$+ \frac{\alpha Z \text{Im}(C_S C_T^* + C_S C_T^* - C_V C_T^* - C_V C_T^*)}{\beta |C_T|^2 + |C_T'|^2 + |C_A|^2 + |C_A'|^2} > 0.5,$$

$$\alpha Z / \beta \approx 0.14.$$

The present result therefore indicates that the $\beta$ 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. 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 $C' \approx 0$.

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†On leave of absence from the Institute for Nuclear Research, Amsterdam, and the Technical University, Delft.
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 $A$, as in the case of $Co^{60}$.

**Parity in Nuclear Reactions**

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The failure of parity conservation recently observed in $\beta$ decay has raised the question of how accurately parity is conserved in nuclear reactions. A quite sensitive test is to be found in certain $(p,\alpha)$ 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 of $Ne^{20}$. Normally the state decays by the $\alpha_1$ 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 $\alpha_0$ 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 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 $(p,\alpha_0)$ and $(p,\alpha_1)$ reactions, and $\Gamma_{\alpha_0}$ and $\Gamma_{\alpha_1}$ are the partial widths for $\alpha_0$ and $\alpha_1$ 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 $F^{19}(p,\alpha)O^{16}$ in the region of the 340-kev resonance, using $\alpha F_3$ targets of thickness comparable with the resonance width of 3 kev. Counts were taken at both $0^\circ$ and $90^\circ$ with a CsI scintillation counter subtending a solid angle of 0.1 of a sphere. Scattered protons and short range $\alpha$ particles were excluded by absorbing foils.

Figure 1 shows a typical yield curve of $F^{19}(p,\alpha)O^{16}$, corrected for $s$-wave barrier penetrability, together with the yield of $\gamma$ radiation from $F^{19}(p,\alpha_1\gamma)O^{16}$. This curve indicates an upper limit of 2% for a $F^{19}(p,\alpha_0\alpha_1\gamma)O^{16}$ 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