At first sight, one can explain the results for Sc^{46} and Au^{198} rather easily by dropping assumption (b) and postulating that Fermi transitions occur through the vector interaction. This assignment is in agreement with the recent A^{35} recoil experiment by Herrmannsfeldt, Maxson, Stähelin, and Allen,[12] but in sharp contradiction with the recoil data on Ne^{19} and the beta—circularly polarized gamma correlation results of Boehm and Wapstra.[13] At present there is no reason to declare either of the two contradicting sets of experiments wrong. However, in order to explain all the data one is then forced to abandon more than just assumption (b).

We thank T. D. Lee and C. N. Yang for suggesting the investigation of Fermi transitions. J. Weneser, K. Alder, B. Stech, and A. Winther have helped us in our attempt to understand the problems involved in the interpretation of the results.

† Assisted by the joint program of the Office of Naval Research and the U. S. Atomic Energy Commission.
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Parity and Electron Polarization: $0 \rightarrow 0$ Transition in Ga^{66}†

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A SURVEY of recent parity experiments in beta decay reveals the following situation. All results for pure *Gamow-Teller* transitions can be adequately described by the two-component theory, the polarization being given by $P=\pm(v/c)$, where the positive sign applies to positrons, and the negative to electrons. However, transitions in which both *Gamow-Teller and Fermi* matrix elements compete (e.g., Sc^{46}, Co^{58}, Au^{198}) show a different behavior,[1–3] and it seems not possible to explain all experimental results within the framework of the two-component theory. A major contradiction exists between the experiments on beta-gamma correlation[2] and on electron polarization.[3] The former demand large constructive interference terms, the latter show a considerably reduced polarization. Alder, Stech, and Winther have analyzed the problem and have pointed out that a possible way to explain the data consists in assuming that parity *is* conserved in pure Fermi transitions.[4]

The suggestion of Alder, Stech, and Winther can be tested by measuring the electron polarization in a pure Fermi transition. Such transitions are rare and nearly all have inconveniently short half-lives. Recently, however, evidence for a suitable 0^+-0^+ transition has been put forward, when it was shown that the magnetic moment of the odd-odd nuclide Ga^{66} is smaller than 10^{-3} nuclear magneton.[5] A 0^- ground state in Ga^{66} is implausible, since no positron transition to the first excited state in Zn^{66} occurs, and since the shell model renders a negative-parity state unlikely. The 4.15-Mev positron branch from Ga^{66} to the ground state of Zn^{66}, hence, is very likely a pure Fermi transition. Since Ga^{66} can be readily prepared and has a half-life of 9.4 hours, we chose it to investigate the polarization resulting from the Fermi interaction.

Table I. Polarization of the positrons from the 4.15-Mev ground-state transition Ga^{66}–Zn^{66}. The errors given in the table are statistical. The polarization P was determined from δ by using the results of Bincer.[a]

	Positron energy E_0 in Mev	v/c	δ	Polarization P
Source 1	>1	>0.94	$+0.037\pm0.037$	
Source 2	>1.25	>0.96	-0.004 ± 0.020	
Average		0.98	$+0.005\pm0.017$	$+0.09\pm0.31$

[a] A. M. Bincer, Phys. Rev. (to be published).

Ga^{66} was prepared by irradiation of copper with alpha particles, the gallium was then separated by ether extraction, and deposited on an aluminum foil (1.8 mg/cm^2). The longitudinal polarization of the positrons was measured by using Møller (or Bhabha) scattering.[6] The energy discrimination in the beta counters was chosen so that only the polarization of positrons with initial energies >1 Mev was determined. From the total coincidences we subtracted the contributions due to beta-gamma and gamma-gamma events (about 30%) in order to find the "Møller coincidences." Spurious effects, such as those due to pair production by high-energy gamma rays, were estimated to be very small, and were therefore neglected. The results are shown in Table I.

The results in Table I make it very probable that the 4.15-Mev positrons from Ga^{66} are not polarized. This seems to bear out the conjecture of Alder, Stech, and Winther that Fermi transitions conserve parity. It seems, however, very desirable that experiments with different methods be performed to substantiate this conclusion.

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μ-Meson Polarization in a Strong Magnetic Field*

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THE muon polarization arising in the $\pi^+-\mu^+$ decay is partially destroyed in emulsion by the presence of local magnetic fields. The application of a strong external field, however, decouples the muon from the local atomic fields, and the measured asymmetry coefficient of the μ^+-e^+ decay tends to approach that of the free muon.

In the magnetic field, the spin components parallel and antiparallel to the field have relative populations that depend on the angle of the polarization vector with respect to the field direction. If the muon is completely polarized in its direction of motion, we can calculate the polarization with respect to the field direction as a function of the angle between the initial direction of the muon track and the field vector.

Let a μ meson be emitted from a π meson at rest at an angle α to the direction of the magnetic field. Using the rotation transformation of a spinor, we find that the probability that the electron into which the μ meson decays will be emitted in the angular interval $d(\cos\phi)$ is

$$\tfrac{1}{2}d(\cos\phi)[1+a\cos\alpha\cos\phi]. \quad (1)$$

Here ϕ is measured with respect to the field direction and a is the "asymmetry coefficient"; it is assumed that the probability of emission of an electron in an angular interval θ to $\theta+d\theta$ with respect to the direction of complete polarization has the form

$$\tfrac{1}{2}(1+a\cos\theta)\sin\theta d\theta.$$

We have made an experimental study of the angular distribution predicted by Eq. (1). The measurements were carried out in 600-μ Ilford G5 emulsion pellicles that had been exposed to π^+ mesons in a field of 14 250 gauss. The muon and electron directions were measured relative to the field direction for about 3500 $\pi-\mu-e$ events associated with the stopping of π mesons in the emulsion. In less than 5% of the cases the electron track could not be found; the bias introduced was small, as we demonstrated by examining the angular distribution of the group of electron tracks found in a second intensive study of the events in which no electron was found initially. For comparison with Eq. (1), $|\cos\alpha|$ has been broken down into three intervals, and $\cos\phi$ (taken positive when it has the same sense as $\cos\alpha$) also in three intervals. The mean values, $\langle|\cos\alpha|\rangle$ and $\langle\cos\phi\rangle$, in these intervals have been calculated from the measured events. The probability distribution of Eq. (1) when plotted against $\cos\phi$ is a straight line. The slope, a', of the line determined by the events in a given interval of $|\cos\alpha|$ is an estimate of $a\langle|\cos\alpha|\rangle$. In Fig. 1, we show our results graphically for $\langle|\cos\alpha|\rangle=0.86$, while in Fig. 2 we show the measurements of a' plotted against $\langle|\cos\alpha|\rangle$. The data have been used to evaluate the quantity a, and we obtain

$$a=-0.23\pm0.05.$$

In addition to measuring the asymmetry, the experimental results confirm the linearity of Eq. (1), both in $\cos\alpha$ and in $\cos\phi$, thus providing additional evidence that the muon behavior is described by a single spinor.

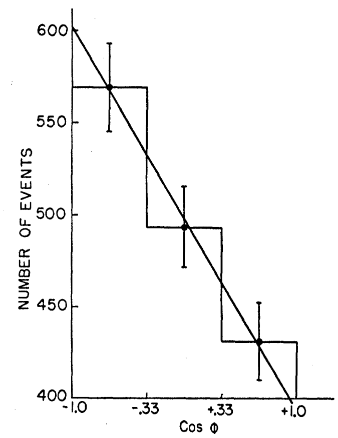

FIG. 1. The number of decay electrons observed as a function of $\cos\phi$ for $\langle|\cos\alpha|\rangle=0.86$. Standard deviations are indicated. The slope a' of the least-squares straight line determined by the points is -0.21 ± 0.05.

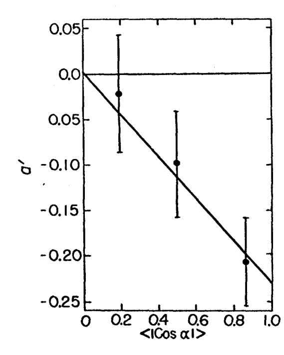

FIG. 2. The measured value of a' plotted *versus* $\langle|\cos\alpha|\rangle$ for three intervals of $|\cos\alpha|$.