as expected. The overwhelming success of the "strangeness" selection rule merely points out the existence of a nonspatiotemporal symmetry in nature (which is preserved as long as the C, P, and T invariances separately hold) but by itself neither implies nor justifies the connection between such a symmetry and the rotational symmetry in isotopic-spin space.

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[1] The result of a "world average" prepared at the University of Chicago under V. L. Telegdi gives binding energies of 1.4–1.7 Mev for both ${}_{\Lambda}H^4$ and ${}_{\Lambda}He^4$.

[2] Brown, Glaser, Meyer, Perl, Vander Velde, and Cronin, preceding letter [Phys. Rev. **107**, 906 (1957)].

[3] Fowler, Shutt, Thorndike, and Whittemore, Phys. Rev. **98**, 121 (1955). Budde, Chretien, Leitner, Samios, Schwartz, and Steinberger, Phys. Rev. **103**, 1827 (1956). Summary report by D. A. Glaser based on the works of the Columbia, Brookhaven, Bologna, Pisa, and Michigan groups, *Proceedings of the Seventh Annual Rochester Conference* (to be published).

[4] See, for instance, H. A. Bethe and F. de Hoffmann, *Mesons and Fields* (Row, Peterson and Company, White Plains, 1955), Vol. 2 (Mesons), p. 62.

[5] It is easy to verify that the inequality (5) must hold even if the production matrix is spin-dependent.

[6] This kind of angular distribution is precisely the prediction of the "predissociation" model [D. C. Peaslee, Phys. Rev. **105**, 1034 (1957)]. Field-theoretically this can be accomplished by assuming the predominance of a process involving a direct interaction between the K particle and the pion [S. Barshay, Phys. Rev. **104**, 858 (1956); J. J. Sakurai, Nuovo cimento **5**, 1340 (1957)]. Apart from the failure to explain the Σ^+K^+ production, such a model cannot be taken seriously if strange particles do not exist in parity doublets.

[7] T. D. Lee, Phys. Rev. **99**, 337 (1955).

[8] See Cool, Piccioni, and Clark, Phys. Rev. **103**, 1082 (1956) for the comparison of $\sigma(\pi^+p)$ with $\sigma(\pi^-d)-\sigma(\pi^-p)+4$ mb. For $\pi-$He experiments see J. J. Sakurai, Phys. Rev. (to be published). We have heard from Professor Glaser that a test for charge symmetry in $\pi-$C interactions is now being carried out.

[9] The mass differences among various members of a given charge multiplet may not be purely electromagnetic in origin if isotopic spin is not conserved in strong interactions.

Parity and Electron Polarization: Au^{198}†

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Soon after the experimental verification of parity nonconservation, it became evident that beta decay had to be reinvestigated.[1] Prior to that time, it was generally assumed that the scalar (S) and tensor (T) interactions were dominant and that the coupling constant for vector (V) and axial vector (A) interactions were small or zero.[2] However, Wu, Lee, and Yang pointed out that the results on Co^{58} led to contradictions if one assumed simultaneously (a) validity of the two-component theory, (b) S and T dominant, and (c) invariance under time reversal.[1,3] The evidence from Co^{58} is not sufficient to decide which of these assumptions are incorrect.

Table I. Longitudinal polarization of the electrons from Au^{198}. The beta transition in Au^{198} is first forbidden, $2^-\rightarrow2^+$, and possesses a maximum energy of 0.96 Mev.

Method	Electron energy in Mev	v/c	Polarization
Mott	0.10	0.55	-0.05 ± 0.06
Mott	0.12	0.6	-0.06 ± 0.05
Møller	>0.3	>0.78	$+0.05\pm0.12$
Møller	0.3–0.8	0.78–0.92	$+0.02\pm0.23$

In order to learn more about beta decay, we decided to investigate the longitudinal electron polarization in decays where both Fermi and Gamow-Teller matrix elements are present. The two-component theory predicts a polarization $-(v/c)$ for S, T, and P, and a polarization $+(v/c)$ for V and A.[4,5] For positrons, the signs are interchanged. Electrons in pure Gamow-Teller transitions indeed show a polarization $-(v/c)$,[6–10] as expected from the assumptions (a) to (c) above. Electron decays with pure Fermi transitions are not easily available and we therefore chose mixed transitions, $\text{Sc}^{46}(4^+\rightarrow4^+)$, and $\text{Au}^{198}(2^-\rightarrow2^+)$. The decay energy of Au^{198}, $E_{\max}=0.96$ Mev, is large enough so that one can use both Mott scattering[6] and Møller scattering[10] to determine the polarization. Sc^{46}, with $E_{\max}=0.36$ Mev, can at present only be investigated by the first method and the results are therefore less reliable.

Before presenting the data, we briefly discuss one difficulty encountered when using Mott scattering. Since we reported the first results,[6] we have investigated this method in more detail, using scintillation counters. We have found that the thickness and the position of the scattering foil are extremely important. In particular, the measured left-right ratio depends rather strongly on the angle between the direction of the incoming beam and the analyzer foil. This dependence is most pronounced with the aluminum foil (1 mg/cm^2) which was used as reference scatterer, and is probably connected with energy loss and plural scattering in the relatively thick foil. Thinner aluminum foils do not scatter enough, and we have therefore replaced the aluminum by silver (0.2 mg/cm^2). The polarization can now be calculated by using the theoretical values for Mott scattering in gold and silver.[11] Even with this precaution, the results are less reliable than the ones obtained by using Møller scattering, and more work is required to transform this method into an accurate tool.

Both nuclides, Au^{198} and Sc^{46}, show a polarization which is, in absolute value, considerably below (v/c). Sc^{46}, we find, for $(v/c)=0.6$, a polarization of -0.34 ± 0.10. The results for Au^{198} are given in Table I.

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.

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† 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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