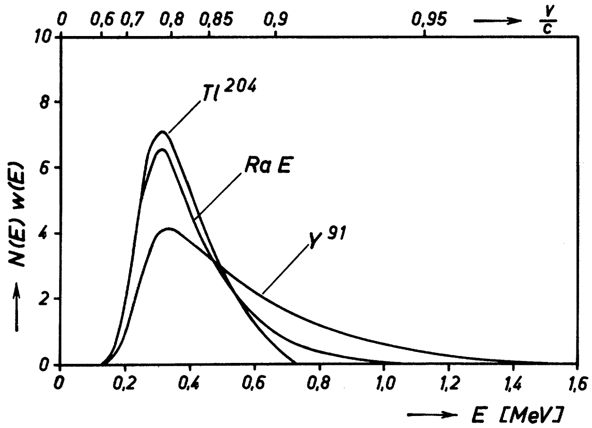

FIG. 1. The electron distributions $N(E)w(E)$ are plotted in arbitrary units. $N(E)$ is the β spectrum, $w(E)$ the total efficiency of the apparatus for electrons of energy E. $w(E)$ has been calculated approximately.[4]

tion defined in Eq. (1) for RaE,[6]

$$\left\langle -\left(\frac{P}{v/c}\right)_{\text{RaE}}\right\rangle_{\text{Av}} = 0.83 \pm 0.02.$$

RaE is the first example of a β emitter which has an electron polarization clearly deviating from $P = -v/c$. Curtis and Lewis[7] have calculated formulas for the polarization and the spectrum shape factor of RaE using STP coupling. For VA coupling[8] the formulas are easily obtained by changing the nuclear matrix elements and coupling constants and reversing the sign of the neutrino momentum,[5] if the two-component theory of the neutrino is valid. The β decay of RaE is governed by three nuclear matrix elements, $\int \vec{\sigma}\times\vec{r}$, $\int \vec{r}$, $\int \vec{\alpha}$. It is convenient to introduce two real[9,10] parameters ξ_1 and η_1 by the relations

$$\xi_1 C_A \int \vec{\sigma}\times\vec{r} = iC_V \int \vec{r},$$

$$\eta_1 C_A \int \vec{\sigma}\times\vec{r} = \left(\frac{\alpha Z}{2\rho}\right)^{-1} C_V \int \vec{\alpha}, \qquad (2)$$

since both the spectrum shape and the polarization are dependent on these two parameters only (the unexplained symbols are defined by Konopinski[11]). For a quantitative discussion of the polarization measurement one has to determine ξ_1 and η_1 by fitting the experimental (2) spectrum shape factor to the theoretical one and to calculate the polarization using these values. To get a rough idea we can use the approximation $\alpha Z \ll 1$, $p\rho \ll 1$, which really is not well satisfied by RaE. Then the polarization can be written conveniently as

$$P = -\frac{v}{c}\,\frac{X(W,\xi_1,\eta_1) - Y(W,\xi_1,\eta_1)}{X(W,\xi_1,\eta_1) - (\frac{v}{c})^2\, Y(W,\xi_1,\eta_1)}. \qquad (3)$$

(W is the electron energy, the functions X and Y can be obtained with the help of reference 7.) It can be seen that a deviation of $-P/(v/c)$ from 1 must occur for $v/c \neq 1$.

A more detailed description of this experiment can be found in reference 5.

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DETERMINATION OF THE PARITIES OF STRANGE PARTICLES FROM DISPERSION RELATIONS*

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Several authors[1-3] have recently suggested that the parities of the K-Λ and K-Σ systems relative to the nucleon might be determined from the forward angle dispersion relations applied to the scattering of K^+ and K^- mesons by nucleons. The dispersion relations together with detailed measurements on the pion-nucleon system have provided an important test of the principle of microscopic causality in field theory. As applied to the K meson-nucleon system the relations will not, as yet, provide a theory capable of much predictive power as to the dynamics, but if we can use experimental results together with them to determine the relative parities of the strange particles an important step will have been taken toward the construction of a possible dynamical theory.

Igi[4] has recently analyzed the present data on K meson-nucleon interactions on the basis of the following dispersion relation[5, 6]:

$$2F=(\omega/K^2)\,\{D_+(\omega)-\tfrac{1}{2}(1+\omega/m_K)D_+(m_K)-\tfrac{1}{2}(1-\omega/m_K)D_-(m_K)\}$$
$$-\frac{\omega}{4\pi^2}\int_{m_K}^{\infty}\frac{d\omega'}{K'}\left\{\frac{\sigma_+(\omega')}{\omega'-\omega}+\frac{\sigma_-(\omega)}{\omega'+\omega}\right\}-\frac{\omega}{\pi}\int_{\omega_0}^{m_K}d\omega'\frac{A_-(\omega')}{K'^2(\omega'+\omega)}\,.$$

Here the $D_\pm$ are forward scattering amplitudes for K^+ and K^-, respectively, of total laboratory energy ω on protons, the $\sigma_\pm$ are total cross sections, m_K is the K meson mass, ω_0 is $\sim 0.4 m_K$, and $A_-(\omega)$ is the absorptive part of the K^--p scattering amplitude. Let us choose the convention that the Σ- nucleon relative parity is positive. Then on the assumption that the Σ-Λ relative parity is positive, Igi[4] uses the following values for $2F$:

$$\text{(a) } 2F=-g_1^2\left(\frac{1}{2M}\ \frac{1}{M_1-M-\omega_1}\right)-g_2^2\left(\frac{1}{2M}\ \frac{1}{M_2-M-\omega_2}\right)$$
$$=-(1.01\,g_1^2+0.64\,g_2^2)\,m_K^{-2}\text{ for scalar }K,$$
$$\text{(b) } 2F=g_1^2\left(\frac{1}{2M}\ \frac{1}{M_1+M+\omega_1}\right),+g_2^2\left(\frac{1}{2M}\ \frac{1}{M_2+M+\omega_2}\right)$$
$$=(0.062\,g_1^2+0.060\,g_2^2)\,m_K^{\ 2}\text{ for pseudoscalar }K. \quad (2)$$

Here M_1, M_2 and M are the Λ, Σ, and nucleon masses, respectively, and g_1 and g_2 are the renormalized couplings of Λ and Σ particles, respectively, to nucleons and K mesons; $\omega_1 \sim 0.107 \times m_K$. and $\omega_2 = 0.268\, m_K$. We now want to drop the assumption of positive Σ-Λ relative parity. If this relative parity is negative then Eq. (2) is changed to read

$$\text{(a) } 2F = 0.062\, g_1^2 - 0.64\, g_2^2 \text{ for scalar } K,$$
$$\text{(b) } 2F = 1.01\, g_1^2 + 0.060\, g_2^2 \text{ for pseudoscalar } K. \quad (3)$$

Now we note immediately that if g_1^2 and g_2^2 do not differ by an order of magnitude or more (which is certainly quite probable[7]) Eqs. (3a) and (3b) both give a negative F. As noted previously,[1-3] Eq. (2a) gives a negative F and Eq. (2b) a positive F. As noted by Salam and Matthews,[3] the relative K-Σ parity might be determined rather unambiguously from the dispersion relation for K^+-n scattering analogous to Eq. (1). Then only the Σ intermediate state contributes to the corresponding F, which if negative implies a scalar K, and if positive implies a pseudoscalar K. To what extent does the sign of F in the K^+-p dispersion relation determine the second unknown relative parity? Igi's analysis[4] shows that if the effective K^+-p potential is repulsive and if the K^+-p cross section is essentially isotropic and energy independent from 0 to ~200 Mev kinetic energy, then F is negative for either a repulsive or an attractive K^--p effective potential.[8] From Eqs. (2) and (3) we see that only if the relative K-Σ parity is negative does a negative F determine the relative Σ-Λ parity (to be negative). If the relative K-Σ parity is positive then a negative F is compatible with either relative Σ-Λ parity. Stated another way, if we had by some method determined the relative Σ-Λ parity, then only if this turned out to be positive would a negative F determine the relative K-Σ parity (to be positive). On the other hand we note if F were to turn out to be positive, Eq. (3b) would imply pseudoscalar K mesons and positive relative Σ-Λ parity.

In the event that a future analysis of K^+-n scattering should indicate a positive K-Σ relative parity[9] then the relative Σ-Λ parity may still have to be determined by some experiment such as the angular variation of the polarization of the Λ from the reaction $\Sigma^-+p\to\Lambda+n$, as suggested by Pais and Treiman,[10] or by the internal conversion coefficient in Σ^0 decay as calculated by Feinberg[11] and by Feldman and Fulton.[12] The latter effect is, unfortunately, almost insensitive to the relative Σ-Λ parity. Both experiments are quite difficult from the standpoint of the accumulation of statistics alone. One might still try to appeal to a dispersion relation at this point. Consider elastic π^0-Λ scattering. A dispersion relation for this process with no subtraction may be written

$$D_0(\omega)=\alpha+(1/2\pi^2)\int_0^\infty K'^2dK'\sigma_0(K')/(K'^2-K^2), \quad (4)$$

where D_0 is the forward scattering amplitude and σ_0 is the total cross section; α is given by $\alpha=-2b^2\omega_0/(\omega^2-\omega_0^2)<0$ for negative relative Σ-Λ parity and $\alpha=[2b^2/(M_1+M_2)^2][\omega_0(\mu^2-\omega_0^2)/(\omega^2-\omega_0^2)]>0$ for positive relative Σ-Λ parity. Here μ is the pion mass, $\omega_0=(M_2^2-M_1^2-\mu^2)/2M_1\sim 70$ Mev, and b is the renormalized coupling of a pion to a Σ and a Λ. Only the Σ^0 intermediate state contributes to α. We cannot scatter pions on hyperons directly, but two potentially useful reactions that produce high-energy and low-energy pion-hyperon states, respectively, are $K^-+p\rightarrow\Lambda+\pi^0$ and $K^-+p\rightarrow\Lambda+\pi^0+\pi^0$. It may be that future experiments on these reactions together with a theoretical analysis could determine the sign of the low-energy scattering length in the Λ-π^0 system.

Finally, we note that Eq. (3), as well as Eq. (2),[2-4] is consistent with renormalized K-meson couplings with $g^2\sim 1-4$.

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ANTI-LAMBDA HYPERON*†

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An event has recently been found in an emulsion stack exposed to a 4.6 ± 0.3 Bev π^--meson beam at the Berkeley Bevatron which is interpreted as the decay of an anti-lambda hyperon, $\overline{\Lambda}^0$. The threshold for production with a free nucleon is 4.73 Bev and extends down to ~ 4.3 Bev with a bound nucleon, the production reaction being of the type

$$\pi^- + p \rightarrow \Lambda^0 + \overline{\Lambda}^0 + n.$$

The side of the stack was exposed to a beam of 10^6 π mesons per sq cm, the intensity falling off by a factor of 10^3 in a distance of 8 in. across the emulsion sheets. The emulsions were scanned for stopping π^+ mesons and these were followed back to their origins if it appeared that they were produced in the region of high π-meson flux. Most tracks which were successfully traced back came from primary π^--meson stars but 3 traced back to decaying K^+ mesons and one to a "V" type event. The event is shown in Fig. 1. The other branch of the "V" event was traced after 3 cm range into a large star from which 3 shower particles were emitted. The visible energy in this star is 783 Mev including the rest masses of the 3 shower particles which were all identified as π mesons; one was arrested and decayed into a μ meson, the other two were identified by the Δg^* vs ΔR and by the $\bar{\alpha}$ vs g^* methods.

The particle connecting the "V" event with the large star has been shown to have been traveling into the star rather than the reverse by ionization measurements on the track. These are summarized in Table I. Every useful grain in the track has been counted and the plateau ionization in each plate has been determined by measuring the beam π mesons. The grain den-