and many remarks, to V. S. Barashenkov, L. N. Usachev, and I. P. Stakhanov for helpful discussions, as well as to the reactor maintenance personnel for aid in setting up the experiment.

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DECAY PROBABILITIES OF THE Σ-HYPERON WITH PARITY NONCONSERVATION

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SEVERAL works[1-3] have investigated the relation between the Σ-hyperons

$$\Sigma^+ \to p + \pi^0 \; (w^0), \quad \Sigma^+ \to n + \pi^+ \; (w^+), \quad \Sigma^- \to n + \pi^- \; (w^-)$$

and it was shown that the quantities

$$X = w^0 / w^+ \text{ and } Y = w^- / (w^+ + w^0) = \tau^+ / \tau^-$$

(where $\tau^\pm$ is the lifetime of the $\Sigma^\pm$-hyperon) should lie on a curve depending on the spin and parity of the Σ-hyperon. This conclusion is based on the assumptions that in the decay of the Σ-hyperon (1) the selection rule $\Delta T = 1/2$ (where T is the isotopic spin) is valid, (2) invariance under time inversion is maintained, and (3) parity is conserved.

It has been shown[1] that data of the Sixth Rochester Conference (X = 1, Y lies between 0.1 and 0.2) are in agreement with the theoretical curves. Later, however, Alvarez and co-workers obtained $w^0/w^+ = 1.0 \pm 0.2$, $\tau^- = (1.86 \pm 0.26) \times 10^{-10}$ sec, $\tau^+ = (0.86 \pm 0.17) \times 10^{-10}$ sec, and $\tau^-/\tau^+ = 2.2 \pm 0.5$. The corresponding X, Y point ($X = 1 \pm 0.2$, $Y = 0.45 \pm 0.10$) does not lie on the theoretical curves, whence Alvarez[4] concludes that assumption (1) is not valid.

We should like to indicate that this conclusion is not inevitable if assumption (3) is dropped. Parity nonconservation in the case of hyperon decay follows from parity nonconservation in $K_{\pi 2}$ and $K_{\pi 3}$ decays, since the hyperon decay can always go through a virtual decay chain with $K \to \pi$ decays.

We shall assume as before that assumption (2) is valid in the sense of Wigner,[5] i.e., with respect to the combined inversion CI.[6] This assumption, from which one can derive the fact that the S matrix is symmetric, makes it possible[1] to express the phases of the matrix elements for decay in terms of the scattering phases in the final state,

$$a_+ = i^1/_3 (\rho_3 e^{i\alpha_3} + \sigma_3 e^{i\alpha_3'}) + i^2/_3 (\rho_1 e^{i\alpha_1} + \sigma_1 e^{i\alpha_1'}), \quad a_0 = i (\sqrt{2} / 3 (\rho_3 e^{i\alpha_3} + \sigma_3 e^{i\alpha_3'}) - i (\sqrt{2}/3) (\rho_1 e^{i\alpha_1} + \sigma_1 e^{i\alpha_1'}),$$

$$a_- = i (\rho_3 e^{i\alpha_3} + \sigma_3 e^{i\alpha_3'})$$

(ρ_3 and ρ_1 here correspond to $\sqrt{3}\rho_3$ and $\sqrt{3/2}\rho_1$ of the previous work referred to[1]). Here the parameters ρ and σ are real, and α and α' are the phases of π-meson—nucleon scattering. For a Σ-hyperon spin of 1/2, the values of (ρ, α) and (σ, α') correspond to transitions in the π-meson—nucleon system to the $S_{1/2}$ and $P_{1/2}$ states, and for Σ spin of 3/2, they correspond to the $P_{3/2}$ and $D_{3/2}$ states, respectively. The indices 3 and 1 refer to isotopic spin states with $T = 3/2$ and $T = 1/2$. The scattering phases α and α' are known and such that $\alpha' \approx 0$.

To calculate the ratios of the probabilities, we make use of the fact that the total probabilities for transitions to states with different parities do not interfere, since their wave functions correspond to orthogonal Legendre polynomials. We then obtain

$$X = \frac{2(\rho_3^2+\sigma_3^2)+2(\rho_1^2+\sigma_1^2)-4(\rho_3\rho_1\cos(\alpha_3-\alpha_1)+\sigma_3\sigma_1)}{(\rho_3^2+\sigma_3^2)+4(\rho_1^2+\sigma_1^2)+4(\rho_3\rho_1\cos(\alpha_3-\alpha_1)+\sigma_3\sigma_1)}, \qquad Y = 3(\rho_3^2+\sigma_3^2)/[(\rho_3^2+\sigma_3^2)+2(\rho_1^2+\sigma_1^2)].$$

Introducing the notation

$$z=\sqrt{(\rho_1^2+\sigma_1^2)/(\rho_3^2+\sigma_3^2)}, \qquad \varkappa=\frac{\rho_3}{\sqrt{\rho_3^2+\sigma_3^2}}, \qquad \mu=\frac{\rho_1}{\sqrt{\rho_1^2+\sigma_1^2}},$$

we obtain

$$X=\frac{2+2z^2-4z\,[\varkappa\mu\cos(\alpha_3-\alpha_1)\pm\sqrt{(1-\mu^2)(1-\varkappa^2)}]}{1+4z^2+4z\,[\varkappa\mu\cos(\alpha_3-\alpha_1)\pm\sqrt{(1-\varkappa^2)(1-\mu^2)}]}, \quad Y=\frac{3}{1+2z^2}.$$

This expression differs from the previous one[1] in that $\cos(\alpha_3-\alpha_1)$ is replaced by

$$Q=\varkappa\mu\cos(\alpha_3-a_1)\pm\sqrt{(1-\varkappa^2)(1-\mu^2)},$$

which can take on arbitrary values with $|Q| \leq 1$. It follows from this that the X, Y point lies in a region bounded by the curve

$$X=(2+2z^2\mp 4z)/(1+4z^2\pm 4z), \quad Y=3/(1+2z^2),$$

which corresponds to curve (1) of the previous work.[1] This region is the same as that obtained by Gatto[7] in investigating the restrictions following only from the selection rule $\Delta T = 1/2$ without accounting for invariance under time inversion.

It is easily seen that the data of Alvarez lies in the allowed region, and thus does not contradict the assumption of the validity of the selection rule $\Delta T = 1/2$.

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A "SYMMETRIC" CIRCULAR SYNCHROCYCLOTRON WITH OPPOSITELY DIRECTED BEAMS

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THE possibilities of using the collision of intense beams of particles accelerated to relativistic energies have recently been considered.[1] The energy used directly for a physical experiment (for instance for particle production) is then greater than that available when a beam hits a stationary target by a factor of about $2E/m_0c^2$, where E is the energy of each beam. The suggestions so far made in this regard involve the use of two adjacent or concentric annular accelerators having a common section or sections in which the collision is to occur.[1]

The present note suggests a means for achieving the collision of beams travelling in opposite direction