decay to the first excited state of Na^{23} is predominantly G-T since, if one accepts the Fermi transition as vector,[2] any admixture of a Fermi transition would lead to a less negative value of λ than $-\frac{1}{3}$.

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FURTHER SEARCH FOR PARITY NONCONSERVATION IN ASSOCIATED PRODUCTION*

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Several authors have pointed out that the case for parity conservation in strong interactions is very much weakened when strange particles are involved.[1,2] If parity is not conserved in the associated production process

$$\pi^- + p \to \Lambda + K^0, \tag{1}$$

then the Λ may have a polarization component in the production plane. The parity-nonconserving decay

$$\Lambda \to p + \pi^- \tag{2}$$

may then, by virtue of its large decay-asymmetry parameter, exhibit a decay asymmetry in the production plane.

In an earlier Letter we reported our analysis of 236 events of the type (1) + (2), produced by 1.12-Bev/c pions incident upon a liquid hydrogen bubble chamber, leading to Λ's of 300 Mev/c c.m. momentum.[3] Those results were consistent with zero decay asymmetry in the production plane. We now report our analysis of 185 events of the same type, but produced at a higher energy by pions of 1.23 Bev/c, leading to 375-Mev/c Λ's in the c.m. system.

One might expect from statistical considerations that adding 185 events to an existing 236 could hardly change the conclusions. However, (a) it turns out that, partly because of a larger observed up-down decay asymmetry, and partly because of a smaller observed decay asymmetry in the production plane, we can set a substantially smaller limit (about one-third as large) to the amount of parity-nonconserving amplitude in the experiment reported here than in the 1.12-Bev/c experiment; and (b) it is conceivable that a parity-nonconserving production amplitude could increase substantially between 300 and 375 Mev/c.

Figure 1 shows the observed decay-asymmetry components in the production plane plotted against θ, the hyperon c.m. production angle. In the left half of the figure we plot the front-back (FB) asymmetry in the π-c.m. coordinate system, in which the positive direction is along $\vec{P}$(π incident). The right half of the figure shows the left-right (LR) asymmetry in the same system. The positive direction is along $\vec{n}\times\vec{P}$(π inc), where $\vec{n}$ is the "up" direction given by $\vec{P}(\pi\text{ inc})\times\vec{P}$(hyperon). All directions are as seen in the hyperon rest frame. These data are clearly consistent with zero asymmetry. A χ^2 test applied to the hypothesis that the FB asymmetry is everywhere zero yields $\chi^2(\text{FB}) = 7.3$, where 6 is "expected." Similarly $\chi^2(\text{LR}) = 1.0$. These combine to give a total $\chi^2 = 8.3$, where 12 is expected if the asymmetry is identically zero. This corresponds to a χ^2 probability of 76%.

The contribution to χ^2 at each value of θ is just the square of the magnitude of the projection of

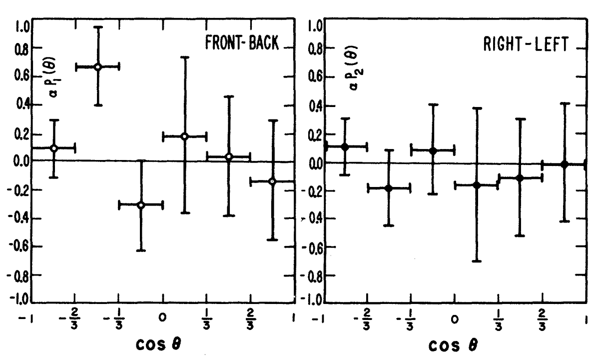

FIG. 1. Decay asymmetry components in the production plane (see text).

the observed decay-asymmetry vector on the production plane, in units of the mean-square statistical error. It is therefore invariant under rotation to a new "preferred axis" in the production plane. The same is true after summing over θ. Therefore zero asymmetry in the production plane fits with 76% probability in any coordinate system.

If we average each component of the asymmetry vector over θ, the result depends on the choice of preferred axis. (The above analysis shows that the result may in any case be consistent with zero.) We make three choices of preferred axes: the π-c.m. system (defined above), and the Λ-c.m. and Λ-lab systems (defined in reference 3). We find

$$(\alpha\overline{P}_1,\ \alpha\overline{P}_2)_{\pi\text{-c.m.}} = (0.14\pm 0.13,\ -0.002\pm 0.13), \quad (3)$$

$$(\alpha\overline{P}_1,\ \alpha\overline{P}_2)_{\Lambda\text{-c.m.}} = (-0.10\pm 0.13,\ -0.16\pm 0.13), \quad (4)$$

$$(\alpha\overline{P}_1,\ \alpha\overline{P}_2)_{\Lambda\text{-lab}} = (0.12\pm 0.13,\ -0.09\pm 0.13), \quad (5)$$

The up-down asymmetry, which demonstrates parity nonconservation in the decay (2), is naturally the same in all three systems and is given by

$$\alpha\overline{P}_n = 0.66\pm 0.13. \quad (6)$$

We can adopt the hypothesis that parity is not conserved in Reaction (1), in order to obtain a rough upper limit to the parity-nonconserving amplitude. The possibility of obtaining such an upper limit arises from the large observed up-down asymmetry (6). An analysis (confined to s and p waves) yields for F, the fractional intensity of parity-nonconserving production,

$$F = 0.58(\alpha\overline{P}_1)^2 + 0.60(\alpha\overline{P}_2)^2 + 0.62\alpha\overline{P}_1\alpha\overline{P}_2, \quad (7)$$

where P_1 and P_2 refer to the π-c.m. system.[2-4] If $\alpha\overline{P}_1$ and $\alpha\overline{P}_2$ are assumed to be independently Gaussian-distributed, with expectation values and standard deviations given by the results (3), we can calculate the probability distribution in F by changing variables and performing one integration. The result can be represented empirically by $P(F)dF = 39\exp(-48F)dF$, for $0 \le F \le 0.015$, and $P(F)dF = 27\exp(-30F)$, for $0.015 \le F$. Thus $F = 0$ is most likely, $\langle F\rangle = 0.029$, $(\langle F^2\rangle - \langle F\rangle^2)^{1/2} = 0.035$, and Prob. $(F>F_0)$ is roughly $0.9 \times \exp(-30\ F_0)$.[5]

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[4]The analysis uses production and decay angular-distribution results at 1.23 Bev/c (to be published). The solutions depend only very weakly on the value of α, in the experimentally allowed region $0.8 < \alpha < 1.0$. There is no evidence for d waves.

[5]In reference 3 we obtained $F = 0.07 \pm 0.08$ by erroneously applying ordinary methods of differential "error propagation" to an expression analogous to Eq. (7). This procedure is clearly incorrect for a quadratic centered near the origin, since the second-order terms are then dominant rather than negligible. Our result $F(1.12\ \text{Bev}/c) = 1.15(\alpha\overline{P}_1)^2 + 0.93(\alpha\overline{P}_2)^2 - 1.44\alpha\overline{P}_1\alpha\overline{P}_2$, leads to a probability distribution $P(F)dF \approx 10\exp(-10F) \times dF$, so that $F = 0$ is most likely, $\langle F\rangle = 0.10$, $(\langle F^2\rangle - \langle F\rangle^2)^{1/2} = 0.10$, and Prob. $(F>F_0) = \exp(-10F_0)$.

ISOTOPIC SPIN SELECTION RULES AND K_2^0 DECAY*

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One of the interesting theoretical points connected with the decays of the strange particles is to determine whether there exists some kind of isotopic spin selection rule for these decays or not. Currently, there are two main view points on this issue. In the first point of view, one chooses the interaction Hamiltonian responsible for the weak decays to obey the familiar $\Delta I = \frac{1}{2}$ selection rule.[1] Though that rule was originally intended to apply for the nonleptonic modes, it may be extended to the leptonic modes also (if we assign zero isotopic spin for leptons). In the second point of view,[2] the weak interaction Hamiltonian is a current-current interaction and the interacting nonleptonic currents are taken to have definite transformation properties: the