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G.V. Silvestrini: ADAIR ARGUMENT AND Θ^0 SPIN.

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Although many experimental data on strange particle production and decay are at present available, no experimental determination of θ^o spin has been made up to now.

Most of the θ^o available are produced in association with a Λ^o in π^--P collisions not very far from threshold. Since the spin of the Λ^o has been determined to be 1/2 without any assumption on θ^o spin(1), it is possible to reverse the Adair argument(2) to determine the θ^o spin.

From the detected θ^o decay into two π^o's(3), the possibility for it having an odd spin can be excluded; neglecting values of the spin $\geq$ 4, our task is a calculation of the angular distribution of θ^o decay products which is to be expected if its spin is 2. If it has no spin the angular distribution is obviously isotropic.

The Adair argument runs in this case as follows.

Consider the reaction $\pi^- + p \rightarrow \Lambda^o + \theta^o$ and select those events for which m = 0, having taken as z-axis the direction of the incident pion. This means choosing only the θ^o's emitted at a c.m. angle β within $0° - \bar{\beta}$ and $180° - \bar{\beta} - \bar{\beta}$, $\bar{\beta}$

being an angle depending on the energy of the incident pion. (The angular distributions at production show that $\bar{\beta}$ can be chosen quite large and that a good fraction of the events satisfy these conditions[4]). For them the projection of the Θ° spin on the z-axis can only be for angular momentum conservation equal to + 1,0 or -1, the weights of the ±1 parts being equal if parity is conserved at production[x]. The relative weight of the 0-part is not known.

Owing to this indeterminacy, we cannot predict an unique angular distribution for Θ° decay, but only a continuum set of possible distributions, namely all the ones of the form,

$$P(\cos\theta) = (9-\alpha)\cos^4\theta - (6-\alpha)\cos^2\theta + 1$$

where the unknown parameter α is the relative importance of the +1 and -1 part with respect to the 0-part. Θ is the angle between the direction of the decay pions of the Θ° (in its rest system) and the z-axis.

Varying α , the shape of the angular distribution varies widely. However, if we consider the ratio

$$R = \frac{\int_0^{0,5} P(\cos\theta)\, d\cos\theta}{\int_{0,5}^{1} P(\cos\theta)\, d\cos\theta}$$

we find that it is always $.36 \leq R \leq .62$, where as for 0 spin we expect of course R = 1.

I have at my disposal only 35 Θ°'s, which were analyzed some years ago in Pisa during a collaboration experiment[5]: to 16 of them the Adair argument can be applied.

In fig. 1 the angular distribution in Θ for all of them and for the 16 good ones (shaded area), is shown. For the

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(x) - The conclusions hold independently of this assumption.

last ones we have

$$R = 5/11$$

Statistics is obviously too poor to draw any conclusion. However, the θ^0 data available to date in the world can certainly give a definite answer to the θ^0 spin question.

References

(1) - F.S. Crawford et al., P.R.L. 2, 114 (1959)
(2) - R.K. Adair, P.R. 100, 1540 (1955)
(3) - F. Eisler et al., N.C. 5, 1700 (1957)
(4) - F. Eisler et al., N.C. 7, 222 (1958)
(5) - F. Eisler et al., N.C. 10, 468 (1958)

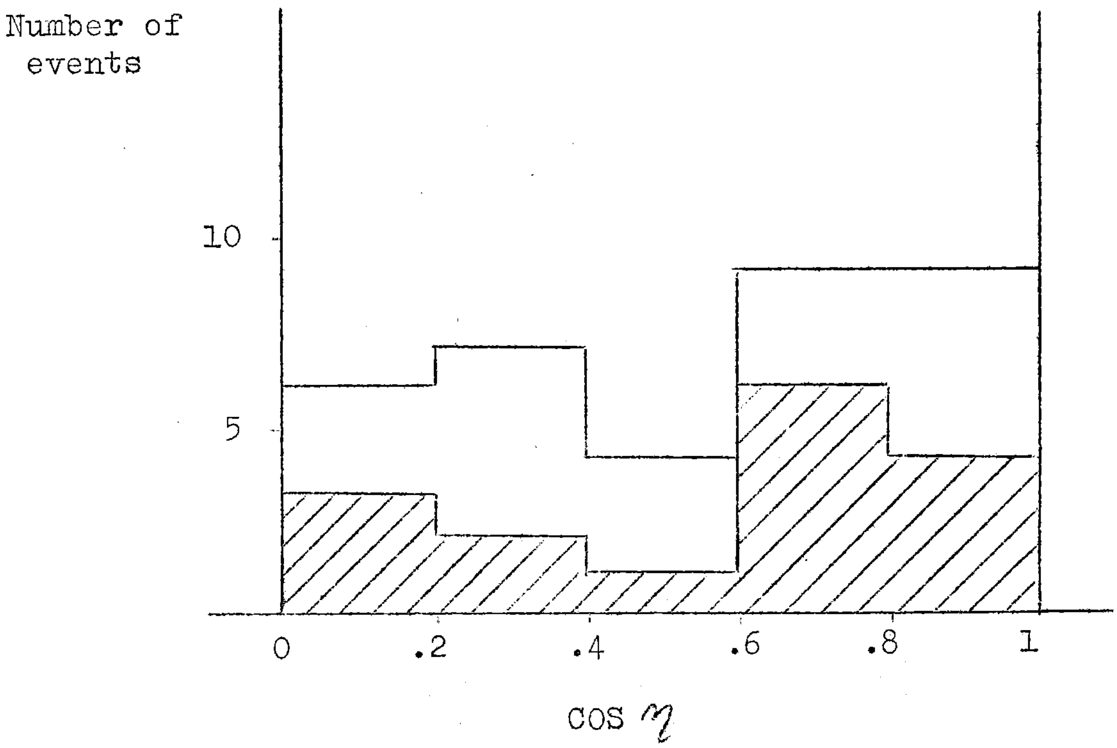

FIG. 1