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#### USE OF A POLARIZED PROTON TARGET TO DETERMINE ISOBAR PARITY

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To determine isobar parity by the method proposed here, there is no need to measure the polarization of the baryon produced as a result of the isobar decay. Our method may therefore prove to be most convenient in the case when this baryon is a nucleon.

The proposed method is based on the relations between the polarization effects in parity-conserving processes. For processes in which spin-1/2 particles participate, these relations are discussed in detail in the review [1]. In [2] is indicated a method of obtaining all the relations between the polarization effects in processes of the type  $a + b \rightarrow c + d$ , in which parity is conserved and particle spin is arbitrary.

Relations of this type have served as the basis for previously proposed methods for determining the parity of hyperons using a polarized proton target [1,3,4].

In [5] it is proposed to use a polarized target to determine the spin and parity of the isobar, but it is also necessary to measure the polarization of the baryon produced as a result of the isobar decay. However, as shown by Byers and Fenster [6], it is sufficient for this purpose to measure the polarization of the baryon with the target unpolarized.

Let us consider the process

$$\Pi_1 + p \rightarrow \Pi_2 + N^*, \quad (1)$$

where  $\Pi_1$  and  $\Pi_2$  are pseudoscalar mesons,  $p$  a proton, and  $N^*$  an isobar with spin  $j \geq 3/2$ .

The polarization moments  $T_L^M$  of the isobar are expressed in terms of the polarization moments  $t_l^m$  of the proton by means of the formula

$$\sum_{L,M} \frac{2L+1}{2j+1} C_{\lambda',LM}^{j\lambda} T_L^M = \frac{1}{F} \sum_{l,m,\mu,\mu'} f_{\lambda\mu}(\vartheta) f_{\lambda',\mu'}^*(\vartheta) \frac{2l+1}{2} C_{(1/2)\mu',lm}^{(1/2)\mu} t_l^m, \quad (2)$$

where

$$F = \sum_{\substack{\lambda, l, m, \\ \mu, \mu'}} f_{\lambda, \mu}(\vartheta) f_{\lambda, \mu'}^*(\vartheta) \frac{2l+1}{2} c_{(1/2)\mu'; l m}^{(1/2)\mu} t_l^m, \quad (3)$$

$\lambda$  and  $\mu$  are the helicities of the isobar and the proton, respectively,  $f_{\lambda, \mu}(\vartheta)$  is the scattering helicity amplitude, which we define in a somewhat different fashion than in the known paper [7]:

$$f_{\lambda, \mu} = \langle \vartheta \varphi; \lambda | T | 0 \varphi \mu \rangle. \quad (4)$$

The quantities  $|\vartheta \varphi; \lambda\rangle$  are also defined somewhat differently than in [7]

$$|\vartheta \varphi; \lambda\rangle = \hat{R}_{\varphi, \vartheta, 0}^{100} |00; \lambda\rangle, \quad (5)$$

where  $\hat{R}_{\alpha, \beta, \gamma}$  is the operator of rotation through the Eulerian angles  $\alpha, \beta, \gamma$ ;  $|00; \lambda\rangle$  is the state of  $N^*$  and  $\Pi_2$  when the momentum of  $N^*$  is directed along the positive  $z$  axis and the helicity of  $N^*$  is equal to  $\lambda$ .

It can be shown that, by virtue of the definition (4) and (5),  $f_{\lambda, \mu}$  does not depend on the angle  $\varphi$ . Using the definitions (4) and (5), and also the properties of the partial helicity amplitudes (given in [7] and resulting from parity conservation) and of the functions  $d_{\lambda, \mu}^J(\vartheta)$ , we can easily show that in the c.m.s.

$$f_{\lambda, \mu}(\vartheta) = \frac{\eta_{N^*} \eta_{\Pi_2}}{\eta_p \eta_{\Pi_1}} (-1)^{j-1/2+\lambda-\mu} f_{-\lambda, -\mu}(\vartheta), \quad (6)$$

where  $\eta_{N^*}$ ,  $\eta_p$ ,  $\eta_{\Pi_1}$ , and  $\eta_{\Pi_2}$  are the parities of  $N^*$ ,  $p$ ,  $\Pi_1$ , and  $\Pi_2$ , respectively.

It can be shown that relation (6) retains the same form in the laboratory frame, too. Replacing in (2)  $f_{\lambda, \mu}$  or  $f_{\lambda, \mu}^*$ , in accordance with (6), we can obtain all the relations between the polarization effects of the process (1).

In particular, if the target is polarized at an angle  $\pi/4$  to the incident meson beam and the isobar is scattered in a plane containing the incident beam and the target polarization vector  $\vec{\xi}$ , then the following relations hold:

$$\begin{aligned} & \sum_L (2L+1) c_{j-(M+M')/2; LM}^{j(M-M')/2} \text{Im } T_L^M(\vartheta) \\ &= \frac{\eta_{N^*}}{\eta_p} (-1)^{j+(M-M')/2} \sum_{L'} (2L'+1) c_{j-(M'+M)/2; L'M'}^{j(M'-M)/2} \text{Im } \tilde{T}_{L'}^{M'}(\vartheta), \end{aligned} \quad (7)$$

where  $T_L^M(\vartheta)$  ( $\tilde{T}_L^{M'}(\vartheta)$ ) are the polarization moments of the isobar scattered through an angle  $\vartheta$  relative to the incident beam in the direction of  $\vec{\xi}_\perp$  ( $-\vec{\xi}_\perp$ ), and  $\vec{\xi}_\perp$  is the projection of the target polarization vector  $\vec{\xi}$  on the plane perpendicular to the incident beam. The axes  $z$  and  $y$ , with respect to which  $T_L^M$  and  $\tilde{T}_L^{M'}$  are defined, are chosen to be in the directions of  $\vec{P}_{N^*}$  and  $[\vec{P}_{\Pi_1} \times \vec{P}_{N^*}]$ , respectively ( $\vec{P}_{N^*}$  and  $\vec{P}_{\Pi_1}$  are the momenta of  $N^*$  and  $\Pi_1$ ). Formula (7) constitutes in fact a set of  $(j^2 - 1/2)$  independent equations (for different  $M$  and  $M'$ ; of

course, there is no summation implied in (7) with respect to  $M$  and  $M'$ ).  $M$  and  $M'$  should have different parities,  $|M| + |M'| \leq 2j$ , and it can be assumed that  $M > 0$  and  $M' > 0$ , so that  $T_L^M = (-1)^M T_L^{M*}$ .

If the target is not polarized, then the polarization moments contained in (7) are equal to zero.

In order to be able to determine with the aid of (7) the parity  $\eta_{N^*}$  of the isobar it is necessary to measure  $\text{Im } T_L^M(\vartheta)$  and  $\text{Im } \tilde{T}_L^M(\vartheta)$  with even  $L$ . As is well known [6], the polarization moments with even  $L$  are determined from the angular distribution of the isobar decay products.

The proposed method is suitable for the determination of the parity of the  $\Omega$  hyperon.

If the isobar spin is  $J = 3/2$ , (7) takes the form

$$\begin{aligned} \text{Im } T_2^1(\vartheta) &= - \frac{\eta_{N^*}}{\eta_p} \text{Im } \tilde{T}_2^2(\vartheta), \\ \text{Im } T_2^2(\vartheta) &= \frac{\eta_{N^*}}{\eta_p} \text{Im } \tilde{T}_2^1(\vartheta). \end{aligned} \quad (7)$$

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#### STATES WITH POPULATION INVERSION IN A SELF-COMPRESSED DISCHARGE

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Stimulated emission is usually observed in gases at relatively low currents, when the electromagnetic forces exert no influence on the discharge development process. It is known, however, that in the case of cumulation of a strong-current pulsed discharge (pinch effect) the plasma is heated at an unusually fast rate, and magnetohydrodynamic instabilities develop. An unstable turbulent state is produced. The heating time is of the order of the time of ionic collisions at maximum pinch compression (without account of the collective processes). Estimates show that for singly-ionized atoms of argon this time amounts to