By passing the neutrons successively through a series of regions of uniform retarding fields H_0, it is possible to attain a considerable reduction in the velocity of the neutrons. For instance, to retard neutrons having an initial velocity $v_0 = 2 \times 10^3$ cm/sec to a velocity $v = 40$ cm/sec with $H_0 \approx 2 \times 10^4$ gauss requires sending the neutrons successively through 15 to 20 retarding fields, and the flight path will be of the order of 200 cm. Under these circumstances the relative flux of neutrons with energies of 10^{-5} degrees K, emerging from a moderator at $T = 1°$K, will be increased more than a thousandfold, and will amount to 10^{-7} of the total current.

These neutrons can be separated from the rest of the flux by reflection from a magnetic mirror, after which the reflected neutrons will be completely polarized. In the case of a pulsed neutron source, the moderation can be effected by a traveling magnetic field.

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POSSIBLE SYMMETRY PROPERTIES FOR THE π-K SYSTEM

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THE Hamiltonian describing the π-K system has the form

$$H = H_\pi + H_K + g\pi_\alpha\pi_\alpha K_\lambda^+ K_\lambda, \quad (1)$$

where H_π is the pion Hamiltonian including the $\pi\pi$ interaction, H_K is the K-meson Hamiltonian, and g is the coupling constant of the $\pi\pi$KK interaction.[1] It is assumed in (1) that the π-meson and K-meson interactions with baryons can be neglected.

The Hamiltonian (1) is invariant under rotations of the pion field operator in isospin space with the K-meson field operator held fixed. In other words, it is possible to consider the pion as an isovector in one space and the K meson as an isospinor in another space. The Hamiltonian (1) is invariant under rotations in either space.

Let us denote pion—K-meson scattering amplitudes by $f(\pi + K \rightarrow \pi + K)$. Then from the above symmetry properties we obtain the following selection rules:

1) The following scattering amplitudes are equal to each other:

$$f(\pi^\pm + K^\pm \rightarrow \pi^\pm + K^\pm) = f(\pi^0 + K^\pm \rightarrow \pi^0 + K^\pm)$$
$$= f(\pi^\pm + K^0 \rightarrow \pi^\pm + K^0) = f(\pi^\pm + \overline{K}^0 \rightarrow \pi^\pm + \overline{K}^0)$$
$$= f(\pi^0 + K^0 \rightarrow \pi^0 + K^0) = f(\pi^0 + \overline{K}^0 \rightarrow \pi^0 + \overline{K}^0). \quad (2)$$

2) The charge-exchange amplitudes vanish:

$$f(\pi^+ + K^- \rightarrow \pi^0 + \overline{K}^0) = f(\pi^- + K^+ \rightarrow \pi^0 + K^0)$$
$$= f(\pi^+ + K^0 \rightarrow \pi^0 + K^+) = f(\pi^- + \overline{K}^0 \rightarrow \pi^0 + K^-) = 0.$$

3) The $K + \overline{K} \rightarrow n\pi$ annihilation process proceeds only through the isoscalar state.

To obtain experimental verification of these selection rules, one can study the angular distribution of the products in the reaction $K + N \rightarrow K + N + \pi$, for which the one-meson term in the cross section is proportional to

$$\Delta^2(\Delta^2 + \mu^2)^{-2} |f(\pi + K \rightarrow \pi + K)|^2, \quad (3)$$

where Δ^2 is the square of the nucleon momentum transfer. Expression (3) has a maximum for $\Delta^2 = \mu^2$ in the physical region.[2] A measurement of the form of this maximum would provide information on the amplitudes $f(\pi + K \rightarrow \pi + K)$.

According to the theory of Okun' and Pomeranchuk[3] and Chew and Mandelstam[4] the scattering phase shifts in high angular momentum states are determined by diagrams with the smallest number of exchanged π mesons. If the K^+ and K^0 have the same parity then the $K + N \rightarrow K + N$ scattering phase shifts in high angular momentum states are determined by diagrams with two mesons exchanged. Consequently a phase shift analysis of the process $K + N \rightarrow K + N$ would give certain information about the amplitudes $f(\pi + K \rightarrow \pi + K)$.

A violation of these selection rules would imply that the Hamiltonian contains terms with derivatives of the form

$$g' \boldsymbol{\pi} \times \frac{\partial}{\partial x_\mu} \boldsymbol{\pi} \cdot K^* \boldsymbol{\tau} \frac{\partial}{\partial x_\mu} K$$

or that baryon pairs play an important role in πK interactions. Since g′ is not dimensionless, a new fundamental length would appear in the Hamiltonian (in the first version).

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