(5) and (7) by the pseudopotential method. This problem was looked into in collaboration with Dr. Kerson Huang. It turns out that it is extremely simple to obtain (7) by the pseudopotential method. A detailed description of this computation will be published shortly.

It should be emphasized that the expansions quoted above are probably all asymptotic expansions. One is led to this conclusion by the following argument. A small and negative value of a corresponds to the case where the force is purely attractive with the scattering length $-a$, for which the gas (for any statistics) collapses. The formula should therefore become meaningless for negative a. This would result if, for example, the physical quantities contain such terms as $\exp.[-a^{-3}\rho^{-1}]$.

[1] A description of the binary collision expansion method, together with formulas (4) and (5) below, had previously been given at the International Conference on Theoretical Physics at Seattle, 1956 (unpublished).

[2] K. Huang and C. N. Yang, Phys. Rev. **105**, 767 (1957); Huang, Yang, and Luttinger, Phys. Rev. **105**, 776 (1957).

Regeneration of θ_1^0 Mesons by a Magnetic Field*

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THIS letter is to point out a surprising phenomenon that should occur if the θ^0 particle has a spin and a magnetic moment. The sequence of events is shown schematically as follows:

$$\theta^0(\uparrow\uparrow)=\frac{\theta_1(\uparrow\uparrow)+i\theta_2(\uparrow\uparrow)}{\sqrt{2}}\xrightarrow[\text{decay}]{}\theta_2(\uparrow\uparrow)=\frac{\theta^0(\uparrow\uparrow)-\bar{\theta}^0(\uparrow\downarrow)}{i\sqrt{2}}$$

$$\xrightarrow[\text{mag. field}]{}\frac{\theta^0+\bar{\theta}^0}{i\sqrt{2}}=-i\theta_1\xrightarrow[\text{decay}]{}2\pi.$$

A θ^0 meson is made, in associated production with a hyperon, and let us say the spin (first arrow) is up. After $\sim10^{-10}$ sec, θ_1 decay has left only the θ_2 component of the original wave.[1] This also has spin up. The θ_2 is part θ^0, part $\bar{\theta}^0$, each of which has, of course, spin up. But the magnetic moment (second arrow) of the $\bar{\theta}^0$ will be oppositely directed from that of the θ^0, since it is the antiparticle of the θ^0. Therefore, if the θ_2 beam, in vacuum, encounters a uniform vertical magnetic field, there will be an energy difference $\Delta\epsilon=2\mu H$ between the θ^0, $\bar{\theta}^0$, and a difference $\Delta\epsilon/\hbar$ in their De Broglie frequencies. The θ^0, $\bar{\theta}^0$ components will therefore, in time, get out of phase. Once they are out of phase, the particle is no longer entirely a θ_2, but has a θ_1 component. The θ_1 component then quickly decays into two π mesons.

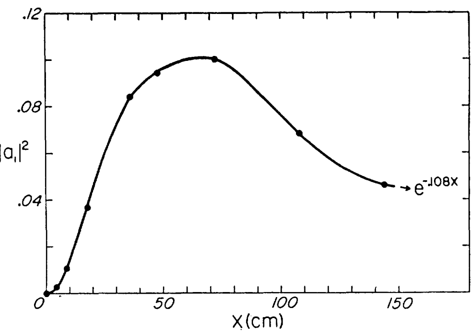

FIG. 1. Regeneration of θ's by magnetic field for $\gamma=6$, $\tau=10^{-10}$ sec, $\omega_2-\omega_1=1/\tau_1=\Delta E_{\text{mag}}$ (which corresponds to 22.7 kg if $\mu=e\hbar/m_Kc$).

A long-lived θ_2 beam can therefore be "quenched" by a magnetic field, if the θ^0 has a magnetic moment.

For a moment $\mu=e\hbar/m_kc$, the fields and times required are about like those needed to rotate a nuclear spin by ~1 radian, or on the order of 10^4 or 10^5 gauss-feet. The effect could therefore be observed experimentally.

The equation for the regenerated θ_1 amplitude can be derived in a manner entirely similar to that of Case.[2] A plot of $|\alpha_1|^2$ *vs* distance into the magnetic field (α_1 is the amplitude of θ_1) is given in Fig. 1. The values of the parameters used are: $\tau_1=10^{-10}$ sec, $\tau_2=\infty$ ($\tau_{1,2}=\theta_{1,2}$ lifetime); $\gamma=1/(1-\beta^2)^{\frac{1}{2}}=6$, $\omega_2-\omega_1=$ (mass difference frequency) $=1/2\tau_1$, and $2\mu H/\hbar=1/2\tau_1$ (for $\mu=e\hbar/m_Kc$, this corresponds to a field of 22.7 kilogauss).

Figure 1 implies that if the magnet is 60 cm long, 10% of the incident θ_2's would decay just beyond the magnet. However, $|\alpha_1|^2(1/\tau\gamma\beta c=1/18$ cm) is the probability, per cm of path, for decay in the magnet. Taking this into account, one sees that the reason the curve is falling, for magnet length $\gtrsim100$ cm, is that most of the particles have decayed in the magnet. The effect is therefore quite large.

It is interesting to speculate whether experiments already performed can rule out reasonable values of the magnetic moment. A quick look indicates that probably this is not the case. Experiments where θ^0's are produced in a magnet cloud chamber do not have much θ_2 path length. On the other hand, in the experiment by Lederman *et al.*,[3] a strong sweeping magnet preceded the cloud chamber. This could have the effect of wiping out all but the $m=0$ substate (which is unaffected by the field). This substate would then not regenerate in the cloud chamber magnet, since its field was parallel to that of the sweeping magnet. Rather, the typical θ_2 three-body decays would be seen.

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[1] M. Gell-Mann and A. Pais, Phys. Rev. **97**, 1387 (1955).

[2] K. Case, Phys. Rev. **103**, 1449 (1956).

[3] Lande, Booth, Impeduglia, Lederman, and Chinowsky, Brookhaven National Laboratory Report BNL-2857, 1956 (unpublished).