Thus the three Fock conditions are necessary and sufficient for the functions satisfying these conditions to belong to the subspace transforming according to the irreducible representation of the symmetric group of interchanges of their arguments.

In closing I want to express my sincere gratitude to M. I. Petrashen' for a discussion of this paper.

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THE HEAVY NEUTRAL MESON: DECAY MODES AND METHOD OF OBSERVATION

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THE classification of the elementary particles admits the existence of a meson with strangeness 0 and isotopic spin 0 (see, e.g., the review by Okun'[1]). Such an hypothesis has been advanced repeatedly.[2,3] Evidently such a meson (let us call it ρ) must be neutral and interact strongly with nuclei; in particular, it may be produced singly in collisions of two nucleons.

We assume that the ρ meson differs from the neutral pion only in mass and isotopic spin, but that the space spin and parity of the ρ meson are the same as for the neutral pion (pseudoscalar). Let the ρ meson be equivalent to a nucleon-antinucleon pair in the state $0^S\,{}^1S_0$, whereas the neutral pion is equivalent to a pair in the state $1^S\,{}^1S_0$, $T_z = 0$ according to the classification of Bethe and Hamilton[4] (see also reference 5). These two pair states differ by the relative phase $\overline{PP}$ and $\overline{NN}$.

In this letter we consider the possible decay modes of the ρ meson and the method of observing it in an experiment. It is obvious that the mass of the ρ meson is greater than that of the neutral pion; otherwise the ρ meson would have been discovered in experiments on neutral pion production. The transformations $\rho \to 2\pi^0$ and $\rho \to \pi^+ + \pi^-$ are not possible as they would not conserve parity: two pions in a state with $L = 0$ are an even system, whereas the ρ meson is odd.

By applying the operator CT (C is charge conjugation, i.e., conversion of particles into antiparticles; T is charge symmetry, i.e., conversion of protons into neutrons). Bethe and Hamilton have shown that three-pion annihilation cannot occur in a 0^S state. Hence the decay modes $\rho \to 3\pi^0$ and $\rho \to \pi^+ + \pi^- + \pi^0$ are forbidden. This applies to any odd number of pions.

To treat the decay into four pions, we separate them into two pairs and denote the isotopic spin of the first pair by t_1, its orbital angular momentum by l_1, the corresponding quantities of the second pair by t_2 and l_2 and the angular momentum of the center of mass of the first pair relative to the other by L. From the assumption that the ρ meson is pseudoscalar and has $T = 0$, it follows that $t_1 = t_2$, $|L| = |l_1 + l_2|$, and that $L + l_1 + l_2$ is odd. If t_1 is even, then l_1 and l_2 are even; if t_1 is odd, then l_1 and l_2 are also odd.

If $l_1 = l_2$, then both pairs can be regarded as identical bosons, and the wave function must be symmetric with respect to their exchange.

The lowest values of the momenta that satisfy all these conditions are $l_1 = l_2 = 2$, $L = 1$, $t_1 = t_2 = 0$, or $t_1 = t_2 = 2$.

For $l_1 \neq l_2$, such a state is $l_1 = 1$, $l_2 = 3$, $L = 3$, and $t_1 = t_2 = 1$. The need for large orbital momenta can reduce substantially the probability of the $\rho \to 4\pi$ decay.

The decay $\rho \to \pi^0 + \gamma$ is forbidden, since radiative $0 - 0$ transitions are forbidden. The decay $\rho \to \pi^+ + \pi^- + \gamma$ is allowed, if the pion pair is in a state with $L = 1$. Also allowed is the decay $\rho \to 2\gamma$, which is analogous to the decay $\pi^0 \to 2\gamma$. If $m_\rho > 2m_\pi$, one can expect the single photon decay to be more probable.

The expected time of decay is 10^{-18} to 10^{-20} sec.

It will be extremely difficult to identify the decay $\rho \to \pi^+ + \pi^- + \gamma$ in the presence of photon background from the $\pi^0 \to 2\gamma$ decay.

We propose below a method for detecting events of single production of ρ mesons in interactions of charged particles by energy-momentum balance. Consider the reaction $p_1 + p_2 \to p_3 + p_4 + \rho$, where

p_1 is a proton from the accelerator, p_2 is a proton at rest, and p_3 and p_4 are also protons.

This process is followed by the decay of the ρ meson, but we do not record the decay products. The energies and momenta of the protons p_1, p_3, and p_4 must be measured with great accuracy. Let us form the expression

$$A = [(E_1 + Mc^2 - E_3 - E_4)^2 - c^2 (p_1 - p_3 - p_4)^2].$$

For single production of ρ mesons we have $A = m_\rho^2 c^4$. In the case of an arbitrary process with production of two or more pions, we have a continuous spectrum of A values.

If it is observed in an experiment that there is a sufficiently narrow line (whose width must correspond to the accuracy of measurement of the magnitudes and directions of p_3 and p_4) in the distribution of A, the existence of a neutral meson with a strong nuclear interaction will have been demonstrated and its mass will have been determined.

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INTERACTION OF A MEDIUM WITH A CURRENT INCIDENT ON IT

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In the present note we analyze the interaction of a constant, straight current of strength I with a medium occupying the half-space $x \leq 0$ and described by arbitrary μ $\epsilon(\omega)$. The current is parallel to the dividing boundary and moves onto the medium with a velocity v which is perpendicular to the dividing boundary. Morozov[1] considered the interaction for the motion along a metal.

The force acting upon a unit current length is of the form

$$F_x = \frac{2I^2}{c^2\sqrt{1-\beta^2}} \int_0^\infty e^{-2kr} \frac{\zeta(-ikv)-\mu}{\zeta(-ikv)+\mu} dk, \tag{1}$$

$$r = -vt, \ \zeta(-ikv) = \zeta(\omega)\big|_{\omega=-ikv};$$

$$\mathrm{Re}\,\zeta > 0, \ \mathrm{Im}\,\zeta(-i\omega) = 0, \tag{2}$$

$$\zeta = \sqrt{1+\beta^2(\varepsilon(\omega)\mu - 1)}\,.$$

Expression (1) can be obtained, for instance, by applying the image method to the separate terms of a plane-wave expansion of the potential, taking it into account that the only singularities of the expressions under the integral sign are the poles ϵ and $1/\epsilon$ which lie in the upper half-plane of complex ω (see references 2 and 3; the time factor here is $e^{i\omega t}$).

For a dispersionless medium we get

$$F_x = -\frac{I^2}{c^2\sqrt{1-\beta^2}} \frac{\mu - \sqrt{1+(\varepsilon\mu-1)\beta^2}}{\mu+\sqrt{1+(\varepsilon\mu-1)\beta^2}} \frac{1}{r}. \tag{3}$$

For $\beta^2 > (\mu^2 - 1)/(\epsilon\mu - 1)$ the attraction changes into repulsion. For sufficiently small r, expression (3) is, of course, inapplicable since dispersion becomes important (from dimensional considerations, the order of magnitude of the excited frequencies is $\omega \sim v/r$).

If ζ is expanded in terms of $(\epsilon - 1)\beta^2$, and if we put $(\mu = 1, \ \beta^2 \ll 1)$

$$\varepsilon = 1 + \frac{4\pi ne^2}{m} \sum_k \frac{f_k}{\omega_k^2 - \omega^2 + i\gamma_k\omega}, \tag{4}$$

we find

$$F_x^k = \frac{\pi ne^2\beta}{mc^3 i\omega_k'} \{e^{-\alpha\eta_k + i\alpha}\,\mathrm{Ei}\,(-\alpha\eta_k - i\alpha)$$

$$- e^{-\alpha\eta_k - i\alpha}\,\mathrm{Ei}\,(-\alpha\eta_k + i\alpha)\}, \tag{5}$$

where Ei is the exponential integral, and

$$F_x = \sum_k f_k F_x^k; \quad \omega_k' = \sqrt{\omega_k^2 - \gamma_k^2/4};$$

$$\eta_k = \gamma_k / 2\omega_k'; \quad \alpha = 2\omega_k' r / v. \tag{6}$$

For $r \gg v/\omega_k$, from (5), in particular, we get in accordance with (3)

$$F_x = \frac{\varepsilon(0)-1}{4} \beta^2 \frac{I^2}{c^2} \frac{1}{r}, \tag{7}$$