plitude can be given only for some energy interval. This problem will be treated in another communication.

*The conditions imposed on the potential by this coincide with the condition that for $k \to \infty$ the scattering amplitude be given by the first Born approximation. Then the dispersion relations are valid for $\tau < 2\alpha$, where α is the maximum positive number for which the integral

$$\int_0^\infty e^{2\alpha} \, |V(y)| \, dy.$$

exists. We note, in addition, that if this integral exists for arbitrary α, then the scattering amplitude does not have "spurious poles."

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TWO CLASSES OF INTERACTION LAGRANGIANS

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LET us consider Lagrangians of the strong interaction of baryons and mesons, retaining their isotopic structure as given by Salam.[1] We note that the wave functions of particles belonging to the same isotopic multiplet behave similarly under all transformations.

We divide strong interaction Lagrangians into two classes. To the first class we assign interactions that contain at least one vertex where the fermion does not change a single one of its fundamental characteristics: mass, electric charge, strangeness. These are the electromagnetic interactions, the interactions of π mesons with nucleons, of π mesons with Σ particles, and of π mesons with Ξ particles. To the second class we assign interactions that contain only vertices at which the fermion necessarily changes at least one of its fundamental characteristics: mass, electric charge, strangeness. These are the interactions of π mesons with Λ and Σ particles, and also all interactions of K particles with baryons.

Let φ, χ, ϕ, ξ be operators of fields of spin zero which transform in the following ways under the operations of space inversion P, charge conjugation C, and time reversal T:

$$\begin{array}{lllll} P: & \varphi' = \varphi & \chi' = \chi & \phi' = -\phi & \xi' = -\xi \\ C: & \varphi' = \varphi^* & \chi' = -\chi^* & \phi' = \phi^* & \xi' = -\xi^* \\ T: & \varphi' = \varphi^* & \chi' = -\chi^* & \phi' = -\phi^* & \xi' = \xi^*. \end{array} \quad (1)$$

The interaction Lagrangians of the first class for the fields φ, χ, ϕ, ξ (taken truly neutral for simplicity) have different forms which cannot be reduced to each other, namely:

$$L_\varphi = g_\varphi \bar{\psi}\psi\varphi_0, \quad (2)$$

$$L_\chi = f_\chi \bar{\psi}\gamma_\mu\psi \, \partial\chi_0 / \partial x_\mu, \quad (3)$$

$$L_\phi = g_\phi \bar{\psi}\gamma_5\psi \; \phi_0 + f_\phi \bar{\psi}\gamma_5\gamma_\mu\psi \, \partial\phi_0 / \partial x_\mu. \quad (4)$$

A characteristic feature of the Lagrangians assigned to the second class is the presence, in addition to the usual terms, of interactions of the form $i(\bar{\psi}_1 O \psi_2 \theta - \bar{\psi}_2 O \psi_1 \theta^*)$. The Lagrangians of the second class describing the interaction of the bosons φ, χ, ϕ, ξ with the fermions ψ_1 and ψ_2, which have the same phase factors under the operations P, C, T, are written in the following form:

$$L_\varphi = g_\varphi (\bar{\psi}_1\psi_2\varphi + \bar{\psi}_2\psi_1\varphi^*) + if_\varphi \left(\bar{\psi}_1\gamma_\mu\psi_2 \frac{\partial\varphi}{\partial x_\mu} - \bar{\psi}_2\gamma_\mu\psi_1 \frac{\partial\varphi^*}{\partial x_\mu}\right), \quad (5)$$

$$L_\chi^* = ig_\chi (\bar{\psi}_1\psi_2\chi - \bar{\psi}_2\psi_1\chi^*) + f_\chi \left(\bar{\psi}_1\gamma_\mu\psi_2 \frac{\partial\chi}{\partial x_\mu} + \bar{\psi}_2\gamma_\mu\psi_1 \frac{\partial\chi^*}{\partial x_\mu}\right), \quad (6)$$

$$L_\phi = g_\phi \; (\bar{\psi}_1\gamma_5\psi_2\phi + \bar{\psi}_2\gamma_5\psi_1\phi^*) + f_\phi \left(\bar{\psi}_1\gamma_5\gamma_\mu\psi_2 \frac{\partial\phi}{\partial x_\mu} + \bar{\psi}_2\gamma_5\gamma_\mu\psi_1 \frac{\partial\phi^*}{\partial x_\mu}\right), \quad (7)$$

$$L_\xi = ig_\xi (\bar{\psi}_1\gamma_5\psi_2\xi - \bar{\psi}_2\gamma_5\psi_1\xi^*) + if_\xi \left(\bar{\psi}_1\gamma_5\gamma_\mu\bar{\psi}_2 \frac{\partial\chi}{\partial x_\mu} - \bar{\psi}_2\gamma_5\gamma_\mu\psi_1 \frac{\partial\chi^*}{\partial x_\mu}\right). \quad (8)$$

The interchanges*

$$\psi_2 \to -i\psi_2, \quad \chi \to \varphi, \quad g_\chi \to g_\varphi, \quad f_\chi \to -f_\varphi$$

bring the expression (6) to the form (5), and the interchanges

$$\psi_2 \to -i\psi_2, \quad \xi \to \phi, \quad g_\xi \to g_\phi, \quad f_\xi \to f_\phi$$

bring (8) to the form (7). Thus there are two types of Lagrangians of the second kind, namely (5) and (7), and the type of interaction is determined by the behavior of the boson field operator under the operation P.

As has been shown by Pais and Jost,[2] the requirement of invariance under C forbids the combination of the scalar and vector couplings for scalar particles. This is true, however, only for interactions of the first class; as can be seen from Eq. (5), a combination of scalar and vector couplings is possible for interactions of the second class.

Following the hypothesis put forward by the writer,[3] let us consider strong interactions invariant with respect to T, but possibly non-invariant with respect to P. As has been shown in Ref. 4, interactions of the second class contain terms in which the parity is not conserved, but isotopically invariant interactions of the first class without gradient coupling do not contain such terms.

In view of the possibility of the replacements $\psi_2 \to -i\psi_2$ and so on, there is only one form of Lagrangian of the second class that is invariant with respect to T, namely (gradient terms are omitted):

$$L = g(\bar{\psi}_1\gamma_5\psi_2\phi + \bar{\psi}_2\gamma_5\psi_1\phi^*) + ig'(\bar{\psi}_1\psi_2\phi - \bar{\psi}_2\psi_1\phi^*). \quad (9)$$

We note that the Lagrangians of the first class invariant with respect to T will be different for the operators φ and ϕ.

Since the behavior of the π-meson field under the transformation T is known, the terms of the interaction Lagrangian of baryons and mesons belonging to the first class are completely determined, and there exists only one form for the interaction of the second class. Therefore the isotopically invariant Lagrangian of the strong interaction of baryons and mesons, invariant with respect to T, is uniquely determined. The part of this Lagrangian invariant with respect to P has been given in Ref. 1, and the other part in Ref. 4.

*My attention was called to the possibility of this sort of replacements by Chzhou Guan-Chzhao, to whom I express my gratitude.

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ON THE SYSTEMATICS OF MESONS AND BARYONS

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In a paper by the writer[1] a classification of baryons has been given on the basis of two quantum numbers — the third component of the isotopic spin, t_3, and the third component of the so-called isotopic moment, v_3. The results obtained can be represented as shown in Table I.

TABLE I

Type of baryon	p	n	Ξ^0	Ξ^-	Σ^-	Σ^0	Σ^+	Ω^-	Λ^0	Z^+
t_3	$-\frac{1}{2}$	$+\frac{1}{2}$	$-\frac{1}{2}$	$+\frac{1}{2}$	1	0	-1		0	
v_3	$-\frac{1}{2}$		$+\frac{1}{2}$			0		1	0	-1

In order to obtain the analogous scheme for the mesons, one must set up the irreducible equations for the multiplets of free bosons.

We note that from the equation

$$[\beta_\nu \partial / \partial x_\nu + k_0 \exp(a\eta_5)]\psi = 0 \quad (1)$$

there follows the ordinary second-order wave equation. Here β_ν and η_ν are the Kemmer-Duffin matrices,[2] a is a constant, and

$$\eta_5 = \eta_1\eta_2\eta_3\eta_4. \quad (2)$$

Equation (1) is a generalization of the Proca-