dipole transitions and their polarizations. It turns out that the Zeeman picture of the transition $^2\Gamma_3$ ($^5I_7$) $\rightarrow$ $^2\Gamma_3^{(2)}$ ($^5I_8$) should consist of two π_m components, the relative intensity of which depends only on the coefficients A and B. We actually observed in our experiments in the π_m polarization two lines of different intensity. The difference in the intensities of these Zeeman components is due to the fact that the coefficient B of $^2\Gamma_3$ ($^5I_7$) is smaller than A as a result of the fact that the level $^3\Gamma_5^{(2)}$ is farther away from $^2\Gamma_3$ than $^3\Gamma_4^{(1)}$ is from $^2\Gamma_3^{(2)}$ ($^5I_8$).

A similar excitation of a forbidden line is observed in the spectra of CaF_2 and SrF_2 activated with Sm^{2+} in fields of 110 kOe [5].

We observed also the appearance in a magnetic field of the two lines B-I and B-II (λ = 2.346 μ and λ = 2.327 μ), the intensity of which is vanishingly small in the absence of a magnetic field. As seen from the level scheme in the figure, both lines are connected with transitions that are allowed by symmetry. Their very low intensity at $H_0 = 0$ is an accidental circumstance, connected with the character of the electric field of the CaF_2 crystal, which splits the states $^5I_7$ and $^5I_8$ of the Dy^{2+} ion.

The excitation of symmetry-allowed lines B-I and B-II in a magnetic field and the excitation of the forbidden line B-III are connected with the interaction of the closely-lying Stark sublevels. For example, the excitation of the B-II line is connected with the interaction of the closely-lying levels $^2\Gamma_3$ and $^3\Gamma_5^{(2)}$ of the state $^5I_7$ in the magnetic field. When the lines are excited, the intensity of the Zeeman components of the closely-lying allowed intense lines decreases. A transfer of intensity takes place.

In conclusion we note that the excitation of the B-I line observed by us was recorded also in [1].

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PHENOMENOLOGICAL BARYON-MESON INTERACTION LAGRANGIAN THAT IS INVARIANT AGAINST THE CHIRAL GROUP SU(3) × SU(3)

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Recently Weinberg [1], Schwinger [2], and Wess and Zumino [3] proposed a method of constructing a strong-interaction phenomenological Lagrangian satisfying the current algebra of the chiral group SU(2) × SU(2) and the hypothesis of partial conservation of the axial current (PCAC), making it possible to obtain their various consequences in simple form.

The method proposed in [1-3] is apparently highly general and can be applied to different dynamic systems with Goldstone-particle spectrum, and is a phenomenological method of describing the interaction of such particles.

In this note we consider a phenomenological Lagrangian for interacting baryons and pseudoscalar mesons for the case of the chiral symmetry group SU(3) × SU(3).*

1. A generalization of the linear transformation of Schwinger, Wess, and Zumino to the case of the chiral symmetry group SU(n) × SU(n) has the following form

$$\delta A = R + ARA - (1 + A^2)\left[\frac{Sp(A^2 R)}{n + Sp(A^2)}\right], \tag{1}$$

where A is an n-dimensional Hermitian matrix with zero trace, whose components correspond to meson fields apart from a normalization factor, and R is a similar matrix corresponding to infinitesimally small transformations of the type $\exp(i\gamma_5 R)$ of the chiral group SU(n) × SU(n).

2. Under the transformations (1) the baryon and meson fields which do not belong to A transform in accordance with representations induced by the subgroup SU(n) of transformations of the type exp(ih). The matrix h for the transformations of the type $\exp(i\gamma_5 R)$ is given by the following expression

$$-ih \pm (1 + A^2)^{1/2} RA (1 + A^2)^{-1/2} + (1 + A^2)^{1/2} \delta' (1 + A^2)^{-1/2}, \tag{2}$$

where the symbol δ' corresponds to variation of the expression following the symbol, with subsequent substitution $\delta' A = R + ARA$.

3. In the case of the group SU(3) × SU(3), we confine ourselves to a consideration of the octet of pseudoscalar mesons $M = f^{-1}A$ and the baryon B octet that transforms in accordance with the induced representation

$$\delta B = i[h, B]. \tag{3}$$

The phenomenological Lagrangian for this case is of the form

$$L = L_0 + L', \tag{4}$$

where L_0 is the part of the Lagrangian which is invariant against the transformations (1) and (3). If the derivatives of the meason field are of order not higher than the second for the meson part of the Lagrangian and the first for the terms of the interaction, then L_0 is given by

$$L_0 = S_p\{-\frac{1}{8f^2}\partial_\mu K \partial_\mu K^{-1} + \bar{B}(i\gamma_\mu \partial_\mu - m)B + \bar{B}\gamma_\mu [B, L_\mu^{(+)}]$$
$$+ a_F \bar{B}\gamma_5\gamma_\mu [B, L_\mu^{(-)}] + a_D \bar{B}\gamma_5\gamma_\mu \{B, L_\mu^{(-)}\}\}, \tag{5}$$

where

$$K = \left(\frac{1 + iA}{1 - iA}\right)\left(\frac{1 + {}^1/2 SpA^2 + {}^i/3 SpA^3}{1 + {}^1/2 SpA^2 - {}^i/3 SpA^3}\right)^{1/3} \tag{6}$$

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* A phenomenological Lagrangian for the chiral group U(3) × SU(3) was considered in [4,5] and partly in [3].

and

$$L_\mu^{(\pm)} = \frac{1}{2i}(K^{-1/2}\partial_\mu K^{1/2} \pm K^{1/2}\partial_\mu K^{-1/2}). \qquad (7)$$

L' is the part of the Lagrangian which breaks the SU(3) × SU(3) symmetry and which we shall not specify here concretely.

In expression (5), f, α_F, and α_D are phenomenological coupling constants. The constant f determines the S-wave lengths for the scattering of mesons by baryons. The constants α_F and α_D correspond to the known constants of the F- and D-couplings of the baryon and meson octets.

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SCATTERING OF AN ELECTRON NEAR THE FOCUS OF A LASER

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From the elastic scattering of an electron by an electromagnetic field of light waves it is possible to determine the intensity of the field and its distribution near the focus of a laser beam.

The interaction of the electron with the electromagnetic field is in this case the result of second-order forces proportional to grad $\bar{E}^2$ and due to the time-averaged term $(e^2/2mc^2)|\bar{A}|^2$ in the Hamiltonian of the electron [1].

In the nonrelativistic case the interaction force $F_y = -\partial\varphi/\partial y$ can be readily expressed in terms of the average kinetic energy

$$\phi(x, y) = \frac{e^2\bar{E}^2(x, y)}{4m\omega^2},$$

which is possessed by the electron if it undergoes oscillations described by the equation

$$m\ddot{\xi} = eE(x, y)\sin\omega t$$

near the point (x, y) of an alternating field $E(x, y)\sin\omega t$ with a slowly varying amplitude. Essentially $\varphi(x, y)$ should be regarded as the potential of the field from which the electron is scattered. If the energy of the electron moving in the direction of the x axis is

$$eU = \frac{mv^2}{2} \gg \varphi$$

and the scattering is at a small angle α in the focal plane (x, y)