NINTH PSEUDOSCALAR MESON IN BROKEN $SU_W(6)$ SYMMETRY

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1. There exists a point of view that the symmetry properties become weaker on going from the static to the collinear case, and further to complanar processes (hierarchy of subgroups) [1]. A group $SU_x(6)$ was proposed in [2], containing the group $SU_W(6)$ as the collinear limit; it leaves the free equations invariant and is applicable to binary reactions of the general type. This makes it possible to advance the hypothesis that the classification of particles and resonances, their masses, and the vertices and amplitudes of binary reactions can be considered in a unified relativistic manner on the basis of the $SU_x(6)$ group. In multiplets, however, the mass differences are large and it is clear that the symmetry will be broken.

We discuss in this note the possible violations of the $SU_W(6)$ group, and as the first step we obtain the mass formulas. In the analysis of the violations (spurions) we make use of the following natural requirements:

1. In order to conserve relativistic invariance and parity, the spurion must be a scalar with positive parity.

2. To conserve isospin and hypercharge, the spurion must transform like a singlet or like a 3-3 component of an octet relative to SU(3).

Besides these, there is one more requirement peculiar to the investigated group. The definition of the W- or x-spin matrices includes vectors e^i_μ [2] made up of the momenta of the particles that take part in the reaction. They must be excluded from the mass formulas. This leads to the third condition:

3. The spurion must be such that the masses split with respect to ordinary spin, but not W- or x-spin.

Finally, we confine ourseleves to spurions with two upper and two lower indices. A detailed analysis of the violations will be published elsewhere.*

In the general case we obtain two mass formulas for the mesons:

$$\chi + \eta + \pi = \omega + \phi + \rho, \tag{A}$$

i.e., the sums of the masses of the non-strange mesons are identical in the pseudoscalar and vector nonets, and

$$\begin{aligned} &\{[4K^* - \rho][3(\omega + \phi) - (4K^* - \rho)] - 9\phi\omega\}^{1/2} - \\ &- \{[4K - \pi][3(\chi + \eta) - (4K - \pi)] - 9\eta\chi\}^{1/2} = \sqrt{2}[(K - \pi) - (K^* - \rho)], \end{aligned} \tag{B}$$

where the particle symbol denotes the square of its mass, and χ is the ninth pseudoscalar meson. We note that formula (A) remains in force even when account is taken of the T^{33}_{33} component of the 27-plet from the higher representations of $SU_x(6)$.

Formulas (A) and (B) can be regarded as a system of equations for the determination of the unknown mass of the χ meson and the mass of the ρ meson (the ρ-meson width is large, 160 MeV, and the ρ-meson mass depends on the method of the experimental data reduction). Then, taking the masses of all the other particles from the tables [4], we find that the χ-meson mass is 1400 MeV,** and that of the ρ meson is 790 MeV. It follows therefore that formulas (A) and (B) are well satisfied if one takes the ninth pseudoscalar particle to be the E(1420) meson, whose most likely spin-parity value, according to new experimental data [5], is 0^+. The mixing angle of the η E mesons is 6.5°.

The meson $X^0(960)$ does not fit in the 0^- nonet from $SU_W(6)$. We note that it cannot be definitely assumed that the X^0 meson is pseudoscalar [7]. Its spin-parity was determined in [8] from the decay $X^0 \to \rho + \gamma$ by using only the simplest matrix elements and disregarding the higher multipole transitions, a procedure not convincingly justified at high energy release (∿ 200 MeV). If these transitions are taken into account, then an angular correlation of the $\sin^2\theta$ type appears not only for spin-parity 0^-, but also for 1^+, 2^-, etc. The Dalitz diagram for the $X^0 \to \eta 2\pi$ decay does not make it possible to distinguish between 0^- and 2^- [9] even when the simplest matrix elements are used.

The usual mass formulas of static SU(6) symmetry are obtained for the baryon 56-plet.

In conclusion, we emphasize once more that from the point of view of broken $SU_W(6)$ and $SU_x(6)$ symmetries it is very important to set up experiments aimed at a unique determination of the spins and parities of the E(1420) and $X^0(960)$ mesons. If the experiments confirm the value 0^- for the E(1420) meson, then this meson should be regarded as the ninth pseudoscalar meson within the framework of $SU_W(6)$ and SU_x; failure will serve as weighty evidence against $SU_W(6)$.

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*Octet $SU_W(6)$ symmetry breaking of a particular type was considered for vertices and annihilation by Gupta in [3].

**We note that Schwinger's formula [6] yields for the ninth pseudoscalar meson a mass value ∿ 1.6 GeV.

REAL PART OF SCATTERING AMPLITUDE AT HIGH ENERGIES AND DISPERSION SUM RULES

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1. The real part Re f(E) of the πN scattering amplitude at the (presently) maximum attainable energies, in the interval 6 - 28 GeV, was experimentally determined in a number of recent investigations [1,2]. It has turned out that Re f(E) is anomalously large in this