TWO AXIAL OCTETS

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The recently discovered nonet of tensor mesons [1]

$$\underline{9}(2^+) = A_2(1320) + K^{**}(1430) + f(1250) + f'(1525) \qquad (1)$$

can fit, within the framework of SU(6) symmetry, only in a supermultiplet of dimensionality 405

$$\underline{405} = \underline{9}(2^+) + \underline{27}(2^+) + \underline{9}(0^+) + \underline{27}(0^+) + \underline{8}(1^+) + \underline{8}(1^+) + \underline{10}(1^+) + \underline{10}^*(1^+) + \underline{27}(1^+). \qquad (2)$$

This 405-plet contains two axial octets, which differ in the G-parity of their nonstrange components. We propose to identify them with the known resonances in the following fashion:

$$\begin{aligned} \underline{8}^{(a)} &= A_1(1090) + C(1215) + E(1410), \\ \underline{8}^{(b)} &= B(1215) + C'(1330) + D(1280). \end{aligned} \qquad (3)$$

In this case we can explain many experimental regularities.

<u>Masses</u>. First to be verified is the interval rule

$$m_{A_1}^2 - m_C^2 = m_B^2 - m_{C'}^2 = m_{A_2}^2 - m_{K^{**}}^2. \qquad (4)$$

The maximum deviation from equality does not exceed 5%. This speaks in favor of joining the axial and tensor mesons in a single supermultiplet.

The Gell-Mann - Okubo formula is not satisfied for the octets, since each of them interferes with the decimets $\underline{10}$ and $\underline{10}^*$. By determining the mixing angle

$$\cos\theta_1 = \sqrt{2/3}, \qquad (5)$$

we obtain the particle masses from the formula

$$m^2 = m_a^2 \cos^2\theta + m_b^2 \sin^2\theta, \qquad (6)$$

$$m_\rho^2 = 1.380, \quad m_K^2 = 1.672, \quad m_\omega^2 = 1.755 \qquad (6a)$$

(ρ, K, and ω correspond to isospins 1, 1/2, and 0). They satisfy splendidly the octet mass formula

$$3m_\omega^2 + m_\rho^2 = 4m_K^2. \qquad (6b)$$

<u>Mixing angles</u>. The mixing angle of the axial octets with the decimets is given above - the good agreement of the masses confirms its correctness. The mixing angle in the nonet of tensor mesons can also be determined theoretically

$$\cos\theta_2 = 4/\sqrt{21}, \qquad \theta_2 = 29°. \qquad (7)$$

This is precisely the required experimental quantity (see [1]). We note incidentally that the mixing angle in the scalar nonet coincides with θ_2.

Widths. An axial meson cannot decay into a pair of particles having identical spin and parity. Its decay follows the scheme

$$(1^+) \rightarrow (0^-) + (1^-), \qquad (8)$$

with the symmetry of the 405-plet requiring that the coupling be of pure F type. This leads to the following relations between the widths

$$\Gamma(A_1) = \Gamma(B) = 2\Gamma(C) \qquad (9)$$

(the experimental values are 125, 122, and 60 MeV respectively [2]). In the decays of tensor mesons, pure D-coupling is realized, and if we assume that SU(6) symmetry is exactly satisfied, we obtain the ratio

$$\Gamma(A_2) = \tfrac{3}{5}\,\Gamma(B) \qquad (10)$$

(experiment yields a ratio 0.65 ± 0.10 [2]).

We can thus assume that the greater part of the 405-plet has already been observed.

This raises the following problems: a - searches for scalar mesons, b - searches for 27-plets. The second problem is easier to solve by investigating the states $K_+K^*_+$, $K_+\rho_+$, and $\pi_+\rho_+$. Discovery of a resonance in any of them would be evidence in favor of the existence of $27(1^+)$.

We note that the multiplets $27(1^+)$ and $27(2^+)$ are nonexistent if the particles considered are part of the 189-plet (and not the 405-plet). This supermultiplet, however, does not interact with the baryon current, and has different mixing angles and different types of decay interactions. All this influences us in favor of the 405-plet.

[1] S. Glashow and R. Socolow, Phys. Rev. Lett. 15, 329 (1965).
[2] A. Rosenfeld et al., Revs. Modern Phys. 36, 977 (1964).

NON-EINSTEINIAN GRAVITATION

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According to Einstein's hypothesis, the invariant Lagrangian density of the free gravitational field in $\Lambda = R/\kappa$, where R is the scalar space-time curvature and $\kappa = 2 \times 10^{-48}$ g/cm-sec^2. The only experimental argument in favor of this hypothesis is that it leads automatically to Newtonian gravitation and to correct relativistic corrections in the case of a weak field. The argument is not unique. An analysis shows that none of the presently known facts proves the incompatibility with experiment of an infinite set of non-Einsteinian expressions for Λ. Therefore, without patently contradicting experiment, we assume that the expression $\Lambda = R/\kappa$ is actually only an approximation, which is valid only for a sufficiently weak field (a criterion will be given later). Speaking somewhat more precisely - we assume that Einstein's equations do not present a fully equivalent description of non-quantum gravitation.