SU(6) SYMMETRY AND ELECTROMAGNETIC BARYON MASS SPLITTING

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The electromagnetic baryon mass differences in SU(6) symmetry were recently considered by Sakita[1] and Chan and Sarker[2]. However, the structure of the electromagnetic interaction was considered by them under more stringent limitations than are actually needed.

We propose the following structure of electromagnetic interactions leading to the splitting of the masses of particles within baryon multiplets:

$$B_{ABC}[3m_1\delta^A_{A'}\delta^B_{B'}C^C_{C'} + 9m_2\delta^A_{A'}C^B_{B'}C^C_{C'} + 9m_3\delta^A_{A'}(\underset{\to}{C})^B_{B'}(\underset{\to}{C})^C_{C'}]B^{A'B'C'} \qquad (1)$$

where B^{ABC} is a symmetrical tensor corresponding to the baryon octet and decuplet[2],

$$C^A_{A'} = \delta^\alpha_{\alpha'}Q^a_{a'}, \qquad \underset{\to}{C}{}^A_{A'} = (\underset{\to}{\sigma})^\alpha_{\alpha'}\, Q^a_{a'}$$

(α, a, and A are the indices of two-, three-, and six-component spinors, respectively), and

$$Q = \frac{1}{3}\begin{pmatrix} 2 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix}$$

is the charge operator in SU(3) space.

The structure of expression (1) is determined uniquely by the following natural requirements:

1. The elementary interaction of the baryons with the electromagnetic field, which breaks the SU(6) symmetry, is described by the operators $C^A_{A'}$ and $\underset{\to}{C}{}^A_{A'}$.

2. The operators $C^A_{A'}$ and $\underset{\to}{C}{}^A_{A'}$, enter bilinearly in the mass operator (1)[1].

Expression (1) leads to the following relations for the electromagnetic mass difference of the particles of the baryon octet:

$$p - n = m_1 + m_2 + m_3, \qquad \Sigma^+ - \Sigma^0 = m_1 + m_2 + 4m_3$$
$$\Xi^0 - \Xi^- = m_1 - 2m_2 + 4m_3, \qquad \Sigma^0 - \Sigma^- = m_1 - 2m_2 + m_3 \qquad (2)$$

and for the baryon decuplet

$$N^{*++} - N^{*+} = m_1 + 4m_2 + 4m_3, \quad Y_1^{*+} - Y_1^{*0} = m_1 + m_2 + m_3,$$
$$N^{*+} - N^{*0} = m_1 + m_2 + m_3, \quad Y_1^{*0} - Y_1^{*0} = m_1 - 2m_2 - 2m_3, \quad (3)$$
$$N^{*0} - N^{*-} = m_1 - 2m_2 - 2m_3, \quad \Xi^{*0} - \Xi^{*-} = m_1 - 2m_2 - 2m_3$$

From (2) and (3) follow all the relations for the mass differences obtained in SU(3) symmetry.[3] In addition, the following relations hold between the octet and decuplet particle masses:

$$N^{*+} - N^{*0} = Y_1^{*+} - Y_1^{*0} = p - n$$
$$N^{*0} - N^{*-} = Y_1^{*0} - Y_1^{*-} = \Xi^{*0} - \Xi^{*-} = p - n - \Sigma^+ - \Sigma^- + 2 \quad (4)$$
$$N^{*++} - N^{*+} = p - n + \Sigma^+ + \Sigma^- - 2$$

Comparison of (4) with the experimental mass values is impossible at present, owing to the large errors in the determination of the resonance masses.

In conclusion, the author thanks A. I. Akhiezer for discussing the present results.

[1] B. Sakita, Phys. Rev. Lett. 13, 643 (1964).

[2] C. H. Chan and A. G. Sarker, Phys. Rev. Lett. 13, 731 (1964).

[3] S. P. Rosen, ibid, 11, 100 (1963).

1) We note that the term of (1) linear in C_A^A, is the result of the relations $\underset{\rightarrow}{C}{}_{A\rightarrow}^{B}C_{B}^{C} = 3C_A^B C_B^C = C_A^C + (2/3)\delta_A^C$.

ELECTRIC RESISTIVITY OF METALS WITH LOW MAGNETIC IMPURITY IN THE PRESENCE OF IMPURITY FERROMAGNETISM AND AN EXTERNAL MAGNETIC FIELD

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In an earlier note[1] we presented the results of calculations of the electric resistivity of a nonmagnetic metal with small admixture of magnetic atoms. In the present paper we consider the case of impurity ferromagnetism, and determine the dependence of the resistivity on an external magnetic field.