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Is There a Third Companion of L and S^0?

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The idea was exploited in Ref.1 that nucleon can be considered as quark-diquark system following the proposal of Ida and Kobayashi [2] and Lingenfeld and Tassie [3]. If to assume that magnetic moment of a nucleon can be expressed as the sum of Dirac magnetic moments of different quarks

$$\mathbf{m} = m_N \mathbf{S} e_i g_i \mathbf{J}_i \qquad (1)$$

here e_i, g_i and $\mathbf{J}_i$ are the charge, factor of Lande and moment of a constituent quark, m_N- is a nuclear magneton, then one can write the system of two equations: for magnetic.moments of neutron and proton as different members of one isospin multiplet. The expression (1) assumes that the only representative mass parameter is a mass of a nucleon which determines the overall scale. This supposition is quite natural for confined quarks. The nucleon is a good object to compose this system because the masses of neutron and proton are very close (the mass difference is about 0.1% of a mass of a nucleon what is not observed for other baryons).

So if to take into account that diquark can exist as a pair of like quarks and as a pair of different quarks two systems of equations can be written:

Case I: n = u + dd p = d + uu

$$\begin{cases} \frac{2}{3} g_1 J_1 - \frac{2}{3} g_2 J_2 = -1.913 \\ -\frac{1}{3} g_1 J_1 + \frac{4}{3} g_2 J_2 = 2.793 \end{cases}$$

From here it follows that: g_1J_1= -1.033 and g_2J_2 =1.836

The fact that g_1J_1 turned out to be very close to 1 means that the single quark acts as elementary particle placed at the center of nucleon, some extra of 0.033 may be assumed here as a correction similar to the Schwinger correction to magnetic moment of electron.

Case II. The similar equations can be written for the case when diquark **ud** is in a state $^3S_1$, only here g_1J_1 is the value assigned to the single quarks, constituents of a diquark **ud**:

n = ud + d p = ud + u

$$\begin{cases} \frac{1}{3} g_1 J_1 - \frac{1}{3} g_2 J_2 = -1.913 \\ \frac{1}{3} g_1 J_1 + \frac{2}{3} g_2 J_2 = 2.793 \end{cases}$$

To satisfy this system one should take: g_1J_1= -1.033 and g_2J_2 =4.7. The fact that g_1J_1 turned out to be close to 1 (with the same correction) agrees perfectly with the assumption ^3S . Generally we have two

close to 1 (with the same correction) agrees perfectly with the assumption $^3S_1$. Generally we have two more states in this case: one with a spin of a peripheral quark up, and another one - with a spin down.

The argument in favor that the model presented here is realistic is that one finds agreement with the measured magnetic moments of both nucleons if quarks at the center of nucleon act as elementary particles, this is observed for all three states. Qualitatively this conforms the parton model of the nucleon and *x*-scaling behavior in deep-inelastic lepton scattering. A notable thing is also that if to consider a center of nucleon as the place of the highest priority, the couple of mixed quarks is ?stronger? then a single quark which is ?stronger? then a couple of like quarks. Figure 1 of Ref.1 illustrates these states. The question why these states can be the stationary states is discussed in Ref. 4. Of course the arguments presented here are very speculative but if these states are real and will be found [5], this can be important in view of their possible application in practice.

For the quark content uds (or udc, udb) one can expect three possible configurations: ud + s, us + d, ds + u. Two baryons of this quark content were found: L and S^0. In the framework of our consideration one more baryon of this type is missing. In fact it well may be that the third companion was really observed. The last update of Particle Data Group [6] tells about S(1670) and S(1670)B that ?Probably There are two states at the same mass with the same quantum numbers, one decaying to Sp and Lp, the other to L(1405) p?. This can be the manifestation that the scheme discussed here is valid.

References.

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