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Spin Crisis of Proton and Baryon's Magnetic Moment

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ABSTRACT

At the end of the 1960s, a collaboration of physicists from the Massachusetts Institute of Technology and the Stanford Linear Accelerator Center (SLAC) studied the inner structure of nucleons by passing a high-energy beam of electrons through liquid hydrogen. In the mid-1980s experimental results indicated that essentially none of a nucleon's spin was attributable to its quarks' spins. That surprise birthed the "spin crisis." EMC deep inelastic experiment using a polarized muon beam scattering on a polarized hadron target has raised serious question about spin crisis. The proton spin crisis (sometimes called the proton spin puzzle) is a theoretical crisis precipitated by an experiment carried out by EMC (European Muon collaboration) in 1987 at CERN. This experiment has shocked the particle physics community; none or little proton's spin can be attributed to the spin of three constituent quarks, two up and one down quark. The concept of rotating proton has been first emphasized by Chou and Yang in 1974. In continuation, there were several attempts; the baryon magnetic moment has been executed to explain the importance of constituent quark rotation. In 1999 M Casu and LM Sehgal in his paper proposed a successful model with collective quark rotation is used in discussing proton's spin and baryon magnetic moment. After this so many attempts has been tried to get the fitting parameters to the experimental results. Li and X Cai a model with collective quark rotation is used with great success to get the better fits to the experimental results. The contribution from the orbital angular moment with some additional modifications we have calculated to better fits.

Key words: Spin crisis, EMC, Naive quark model, quark rotation asymmetry, baryon magnetic moment

INTRODUCTION

The proton spin crisis refers to the experimental finding that very little of the spin of the proton contributed to the spin of quarks by which it was built up as spin is a fundamentally quantum mechanical theory. According to Bohr the whole experimental setup must be considered when we observe quantum mechanical systems. It means that "quantal object does not really exist" independently how it is observed.

For spin of the proton, let us compare two different experimental set ups designed to measure it ;(1) The Stern-Gerlach experiment which uses as an inhomogeneous magnetic field to measure the proton spin state;(2) Deep inelastic scattering (DIS) which uses an elementary probe (electron and neutrino) that in elastically scatters of the proton. In (1) and (2), according to Bohr's complimentary physical set ups if one measures the first, the other cannot be measured simultaneously, and vice -versa. SG thus measures the total spin state of proton, but does not resolve any patrons.

Fig.1 At low resolution the proton appears to be a "soft" blob (gray), about 2 × 10^{-15} meter

Fig.2 The quark model describes the proton as the sum of two up quarks (*green*) and one down quark (*blue*)

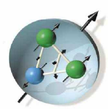

Fig.3 Experiments at the end of the 1960s revealed quarks to be essentially point particles within the proton, and the theory of quantum chromodynamics (QCD) described the force holding them together, illustrated here as a kind of elastic cord (*white*). The cord is a manifestation of particles (gluons) that each has a spin of one

Another complication is the following; while in quantum electrodynamics an atomic wave function can approximately be separated into independent parts due to the weak interaction and spin of the constituents (nuclei and electrons) can be measured separately as they can be studied in isolation. In quantum chromo dynamics it fails as the interaction between fields in an undisturbed proton is much stronger than in the QED state.

The proton spin crisis (sometimes called the "proton spin puzzle") is a theoretical crisis precipitated by an experiment in 1987 which tried to determine the spin configuration of the proton. The experiment was carried out by the European Muon Collaboration (EMC). Physicists expected that the quarks carry all the proton spin. However, not only was the total proton spin carried by quarks far smaller than 100%, these results were consistent with almost zero proton spin being carried by quarks. This surprising and puzzling result was termed the "proton spin crisis". The problem is considered one of the important physics. It is generally held that the NRQM predicts [1], a value for the nucleon-axial vector coupling constant. GA/ GV = 5/3 which is quite differing from current algebra estimation. As it was known in naïve quark model (NQM) the proton spin is assumed to be carried by three valence quarks. As a rough approximation, every meson can be regarded as consisting of quarks and anti quarks and every baryon of third quarks. To be more precise, in addition to valent quarks and (anti quarks) every hadron contains a 'sea' of continuously produced and absorbed virtual quark and anti quark pairs. Virtual gluons are also often included in the sea concept. All constituent sub particles included in the sea concepts of hadrons (i.e. valent quarks and virtual particles consisting the sea) are partons.

In 1987 , [2-3] the European Muon collaboration, which had been scattering muon off polarized proton at CERN , shocked the particle physics community , none or little proton's spin can attributed to the spin of three constituent quarks, two up and one down quarks. These experiments represented the surprising conclusion that only small part of the proton spin is carried out by the spin of light (quark anti quarks), it contains. Some author urged that the proton's spin is contributed by the orbital angular momentum of constituent quarks. At that time, there was quite contradiction between the EMC data and theoretical predictions [4-7]. The concept of rotating proton has been first emphasized by Chou and Yang in 1974. In continuation, there was several attempts has been executed to explain the importance of constituent quark rotation. Meng et al [9] has performed the experiments to test the possibility of exiting rotational constituents in attempts. The baryon magnetic moments in regards the sea quark polarization in the proton, GSE (generalized Sehgal equation) has been derived which linked quark axial vector currents [10-11]. Casu and Sehgal [12] proposed a successful model with collective quark rotation to explain the proton spin and baryon magnetic moment with a appreciable achievement of experimental fittings. In a recent work by Li and Cai, a model with collective quark rotation is used in discussing proton's spin and baryon magnetic moment with a great success to get the better fits to the experimental results. They have assumed the interaction potential enforced on constituents to be linear and Columbians as well [15]. Later on different approaches [16-24] have been executed to attain so better theoretical predictions to achieve the goal for better and nearest justified experimental findings.

Using the same concept as mentioned above, with some modification, we have calculated the baryon moments in terms of quark moments. We fit the baryon magnetic moments with those from experiments.

In section 2, the formulae for baryon magnetic moments in terms of quark moments are derived [13-14] quantum mechanically. In section 3, the contribution from the orbital angular moment with some modification was calculated and fitted results are presented in table 1 and 2. The last section is a brief conclusion.

FORMULA FOR BARYON MAGNETIC MOMENT IN TERMS OF QUARK MOMENTS

In this section, we calculated the baryon magnetic moments, without the contribution from constituent quark rotation. The spin of polarized proton in z direction is related to the z component of the polarized quark and anti quark as mentioned bellow- $\langle S_z \rangle = (\Delta u + \Delta d + \Delta s)/2$,

with Δq ,the net polarization of quark of flavour q ,and $\Delta q = \int dx\left[q_+(x) - q_-(x)\right] + \int dx\left[\bar{q}_+(x) - \bar{q}_-(x)\right]$,

With $q_\pm\left(\bar{q}_\pm\right)$ being the densities of parton quark (anti quarks)with helicities $\pm\frac{1}{2}$ in a proton with helicity ½. Δu , Δd and Δs are the parton spins, which can be related to the values of the axial vector coupling constants G_A,a^8 and S_z as follows;

$$\Delta u = \frac{2}{3}\langle S_z \rangle + \frac{1}{2}G_A + \frac{1}{6}a^8$$

$$\Delta d = \frac{2}{3}\langle S_z \rangle - \frac{1}{2}G_A + \frac{1}{6}a^8$$

$$\Delta s = \frac{2}{3}\langle S_z \rangle - \frac{1}{3}a^8$$

We take G_A and a^8 their experimental measured values 1.26 and 0.60 respectively, $\langle S_z \rangle$ is used as a fitting parameter. The magnetic moment operator $\hat{\mu}_B$ of a baryon is given by-

$$\hat{\mu}_B = \sum_{i=1}^{3} \mu_q(i)\hat{\sigma}(i)$$

Where the sum is over the three quarks in baryon and $\hat{\sigma}$ is the Pauli's matrix. The magnetic moment of any baryons is the expectation value of quark moment $\mu_q(i)$ with respect to a baryon wave function Ψ_B which is maximum polarized along the z axis that is [13]

$$\mu_B = \langle \Psi_B | \sum_{i=1}^{3} \mu_q(i)\hat{\sigma}(i) | \Psi_B \rangle$$

With special values of flavour and spin wave function μ_B may be calculated in terms of quark's moments for spin ½ baryon octet as follows [13-14]

$$\underline{\mu}(P) = \mu_u\delta_u + \mu_d\delta_d + \mu_s\delta_s$$
$$\underline{\mu}(n) = \mu_u\delta_u + \mu_d\delta_u + \mu_s\delta_s$$
$$\underline{\mu}(\Sigma^+) = \mu_u\delta_u + \mu_d\delta_s + \mu_s\delta_d$$
$$\underline{\mu}(\Sigma^-) = \mu_u\delta_s + \mu_d\delta_u + \mu_s\delta_d$$
$$\underline{\mu}(\Xi^0) = \mu_u\delta_d + \mu_d\delta_s + \mu_s\delta_u$$
$$\underline{\mu}^{(\Lambda^0)} = \frac{1}{6}(\delta_u + 4\delta_d + \delta_s)(\mu_u + \mu_d) + \frac{1}{6}(4\delta_u - 2\delta_d + 4\delta_s)\mu_s$$
$$\underline{\mu}^{(\Sigma^0)} = -\frac{1}{2\sqrt{3}}(\delta_u - 2\delta_d + \delta_s)(\mu_u - \mu_d)$$

Where δ_q is expressed as –

$$\delta q = \int dx\left[q_+(x) - q_-(x)\right] - \int dx\left[\bar{q}_+(x) - \bar{q}_-(x)\right]$$

Which differs from Δq in the sign of anti quark contribution. To relate Δq and δq, we have employed with the same manner as [12] with the hypothetical assumptions, which are basically based on the consideration of nucleonic structure. Hence these considerations may be reasonable and acceptable.

Hypotheses I

Under this assumption, the sea quarks in a polarized baryon reside entirely in a cloud of spin zero mesons. In this case antiquarks have no net polarization i.e. $q_+ - \bar{q}_- = 0$, so that $\Delta q = \delta q$. Models of this type have been discussed in [12].

Hypotheses II

In this hypotheses sea quarks (antiquarks) are generated entirely by the perturbative splitting of gluons: $q \rightarrow q\bar{q}$, In such a case , it is reasonable to expect $\bar{u}_+ - \bar{u}_- \approx \bar{d}_+ - \bar{d}_- \approx k\left(\bar{s}_+ - \bar{s}_-\right) \approx k\left(s_+ - s_-\right)$ where k represents the relative abundance of various antiquark within the baryon. For K=1, it is the case in ref.[14]. Generally $\delta u = \Delta u - k\Delta s$, $\delta d = \Delta d - k\Delta s$ and $\delta s = 0$, the case K=0.5 has also discussed in [15]. We have taken K=0.75 in our work.

Considering, all the above parameters with additional two relationship i.e. $\mu_u = -2\mu_d$ and $\mu_{s=}\left(3/5\right)\mu_d$, one can reexpress the contributions of quark moments to the baryon magnetic moments in terms of the parameters μ_u , G_A and a^8 in which only μ_u and $\langle S_z \rangle$ are undetermined.

QUARK ROTATION ASYMMETRY AND BARYON MAGNETIC MOMENTS

It has assumed hypothetically that the quarks in baryon are hold together by flux string in "Mercedes Star" configuration. The quark will tend to be situated at the corner of equilateral triangle (in figure).The whole structure containing three quarks rotates collectively around the z axis, with total angular momentum $\langle L_z \rangle$. Resultantly these effects of an angular momentum $\langle L_z \rangle$ associated with the motion of three constituent quarks has to be added with magnetic moment of baryons in terms of quark moments. Some reasonable and fitted with experimental results has obtained. In reference [12], the total angular momentum $\langle L_z \rangle$ of a polarized proton can be resolved as $J_z = S_z + L_z + \Delta G = \frac{1}{2}$. Here L_z is only due to orbital motion of quark within the baryon shared by all the constituents. In this reference, it has considered that each revolving quark have equal radius r, then orbital angular momentum of each quark is merely proportional to its mass. With more appreciable attempts due to simplicity of ideas, the theoretical estimation of magnetic moment of baryons was quite impressive.

Later on reference [15] , it has urged that when SU(2) as well as SU(3) symmetry was violated , in other words , we can say that mass of strange quark becomes greater than u and d quarks, resultantly rotational symmetry is broken and then effect of constituent quark asymmetry became possible. The concept of asymmetry may be resides in the sense that each constituent quark rotates along the geometrical centre of triangle composed by three quarks, but due to mass difference between constituents, the triangle is scalene instead of equilateral; which means the radius r for each constituent quark when they rotate along the z-axis is different. In reference [15], it has assumed that centripetal force required for revolving electron is entirely provided by the interaction between constituents. The interaction potential has assumed to be in simplest form. The total interaction potential enforced on a quark from rest of all other quarks within the baryons are assumed to be proportional linear arly or inversely to the revolving radius of quark. The first interaction potential form corresponds to the color tube while other is Colombian type.

In the first case, it has considered a quark in a linear potential say U = Cr, where C is a positive number and r is the radius of quark with mass m revolving around the axis. The force acting on a quark F = -dU/dR ,it means F= -C is constant. This force acting on all revolving quarks are the same for for energy valence quark within the baryons. Now using F = ma = m dv/dt = m dr ω /dt = mv ω = m ω^2r .One can get the dependence r on m as r= F/mw^2 which indicates $r \propto 1/m$, this dependence may also get from orbital angular momentum L_z = r x p where $r = \frac{L_z}{mv}$ then $r \propto 1/m$ also .

Hence orbital angular momentum contributed from quark q_i of mass m_i is the multiplication of mass m_i is the multiplication of the mass factor with L_z as follows-

$$\left[\frac{1}{m_i} \Bigg/ \frac{1}{m_1} + \frac{1}{m_2} + \frac{1}{m_3} \right] \langle L_Z \rangle$$

Adding the revolving quark contribution to baryon magnetic moment mentioned in reference [15], when the interaction potential between constituents have assumed to be linear one. In each hypothesis, there are two fits.

In fit 1, we let μ_u ,S_Z as fitting parameters with the constraints $\langle L_Z + S_Z \rangle = 1/3$. In fit 2 μ_u ,$\langle S_Z \rangle$ and $\langle L_Z \rangle$ as fitting parameters where $\langle S_Z \rangle$ and $\langle L_Z \rangle$ are free . In fitting results are given in table with reference [15].

In the same work [15], the second assumed interaction potential between the constituent quark is of the coulomb type , $U = C/r$, then the force acting on a quark $F = -dU/dr$, and then $F = -\frac{d}{dr}\left(\frac{C}{r}\right)$ also then we will get F = C/r^2 but $F = m\omega^2 r$ and then $m\omega^2 = C/r^3$ which indicates clearly $m \propto 1/r^3$ or $r \propto 1/\sqrt[3]{m}$. Hence the orbital angular momentum carried by quark q_i of mass m_i is as follows-

$$\left[\sqrt[3]{m_i} \Big/ \sqrt[3]{m_1} + \sqrt[3]{m_2} + \sqrt[3]{m_3} \right]$$

With this revolving quark correction, taken into consideration of interaction potential is assumed to be Columbian like one, has in reference [15]. In the correction term $\lambda^* = \left[\sqrt[3]{m_d / m_s}\right] = \sqrt[3]{0.6}$, the fitted results are given in table 1 and 2 in work [15].

In our work, we have to assumed the second order linearity of interaction potential as $U = Cr + Cr^3$, in which we have to implemented only Cr^3, where $r \propto m$. Hense the orbital angular momentum contribution from quark of mass m_i is as follows- $\left[\dfrac{\frac{1}{m_i}}{\frac{1}{m_1}+\frac{1}{m_2}+\frac{1}{m_3}}\right]\langle L_Z\rangle$

Mentioned in above is merely a mass parameter of quark q_i with mass m_i .Then the correction term for revolving quark of concerning baryon may be written, after multiplication with orbital angular momentum $\langle L_Z\rangle$ in such a way.

For each constituent of proton and neutron, the mass parameter, which is basically the ratio of corresponding quark to all the addition of baryon may be written as-

For proton -u quark – the mass parameter is-

$$\left[\dfrac{m_u \times \frac{1}{m_u}}{\left[m_u + m_u + m_d\right] \times \frac{1}{m_u}}\right] = 1/3$$

and also for d-quark the mass parameter is-

$$\left[\dfrac{m_d \times \frac{1}{m_d}}{\left[m_u + m_u + m_d\right] \times \frac{1}{m_d}}\right] = 1/3$$

The value of 1/3 is quite analogous to the case $r \propto m$ as before. If we multiply their mass parameter to the corresponding quark moments associated with orbital angular momentum $\langle L_Z\rangle$, then correction term (rotation asymmetry) may be expressed as-

For proton- $\left[2\mu_u \times 1/3 + \mu_d \times 1/3\right]\langle L_Z\rangle$

Foe neutron- $\left[2\mu_d \times 1/3 + \mu_u \times 1/3\right]\langle L_Z\rangle$

Which as the same as discussed in reference [15].

In the same fashion the constituent of $\Sigma^+(uus)$, we let the Parameters as –

For constituent u quark - $1/(2+\lambda)$

For particle constituent s quark - $\lambda/(2+\lambda)$

Now multiplying these parameters to the mass parameter of proton (unit parameter) 1/3 separately and taking square root, we get for $\Sigma^+(uus)$ as follows-

For u quark- $\left[1/\left\{3\left(2+\lambda^2\right)\right\}^{1/2}\right]$

For s quark- $\left[\lambda \Big/ \left\{3\left(2+\lambda^2\right)\right\}^{1/2} \right]$

Now multiplying these terms to the corresponding quark moment associated with the orbital angular momentum $\langle L_Z \rangle$, we can get the correction (rotation asymmetry) term for $\Sigma^+(uus)$ as follows-

$$\left[\left(2\mu_u \Big/ \left\{3\left(2+\lambda^2\right)\right\}^{1/2}\right)+\left(\mu_s\lambda \Big/ \left\{3\left(2+\lambda^2\right)\right\}^{1/2}\right)\right]\langle L_Z \rangle$$

In the same procedure, for all other baryon, the correction term may be obtained. In aggregate, one can get the entire formulae of baryon magnetic moment when the interaction potential between constituent is taken to be only linear one.

$$\mu_L(P)=\underline{\mu}(P)+\left[2\mu_u\times 1/3+\mu_d\times 1/3\right]\langle L_Z \rangle$$

$$\mu_L(P)=\underline{\mu}(P)+\left[2\mu_u\times 1/3+\mu_d\times 1/3\right]\langle L_Z \rangle$$

$$\mu_L(\Sigma^+)=\underline{\mu}(\Sigma^+)+\left[2\mu_u \Big/ \left\{3(\lambda^2+2)\right\}^{1/2}+\mu_S\lambda \Big/ \left\{3(\lambda^2+2)\right\}^{1/2}\right]\langle L_Z \rangle$$

$$\mu_L(\Sigma^-)=\underline{\mu}(\Sigma^-)+\left[2\mu_d \Big/ \left\{3(\lambda^2+2)\right\}^{1/2}+\mu_S\lambda \Big/ \left\{3(\lambda^2+2)\right\}^{1/2}\right]\langle L_Z \rangle$$

$$\mu_L(\Xi^-)=\underline{\mu}(\Xi^-)+\left[2\mu_s.\lambda \Big/ \left\{3(2\lambda^2+1)\right\}^{1/2}+\mu_d \Big/ \left\{3(2\lambda^2+1)\right\}^{1/2}\right]\langle L_Z \rangle$$

$$\mu_L(\Xi^0)=\underline{\mu}(\Xi^0)+\left[2\mu_s.\lambda \Big/ \left\{3(2\lambda^2+1)\right\}^{1/2}+\mu_u \Big/ \left\{3(2\lambda^2+1)\right\}^{1/2}\right]\langle L_Z \rangle$$

$$\mu_L(\Lambda^0)=\underline{\mu}(\Lambda^0)+\left[\mu_u \Big/ \left\{3(2+\lambda^2)\right\}^{1/2}+\mu_d \Big/ \left\{3(2+\lambda^2)\right\}^{1/2}+\mu_s\lambda \Big/ \left\{3(2+\lambda^2)\right\}^{1/2}\right]\langle L_Z \rangle$$

Where $\lambda = m_u/m_s = m_d/m_s$ where the subscript L indicates linear potential ones .In our work , we fit the baryon magnetic moment with two different hypotheses . for every hypothesis ,we perform two fits. In fit 1, we let μ_u ,S_z□ as fitting parameter , with the constraint $\langle L_Z \rangle+\langle S_Z \rangle = 1/2$. In fit 2, μ_u ,S_z□ and L_Z are fitting parameters, where $\langle L_Z \rangle$ and $\langle S_Z \rangle$ are free. The fitting results are given in table1.

For the second assumed potential, the interaction between constituent quark is of Colombian type U=C/r, where $r \propto \sqrt[3]{m_i}$. Hence orbital angular momentum carried by quark q_i of mass m_i is $\sqrt[3]{m_i} \Big/ \left[\sqrt[3]{m_1}+\sqrt[3]{m_2}+\sqrt[3]{m_3}\right]\langle L_Z \rangle$

Now we have to take into account with the same analogy as preceding before. The mass parameter for proton and neutron will become 1/3.For other particles of baryons, let us take $r^2 \propto \left(1/\sqrt[3]{m_i} \right)^2$. In this way for each constituent quark of baryon, the mass parameter may be written as,

For Σ^+ (uus) for u constituent quark $\left(\sqrt[3]{m_u}\right)^2 \Big/ \left[\sqrt[3]{m_u} + \sqrt[3]{m_u} + \sqrt[3]{m_s}\right]\langle L_Z \rangle$

For Σ^+ (uus) for s constituent quark $\left(\sqrt[3]{m_s}\right)^2 \Big/ \left[\sqrt[3]{m_u} + \sqrt[3]{m_u} + \sqrt[3]{m_s}\right]\langle L_Z \rangle$

If we devide $\left(\sqrt[3]{m_u}\right)^2$ on numerator and de numerator and also putting $\lambda =$ □m_u/m_s = □m_d/m_s then we will get the mass parameters for and s quark are - $\lambda^{*2} / 2\lambda^{*2} + 1$ and $1/ 2\lambda^{*2} + 1$ respectively.

Now multiply these mass parameters to the proton mass parameter (unit parameter), then those mass parameter s mentioned above will become as follows-

For u constituent quark - $\lambda^{*2} \big/ 3\left(2\lambda^{*2} + 1\right)$

For s constituent quark - $1 \big/ 3\left(2\lambda^{*2} + 1\right)$

Now taking the case $r \propto \sqrt[3]{m}$

Then these parameters will become -

For u quark - $\lambda^{*} \big/ \left\{3\left(2\lambda^{*2} + 1\right)\right\}^{1/2}$

For s quark - $1 \big/ \left\{3\left(2\lambda^{*2} + 1\right)\right\}^{1/2}$

Now multiply these terms to the corresponding quark moment associated with orbital angular momentum $\langle L_Z \rangle$ where $\lambda^* = \sqrt[3]{m_u/m_s} = \sqrt[3]{m_d/m_s} = 0.87$ the correction term (rotational asymmetry) may be written as-

$$\left[\frac{2\mu_u \times \lambda^*}{\left\{3\left(2\lambda^{*2}+1\right)\right\}} + \frac{\mu_s}{\left\{3\left(2\lambda^{*2}+1\right)\right\}}\right]\langle L_Z \rangle$$

Resultantly one can get the entire formula of baryon magnetic moment when the interaction potential between constituent quark is assumed to be Colombian one,

$$\mu_C(P) = \underline{\mu}(P) + \left[2\mu_u \times 1/3 + \mu_d \times 1/3\right]\langle L_Z \rangle$$

$$\mu_C(N) = \underline{\mu}(N) + \left[2\mu_d \times 1/3 + \mu_u \times 1/3\right]\langle L_Z \rangle$$

$$\mu_C(\Sigma^+) = \underline{\mu}(\Sigma^+) + \left[\frac{2\mu_u \times \lambda^*}{\left\{3\left(2\lambda^{*2}+1\right)\right\}^{1/2}} + \frac{\mu_s}{\left\{3\left(2\lambda^{*2}+1\right)\right\}^{1/2}}\right]\langle L_Z \rangle$$

$$\mu_C(\Sigma^-) = \underline{\mu}(\Sigma^-) + \left[\frac{2\mu_d \times \lambda^*}{\left\{3\left(2\lambda^{*2}+1\right)\right\}^{1/2}} + \frac{\mu_s}{\left\{3\left(2\lambda^{*2}+1\right)\right\}^{1/2}}\right]\langle L_Z \rangle$$

$$\mu_C(\Xi^-) = \underline{\mu}(\Xi^-) + \left[\frac{2\mu_s}{\{3(\lambda^{*2}+2)\}^{1/2}} + \frac{\mu_d \lambda^*}{\{3(\lambda^{*2}+2)\}^{1/2}} \right] \langle L_Z \rangle$$

$$\mu_C(\Xi^0) = \underline{\mu}(\Xi^0) + \left[\frac{2\mu_s}{\{3(\lambda^{*2}+2)\}^{1/2}} + \frac{\mu_u \lambda^*}{\{3(\lambda^{*2}+2)\}^{1/2}} \right] \langle L_Z \rangle$$

$$\mu_C(\Lambda^0) = \underline{\mu}(\Lambda^0) + \left[\frac{\mu_u \lambda^*}{\{3(2\lambda^{*2}+1)\}^{1/2}} + \frac{\mu_d \lambda^*}{\{3(2\lambda^{*2}+1)\}^{1/2}} + \frac{\mu_s}{\{3(2\lambda^{*2}+1)\}^{1/2}} \right] \langle L_Z \rangle$$

$$\mu_C(\Sigma^0) = \underline{\mu}(\Sigma^0) + \left[\frac{\mu_u \lambda^*}{\{3(2\lambda^{*2}+1)\}^{1/2}} + \frac{\mu_d \lambda^*}{\{3(2\lambda^{*2}+1)\}^{1/2}} + \frac{\mu_s}{\{3(2\lambda^{*2}+1)\}^{1/2}} \right] \langle L_Z \rangle$$

Where $\lambda^* = \left\{ \sqrt[3]{\frac{m_d}{m_s}} \right\} = \left\{ \sqrt[3]{\frac{m_u}{m_s}} \right\} = \sqrt[3]{(0.66)} = 0.87$ and the subscript C denotes the coulomb potential. We have also compared the fitted results with experimental values. The fitting procedure and constraints are exactly the same as for the case with linear potential. The fitted results are given in table 2.

Table – 1 Fits of the Magnetic Moments when Quark Interactions are Linear Potential

Magnetic moments	Experimental data	Hypotheses I		Hypotheses II	
		Fit1	Fit2	Fit1	Fit2
$\mu_L(P)$	2.79±0.10	2.77	2.689108474	2.77	2.80757
$\mu_L(N)$	–1.91±0.10	-1.84	-1.950891408	-1.87	-1.76
$\mu_L(\Sigma^+)$	2.46±0.10	2.698745	2.650639147	2.67	2.583544
$\mu_L(\Sigma^-)$	–1.16±0.10	-1.08815	-1.229920625	-1.03	-1.14864
$\mu_L(\Xi^-)$	–0.65±0.10	-0.44977	-0.610675051	-0.42	-0.51877
$\mu_L(\Xi^0)$	–1.25±0.10	-1.2861	-1.391070498	-1.34	-1.35706
$\mu_L(\Lambda^0)$	–0.6±0.10	-0.52995	-0.640431283	-0.55	-0.51877
$\mu_L(\Sigma^0)$	–1.61±0.10	-1.5666	-1.518425791	-1.58	-1.63306
Fitted parameters		μ_u =2.3102143 μ_d = -1.1551071 μ_s = -0.69306421 δ_u = 0.9226853 δ_d = -0.3373147 δ_s = -0.0073146 S_z = 0.289028 L_z = 0.210972	μ_u =2.2947063 μ_d = -1.1473531 μ_s = -0.688418 δ_u = 0.6560901 δ_d= -0.6039099 δ_s = -0.2726126 S_z = -0.1108648 L_z = 0.2640905	μ_u = 2.3668911 μ_d = -1.834455 μ_s = -0.7100673 S_z = 0.3592232 L_z = 0.1407768 δ_u = 0.9398705 δ_d = 0.3201295	μ_u = 2.720861 μ_d = -1.3604305 μ_s = -0.8162583 δ_u = 1.2262919 δ_d = 0.037081 S_z = 2.0777511 L_z = -0.4207689

Table- 2 Fits of the Magnetic Moments when Quark Interactions are Columbian Potential

Magnetic moments	Experimental data	Hypotheses I		Hypotheses II	
		Fit1	Fit2	Fit1	Fit2
$\mu_C(P)$	2.79±0.10	2.779895656	2.736297	2.779999933	2.78
$\mu_C(N)$	–1.91±0.10	-1.81999638	-1.88067	-1.779997377	-1.78
$\mu_C(\Sigma^+)$	2.46±0.10	2.649179315	2.599113	2.642222101	2.620953
$\mu_C(\Sigma^-)$	–1.16±0.10	-1.16177561	-1.11446	-1.098182657	-1.09452
$\mu_C(\Xi^-)$	–0.65±0.10	-0.5609635	-0.52204	-0.490587284	-0.4813
$\mu_C(\Xi^0)$	–1.25±0.10	-1.33214635	-1.38798	-1.307503152	-1.32734
$\mu_C(\Lambda^0)$	–0.6±0.10	-0.5744245	-0.60951	-0.533314115	-0.54212
$\mu_C(\Sigma^0)$	–1.61±0.10	-1.51976993	-1.55943	-1.502269124	-1.47755
Fitted parameters		μ_u =2.2445406 μ_d = -1.1223203 μ_s = -0.6733921 δ_u = 0.8508987	μ_u =2.3101589 μ_d = -1.14550794 μ_s = -0.6930476 δ_u = 0.81430	μ_u = 2.2014403 μ_d = -1.1007201 μ_s = -0.660432 δ_u = 0.902876	μ_u = 2.068411 μ_d = -1.0342055 μ_s = -0.6205233 δ_u = 0.7988721

	δ_d = -0.409103 **δ_s = -0.0791012** **S_z = 0.1813481** **L_z = 0.3186519**	**δ_d= -0.4456279** **δ_s = -0.1156279** **S_z = -0.1156279** **L_z = 0.2283824**	**δ_d = -0.3571239** **S_z = 0.1372567** **L_z = 0.3627433**	**δ_d = -0.4611279** **S_z = -0.4867674** **L_z = 0.6291815**

CONCLUSION

In this case we have tried to modify the collectively quark asymmetry correction term within the baryons except two on strange particles (proton and neutron). These correction term to the baryon magnetic moment in terms of quark moments basically depend only on different mass parameters associated with corresponding quark moment with linear and Columbian interaction potential. In this work we would emphasized some slight improvement for the hypotheses on sea quark contribution and some reasonable assumption about internal interaction i.e. second order linear or Columbian interaction potential, the baryon magnetic moments are calculated [13]. The baryon magnetic moment in terms of quark moments is calculated only by quantum mechanical method while the quark rotation asymmetry contribution has calculated quasi classically approximation. The fitted results appear to be consistent with experimental measurement in certain limit of accuracy.

In our work, we assume two types of quark interaction potential (linear or Colombian).from the study of hadrons spectrum, the quark potential between the quarks have been written as Ar+B/r. In addition, for our simplicity, we have assumed the second order linearity also as Cr^2+D/r^2, but mass parameter is included only in first order. The parameters A, B, C and D are to be chosen very small. In this work, a clear picture of revolving quark, within the baryon is presented along with other terms like axial vector coupling GA, a8 as 1.26 and 0.60 respectively. In present context, it should require most data, to test the validity of quark patron model. In figure, it will be possible with some experimental on LHC, which discloses the entirely clear picture of nucleon structure.

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