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A Prediction in the Way of field Unification

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Abstract

Shell model of nucleus considers that protons possess spin angular momentum along with the orbital angular momentum in nucleus. So, a kind of spin-orbital interaction of proton is present in nucleus. Depending upon this spin-orbital interaction in an infinitesimal region of nucleus a new prediction on strong field has been introduced in this paper which also leads to propose a picture of space-time geometry of strong field.

Keywords: Strong field, space-time geometry.

Introduction

The origin of the strong force or nuclear force is one of the major unsolved problems in particle and nuclear physics even after the establishment of the quantum chromo dynamics. According to the modern concept in physics the exchange particle that mediates strong force is gluon[1] which is responsible to form nuclei holding neutrons and protons together. Again, the exchange particle that mediates electromagnetic force is photon. But, according to the nature of photon, it be not only a particle or a wave but also, it is a system and a kind of spin-linear (S-L) interaction as well as gravitational interaction is happening in this system[2]. Depending upon the present concept of photon, SSP (Super System of Photon[2]) picture of it has been introduced. Using this picture, mathematical relations[2] between electromagnetic field ($\psi(r,t)$) and gravitational field ($G'(r',t')$) has been consider, which are $\psi_\alpha(r,t) = \Upsilon_1 \bar{Z}_{ij} G'_\alpha(r',t')$ and $G'_\alpha(r',t') = \Upsilon_2 Z_{ij}\ \psi_\alpha(r,t)$ where, $\bar{Z}_{ij}$ and Z_{ij} are the transformation matrices in the picture of SSP , Υ_1 and Υ_2 are constants and α (subscript) $= x$, y, z, t

Now, shell model of nucleus considers that protons possess spin angular momentum along with the orbital angular momentum having electric charge. So, a kind of electromagnetic interaction due to spin-orbital interaction of proton is present in nucleus. This spin-orbital interaction implies a system of two simultaneous superimposed rotational motions. Depending upon this system and following SSP picture a prediction has been made in the present paper connecting strong field and electromagnetic field in nucleus.

A New Prediction on Strong Force

For clarity of two simultaneous superimposed rotational system denoted by S-S system[2], it is stated that frames S and S_1 have both their X axes aligned and S_1 is moving at an angular velocity ω_1 about X_1 axis as observed by S. The frame S_1 has another co-ordinate reference frame S_2, where X_2 axis of S_2, are rotated by an angle θ counter clockwise with respect to S_1 on X_1Y_1 plane. Frames S_2 and S_3 have both their X axes aligned and S_3 is moving at an angular velocity ω_2 about X_3 axis as observed by S_2. For the case when the origin of frames are same with respect to S and the particle be at the origin of S_3, then it possesses Spin-Spin (S-S) interaction with respect to frame S. The system would be denoted by the term S-S system. Matrix for coordinate transformation from S to S_3 would be S_{ij} and similarly matrix for coordinate transformation from S_3 to S would be $\bar{S}_{ij}$ as discussed in the system[2].

Now, if $\psi'_\alpha(r',t')$ be a function of electromagnetic field in S_3 then it would appear as a new field function $\bar{G}_\alpha(r,t)$ with respect to an observer in S. therefore, the relation between $\psi'_\alpha(r',t')$ and $\bar{G}_\alpha(r,t)$ would be

$$\bar{G}_\alpha(r,t) = \bar{\Upsilon}\bar{S}_{ij}\psi'_\alpha(r',t') \quad (1)$$

where, $\bar{S}_{ij}$ is the transformation matrix in S-S system as said above and $\bar{\Upsilon}$ is a constant.
Following SSP picture (which depends upon the S-L system) a relation has been proposed in a previous work[2] as

$$G_\alpha(r,t) = \Upsilon\bar{Z}_{ij}\ \psi'_\alpha(r',t') \quad (2)$$

where, $\psi'_\alpha(r',t')$ would be the electromagnetic field and $G_\alpha(r,t)$ may be a kind of strong gravitational field (or a new

attractive field) which is created by electromagnetic interaction in a system like SSP and Υ is a constant.

Now, $G_\alpha(r,t)$ in (2) may be one kind of strong gravitational field[2] (or a new attractive field) which is created in S-L system like SSP and if it is so, then it should be assumed from (1) that $\overline{G}_\alpha(r,t)$ would be a field of same characteristics (i.e. one kind of strong gravitational field or a new attractive field) which is created in S-S system. Our prediction is that this system is connected with strong field in nucleus as proposed below.

The nuclear shell model has been one of the most successful models for describing nuclei. Shell model of nucleus considers that protons possess spin angular momentum along with the orbital angular momentum[3] in the infinitesimal region of nucleus. Therefore they have spin-orbital interaction. Electromagnetic field is attributed to protons having electric charge. In the infinitesimal region of nucleus spin-orbital interaction of a proton would be analogous to S-S system as discussed above. Therefore electromagnetic interaction is happening in nucleus due to spin-orbital interaction of proton and result would be connected with equation (1). This means that $\overline{G}_\alpha(r,t)$ would be one kind of strong gravitational field (strong field) in nucleus which is created due to spin-orbital interaction (i.e. electromagnetic interaction) of a proton. Under this field, nucleons are concentrated in an infinitesimal region of nucleus.

In case of spin and orbital motion of proton, different parts of the electromagnetic field of it experience different curvilinear velocities and relativistic effects are generated throughout the electromagnetic field along the radius vector from the centre of curvature to the path of motion. Therefore, first a short range part (at the surface of the proton) of strong electric field remain unchanged and this electric field would be strong repulsive among the nuclei. Such short range repulsion in nucleus is important for the stability of atomic nuclei against collapse.

Next region is the medium range part. In this region strong electric field is affected by adequate velocity and creates strong field (attractive field) according to relation (1). This field has great role to bind the atomic nuclei.

Third region is the outermost and long range part in which, respectively weak electric field is affected by adequate velocity and creates an attractive field but it is respectively weak.

So, there should be three region of field to the surrounding of a proton in nucleus. But, according to experimental result of present physics, ranges of above three parts[4] in nucleus are as shown in the table-1,

Table-1
The ranges of three parts in nucleus

Region	Nature of the field	Relative distance from centre of nucleus
short range part	strong repulsive	$r < 1$ fm
medium range part	strong attractive	1 fm $< r <$ 2 fm
long range part	attractive	$r > 2$ fm

Super System of Gluon (SSG)

Although, there is no any strong experimental evident (which is expected) in favour of this prediction but, electromagnetic interaction due to spin-orbital interaction of proton in the infinitesimal region of nucleus should make a relation as in equation (1). According to Yukawa model strong force is spin dependent[3]. It is also accepted that spin and orbital angular momentum of nucleon are distributed over its quarks and gluons[5, 6]. Usually we consider the nuclei like the non relativistic system. But it must be taken in to the consideration that nuclear force has a great spin-orbit interaction[7]. Again, in modern concept, the exchange particle that mediates strong force is the gluon[1].

From these ideas and following the SSP picture of photon, we propose the Super System of Gluon (SSG) picture for gluon where, electromagnetic field of proton in nucleus make a gluon field (or strong filed) due to spin orbital interaction of it. This means that gluon be not only a particle but also a complex system and a kind of S-S interaction as well as electromagnetic interaction is happening in this complex system.

SSG picture depends upon the spin-orbital interaction of protons. Spin-orbital interaction of protons in nucleus implies that electromagnetic field of it (protons) possess two simultaneous superimposed rotational motion which leads to gluon field. To framework spin-orbital interaction of protons in nucleus and to clarify the SSG we can consider four reference frames S, S_1, S_2 and S_3 where, S is the rest or observer's frame and the other three reference frames (S_1, S_2 and S_3) are in the SSG which are also movable as discussed above S-S system. A proton (i.e. electromagnetic field) is present in the frame S_3 and, matrix for co-ordinate transformation from frame S_3 to frame S in this system is $\overline{S}_{ij}$. Using $\overline{S}_{ij}$ and assuming electromagnetic field in S_3, one may connect the electromagnetic field and strong field by the relation as in equation (1) where, electromagnetic field ($\psi'_\alpha(r',t')$) of S_3 would be the strong field or gluon field ($\overline{G}_\alpha(r,t)$) with respect to an observer in frame S. Then, the system is called gluon or Super System of Gluon (SSG).

Space-Time Geometry of Strong Field

Space-time geometry of S-S system[8] is stated as

$$ds^2 = P_1 dx'^2 + P_2 dy'^2 + P_3 dz'^2 + P_4 dt'^2 + 2(Q_1 dx'dy' + Q_2 dx'dz' + Q_3 dx'dt' + Q_4 dy'dz' + Q_5 dy'dt' + Q_6 dz'dt') \quad (3)$$

where,

$P_1 = \bar{S}_{11}^{\,2} + \bar{S}_{21}^{\,2} + \bar{S}_{31}^{\,2} - \bar{S}_{41}^{\,2}$,

$P_2 = \bar{S}_{12}^{\,2} + \bar{S}_{22}^{\,2} + \bar{S}_{32}^{\,2} - \bar{S}_{42}^{\,2}$,

$P_3 = \bar{S}_{13}^{\,2} + \bar{S}_{23}^{\,2} + \bar{S}_{33}^{\,2} - \bar{S}_{43}^{\,2}$,

$P_4 = \bar{S}_{14}^{\,2} + \bar{S}_{24}^{\,2} + \bar{S}_{34}^{\,2} - \bar{S}_{44}^{\,2}$,

$Q_1 = \bar{S}_{11}\bar{S}_{12} + \bar{S}_{21}\bar{S}_{22} + \bar{S}_{31}\bar{S}_{32} - \bar{S}_{41}\bar{S}_{42}$,

$Q_2 = \bar{S}_{11}\bar{S}_{13} + \bar{S}_{21}\bar{S}_{23} + \bar{S}_{31}\bar{S}_{33} - \bar{S}_{41}\bar{S}_{43}$,

$Q_3 = \bar{S}_{11}\bar{S}_{14} + \bar{S}_{21}\bar{S}_{24} + \bar{S}_{31}\bar{S}_{34} - \bar{S}_{41}\bar{S}_{44}$,

$Q_4 = \bar{S}_{12}\bar{S}_{13} + \bar{S}_{22}\bar{S}_{23} + \bar{S}_{32}\bar{S}_{33} - \bar{S}_{42}\bar{S}_{43}$,

$Q_5 = \bar{S}_{12}\bar{S}_{14} + \bar{S}_{22}\bar{S}_{24} + \bar{S}_{32}\bar{S}_{34} - \bar{S}_{42}\bar{S}_{44}$,

$Q_6 = \bar{S}_{13}\bar{S}_{14} + \bar{S}_{23}\bar{S}_{24} + \bar{S}_{33}\bar{S}_{34} - \bar{S}_{43}\bar{S}_{44}$

Here, $\bar{S}_{ij}$ is the transformation matrix in S-S system.

According to our consideration, strong field is the cause of spin-orbital interaction of proton in nucleus (i.e. electromagnetic interaction in S-S system) so, following equation (1) and using $dx' = dx^{em}$, $dy' = dy^{em}$, $dz' = dz^{em}$, $dt' = dt^{em}$ we obtain from equation (3), the space-time geometry of strong field

$$(ds^{st})^2 = P_1 (dx^{em})^2 + P_2 (dy^{em})^2 + P_3 (dz^{em})^2 + P_4 (dt^{em})^2 + 2(Q_1 dx^{em} dy^{em} + Q_2 dx^{em} dz^{em} + Q_3 dx^{em} dt^{em} + Q_4 dy^{em} dz^{em} + Q_5 dy^{em} dt^{em} + Q_6 dz^{em} dt^{em}) \quad (4)$$

Where, superscript 'st' represents the system of strong field and superscript 'em' represents the system of electromagnetic field.

Conclusion

Equation (4) represents a picture of space-time geometry of the strong field in the system of nucleus. This implies that a geometrical relation is existed in between electromagnetic field and strong field. It is also predicted that all fundamental field in known physics are inter changeable changing its parameters through a proper system.

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