JOURNAL OF INTERNATIONAL ACADEMIC RESEARCH FOR MULTIDISCIPLINARY
Impact Factor 4.991, ISSN: 2320-5083, Volume 6, Issue 10, November 2018

ANHARMONIC OSCILLATOR STUDY FOR PURE GAUGE THEORY (GLUONS WITHOUT QUARKS) WITH GROUP SU(2)

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Abstract

In this paper, We take the effective Hamiltonain operator until the sixth degree with the group SU(2); which represents nine anharmonic oscillators. We used the perturbation theory and two operators of creation and annihilation then calculate and draw the energy levels from to at which this study is still correct and stable. We conclude that the perturbation theory is not broken down when; it still correct until.

Keywords: Anharmonic Oscillator And Two Creation And Annihilation Operators, Quarks And Gluons Plasma.

Introduction:

Quantum-chrome-dynamic (QCD) is the theory of the strong interaction which represents the confinement of quarks and gluons at a low temperature and the system turns to the phase of quarks and gluons plasma at an enough high temperature [1-10].

The real time evolution of quarks and gluons plasma was studied for the pure gauge theory with the two groups SU(2) and SU(3) in [5-6]. In these studies, the perturbation theory which depends on the creation operator and annihilation operator , was used .The effective Hamiltonian operator expansion was taken into consideration until the fourth degree.

In [13] the harmonic oscillator of pure gauge theory with group SU(2) was studied numerically using creation operator and annihilation operator.

In this work, the anharmonic oscillator of pure gauge theory with group SU(2) is studied numerically using creation operator and annihilation operator , A semi-particle called glonon, which is a boson similar to a phonon but different in the color charge, was believed to be existed, which means that the glonons have a mutual effect.

2. RESEARCH METHODOLOGY:

"Introduction to our research in words"

According to [3], the Hamilton operator of pure gauge theory with group SU(2) can be described in loop (L^3).

$$\mathcal{L}H_{eff} = \frac{1}{2}\left(\frac{1}{g^2(L)} + \alpha_0\right)^{-1} \hat{\Pi}_i^a \hat{\Pi}_i^a + \alpha_1 \hat{B}_i^a \hat{B}_i^a + \frac{1}{4}\left(\frac{1}{g^2(L)} + \alpha_2\right) \hat{F}_{ij}^a(B) \hat{F}_{ij}^a(B)$$

$$+\alpha_3\left(\hat{B}_i^a \hat{B}_i^a \hat{B}_j^b \hat{B}_j^b + 2\hat{B}_i^a \hat{B}_j^a \hat{B}_i^b \hat{B}_j^b\right) + \alpha_4 \hat{B}_i^a \hat{B}_i^a \hat{B}_i^b \hat{B}_i^b + \alpha_5 \sum_i \left(\hat{B}_i^a \hat{B}_i^a\right)^3$$

$$+\alpha_6 \sum_{i \neq j} \hat{B}_i^a \hat{B}_i^a \left(\hat{B}_j^b \hat{B}_j^b\right)^2 + \alpha_7 \hat{B}_1^a \hat{B}_1^a \hat{B}_2^a \hat{B}_2^a \hat{B}_3^a \hat{B}_3^a + \alpha_8 \hat{F}_{ij}^a(B) \hat{F}_{ij}^a(B) \hat{B}_k^b \hat{B}_k^b$$

$$+\alpha_9 \sum_{i \neq j} \hat{F}_{ij}^a(B) \hat{F}_{ij}^a(B) \hat{B}_j^b \hat{B}_j^b + \alpha_{10}\left(\hat{B}_1^a \hat{B}_2^a \hat{B}_3^a\right)^2 +$$
$$O\left(\hat{B}^8\right) \qquad (1)$$

where i, j=1,2,3 the guide of local coordinates,.

a, b=1,2,3 are the evidences of group SU(2) generators,.-

$\alpha_1, \ldots, \alpha_{13}$ are constants resulted from quantization of inhomogeneous modes of gauge field by the method of paths integration.

α_0 is a constant resulted from quantization of inhomogeneous time derivative modes of gauge field by the method of paths integration and it has the following values [3]:

$$\alpha_0 = 0.021810429, \alpha_1 = -0.30104661, \alpha_2 = 0.024624$$
$$\alpha_3 = 0.0021317, \alpha_4 = -0.0078439, \alpha_5 = 4.9676959 \times 10^{-3}$$
$$\alpha_6 = -5.5172502 \times 10^{-3}, \alpha_7 = -1.2423581 \times 10^{-3}, \alpha_8 = -1.1130266 \times 10^{-4}$$
$$\alpha_9 = -2.1475176 \times 10^{-4}, \alpha_{10} = -1.2775652 \times 10^{-3} \qquad (2)$$

F_{ij}^a are tensors of the magnetic field intensity represented as [3]:

$$F_{ij}^a = \varepsilon^{abc} B_i^b B_j^c \qquad (3)$$

$\hat{B}_i^a$ is the operator of homogeneous magnetic field, and $\hat{\Pi}_i^a$ is the operator of momentum.

$$\varepsilon^{abc} = \begin{cases} 1 \text{ At direct replacement} \\ 0 \text{ When two evidences are equal} \\ -1 \text{ At indirect replacement} \end{cases}$$

$O\left(\hat{B}^8\right)$ indicates that the limits of degree greater than B^6 are neglected.

$g^2(L)$ is a coupling constant represented in the following relation [3]:

$$g^2(L) = -\frac{1}{2b_0 \log(\Lambda_{ms}L)} - \frac{b_1 \log[-2\log(\Lambda_{ms}L)]}{4b_0^3 [\log(\Lambda_{ms}L)]^2} + \cdots \qquad (4)$$

where:

$$b_0 = \frac{22}{3}(4\pi)^2, b_1 = \frac{136}{3}(4\pi)^4, \Lambda_{ms} = 74.1705\text{MeV}$$

$\Lambda_{ms} = 74.1705\text{MeV}$ represents an identified constant by minimum subtraction of dimension organization.

L is the loop length in all spatial directions.

According to this method of Hamilton operator $\hat{H}_{eff}$, the study of pure gauge theory with group SU(2) becomes a form of quantum mechanics with group SU(2), This mean that the study of infinite number of particles and freedom degrees (quarks and gluons plasma), has been physically transformed to a study of three global particles .naemly, to confine the study to nine anharmonic oscillators. nine freedom degrees and particularly nine anhamonic oscillators.

$\hat{H}^0_{eff}$ is the harmonic part of the operator $\hat{H}_{eff}$:

$$L\hat{H}^0_{eff} = \sum_{a=1}^{3}\sum_{i=1}^{3}\left[\frac{1}{2}\,\tilde{\alpha}_0\,\hat{\Pi}_i^a\hat{\Pi}_i^a + \frac{1}{2}\tilde{\alpha}_1\hat{B}_i^a\hat{B}_i^a\right] \quad (5)$$

Where:

$\tilde{\alpha}_0 = \left(\frac{1}{g^2(L)} + \alpha_0\right)^{-1}$, $\tilde{\alpha}_1 = 2\alpha_1$

, the creation operator can be identified as the following [5,6]:

$$\hat{D}^{+a}_i = \sqrt{\frac{\sqrt{\frac{\tilde{\alpha}_1}{\tilde{\alpha}_0}}}{2\hbar}}\,\hat{B}_i^a - \frac{i}{\sqrt{2\hbar\sqrt{\frac{\tilde{\alpha}_1}{\tilde{\alpha}_0}}}}\hat{\Pi}_i^a \quad (6)$$

and annihilation operator is defined as:

$$\hat{D}_i^a = \sqrt{\frac{\sqrt{\frac{\tilde{\alpha}_1}{\tilde{\alpha}_0}}}{2\hbar}}\,\hat{B}_i^a + \frac{i}{\sqrt{2\hbar\sqrt{\frac{\tilde{\alpha}_1}{\tilde{\alpha}_0}}}}\hat{\Pi}_i^a \quad (7)$$

$\hbar = 1$ (Plank constant) in a system of natural units .

In this case, we find that:

$$\left[\hat{D}_i^a, \hat{D}^{+b}_j\right]_- = \delta_{ij}\delta^{ab} \quad (8)$$

$$\left[\hat{D}_i^a, \hat{D}_j^b\right]_- = \left[\hat{D}^{+a}_i, \hat{D}^{+b}_j\right]_- = 0 \quad (9)$$

δ_{ij}, δ^{ab} are Kroanker symbols of spatial coordinates and evidences of generating group SU(2). These Kroanker constants are respectively, defined as:

$$\delta_{ij} = \begin{cases} 1 & i = j \\ 0 & i \neq j \end{cases} \quad (10.a)$$

$$\delta^{ab} = \begin{cases} 1 & a = b \\ 0 & a \neq b \end{cases} \quad (10.b)$$

The result of adding the equation (6) to (7) is the operator of homogeneous magnetic field:

$$\hat{B}_i^a = \sqrt{\frac{\hbar}{2\sqrt{\frac{\tilde{\alpha}_1}{\tilde{\alpha}_0}}}}\left(\hat{D}^{+a}_i + \hat{D}_i^a\right) \quad (11)$$

The result of subtracting the equation (6) out of (7) is the operator of momentum given as:

$$\hat{\Pi}_i^a = i\sqrt{\frac{\hbar\sqrt{\frac{\tilde{\alpha}_1}{\tilde{\alpha}_0}}}{2}}\left(\hat{D}^{+a}_{\ i} - \hat{D}_i^a\right) \qquad (12)$$

After calculating $\frac{1}{2}\ \tilde{\alpha}_0\ \hat{\Pi}_i^a\hat{\Pi}_i^a, \frac{1}{2}\tilde{\alpha}_1\hat{B}_i^a\hat{B}_i^a$:

$$\frac{1}{2}\tilde{\alpha}_0\ \hat{\Pi}_i^a\hat{\Pi}_i^a = \frac{\hbar}{4}\sqrt{\tilde{\alpha}_0\tilde{\alpha}_1}\left[\hat{D}^{+a}_{\ i}\hat{D}_i^a - \hat{D}^{+a}_{\ i}\hat{D}^{+a}_{\ i} + \hat{D}_i^a\hat{D}^{+a}_{\ i} - \hat{D}_i^a\hat{D}_i^a\right] \qquad (13.a)$$

$$\frac{1}{2}\tilde{\alpha}_1\hat{B}_i^a\hat{B}_i^a = \frac{\hbar}{4}\sqrt{\tilde{\alpha}_0\tilde{\alpha}_1}\left[\hat{D}^{+a}_{\ i}\hat{D}^{+a}_{\ i} + \hat{D}^{+a}_{\ i}\hat{D}_i^a + \hat{D}_i^a\hat{D}^{+a}_{\ i} + \hat{D}_i^a\hat{D}_i^a\right] \qquad (13.b)$$

and after compensating (13.a) and (13.b) by (5) we find:

$$L\hat{H}_{eff}^0 = \sum_{a=1}^{3}\sum_{i=1}^{3}\frac{\hbar}{4}\sqrt{\tilde{\alpha}_0\tilde{\alpha}_1}\ \left[2\hat{D}^{+a}_{\ i}\hat{D}_i^a + 2\hat{D}_i^a\hat{D}^{+a}_{\ i}\right] \qquad (14)$$

Depending on the two equations (10.a) and (10.b), the equation will become (8):

$$\left[\hat{D}_i^a, \hat{D}^{+a}_{\ i}\right]_- = 1 \Rightarrow \hat{D}_i^a\hat{D}^{+a}_{\ i} - \hat{D}^{+a}_{\ i}\hat{D}_i^a = 1 \Rightarrow \hat{D}_i^a\hat{D}^{+a}_{\ i} = 1 + \hat{D}^{+a}_{\ i}\hat{D}_i^a$$

Depending on this relation, the equation (14) becomes:

$$L\hat{H}_{eff}^0 = \sum_{a=1}^{3}\sum_{i=1}^{3}\frac{\hbar}{4}\sqrt{\tilde{\alpha}_0\tilde{\alpha}_1}\ \left[2\hat{D}^{+a}_{\ i}\hat{D}_i^a + 2\hat{D}^{+a}_{\ i}\hat{D}_i^a + 2\ \right]$$

$$L\hat{H}_{eff}^0 = \sum_{a=1}^{3}\sum_{i=1}^{3}\hbar\sqrt{\tilde{\alpha}_0\tilde{\alpha}_1}\ \left[\hat{D}^{+a}_{\ i}\hat{D}_i^a + \frac{1}{2}\right] \qquad (15)$$

We make $\hat{N}_i^a = \hat{D}^{+a}_{\ i}\hat{D}_i^a, \hat{N} = \sum_{a=1}^{3}\sum_{i=1}^{3}\hat{N}_i^a$

After the substitution into Eq. (15), we have

$$L\hat{H}_{eff}^0 = \hbar\sqrt{\tilde{\alpha}_0\tilde{\alpha}_1}\left(\hat{N} + \frac{9}{2}\right) \qquad (16)$$

Following [5,6], using the equations

$$\hat{D}_i^a|\ldots n_i^a\ldots\rangle = \sqrt{n_i^a}|\ldots n_i^a - 1\ldots\rangle \qquad (17)$$

$$\hat{D}^{+a}_{\ i}|\ldots n_i^a\ldots\rangle = \sqrt{n_i^a + 1}|\ldots n_i^a + 1\ldots\rangle \qquad (18)$$

$$\hat{N}_i^a|\ldots n_i^a\ldots\rangle = n_i^a|\ldots n_i^a\ldots\rangle \qquad (19)$$

$$\hat{D}_i^a|\ldots 0\ldots\rangle = 0\ ,\hat{N}_i^a|\ldots 0\ldots\rangle = 0 \qquad (20)$$

3. RESULTS AND DISCUSSION:

we calculated the Hamiltonian matrix for anharmonic oscillator:

$$LH_{n_i^a,m_i^a} = \langle n_i^a|L\hat{H}|m_i^a\rangle = \hbar\sqrt{\tilde{\alpha}_0\tilde{\alpha}_1}\left(\sum_{a=1}^{3}\sum_{i=1}^{3}\mathrm{m}_i^a\delta_{n_i^a,m_i^a} + \frac{9}{2}\right) + \alpha_3\sum_{a=1}^{3}\sum_{b=1}^{3}\sum_{i=1}^{3}\sum_{j=1}^{3}\left[3\frac{\hbar^2}{4\frac{\tilde{\alpha}_1}{\tilde{\alpha}_0}}\right.$$

$$\left(\sqrt{\mathrm{m}_i^a+1}\sqrt{\mathrm{m}_i^a+2}\sqrt{\mathrm{m}_i^a+3}\sqrt{\mathrm{m}_i^a+4}\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a+4}\right.$$

$$+\mathrm{m}_i^a\sqrt{\mathrm{m}_i^a+1}\sqrt{\mathrm{m}_i^a+2}\,\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a+2} + (\mathrm{m}_i^a+1)\sqrt{\mathrm{m}_i^a+1}\sqrt{\mathrm{m}_i^a+2}\ \delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a+2}$$

$$+\mathrm{m}_i^a(\mathrm{m}_i^a-1)\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a} + \sqrt{\mathrm{m}_i^a+1}\sqrt{(\mathrm{m}_i^a+2)^3}\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a+2}$$

$$+(\mathrm{m}_i^a)^2\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a} + \mathrm{m}_i^a(\mathrm{m}_i^a+1)\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a} + \sqrt{\mathrm{m}_i^a}\sqrt{\mathrm{m}_i^a-1}(\mathrm{m}_i^a-2)\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a-2}$$

$$+\sqrt{\mathrm{m}_i^a+1}\sqrt{\mathrm{m}_i^a+2}(\mathrm{m}_i^a+3)\ \delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a+2} + \mathrm{m}_i^a(\mathrm{m}_i^a+1)\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a}$$

$$+(\mathrm{m}_i^a+1)^2\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a} + \sqrt{\mathrm{m}_i^a}\sqrt{(\mathrm{m}_i^a-1)^3}\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a-2}$$

$$+(\mathrm{m}_i^a+1)(\mathrm{m}_i^a+2)\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a} + \sqrt{(\mathrm{m}_i^a)^3}\sqrt{\mathrm{m}_i^a-1}\ \delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a-2}$$

$$+(m_i^a+1)\sqrt{m_i^a}\sqrt{m_i^a-1}\,\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a-2}+\sqrt{m_i^a}\sqrt{m_i^a-1}\sqrt{m_i^a-2}\sqrt{m_i^a-3}\,\delta_{ij}\delta^{ab}\delta_{n_i^a,m_i^a-4})\Big]$$

$$+\alpha_4\sum_{a=1}^{3}\sum_{b=1}^{3}\sum_{i=1}^{3}\Bigg[\frac{\hbar^2}{4\frac{g_1}{g_2}}\Big(\sqrt{m_i^a+1}\sqrt{m_i^a+2}\sqrt{m_i^a+3}\sqrt{m_i^a+4}\,\delta^{ab}\delta_{n_i^a,m_i^a+4}$$

$$+m_i^a\sqrt{m_i^a+1}\sqrt{m_i^a+2}\,\delta^{ab}\delta_{n_i^a,m_i^a+2}+(m_i^a+1)\sqrt{m_i^a+1}\sqrt{m_i^a+2}\,\delta^{ab}\delta_{n_i^a,m_i^a+2}$$

$$+m_i^a(m_i^a-1)\delta^{ab}\delta_{n_i^a,m_i^a}+\sqrt{m_i^a+1}\sqrt{(m_i^a+2)^3}\,\delta^{ab}\delta_{n_i^a,m_i^a+2}$$

$$+(m_i^a)^2\delta^{ab}\delta_{n_i^a,m_i^a}+m_i^a(m_i^a+1)\delta^{ab}\delta_{n_i^a,m_i^a}+\sqrt{m_i^a}\sqrt{m_i^a-1}(m_i^a-2)\delta^{ab}\delta_{n_i^a,m_i^a-2}$$

$$+\sqrt{m_i^a+1}\sqrt{m_i^a+2}(m_i^a+3)\,\delta^{ab}\delta_{n_i^a,m_i^a+2}+m_i^a(m_i^a+1)\delta^{ab}\delta_{n_i^a,m_i^a}$$

$$+(m_i^a+1)^2\delta^{ab}\delta_{n_i^a,m_i^a}+\sqrt{m_i^a}\sqrt{(m_i^a-1)^3}\,\delta^{ab}\delta_{n_i^a,m_i^a-2}$$

$$+(m_i^a+1)(m_i^a+2)\delta^{ab}\delta_{n_i^a,m_i^a}+\sqrt{(m_i^a)^3}\sqrt{m_i^a-1}\,\delta^{ab}\delta_{n_i^a,m_i^a-2}$$

$$+(m_i^a+1)\sqrt{m_i^a}\sqrt{m_i^a-1}\,\delta^{ab}\delta_{n_i^a,m_i^a-2}+\sqrt{m_i^a}\sqrt{m_i^a-1}\sqrt{m_i^a-2}\sqrt{m_i^a-3}\,\delta^{ab}\delta_{n_i^a,m_i^a-4})\Big]$$

$$+\alpha_5\sum_{a=1}^{3}\sum_{i=1}^{3}\Bigg[\frac{\hbar^3}{8\left(\frac{g_1}{g_2}\right)^{\frac{3}{2}}}\Big(\sqrt{m_i^a+1}\sqrt{m_i^a+2}\sqrt{m_i^a+3}\sqrt{m_i^a+4}\sqrt{m_i^a+5}\sqrt{m_i^a+6}\,\delta_{n_i^a,m_i^a+6}$$

$$+m_i^a\sqrt{m_i^a+1}\sqrt{m_i^a+2}\sqrt{m_i^a+3}\sqrt{m_i^a+4}\,\delta_{n_i^a,m_i^a+4}$$

$$+\sqrt{(m_i^a+1)^3}\sqrt{m_i^a+2}\sqrt{m_i^a+3}\sqrt{m_i^a+4}\,\delta_{n_i^a,m_i^a+4}$$

$$+m_i^a(m_i^a-1)\sqrt{m_i^a+1}\sqrt{m_i^a+2}\,\delta_{n_i^a,m_i^a+2}$$

$$+\sqrt{m_i^a+1}\sqrt{(m_i^a+2)^3}\sqrt{m_i^a+3}\sqrt{m_i^a+4}\,\delta_{n_i^a,m_i^a+4}$$

$$+(m_i^a)^2\sqrt{m_i^a+1}\sqrt{m_i^a+2}\,\delta_{n_i^a,m_i^a+2}+m_i^a\sqrt{(m_i^a+1)^3}\sqrt{m_i^a+2}\,\delta_{n_i^a,m_i^a+2}$$

$$+m_i^a(m_i^a-1)(m_i^a-2)\,\delta_{n_i^a,m_i^a}+\sqrt{m_i^a+1}\sqrt{m_i^a+2}\sqrt{(m_i^a+3)^3}\sqrt{m_i^a+4}\,\delta_{n_i^a,m_i^a+4}$$

$$+m_i^a\sqrt{(m_i^a+1)^3}\sqrt{m_i^a+2}\,\delta_{n_i^a,m_i^a+2}+\sqrt{(m_i^a+1)^5}\sqrt{m_i^a+2}\,\delta_{n_i^a,m_i^a+2}$$

$$+m_i^a(m_i^a-1)^2\,\delta_{n_i^a,m_i^a}+\sqrt{(m_i^a+1)^3}\sqrt{(m_i^a+2)^3}\,\delta_{n_i^a,m_i^a+2}$$

$$+(m_i^a)^2(m_i^a-1)\,\delta_{n_i^a,m_i^a}+m_i^a(m_i^a+1)(m_i^a-1)\,\delta_{n_i^a,m_i^a}$$

$$+\sqrt{m_i^a}\sqrt{m_i^a-1}(m_i^a-2)(m_i^a-3)\delta_{n_i^a,m_i^a-2}$$

$$+\sqrt{m_i^a+1}\sqrt{m_i^a+2}\sqrt{m_i^a+3}\sqrt{(m_i^a+4)^3}\,\delta_{n_i^a,m_i^a+4}$$

$$+m_i^a\sqrt{m_i^a+1}\sqrt{(m_i^a+2)^3}\,\delta_{n_i^a,m_i^a+2}+\sqrt{(m_i^a+1)^3}\sqrt{(m_i^a+2)^3}\,\delta_{n_i^a,m_i^a+2}$$

$$+(m_i^a)^2(m_i^a-1)\,\delta_{n_i^a,m_i^a}+\sqrt{(m_i^a+1)}\sqrt{(m_i^a+2)^5}\,\delta_{n_i^a,m_i^a+2}+(m_i^a)^3\,\delta_{n_i^a,m_i^a}$$

$$+(m_i^a)^2(m_i^a+1)\,\delta_{n_i^a,m_i^a}+\sqrt{m_i^a}\sqrt{m_i^a-1}(m_i^a-2)^2\delta_{n_i^a,m_i^a-2}$$

$$+\sqrt{m_i^a+1}\sqrt{(m_i^a+2)^3}(m_i^a+3)\delta_{n_i^a,m_i^a+2}+(m_i^a)^2(m_i^a+1)\,\delta_{n_i^a,m_i^a}$$

$$+m_i^a(m_i^a+1)^2\,\delta_{n_i^a,m_i^a}+\sqrt{m_i^a}\sqrt{(m_i^a-1)^3}(m_i^a-2)\,\delta_{n_i^a,m_i^a-2}$$

$$+m_i^a(m_i^a+1)(m_i^a+2)\,\delta_{n_i^a,m_i^a}+\sqrt{(m_i^a)^3}\sqrt{m_i^a-1}(m_i^a-2)\,\delta_{n_i^a,m_i^a-2}$$

$$+(m_i^a+1)\sqrt{m_i^a}\sqrt{m_i^a-1}(m_i^a-2)\delta_{n_i^a,m_i^a-2}+\sqrt{m_i^a}\sqrt{m_i^a-1}\sqrt{m_i^a-2}\sqrt{m_i^a-3}(m_i^a-4)\,\delta_{n_i^a,m_i^a-4}$$

$$+\sqrt{m_i^a+1}\sqrt{m_i^a+2}\sqrt{m_i^a+3}\sqrt{m_i^a+4}(m_i^a+5)\,\delta_{n_i^a,m_i^a+4}$$

$$+m_i^a\sqrt{m_i^a+1}\sqrt{m_i^a+2}(m_i^a+3)\,\delta_{n_i^a,m_i^a+2}+\sqrt{(m_i^a+1)^3}\sqrt{m_i^a+2}(m_i^a+3)\,\delta_{n_i^a,m_i^a+2}$$

$$+m_i^a(m_i^a-1)(m_i^a+1)\,\delta_{n_i^a,m_i^a}+\sqrt{m_i^a+1}\sqrt{(m_i^a+2)^3}(m_i^a+3)\,\delta_{n_i^a,m_i^a+2}$$

$$+(m_i^a)^2(m_i^a+1)\,\delta_{n_i^a,m_i^a}+m_i^a(m_i^a+1)^2\,\delta_{n_i^a,m_i^a}+\sqrt{m_i^a}\sqrt{(m_i^a-1)^3}(m_i^a-2)\,\delta_{n_i^a,m_i^a-2}$$

$$+\sqrt{m_i^a+1}\sqrt{m_i^a+2}(m_i^a+3)^2\,\delta_{n_i^a,m_i^a+2}+m_i^a(m_i^a+1)^2\,\delta_{n_i^a,m_i^a}+(m_i^a+1)^3\,\delta_{n_i^a,m_i^a}$$

$$+\sqrt{m_i^a}\sqrt{(m_i^a-1)^5}\,\delta_{n_i^a,m_i^a-2}+(m_i^a+1)^2(m_i^a+2)\,\delta_{n_i^a,m_i^a}+\sqrt{(m_i^a)^3}\sqrt{(m_i^a-1)^3}\,\delta_{n_i^a,m_i^a-2}$$

$$+(m_i^a+1)\sqrt{m_i^a}\sqrt{(m_i^a-1)^3}\,\delta_{n_i^a,m_i^a-2}+\sqrt{m_i^a}\sqrt{m_i^a-1}\sqrt{m_i^a-2}\sqrt{(m_i^a-3)^3}\,\delta_{n_i^a,m_i^a-4}$$

$$+\sqrt{m_i^a+1}\sqrt{m_i^a+2}(m_i^a+3)(m_i^a+4)\delta_{n_i^a,m_i^a+2}+m_i^a(m_i^a+1)(m_i^a+2)\,\delta_{n_i^a,m_i^a}$$

$$+(m_i^a+1)^2(m_i^a+2)\,\delta_{n_i^a,m_i^a}+\sqrt{(m_i^a)^3}\sqrt{(m_i^a-1)^3}\,\delta_{n_i^a,m_i^a-2}$$

$$+(m_i^a+1)(m_i^a+2)^2\,\delta_{n_i^a,m_i^a}+\sqrt{(m_i^a)^5}\sqrt{m_i^a-1}\,\delta_{n_i^a,m_i^a-2}$$

$$+\sqrt{(m_i^a)^3}\sqrt{m_i^a-1}(m_i^a+1)\,\delta_{n_i^a,m_i^a-2}+\sqrt{m_i^a}\sqrt{m_i^a-1}\sqrt{(m_i^a-2)^3}\sqrt{m_i^a-3}\,\delta_{n_i^a,m_i^a-4}$$

$$+(m_i^a+1)(m_i^a+2)(m_i^a+3)\,\delta_{n_i^a,m_i^a}+\sqrt{(m_i^a)^3}\sqrt{m_i^a-1}(m_i^a+1)\,\delta_{n_i^a,m_i^a-2}$$

$$+(m_i^a+1)^2\sqrt{m_i^a}\sqrt{m_i^a-1}\,\delta_{n_i^a,m_i^a-2}+\sqrt{m_i^a}\sqrt{(m_i^a-1)^3}\sqrt{m_i^a-2}\sqrt{m_i^a-3}\,\delta_{n_i^a,m_i^a-4}$$

$$+\sqrt{m_i^a}\sqrt{m_i^a-1}(m_i^a+1)\,(m_i^a+2)\delta_{n_i^a,m_i^a-2}$$
$$+\sqrt{(m_i^a)^3}\sqrt{m_i^a-1}\sqrt{m_i^a-2}\sqrt{m_i^a-3}\,\delta_{n_i^a,m_i^a-4}$$
$$+(m_i^a+1)\sqrt{m_i^a}\sqrt{m_i^a-1}\sqrt{m_i^a-2}\sqrt{m_i^a-3}\,\delta_{n_i^a,m_i^a-4}$$
$$+\sqrt{m_i^a}\sqrt{m_i^a-1}\sqrt{m_i^a-2}\sqrt{m_i^a-3}\sqrt{m_i^a-4}\sqrt{m_i^a-5}\,\delta_{n_i^a,m_i^a-6})\Big]$$
$$+\alpha_7\sum_{a=1}^{3}\left[\frac{\hbar^2}{8\left(\frac{x_1}{x_2}\right)^{\frac{3}{2}}}\right.$$
$$\left(\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a+2}\right.$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a+1}\sqrt{m_2^a+2}m_3^a\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}m_2^a\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}m_2^a m_3^a\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+m_1^a\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a+2}$$
$$+m_1^a\sqrt{m_2^a+1}\sqrt{m_2^a+2}m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+m_1^a m_2^a\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}+m_1^a m_2^a m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a+1}\sqrt{m_2^a+2}(m_3^a+1)\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a-2}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}m_2^a(m_3^a+1)\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}m_2^a\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+m_1^a\sqrt{m_2^a+1}\sqrt{m_2^a+2}(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+m_1^a\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a-2}$$
$$+m_1^a m_2^a(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+m_1^a m_2^a\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}(m_2^a+1)\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}(m_2^a+1)m_3^a\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a}\sqrt{m_2^a-1}m_3^a\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+m_1^a(m_2^a+1)\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+m_1^a(m_2^a+1)m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+m_1^a\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a+2}$$
$$+m_1^a\sqrt{m_2^a}\sqrt{m_2^a-1}m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}(m_2^a+1)(m_3^a+1)\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}(m_2^a+1)\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a}\sqrt{m_2^a-1}(m_3^a+1)\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a-2}$$
$$+m_1^a(m_2^a+1)(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+m_1^a(m_2^a+1)\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+m_1^a\sqrt{m_2^a}\sqrt{m_2^a-1}(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+m_1^a\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a-2}$$
$$+(m_1^a+1)\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a+2}$$
$$+(m_1^a+1)\sqrt{m_2^a+1}\sqrt{m_2^a+2}m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)m_2^a\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+(m_1^a+1)m_2^a m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a+1}\sqrt{m_2^a+2}m_3^a\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}m_2^a\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}m_2^a m_3^a\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)\sqrt{m_2^a+1}\sqrt{m_2^a+2}(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$

$+(m_1^a+1)\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a-2}$

$+(m_1^a+1)m_2^a(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+(m_1^a+1)m_2^a\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a+1}\sqrt{m_2^a+2}(m_3^a+1)\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a-2}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}m_2^a(m_3^a+1)\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}m_2^a\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$

$+(m_1^a+1)(m_2^a+1)\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$

$+(m_1^a+1)(m_2^a+1)m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+(m_1^a+1)\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a+2}$

$+(m_1^a+1)\sqrt{m_2^a}\sqrt{m_2^a-1}m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}(m_2^a+1)\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}(m_2^a+1)m_3^a\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a+2}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a}\sqrt{m_2^a-1}m_3^a\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$

$+(m_1^a+1)(m_2^a+1)(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+(m_1^a+1)(m_2^a+1)\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$

$+(m_1^a+1)\sqrt{m_2^a}\sqrt{m_2^a-1}(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$

$+(m_1^a+1)\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a-2}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}(m_2^a+1)(m_3^a+1)\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}(m_2^a+1)\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a}\sqrt{m_2^a-1}(m_3^a+1)\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a-2})]$

$+\alpha_{10}\sum_{a=1}^{3}\left[\frac{\hbar^3}{8\left(\frac{\mu_1}{\mu_2}\right)^{\frac{3}{2}}}\right.$

$(\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a+2}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a+1}\sqrt{m_2^a+2}m_3^a\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}m_2^a\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}m_2^a m_3^a\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+m_1^a\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a+2}$

$+m_1^a\sqrt{m_2^a+1}\sqrt{m_2^a+2}m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$

$+m_1^a m_2^a\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}+m_1^a m_2^a m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a+1}\sqrt{m_2^a+2}(m_3^a+1)\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a-2}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}m_2^a(m_3^a+1)\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}m_2^a\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$

$+m_1^a\sqrt{m_2^a+1}\sqrt{m_2^a+2}(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$

$+m_1^a\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a-2}$

$+m_1^a m_2^a(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}+m_1^a m_2^a\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}(m_2^a+1)\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}(m_2^a+1)m_3^a\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a+2}$

$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a}\sqrt{m_2^a-1}m_3^a\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$

$+m_1^a(m_2^a+1)\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$

$+m_1^a(m_2^a+1)m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$

$+m_1^a\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a+2}$

$$+m_1^a\sqrt{m_2^a}\sqrt{m_2^a-1}m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}(m_2^a+1)(m_3^a+1)\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}(m_2^a+1)\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a}\sqrt{m_2^a-1}(m_3^a+1)\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a+1}\sqrt{m_1^a+2}\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a+2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a-2}$$
$$+m_1^a(m_2^a+1)(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+m_1^a(m_2^a+1)\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+m_1^a\sqrt{m_2^a}\sqrt{m_2^a-1}(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+m_1^a\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a-2}$$
$$+(m_1^a+1)\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a+2}$$
$$+(m_1^a+1)\sqrt{m_2^a+1}\sqrt{m_2^a+2}m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)m_2^a\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+(m_1^a+1)m_2^am_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a+1}\sqrt{m_2^a+2}m_3^a\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}m_2^a\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}m_2^am_3^a\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)\sqrt{m_2^a+1}\sqrt{m_2^a+2}(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a-2}$$
$$+(m_1^a+1)m_2^a(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)m_2^a\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a+1}\sqrt{m_2^a+2}(m_3^a+1)\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a+1}\sqrt{m_2^a+2}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a+2}\delta_{n_3^a,m_3^a-2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}m_2^a(m_3^a+1)\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}m_2^a\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+(m_1^a+1)(m_2^a+1)\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+(m_1^a+1)(m_2^a+1)m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a+2}$$
$$+(m_1^a+1)\sqrt{m_2^a}\sqrt{m_2^a-1}m_3^a\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}(m_2^a+1)\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}(m_2^a+1)m_3^a\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a+1}\sqrt{m_3^a+2}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a+2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a}\sqrt{m_2^a-1}m_3^a\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)(m_2^a+1)(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)(m_2^a+1)\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+(m_1^a+1)\sqrt{m_2^a}\sqrt{m_2^a-1}(m_3^a+1)\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+(m_1^a+1)\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a-2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}(m_2^a+1)(m_3^a+1)\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}(m_2^a+1)\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a}\delta_{n_3^a,m_3^a-2}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a}\sqrt{m_2^a-1}(m_3^a+1)\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a}$$
$$+\sqrt{m_1^a}\sqrt{m_1^a-1}\sqrt{m_2^a}\sqrt{m_2^a-1}\sqrt{m_3^a}\sqrt{m_3^a-1}\delta_{n_1^a,m_1^a-2}\,\delta_{n_2^a,m_2^a-2}\delta_{n_3^a,m_3^a-2})] \qquad (21)$$

The equation (21) represents Hamiltonian operator matrix until sixth degree in case pure gauge theory (gluons without quarks).

In [11], Landau and Lifshitz use the complex energy to describe the particles which can be decayed or decomposed by this relation:

$$E = E_0 - \frac{1}{2} i\Gamma \tag{22}$$

i.e. the Hamiltonian operator becomes non-hermetical.

Since the operator $\hat{H}$ is complex, the energy can be written as E_i:

$$E_i = |H_i| = \sqrt{H_i H_i^*} \quad : i = 0, \ldots, 11 \tag{23}$$

That: $1fm = \frac{1}{197}(MeV^{-1}) = \frac{1000}{197}(GeV^{-1}) = 5.076142131(GeV^{-1})$

The coupling constant was then calculated from equation (4), whereas the energy levels from E_{+0} until E_{+11} were calculated from equation (21) by making a program in Fortran language, then multiplied by $\frac{1}{L\,(GeV^{-1})}$ in order to evaluate the energy level by ***Gev***.

The numeral results of anharmonic energy level values are shown in table (1)

The graphic curve of anharmonic classical potential is represented by:

$$LV_{eff}^{Torr} = \alpha_1 (B_1)^2 + 3\alpha_2 (B_1)^4 + 2\alpha_4 (B_1)^4 + \alpha_5 (B_1)^6 \tag{24}$$

The anharmonic classical potential is related to the homogenous gauge fields through the compound $B_i^a = B_i n^a$ .In this case, $n^a n^a = 1$, and the result are shown in figures (1,2,3,4) which represents the

By looking at table(1) note that for coupling constants: (0.549915534-0.599009088) is perturbation correct for $n_i^a, m_i^a \leq 11$, while for coupling constants: (0.649775708-0.698013648)) is perturbation correct for $n_i^a, m_i^a \leq 10$, while for coupling constants: (0.799669744-0.893003919) is perturbation correct for $n_i^a, m_i^a \leq 8$, while for coupling constant:0.996810855 is perturbation correct for $n_i^a, m_i^a \leq 7$, while for coupling constants: (1.097106472-1.198054106) is perturbation correct for $n_i^a, m_i^a \leq 6$, while for coupling constants: (1.298620381-1.398613975) is perturbation correct for $n_i^a, m_i^a \leq 5$, while for coupling constants: (1.499088396-1.599938721-1.699870674-1.799998265) is perturbation correct for $n_i^a, m_i^a \leq 4$, while for coupling constants: (1.899885714-1.998481321-2.098360361-2.199974688-2.399626926) is perturbation correct for $n_i^a, m_i^a \leq 3$ while for coupling constants: (2.598905472-2.792966579-2.999278861-3.199628273-3.398312073) is perturbation correct for $n_i^a, m_i^a \leq 2$.

We note that potential expansion until sixth degree describes the field potential on full field where there is minimum boundary limit. thus Gluons and Quarks are found in bottom; which can be called confinement within hadrons. As a result, thus it need the Gluons and Quarks require to high kinetic energy until free from confinement and become free:

$E_p \gtrsim |V_{min}| = 7GeV$; and the outcome is nearly zero and thus we find that the minimum energy for g is $E_{(0)} \gtrsim 0.151455195\ Gev$.

The degree of decomposition is given in this relation:

$d = \frac{(N+8)!}{N!\ 8!}$

And we drew $E_{+2} = f(g)$ and $g = f(E_{+2})$ we find:

We notice that whenever the coupling constant increases, the level energy $|E_{+2}|$ increases. The reason of taking the level $|E_{+2}|$ in particular is because it is the common level at which all the solutions are still stable for the values g. and we noticed through the curves (5) and (6), it is possible to consider all the values of coupling constants in these curves: $E_{+2} \lesssim 1GeV$ for all g values. i.e. $E_{+2} = 1GeV$ an approximating curve. The result corresponds with the result of [12], but in our search that perturbation theory by this way cannot be broken down when $g \gtrsim 0.549915534$.

The perturbation theory applied on QCD for small values for coupling constant and the Nobel prize was awarded for the year 2004 [12] and that perturbation theory remains on QCD for $g \leq 0.4$ while in we search and this way we have proved that it can be applied perturbation theory using creation operator and annihilation operator until values $g \leq 3.398312073$, that is the perturbation theory can always be applied on QCD and thus solving the QCD problem with perturbation theory.

4. CONCLUSIONS AND RECOMMENDATIONS:

In this study, the use of a anharmonic oscillator with nine degrees of freedom is proposed and for the first time in quantum mechanics. In addition, a believe semi-particle called Glonon. In this paper , it is recommend that studying the anharmonic oscillator should be done with twenty four freedom degrees, i.e. the gauge theory with group SU(3).

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Figure legends:

Figure(1):shows the anharmonic classical potential expansion and illustrates the energy levels when g=1.198054106 and the perturbation is correct when $n_i^a, m_i^a \leq 6$.

Figure(2):shows the anharmonic classical potential expansion and illustrates the energy levels when g=1.899885714 and the perturbation is correct when $n_i^a, m_i^a \leq 3$.

Figure(3):shows the anharmonic classical potential expansion and illustrates the energy levels when g=1.998481321 and the perturbation is correct when $n_i^a, m_i^a \leq 3$.

Figure(4):shows the anharmonic classical potential expansion and illustrates the energy levels when g=3.398312073 and the perturbation is correct when $n_i^a, m_i^a \leq 2$.

Figure (5): shows that $E_{+2} = f(g)$

Figure (6): shows that $g = f(E_{+2})$

Table(1):shows the values of anharmonic energy levels and according to coupling constant g(L).

g	E_{+0} (GeV)	E_{+1} (GeV)	E_{+2} (GeV)	E_{+3} (GeV)	E_{+4} (GeV)	E_{+5} (GeV)	E_{+6} (GeV)	E_{+7} (GeV)	E_{+8} (GeV)	E_{+9} (GeV)
0.549915534	0.151455195	0.184900402	0.217744235	0.249585617	0.280023791	0.308657602	0.335086292	0.358908707	0.379724167	0.397131439
0.599009088	0.164103048	0.200298824	0.235722354	0.269858807	0.302193352	0.332211158	0.359397316	0.383237073	0.403215519	0.418817904
0.649775708	0.177150802	0.216173103	0.254215894	0.290625987	0.324750271	0.355935793	0.383529364	0.406877951	0.425328443	0.438227809
0.698013648	0.18951783	0.231208268	0.271691064	0.310160943	0.345812861	0.377841778	0.405442494	0.42780989	0.444138767	0.453624004
0.799669744	0.215475724	0.262727592	0.308183147	0.350644846	0.388915224	0.421796505	0.448091459	0.466602232	0.476131515	0.475481764
0.893003919	0.239174558	0.291453065	0.34125352	0.386923784	0.426811796	0.459265419	0.482632745	0.495261559	0.495499878	0.481695563
0.996810855	0.265368557	0.323139731	0.377499246	0.426172735	0.46688576	0.497363957	0.515332808	0.518517873	0.504644865	0.471439266
1.097106472	0.290499319	0.353471014	0.411938678	0.462899674	0.503351365	0.530291038	0.54071598	0.531623708	0.500011431	0.442876283
1.198054106	0.315604299	0.383696811	0.44598262	0.498590463	0.537649384	0.559288042	0.559635482	0.534820286	0.4809715	0.394218012
1.298620381	0.340412956	0.413486378	0.479239543	0.532792562	0.56926524	0.58377738	0.571449091	0.527400026	0.446750217	0.324619545
1.398613975	0.364868632	0.442768412	0.51161837	0.565385345	0.598036095	0.603537459	0.575856044	0.508958916	0.396812683	0.233384334
1.499088396	0.389217303	0.471833816	0.54342648	0.596646038	0.624143383	0.618569335	0.572574405	0.478809566	0.329925712	0.118573279
1.599938721	0.413419245	0.500630328	0.574589418	0.626461369	0.64741172	0.628605481	0.561208038	0.436384322	0.245299951	0.020880144
1.699870674	0.437154739	0.528775608	0.604684729	0.654407452	0.667469278	0.633395936	0.541712473	0.38194477	0.143618024	0.183742187
1.799998265	0.460681043	0.556572894	0.634031225	0.680766818	0.684490685	0.632913837	0.513747134	0.314701511	0.02348798	0.372182676
1.899885714	0.483886361	0.58388826	0.66247968	0.705387118	0.698336847	0.627055363	0.477268787	0.234703769	0.114913344	0.585856206
1.998481321	0.506523746	0.610431649	0.689731172	0.728016426	0.708882053	0.615922238	0.43273147	0.142904013	0.269965795	0.822283618
2.098360361	0.529176346	0.636885642	0.716481586	0.749221715	0.716363567	0.59916506	0.378883957	0.036777721	0.445895731	1.087878787
2.199974688	0.551925871	0.663340016	0.742799697	0.769001784	0.720642998	0.576420515	0.315031508	0.084827604	0.644459269	1.385167446

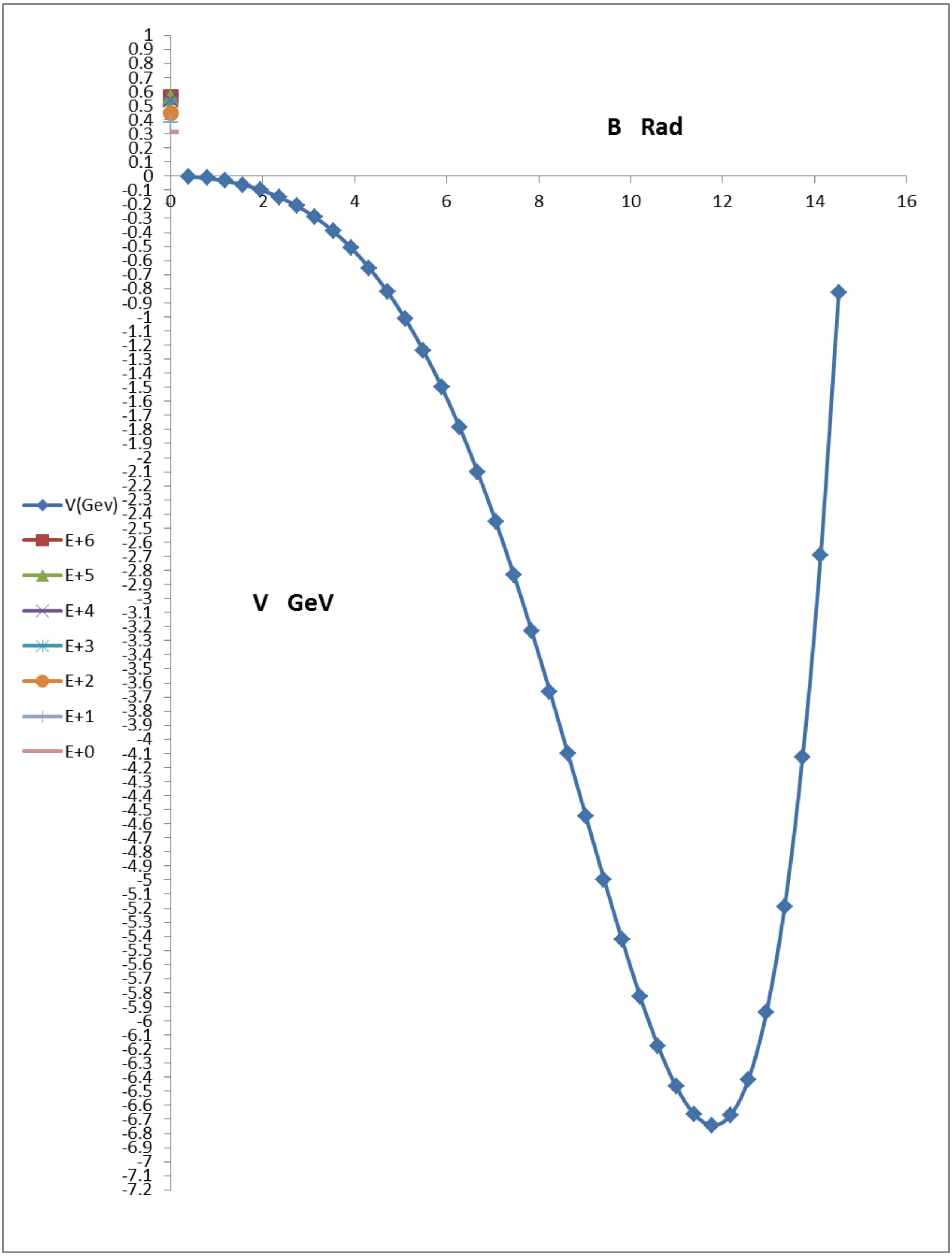
Impact Factor 4.991, ISSN: 2320-5083, Volume 6, Issue 10, November 2018

E_{+10} (GeV)	E_{+11} (GeV)
0.410729686	0.42011807
0.429529395	0.434835004
0.444923017	0.444760877
0.455460638	0.448843314
0.463455206	0.438854529
0.452196709	0.405350945
0.416626714	0.337932767
0.357216012	0.240027596
0.270688559	0.106512109
0.156127966	0.063604637
0.012640477	0.27145205
0.162596761	0.520933362
0.3709905	0.813865805
0.610610286	1.147460772
0.88459975	1.526051016
1.192398698	1.94881379
1.530454588	2.410884895
1.907913983	2.924743403
2.328253904	3.495022373

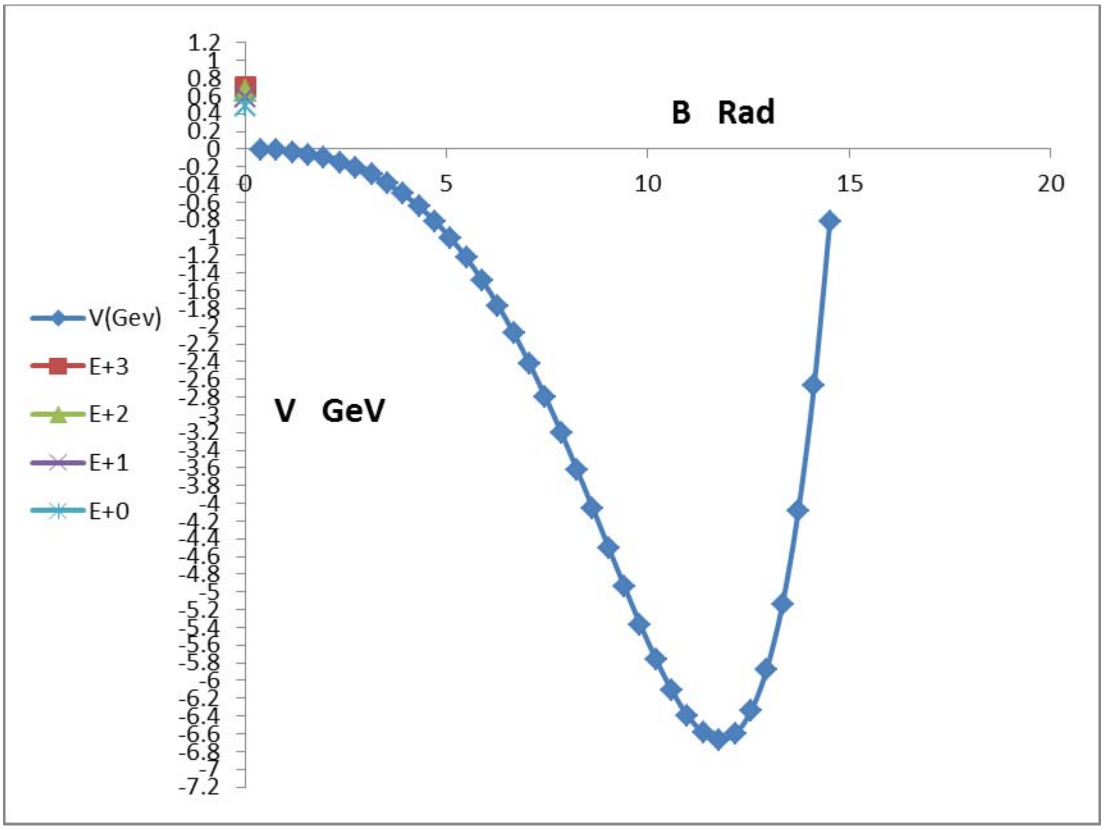
g	E_{+0} (GeV)	E_{+1} (GeV)	E_{+2} (GeV)	E_{+3}(GeV)	E_{+4}(GeV)	E_{+5}(GeV)	E_{+6}(GeV)	E_{+7} (GeV)	E_{+8} (GeV)
2.399626926	0.595726082	0.713936122	0.791837569	0.802558457	0.719225838	0.514967669	0.16291138	0.363815148	1.092084335
2.598905472	0.638218344	0.762568872	0.837219466	0.829036452	0.704887369	0.431637794	0.023844884	0.694694487	1.614044156
2.792966579	0.678385503	0.808100981	0.877987543	0.848160751	0.678735038	0.329824308	0.238456627	1.065993564	2.192671014
2.999278861	0.719747312	0.854510138	0.91765918	0.861452793	0.638147828	0.200002263	0.500726297	1.511780253	2.880901623
3.199628273	0.758572395	0.897605834	0.952635048	0.867656469	0.586667206	0.053664065	0.787355693	1.992395112	3.61745791
3.398312073	0.795759498	0.938435424	0.983964363	0.867580157	0.524517921	0.10998715	1.100700168	2.512385788	4.409809344

$E+_9\ (GeV)$	$E+_{10}\ (GeV)$	$E+_{11}\ (GeV)$
2.048768298	3.260740438	4.754872044
2.815026277	4.330776252	6.194425716
3.658375826	5.502992286	7.766406187
4.655833106	6.884317024	9.614109870
5.718546151	8.351667164	11.57281023
6.857736996	9.920931899	13.66423384

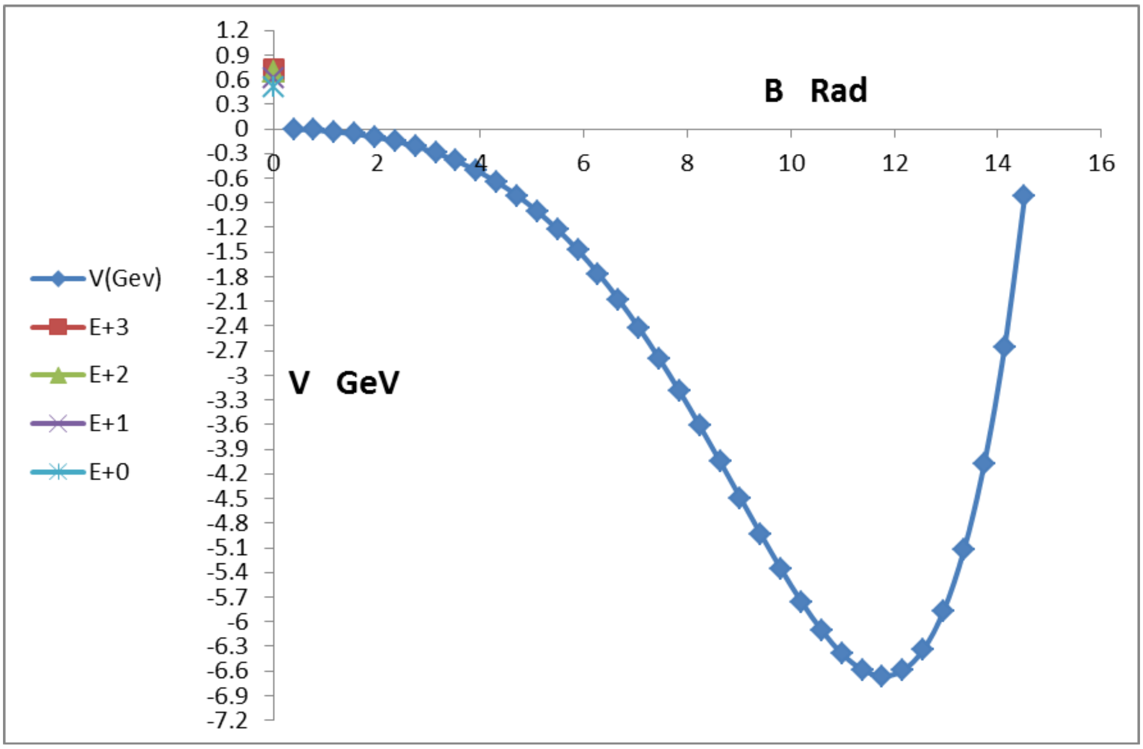
Figure(1)



Figure(2)



Figure(3)



Figure(4)

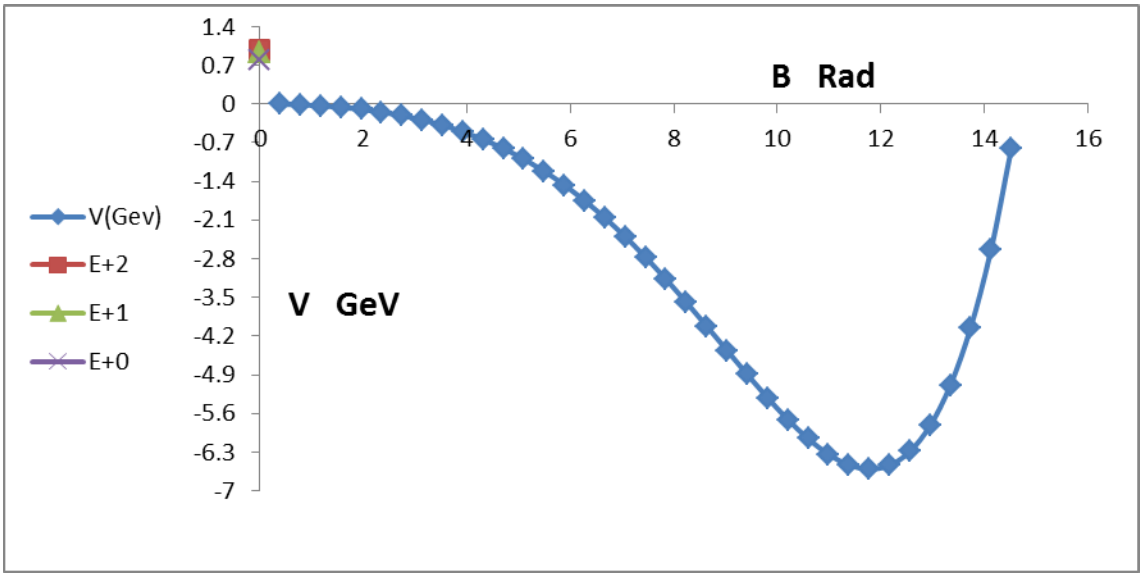


Figure (5)

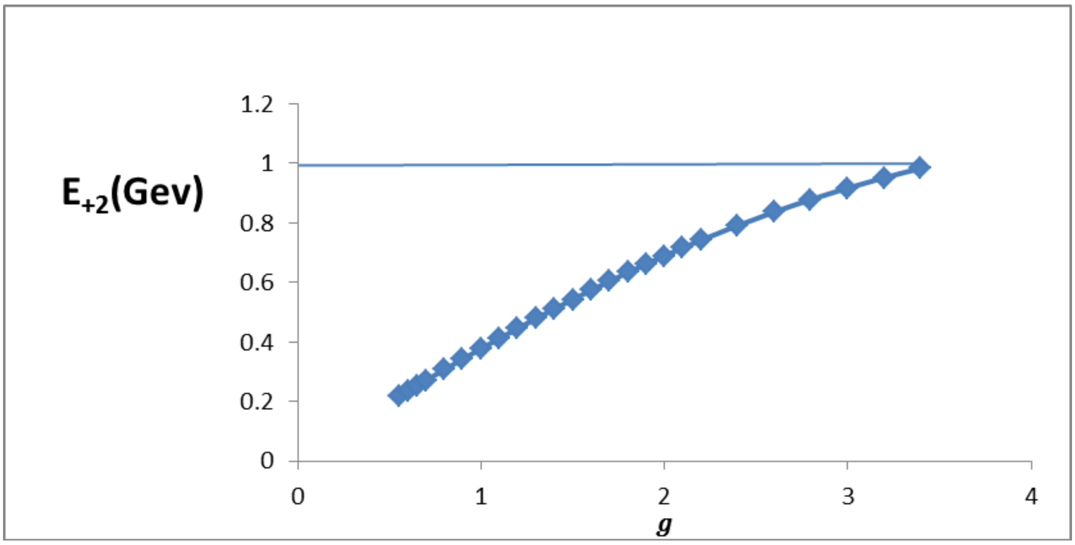


Figure (6)