Strange results pertaining to Fermi’s weak coupling constant, Strong coupling constant and Newtonian gravitational constant

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Abstract: Assuming that Planck scale plays a crucial role in Strong and Electroweak interactions, we made an attempt to inter-relate the Newtonian gravitational constant, Fermi’s weak coupling constant and Strong coupling constant.

Keywords: Planck scale; Weak coupling constant; Strong coupling constant; Newtonian gravitational constant;

1. Introduction

In this letter, by considering the Planck scale and proton-electron mass ratio, we proposed very simple relations among the Newtonian gravitational constant, Fermi’s weak coupling constant and Strong coupling constant [1-4].

2. Two results connected with proton-electron mass ratio

\[ \left( \frac{m_p}{m_e} \right) \] is the proton-electron mass ratio.

\[ G_F \] is the Fermi’s weak coupling constant.

\[ G_N \] is the Newton’s gravitational constant.

\[ \alpha_s \] is the strong coupling constant.

Let,

\[ R_{pl} \equiv \text{Schwarzschild radius of Planck mass} \]

\[ \equiv \frac{2G_NM_{pl}}{c^2} \equiv 2\sqrt{G_N \frac{\hbar}{c^3}} \text{ where } M_{pl} \equiv \sqrt{\frac{\hbar}{G_N}} \]

Result-1: It is noticed that,

\[ \left( \frac{m_p}{m_e} \right) \equiv \left( \frac{G_F}{\hbar c R_{pl}^2} \right)^{\frac{1}{10}} \equiv \left( \frac{G_F c^2}{4G_N \hbar^2} \right)^{\frac{1}{10}} \]

Result-2: It is noticed that,

\[ \left( \frac{m_p}{m_e} \right) \equiv \left( \frac{1}{\alpha_s} \right)^{\frac{1}{10}} \left( \frac{\hbar c}{G_N m_p} \right)^{\frac{1}{10}} \equiv \left( \frac{1}{\alpha_s} \right)^{\frac{1}{10}} \left( \frac{M_{pl}}{m_p} \right)^{\frac{1}{10}} \]

3. Other derived results

Based on the above two strange results,

\[ \left( \frac{m_p}{m_e} \right) \equiv \frac{4\hbar^3}{\alpha_s m_c^2 c G_F} \]

\[ m_e \approx \frac{\alpha_s m_c^4 c G_F}{4\hbar^3} \]

\[ \alpha_s \approx \frac{4\hbar^3 m_e^2 c G_F}{m_p^2 c G_F} \]

\[ G_F \approx \left( \frac{m_p}{m_e} \right)^{10} \left( \frac{4G_N \hbar^2}{c^2} \right) \]

\[ G_N \approx \left( \frac{m_e}{m_p} \right)^{10} \left( \frac{G_F c^2}{4\hbar^2} \right) \]

\[ G_F \approx \left( \frac{m_p}{m_e} \right)^{10} \left( \frac{4\hbar^3}{c^2} \right) \]

4. Discussion

In our previous published contributions and papers [5-7] we proposed that, there exist two large pseudo gravitational constants associated with nuclear and electromagnetic interactions and presented many interesting applications [7] starting from nuclear radii to neutron star radius. By eliminating the two pseudo gravitational constants, in this latter, we proposed the above relations.

With reference to the recommended value of

\[ G_N \approx 6.67408 \times 10^{-11} \text{ m}^3 \text{kg}^{-1} \text{sec}^{-2} \]

\[ G_F \approx 1.438965 \times 10^{-62} \text{ Jm}^2 \text{ and } \alpha_s \approx 0.1152934 \]

With reference to the recommended value of

\[ G_F \approx 1.435850984 \times 10^{-62} \text{ Jm}^2 \]

\[ G_N \approx 6.65963739 \times 10^{-11} \text{ m}^3 \text{kg}^{-1} \text{sec}^{-2} \text{ and } \]

\[ \alpha_s \approx 0.11554343 \]
From the above relations and estimated magnitudes, we would like to say that,

1) Gravity and Planck scale play a vital role in electroweak interactions.

2) With reference to the above proposed relations, magnitude of $\alpha_s$ seems to be around 0.1153. The same conclusion can also be extracted from Particle data group’s (PDG) review on Quantum chromodynamics [5]. See the following table-1.

<table>
<thead>
<tr>
<th>#</th>
<th>$\alpha_s (M_Z^2)$</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\alpha_s (M_Z^2) = 0.1160^{+0.0041}_{-0.0048}$</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$\alpha_s (M_Z^2) = 0.1151^{+0.0093}_{-0.0087}$</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$\alpha_s (M_Z^2) = 0.1148\pm 0.0014(exp.) \pm 0.0018(PDF)^{0.0050}_{-0.0000}$</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$\alpha_s (M_Z^2) = 0.1134\pm 0.0011$,</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>$\alpha_s (M_Z^2) = 0.1142\pm 0.0023$,</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>$\alpha_s (M_Z^2) = 0.1151^{+0.0033}_{-0.0032}$</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>$\alpha_s (M_Z^2) = 0.1158\pm 0.0035$,</td>
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<tr>
<td>8</td>
<td>$\alpha_s (M_Z^2) = 0.1154\pm 0.0020$,</td>
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<td>9</td>
<td>$\alpha_s (M_Z^2) = 0.1134^{+0.0028}_{-0.0022}$</td>
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<tr>
<td>10</td>
<td>$\alpha_s (M_Z^2) = 0.1156^{+0.0021}_{-0.0022}$</td>
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<td>11</td>
<td>$\alpha_s (M_Z^2) = 0.1156^{+0.0041}_{-0.0034}$</td>
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<tr>
<td>12</td>
<td>$\alpha_s (M_Z^2) = 0.1151^{+0.0093}_{-0.0087}$</td>
<td></td>
</tr>
</tbody>
</table>

Table-1: Magnitude of $\alpha_s$ close to 0.1153

All of the above relations can be simplified with the following assumption.

In nuclear structure, there exists a very large gravitational constant [8,9,10], $G_s \approx 3.328 \times 10^{-28}$ m$^3$kg$^{-1}$sec$^{-2}$, in such a way that,

\begin{align}
\text{Strong coupling constant, } &\alpha_s \approx \left( \frac{hc}{G_s m_p^2} \right)^2 \approx 0.1153 \quad (9)
\end{align}

\begin{align}
\text{Nuclear charge radius, } &R_0 \approx \frac{2GM_p}{c^2} \approx 1.24 \text{ fm} \quad (10)
\end{align}

\begin{align}
\text{Magnetic dipole moment of proton, } &\mu_{\text{proton}} \approx \frac{eGM_p}{2c} \approx 1.49 \times 10^{-26} \text{ J/Tesla} \quad (11)
\end{align}

\begin{align}
\text{Proton-electron mass ratio, } &\frac{m_p}{m_e} \approx \left( \frac{G_s}{G_N} \right) \left( \frac{G_m^2}{hc} \right)^{\frac{1}{2}} \quad (12)
\end{align}

Fermi's Weak coupling constant, $G_F \approx \frac{4G_s^2 m_e^2 h}{c^2}$ \quad (13)

### 5. Conclusion

We would like to stress that, with reference to String theory models and Quantum gravity models, presented results can be given some consideration in developing a ‘workable model’ of ‘final unification’.

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### References


