The 3 atomic forces and the strong coupling constant

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Abstract: Key conceptual link that connects the gravitational force and non-gravitational forces is - the classical force limit, $F_C \cong \left(\frac{c^4}{\pi}\right)$. Nuclear weak force magnitude is $F_W \cong \frac{F_C}{N^2}$ where $N$ is the Avogadro number. Relation between the nuclear strong force and weak force magnitudes can be expressed as $\sqrt{\frac{F_S}{F_W}} \cong 2\pi \ln(N^2)$. It is noticed that there exists simple relations in between the nuclear strong force, weak force and the force on the revolving electron in the Bohr radius of the Hydrogen atom. An attempt is made to couple the strong coupling constant with these 3 forces.

Keywords: Avogadro number; nuclear strong force; nuclear weak force; weak coupling angle; up and down quark mass ratio; up quark and electron mass ratio; proton and electron mass ratio; neutron and proton mass difference; strong coupling constant;

2 Key assumptions in unification

Assumption-1
Nucleon behaves as if it constitutes molar electron mass. Molar electron mass $(N.m_e)$ plays a crucial role in nuclear and particle physics.

Assumption-2
The key conceptual link that connects the gravitational and non-gravitational forces is - the classical force limit

$$F_C \cong \left(\frac{c^4}{G}\right) \cong 1.21026 \times 10^{44} \text{ newton}$$ (1)

It can be considered as the upper limit of the string tension. In its inverse form it appears in Einstein’s theory of gravitation as $\frac{8\pi G}{c^4}$. It has multiple applications in Black hole physics and Planck scale physics [4]. It has to be measured either from the experiments or from the cosmic and astronomical observations.

Assumption-3
Ratio of ‘classical force limit = $F_C$’ and ‘weak force magnitude = $F_W$’, ’ is $N^2$ where $N$ is a large number close to the Avogadro number. $F_C \cong N^2 \cong \frac{\text{Upper limit of classical force}}{\text{nuclear weak force magnitude}}$ (2)

Thus the proposed weak force magnitude is $F_W \cong \frac{\Delta}{N^2G} \cong 3.33715\times10^{-4}$ newton and can be considered as the characteristic nuclear weak string tension. It can be measured in the particle accelerators.

Assumption-4
The strong force magnitude can be defined as follows.

$$\sqrt{\frac{F_S}{F_W}} \cong 2\pi \ln(N^2) \cong 4\pi \ln(N)$$ (3)
is the mass of its corresponding boson then

Thus \( \Psi \sim \frac{m_e c^2}{m_f c^2} \) \( \sin \theta_W \sim \frac{1}{X_E \alpha} \) \( \approx 0.46443353 \) \( \text{(5)} \)

where \( m_e \) is the rest mass of electron and \( m_f \) is the rest mass of fermion and \( \sin \theta_W \) is the weak coupling angle. In the modified Susy the fermion and boson mass ratio \( \Psi \) can be fitted in the following way.

\[
\Psi^2 \ln (1 + \sin^2 \theta_W) \approx 1 \quad \text{(6)}
\]

Thus \( \Psi \approx 2.262706 \). If \( m_f \) is the mass of fermion and \( m_b \) is the mass of its corresponding boson then

\[
m_b \approx \frac{m_f}{\Psi} \quad \text{(7)}
\]

With this idea super symmetry can be observed in the strong interactions \( [1] \) and can also be observed in the electroweak interactions \( [2] \).

2.2 Strong force magnitude and its applications in nuclear physics

The characteristic nuclear size is

\[
R_0 \approx \sqrt{\frac{e^2}{4\pi \varepsilon_0 F_S}} \approx 1.2084 \text{ fm} \quad \text{(8)}
\]

Magnetic moment of electron is close to

\[
\mu_n \approx \frac{1}{2} \sin \theta_W \cdot e c \cdot \sqrt{\frac{e^2}{4\pi \varepsilon_0 F_W}} \approx 9.274 \times 10^{-24} \text{ J/tesla} \quad \text{(9)}
\]

Similarly magnetic moment of proton is close to

\[
\mu_p \approx \frac{1}{2} \sin \theta_W \cdot e c \cdot \sqrt{\frac{e^2}{4\pi \varepsilon_0 F_S}} \approx 1.348 \times 10^{-26} \text{ J/tesla} \quad \text{(10)}
\]

Proton rest mass is close to

\[
\left( \frac{F_S}{F_W} + X_E^2 - \frac{1}{\alpha^2} \right) \cdot E_W \approx m_p c^2 \approx 938.18 \text{ MeV} \quad \text{(11)}
\]

where

\[
E_W \approx \sqrt{\frac{e^2 F_W}{4\pi \varepsilon_0}} \approx 1.731843735 \times 10^{-3} \text{ MeV} \quad \text{(12)}
\]

Neutron and proton mass difference is close to

\[
\sqrt{\frac{F_S}{F_W} + X_E^2} \cdot E_W \approx m_n c^2 - m_p c^2 \approx 1.2966 \text{ MeV} \quad \text{(13)}
\]

where \( m_n \) and \( m_p \) are the neutron and proton rest masses respectively \( [3] \).

3 Relation between the 3 atomic forces

3.1 Nucleons and the up & down quark masses

It was also defined that

\[
\frac{m_u c^2}{m_e c^2} \approx e^{X_E \alpha} \quad \text{(14)}
\]

In our earlier published papers suggested up quark mass is 4.4 MeV and down quark mass is 9.48 MeV. With these magnitudes it is noticed that,

\[
(m_n - m_p) c^2 \approx \ln \left( \frac{m_u m_d}{m_e} \right) \cdot m_e c^2 \quad \text{(15)}
\]

Here lhs = 1.2933 MeV and rhs = 1.2963 MeV.

3.2 To fit the strong coupling constant

Semi empirically it is noticed that

\[
\frac{m_u c^2}{m_e c^2} \approx \ln \left( \frac{F_S}{F_W F_E} \right) \quad \text{(16)}
\]

where \( F_E \approx 8.2387 \times 10^8 \) newton is the force of attraction between the electron and the proton in the Bohr radius of the Hydrogen atom. Here in this relation, lhs = 8.6120421 and rhs = 8.61054448. This may not be an accidental coincidence. Inserting the 3 atomic forces in one relation is very interesting and is a requirement of the unification. The important question to be answered is: What will be the physics of this coincidence? In this connection it can be suggested that,

\[
\frac{1}{\alpha_s} \approx \ln \left( \frac{F_S}{F_W F_E} \right) \approx 8.61054448 \quad \text{(17)}
\]
where $\alpha_s$ is the strong coupling constant. Thus $\alpha_s \cong 0.1161367$. This can be compared with the CODATA recommended value [3]. It can be written as

$$\frac{1}{\alpha_s} \cong \ln \sqrt{\frac{e^2}{4\pi\epsilon_0 R_0^2 F_W F_E}} \cong 8.6105448 \quad (18)$$

where $R_0 \cong 1.21$ fm. If $F_W$ and $F_E$ are the characteristic force constants and as the nuclear distance decreases $F_S$ magnitude increases and the magnitude of $\alpha_s$ decreases.

### 3.3 Combined role of $\alpha$ and $\alpha_s$ in fitting the nucleon rest masses

It is well established that, neutrons and protons constitute up and down quarks. It is noticed that

$$\left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right) \sqrt{m_u m_d} c^2 \cong 939.4; \text{MeV} \quad (19)$$

Another interesting relation is

$$\frac{\sqrt{m_u m_d} c^2}{(m_n - m_p) c^2} \cong \ln \left(\frac{1}{\alpha} + \frac{1}{\alpha_s}\right) \quad (20)$$

### Conclusion

At one go a unified theory can not be developed. Searching, collecting, sorting and compiling the cosmic code is an essential part of unification. In this attempt the above observations can be given a chance. Further research and analysis may reveal the mystery of the 3 atomic forces.

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