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Is Electroweak Interaction – a Kind of Cosmological Lambda Term in Maintaining Nuclear Existence and Stability?

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- **Lambda term was a cosmic physical constant proposed for maintaining a static universe without collapsing. When it was realized that, universe is expanding, Lambda term has been ignored for many years. By observing the accelerating nature of galaxies, now, Lambda term is being interpreted as a mysterious (dark) energy term having negative pressure causing the universe to accelerate.**
- **Up & Down quarks, Pions & electroweak bosons, play a crucial role in nuclear structure and nuclear binding energy.**
- **Analogous to the cosmological Lambda term, electroweak interaction helps in maintaining the existence of atomic nucleus without collapsing due to strong interaction.**
- **There exists an electroweak fermion of rest energy 585 GeV.**

Interesting points to be noted are:

1. Mass ratio of pions and weak bosons is 0.0016 and it is approximately twice the product of Fine structure ratio and strong coupling constant.

$$k \cong \left[\frac{\sqrt{(m_\pi)^0 (m_\pi)^\pm}}{\sqrt{(m_z)^0 (m_w)^\pm}}\right] \cong 0.0016 \cong \left[\frac{m_p}{M_{wf}} \cong \frac{938.272\ \mathrm{MeV}/c^2}{584.725\ \mathrm{GeV}/c^2}\right]$$

$$\approx (2*\alpha*\alpha_s) \cong 0.00168 \text{ to } 0.00175 \text{ for } \alpha_s = 0.115 \text{ to } 0.12$$

where, M_{wf} = Proposed Electroweak fermion mass = 584.725 GeV/c^2

$\alpha =$ Fine structure ratio, $\alpha_s =$ Strong coupling constant

2. $(2Z)$ and $k = 0.0016$ play a significant role in understanding nuclear stability line.

$$A_s \cong 2Z + k(2Z)^2 \cong 2Z + 0.0064Z^2$$

3. Increasing number of free nucleons $\left\{1+\left[0.0016\left(\left(Z^2+A^2\right)/2\right)\right]\right\}$, Increasing nuclear radii $A^{1/3}$ and Increasing asymmetry about stable mass number $\left[(A_s - A)^2/A_s\right]$ play an important role in reducing nuclear binding energy.

4. Nuclear binding energy can be addressed with four simple terms and single energy coefficient. For, Z = (3 to 120) and (N>=Z),

$$\boxed{BE \cong \left\{ A - \left[1 + \left(0.0016 \left(\frac{Z^2 + A^2}{2} \right) \right) \right] - A^{1/3} - \frac{(A_s - A)^2}{A_s} \right\} (10.1 \text{ MeV})}$$

5. Unified nuclear binding energy coefficient is associated with the average rest energy of 3 Up quarks and 3 Down quarks.

$$\frac{1}{2}\left[\left(2m_u c^2 + m_d c^2\right) + \left(m_u c^2 + 2m_d c^2\right) \right] \cong 10.1 \text{ MeV}$$

where (m_u, m_d) reprsent Up and Down quark masses.

6. Proton drip lines can be understood in a unified approach.

$$(A_P)_{low} \cong \left(2Z + kZ^2\right) - \ln\left(\frac{1}{k}\right) \cong \left(2Z + kZ^2\right) - 6.44$$

$$(A_P)_{up} \cong \left(2Z + 2kZ^2\right) \cong 2Z(1 + kZ)$$

$$(A_P)_{gm} \cong \sqrt{(A_P)_{low}(A_P)_{up}}$$

7. Neutron drip lines can be understood in a unified approach.

$$A_N \cong (A_P)_{up} + Z$$

$$\cong \left(2Z + 2kZ^2\right) + Z \cong 3Z + 2kZ^2$$

8. With reference to Up and Down quark arrangement, number range associated with harmonic oscillator coupling and spin-orbit coupling can be considered as a representation of mass number range of a proton number having magic behavior. 'n' being an integer,

$(A_n)_{lower} \cong \left[\frac{(n^3 + 2n)}{3}\right] - n \cong \sum_{n=1}^{n} n(n-1)$ For $n = 7$, $(A_n)_{lower} = 112$	$(A_n)_{upper} \cong \left[\frac{(n^3 + 2n)}{3}\right] + n \cong 2n + \sum_{n=1}^{n} n(n-1)$ For $n = 7$, $(A_n)_{upper} = 126$

➢ **Z=50 strictly follows the mass range of 112 to 126 at n = 7.**