A Simple Formula Suggests a Profound Mass Relation between Quarks and Leptons

Rodolfo A. Frino - November 2014
Electronics Engineer – Degree from the National University of Mar del Plata - Argentina
rodolfo_frino@yahoo.com.ar

Abstract

This paper is concerned with a formula for the mass of the neutron. This formula is based on the mass of the proton and the masses of the three heavier leptons: the electron (generation 1), the muon (generation 2) and the tau particle (generation 3). The formula is, at least, accurate to 4 decimal places. Because the mass of the tau particle is poorly known, it is unknown whether this formula is physically correct or it is simply a numeric coincidence. Finally, the formula suggests a deep mass relationship between quarks and leptons.

Keywords*: Neutron, Proton, Electron, Muon, Tau particle (Tauon), Fermion, Generations of Matter.*

1. The Predicted Mass of the Neutron

In 2012 I proposed the following formula for the mass of the neutron

$$m_n = m_p + \pi^3 m_\tau \left(\frac{m_e}{m_\mu} \right)^2 \tag{1}$$

which can also be written as

$$m_n - m_p = \pi^3 m_\tau \left(\frac{m_e}{m_\mu} \right)^2 \tag{2}$$

Where

m_n = neutron rest mass

m_p = proton rest mass = $1.672\,621\,777(74) \times 10^{-27}\, Kg$ (CODATA 2006 [1])

m_e = electron rest mass = $9.109\,382\,91(40) \times 10^{-31}\, Kg$ (CODATA 2006 [1])

m_τ = tauon rest mass = $3.167\,47(29) \times 10^{-27}\, Kg$ (CODATA 2006 [1])

m_μ = muon rest mass = $1.883\,531\,475(96) \times^{-28}\, Kg$ (CODATA 2006 [1])

Let us calculate the mass of the neutron from equation (1)

$$m_n = 1.672\,621\,777 \times 10^{-27}\,Kg + \pi^3 \left(3.167\,47 \times 10^{-27}\,Kg\right)\left(\frac{9.109\,382\,91 \times 10^{-31}\,Kg}{1.883\,531\,475 \times^{-28}\,Kg}\right)^2$$

The result of this calculation is

$$m_n = 1.674\;918\;953 \times 10^{-27}\,Kg \approx 1.674\;92 \times 10^{-27}\,Kg \qquad \text{(R1)}$$

2. The Measured Mass of the Neutron

According to CODATA 2006 [1], the measured value for the rest mass of the neutron is

$$m_{n\_\exp} = 1.674\;927\;351(74) \times 10^{-27}\,Kg \qquad \text{(CODATA 2006)}$$

3. Mass Comparison

Let us compare the theoretical value calculated in section 1 with the experimental counterpart from section 2. The following table contains both values to make the comparison easier

	Neutron Mass (Kg)
Measured value $m_{n\_\exp}$ (CODATA 2006 [1])	$1.674\;927\;351 \times 10^{-27}$
Theoretical value m_n (Formula 1)	$1.674\;92 \times 10^{-27}$

4. Conclusions

We conclude that formula (1) is, at least, accurate to 4 decimal places (and possibly 5). We can ask the following question: is this formula an exact description of nature? Unfortunately the measured mass of the tau particle does not have the required precision to even suggesting an answer. However, if this formula were numerically correct to, approximately, nine decimal places, every theory of everything should answer the following questions: a) does formula (1) indicate a connection between quarks and leptons or is it simply a numeric coincidence?, b) are the masses of all particles in the universe linked by formulas similar to the one presented here?; and finally c) does this formula respond to the following "design"

$$m_n = m_p + \pi^G m_\tau \left(\frac{m_e}{m_\mu} \right)^{G-1} \qquad (3)$$

where G is the number of known generations of matter ($G = 3$)?

Perhaps the answers to the above questions are around the corner, or perhaps they are a few years away. I look forward to seeing the former possibility to come true.

REFERENCES

[1] NIST 2006, *Fundamental Physical Constants—Extensive Listing,* retrieved from http: //physics.nist.gov/constants, (2006)