Relativistic analysis of the Nucleonic mass difference

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Abstract

Electrodynamic analysis of the neutron structure leads us to find, that if we assume the relativistic mass of a single-electron charged, concentric ring, orbiting a proton, is equal to the mass difference between the proton and the neutron, then, with a theoretical relative error of 0.053%, that orbiting ring has the rest mass of an electron.

We seek to model the neutron by assuming it is composed of a proton, circumscribed by an orbiting ring whose charge is equal to that of an electron and whose relativistic mass is given by the following equation.

$$mass_{ring} = mass_{neutron} - mass_{proton} \qquad (1)$$

Special relativity states that the rest mass of an orbiting ring subjected to a perpendicular force, generated by the electric field of the proton, will under go a mass increase according to the following formula.

$$mass_{ring} = \frac{mass_{ring\ rest}}{\sqrt{1-\frac{v_{ring}^{2}}{c^{2}}}} \qquad (2)$$

We can manipulate eq. (2) to give us the following equation.

$$v_{ring}^{2} = c^{2}\left(1-\left(\frac{mass_{ring\ rest}}{mass_{ring}}\right)^{2}\right) \qquad (3)$$

Using Newtonian and electrodynamic analysis, we find that the following equation describes our theoretical model of the neutron.

$$\frac{k_0 e^2}{R^2} = \frac{mass_{ring} * v_{ring}^{2}}{R} \qquad (4)$$

Substituting eq. (3) into eq. (4) and solving for the rest mass of the negatively charged circumscribing ring, we get the following formula.

$$mass_{ring\ rest} = \sqrt{(mass_{ring})^2 - \left(\frac{k_0 * e^2}{R * c^2} * mass_{ring}\right)} \qquad (5)$$

If we assume that the ring's orbital radius, and hence, the electrodynamic interaction distance between the center of the proton and the edge of the ring, is equal to the un-reduced Compton wavelength of a neutron, then we will need to utilize the following equation in our analysis.

$$R = \frac{h}{mass_{neutron} * c} \qquad (6)$$

Finally, substituting eq. (6) into eq. (5), we get the final form for the formula of our ring's rest mass.

$$mass_{ring\ rest} = \sqrt{(mass_{ring})^2 - \left(\frac{k_0 * e^2}{h * c} * mass_{neutron} * mass_{ring}\right)} \tag{7}$$

Substituting the following experimentally determined values[1],

$$mass_{ring} = 2.305573039 * 10^{-30}\, kg$$

$$\frac{k_0 * e^2}{h * c} = \frac{1}{137.03599911(2\pi)}$$

$$mass_{neutron} = 1.674927292 * 10^{-27}\, kg$$

into eq. (7), we calculate the following value for the theoretical rest mass of our proton-orbiting ring.

$$mass_{ring\ rest} = 9.1142150 * 10^{-31}\, kg$$

The current experimental value for the mass of the electron is $9.1093826*10^{-31}$ kg[1]. Which gives us a relative error of 0.053% for our theoretical result.

It is interesting to note, that if we assume that the orbiting particle does not circumscribe the proton, but instead has a more localized position, relative to the center of the proton, center-of-mass dynamical analysis requires that our theoretical rest mass equation, for the orbiting particle, change to the following. Assuming of course, that like our ring analysis above, the relativistic mass of the orbiting particle is also equal to the mass difference between the proton and the neutron.

$$mass_{orbiting\ particle\ rest} = \sqrt{(mass_{orbiting\ particle})^2 - \left(\frac{k_0 * e^2}{h * c} * mass_{proton} * mass_{orbiting\ particle}\right)} \tag{8}$$

Using the current experimental value[1] for the mass of the proton,

$$mass_{proton} = 1.67262171 * 10^{-27}\, kg$$

we calculate the following value for our theoretical, non-circumscribing, particle's rest mass.

$$mass_{orbiting\ particle\ rest} = 9.148020832 * 10^{-31}\, kg$$

Which yields a relative error of 0.422%, nearly eight times the error found in our ring model.

Conclusion

Achieving such an infinitesimal relative error in our theoretically calculated circumscribing rest mass, given our non-Quantum Chromo-Dynamic approach towards the structure of the neutron, leaves little doubt that the results of our analysis are not merely coincidental. Further more, the significant increase in our error, when the center-of-mass of our neutron model was not assumed to be at the center of the proton, may have far reaching consequences for developing new theories on the behavior of the electron at all scales.

References:

1. S. Eidelman *et al.*, Physics Letters B**592**, 1 (2004). http://pdg.lbl.gov/2005/reviews/consrpp.pdf