A Theoretical Account of the Proton-Electron Mass Ratio

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Abstract

The experimental value of the proton-electron mass ratio is

$$\frac{m_p}{m_e} \sim 1836.15267343(11).$$

A recent investigation by the author revealed that the dimensionless number could be extremely well approximated by the simple closed-form expression:

$$\sqrt[4]{11366719876399} \sim 1836.15267343109087.$$

That such an accurate value could be generated by such a simple formula inspired me to try to account for this fact.

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The Proton-Electron Mass Ratio

Suppose the proton and electron are isotropic radiators of unobservable virtual particles as allowed by the Heisenberg uncertainty principle and further suppose these virtual particles possess a certain amount of power. If the power of a transmitter, call it T_x, is denoted by P_t and if isotropic radiators (transmitters which will radiate energy uniformly in all directions) are assumed, then the power density at a distance R from the transmitter is equal to the radiated power divided by the surface area $4\pi R^2$ of an imaginary sphere of radius R, i.e., the power density at range R from an isotropic radiator is

$$= P_t/4\pi R^2 \quad \text{Watt/m}^2. \tag{1}$$

The target intercepts a portion of the incident energy and re-radiates it in all directions. It is only the power density re-radiated in the direction of the original transmitter (echo) that is of interest. The signal cross-section of the target determines the power density returned to the transmitter for a particular power density incident on the target. It is denoted by σ. The reradiated power density returning back at the transmitter (now the receiver) is (1):

$$\frac{P_r}{\sigma_r} = \frac{P_t \sigma_t}{4\pi R^2 \cdot 4\pi R^2}. \tag{2}$$

The cross-section has units of area, but it can be misleading to associate the cross-section directly with the objects physical size. The cross-section is more dependent on shape than size.

Simple algebraic manipulation of Eqn. 2 leads to:

$$R = \sqrt[4]{\frac{P_t}{P_r}\frac{\sigma_t\sigma_r}{(4\pi)^2}} \tag{3}$$

Now for an ansatz. For reasons that will become clear momentarily, suppose that the distance from the proton to the electron $R_{p,e}$ does not equal the distance from the electron to the proton $R_{e,p}$ (i.e., the distance is nonreflexive) and that that discrepancy means that the motion of the electron along an arc length s and an equivalent amount of motion of the proton along an arc length s', where $|s| = |s'|$, would result in the traversal of different central angles (thus an apparent difference in relative inertia even though the two particles may be moving the same distance and speed along s (electron) and s' (proton) , i.e.,

$$\frac{R_{p,e}}{R_{e,p}} = \sqrt[4]{\frac{P_{t,p}}{P_{r,p}} \cdot \frac{P_{r,e}}{P_{t,e}}} = \frac{m_p}{m_e} \tag{4}$$

Eqn. 4 essentially amounts to relativistic quantization of spacetime and it is proposed that the virtual particles are actually *creating* spacetime and relative mass. Given that, the proton-electron mass ratio would be completely accounted for if it could be proven experimentally that

$$B = \frac{P_{t,p}}{P_{r,p}} \cdot \frac{P_{r,e}}{P_{t,e}} = 11,366,719,876,399 \tag{5}$$

and that, in essence, would account for the proton-electron mass ratio simply by introducing a new constant of nature, which we'll call Bonnar's constant, and denote it by B.

Now suppose the theory is factual and further suppose $P_{t,p}/P_{t,e} = 1$, then we have

$$\frac{P_{t,p}}{P_{r,p}} \cdot \frac{P_{r,e}}{P_{t,e}} = \frac{\sigma_p}{\sigma_e}. \tag{6}$$

We can use this fact to solve for the approximate radius of the electron in the following way: The accepted value for the radius of a proton is $r_p = 8.4 \times 10^{-16}$ m, giving us a cross section $\sigma_p = \pi r_p^2 = 2.2167 \times 10^{-30}\,\mathrm{m}^2$ for the proton.

So we have

$$\frac{2.2167 \times 10^{-30}\,\mathrm{m}^2}{\sigma_e} = 11,366,719,876,399.$$

This gives

$$\sigma_e = \pi r_e^2 = 1.9501668 \times 10^{-43}\,\mathrm{m}^2$$

and we have

$$r_e = 2.49 \times 10^{-22}\,\mathrm{m}.$$

Note that experimentally, observation of a single electron in a Penning trap suggests the *upper limit* of the particle's radius to be about 10^{-22} meters (2).

References

1. Sharma, K.K., S.K. Kataria & Sons, *Introduction to Radar Systems.*

2. Dehmelt, H. (1988). "A Single Atomic Particle Forever Floating at Rest in Free Space: New Value for Electron Radius". *Physica Scripta.* T22: 102-110.