

Revisiting the Electron Radius in Light of Length Contraction

Julie Marty

Independent Researcher, New Hope, USA

Email: julie.marty.mn@gmail.com

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Abstract

In previous work, the electron radius was identified as the “actual electron radius.” However, this is more accurately described as the electron radius at rest. This study reexamines the electron with an emphasis on the electron radius under motion, incorporating the effects of length contraction. The findings suggest that the radius is subject to Lorentz contraction, which has interesting implications for relativistic effects at the subatomic level.

Keywords

Electron Radius, Length Contraction, Lorentz Factor, Relativistic Effects, Subatomic Particles, Compton Scattering

1. Introduction

In the earlier paper [1], the electron orbits of the constitutional charges were assumed to overlap in something of a slight tilt in order to provide stability in investigating the equations of the charges and running simulations, the orbits were found to be equivalent to a single current ring as seen in Gunther’s paper [2].

Additionally, the electron radius was determined as $3.86e^{-13}$ meters. This value, however, corresponds to the rest radius, not accounting for relativistic effects. This paper aims to correct this oversight by considering the Lorentz factor’s impact on the electron’s mass and radius during motion.

2. Determining the Equations

I’m currently assuming that there will be three equations to dictate the motion of the light charges. The equations will dictate the change of direction of the variable speed velocity vector, the change of direction of the light speed velocity vector,

and the change of the magnitude of the variable speed velocity vector.

$$\frac{d\varphi}{dt} = \frac{v * 2 * \sin\left(\frac{\theta}{2}\right)}{d} \quad (1)$$

In this equation, $\Delta\varphi$ represents the change of angle of the velocity vector either towards or away from another light charge depending on whether they attract or repel. V is the magnitude of the velocity. D is the distance between the two light charges. θ is the angle between the velocity vectors. Specifically, you would take the two velocity vectors, connect them at the base points, find the plane on which they are both sitting, and find the angle between them.

$$\frac{d\varphi}{dt} = \frac{c * 2 * \sin\left(\frac{\theta}{2}\right)}{d} \quad (2)$$

This one is basically the same except it replaces the variable speed velocity vectors for the light speed vectors.

The last equation has yet to be determined.

As a side note, as early as Klein in the Kaluza-Klein papers, Quantum Theory and Five-Dimensional Theory of Relativity [3], the method to explain away our lack of contact with a higher large 4th spatial dimension has been compactification of a spatial dimension, suggesting that if a higher dimension exists, it must be curled up to a radius of the planck length. I think there might be an alternative explanation that involves a higher spatial dimension. Namely, something about the distribution of matter based on the equations that cause the light charges to form into structures of matter forces them into what are effectively 3d hyperplanes that typically only push into the 4th spatial dimension on the order of the radius of the planck length. Basically, the idea is an effective but not forced “compactification of matter” rather than space. For the last equation, one of my first attempts will be something like

$$\frac{dv}{dt} = \frac{\text{planck_length}}{d} * \frac{(v_2 - v_1)}{v_1}$$

3. Simulation of Light Charges

In simulating the motion of the light charges of the light charges for the electron, I found that the variable speed vector and the light speed vector are not locked with respect to one another, even though in the case of the electron at rest and the photon they do remain at 90 degree angles with respect to one another. The simulation of the electron in **Figure 1** at rest yielded the result below where the radius is $3.86e-13$ and the height is half of the planck length.

Although the two equations above are relatively straightforward, obtaining these simulation results in **Figure 1**. were more involved than one might initially anticipate.

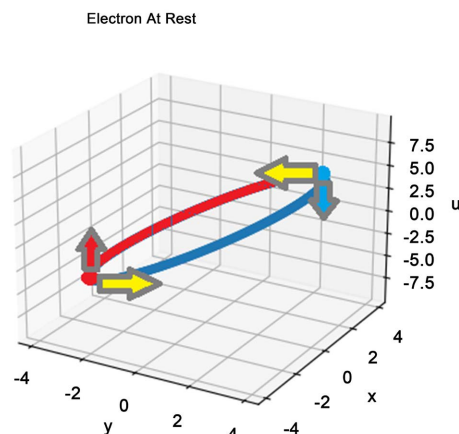


Figure 1. An electron at rest with a planck length height and a rest radius.

First, since there are 4 large spatial dimensions in this model, handling the δ_ϕ calculations was not trivial. Typically, one could use the Sympy python library with geometric algebra to calculate these changes. However, this approach was too slow. Since it is done in code, it was faster to brute force the results. Namely, for every light charge vector calculated against every other light charge vector, you effectively put the two vectors on a 2d plane, rotate, using the 2d rotation matrix, and then extrapolate with those results in 4d.

Second, the numerical calculations had to be extremely precise. Using a standard class like BigInt is too slow. Therefore, I emulated a 1200 bit register ALU on an Alchitry Au+ fpga. The raspberry pi ran the main code in python on board, and then offloaded the math operations to the fpga over SPI. This change was necessary and caused a significant speedup. The reason stems from the calculations being handled as memory operations instead of register operations.

The setup and code used to generate these results are on github at <https://github.com/silvermagnet/LightChargeHypothesis>. The results showed that after 1 complete cycle, the new coords were $[8.825584149603098e-36, -2.1312127032553555e-14, 3.9304390172955826e-13, 0.0]$; whereas, theoretically, it should have been $[8.081275e-36, 0.0, 3.8615926796089057e-13, 0.0]$. However, due to a loss of precision using the registers and the fact that dt was $1/1000$ of the electron period rather than approaching 0 due to computational restrictions, I found these results to be in good agreement with expectations.

In future work, if all equations were found and were matching experimental results, then in principle, the simulation physics code could be paired with reinforcement machine learning models to make progress on complex engineering problems.

4. Investigating the Electron in Motion

What I deemed the actual electron radius in my previous paper, was the electron radius at rest. Since the mass is a function of the actual radius, the radius is also

affected by length contraction.

R_o = rest radius of the electron, dubbed as the “actual electron radius” in the previous paper

$$m = \frac{h}{2\pi cr_o}$$

However, this is only valid when the electron is at rest. Once the electron starts moving, mass is affected by the Lorentz factor and we must apply it to the mass.

$$m * \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{h}{2\pi cr_o} * \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

In other words, the Lorentz factor, when applied to the mass, is nothing but a length contraction of the radius of the electron.

$$L_v = L_o * \sqrt{1 - \frac{v^2}{c^2}}$$

This conclusion must be the case both logically and mathematically since all the other terms are constants.

Analyzing this statement, I create an arbitrary test case and assume that $L_v = 0.5 * L_o$ where L_o = electron radius at rest, and the Lorentz factor is normal. Solving for this quick statement gives an expected velocity of 2.59627884e8 m/s.

Next, let’s analyze what this value should be structurally based on the models. Based on the models, the “rest energy” component should have a similar calculation as the total energy used to calculate mass via $E = m * c^2$ for the previous paper, except here, we swap out the rest electron radius, r_o , for the test half rest radius, r_v .

Rest energy component ->

$$E = 2 * q * \epsilon * d = 2 * q^2 * k * \frac{1}{r_v} = \frac{hc}{2\pi r_v}$$

There is a second component that is the time that the light charges are simply moving forward rather than looping in a smaller radius. However, this component, the moving component, can be ignored since $E = q * V$ where q is the charge and V is the voltage. Because the charges are equal and opposite, this component exactly cancels out to zero. Namely, we should be able to set the energies equal to each other, plug in the test radius for r_v , and get the same velocity as expected.

$$E = \sqrt{m^2 * c^4 + m^2 * c^2 * v^2} * \frac{1}{1 - \frac{v^2}{c^2}} = \frac{hc}{2\pi r_v}$$

Solving for the following equation in terms of v gives the same answer, 2.59627884e8 m/s.

5. Deriving Einstein’s Energy Mass Equivalence Equation

The previous point leads to an interesting point. Is this algebraic expression

equivalent to Einstein's energy equation implying a quantum origin? Let's do some algebraic manipulation to find out.

$$\begin{aligned}
 E &= \frac{hc}{2\pi r_v} \\
 E &= \frac{hc}{2\pi r_o * \sqrt{1 - \frac{v^2}{c^2}}} \\
 E^2 &= m^2 * c^4 * \frac{1}{1 - \frac{v^2}{c^2}} \\
 E^2 &= m^2 * c^4 * \frac{1}{1 - \frac{v^2}{c^2}} * \left(1 - \frac{v^2}{c^2} + \frac{v^2}{c^2}\right) \\
 E^2 &= m^2 * c^4 * \frac{1}{1 - \frac{v^2}{c^2}} * \left(\left(1 - \frac{v^2}{c^2}\right) + \frac{v^2}{c^2}\right) \\
 E^2 &= m^2 * c^4 * \left(1 + \frac{v^2}{c^2} * \frac{1}{1 - \frac{v^2}{c^2}}\right) \\
 E^2 &= m^2 * c^4 + m^2 * v^2 * c^2 * \frac{1}{1 - \frac{v^2}{c^2}} \\
 E^2 &= m^2 * c^4 + p^2 * c^2 \\
 E &= \sqrt{m^2 * c^4 + p^2 * c^2} \\
 E &= \sqrt{m^2 * c^4 + p^2 * c^2} = \frac{hc}{2\pi r_v}
 \end{aligned}$$

This equivalence seems valid.

6. Future Work

Next steps involve simulating a moving electron and identifying the third equation through Compton scattering simulations. Further exploration of the Robison models [4] may provide additional insights into electron orbitals.

7. Conclusions

This study revisited the concept of the electron radius by incorporating the effects of length contraction, a significant relativistic effect. The previously identified "actual electron radius" is more accurately described as the electron radius at rest. Through detailed simulations and mathematical analysis, it became evident that the electron radius contracts under motion according to the Lorentz factor. This contraction impacts the mass and energy calculations of the electron, aligning with relativistic principles.

The findings underscore the necessity of considering relativistic effects in subatomic particle studies, as they provide a more accurate depiction of particle behavior under motion. The simulations facilitated by computation techniques, including the use of an FPGA for precise calculations, were crucial in deriving these insights. Future work will focus on simulating moving electrons and refining the third governing equation through further exploration, such as Compton scattering simulations and Robinson models [4].

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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