Neutron Compton Wavelength as a Composite Electron-Proton Close Orbital

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Abstract

An article by Alexander Unzicker "The Neutron Coincidence" in Nuclear and Atomic Physics (viXra:2411.0178) intrigued me enough to examine it more thoroughly. Here we investigate the possibility that the neutron is a two-particle e/P system in a classical orbit. N.I.S.T. (codata 2022) numbers are used to obtain the electron and proton velocities, radii, Lorentz masses and the centrifugal and electrostatic forces involved. We offer a precise reason for the neutron's measured mass derived from the standard constants.

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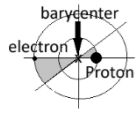
$$\frac{M_P}{\sqrt{1-v_P^2}} + \frac{m_e}{\sqrt{1-v_e^2}} = \text{Neutron rest mass}$$

$$\frac{M_P}{\sqrt{1-v_P^2}} \Big/ \frac{m_e}{\sqrt{1-v_e^2}} = \frac{v_e}{v_P} = \frac{r_e}{r_P}$$



Essentially, we're going to put the electron and proton into a lopsided 'dumbbell' planetary orbit such that the diameter of the composite orbit (r_e+r_p) is equal to the neutron's Compton wavelength and its mass as well. V^2 is expressed as equal to v^2/c^2 … the fraction of light speeds that any particle is moving at in this article. Clearly, we can force the issue by algebraically constructing the specific necessary values of mass and velocity. The relevant question is … *"Is there anything unique about the resulting hypothetical bound state?"* … or do other unknown non-classical or relativistic parameters determine the neutron's mass?

$$r_e/r_p = V_e/V_p = \gamma m_p/\gamma m_e$$

These relations must hold to make a viable classical, relativistic model.

Specifically, will the resulting masses and velocities satisfy the equality of centrifugal force and electrostatic force required to hold together the imagined pair as a viable bound state? This is the main constraint after the above equalities are satisfied.

We proceed as follows … first isolating $\mathbf{V_e}$ (the velocity of the electron) relative to $\mathbf{V_p}$.

$$\frac{M_P}{\sqrt{1-v_P^2}} \Big/ \frac{m_e}{\sqrt{1-v_e^2}} = \frac{v_e}{v_P}$$

$$v_e = \frac{v_P}{\sqrt{1-v_P^2}} \frac{M_P}{m_e} \sqrt{1-v_e^2}$$

$$\frac{m_e}{M_P} \frac{v_e}{v_P} = \frac{\sqrt{1-v_e^2}}{\sqrt{1-v_P^2}}$$

$$\beta \frac{v_e}{v_P} = \sqrt{\frac{1-v_e^2}{1-v_P^2}}$$

$$\beta^2 \frac{v_e^2}{v_P^2} = \frac{1-v_e^2}{1-v_P^2}$$

$$\beta^2 = \frac{1/v_e^2 - 1}{1/v_P^2 - 1}$$

$$2.966077\text{e-}7 = \frac{1/v_e^2 - 1}{1/v_P^2 - 1}$$

$$2.966077\text{e-}7/v_P^2 - 2.966077\text{e-}7 + 1 = 1/v_e^2$$

$$v_e^2 = 1/\left(2.966077\text{e-}7/v_P^2 - 2.966077\text{e-}7 + 1\right)$$

$$v_e = \sqrt{1/\left(2.966077\text{e-}7/v_P^2 - 2.966077\text{e-}7 + 1\right)}$$

Equation #1 $$v_e = \sqrt{1/\left(\beta^2/v_P^2 - \beta^2 + 1\right)}$$

We can now test **Vp** values here to obtain the paired **Ve** that will have the required ratio.

We can also make a second equation for generating the values of $\mathbf{r_e}$ $\mathbf{r_p}$ and $\mathbf{R_Q}$ (the electrostatic distance between charges) from the values of $\mathbf{v_p}$ and $\mathbf{v_e}$ that we get from Equation #1 … utilizing the fact that the electrostatic force equation and the centrifugal force equation **MUST** be equal. This should give us one consistent answer to the problem of whether the measured values of the relevant constants are sufficient to produce a unique solution to the *"neutron mass problem".*

Centrifugal Force = **Electrostatic Force**

$$\frac{\gamma_e m_e (v_e c)^2}{r_e} = \frac{e^2}{4\pi\varepsilon_0 R_Q^2}$$

$$\frac{\gamma_e m_e (v_e c)^2}{r_e} = \frac{e^2}{4\pi\varepsilon_0 (r_e + r_p)^2}$$

$$\frac{\gamma_e m_e (v_e c)^2}{r_e} = \frac{e^2}{4\pi\varepsilon_0 (r_e + r_e \frac{v_p}{v_e})^2}$$

$$\frac{\gamma_e m_e (v_e c)^2}{r_e} = \frac{e^2}{4\pi\varepsilon_0 \, r_e^2 (1 + \frac{v_p}{v_e})^2}$$

$$\frac{r_e^2}{r_e} = \frac{e^2}{4\pi\varepsilon_0 (1 + \frac{v_p}{v_e})^2 \gamma_e m_e (v_e c)^2}$$

$$r_e = \frac{e^2}{4\pi\varepsilon_0 (1 + \frac{v_p}{v_e})^2 \gamma_e m_e (v_e c)^2}$$

$$r_e = \frac{2.817940320459489e\text{-}15}{(1 + \frac{v_p}{v_e})^2 \gamma_e v_e^2}$$

Equation # 2

$$r_e = \frac{2.817940320459489e\text{-}15}{(v_e + v_p)^2 \gamma_e}$$

$$r_p = \frac{1.5346982640656338e\text{-}18}{(v_e + v_p)^2 \gamma_p}$$

isolating the electron, proton radii and quantifying the constants on top

If only one value is unique, we will have a 'discovery'. If multiple valid solutions satisfy the Equations #1 and #2 … then some other parameter determines the neutron's unique mass.

Note: The centrifugal force must be equal for both proton and electron because they exist at opposite sides of a 'tethered' connection (though with different radii). The tether is the electrostatic force that must also be equal to those values … if the orbit is stable.

Here are values that can be obtained by iteratively guessing the velocity of the proton (V_p).

Equation #1 $v_e = \sqrt{1 / (\beta^2 / v_p^2 - \beta^2 + 1)}$

	VELOCITIES		RATIOS	GAMMA FACTORS	
	A	B	C	D	E
	V_p	V_e	$\frac{V_e}{V_p} = \frac{R_e}{R_p} = \frac{\gamma m_p}{\gamma m_e}$	$\gamma_e = 1/\sqrt{1 - v_e^2}$	$\gamma_p = 1/\sqrt{1 - v_p^2}$
1	.00001254	.02301925331	1,835.666133	1.0002650483	1.000000000078
2	.0001254	.22438235439	1,789.332969	1.0261660177	1.00000000786
3	.001254	.91723067099	731.44391626	2.5103142924	1.00000078625
4	.0012645447067	.91844173841	**726**.30230750	2.52808523736	1.0000007995
5	.001274	.91950616159	721.74737958	2.5440399443	1.00000081153
6	.01274	.99908767740	79.672063588	23.415846489	1.00008116368
7	.1274	.9999910112	7.849223	235.84958	1.0082155

I've given my best current guess at line 4. Those guesses 1-3 are lesser values to show the general trend. Lines 5-7 are greater than line 4 to show the trend in that direction. Column C is expressed as the larger ratio rather than its inversion to avoid zeroes that take up space … otherwise all values in each column go from smaller to larger.

Next are radii and masses generated by the $\mathbf{v_e / v_p}$ ratio. We set the known neutron Compton wavelength and neutron mass and divide them up into $\mathbf{r_e + r_p}$ or $\mathbf{m_e + m_p}$ by that ratio.

Note: If the ratio is say, 20/1, the electron is 1/21 of the neutron mass while the proton is 20/21 of the neutron mass. To preserve the ratio, we must always add '1' to the denominator.

RADII FROM RATIO

	r_p x e-18	+ r_e x e-15	$N\lambda$
1	7.18470755e-19	1.318872433	$\lambda = h/m_N c$
2	7.37064516e-19	1.318853839	
3	1.8016272297	1.317789276	
4	1.8143636974	1.3177765401	
5	1.8257982541	1.3177651055	
6	1.6357470e-17	1.3032334332	
7	1.4911940e-16	1.1704714948	
	1.31959090382 e-15 ←		

MASSES FROM RATIO

	$\gamma_e m_e$ +	$\gamma_p m_p$	$= N_m$
1	9.1193901e-31	1.6740155e-27	*Neutron mass*
2	9.3553966e-31	1.6739919e-27	
3	2.2867655e-30	1.6726407e-27	
4	2.3029316e-30	1.6726245e-27	
5	2.3174452e-30	1.6726100e-27	
6	2.0762175e-29	1.6541653e-27	
7	5.2250252e-29	1.6226772e-27	
	1.67492750056 e-27 ←		

At this point, nothing *"special"* has been exposed. A true discovery would consist of eliminating the neutron mass as an independent constant by showing it to be derived from other constants … thereby *"knocking one off the list"* of things in need of explanation.

In this case, we need a known parameter (within classical relativistic physics) that singles out the neutron mass and its Compton wavelength exclusively, i.e. so that no other mass value can make a logically consistent orbital construction. Clearly, as the electrostatic attraction increases by the inverse square law … the electron-proton composite can simply adopt faster velocities and concomitant relativistic mass increases to supply the necessary centrifugal force to achieve stability at any specified $\mathbf{R_Q}$.

Here is the force value that we need to generate uniquely …

CENTRIPETAL FORCE VALUES ELECTROSTATIC

	L	M	N
	$\frac{\gamma_p m_p (v_p c)^2}{r_p}$ =	$\frac{\gamma_e m_e (v_e c)^2}{r_e}$ =	$e^2/4\pi\varepsilon_0 R_Q^2$
1	8.170841406e-6	8.17084123e-6	8.17085756e-6
2	0.07763793412	0.07763793243	0.07763793246
3	129.943862144	129.943862139	129.943862143
4	132.490142387	132.490142407	132.490142424
5	134.793098907	134.793090983	134.793098886
6	16,279.4095942	16,279.414430	16,279.409852
7	2,054,049.5736	2,054,045.9450	2,054,046.4715
	When R_Q is neutron Compton λ ⇨		**132.49014239**

Thus, any reasonable mass chosen for the neutron mass will fill the bill for a stable e/P orbital. So, we can imagine a neutron mass that is, say, 5 electron masses greater than the e_m+P_m composite mass instead of the actual ~2.53 electron masses and still find a viable stable orbit. All the math will still work out … unless there is some 'special mass' that is uniquely required.

Here is what distinguishes the neutron mass from all others …

MASSES CALCULATED ➡ SUMMED

	F	G	H	H
	$\gamma_e m_e$ +	$\gamma_p m_p$	$\gamma m_e + \gamma m_p$ x e-27	$h/mc = R_Q$ ➡ $R_Q = h/mc$
1	9.1193901e-31	1.6740155e-27	1.67353310589	1.32069039e-15
2	9.3553966e-31	1.6739919e-27	1.6735567	1.32067177e-15
3	2.2867655e-30	1.6726407e-27	1.674909982	1.31960470e-15
4	2.3029298e-30	1.6726232e-27	1.6749261930	1.31959184e-15
5	2.3174452e-30	1.6726100e-27	1.674940746	1.31958046e-15
6	2.0762175e-29	1.6541653e-27	1.694088075	1.30466598e-15
7	2.1484443e-28	1.6863633e-27	1.901207732	1.16253424e-15
	N_m = 1.67492750056 e-27			

VIABLE CONSTRUCT

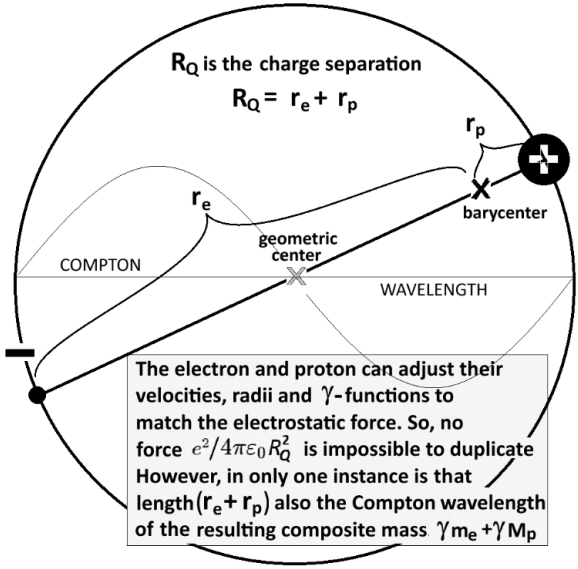
RADII (CALCULATED by EQUATIONS #2) ➡ SUMMED

	I	J	K	K
	r_p x e-18 +	r_e x e-15 =	R_Q x e-15	$h/mc = R_Q$ ➡ $m = h/R_Q c$
1	2.8931269e-15	5.31081518e-12	5.3137083e-12	4.15946636e-31
2	3.0448107e-17	5.44818029e-14	5.4512251e-14	4.05629352e-29
3	1.8191932473	1.33063783327	1.3324570265	1.65875366e-27
4	1.8143636975	1.31777653995	1.31959090365	1.67492750e-27
5	1.8101340669	1.30645951962	1.30826965368	1.68960685e-27
6	1.49890685103	1.17546260e-16	1.1904516 e-16	1.88029725e-26
7	1.1976240160	9.40042628e-18	1.0598050 e-17	2.08549600e-25
	$N\lambda$ = 1.31959090382 E-15			

The relativistic masses of the proton and electron in the '**H**' column (derived from Eq.#1) must match the masses derived from their added radiuses (**I+J=K** derived from Eq.#2) when we calculate mass from those paired radiuses as though they were the Compton wavelength (**K***). These two equations (below) derived from the equality of electrostatic and centrifugal forces (or 'centripetal' for purists) … allow only the one consistent solution when compared to the values derived from Eq.#1 **(H**) which are greatly at odds with those of Eq.#2 (**K***) … except when nearing the experimentally measured neutron mass. Vice versa for the **H*** and **K** columns.

$$r_e = \frac{2.817940320459489e\text{-}15}{(V_e + V_p)^2\,\gamma_e} \qquad r_p = \frac{1.5346982640656338e\text{-}18}{(V_e + V_p)^2\,\gamma_p}$$

The best explanation is the one pictured as an orbital circle. Nature has so constructed the universe that the mass of any particle … when converted into energy … is exactly equal to the energy of a quantum of light whose wavelength is equal to the Compton wavelength of that particle. The Compton wavelength of a particle reveals the energy it possesses … (**$mc^2 = e = hf$**).



Recapping

We guess a proton velocity $\mathbf{v_p}$ then compute the electron velocity $\mathbf{v_e}$ using equation **#1**. We also compute the **γ**-factors $1/(1-v_e^2)^{1/2}$ and $1/(1-v_p^2)^{1/2}$ as well as γM_p, γm_e, r_e, r_p, and M_N from our iterative $\mathbf{v_p}$ guesses.

Then …

Using $\mathbf{v_p}$ and $\mathbf{v_e}$ from eq.#1, we again compute r_e, r_p, γM_p, γm_e, and M_N using equations **#2**. This yields discrepancies in all values … except that value nearest the experimentally measured neutron mass … indicating that the measured neutron is the unique non-contradictory solution chosen by nature.

Conclusions

The experimentally measured neutron mass is the **ONLY** mass that is logically consistent with the well-known laws of physics (Newtonian + relativistic). We conclude that the neutron's mass and Compton wavelength have viable and unique explanations that do not require new physics.

It would appear a fundamental philosophical tenet of $_{\text{modern}}$ physics needs revision. To wit … the belief that quantum mechanics totally takes over at the smallest levels … that there is a dividing line (however ill-defined) that exists between two realms of existence.

I posit here that there is *"no line"* of demarcation. More likely, the tenets of classical physics carry on into the infinitesimally small … acting as a 'guide' for the chaos of indeterminacy. It is my present conjecture that what is moving in exact classical fashion is the *"locus of action"*. This is the average point about which the probability functions of quantum mechanics center themselves. That is, if the locus of probability was visible, one would find it carrying on in a perfectly reasonable classical manner all the way down to the infinitely small (or perhaps the Planck scales, if these have true physics meaning).

Unfortunately, the magnetic moment generated by this model of the neutron is 3.00822 times too strong. This will no doubt require a great deal more thought.

References

Alexander Unzicker: "The Neutron Coincidence" viXra:2411.0178
The NIST Reference: https://physics.nist.gov/cuu/Constants/