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Relations Between Planck's Mass and the Proton or Neutron Mass

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Abstract: The article is about a formula which shows relations between the proton, and neutron mass in relation to Planck's mass. The obtained coefficients are "1" for proton and "1/3" for neutron, whose physical meaning should be examined further.

Keywords: neutron, proton, Planck's mass

1. Introduction

In my previous works, I applied the Theory of Unity of the Whole and its Parts [1], by applying relations that parts have towards the whole, for example, the relation of the proton mass towards the mass of the Universe as a whole. In this article, I will compare all the masses with Planck's mass, allowing me to avoid the use of the mass of the Universe as a whole, which does not have an accepted value.

2. Relation between Planck's mass and the proton mass

I will use the following fundamental physical constants:

proton-to-electron mass ratio	**$\mu=m_p/m_e$, $\underline{\mu}=\log_2(m_p/m_e)$**
neutron-to-proton mass ratio	**$\gamma=m_n/m_p$, $\underline{\gamma}=\log_2(m_n/m_p)$**
inverse value of the fine-structure constant:	**ά**

The formula from [2, f 1], which shows the neutron-to-proton mass ratio γ and the proton-to-electron mass ratio μ can be presented in the following form (1):

$$\underline{\gamma}=\log_2\gamma=\log_2(m_n/m_p)=q/(1+\alpha'^2\underline{\mu}) \qquad \textbf{(1)}$$

where q is in the function of p from [2, preceding f1], while p is the relation between the mass of the whole universe and that of a proton (2).

$$p=\log_2(M_u/m_p) \qquad \textbf{(2)}$$

Here I will not include the mass of the universe M_u, since that mass will be cut out in the quotients of the formulas that follow:

$$q=e^{2\pi}/2+p/2+3\log_2(2\pi)/2 \qquad \textbf{(3)}$$

To keep formulas short, for base 2 logarithm I will use one letter when mass is in relation to the mass of the universe, while I will use an underlined letter when it is in relation to some other mass.
And since the following is true for Planck's mass from [3, level **g** in the Table]:

$$g=\log_2(M_u/m_{pl})=q/2 \qquad \textbf{(4)}$$

Then the relation between the proton mass and Planck's mass, which is of our interest, is the following:

$$\underline{p} = \log_2(m_{pl} / m_p) = p - g \qquad \textbf{(5)}$$

According to (3): $$p = 2q - e^{2\pi} - 3\log_2(2\pi) \qquad \textbf{(6)}$$

And by using (3) and (6) in (5) we get (7).

$$\underline{p} = 2q - e^{2\pi} - 3\log_2(2\pi) - q/2 = 3q/2 - e^{2\pi} - 3\log_2(2\pi) \qquad \textbf{(7)}$$

Using (1), we also get that q is:

$$q = \underline{\gamma} * (1 + \alpha'^2 \log_2 \mu) \qquad \textbf{(8)}$$

While exchanging q from (8) into q from (7) we get:

$$\underline{p} = 3\underline{\gamma} * (1 + \alpha'^2 \underline{\mu})/2 - e^{2\pi} - 3\log_2(2\pi) \qquad \textbf{(9)}$$

that is a base 2 logarithm of the relation between Planck's mass and the proton mass.

3. Relation between Planck's mass and the neutron mass

Logarithm of relation between Planck's mass and the neutron mass is because of (1) lower by the value of $\underline{\gamma}$ from the same relation for proton.

$$\underline{n} = \log_2(m_{pl} / m_n) = \underline{p} - \underline{\gamma} \qquad \textbf{(10)}$$

Namely, by inserting (10) into (9):

$$\underline{n} = 3\underline{\gamma} * (1 + \alpha'^2 \underline{\mu})/2 - e^{2\pi} - 3\log_2(2\pi) - \underline{\gamma} \qquad \textbf{(11)}$$

Then if we integrate $\underline{\gamma}$, we get:

$$\underline{n} = 3\underline{\gamma} * (1 - 2/3 + \alpha'^2 \underline{\mu})/2 - e^{2\pi} - 3\log_2(2\pi) \qquad \textbf{(12)}$$

i.e.:

$$\underline{n} = 3\underline{\gamma} * (1/3 + \alpha'^2 \underline{\mu})/2 - e^{2\pi} - 3\log_2(2\pi) \qquad \textbf{(13)}$$

Look closely at (9) and (13). One difference between those two relations is the coefficient in brackets; "1" for proton and "1/3" for neutron. The derivation procedure from (10) to (13) clearly shows that coefficients "1" and "1/3" are exact values. That is why we will express relations (9) and (13) in such a way that those two coefficients are separated on one side.

For proton we get (14):

$$2[\underline{p}+e^{2\pi}+3\log_2(2\pi)]/3\underline{\gamma}-\alpha'^2\underline{\mu}=1 \qquad \textbf{(14)}$$

And for neutron we get (15):

$$2[\underline{n}+e^{2\pi}+3\log_2(2\pi)]/3\underline{\gamma}-\alpha'^2\underline{\mu}=1/3 \qquad \textbf{(15)}$$

An interesting question for someone to answer is how "-2/3" in (12) and "1/3" in (13) are manifested in the nature.

One can doubt the relations presented in the formulas above, as it may be that it is a mere coincidence with approximate results, allowing for the difference in relation to real physical constants to be shown only when it comes to constants with a greater number of significant digits. Even then, (14) and (15) can be considered to be exact formulas if we define γ as a relation between the proton mass and some virtual "as a neutron" mass for which we should prove that it is a neutron or something else with similar mass. The presented formulas are very sensitive to the change in values of γ or $\underline{\gamma}$, hence the above discussion allows for them to be determined precisely.

4. Verification of formulas

We will check formulas (14) and (15) by using the CODATA reports [4] published between 1969 and 2014, presented in the Table below:

Table – Results according to formulas (14) and (15) with the use of CODATA values

Year	CODATA values					According to formula	
	Inverse alpha ά	**γ=m$_n$/m$_p$**	m=m$_p$/m$_e$	Proton m$_p$ [kg]	Planck's mass	**(14)**	**(15)**
1969	137.03602	1.001379	1836.109	1.67261E-27	2.17663E-08	-84.08	-84.75
1973	137.036040	1.001379	1836.15152	1.6726485E-27	2.17683E-08	-84.74	-85.40
1986	137.0359895	1.0013784040	1836.152701	1.6726231E-27	2.17671E-08	3.316	2.650
1998	137.03599976	1.00137841887	1836.152668	1.67262158E-27	2.17670E-08	1.090	0.423
2002	137.03599911	1.00137841870	1836.152673	1.67262171E-27	2.17645E-08	1.061	0.394
2006	137.035999679	1.00137841918	1836.152672	1.672621637E-27	2.17644E-08	0.986	0.320
2010	137.035999074	1.00137841917	1836.152672	1.672621777E-27	2.17651E-08	1.005	0.338
2014	137.035999139	1.00137841898	1836.15267389	1.672621898E-27	2.176470E-08	1.024	0.357

- It is evident that the results are approaching the values of "1" in (14) and "1/3" in (15) as the measurement methods are being perfected over the years.
- An exceptional improvement was made in the 1986 report, when compared to the report preceding it.
- The 2014 report offered no improvement when compared to the 2010 report.
- Improvement can be expected in the next CODATA report.

5. Conclusion

By comparing the proton and neutron mass to Planck's mass we obtained formulas (14) and (15) featuring interesting relations and simple constants, "1" in (14) and "1/3" in (15). It is important to note that the constants are exact, which is not the case for masses and mass relations used in formulas which are most probably irrational quantities. The validation of formulas in Section 4 of the article showed that the results of formulas (14) and (15) are approaching the expected values as the experimental measurements are being improved.

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[1] Branko Zivlak, *The Theory of Unity of the Whole and its Parts*, viXra: 1703.015

[2] Branko Zivlak, *Neutron, proton and electron mass ratios*, viXra: 1211.0090

[3] Branko Zivlak, *Ciklusom ka Metodologiji Svega*, http://gsjournal.net/Science-Journals/Research%20Papers/View/6732

[4] CODATA internationally recommended values of the Fundamental Physical Constants, (3010) values of the constants, http://physics.nist.gov/cuu/Constants/