Three Physics Identities; Navigating the Decimal Universe Using the NIST Codata

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Three possible identities are presented. The identities use physics values from the NIST 2022 CODATA. The Newton constant G is realigned within Codata against values having more precision, accuracy and lower uncertainties. That the identities match to 7-8 significant figures are a curiosity and is either a coincidence or remains to be explained. It is also made interesting in that two relations incorporate similar physics values.

Identities whether purely math based or physics based are often difficult to prove. So this paper is not about proving the identities that are presented. The only guidance as to determining any near veracity of the three relations being presented is the use of the NIST 2022 Codata parameter values [1.]. All values are in SI units in accordance with Codata. That a large number of these values have significant figures in the 8 to 11 range makes for navigable terrain to zero in to an accurate and hopefully precise number. That is all that is attempted here. Expect no more.

The Three

These relations are close in value but not in a surprising way;

$$\frac{hc}{\pi G m_p m_n} = 3.38164 \times 10^{38}\ (dimensionless) \tag{1}$$

$$2\sqrt[4]{\frac{e}{2}}\, e^{\pi/4\alpha}\ \alpha^4 = 3.3820238042 \times 10^{38}\ (dimensionless) \tag{2}$$

$$exp\left(2\pi\sqrt{163}\right) 70^2 \frac{m_n}{m_p} = 3.38202418959 \times 10^{38}\ (dimensionless) \tag{3}$$

All three were calculated using the 2022 Codata respective values. The following is a tabulation of the 2022 Codata values used in this paper including any mathematical constants.

<u>In Codata 2022</u>

$M_{pl} = 2.176434\ \times 10^{-8} kg \quad (Planck\ mass)$
$G = 6.67430\ \times 10^{-11}\ m^3\ kg^{-1}\ s^{-2} \quad (Newton\ constant)$
$h = 6.62607015\ \times 10^{-34}\ kg\ m^2\ s^{-1} \quad (Planck\ constant)$

$c = 299792458\ m/s\ (speed\ of\ light\ in\ a\ vacuum)$
$m_p = 1.67262192595\ \times 10^{-27} kg\ \ (proton\ mass)$
$m_n = 1.67492750056\ \times 10^{-27} kg\ \ (neutron\ mass)$
$\alpha = 0.0072973525643\ (fine\ structure\ constant)$

<u>Mathematical constant</u>

$e = 2.718281828\ ...\ \ (Euler's\ number)$

Relations (2) and (3) agree within 5 decimal figures while relation (1) only agrees to 2 decimal places. This is nothing to get excited about and these remain meaningless coincidences. Relation (1) has the least probability of being related to the other two. Relation (1) has a Codata value that has a high uncertainty and low accuracy compared to the other values in that relation. That value is the Newton constant *G*. However, I stated that this is a numerical navigation using very well established accurate and precise Codata values. If one observes that relation (2) only has the Codata value *fine structure constant α*, this is determined to 11 significant figures. The other value is a math constant. If we take relation (1) and set it to relation (2) using the Newton constant as the unknown *x* a realignment of *G* is then calculated.

$$\frac{hc}{\pi\, x m_p m_n} = 2\sqrt[4]{\frac{e}{2}}\, e^{\pi/4\alpha}\ \ \alpha^4 \qquad (4)$$

$$x = G_r = 6.6735420\underline{4} \times 10^{-11}\ m^3 kg^{-1} s^{-2}$$

Eight significant figures are obtained limited by the proton and neutron mass significant figures.

Is it acceptable to isolate the Newton constant G in this manner to realign with Codata values that have much better determinations and lower uncertainties? It certainly not cherry picking or placing corrections to bias the value outright. Historically and currently measuring G has been very difficult to measure with high accuracy and has higher uncertainty than the other constants. The Newton constant G is the least precisely known of the fundamental constants. So does this calculation predict where the value G should lay? I could not say as what is being presented is a method of using the current very well determined Codata fundamental values to see if there is more than a coincidence to the relations (1), (2) and (3). We are certainly not coming from a fundamental direction in this method other than seeing if the coincidences are more than just that.

Finally, if one made it this far, we recalculate relations (1), (2), and (3) using the new Codata aligned G_r .

$$\frac{hc}{\pi G_r m_p m_n} = 3.382023802\underline{3} \times 10^{38} \quad (5)$$

$$2\sqrt[4]{\frac{e}{2}}\, e^{\pi/4\alpha}\ \alpha^4 = 3.382023804\underline{2} \times 10^{38} \quad (6)$$

$$exp\left(2\pi\sqrt{163}\right) 70^2 \frac{m_n}{m_p} = 3.382024189\underline{6} \times 10^{38} \quad (7)$$

The three relations agree very well to 6-7 significant figures. If one takes the context of the similar fundamental constants involved in all three relations it begins to seem a little more surprising.

A final note,

$$\frac{hc}{\pi G_r m_p m_n} = exp\left(2\pi\sqrt{163}\right) 70^2 \frac{m_n}{m_p} \quad (8)$$

then,

$$\frac{hc}{\pi G_r m_n m_n} = exp\left(2\pi\sqrt{163}\right) 70^2 \quad (9)$$

$$\frac{hc}{\pi G_r m_n m_n} = 3.3773683\underline{8} \times 10^{38} \quad (10)$$

$$exp\left(2\pi\sqrt{163}\right) 70^2 = 3.377368758... \times 10^{38} \quad (11)$$

Relation (11) generates an "almost integer" using the exponential involving the *Heegner* number 163 in the exponential power of two. The 70^2 is possibly related to the *Lucas* Cannonball problem and or the 0 Weyl vector used in the construction of the 26-dimensional Lorentzian unimodular lattice.

Reference

[1.] National Institute of Standards and Technology (NIST), The NIST Reference on Constants, Units and Uncertainty, Fundamental Physical Constants, *CODATA* Internationally recommended 2018 and 2022 values of the Fundamental Physical Constants, Gaithersburg, MD
https://www.nist.gov/programs-projects/codata-values-fundamental-physical-constants and https://physics.nist.gov/cuu/Constants/

[2.] Thomas, Mark (2024), 'Monster Symmetry, a Mini Computational Workshop* CODATA Invariants in a Symmetry Operation v2, viXra