Gravitational Constant Planck's Constant Speed of Light Proton-Compton Wavelength Classical Electron Radius Relationship

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Abstract: The formula connecting fundamental physical constants has been verified based on the 2010 and 2014 recommended CODATA values of physical constants.

Keywords: gravitational constant, Planck's constant, speed of light, proton-Compton wavelength, classical electron radius, Planck's length

Introduction

We will use the 2014 CODATA data from [1]:

G – Newtonian gravitational constant	6.674 08 e-11	0.000 31 e-11	m^3 kg^-1 s^-2
ħ – Planck's constant over 2 pi	1.054 571 800 e-34	0.000 000 013 e-34	J s
c – the speed of light in vacuum	299 792 458	(exact)	m s^-1
λ – proton-Compton wavelength	1.321 409 853 96 e-15	0.000 000 000 61 e-15	m
r – classical electron radius	2.817 940 3227 e-15	0.000 000 0019 e-15	m
l_{pl} – Planck's length	1.616 229 e-35	0.000 038 e-35	m

The claim is that the following is true:

$$\sqrt{\frac{\hbar G}{c^3}} = \frac{(32/\pi)^{1/4} * \lambda}{2^{[e^{2\pi}+3/(\pi * r/\lambda+1)]/8}} = l_{pl} \qquad \textbf{(1)}$$

Here, $e^{2\pi}=\exp(2\pi)=535.4916555$ is a mathematical constant.

The first parameter in (1) is the known relation between three fundamental physical constants which as a result yields Planck's length $\mathbf{l_{pl}}$. The second parameter in (1) is one of relations which can be obtained through transfomations and simplifications from relations published in [2], [3] or most simply from the Table in [4]. Note that all the relations have been obtained by consistent appreciation of rationalist theories [5] and Mach's principle [6].

Let's verify (1) by comparing results obtained through the use of the 2010 and 2014 CODATA input values.

Analysis

The above shown data for G, $\hbar$, c, λ, r, l_{pl}, we will insert in the Table with the base value, without uncertainties, in the column "year 2014". Similarly, we will insert the data from [1] in the column "year 2010".

Since the Table has been prepared in Excel, by applying formulas from (1), the results in the last two raws of the Table are obtained automatically.

Table – Verification of the formula (1)

		CODATA Values	
Physical constants	from [4]	year 2010	year 2014
G – gravitational constant	6.67384E-11	6.67384E-11	6.67408E-11
$\hbar$ – Planck's constant over 2 pi	1.054571726E-34	1.054571726E-34	1.054571800E-34
c – speed of light	299792458	299792458	299792458
λ – proton-Compton wavelength	1.32140985625E-15	1.32140985623E-15	1.32140985396E–15
r – classical electron radius	2.8179403267E-15	2.8179403267E-15	2.8179403227E-15
l_{pl} – Planck's length	1.616199E-35	1.616199E-35	1.616229E-35
$\sqrt{(\hbar G/c^3)}=$	1.616199E-35	1.616199E-35	**1.616228E-35**
$(32/\pi)^{1/4}*\lambda/2^{[\exp(2\pi)+3/(\pi r/\lambda+1)]/8}=$	1.616199E-35	1.616199E-35	1.616199E-35

The result obtained through relational approach and formulas deriving from it are the same with seven significant digits for the first and second member in (1). Also, the same result is obtained when the input data are the 2010 CODATA values.

When the 2014 CODATA values are used for the second member in the formula (1), the same value as the the previous one is obtained, with seven significant digits (*see tha last row*). However, for the first member in (1), a different value is obtained, which is still within the boundaries of uncertainty (*see the penultimate row*).

Let's also notice that Planck's length obtained via the formula is the same as for the year 2010, but then the CODATA uncertainty was much greater (0.000 097 e-35 m) than in the year 2014 (0.000 038 e-35 m).

Conclusion

All the constants used here are to a great extent dependant on the accuracy of Newtonian gravitational constant. It is known that the experimental determination of the value is a demanding task. The value in the 2010 CODATA year is accompanied by statistical analysis of the used input data [7].

Planck's length is obtained through the use of the second member in the formula (1) within 1 sigma uncertainty in both CODATA reports. For the year 2010, the value obtained through the formula even matches the basic recommended value of Planck's length.

Analysis for the year 2014, similar to this in [7], which would additionally take into account the exceptional matching of the data recommended in 2010 with those obtained through the formula, would contribute to better understanding of all the constants mentioned here and especially Newton's gravitational constant.

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Literature:

[1] *CODATA internationally recommended values of the fundamental physical constants,* http://physics.nist.gov/cuu/Constants/

[2] Zivlak B., "*Dozen Coincidences*?! One Rule", http://viXra.org/abs/1312.0081

[3] Zivlak B., Stoiljković D., *Relations between Significant Masses Based on Boscovich's Theory,* http://www.researchgate.net/profile/Dragoslav_Stoiljkovic/publications

[4] Zivlak B., *Mathematical Connection among the Structures of Universe,* http://fqxi.org/data/essay-contest-files/Zivlak_MathStructure.pdf

[5] *Relational theory*, https://en.wikipedia.org/wiki/Relational_theory

[6] *Mach's principle*, https://en.wikipedia.org/wiki/Mach's_principle

[7] Barry M. Wood, *Recommending a value for the Newtonian gravitational constant* http://rsta.royalsocietypublishing.org/content/372/2026/20140029