Calculation of Newton's gravitational constant

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Abstract

Newton's gravitational constant at laboratory scale experiments is numerically calculated using number constants and the fundamental constants h_{bar} (Planck's quantum of action), c (velocity of light in vacuum) and m_e (electron mass).

Keywords: Fundamental constants, Newton's constant, dimensionless gravitational constant, number constants.

Currently no established theoretical formula is known which manifests a quantitative relationship between Newton's gravitational constant (G_N) and other natural constants. Since Newton's theory does not make a statement about G_N either, it only remains to determine G_N experimentally. There are many publications on experiments, but many authors disagree about its true value. While the 2014 CODATA recommended value of G_N was 6.674 08(31) 10^{-11} $m^3s^{-2}kg^{-1}$ with an uncertainty of ≈50 ppm, it was changed to 6.674 30(15) 10^{-11} $m^3s^{-2}kg^{-1}$ in 2018 with half the uncertainty. Most physicists believe that the constant G_N cannot be calculated and is in no way related to other constants. In the following, a simple numerical relationship using number constants [1] and natural constants is proposed.

The empirical constant G_N shall be equal to the product $\lambda\ \alpha_{grav}\ m_{grav}^{-2}\ \{h_{bar}c/m_e^2\}_{Codata}$. The dimensionless quantity α_{grav} stands for the gravitational coupling parameter of two particles of mass m_{grav} analogous to the electromagnetic coupling parameter α and is $(5/3)\ (2\pi^8)^{-9}$ [1] or ≈5.22 10^{-39}. The mass m_{grav} in units of the electron mass m_e is also without units and has the numerical value $2^{-3}\pi^{25/3}$ [1] or ≈1737. The term $\{h_{bar}c/m_e^2\}_{Codata}$ defines the physical unit $m^3s^{-2}kg^{-1}$ of G_N with respect to the SI, and the heuristic coefficient λ, which should be a simple math expression and numerically of the order of ≈1, results as a first approximation by comparing the product ansatz with experimental data. If λ is set to $1+(1/9)^2$, a possible "theoretical" value of the Newton constant of **≈6.673 97 10^{-11} $m^3s^{-2}kg^{-1}$** can be extracted, which is within the error limits of the 2014 CODATA value, but outside the error limits of 2018. The origin of the term $1+(1/9)^2$ is unclear. Intriguingly, the total number of stable elements is 9^2 if the element bismuth is included. More experiments are needed to clarify whether the ansatz creates a concise connection between G_N and the rest of physics, or whether the good agreement is a numerical coincidence.

References

[1] Hans Peter Good, On the Origin of Natural Constants, De Gruyter 2018.