viXra.org

Newton’s gravitational constant is not a constant

Ilija Barukčić

Internist: Horandstrasse, DE-26441 Jever, Germany.
Email: Barukcic@t-online.de

How to cite this paper: Barukcic, Ilija. Newton’s gravitational constant is not a constant. *Preprint,* **2017**, 1-6.

Received: 2017, 08, 12
Accepted: 2017, 08, 12
Published: 2017, 08, 12

Copyright © 2017 by Barukcic, Ilija, Horandstrasse, 26441 Jever, Germany. This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/
Open Access

Abstract

BACKGROUND AND AIM: Despite of one of the longest history of measurements in physics, a definite value of Newton's gravitational constant γ is still not in sight.

MATERIAL AND METHODS: A thought experiment is performed to analyze the logical structure of the claim that Newton's gravitational constant γ is a constant. Two masses in deep space are accelerated (non-inertial frames of reference). After a period of time the acceleration stops. The behavior of Newton's gravitational constant γ is analyzed.

RESULTS: The assumption of the constancy of Newton's gravitational constant γ leads straightforward to a logical contradiction. Thus far, if we accept that Newton's gravitational constant γ we must accept too that +1=+0.

CONCLUSIONS: Newton's gravitational constant γ is not a constant.

Keywords

Newton’s gravitational constant, Einstein’s general theory of relativity

1. Introduction

Newton's Principia [1] published in a philosophically very tumultuous time marked a radical transformation of the scientific methodological approach from studying texts (i.e. commentaries on Aristotle and other authors) to observations or conducting experiments. In his *Principia*, Newton derived the law of universal gravitation by inductive reasoning, a general physical law meanwhile superseded by Albert Einstein's theory of general relativity but still used as an excellent approximation of the effects of gravity as

> "vis attractiva puncti cujusqe decrescit in duplicata ratione distantiae corporis attracti: dico quod vis tota qua hujusmodi Sphaera una attrahit aliam sit reciproce proportionalis quadrato distantiae centrorum." [1]

Figure 1. Philosophiae Naturalis Principia Mathematica, Prop. LXXVI. Theor. XXXVI, page 178.

Translated from the Latin into English.

"The attractive force of every point decreases in the duplicate ratio of the distance of the body attracted; I say, that the whole force with which one of these spheres attracts the other will be reciprocally proportional to the square of the distance of the centers."

Newton's key statement of proportionality is the source of Newton's gravitational constant G. Newton's gravitational constant big G along with some other physical constants (the speed of light c, Planck's constant h et cetera), belongs to one of the most universal and fundamental constants in nature. Approximately 71 years after Newton's death Cavendish [2] measured as one of the first the value of Newton's gravitational constant G. In contrast to the most other physical constants and about 220 years later, the value of G is extremely difficult to measure and still not precisely known. Meanwhile, the determination of the numerical value of Newton's gravitational constant G carried out by so many experimental groups vary so much bringing the constancy of this constant into question. In the period between 1983 and 2000, the lowest (1983) average value of Newton's constant big G was measured by Faller et al. [3] as 6.575, while the highest (2000) average value of Newton's gravitational constant G was published by Jens et al. [4] as 6.674215, a difference of about 1.5 percent and too much for a constant. Leaving aside that the constancy of Newton's gravitational constant G is under dispute [5], [6], Newton's gravitational constant G is still treated as a constant and even part even of Einstein's general relativity theory [7] too.

2. Material and methods

2.1. Definitions

Definition 1. Newton's Law of Gravitation from the Standpoint of a stationary observer R

Newton's masterpiece *Philosophiae naturalis principia mathematica* has influenced the development of modern physics like no other scientific work and is because of this still at least of historical importance. Isaac Newton (1642-1727) published on 5 July 1686 in his book Philosophiae Naturalis Principia Mathematica on page 178 (Prop. LXXVI. Theor. XXXVI) his well known universal law of gravitation. Newton defines the force of gravity as

$$ {}_{R}\vec{F} \equiv {}_{R}\gamma \times \frac{{}_{R}m_{1} \times {}_{R}m_{2}}{{}_{R}d^{2}} \equiv {}_{R}\gamma \times \frac{{}_{R}m_{1} \times {}_{R}m_{2}}{\left({}_{R}c \times {}_{R}t\right)^{2}} \tag{1} $$

where

${}_{R}F$ is the force between the masses as measured by the stationary observer R,
${}_{R}\gamma$ is the gravitational constant as measured by the stationary observer R,
${}_{R}m_{1}$ is the first mass as measured by the stationary observer R,
${}_{R}m_{2}$ is the second mass as measured by the stationary observer R,
${}_{R}d$ is the distance between the centers of the masses as measured by the stationary observer R,
${}_{R}c$ is the speed of the light as measured by the stationary observer R,
${}_{R}t$ is the time as measured by the stationary observer R.

Based on this definition, the value of Newton's gravitational constant G is calculated as

$$ {}_{R}\gamma \equiv \frac{{}_{R}\vec{F} \times {}_{R}d^{2}}{{}_{R}m_{1} \times {}_{R}m_{2}} \equiv \frac{{}_{R}\vec{F} \times \left({}_{R}c \times {}_{R}t\right)^{2}}{{}_{R}m_{1} \times {}_{R}m_{2}} \tag{2} $$

Under conditions of the special theory of relativity, the net force ${}_{R}F$ is equal to zero.

2.1. Axioms

Axiom I.

$$ +1 = +1 \tag{3} $$

3. Results

The validity of Newton law of gravitation has been tested many times at short range distances in laboratory experiments [8] and equally by long range tests [9] performed by observations of the motions of planets (in the solar system). The accuracy of experiments has shown impressive progress and the agreement between experiment and theory is good. Still, the general validity of Newton's law of gravitation is in question.

3.1. Theorem. Newton's constant γ is not a constant

Claim.

Newton's gravitational constant γ is not a constant. If you accept that Newton's gravitational constant γ is a constant, then you must accept to that

$$+1 = +0 \tag{4}$$

Proof.

In general it is

$$+1 = +1 \tag{5}$$

or

$$_R\gamma = {_R\gamma} \tag{6}$$

According to Newton's law of gravitation, **two masses $_Rm_1$ and $_Rm_2$ are accelerated** (non-inertial frames of reference) while the distance between these two masses is measured as $_Rd$. The net force $_RF$ is different from zero (non-inertial frames of reference) and Newtown's constant $_R\gamma$ is calculated as

$$_R\gamma \equiv \frac{_R\overrightarrow{F} \times {_Rd^2}}{_Rm_1 \times {_Rm_2}} \tag{7}$$

After a certain period of time, the acceleration of the two masses (i. e. rockets in deep space) $_Rm_1$ and $_Rm_2$ is stopped. The acceleration and **the net force becomes zero**. We are no longer inside a non-inertial frame of reference. The experimental conditions before changes from a non-inertial frame of reference to an inertial frame of reference and the equation before changes to

$$_R\gamma \equiv \frac{0 \times {_Rd^2}}{_Rm_1 \times {_Rm_2}} \tag{8}$$

or to

$$ {}_{R}\gamma = 0 \tag{9} $$

In general, it is claimed that Newton's gravitational constant γ is a constant, while the same is equally different from zero. Thus far, we obtain

$$ +\frac{{}_{R}\gamma}{{}_{R}\gamma} = +\frac{0}{{}_{R}\gamma} \tag{10} $$

or

$$ +1 = +0 \tag{11} $$

Quod erat demonstrandum.

4. Discussion

The experiment before is properly constructed. Two masses in deep space (i.e. rockets) are properly accelerated thus that we are under experimental conditions of non-inertial frames of references where Newton's law of universal gravitation is valid in principal. Under these conditions Newton's gravitational constant γ is calculated.

After a certain period of time the acceleration stops. Such an experiment is a real world experiment too. In this case the experimental conditions are changing from non-inertial frames of reference to inertial frames of reference and the net force becomes zero. Under these conditions we obtain a logical contradiction if we accept too that Newton's gravitational constant γ is a constant.

Thus far, **either** a non-inertial frame of reference cannot change to an inertial frame of reference **or** Newton's gravitational constant γ is not a constant and must change too.

5. Conclusion

Newton's gravitational constant γ is not a constant. This can have consequences for Einstein's theory of general relativity and Einstein's field equations too.

Acknowledgements

None.

References

[1] Newton, I. (1686) Philosophiae Naturalis Principia Mathematica. Pepys, Londini, 178. https://doi.org/10.3931/e-rara-1237

[2] Cavendish, H. (1798) Experiments to Determine the Density of the Earth. *Philosophical Transactions of the Royal Society of London*, **88**, 469-526. https://doi.org/10.1098/rstl.1798.0022

[3] Faller, J. E. and Koldewyn, W. A. (1983). A prototype measurement of the Newtonian gravitational constant using an active magnetic suspension torsion fiber. Precision measurement and gravity experiment. Proceedings of the 1983 International School and Symposium, Taipei: National Tsing Hua University, pp. 541-556. https://jila.colorado.edu/publications/prototype-measurement-newtonian-gravitational-constant-using-active-magnetic-suspension

[4] Jens, H. G. and Stephen, M. M. (2000) Measurement of Newton's constant using a torsion balance with angular acceleration feedback. *Physical Review Letters*, **85**, 2869-2872. https://doi.org/10.1103/PhysRevLett.85.2869

[5] Barukčić, I. (2015) Anti Newton - Refutation of the Constancy of Newton's Gravitational Constant Big G. *International Journal of Applied Physics and Mathematics*, **5**, 126-136. https://doi.org/10.17706/ijapm.2015.5.2.126-136

[6] Barukčić, I. (2016) Newton's Gravitational Constant Big G Is Not a Constant. *Journal of Modern Physics*, **7**, 510-522. https://doi.org/10.4236/jmp.2016.76053

[7] Einstein, A. (1916) Die Grundlage der allgemeinen Relativitätstheorie. *Annalen der Physik*, **354**, 769-822. https://doi.org/10.1002/andp.19163540702

[8] Adelberger, E.G., Heckel, B.R. and Nelson, A.E. (2003) Tests of the gravitational invers-square law. *Annual Review of Nuclear and Particle Science*, **53**, 77-121. https://doi.org/10.1146/annurev.nucl.53.041002.110503

[9] Talmadge, C., Berthias, J. -P., Hellings, R. W. and Standish E. M. (1988) Model-Independent Constraints on Possible Modifications of Newtonian Gravity. *Physical Review Letters*, **61**, 1159. https://doi.org/10.1103/PhysRevLett.61.1159