MedCrave
Step into the World of Research
Aeronautics and Aerospace Open Access Journal

Opinion

Open Access
CrossMark

Basics of post Newtonian gravity- a new simpler approach

Abstract

Galileo studied bodies falling under gravity and Tycho Brahe made extensive astronomical observations which led Kepler to formulate his three famous laws of planetary motion. All these observations were of relative motion. This led Newton to propose his theory of gravity, which could just as well have been expressed in a form that does not involve the concept of force.

Keywords: Newtonian gravity, theory of relativity, simpler approach

Volume 8 Issue 1 - 2024

H Ron Harrison
Department of Mechanical Engineering and Aeronautics, City University of London, UK

Correspondence: H Ron Harrison, Retired (Ph.D. F.R.Ae.S), Department of Mechanical Engineering and Aeronautics, City University of London, UK,
Email h.ron.harriso@harmonic.plus.com

Received: March 06, 2024 | **Published:** March 18, 2024

Introduction

The proposed approach extends the Newtonian theory and the Special Theory of Relativity by including relative velocity and by comparison with electromagnetic effects. This enables the non-Newtonian effects of gravity to be calculated in a simpler manner than by use of the General Theory of Relativity (GR). Application, using only the first two terms of the basic equation, to the precession of the perihelion of Mercury and the gravitational deflection of light, gives results which agree with observations and are identical to those of GR. It also gives the accepted expression for the Schwarzschild radius. This approach could be used to determine non-Newtonian variations in the trajectories of satellites.

The third term added to the initial basic equation acts in the direction of the relative velocity. The amended basic equation now predicts a change in the speed of light and generates the accepted result for the Shapiro time delay. It also gives a value for the Last Stable Orbit which also agrees with the accepted value.

Because the extra term is a function of $(v/c)^4$, which includes the radial component of the relative velocity, the prediction of the precession of the perihelion of Mercury will not be significantly changed. It can be shown that the variation of the speed of light and its deflection when passing through a gravitational field agrees with Snell's Law.

The basic equation

The acceleration of body B relative to body A is

$$\mathbf{a} = -\frac{K}{r^2}\left(1-\frac{v^2}{c^2}\right)\mathbf{e_r} + \frac{2K}{r^2c^2}\mathbf{v}\times\left(\mathbf{v}\times\mathbf{e_r}\right) \quad + \quad \frac{2K}{r^2c^2}v_r\left(\frac{v}{c}\right)^2\mathbf{v}$$

Where v is the velocity of B relative to A and v_r is the radial component.

The separation is r, $K = G(m_A + m_B)$, the Gravitational constant times the sum of the masses. Also c is the speed of light in a gravity free vacuum. More information in reference,[1] See also the Addendum.

This equation will be considered to be the basic for Post Newtonian Gravity. Justification will come from agreement with verified experimental data.

Note that the second term is normal to the relative velocity. The third term is in the direction of the relative velocity but its magnitude is determined by the value of the radial component of the velocity.

The basic equation may be rewritten as:

$$\mathbf{a} = -\frac{K}{r^2}\left(1+\frac{v^2}{c^2}\right)\mathbf{e}_r + \frac{2Kv_r}{r^2c^2}\left(1+\frac{v^2}{c^2}\right)\mathbf{v}$$

Consider body A to be the Earth, then from this equation it is seen that for circular motion, if the speed approaches that of light the acceleration could be become close to double the Newtonian. However, for outward radial motion if the speed approaches 70% of the speed of light the acceleration could tend towards zero. Also, if the speed is close to that of light the acceleration will tend towards double the Newtonian but is repulsive. For inward radial motion the speed of light is reduced following Snell's Law, as does light entering the atmosphere. However, for mass particles moving inwards the speed increases. If v/c is zero then the relative acceleration, a, reverts to the Newtonian form without using the concept of force.[2]

There is still no evidence of dark matter in the Solar System therefore there is no need to change the basic equation as it is based on the verified data in the Solar System. The question is, could the equation have any effect on Cosmology outside the Solar System.

A convenient definition of force may be written $F = \mu a$ where $\mu = \frac{m_A m_B}{(m_A + m_B)}$ known as the reduced mass. This means that the two body problem orbiting the centre of mass is equivalent to a mass μ orbiting a fixed mass= $(m_A + m_B)$

It is important to notice that only one definition of mass is required, it could simply be the number of basic particles. Because force and inertia are both defined quantities the principle of the equivalence of gravitational and inertial mass does not arise. Force is a very useful concept in dynamics, in the same way that money is a useful concept in commerce. Or, as said by Hertz, force is a sleeping partner. The basic quantities of distance and time are as measured by the observer. Light is assumed to travel in a straight line in empty space which defines a non-rotational frame of reference. The measurement of time and distance are all of one body relative to another so the equivalence of frames of reference also does not appear. The concept of the curvature of space time may be helpful but it is similar to studying the curvature of a distance time graph.

A summary of the justifications of this simpler approach is that the following phenomena are predicted:

1) The precession of the perihelion of Mercury.
2) The deflection of light grazing the Sun.
3) The Schwarzschild Radius.
4) Variation of the speed of light due to gravity (VSL) and agreement with Snell's Law.
5) The Shapiro Time Delay.
6) The Last Stable Orbit.

It should be noted that light approaching a massive body is slowed down by gravity. This is the opposite effect to that of mass particles.[3]

The de Sitter, or Geodetic, effect agrees with the accepted results of analysis whether algebraically or by numerical integration for two body systems or large non-rotating bodies. However, for rotating bodies the Lense-Thirring, or Frame Dragging, terms there is an unresolved factor of two which affects both nodal and pericentre precession. Also an extra term appears in the expression for the nodal precession which is not in the accepted result.

The published test on the Earth satellites LAGEOS I & II appear to agree with the accepted theory. The inclination of the satellites is approximately 90^0 +/ -20^0. The reason for this is that the accepted Lense-Thirring term does not depend on the inclination but all other effects do and therefore can be cancelled out. The extra term in the present theory also depends on the inclination and therefore cancels out as well. In this configuration it is small compared to the main term.[4]

The Gravity Probe B experiment testing the precession of gyroscopes in Earth orbit displays two equations, one for the geodetic term and one for the frame-dragging effect. The geodetic term does not involve the rotation of the Earth but the frame-dragging term does. The same form of equations has been generated algebraically but the frame-dragging term is half of the published value. However, the geodetic term is two thirds of the published value.[5]

It has proved to be impossible, so far, to find any modification to the basic equation such that it gives the generally accepted value for the Lense-Thirring effect without changing the de Sitter effect applications. The de Sitter results have been obtained by several observations but the Lense-Thirring effect is very small compared to other effects. In the LAGEOS experiments for the precession of the pericentre the Lense-Thirring effect is less than 1% of the de Sitter effect, which makes it more difficult to evaluate. The GP-B test results have been published. There are four gyroscopes, two of which have frame-dragging results which are close to that predicted by the new theory. The geodetic results are, on average, close to that of the accepted value. Nevertheless, over a one month period two of the gyroscopes process at a rate close to the new theory predictions.[6]

In discussing binary decay the decay is said to be related to energy loss due to gravity waves. This could be the case but not for the method used. In some cases energy loss may also be associated with outward spiralling so it depends how the energy is lost. Which is the case for the Earth Moon system. When general relativity is applied to multiple body systems several authors have produced slightly different results. Some results even do not return to the Newtonian form when the velocities are zero but only if the speed of light is taken to be infinite. This new approach does not undermine the General Theory of Relativity but because it is a simpler method it leaves less room for misinterpretation. Many of the extensions of GR are very complex mathematically making errors more likely.[7]

Conclusion

The question of anti-gravity is still discussed. There is the possibility that matter with a negative gravitational charge could exist. If we start with a pool of particles with positive and negative electrical and gravitational charge then, because the electrical effect is stronger, groups of zero electrically charged particles will form. Some of these will have positive gravity charge, as we experience, but some may have negative charge. These groups will form separate clusters which will then repel each other. Unless some negative gravitationally charged particles became trapped in the early stages then we may not be aware of their existence. Using the basic equation it is possible to show that a wheel spinning about a horizontal axis above the surface of the Earth may lose weight. However, the speed of the wheel has to be very close to that of light to make it measureable, so it is very unlikely to be demonstrated.

Basics addendum

This addendum is to show the reasoning behind the simpler approach to Post Newtonian Gravity. The logic is to form an equation that predicts the measured gravitational dynamics without requiring any extension, such as force, to the physics of gravitation.

There are 5 things I will never fully understand. They are Space, Time, Matter, Charge (Electrodynamics and Gravitation) and "Me". Once these properties are regarded as axioms then all other concepts, such as force, can be defined.

Space, time and matter are as defined and are measured by using the SI Units. Charge is specified by the relative movement of bodies. The charge associated with electrical charge is repulsive for like charged particles and attractive for opposite charged particles. So electrons with negative charge repel each other so do positively charged protons. But electrons are attractive to protons forming zero electrically charged particles. However, for gravity like charged positive or negative particles attract each other. The value of charge is measured by the relative acceleration generated per unit mass. This is much weaker than electrodynamics effect. If negative gravity existed then it would form groups where unlike groups would repel each other.

Newtonian Gravity can be expressed without using the concept of force from which it follows that only one definition of mass is required. The basic equation can be created from measured observations, as Newton did.

Generation of Post Newtonian Gravity is also based on measured observations. For guidance with large relative velocity the form of Lorentz Force in electromagnetism is used. Maxwell used a mechanical modal as a guide but dropped it once he was satisfied with its outcome.

My equation based on this form has two terms and predicts many of the measured results but an extra term is added which predicts observations which involve variation of the speed of light.

The equation with three terms now predicts all of the well verified gravitational observations within the Solar System.

Acknowledgments

None.

Conflicts of interest

The authors declare that there is no conflict of interest.

References

1. Harrison HR. Post Newtonian gravity, a new simpler approach. *International Journal of Space Science and Engineering*. 2016;4(2).
2. Harrison HR. Gravity, Galileo to Einstein and Back. 2006/8.
3. Harrison HR. Gravitomagnetics, the basics of a simpler approach. *viXra*. 2009.
4. Harrison HR. Binary pulsars, orbital precession and decay. *viXra*. 2011.
5. Harrison HR. Gravitomagnetics, a simpler approach applied to rotating bodies. *viXra*. 2011.
6. Harrison HR. Advanced engineering dynamics. 1997.
7. Harrison HR. Gravitomagnetics a simpler approach applied to dynamics within the solar system. *Global Journal of Researches in Engineering.* 2022; 22(1).

Citation: Harrison HR. Basics of post Newtonian gravity- a new simpler approach. *Aeron Aero Open Access J.* 2024;8(1):54–56.
DOI: 10.15406/aaoaj.2024.08.00193