Measurement method to determine the speed of gravity

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Abstract

We present a method by which we can determine directly the propagation speed of the sun gravitational field. We propose as to attain this objective, to compare the lengthiness of two cosmic distances through direct measurements. The first distance is given by the length between a planet and the sun, while the other distance is caused by the movement of the Solar System, including the sun and planet, within its trajectory around the galactic center of the Milky Way. Since cosmic distances have to be crossed by the gravitational field of the sun and planet as well we show that one of them has to be neglected. This fact creates a retarded gravitational field of the sun which falls at an acute angle on the planet. This angle is determined by the fact that the gravitational field suffers a composed movement in two directions simultaneously and transport phenomenon occurs. We show that the measured angle aperture depends directly on the speed of gravity of the sun. Further investigation is made regarding the identification of the "Privileged directions" in the solar system, which probably shape the planetary elliptic movement due to the motion of the whole solar system around the galaxy on the galactic circle.

Keywords

Speed of gravity, gravitational field propagation speed, speed of light

Introduction

The attraction phenomenon exercised upon all objects at the surface of the Earth known as the "falling objects fact" measured directly by Galileo Galilei in his "falling bodies experiment" [1] leads him to the point to discover the tube that bears his name "Galileo's vacuum tube". This device can be considered the birth certificate of the modern study of the gravitational field as an independent concept in physics. Few years later Isaac Newton in his "Philosophiæ Naturalis Principia Mathematica" [2] states an incredible idea that not only objects fall into the planet gravitational field but also the planet itself falls in the gravitational field made by the object. This revolutionary idea of being a connection of direct dependency between mass and gravitational field for any object regardless of size forged our thinking's ever since. Besides all these, Newton generalized this behavioral property of any object in the vicinity of

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our planet, to the orchestration of the Universe and to the movement cause of all celestial bodies. This was a huge step in our perception about the Cosmos and it started to change the way in which we apply our methodology in science and research because his work opened us a door through which we are able to discover globally properties starting from the study of local properties. For Newton the speed of gravity did not represented a problem since for him any changes in mass of a body, change instantly its gravitational attractive force. From the Newton point of view, gravity propagates instantly regardless the distance, which is equivalent to assume that the speed of gravity is infinite. It's strange how this peculiar aspect of the propagation speed of gravity did not stop him to elaborate the quantitative law of the universal attraction. For almost 200 years [3], [4] this assumption has not been doubted, until Le Verrier [5] questioned the validity of the Newtonian celestial mechanics related to the Mercury precession. A next step has been done by Laplace [6] the father of the gravitational waves concept, who obtained a finite value for the gravity speed but higher than the speed of light. Manny attempts have been made at the beginning of the early twentieth century among which worth mentioning the works of Gerber [7], Lorentz [8], Poincare [9], but the finishing stroke came from Einstein [10] who postulated the finite limited value of any speed in the Universe as being the speed of the light. Taking into account this restriction, question arose to what extent the gravitational field is connected or subordinated to the speed of light.

With the implementation of relativity in physics, somehow each new research has been connected more or less to it, ever since. Numerous studies have been made such as those: relying on binary pulsar data Flandern [11] who had found for the gravity speed a higher value that the speed of light revisited by Ibison [12], by studying the gravitational waves of supermassive black hole binaries formed during galaxy mergers made by Shannon [13], by direct measurements of a quasar radio source deflection by the Jupiter gravitation [14], [15], [16], taking into account the Linear Lorentz-invariant transformation for the relativistic time delay [17], [18], through measurements using light particle or radio wave [19], methods which imply relativistic VLBI experiment [20], under correlations between gravitational waves, electric field and radiation [21], who showed that aberration is almost exactly canceled by velocity-dependent interactions [22] or studies based on a peculiar method to determine the gravity speed resorting on the gravity tide of the Earth [23].

Latest works belong to Gogberashvil [24] who approach the phenomenology from a thermodynamic point of view, while Coumbe [25] view it from quantum gravity perspective. An overall view highlights the fact that the narrow path of the gravity speed researches [26] rely on a few pillars such as: aberration of the field direction in relativistic environment, propagation time delay, Liénard-Wiechert potential, parameterized post-Newtonian formalism, light deviation measurements.

We intend to clarify further on the fact that the gravitational waves concept we consider as being a free assertion mainly because any wave needs two things: an oscillator and a medium of propagation. Until

this moment we have no valid experimental background to sustain any of them. Hence, we shall try to avoid such concept. In the same time another concept as gravitons as an elementary particle mediator of the gravitational field we shall avoid to mention and to discuss it based on the same considerations. We will refer only to the simple fact that the gravitational field reaches somehow the planets and this fact show us undoubtedly that it has to propagate at a large distances with a particular speed. The presentation of the method to measure the speed of gravity is our main objective.

The method

In order to present the method, which is incredibly simple, we have to starts from highlighting some evident facts, which all stands as the fundament of our point of view, such as: 1 - Between any planet from our solar system and the sun there are distances larger than the diameter of any planet or even of the sun; 2 - The sun as well as any other planet from the solar system moves together with the same speed throughout the Milky Way on the galactic plan; 3 - To order to reach a planet the sun gravitational field has to propagate throughout the space between the sun and the planet; 4 - Any celestial body, including any planet, is pulled hierarchically by the gravitational field of the closest heaviest source. Hence, in the solar system a planet is pulled by the sun and not by the center of the Milky Way galaxy; 5 - The exclusion principle by which different size of gravitational sources does not act equally but rather by excluding the weakest one when we analyze their correlations.

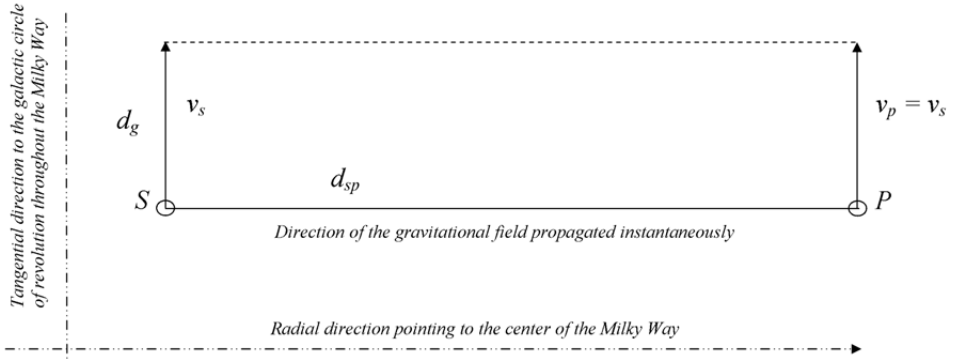

Fig. 1 Depiction regarding the positioning of a given planet in relation to the sun and the Galaxy

For the sake of investigation we shall freeze the position of the sun noted with *S* and of a planet *P*, as we can see depicted in *Fig.1*. Due to the huge distances between them we shall consider both cosmic objects as being point like, one to the other. Let's note with d_{sp} the distance between the planet and sun, with v_s which is equal with v_p the speed of the sun and planet within the solar system on the galactic plan

of the Milky Way and with d_s the distance traveled by the sun as well as the planet in a given time interval around the center of the Galaxy on the galactic circle of revolution.

We shall try to avoid the Einstein relativity, the Newtonian law of universal attraction, focusing on simplicity and we shall only treat the tendency of two cosmic bodies to attract each other even at large distances. From these perspectives we can say that there is a subordination of a planet movement to the sun rather than to the galaxy's existence which is equal to say that sun drags the planet and not vice-versa.

Based on this observation in *Fig. 2* we can identify the retarded gravitational field due to the fact that the influence of *S* upon *P* is much greater than the influence of *P* upon *S* therefore the *P* movement relative to the ecliptic of the solar system can be neglected and we may assume that $v_p=0$.

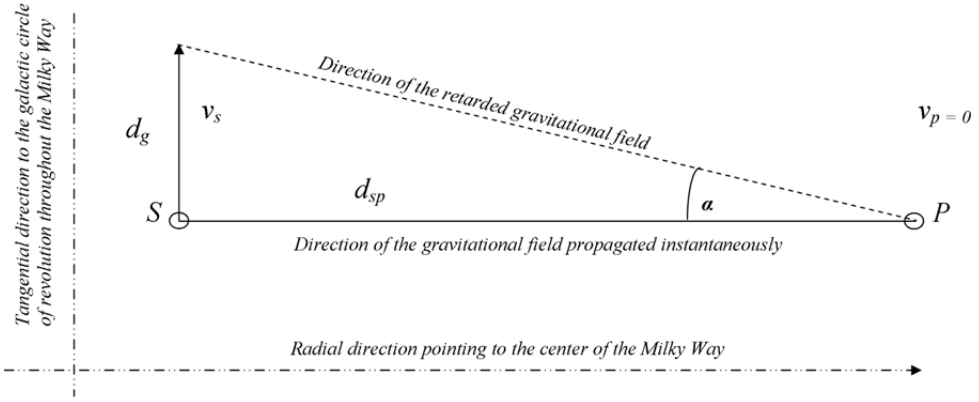

Fig. 2 Representation of the direction of the retarded gravitational field of the sun reaching the planet

The horizontal direction between sun and planet corresponds to the direction of the instantaneous propagated gravitational field of the sun with d_{sp} as being its length. It corresponds to a geometric length between sun and planet. Due to the fact that *P* movement can be neglected because it is not the source of the solar system movement we can identify the d_g length. This distance corresponds to the sun traveled length on the galactic circle in the same time interval in which his gravitational field travels to the planet. As result of these two movements the direction of the gravitational field of the sun becomes retarded becoming tilted to an angle α which is not null.

Let's assume that the speed of gravity is equal with the speed of light then we can write:

$$tg\ \alpha = \frac{d_g}{d_{sp}} \tag{1}$$

By extrapolating we can conclude that for higher speed of the gravity the angle of the retarded gravitational field direction becomes γ being smaller than α, while for lower speed of the sun gravitational field the angle β becomes larger, as it is depicted in *Fig.3* for each particular d_{g1}, d_{g2}, d_{g3}. We can observe

that the angle opening is in direct dependency with the speed of the sun gravity. All angles have been represented exaggeratedly just to serve to the aim we pursued.

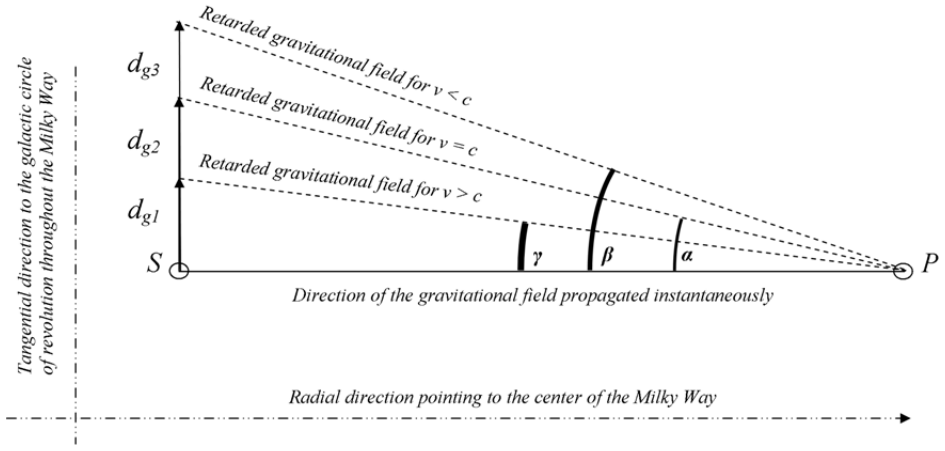

Fig. 3 Representation of the dependence between the speed of gravity and angles

The method we just presented allows us to calculate angles based on distances measurement and upon it to evaluate the gravity speed. It gives us a net differentiation of gravity speed either is higher, lower or equal with the speed of light. Using this method we can obtain a map of the speed of gravity depending on distances for different planets in case that it is a distance dependent quantity.

We can observe that as the propagation velocity of the sun gravitational field decreases the greater become the angle of the retarded direction. In the same time as the gravity speed increases the angle become sharper. We neglected intentionally the travel time problem in order to avoid relativity as much as possible, and to keep simple our endeavor.

The future will show us if we will have to introduce compulsory the relativity approach or not.

Further investigations – "Privileged directions"

If so far all we have done it was a simple comparison of two distinct correlated cosmic distances, which lead us to the possibility to calculate the speed of gravity, from this point forward we shall focus on studying of all directions related to the movement of the solar system on the galactic plan. We know that the ecliptic plan is tilted sideways at an about 60^0 up to 90^0 angle with respect to the galactic plan due to the Opher and his team [27] measurements.

Also we know that the Solar System is traveling on the galactic circle of revolution at an average speed of 230 km/s [28] within its trajectory around the galactic center of the Milky Way. Let's make some drawings with imaginary axis in order to investigate the privileged directions in the solar system. The first axis passes through the center of galaxy and sun, the second axis is tangential to the galactic circle of revolution while the third axis merges with the ecliptic an fall on the first axis at a 90^0 angle with the

second axis makes a 60^0 angle as in *Fig.4* is presented. In *O* stays the sun while the circle in the figure represents the ellipse trajectory of a planet. As result of intersections of this elliptic path with the mentioned directions we can identify the followings privileged directions:

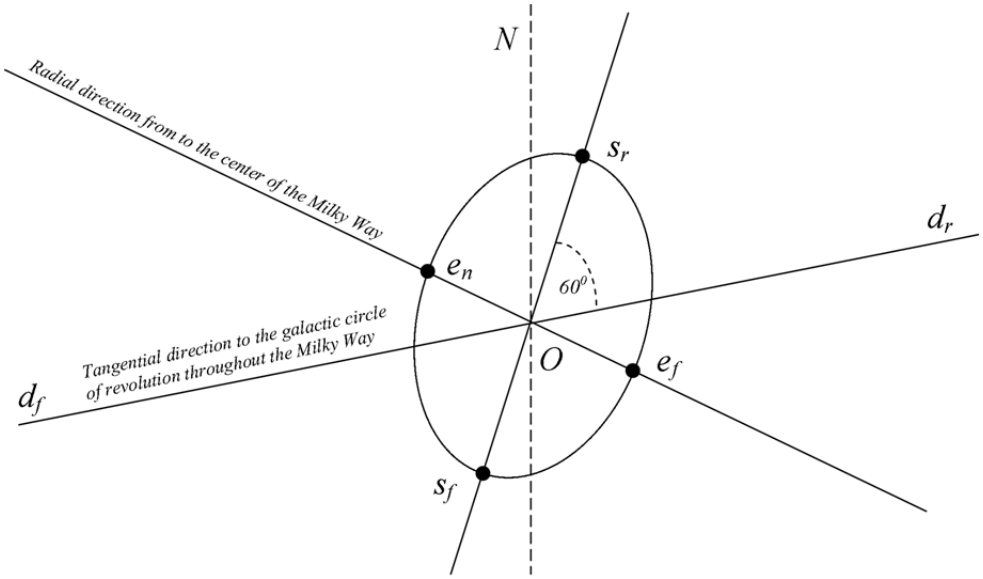

Fig. 4 Privileged directions in the solar system

e_n - *Equinoctial near point.* Is the point of intersection between the galactic plan and the planet elliptic trajectory. It is localized between the galaxy center and the sun. On this section the planet is attracted by the sun and in opposition by the center of the galaxy. Hence, the pulling is reduced in intensity, the sun gravitational field is attenuated, fact that imply a composed effect that give the following the inequality $oe_n > oe_f$.

e_f - *Equinoctial far point*. Is the point of intersection between the galactic plan and the planet elliptic trajectory. It is localized beyond the sun viewed from de galaxy center. On this section the planet is attracted by the sun as well by the center of the galaxy. Hence, the pulling is intensified, the sun gravitational field is coupled, fact that imply a composed effect that sustain the same inequality $oe_n > oe_f$.

s_r - *Retarded solstice point*. Is the point of intersection between the planet elliptic trajectory and the third axis which correspond to the 30^0 retarded gravitational field of the sun to the normal direction *N* to the galactic plan. This point corresponds to the maximum pulling of the planet by the sun gravitational field caused by the movement of the sun around the galactic center. This fact imply that $os_r > os_f$.

s_f - *Forwarded solstice point*. It is the point of intersection between the planet elliptic trajectory and the third axis which correspond to the 30^0 forwarded gravitational field of the sun to the normal direction *N* to the galactic plan. This point corresponds to the maximum pushing of the planet by the sun gravitational field caused by the movement of the sun around the galactic center. This fact imply that $os_r > os_f$.

d_f - *Forwarded direction*. It corresponds to the direction of motion of the solar system on the galactic plan, being tangential to the galactic circle of revolution. The whole solar system moves towards the forwarded direction of the sun gravitational field.

d_r - *Retarded direction*. It corresponds to the direction of opposite sense of movement of the solar system on the galactic plan, being tangential to the galactic circle of revolution. The whole solar system moves away from retarded sun gravitational field.

In our solar system there are 6 privileged directions, which are all result of the movement around the galactic circle in the Milky Way. Despite the fact that all these directions can be identified as working apparently in pairs on a 3 linear intersected trajectories, the characteristics of each of them are not similar at all. As effect of all these, any planetary elliptical trajectory has to be compressed on the outward direction to the galaxy and expanded on the direction to the center of the galaxy. In the same time on the retarded direction the distance from the planet to the sun is longer than on the forwarded direction which is shorter compared to the first one. We do not exclude the possibility that future research may clarify based of the studies of these "privileged directions" that the elliptic movement of planets is a direct consequence of them as a natural consequence of distortions.

Conclusions

We have investigated the statics of two cosmic bodies (the sun and a planet) based on their reciprocal influence and of the galaxy influence, on the description of their relative position and on the assumption that the gravitational field has to reach somehow from one to the other. We have showed that as result of the movement on the galactic circle, of the solar system, the distance between the sun and planet is connected to the distance traveled by the sun. The ratio between them gives us a direct method to evaluate the speed of gravity of the sun. Further investigation has been made regarding the "privileged directions" undergone by the solar system. We found that 6 directions all intersecting in the sun are characteristic to the movement of any planet. More than that, each of these directions acts independently while all of them participate in the shaping of the planet elliptical trajectory around the sun.

We aimed to achieve a qualitative rather than a quantitative analysis.

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