Alternative Reflections on the "Speed of Gravity"

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ABSTRACT

The attractive force of gravity, according to Newton's law, enables the planet Earth to move on a planetary orbit around the Sun. The observed stability of Earth's orbital parameters obviously demands an instantaneous interaction along the line between the actual positions of both bodies. Especially on the basis of Special Relativity (STG), General Relativity (GTR), and a lot of experimental results, it is a commonly accepted result, that the speed of gravity, at which gravitational interactions propagate, is equal to c, the speed of light. This rather low speed, however, leads to aberration effects with an amount of 20 arcsec, which prevent a stable orbit. Newtonian Mechanics therefore prefer to assume an almost infinitely high value of the speed of gravity to solve this problem. Relativistic Mechanics seem to favor the existence of appropriate forces which are dictated by conservation laws and the quadrupole nature of gravitational radiation. The Alternative Reflections on Gravitation (ARG), however, let expect quite different results. In a Sun-Earth system the aberration is at least five orders of magnitude lower than expected from Newtonian Mechanics. In a Sun-satellite system the aberration is immeasurably small. This result may be compared to Newtonian and Relativistic Mechanics which also for this system let expect the same amount of aberration of 20 arcsec as for the Sun-Earth system.

1. INTRODUCTION

Newton's law of gravitation was published already in 1687. Until now it is used successfully as basis for the calculation of planetary orbits and satellite-travels in the solar system. In order to allow a stable orbit of a planet around the Sun, the instantaneous interaction between the Sun and the planet seems to be necessary. Especially on the basis of Special Relativity (STG), General Relativity (GTR), and a lot of experimental results, it is a commonly accepted result, that the speed of gravity, at which gravitational interactions propagate, is equal to c, the speed of light. This rather low speed, however, leads to aberration effects with an amount of 20 arcsec in a Sun-Earth system, that should produce a strong destabilization of the planetary orbit, which in reality doesn't occur. This problem is discussed in the following chapters in connection with Newtonian Mechanics, Relativistic Mechanics, and the "Alternative Reflections on Gravitation" (ARG).

2. NEWTONIAN GRAVITATION

In connection with Newtonian Gravitation and aberration effects wikipedia [1] may be cited: "Isaac Newton's formulation of a gravitational force law requires that each particle with mass respond instantaneously to every other particle with mass irrespective of the distance between them. ... Therefore, the theory assumes the speed of gravity to be infinite. ... This led Laplace to conclude that the speed of gravitational interactions is at least $7*10^6$ times the speed of light." And this conclusion was already established by Laplace in 1805 [2]. Later, in 1998, Tom van Flandern, an expert in the area of celestial mechanics [3], stated that the speed of gravity should be at least $2*10^{10}$ times faster than c, the speed of light, or even infinitely high.

3. GENERAL RELATIVITY AND ABERRATION EFFECTS

It is quite commonly assumed that the General Theory of Gravitation (GTR) has solved the problem of aberration which occurs with Newtonian Mechanics. When the GTR appeared in 1915, it was well-known that Laplace already in 1805 assumed a speed of gravity of at least $7*10^6$ times the speed of light [2]. Therefore, one should expect that the solution of the aberration problem could be solved easily on the basis of the GTR, quickly after 1915.

If , however, one asks wikipedia [4] as a reference, one finds a paper which was published by S. Carlip in 1999 [5], 84 years after the GTR appeared. The abstract of this paper contains the following statement: "The observed absence of gravitational aberration requires that “Newtonian” gravity propagate at a speed $c_g > 2*10^{10}c$. By evaluating the gravitational effect of an accelerating mass, I show that aberration in general relativity is almost exactly canceled by velocity-dependent interactions, permitting $c_g = c$. This cancellation is dictated by conservation laws and the quadrupole nature of gravitational radiation."

Of course can conservation laws demand certain forces on the basis of a correct theory. But do these forces really exist and are they produced by gravitational radiation? The aberration of 20 arcsec of a Sun-Earth system corresponds to a force with a value of 10^{-4} times that of the attracting force of the Sun. This force is even a little higher than the tidal force from the Sun, both with values of about $5*10^{-7}$ m/s^2. Superconducting gravimeters are able to detect changes in gravity towards the center of Earth with a resolution of $1*10^{-11}$ m/s^2. Should these instruments not notice a remarkable effects from the assumed gravitational radiation? The problem, however, may be due to the fact, that ephemerids programs can easily hide such rather small effects by suitable adjustment of a huge number of parameters, which are necessary to describe the gravitational interactions between all objects in the solar system.

4. ALTERNATIVE REFLECTIONS

According to the "Alternative Reflections on Gravitation", (ARG), the attractive gravitational forces between two masses, M_1 and m_2 result, as a secondary effect, from the mutual screening against the primary effect, repulsive gravitational radiation [6], [7]. There are two essential points, which differ substantially from the considerations, which lead to the problems concerned with the speed of gravity, explained on the basis of Newton's theory or Relativistic Mechanics.

4.1 ABERRATION IN A SUN-EARTH-SYSTEM

As a suitable model, the mostly viewed system will be considered also here, containing only the masses of the Sun, (M_1), and of Earth, (m_2). After, according to T.v.Flandern's argumentation on the basis of Newton's theory, the attractive force from the first position P_1 of M_1 was emitted and has transversed the distance R (150 Mill. km) to Earth, the Earth has moved with a speed v_2 (v_2 = 30 km/s) on its orbital path towards its position p_2 at a distance s_2. This leads to the above mentioned high retardation angle alpha of 20 arcsec.

The ARG requires a completely different picture: At every place around the mass M_1 of the Sun the gravitational shielding effect already exists there, when the second mass m_2 appears at such a place. The gravitational shielding produces an attractive force towards the source at the position P_1 of M_1, where the shielding occurred. Thus, here not the distance s_2, but the distance S_1 determines the angle gamma, which due to the value of the masses M_1 and m_2, is 333000 times smaller than alpha. Already these considerations on the basis of the ARG demand a decrease of the aberration effect by this high factor of more than 5 orders of magnitude, compared with Newtonian Mechanics. But even this much lower value would not prevent a measurable effect of aberration, if one assumes that the necessary speed of gravity for an instantaneous reaction must be at least 10^{10} c. But is this value, determined on the basis of Newtonian Mechanics and ephemerids programs with a lot of adaptable parameters, really believable?

4.2 ABERRATION IN A SUN-SATELLITE SYSTEM

Besides the above discussion of the gravitational interactions in the Sun-Earth system, a second system may be considered: A system, far away from other masses, containing only two bodies, one with the mass M_1 of our Sun ($2*10^{30}$ kg) and a one with a weight of 2000 kg, the typical mass of an artificial satellite. It may be assumed that this satellite moves around M_1 on the same orbit as the Earth with R = 1 AU. Then from Newtonion Mechanics the same aberration effect with an angle of 20 arcsec must be expected, as it is valid for the Sun-Earth system. And therefore , also here, the same speed of gravity of about $10^{10}*c$ would be necessary to prevent a measurable deviation from a stable orbit.

On the basis of the ARG, however, the situation in the system Sun-Satellite is drastically different from that of the Sun-Earth system. Due to the masses of the Earth ($6*10^{24}$ kg) and of the satellite, the distance S_1 at which the Sun moves around the barycenter is about $3*10^{21}$ times smaller than in the case of the Sun-Earth system. The corresponding aberration is far too small, to produce any measurable deviation from a stable orbit of the satellite. That means that, especially for this system, the ARG calculations are compatible with a speed of gravity equal to the speed of light, and don't demand speeds which are at least 10^{10} times higher than c, as considered by Newtonian Mechanics. And travels of artificial satellites inside this system can be described very well on the basis of Newton's law of gravitation, without any trouble due to aberration-effects.

5. CONCLUSION

Newtonian Mechanics, and also Relativistic Mechanics, are both connected with the problem that strong aberration effects should occur and disturb the orbits of the planets in the solar system. Because disturbances with an appropriate amount obviously don't exist, both theories offer an own explanation which allows a cancellation of these high aberrational effects. In the case of Newtonian Mechanics an almost infinite " Speed of Gravity" is proposed. Proponents of Relativistic Mechanics assume that the radiation pressure from gravitational waves compensates the aberrational effects. On the basis of the ARG, the arguments of proponents of both theories against each other are well understandable. Both explanations, however, are concerned with aberrations, which on the basis of the ARG don't exist with such high values.

6. REFERENCES

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