Jupiter's orbit and alignment relative to the galaxy is the physical basis of periodic variations of gravitational constant G and the length of day

Preston Guynn
guynnengineering@gmail.com
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1. Abstract

Anderson et al.[1] analyzed measurements of gravitational constant G, and found a periodic variation that matched both the frequency and phase of length of day (LOD) variations previously described by Holme and de Viron[2]. Anderson speculated that the variation might not be real but an undetermined mechanism affecting both measurements in a similar manner. The basis for the periodic variations and the correlation between them has been an area of continuing research. Substantiation of the reported periodic variations in G and LOD is of relevance to researchers in fundamental physics, astrophysics, metrology, geophysics, and particle physics. Reported herein is that the physical basis for the periodic variations is Jupiter's orbit and alignment relative to the Milky Way galaxy.

2. Introduction

In their groundbreaking paper 'Measurements of Newton's gravitational constant and the length of day', Anderson et al. reported a periodic variation in gravitational constant G, which would explain the inability to obtain higher accuracy measurements of a value that was assumed to be constant. Anderson showed "a one-to-one correlation between an apparent temporal periodicity in measurements of G, generally thought to result from inconsistency in measurements, with recently reported oscillatory variations in measurements of LOD". The reported statistical significance was 0.99764.

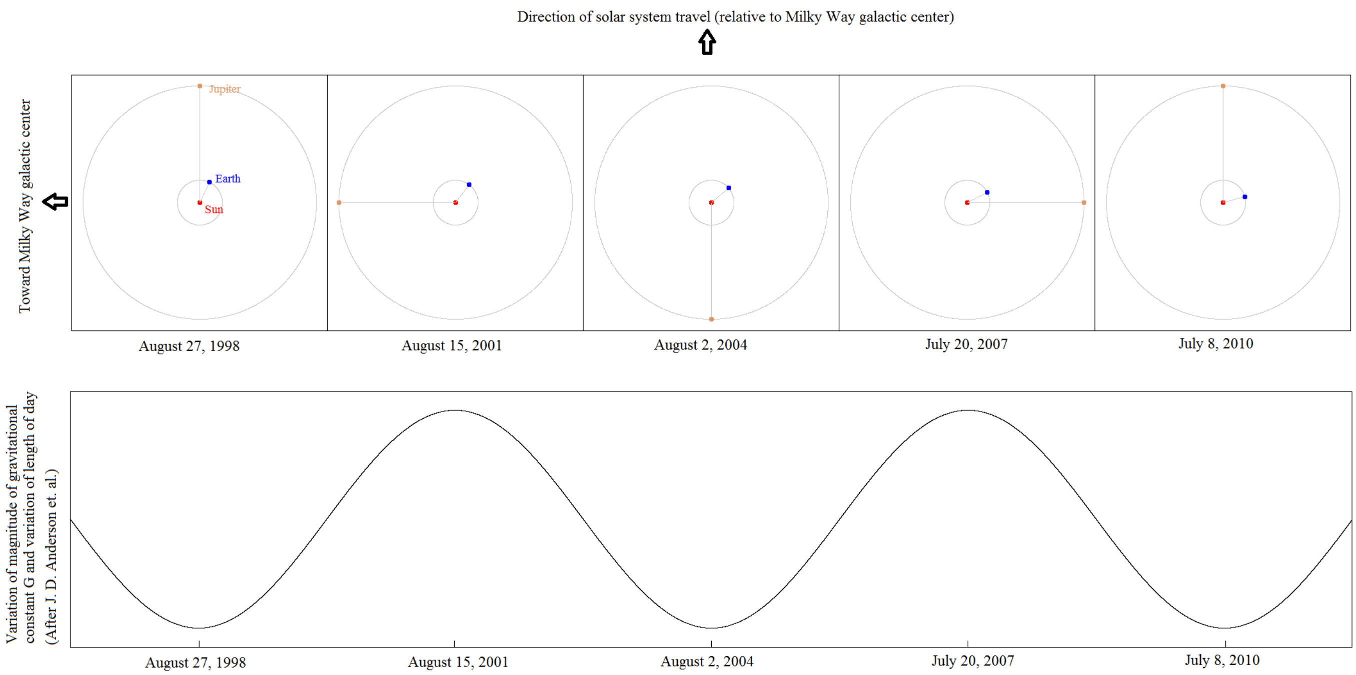
The report by Anderson showed G varying as a sinusoid with a period of 5.899 +/- 0.062 years. By applying filtering to the LOD data of Holme and de Viron, Anderson showed the LOD oscillations had a period of 5.90076 +/- 0.00074 years. Moreover, not only the frequency, but the phase of the two oscillations were in "near perfect agreement".

Anderson et al. stated that the periodic signal in LOD had been attributed to fluid core motions and inner-core coupling. They claimed no satisfactory explanation for the G/LOD correlation, but after noting that the oscillation period is about half of a solar activity cycle and evaluating that possibility, they stated that the correlation is most likely of terrestrial origin. Anderson posited that "Least unlikely, perhaps, are currents in the Earth's fluid core that change both its moment of inertia (affecting LOD) and the circumstances in which the Earth-based experiments measure G."

3. Jupiter's half orbital period

Jupiter's orbital period is 4332.589 Earth days[3], or 11.86179 Earth years, and half of that period is 5.930894 years. That half period is well within the uncertainty of the reported period of variation in G. Jupiter's mass is roughly 2.5 times the combined mass of all the other planets[4]. The Sun has only 1047 times the mass of Jupiter. Jupiter and the Sun orbit their barycenter 743,000 km from the Sun's center[5]. Thus, it is not unexpected that Jupiter's orbit could influence length of day as well as measurements of the gravitational constant over the half orbital period.

Anderson stated "Although we recognize that the one-to-one correlation between the fit to the G measurements and the LOD periodicity of 5.9 years could be fortuitous, we think this is unlikely, given the striking agreement shown in Fig. 1." The Jupiter Sun orbital interaction provides a reasonable physical basis for the precise period of varying G/LOD, greatly reducing the likelihood that the correlation is fortuitous. With the additional consideration of the phase of Jupiter's orbit with respect to galactic orientation, the likelihood of chance correlation becomes negligible. Figure 1 below shows a section of the oscillation graph from Fig. 1 of Anderson's paper, with interpolated dates of maximums and minimums annotated. Above the graph are sketches showing the relative orientation of the Sun, Earth, and Jupiter with respect to the galaxy on the dates of G/LOD maximums and minimums. The Milky Way galactic center, which is the location of SgrA*, is precisely to the left of each sketch, and the observed direction of solar system travel is directly toward the top of each sketch. As can be seen in the figure, the maximums of measured G and LOD values coincide with Jupiter located on the axis from the galactic center, and the minimums of measured G and LOD coincide with Jupiter located on a line drawn in the direction of solar system travel.



Positions of Jupiter, Earth, and Sun, and their orientation relative to direction of travel with respect to the Milky Way galaxy on dates of gravitational constant G and length of day maximums and minimums

Figure 1. Correspondence between period and phase of varying G, LOD, and Jupiter's half orbital period

The very close correspondence between the half orbital period of Jupiter and the varying G/LOD period, and the significance of the Jupiter Sun barycenter to solar system dynamics support the theory that the physical basis for the periodic variation described by Anderson is Jupiter's orbit. This shifts the research emphasis from Earth geophysics to astrophysics. That the phase of the G/LOD periodic variation is synchronous with alignment between Jupiter, the Sun, and the Milky Way's center extends the research domain to galactic interaction.

Newtonian gravity does not fully describe the solar system's orbital dynamics, with the precession of Mercury's perihelion being a notable example.[6] General Relativity (GR) was intended to provide a full description of orbital interaction[7], but failed to describe orbital velocities of star systems with respect to spiral galaxies.[8] GR does not describe the orbit of our solar system with respect to the Milky Way galaxy and neither does Newtonian gravitation.[8] Therefore, neither GR nor Newtonian gravitational theory can be relied upon for analysis of the Jupiter Sun orbit and alignment with respect to galactic orientation, regarding effects on the gravitation constant.

The significance of the time variation of G reported by Anderson is acknowledged by I. Debono and G.F. Smoot in their paper 'General Relativity and Cosmology: Unsolved Questions and Future Directions'[9], when they write "A non-constant G would have serious implications both for Newtonian physics and for General Relativity." Expectation that GR could be correct, despite its failure to describe our solar system's relationship to the Milky Way galaxy, was a sharp divergence from the scientific method that is still unsupported. Hypothetical matter that does not couple via the electromagnetic interaction, but couples gravitationally, referred to as "dark matter", which could be distributed in such a way that GR would be correct, has not been detected.[10] The evidence of the rotation velocity of spiral galaxies, including our own galaxy, combined with the periodic variation of G determined by Anderson et al., and the correspondence of that period with half Jupiter's orbital period, and the correspondence of the phase of varying G with the galactic orientation of Jupiter and the Sun, should be sufficient impetus to discard GR as a falsified theory.

Though not yet widely known, research reported in 'Thomas precession is the basis for the structure of matter and space'[11] proved that the quantization of space time as matter, and the interactions of that matter, are described by special relativity. In that research, our solar system's galactic rotation velocity was shown to be a critical component of what were previously considered universal constants such as the fine structure constant, Planck's constant, and elementary particle mass. Thus, that the effect on G/LOD by Jupiter and the Sun is correlated with their orientation relative to the galactic center and direction of motion is consistent with the previously determined results.

The orientation of Jupiter and the Sun with respect to the galactic center has, at the very least, a direct correspondence with gravitational like effects between them and the Milky Way galaxy as a whole. That is to say, the orientation shown in the sketches is not arbitrary when considering gravitational effects, and thus the phase correlation is supported.

Additionally, it was shown in [11] that there is a frame of reference with respect to which the Milky Way's rotation velocity at our solar system's position is 0.866148538 c, where c is the speed of light, so the Lorentz factor is 2.000853708, and the angular precession is greater than rotation. The observed rotation velocity is actually the difference between rotation and precession, with a magnitude of 221677.9249 m/s. This accuracy is far beyond what has been determined observationally; the IAU value is 220000 m/s. The extremely high reported accuracy was achieved based on laboratory experimental measurements of e.g. elementary particle spin angular momentum and mass. The galactic angular precession results in slightly more than 2 rotations in our frame of reference for one rotation in the non-rotating galactic center reference frame. (This is analogous to the 4π symmetry of spinors such as electrons, protons, and neutrons which spin with their velocity varying around $\sqrt{3}/2\ c$.) Thus, a half rotation of the Jupiter Sun system in our frame of reference is close to one full rotation in the non-rotating galactic center frame of reference. That there is an effect with symmetry to a half orbital period therefore is also consistent with the previous results.

Schlamminger et al.[12] contributed additional data and further refined Anderson's gravitational data. They concluded that "A least squares regression to a sinusoid with period 5.9 years still yields a better fit than a straight line. However, our additions and corrections to the G data reported by Anderson et al. significantly weaken the correlation." The Jupiter Sun half orbital period and phase however is a credible physical basis for the periodic variation of G and its correlation with LOD. A recent paper titled 'Intradecadal variations in length of day and their correspondence with geomagnetic jerks'[13] by Pengshuo Duan and Chengli Huang indicates the continued relevance of LOD variation. They state that "The intradecadal variation (i.e., 5–10-year scales) in length of day (LOD) is an interesting topic in fundamental astronomy and geophysics as it may closely correlate with the fast dynamics of the Earth's core and the geomagnetic field changes".

4. Conclusion

GR theory was an ambitious attempt to describe the interaction of matter and space, but it has been falsified. Likewise, Newtonian gravitational theory fails to describe gravitational like effects at galactic scales, and it is also inconsistent with time varying G. Newtonian gravitational theory also had no explanation for the value of G nor the units of G. These failings have been impeding progress. Length contraction, time dilation, and angular precession, as described by special relativity, have been proven to be the basis for the structure of matter and its interactions from the scale of elementary particles to the scale of the Milky Way galaxy.[11] Periodically varying G, and the basis for the variation's period and phase in solar system and galactic interaction, are consistent with the previously reported special relativistic effects.

Further research is required in order to fully describe periodically varying G and LOD, but a theoretical basis is in place. The immediate physical basis has been identified as interaction between Jupiter, the Sun, and Milky Way. The vast amount of astronomical data that has been accumulated should be reevaluated in context of our solar system's time dilated frame of reference with respect to the frame of reference of the non-rotating galactic center. Not only does varying G have implications for astronomy, but also for fundamental physics, geophysics, metrology, and because of its interaction through mass, particle physics.

5. References

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