On the Anomalous Oscillation of Newton's Gravitational Constant

BRENT JARVIS

Periodic oscillations are observed in Newton's gravitational constant $G$ that are contemporaneous with length of day data obtained from the International Earth Rotation and Reference System (IERRS). Preliminary research has determined that the oscillatory period of $G$ is $\approx 5.9$ years ($5.899 \pm 0.062$ years). In this paper, the oscillations are shown to be concomitant with the Earth's distance from the Sun and the angular frequency of its orbit. A novel deep space craft is disclosed and a solution for dark matter is given.

INTRODUCTION

Ground based measurements of Newton's gravitational constant $G$ oscillate between $6.672 \times 10^{-11}$ and $6.675 \times 10^{-11} \text{ N} \cdot (\text{m/kg})^2$ (a difference of $10^{-4}$ %) with a periodicity of $\approx 5.9$ years\cite{1,2}. The variations in $G$ can be predicted from length of day (LOD) data obtained from the International Earth Rotation and Reference System (IERRS)\cite{3}:

Fig. 1: $G$/LOD synchronicity. The solid curve is a CODATA set of $G$ measurements and the length of day (LOD) measurements are represented by the dashed curve.

The mean motion $n$ of a secondary’s orbit is
where $\omega$ is the angular frequency of the orbit, $P$ is the sidereal period, $M$ is the mass of the primary, $m$ is the mass of the secondary, and $a$ is the secondary's semi-major axis. The mean motion $n$ assumes a circular orbit where the secondary's distance from the origin remains constant and equivalent to its semi-major axis $a$. For elliptical orbits, however, the secondary's velocity $v$ and distance $r$ from the primary varies according to Kepler's 2nd law,

$$\frac{dA}{dt} = \lim_{\Delta t \to 0} \frac{\vec{r}(t) \times \vec{r}(t + \Delta t)}{2\Delta t} = \frac{\vec{r}(t) \times \vec{v}(t)}{2}$$

where $A$ is the elliptical area swept by the secondary during its orbit and $t$ is time.

From Newton's version of Kepler's 3rd law we know

$$(3) \quad G(M + m) = rv.$$ 

Combining Kepler's 2nd law with Eq. (3) yields

$$(4) \quad \frac{G(M + m)}{v(t)} = 2 \frac{dA}{dt} = \vec{h},$$

where the constant $h$ is the secondary's specific relative angular momentum. A definition for $G$ can then be deduced from Eqs. (1) through (4) as

$$(5) \quad G = \frac{\omega^2 r^3}{(M + m)} = 2 \frac{dA}{dt} = \frac{\vec{h} \cdot \vec{v}(t)}{(M + m)}.$$ 

From the laws of conservation we know the secondary's total angular momentum $L_T$ is

$$(6) \quad L_T = L_S + L_O,$$

where $L_S$ and $L_O$ are the secondary's spin and orbital angular momentum respectively. Due to spin–orbit coupling, an increase in the Earth's length of day (a decrease in the angular frequency of its spin) must result in an increase in $\omega$ and $v$ in Eq. (5). Since mass is a conserved quantity, the increase of $\omega$ and $v$ results in an increase in $G$, confirming the $G$/LOD synchronicity illustrated in Fig. 1[13,12,11].

An alternative method to confirm if the oscillation of $G$ is concomitant with the angular frequency of the Earth's orbit is to measure the annual variations in $G$ relative to an equation of time graph:
Since it is assumed that the angular frequency of the Earth's orbit varies due to spin–orbit coupling, the miniscule changes in the annual value of $G$ should oscillate proportionately with the red curve graphed in Fig. 2 (assuming the measurements are taken at the Earth's equator). When the red curve is positive, the shadow of a sundial "ticks" faster than a clock showing local mean time (i.e. the Earth is spinning faster when the curve is positive). When the curve is negative, the Earth is spinning slower as it orbits the Sun.

**IMPLICATIONS FOR SPACE EXPLORATION**

Newton’s gravitational force $F_g$ law is

$$F_g = G \frac{Mm}{r^2}. \tag{7}$$

Combining Newton’s force law with the definition of $G$ in Eq. (5) yields

$$F_g = \frac{Mm(\omega_2^2)^3}{(M + m)r^2} = \frac{\mu r}{\omega^2}. \tag{8}$$

where $\mu$ is the reduced mass of the system ($\mu \approx m$ when $M \gg m$). This version of Newton’s force law indicates it is possible to use spin–orbit coupling to produce artificial tidal forces that would diminish the apparent force of gravity. Increasing a body’s spin angular momentum would decrease its orbital angular momentum, decreasing the angular frequency $\omega$ of its orbit. This effect would be greater for contra–rotating systems since the relative angular frequencies of their spins are greater. Since the spin of Venus is retrograde from Sun’s spin and the spin of the other planets, Eq. (8) also indicates its precession rate should be less than predicted from Eq. (7).

According to General Relativity, a rapidly spinning body produces a gravitomagnetic (GM) field$^{4,5,6}$

$$\bar{B}_g = \frac{G}{2c^2} \frac{\dot{L}_g}{r^3} = \frac{\dot{\alpha}}{2mc^2} \frac{\dot{\omega}_g}{r^3}. \tag{9}$$
where $B_g$ is the field measured at the body's equator, $c$ is the velocity of light in a vacuum, $\omega_S$ is the angular frequency of the body's spin and $I$ is its moment of inertia.

From Special Relativity we know

$$mc^2 = E\sqrt{1 - (v/c)^2} = E\gamma,$$

where $E$ is energy and $\gamma$ is the Lorentz factor. A definition for the equatorial GM field can therefore be deduced from Eqs. (5) & (10) as

$$B_g = \frac{\overline{I}\overline{\omega}_S}{2E\gamma \overline{r}^3}$$

The kinetic temperature of a body is

$$\frac{3}{2}kT = E_{K},$$

where $k$ is the Boltzmann constant, $T$ is temperature and $E_K$ is the average kinetic energy. Eqs. (11) & (12) highlight the possibility that $B_g$ is inversely proportional to a body's temperature. Experiments conducted by M. Tajmar & C. de Matos\[7\] show that the GM field of low temperature superconductors are no less than one hundred million trillion times greater than predicted with General Relativity. The fact that superconductors have zero electrical resistance also suggests that the GM field is inversely proportional to a body's resistance. Alternatively, since entropy is the inverse of temperature, $B_g$ would be directly proportional to a body's entropy, lending credence to E. Verlinde's entropic theory of gravity\[8\].

Evidence for the decay rate of radioactive materials being contemporaneous with the Earth's spin has been given by J. H. Jenkins, E. Fischbach, P. A. Sturrock & D. W. Mundy\[9\]. It was shown in a previous paper published by the author\[10\] that the square root of Newton's constant (the Gaussian gravitational constant) is directly proportional to $Z_0\phi_0f$, where $Z_0$ is the charge of an alpha particle ($2e$), $\phi_0$ is the magnetic flux quantum and $f$ is frequency (in units based upon the mass of a helium nucleus). Since the evidence presented in this paper suggests $G$ is dependent upon a body's angular frequency, an alternative method to test this hypothesis (and a hypothetical craft for deep space exploration) is illustrated in Fig. 3:

Fig. 3: Concept for a deep space exploration craft.

If $G$ is dependent upon a body's angular frequency then the half–life of a radioactive material may be reduced by increasing its spin rate\[9, 10\]. For higher thrust applications, alpha emitters would be more efficient than beta emitters since alpha particles are more massive (i.e they would impart more force.
against the dish reflector). Applying a high voltage positive charge to the dish would also increase the thrust since the alpha particles would be repelled by the dish. For higher velocity applications, however, beta and gamma ray emitters would be better since they have less inertia and they could impart their force against the reflector faster than alpha particles.

**IMPLICATIONS FOR DARK MATTER**

Geological evidence\(^{11}\) indicates our Sun oscillates vertically about the plane of our galaxy in 31 ± 1 Myr cycles during its estimated 225–250 Myr revolution. In effect, the Sun's mean motion is much less than the angular frequency of its orbit. It was shown previously in Eqs. (3) & (5) that

\[
G(M + m) = \frac{\omega^2 r^3}{v^2},
\]

so the relative consistency observed in a stellar orbital speeds can be resolved by

\[
v = r\omega.
\]

It is hypothesized that the gravitational lensing effect is caused by the warping of light and gasses near the center of mass (COM) points between interstellar \(n\)-body systems. It may be possible to utilize these "virtual mass" points to increase the efficiency of deep space exploration. This topic will be expanded upon in a subsequent paper.

**REFERENCES**


