"Gravity, Anti-gravity, Libration Points, Relativity and Exposing Light on Dark Matter"

P.A. Murad
Morningstar Applied Physics, LLC[1]

Abstract

Different gravitational laws are examined to include attraction and induced angular momentum. These alternative laws, to include an electromagnetic counterpart and evidence of angular momentum, are wave equations allowing gravitational waves using Newtonian gravitation boundary conditions. Wave equation transient terms are exponentially damped; if otherwise, exponentially growing terms may alter theories leading toward explaining the Big Bang or supernovae. Likewise, the mathematical notion about anti-gravity may offer an explanation about the numerous Trojan Asteroids located at the off-angle Libration points between the Sun and Jupiter. Such asteroids over eons should have congealed to form small planetoids. This did not occur. Additionally, gravitational anomalies may be incorrectly identified with Pulsating Libration Points, as poor analytical clarification. The same can be said about, not including relativity. Evidence from the Pioneer 10 and 11 and MOND implies that gravity does not vanish during very large distances as expected but reaches a constant value. Thus, this substantiation implies that Dark Matter may appear only as an intellectual artifact using mass for providing additional gravitation. Furthermore, a test to validate Dark Matter is described in a straightforward simple experiment. Conclusions are gravitation is not as commonplace as initially assumed.

Keyword: Gravitational law, binary pulsars, dark matter, torsion, spin, angular momentum.

I. Introduction

There are many aspects to consider how to investigate the far-abroad cosmos. You can use a warp drive [1-11] designed to generate thrust, field concepts that influence the environment's electric and/or magnetic field, or you can alter gravitation. Before we can study gravity, the issue is if we fully understand gravity and its implications. This may suggest we normally appreciate gravity to raise different concerns where anomalous behavior may be of interest. If we are honest about gravitational anomalies and the results are real, then it is our obligation to alter the conventional wisdom and incorporate the anomalies to see if a new technological capability is applicable for space travel. Unfortunately, the result of the success of these modified models requires additional evidence as well as investigations.

II. Discussion

This section will discuss some anomalies/phenomenon and details for some gravitational model details.

A. Phenomenon and Anomalous Evidence

Let us describe some unusual evidence that raises anomalous behavior.

A-1. Pioneer Effects

Pioneer spacecraft investigations [12-19] were to examine the existing magnetic field of the solar system where one satellite moved in a specific direction and the other moved directly in the opposite direction. After decades, they reached out past the solar system. Beyond Saturn, the sensor systems that use electricity from a neutronic system were turned off. A week later, both spacecraft could not be located. The *Pioneer anomaly* or *Pioneer effect* was the observed deviation from predicted Newtonian accelerations of the *Pioneer 10* and *Pioneer 11* spacecraft after they passed about 20 astronomical units (3×10^9 km; 2×10^9 mi) on their trajectories out of the Solar System. The apparent anomaly was a matter of much interest for many years but has been explained as an anisotropic radiation pressure caused by the spacecraft's heat loss.

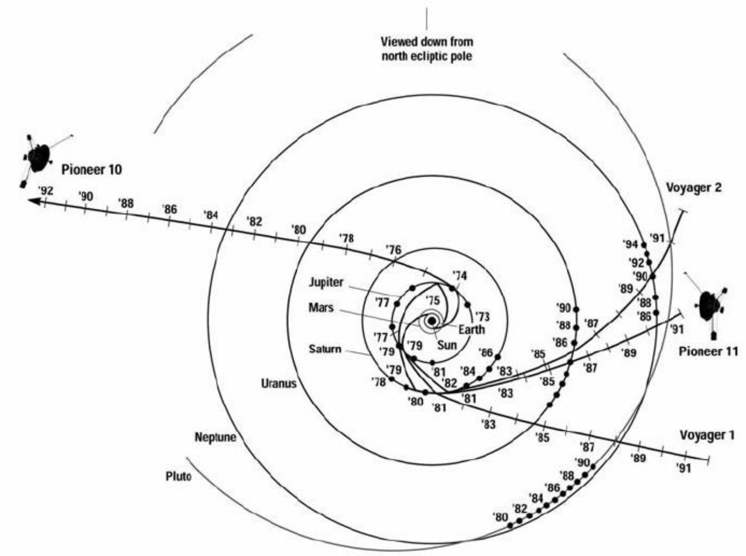


Figure 1. A polar view of the Pioneer 10 and 11 spacecraft trajectories. Pioneer 11 is moving in the direction of the Sun's orbital motion about the galactic center which is located approximately toward the top of the figure.

In 2012, an appropriate model of the recoil force during Pioneer satellites assumed that an anisotropic emission of thermal radiation of the spacecraft was able to accommodate but for only about *80%* of the *unexplained acceleration* plaguing the telemetry of both the Pioneer probes as far as magnitude, temporal behavior, and direction of concern. The use of more detailed information [15] from Pioneer provides the following graph.

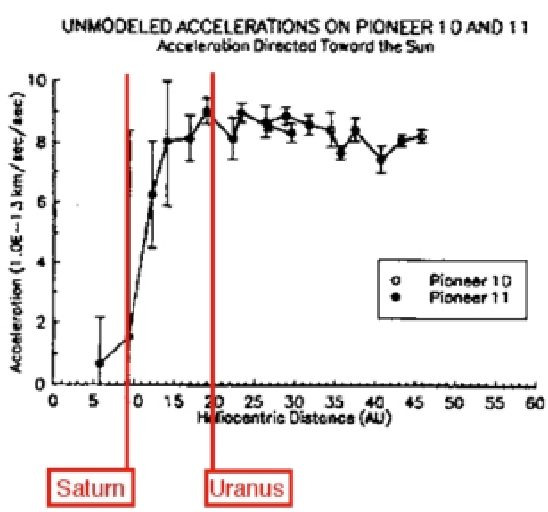


Figure 2. The gravitational change.

The remaining 20% still does represent a statistically significant anomaly in view of uncertainties in the acceleration estimates using Doppler telemetry and thermal models. The Pioneer anomaly may be due to some *exotic* gravitational mechanism external to the spacecraft. This resulted in the form of a constant value and uniform acceleration directed towards the Sun. It turned out the Pioneer anomaly may also provide induced anomalous signatures of other previous probes to Uranus, Neptune, and Pluto. Upon close examination of navigational data, the spacecraft were found to be slowing slightly more than expected. The acceleration is found to be a = $8.74 \pm 1.33 \times 10^{-8}$ cm s^{-2} based on [16-17].

This anomaly would be far too large to consider the initial conditions or strong tensions between the Galactic tide dominant in including observable Oort cloud comets. The action may be a *putative Pioneer anomaly*-like acceleration in those remote peripheries of the Solar system or our understanding of weight and 'local' gravity that may require alternative conclusions. Thus, these anomalies may consider conventional physics possesses a great potential to uncover modifications of our currently accepted picture of natural laws. Nonetheless, before this dream really comes true, it is mandatory that the unexpected patterns are confirmed to an adequate level of statistical significance by further independent analyses, and any possible conventional viable mechanism could be responsible can be reliably excluded.

A-2 The Kuiper Edgeworth Belt is as old as the Solar System and estimated to stretch across 20 astronomical units (AU) of space from roughly the orbit of Neptune at 30 AU out to about 55 astronomical units from the Sun as part of a population of worlds called Trans-Neptunian Objects. The main body of this belt covers from nearly 40 AU to 48 AU. It is thick in most places and probably more torus-shaped than a belt. It was during the formation of our Solar System that most of rocks, dust, and gases were used up to form the Sun and the 8 planets. The remaining rocks, dust, and gases were then swept away into the Sun or the outer reaches of the Solar System. The Kuiper Belt is elliptical in shape. To be precise, it is an elliptical plane. It spans a distance of 4.5 to 7.4 billion kilometers from Sun or 30 to 50 AU. The Kuiper Belt closely resembles the asteroid belt that is known to exist between giant Jupiter and our neighbor, Mars. However, unlike in this asteroid belt, the objects in Kuiper Belt are icier. The busiest part of this belt is located at a distance of 42 to 48 AU. Thus, Pioneer has penetrated this region.

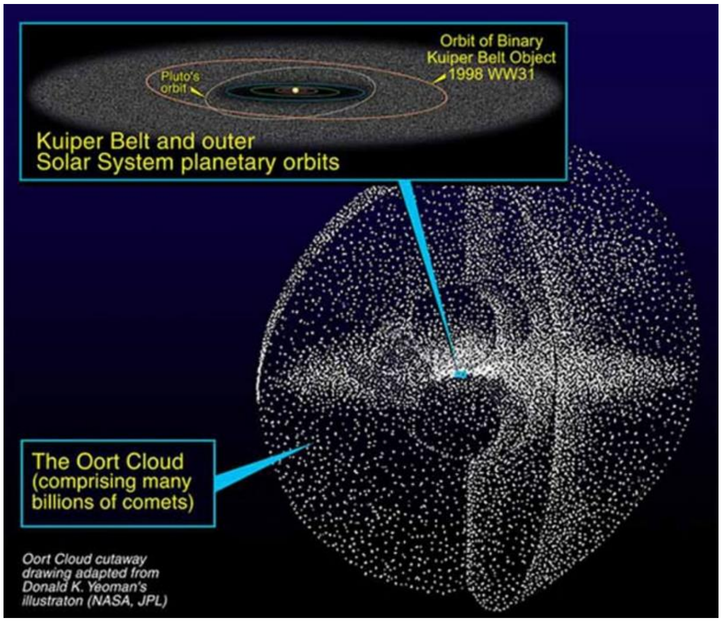


Figure 3. The Kuiper Belt amid the Oort Cloud

What is surprising is that with the Kuiper Belt, no gravitational contribution on Pioneer appears to exist where there should have been some influence as these crafts go closer to and amongst these asteroids. As these crafts approach the Oort cloud, there should have been an Omni-directional attraction with the belt that opposed the anomalous attraction from the sun. Moreover, once inside the belt, the gravitational effects would be homogeneous with an isotopic potential that would minimize any effects of local debris resulting in no additional gravitational attraction. This did not occur. The only rationale is that the belt's meteorite distribution is such that the effects may cancel some of the gravitational attraction, however, there still should be a movement in disparity to an acceleration initially toward the sun upon entry. Furthermore, the asteroids in the belt may be inhomogeneous, which should have also created additional unexpected gravitational attractions.

The other point of concern is that upon entering and exiting from the Kuiper belt, why were the magnetic field sensors and others not used? Would not these spiral magnetic fields from the sun be of concern if the belt really consists of ice or what if there were possible regions with ferromagnetic capabilities? If so, the disk would have created an unusual magnetic field.

A final point is since the Pioneers went through this region, do we have any capability of learning if the spacecraft was structurally damaged upon impact with ice meteorites? Both this and the magnetic fields would have been of extreme value to understand the behavior of the far-abroad. Thus, if the sensors were *reinitiated*, you would have a better definition if the gravitational anomaly exists, characterization of the magnetic field in the Kuiper belt as well as if the spacecraft can survive in such an environment.

A-3. Linear Gravitation

How far can we go to support the view of linear gravitation? Pharis Williams [20] mentioned that T.C. Van Flandern, of the Naval Observatory, has reported a measuring a very small time rate of decrease in the gravitational field where he determined to be approximately 6-parts in 10^{11} per year. This impacts other astronomical constants and provides a value of $b = -1.9 \times 10^{-18}sec^{-1}$ of the equation to be discussed on four-derivative theory to be discussed later.

Jos´e A. de Diegoa et al [21] comes to an acceleration of $a_\lambda = c^2 \sqrt{\lambda} = 9.79 \times 10^{-8}$ cm /s^2, which is comparable to the previous acceleration. They find that for $r \geq 20$ AU, there is a constant acceleration towards the Sun on mentioned objects, which, with the proper amount of mass, accounts for the blue shift detected[2] on the Pioneers space crafts. They also discuss the effect of this gravitational pull on Neptune and comment on the possible origin of such a matter distribution. They also develop a gravitational law that says when r is greater than r_1, gravity becomes nearly a straight line. r_1 could be at 20 AU units where $a_P = -2\pi G \alpha (1 - (r_1/r)^2)$. Where α is based upon the Pioneer trajectories. However, there is a problem when r is at r_1 and gravity goes to zero and the sign change occurs so one would have to shift these values.

A-4. MOND

In physics, **Modified Newtonian Dynamics** (**MOND**) [22-27] is a theory that proposes a modification of Newton's laws for observed properties of galaxies. Israeli physicist Mordehai Milgrom in 1983 developed the theory's original motivation to explain the observed velocities of stars in galaxies that were larger than expected based on Newtonian mechanics. Milgrom noted that this discrepancy could be resolved if the *gravitational force experienced by a star in the outer regions of a galaxy was proportional to the square of its centripetal acceleration (as opposed to the centripetal acceleration itself, as in Newton's second law), or alternatively if gravitational force came to vary inversely with radius (as opposed to the inverse square of the radius, as in Newton's law of gravity).* In MOND[3], violation of Newton's laws occurs at extremely

[2] There is another explanation about the data from this acceleration. The deep-space radio data from the Pioneers as well as the Venus radar data from the sixties could be an explanation if it could not confirm with the consistency of the speed of light.

[3] The author appreciates the contribution from Hal Puthoff.

small accelerations, characteristic of galaxies yet far below anything typically encountered in the Solar System or on Earth.

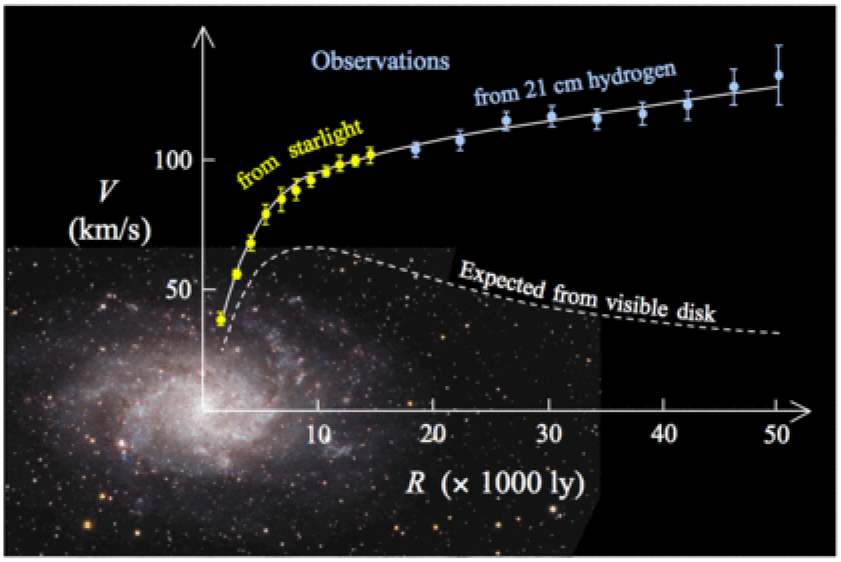


Figure 4. Comparison of the observed and expected rotation curves of the typical spiral galaxy M33

The value in MOND can be due to galaxy distances whereas the Pioneer results are within our solar system. In other words, one might expect the lower value reminiscent of longer distances having the span of a galaxy's radius or that these anomalies as well as Pioneer, may be created by linear acceleration feature.

A-5. Dark Matter [21, 28-34] is claimed that it consists of particles that are neutrally charged electrically, magnetically and are stable. Natural candidates are called WIMPs (Weakly Interacting Massive Particles) for Dark matter particles. The implication is that gravity, in contrast to the Newtonian Gravitational model is a constant value albeit a very small value. This provides a problem. There are spirals in the galaxies as well as far-away stars that do not obey Newton's law. The solution is to create an intellectual artifact called ‘Dark' matter. It is dark because you cannot see it and yet it also does not have electrical or magnetic fields which would be attracted to these bodies. So it exists but yet it does not exist. One could go further to say that dark matter does not consist of physical particles but say, WIMPS, are like gravitons. This would be a weak rationale to satisfy the anomalous gravitational effects.

There is another solution and with MOND that is the use of Newtonian gravitational law for these distances may be flawed. Gravity may be some trivial small value of gravity, like the solar noise, that exists within a galaxy. No speculation could be raised about the void between galaxies because of the lack of data. What should raise some concern is that travel from several spacecraft have gone away from the Earth and none of these have impacted dark matter unless dark matter does not exist within our solar system?

B. Neutron stars, Black Holes, Magnetars and Rotation

When a Red Giant star [35] reaches the end of its existence, it may die with a supernova. This results basically in an implosion where the star's external surface forces the interior to high temperatures and pressure. If the initial mass is greater than 1.4 times the solar mass of our Sun, this may result in a neutron star, if lesser, it will result in a black hole. These two celestial bodies are in contrast to each other. What is of interest is that the neutron star is influenced by its angular momentum where it gains a considerable amount from the initial star. What is surprising is that the implosion creates pressure to produce neutrons and the size of the star is of the order of one to ten kilometers in diameter. This spin, because of the angular momentum will go from 10 to 600 rps compared to the initial star which was at, say one revolution per month. The gravitational attraction of a neutron star is higher than what one would expect for a celestial body. What is further of interest is that the black hole will generally attract a higher gravitation attraction than either a benign celestial body such as a star or even a neutron star. Likewise, black holes are not stationary and also rotate. One could speculate that the rotation rate may have some impact to significantly raise the gravity in a black hole.

Understanding this attraction 'power' is difficult to comprehend. Companions of binary pulsars [35-42] tend to move considerably faster than the planets in our solar system because of this higher gravitation. For the neutron star, there is a higher density due to the close stacking of neutrons which may explain part of the difference, however, for a black hole, any concept would be speculative. It is as if a black hole [43-46] possesses a gravitational venture that acts as such a multiplier. This may be a future issue of investigation.

Every black hole has an accretion disk that is based upon debris tangentially rotating about the black hole as a consequence of centrifugal motion. If no rotation occurred, the black hole would be a gravitational sink swallowing everything with no accretion disk. Thus, all black holes that have accretion disks must rotate. The size of the disk depends upon the black hole's gravitational pull; the smaller the disk, the greater the gravitation. A black hole is a collapsed star where the forces of gravity are so large that even light does not escape. This means that everything that moves at or less than the speed of light will remain within the black hole to include magnetic and electric fields.

If a jet leaves the black hole, it must either move at greater than the speed of light or by some other unknown mechanism. If greater than light speed, then the jets that exist are clear evidence of the naturally occurring hyper-light phenomenon. Thus it would be beneficial to find a black hole that is not rotating with no accretion disk but with a jet.

If, from the black hole itself, the jet consists of a spiral that is moving outward along its ejection axis as well as rotating about this axis. How is this achieved just considering fluid dynamics? Unfortunately, there are no direct means to measure the rotation rate of a black hole or for that matter the jet rotation rate. Such rotation can be approximated only indirectly by examining the surrounding environment.

This is not the case for a neutron star where the beam of radiation would sweep over the Earth for detection due to the lighthouse effect for neutron stars. A Magnetar is a neutron star with an extremely strong magnetic field generated by the convection of hot nuclear matter produced as a consequence of nuclear reactions. Winterberg [46] looks at a laboratory analog of a geodynamo or Magnetar that involves a rapidly rotating liquid metal.

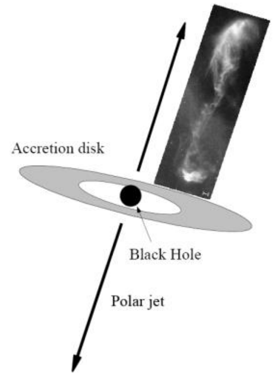


Figure 5. Scheme of a Herbig-Haro object HH47 and the collimated jets of partially ionized gas claimed as belonging to the accretion disk, taken by the Hubble Space Telescope.

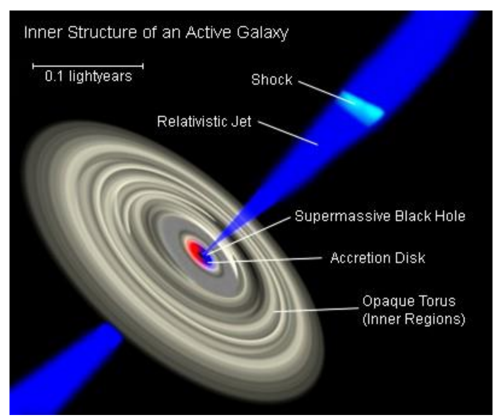


Figure 6. Some details may indicate a gas dynamic shock may appear in the jet as suggested in this artist rendition.

These Magnetars have masses that could be far larger than our sun at larger rates. Jeong [12] implies that the jet from a black hole or a neutron star may be forced outward by a repulsive gravitational source.

It is hypothesized that the spiral motion within the jet can create a repulsive gravitational source based upon an analysis of a Magnetar by Winterberg. Here we can assume the jet swirls at such a rotation rate that results are a repulsive gravitational source.

Based on the above figures, the jet material can move faster than the speed of light if from the black hole. Moreover, a convergence of cloud material could be nothing more than gas dynamic shocks coalescing due to deceleration of the jet matter caused by the original backward gravitational pull of the black hole.

C. *Gravitational Models*

Based upon the questions about the stability, wide scatter, and strength of the Libration Points and some celestial bodies, it would be reasonable to open the door to look at a different gravitational model potentially in contrast to the conventional Newtonian gravity model. There are many types of gravity laws [47]. Several different types of gravity that may be examined.

Foremost of these laws for a 2-body problem is the ***Newtonian gravity law*** that assumes there is an attraction between two separate bodies. It is based on the masses of and the separation distance between these bodies:

$$\bar{g} \approx -G\frac{m}{r^3}\,\bar{r} = -G\,\frac{m}{r^2}\,\hat{r}\,. \tag{1}$$

This is the ground-based standard for the conventional wisdom. Of these, $\boldsymbol{r}$ is the distance as a vector between both bodies and the 'normal' vector $\hat{r}$ is in the radial unit direction anchored with a coordinate system, $\boldsymbol{G}$ is a constant value and $\boldsymbol{m}$ is the mass. This law is broken down mathematically into $\nabla \times \bar{g} = 0.\, and\ \nabla \cdot \bar{g} = -4\pi G\rho_s,$ where ρ_s is a mass source term. This indicates that no rotation is involved. The gravitational law becomes:

$$\vec{g} = -\nabla\phi\ \ and\ \ \nabla^2\phi = 4\pi G\rho_s\ \ where\ \ \vec{g} \approx {}^{1}\!/_{r^2}\,. \tag{2}$$

In this model, gravity asymptotically goes to zero at extremely large distances disappearing at infinity. This tends to limit values where gravity would grow away from, say outside of a source. However, all of this is based only on our knowledge close to the near-aboard within the innermost regions of the solar system.

Newtonian gravitation has been very successful and accurate for describing satellite and celestial bodies in their motion within the surrounding environment. However, this does not involve all situations and other anomalies may be of concern. These anomalies involve rotation as well as the creation of gravitational waves described by Einstein. Mathematically, this is an elliptical partial differential equation and does *not* create characteristics or waves, hence gravity waves. Either gravity waves exist or they do not. This standard is used with all laws that they should satisfy asymptotic boundary conditions such as gravity disappears at infinity.

Pharis Williams [20, 48-49] offers where it is worthwhile to look at alternative gravitational laws:

> *"Kepler's first law states that a planet describes a closed elliptical orbit with the sun at a focal point. However, the presence of such small influences as other planets moving in the suns' field causes a perturbation in the motion of a given planet, and the resulting orbit is not precisely elliptic. Indeed, one may think of the actual orbit as a slightly bumpy ellipse which may precess in the plane of motion; that is, the perihelion shifts about and does not always occur at the same angular position. This provides evidence of gravitational angular momentum. The fact that the idealized classical orbit in a closed ellipse is a result peculiar to the Newtonian inverse-square law; in fact, Newton himself found that, if the force of gravity were proportional to $1/r^{(2+\delta)}$ instead of $1/r^2$, then a planetary orbit would not be closed and a perihelic shift of order δ would occur. Indeed, this result was taken to indicate that, since planetary orbits are very nearly closed, the Newtonian inverse-square law must be very accurate, as, in fact, it is."*

C-1 Four-derivative theories [49] are a conformal gravity as an example from the theory of relativity. This means each term in the wave equation can contain up to 4 derivatives. There are pros and cons to 4-derivative theories. The pros are that the quantized version of the theory is more convergent and renormalizable. The cons are there may be issues with causality. A simpler example of a 4-derivative wave equation is the scalar 4-derivative wave equation:

$$\nabla^4 \phi(r) = 0. \tag{3}$$

For this potential, gravity is similar to other equations satisfying: $\vec{g} = -\nabla\phi(r)$, where the solution is in a central field of force. The first two terms are the same as a normal wave equation. An equivalent solution to the Schwarzschild solution in General Relativity on a spherical source for conformal gravity has a metric with:

$$\begin{aligned} \phi(r) &= 1 - 2\,m/r + ar + br^2 \\ \phi(r) &= g^{oo} = (1-6bc)^{1/2} - \tfrac{2b}{r} + cr + \tfrac{d}{3}\,r^2. \end{aligned} \tag{4}$$

Since this equation is a simpler approximation to conformal gravity, then *m* corresponds to the mass of the central source. The last two terms are unique to 4-derivative wave equations. One may assign small values to them to account for the galactic acceleration constant (also known as dark matter) and the dark energy constant.

There may exist a positive increase in gravity away from a source term, which by our initial assumptions, we should ignore this and the constant term. This shows a difference between models created by General Relativity. The term ***6 bc*** is very small so it can be ignored. The problem is that now ***c*** is the total mass-energy of the source, ***b*** is the integral of density time's distance to the source squared. So this is a completely different potential to General Relativity and not just a small modification. The main issue with conformal gravity theories, as well as any theory with higher derivatives, is the typical presence of instabilities of the quantum version of the theory, although there might be a solution to this problem.

Note that this approaches Newtonian gravitation because of the ***r*** and $\boldsymbol{r^2}$ terms. However, based on establishing different views about results during Pioneer 10 and 11, the existence of such terms may be explained. The issue is if this law should compensate for the degradation in the inverse radius function where the terms tend to approach a *constant value* as implied by the Pioneer trajectory data.

C-2. Winterberg's rule [46] accounts for situations with pulsars and neutron stars. This implies the large rotational rate of these bodies somewhat change the strength of the gravitational attraction. Thus there is a consideration for angular momentum in the body itself as a source term in this law. Winterberg does not prove this rationale but this difference in mass could be attributed to a similar effect to using light to understand dark matter because all forms of celestial bodies usually rotate. His gravitational rule is $\vec{g} = -\nabla\phi(r)$ *and* $\nabla^2\phi = -2\,\omega^2$ *where* $\vec{g} \approx {}^{1}/_{r^2}$. this is:

$$\nabla\cdot\vec{g} = -4\pi G\rho_s = 2\omega^2 \ \textit{where}\ \rho_s = -\frac{\omega^2}{2\pi G}. \tag{5}$$

These values imply that rotation may become a source that would increase gravitation. Because of the square term, rotation going clockwise or counter-clockwise is irrelevant but always increases gravity. Is this reasonable?

Under the gravitational force magnitude interpretation, an object with negative mass would repel ordinary matter as well and could be used to produce an anti-gravity effect. Alternatively, depending on the mechanism assumed to underlie the gravitational force, it may seem reasonable to postulate a material that shields against gravity or otherwise interferes with a gravitational force.

According to Winterberg with Magnetars, the source term $\boldsymbol{\rho_s}$ is negative for a repulsive mass density. If a gyroscope is placed at 45^o on a table and lets it go, the gyroscope falls. However, if the rotor is spinning, it is capable of remaining aligned at this initial angular orientation. As the rotor speed decays, the gyroscope starts to precess rotating in a circumferential direction. When the rotation drops below a certain limit, the gyroscope falls to the tabletop. The conventional wisdom suggests angular momentum couples explain this effect. An alternative solution is that the rotation may induce a repulsive gravitational source that levitates the gyroscope according to this equation. Moreover, one could classify this as an 'Inverse Coriolis effect'. Another way of considering this is that a gravitational field would repulse negative mass. Such a source can be considered as negative matter [50]. One could argue that this phenomenon is also based upon creating anti-gravity.

C-3. Jefimenko gravitational model and Variants

This involves an attractive force between two bodies as well as create an angular momentum. The gravitational law [51-53] is not only a function of the distance between the two bodies but also a consideration for the relativity velocity function between the two bodies. A formulation of the Jefimenko model involves:

$$\bar{g} = -\frac{G}{r^3}\frac{m}{\left(1-{\bar{r}\cdot\bar{v}}/{rc}\right)^3}\left[\left(\bar{r}-\frac{r\bar{v}}{c}\right)\left(1-\frac{v^2}{c^2}\right)+\bar{r}\times\left[\left(\bar{r}-\frac{r\,\bar{v}}{c}\right)\times\ldots\right]\right]\approx$$
$$\bar{g}\approx -G\frac{m}{r^3}\left[\left(1-\frac{v^2}{2c^2}\right)\bar{r}_o-\frac{2rv^2}{3c^3}\bar{v}_o\right]. \qquad (6)$$

Note that the last results involve initial location and velocity. These laws are derived from using a Maxwell-type relationship where gravity is analogous to electricity while co-gravity, K, is comparable to magnetism. The last two laws in Table I are modifications to Jefimenko's laws from the author. The point in the first system of partial differential equations is to obtain symmetry between the gravitational and co-gravitational fields. Whereas Jefimenko considers gravitational currents, an additional law considers that co-gravitational currents should also exist. The same holds for the co-gravity source term yet to be defined. A discipline of interest would be to examine the creation and experimental evidence of any of these currents and sources. Here, force can be represented with: $\bar{F}=m(\bar{g}+\bar{v}\times\bar{K}/c)$.

The author implies in a previous paper [54] that angular momentum could be transferred into linear momentum especially if nonlinear effects are realized[4]; say for example, in Einstein's field equations. Usually, these problems are evaluated using a linearized or a vector version of the gravity tensor. This means that only main diagonal terms exist and off-diagonal terms are ignored. If an off-diagonal element does exist, effects from one conservation equation would stream into another and the same would hold for different space-time continuums.

Obviously, Jefimenko's notions are contrary to Newtonian gravitation, which is considered only as an attractive force. Is there any semblance of proof that this is true? Two moons of Jupiter, Himalia and Elara are probably recently captured asteroids that have not yet had sufficient time in orbit to synchronize their period and rotation[5]. Himalia is the tenth known satellite of Jupiter. As the brightest of Jupiter's outer satellites, Himalia, was captured by Cassini and resolved, for the first time, in a series of narrow-angle

[4] The notion is that rotational effects may create angular momentum as well as attractive forces to influence gravity. If you were to look at a moving body in a rotating coordinate system where the rotational rates are constant, the forces in a Cartesian coordinate system may depend upon rotation or:

$$F_x = m\left(\dot{V}_x + V_z\,\omega_y - V_y\,\omega_z\right)$$
$$F_y = m\left(\dot{V}_y + V_x\,\omega_z - V_z\,\omega_x\right)$$
$$F_z = m\left(\dot{V}_z + V_y\,\omega_x - V_x\,\omega_y\right)$$

Where x, y, z are the coordinate locations and ω represents rotation about each of these axes. Thus, rotation plus velocity can influence the force distributions in a trajectory.

[5] It is appreciated by the contribution by John Cole, formerly at NASA Marshall.

images taken on December 19, 2000. It is likely that Himalia is not spherical; it is believed to be an irregularly shaped asteroid.

Elara is the twelfth known satellite of Jupiter. Very little is known about Elara. Comparing these numbers, as the orbital period increases, the rotational period increases. This may allow seeing the same side of the asteroid from the Jupiter surface per Jefimenko's initial claim that an inhabitant will only see the same side of a major moon from a planet's surface and that gravity induces angular momentum that limits the rotation of the moon.

Table I. Different Gravitational Laws which cover a spectrum of conditions of interest.

Gravity Law	***Assumptions***	***Gravitational Rule***
Newtonian Gravitation	$\nabla \times \bar{g} = 0. \, and \, \nabla \cdot \bar{g} = -4\pi G\rho_s,$	$\vec{g} = -\nabla\phi(r) \;\; and \;\; \nabla^2\phi = 4\pi G\rho_s$ $where \;\; \vec{g} \approx {}^1/_{r^2}\,.$
Four-Derivative theories	$\phi(r) = 1 - 2\,m/r + ar + br^2$ $\phi(r) = g^{oo} = (1-6bc)^{1/2} - \frac{2b}{r} + cr + \frac{d}{3}\,r^2.$	$\vec{g} = -\nabla\phi(r)$
Winterberg's Rule	$\nabla \cdot \vec{g} = -4\pi G\rho_s = 2\omega^2$ $where \; \rho_s = -\frac{\omega^2}{2\pi G}.$	$\vec{g} = -\nabla\phi(r) \; and \;\; \nabla^2\phi = -2\,\omega^2$ $where \;\; \vec{g} \approx {}^1/_{r^2}\,.$
Jefimenko's gravity and co-gravity.	$\nabla \times \bar{g} = -\frac{\partial \bar{K}}{\partial t}; \; \nabla \cdot \bar{g} = -4\pi G\rho_s; \; \nabla \cdot \bar{K} = 0.$ $and \; \nabla \times \bar{K} = -\frac{4\pi G}{c^2}\bar{J}_s + \frac{1}{c^2}\frac{\partial \bar{g}}{\partial t}.$	$\frac{1}{c^2}\frac{\partial^2 \bar{g}}{\partial t^2} - \nabla^2\bar{g} = 4\pi G\left[\nabla \cdot \rho_s + \frac{1}{c^2}\frac{\partial \bar{J}_s}{\partial t} - \frac{\nabla \times \bar{J}_s}{c}\right],$ $\frac{1}{c^2}\frac{\partial^2 \bar{K}}{\partial t^2} - \nabla^2\bar{K} = 4\pi G\left[\frac{\nabla \cdot \rho_s}{c^3}\right],$
Murad's modification of Jefimenko	$\nabla \times \bar{g} = -\frac{\partial \bar{K}}{\partial t} - \frac{4\pi G}{c}\bar{J}_c; \; \nabla \cdot \bar{g} = -4\pi G\rho_s;$ $\nabla \cdot \bar{K} = -\frac{4\pi G}{c^2}\rho_c \; and \; \nabla \times \bar{K} = -\frac{4\pi G}{c^2}\bar{J}_s + \frac{1}{c^2}\frac{\partial \bar{g}}{\partial t}.$	$\frac{1}{c^2}\frac{\partial^2 \bar{g}}{\partial t^2} - \nabla^2\bar{g} = 4\pi G\left[\nabla \cdot \rho_s + \frac{1}{c^2}\frac{\partial \bar{J}_s}{\partial t} - \frac{\nabla \times \bar{J}_c}{c}\right],$ $\frac{1}{c^2}\frac{\partial^2 \bar{K}}{\partial t^2} - \nabla^2\bar{K} = 4\pi G\left[\frac{\nabla \cdot \rho_c}{c} - \frac{1}{c^3}\frac{\partial \bar{J}_c}{\partial t} - \frac{\nabla \times \bar{J}_s}{c^2}\right],$
Murad's gravity law	$\nabla \times \bar{g} = -\frac{1}{c}\frac{\partial \bar{g}}{\partial t} + \frac{4\pi\gamma G}{c}\bar{J}_g.$ $and \; \nabla \cdot \bar{g} = -4\pi\gamma G\rho, \text{ where } \gamma = \frac{1}{\sqrt{1-\frac{u^2}{c^2}}}.$	$\frac{1}{c^2}\frac{\partial^2 \bar{g}}{\partial t^2} - \nabla^2\bar{g} = 4\pi\gamma G\left[\nabla \cdot \rho_s + \frac{1}{c^2}\frac{\partial \bar{J}_g}{\partial t} - \frac{\nabla \times \bar{J}_g}{c}\right]$

Himalia is at a distance of 11,480,000 km from Jupiter's surface and rotates every 0.4 days but requires 250.6 days to complete a revolution around Jupiter. So, an observer on Jupiter would certainly be exposed to all sides of Himalia, and similarly with Elara. Elara is at a distance of 11,737,000 km from Jupiter's surface and rotates every .5 days with an orbital period of 259.6 days. Differences are due to orbital eccentricity for Himalia of .1580 and the orbital eccentricity for Elara of .2072. Most of the asteroids that have been closely observed seem to be rotating. Unless the capture mechanism involved a collision, it is hard to know how the angular momentum would change by the capture process. It is possible that these two moons were rotating before they were captured and maintained that rotation rate while being captured.

After capture, tidal effects, or whatever process that creates synchronization, would slowly reduce the rotation rate by transferring angular momentum to Jupiter. Light can carry angular momentum, so heat from tidal friction could radiate some of the angular momenta into space. In other words, two satellites with almost equal weight but different geometric shapes tend to orbit Jupiter at similar distances and have similar rotation rates that imply Jupiter's gravitation is inducing angular momentum. This is more than coincidental.

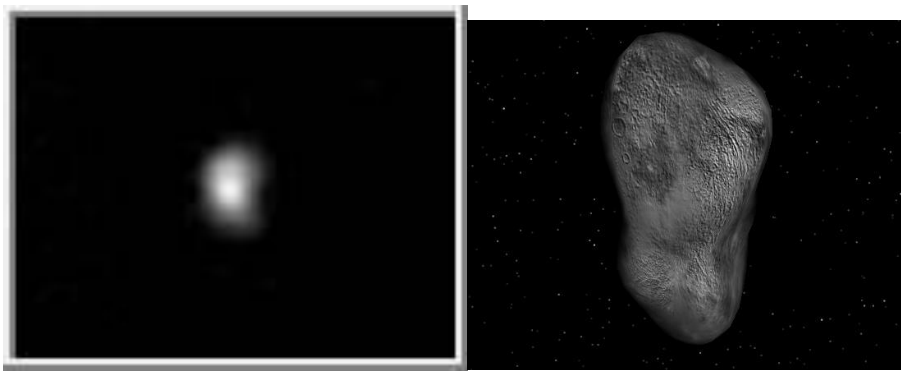


Figure 7. Himalia and Elara, an interesting cosmological coincidence.

C-4. Murad's gravitational model

These models made attempts to create symmetry between gravity and co-gravity. Jefimenko apparently could not eliminate co-gravitation as a need to include the effects of the speed of light motion. The equations below show that indeed this can be defined:

$$\nabla \times \bar{g} = -\frac{1}{c}\frac{\partial \bar{g}}{\partial t} + \frac{4\pi\gamma G}{c}\bar{J}_g.$$
$$and\ \nabla \cdot \bar{g} = -4\pi\gamma G\rho_{,}\ \text{where}\ \gamma = \frac{1}{\sqrt{1-\frac{u^2}{c^2}}}. \quad (7)$$

Again, these quantities involve the need for gravitational currents and sources. However, the final equation to be solved is:

$$\frac{1}{c^2}\frac{\partial^2 \bar{g}}{\partial t^2} - \nabla^2 \bar{g} = 4\pi\gamma G\left[\nabla \cdot \rho_s + \frac{1}{c^2}\frac{\partial \bar{J}_g}{\partial t} - \frac{\nabla \times \bar{J}_g}{c}\right] \quad (8)$$

This equation is rather clean and a simplified formulation that looks promising to eliminate co-gravity.

III. Analysis and Results

A. Gravitational Hyperbolic Partial Differential Equation Model

Einstein's theory of relativity implies that the gravitational model would satisfy wave equations, say such as:

$$\frac{1}{c^2}\frac{\partial^2 \bar{g}}{\partial t^2} - \nabla^2 \bar{g} = 4\pi G\ \nabla \cdot \rho_s \quad (9)$$

We need to discuss this equation. If you look at the separation of variables, the homogeneous equation provides some variables to represent a function of time as well as the radial distance. We also need to recognize these wave equations can have characteristic waves that converge and, it may be possible, to coalesce these waves to create gravitational shocks [55], which, using electric and magnetic fields coupled with boundary conditions, would have implications for a propulsive system.

A-1. Transient Effects

Let us look into the two-body problem modified for separation of variables:

$$\left(\frac{d^2r}{dt^2} - r\left(\frac{d\theta}{dt}\right)^2\right) = -\frac{\mu}{r^2}\,T(t),$$
$$\left(r\frac{d^2\theta}{dt^2} + 2\frac{dr}{dt}\frac{d\theta}{dt}\right) = \frac{1}{r}\frac{d}{dt}\left(r^2\frac{d\theta}{dt}\right) = 0.,\quad h = r^2\left(\frac{d\theta}{dt}\right). \tag{10}$$

Here, there is no additional complexity for the angular momentum but only the transient radial momentum effects. If we attempt to look at gravity on a sphere, this would require solving:

$$\frac{1}{c^2}\frac{\partial^2\bar{g}}{\partial t^2} - \nabla^2\bar{g} = 4\pi G\,\nabla\cdot\rho \quad or \quad \frac{1}{c^2}\frac{\partial^2\bar{g}}{\partial t^2} - \left[\frac{\partial^2\bar{g}}{\partial r^2} + \frac{2}{r}\frac{\partial\bar{g}}{\partial r}\right] = 4\pi G\,\nabla\cdot\rho \tag{11}$$

Let us embed a separation of variables [56-58] solution that includes a specific Newtonian solution:

$$\bar{g} = \tilde{g} + \hat{g},\ where:\ \bar{g}(r,t) = \frac{1}{r}[\bar{R}(r)T(t) + \hat{g}(r)] \tag{12}$$

Then the solution for gravity, for say a gravity self-feeding law, may be required to solve.

$$\hat{g}(r) = \frac{1}{r}\left\{-4\pi G\int_0^r (r-\xi)\rho(\xi)d\xi + \frac{1}{2c^2}\int_0^r (r-\xi)\hat{g}^2(\xi)d\xi + \cdots\right\} \tag{13}$$

The time term from equation 10 and 12 may look like:

$$T(t) = \alpha_1 + \alpha_2 t + \sum_1^n\left(\beta_j \sin c\lambda_j t + \epsilon_j\ \cos c\lambda_j t\right) + \sum_1^n\left(\mu_j \sinh c\lambda_j t + \tau_j \cosh c\lambda_j t\right). \tag{14}$$

Here, λ_j represent eigenvalues, α_o, α_1, β_j, ε_j, μ_j, τ_j are integration constants defined by initial conditions. The issue is how Newtonian gravitation can be correct without considering the time factors. The sinusoidal terms, hyperbolic sine, and cosine terms are never observed. The reason for the latter is that they most likely occur only early during gravitational creation, say during the Big Bang or during a supernova as well as create either a black hole or a neutron star. Moreover, the two functions asymptotically are large values as an exponential function of time and may approach a line that could cancel out the ***t*** term. One formulation may lead to:

$$T(t) = \alpha_1 + \alpha_2 t + \alpha_3\ \cosh(\lambda t)(1 - \tanh(\lambda t)) + \alpha_4\cos(\omega t) + \alpha_5\sin(\omega t). \tag{15}$$

This implies the hyperbolic terms at zero time would have some value suggesting gravity may exist, and then slowly decay. Here this initial value could be canceled out by the α_1 term to compensate for this initial value unless gravity always *existed* before the Big Bang. One may further speculate when the Big Bang occurred, gravity may have expanded exponentially and then simply vanished after energy and mass were all consumed. Obviously, some of these terms may be provided only during the Big Bang[6] or as gravity is initiated. However, these transient terms in this equation also imply several interesting features worth noting which may or may not exist in situations other than the initial conditions. The coefficients of the sinusoidal terms may be larger than those for the hyperbolic sinusoidal terms.

B. Trojan Asteroids- Libration Points and Anti-gravity

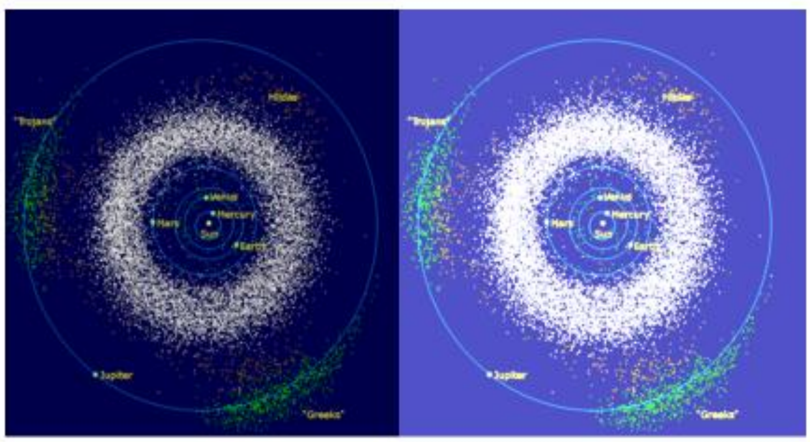
The presence of these transient terms may explain why there is such a large variation in the Trojan

[6] When dealing with these relations, the trend is toward finding an asymptotical solution that gradually reaches some constant value. For the Big Bang, gravity may initially be formed as an exponentially increasing value until sometime, say the force breaking down into electrical, magnetic, nuclear forces. Gravity from its initial form may have decayed considerably over time except in unusual events such as the creation of a supernova.

Asteroids near the triangular Libration Points.

Euler discovered three collinear Libration Points. Historically Lagrange discovered two other points while investigating the Trojan asteroids [59-65]. Based upon the length of the Sun and Jupiter, forming the point of an equilateral triangle. The term "Trojan" originally referred to the "Trojan asteroids" (Jupiter Trojans) named after characters from the Trojan War of Greek mythology. By convention, the asteroids orbiting near the L_4 point of Jupiter are named after the Greek side of the war, whereas those orbiting near the L_5 of Jupiter are from the Trojan side. Jupiter Trojans have orbits at L_4 and L_5 with radii varying a range between 5.05 and 5.35 AU from the Sun (the mean semi-major axis is 5.2 ± 0.15 AU)[7], and orbits are distributed in curved regions around these two Lagrangian points. Each swarm stretches about 26° along the orbit of Jupiter, amounting to a total distance of about 2.5 AU. Jupiter Trojans do not maintain a fixed separation from Jupiter. They slowly vibrate around their respective equilibrium points, periodically moving closer or further from Jupiter. There is also a collection of asteroids near L_3, which is considered an unstable Libration Point. The scatter at this location is as bad as the scatter from the L_4 and L_5 points[8] which are supposedly stable.

Figure 8. The Trojan Asteroids. Estimates of the total number of Jupiter Trojans are based on deep surveys of limited areas of the sky. The false-color picture gives a better description of the Trojan asteroids near Jupiter's orbit as well as the asteroid belt between Mars and Jupiter.



Current Trojan asteroids are believed to hold between 160,000–240,000 asteroids with diameters larger than 2 km and about 600,000 with diameters larger than 1 km. If the L_5 swarm contains a comparable number of objects, there is more than 1 million Jupiter Trojans 1 km in size or larger. The total mass of the Jupiter Trojans is estimated to be low at 0.0001 of the mass of Earth or one-fifth of the mass of the asteroid belt[9]. *One would assume that after eons, these asteroids would congeal and form planetoids. This does not occur implying there may be anti-gravity acting between these asteroids.*

[7] This movement of the asteroids is significant. However, the eccentricity of Jupiter around the sun is 0.0489, which one would incorrectly assume is near circular. Jupiter's orbit distance from the sun is 4.95 to 5.46 AU. This implies the need to account for pulsating Libration points applicable to the analysis with a binary pulsar by the author.

[8] The number of Jupiter Trojans observed in the L_4 swarm is slightly larger than observed in L_5. However, because the brightest Jupiter Trojans show little variation in numbers between the two populations, this disparity is probably due to an observational bias. However, some models indicate the L_4 swarm may be slightly more stable than the L_5 swarm. This cannot be mathematically determined.

[9]. By contrast, the asteroid debris orbit between Mars and Jupiter if all summed up would be the size of the planet Mars. Thus these Trojan asteroids are relatively light and should be strongly influenced by the large celestial bodies.

This motion for studying Libration Points based upon research on binary pulsars by the author is an analysis called a *'Pulsating Libration Point'* [65]. Here, the equations of motion are used in a phase-space representation:

$$\begin{aligned} &Let: u = \dot{x}\ ,\ \dot{u} = \ddot{x}; v = \dot{y}, and\ \dot{v} = \ddot{y}\ , with \\ &\dot{u} - 2\omega v - \omega^2 x = -V_x, \\ &\dot{v} + 2\omega u - \omega^2 y = -V_y. \end{aligned} \tag{16}$$

This is an *x-y* Cartesian coordinate system where ω is rotation rate and V_x and V_y are gravitational terms for the two primary bodies. These equations of motion are rewritten as:

$$\frac{d}{dt}\begin{bmatrix} x \\ y \\ u \\ v \end{bmatrix} + \begin{bmatrix} 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \\ -\omega^2 & 0 & 0 & -2\omega \\ 0 & -\omega^2 & +2\omega & 0 \end{bmatrix}\begin{bmatrix} x \\ y \\ u \\ v \end{bmatrix} = -\begin{bmatrix} 0 \\ 0 \\ V_x \\ V_y \end{bmatrix}, \quad or\ \frac{d}{dt}x + \bar{\bar{A}} \cdot x = F\ . \tag{17}$$

The eigenvalue is important where the three collinear and two triangular points are strongly dependent upon the rotation rate which impacts the centrifugal forces in a cyclic fashion. *Eigenvalues depend primarily upon the rotation rate.* The solution to this problem is:

$$\bar{x}(t) = \bar{x}_o\, e^{\bar{\bar{A}}t} - \int_o^t e^{\bar{\bar{A}}(t-\xi)}(\bar{F}(\xi) - \bar{F}(0))d\xi. \tag{18}$$

However, the solution is modified because of repeating eigenvalues for solving the equation:

$$\bar{x}(t) = \bar{x}_o\, e^{\bar{\bar{A}}t} + \bar{x}_1\, t\, e^{\bar{\bar{A}}t} - \int_o^t e^{\bar{\bar{A}}(t-\xi)}(\bar{F}(\xi) - \bar{F}(0))d\xi. \tag{19}$$

The middle term is problematic. This, in turn, would impact stability. If the rotation is too high for say, a binary star, the debris at the Libration points may break-away from the system. However, the equation satisfies the matrix differential equation if $\boldsymbol{x_1}$ uses eigenvectors[10].

But the problem is incomplete because Jupiter travels with considerable radial motion. The dimensional constant ***l***, the distance between Jupiter and the Sun, is now dependent upon time. These equations are:

$$\begin{aligned} x = \xi l,\ \dot{x} = \dot{\xi} l + \xi \dot{l},\ and\ \ddot{x} = \ddot{\xi} l + 2\dot{\xi} l + \xi \ddot{l}, \\ y = \eta l,\ \dot{y} = \dot{\eta} l + \eta \dot{l},\ and\ \ddot{y} = \ddot{\eta} l + 2\dot{\eta} \dot{l} + \eta \ddot{l}\,. \end{aligned} \tag{20}$$

Substituting these terms into the original set of equations becomes:

$$\begin{aligned} \left(\ddot{\xi} - 2\dot{\eta} - \xi\right) + 2\frac{\dot{l}}{l}\left(\dot{\xi} - \eta\right) + \frac{\ddot{l}}{l}\xi = -V_\xi\ , \\ \left(\ddot{\eta} + 2\dot{\xi} - \eta\right) + 2\frac{\dot{l}}{l}\left(\dot{\eta} + \xi\right) + \frac{\ddot{l}}{l}\eta = -V_\eta\ . \end{aligned} \tag{21}$$

One may ask the value of the derivatives of ***l***. Let us treat with a binary pulsar where both bodies have the same mass. These values are:

$$l = \frac{2\,\tilde{p}}{(1-\varepsilon^2 cos^2\theta)},\ \text{with derivatives: } \frac{\dot{l}}{l} = -\frac{\boldsymbol{2\varepsilon^2\, cos\,\theta\, sin\,\theta}}{\boldsymbol{(1-\varepsilon^2 cos^2\theta)}}\ ;\ \frac{\ddot{l}}{l} = \frac{\boldsymbol{4\,\varepsilon^2\, \dot{l}(sin^2\dot{\theta} - cos^2\theta)}}{\boldsymbol{l\,(1-\varepsilon^2 cos^2\theta)}}\,. \tag{22}$$

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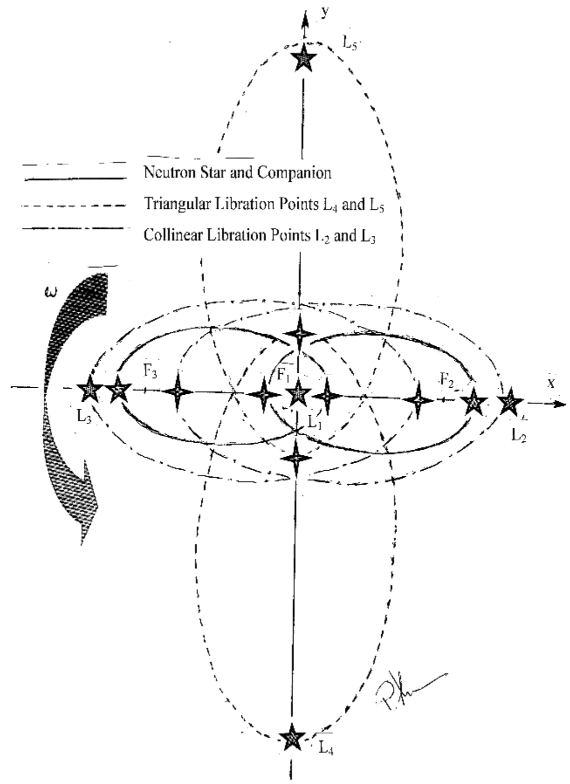
[10] Eigenvectors are: $v_1 = \left(-\frac{1}{\omega}, -\frac{i}{\omega}, -i, 1\right)^{-1}$ $and\ v_2 = \left(-\frac{1}{\omega}, +\frac{i}{\omega}, +i, 1\right)^{-1}$ Basically they should have: $\bar{x}_1\, t\, e^{\bar{\bar{A}}t} = 0.$ with a vector operating on a matrix to satisfy the equality. This satisfies initial conditions as well.

Obviously, if the orbits are circular, ε is zero, these terms vanish and $\boldsymbol{l}$ is constant. The sign also changes at various locations as well. These values can significantly destroy stable locations due to either high rotational rates or considerable eccentricity values[11].

Let us treat the problem with derived eigenvalues[12]. These additional terms due to pulsation may incorrectly appear as a gravitational anomaly.

Figure 9. A representation for binary stars showing the trajectories starting at initial conditions (five-pointed stars) moving to the 180 degrees Position (four-pointed stars) relative to the primaries at $\boldsymbol{F_2}$ and $\boldsymbol{F_3}$. Despite the significant trajectory motion, there is no motion at $\boldsymbol{L_1}$ or the barycenter at $\boldsymbol{F_1}$. With this amount of oscillation, or $\boldsymbol{l}$ is a function of time, four of the Libration Points will escape from this universe.



This is an interesting point [66]. For example, many planets and binary pulsars such as 1913+16 [19] have unusual rotation about the primary orbits. This may be due to an increase as a function of time. Here the latter example indicates the unusual trajectory motion is caused by the loss of energy in the neutron star generating gravitational waves. Note also these time functions may explain the scatter of the asteroids at the triangular Libration Points. Motion is dominated by initial energy levels to define specific trajectories of the asteroids.

The issue is how to relate time to spatial coordinates and especially angular changes. This is something which will not happen in the current time period[13]. Furthermore, transient terms suggest asteroids or other

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[11] For this analysis, stable points for binary pulsars indicate stability at L_1, the barycenter. This would include PSR B1257+12, PSR B1620-26, and J0337+1715 which appear to be three planets, one of which is not much heavier than the Moon. These are large bodies and should satisfy the results previously discussed. If this third object is collinear with the primaries, this would become an experimental validation for this rationale about *Murad* stars. Obviously finding clear experimental proof is a worthwhile continuing activity to gain further insights into these possibilities.

[12] The pulsating solution to these equations using *WOLFRAM Alpha* suggests eigenvalues are transient with $\boldsymbol{l}$:

$$\lambda_1 = -\sqrt{\frac{\dot{l}^2}{l^2} - \frac{\ddot{l}}{l}} + \frac{\dot{l}}{l} - i\omega, \lambda_2 = +\sqrt{\frac{\dot{l}^2}{l^2} - \frac{\ddot{l}}{l}} + \frac{\dot{l}}{l} - i\omega, \lambda_3 = -\sqrt{\frac{\dot{l}^2}{l^2} - \frac{\ddot{l}}{l}} + \frac{\dot{l}}{l} + i\omega, \lambda_4 = +\sqrt{\frac{\dot{l}^2}{l^2} - \frac{\ddot{l}}{l}} + \frac{\dot{l}}{l} + i\omega.$$

If $\boldsymbol{l}$ is a constant, these eigenvalues are similar to the previous results and the trajectories are sinusoidal. If $\boldsymbol{l}$ is a function of time, the results are exponentially increasing or dampening as a function of time. These trajectories will become unstable and leave the system.

[13] The only point is a comment made by Kozyrev who said *the sun is not a thermonuclear fusion device because it should possess a higher surface temperature.* When asked, what then is a star? His response was: *a star is a*

bodies near a Libration Point will be like a pot of boiling water always changing and altering energy. This effect may incorrectly be considered as a gravitational anomaly.

C. Relativistic Effects

Anomalous perihelion precession of Mercury of 42.98 "cy^{-1} (a change of its orbit by 42.98 arc seconds in a century) since it is nowadays fully included in the state-of-the-art models of all of the modern ephemerides. Instead, if real, it would be due to some unmodeled dynamical effects which, in principle, could potentially signal a breakthrough with the currently accepted laws of gravitation. The relativistic dynamical models for the modern ephemerides, for example, Mercury, are not complete, not to say of the other major bodies of the Solar system, which causes the Lense-Thirring effect. This effect would be comparable to the action of a hypothetical ring of undetected moonlets in its neighborhood as a possible solution using conventional gravitational physics regarding the gravitational anomalies of Uranus.

C-1. Relativistic Mechanics

Relativistic effects [67-72] can vary the sense of time dilation and changes in length. Such changes depend upon the velocity. Let our probe move at a stationary orbit about the Earth. The probe's trajectory can be given for a geodesic [73] in:

$$\frac{d^2x^\alpha}{d\tau^2}+\Gamma^\alpha_{\beta\gamma}\frac{dx^\beta}{d\tau}\frac{dx^\gamma}{d\tau}=0. \quad \text{And:} \quad \frac{d^2u}{d\theta^2}+u=\frac{GM}{h^2}+3\frac{GM}{c^2}u^2=\alpha-\beta u^2. \tag{23}$$

where τ is the proper time, x is a linear measure, and $u=1/x$. Note the value of β is basically from the Theory of Relativity and is small which is why this effect is not usually considered regarding short-term celestial mechanics. However, do we fully understand the impact of this value with respect to a given trajectory? For example, an additional term at the RHS can be considered as an anomalous gravity? Let us consider this point.

C-2. Solution Rationale

Using relativity, the integral solution equation for the above ordinary differential equation is:

$$u(\theta)=C_1\cos(\theta-\theta_o)+\alpha K(\theta,\theta)-\beta\int_o^\alpha K(\theta,\xi)u^2(\xi)d\xi=\zeta(\theta,\theta)-\beta\int_o^\alpha K(\theta,\xi)u^2(\xi)d\xi. \tag{24}$$

This is an inhomogeneous Fredholm equation or a Volterra integral equation. Because of the squared term for the independent variable and the coupling between these terms, this is nonlinear. The first term is a previously determined orbit trajectory solution without relativity. Here, we are assuming this tends to minimize the coupling impact with the integral equation.

Normally in using an iterative process, this means if it exists for generating a series, the absolute magnitude of the kernel is basically less than the value of unity and with numerous K^n terms, this becomes insignificant. There are some interesting points for consideration for this mathematical solution[14].The solution to this problem is found:

$$u(x)=f(x)+\lambda\int K(x,s)u^2(s)ds \text{ is } u(x)=\frac{\lambda\int K(x,s)f(s)ds}{1+2\lambda\int K(x,s)f(s)ds}. \tag{25}$$

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machine that converts the space-time continuum into energy! Mass converting into energy, but how can we relate time to either angular momentum, energy or for that matter, mass? This is beyond the realm of our technology.

[14]. For example, the basic solution to the linear integral equation looks like:

$$u(x)=f(x)+\lambda\int K(x,s)u(s)ds \text{ is } u(x)=\frac{\lambda\int K(x,s)f(s)ds}{1-\lambda\int K(x,s)f(s)ds}.$$

Additional solutions[15] can be extended by this methodology. The question of interest is that the nonlinear term due to relativity could be incorporated possibly as a gravitational anomaly converging to include Pioneer data.

D. An Electromagnetic and a Torsion Model

If the electric and magnetic fields were wave equations, the Poynting field should also be a wave equation because of the intimate relationship between these two fields. A Poynting law by using Maxwell's equations, can derive a Poynting Conservation Law in reference [74-75]. This law is a wave equation that includes the influence of a spin factor with the term that is the curl of the curl term:

$$\begin{aligned}\mu_o\left[\frac{1}{c^2}\frac{\partial^2\bar{S}}{\partial t^2}-\nabla^2\bar{S}\right] &= \mu_o\nabla\times\nabla\times\bar{S}-2\,\nabla\times\bar{B}\times\nabla\times\bar{E}\\ &-4\pi\left[-\frac{1}{c}\frac{\partial}{\partial t}(\rho_e\cdot\bar{E}+\rho_m\cdot\bar{B})+\frac{1}{c}\frac{\partial}{\partial t}(\bar{J}_e\times\bar{B}+\bar{E}\times\bar{J}_m)-\nabla(\bar{J}_e\cdot\bar{E}+\bar{J}_m\cdot\bar{B})\right]\end{aligned}\tag{26}$$

The capital words represent vectors. The Poynting field is *S*, the electric field is *E*, *B* is the magnetic field, *J* values represent currents and ρ are the source terms. The subscripts *e* stand for electric field and *m* is the magnetic field. The use of magnetic current is based on the flow of electrons in the Van Allen belts where the movement is due to the strength of the Earth's magnetic field which is far larger than the electric field. During this process, a Cauchy-Riemann like process demonstrated that a second field exists. This field could be an unknown torsion field or represent a localized gravitational field. The equation is:

$$\begin{aligned}\frac{1}{c^2}\frac{\partial^2\bar{V}}{\partial t^2}-\nabla^2\bar{V} &= \nabla\times\nabla\times\bar{V}+\frac{4\pi}{c}\frac{\partial}{\partial t}(\bar{J}_e\cdot\bar{E}+\bar{J}_m\cdot\bar{B})\\ &-4\pi\nabla\cdot[(\bar{J}_e\times\bar{B}+\bar{E}\times\bar{J}_m)-(\rho_e\cdot\bar{E}+\rho_m\cdot\bar{B})]-\frac{2}{c}\frac{\partial}{\partial t}\int_o^r(\nabla\times\bar{B}\times\nabla\times\bar{E})\cdot d\bar{r}\,.\end{aligned}\tag{27}$$

Note that this term also involves spin and that these terms also depend upon electric and magnetic sources and currents. Are these curl terms and rotation valid?

There is a theoretical consideration as well about spin or rotation. In 1913, Dr. Eli Cartan was the first to clearly demonstrate that the "fabric" (flow) of space and time in Einstein's general theory of relativity not only "curved", but it also possessed a spinning or spiraling movement within itself known as "torsion." Moreover, it is generally accepted that the space surrounding the Earth and perhaps the entire Galaxy has "right-handed spin," meaning that energy will be influenced to spin clockwise as it travels through the physical vacuum.

Kozyrev [76-88], a Russian astrophysicist, theorized about his "direct knowledge" that spiraling energy was the true nature and manifestation of "time", more than just a simple function for counting duration. Kozyrev urges time as something tangible and identifiable in the Universe as ultimately nothing but pure spiraling movement similar to the orbital patterns of celestial bodies. From his illuminated observations in the prison camp, Kozyrev considered lifeforms might draw off of an unseen, spiraling source of energy. Terms such as "torsion fields" and/or "torsion waves" where torsion means spinning or twisting, would describe the spiraling flow of "time energy" that Kozyrev discovered. "Torsion waves" continually reminds us of their spiraling nature.

Research of Shipov, Terletskiy, and other Russian theorists have directly associated the energy of torsion fields with the energy of gravity, thus leading to the term "gravispin energy" and the science of "gravispinorics." In these new theories, gravity and spin are coupled similarly as electrostatics and

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[15] This can be extended most likely as follows:

$$u(x)=f(x)+\lambda\int K(x,s)u^n(s)ds \text{ is } u(x)=\frac{\lambda\int K(x,s)f(s)ds}{1+(-1)^n n\lambda\int K(x,s)f(s)ds}.$$

magnetism join to form the electromagnetic wave. Torsion waves can travel in any direction absorbed into the downward flow of a gravitational field. Thus, the pressure of torsion waves would be a slight spiraling movement that is joined by gravity.

Kozyrev [88] concluded this was caused by a "Coriolis-like effect," where an object will show a rotational movement as it is dropped towards the surface of the Earth due to the subtle spiraling pressure of torsion imparted to the flow of aether (gravity) as it rushes into the earth.

The only explanation for this effect is that both objects are drawing energy into themselves from an unseen source, and a rotating ball is thus "soaking up" more of this energy than its counterpart – energy that would normally exist as gravity, moving down into the earth. With the addition of torsion-field research, we can see that a spinning ball was able to harness naturally spiraling torsion waves in its environment, which gave it an additional supply of energy. Jefimenko examined similar effects.

E. A Consolidating Model

The approach is to create a new gravitational model [32] that resembles:

$$\frac{1}{c^2}\frac{\partial^2 \bar{g}}{\partial t^2} - \nabla^2 \bar{g} - \nabla \times \nabla \times \bar{g} = 4\pi\gamma G\left[\nabla \cdot \rho_s + \frac{1}{c^2}\frac{\partial \bar{J}_g}{\partial t} - \frac{\nabla \times \bar{J}_g}{c}\right] \tag{28}$$

This is not Einsteinian because of the addition of gravitational vorticity that accounts for rotation. Considering the influence of rotation, there may be an avenue for considering this effect. As mentioned, one could use Jefimenko, Winterberg, or Kozyrev. This approach could be to include rotation within a Lagrangian and incorporate this into Einstein's field equation. There could be a constant or a different sign for the curl term. Interesting, this could increase gravitation that the need for dark matter disappears.

Part of the solution would include, in terms of a perturbation variable as:

$$\bar{g} = \tilde{g} + \nabla \cdot \left[\frac{1}{r} + \alpha r\right]\hat{r} \text{ where: } \frac{1}{c^2}\frac{\partial^2 \tilde{g}}{\partial t^2} - \nabla^2 \tilde{g} - \nabla \times \nabla \times \tilde{g} = 4\pi\gamma G\left[\nabla \cdot \rho_s + \frac{1}{c^2}\frac{\partial \bar{J}_g}{\partial t} - \frac{\nabla \times \bar{J}_g}{c}\right] \tag{29}$$

Here, α is close to $8.74 \pm 1.33 \times 10^{-8}$ cm s^{-2} from Pioneer and the perturbative vector satisfies additional terms that may involve electromagnetic variables.

F. An Experimental Test

As previously mentioned, there is a constant gravitational acceleration after a given distance from the sun. To disprove that the acceleration does not exist, use a spacecraft with a thrust for an acceleration that compensates for this value resulting in a spacecraft that will move at a constant velocity. If this is the case, the implication is that the gravity model is flawed and there may be no need for dark matter.

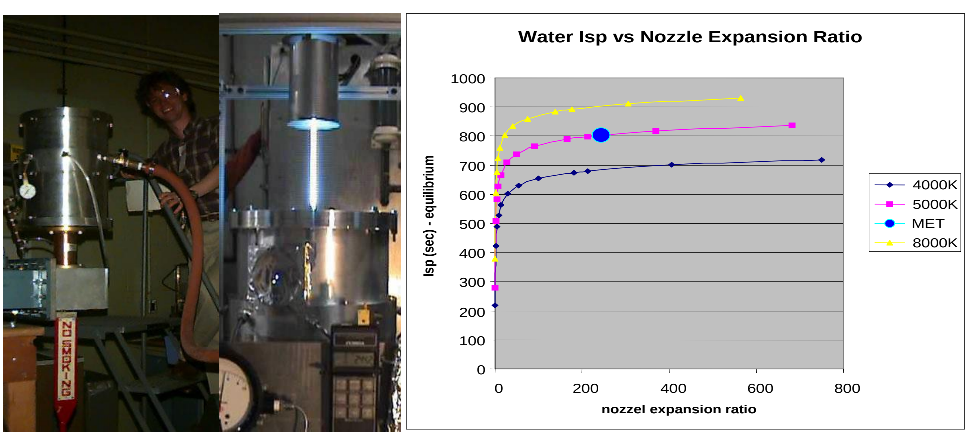

Figure 10. Brandenburg's MICROWAVE Electro-thermal (MET) Thruster may be a candidate.

III Concluding Thoughts

The existence of some gravitational anomalies may be issued because of incomplete definition for a methodology. One may ignore relativistic motion with the possibility that additional gravity may appear. This is also true about looking into Libration points where dimensionality may provide false conclusions. However, there is evidence that indicates gravity at large distances does not literally vanish but may reach a constant value to suggest there is *no* need for dark matter. Likewise, the evidence, for example with two moons of Jupiter, appears to be an angular momentum contribution with gravity. This may point to a new equation which incorporates spinning effects as a gravitational law. Furthermore, some possibility was identified to examine electromagnetic effects that may create local gravitational fields.

There is another point about gravitational law wave partial differential equations. Mathematically, characteristics can converge similar to fluid dynamics where gravity waves could coalesce into gravitational shocks. If controlled by mass, electric and magnetic fields and sources. Such shocks could be used for propulsion aspects.

There are several additional issues regarding mechanisms or physical phenomenon that have propulsion implications. Three separate issues can include:

- Conversion of angular momentum into linear momentum,
- The possibility of spinning Black Hole jets creating repulsive gravitation, and
- Dynamics for the formation of pulsars.

All of these phenomena can have propulsion implications as well as, in some cases, they may stretch the conventional wisdom requiring a different perspective and understanding. Electromagnetic effects are interesting contributions to this problem. Clearly, gravity still requires a different understanding if we intend to go to the far-abroad region of the cosmos.

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