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Gravitational Shocks, Shock Waves, and Exotic Space Propulsion

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Abstract

Several different gravitational laws can be derived that fall within a spectrum that covers an extreme from elliptical partial differential equations for Newtonian gravitation to hyperbolic or wave equations demonstrated by other laws from Jefimenko to Einstein's relativity. If each of these equations is valid for specific conditions at a considerable distance from space, then there is an interesting counterpoint with similar physical mathematical behavior that may be analogous between gravity and say, fluid dynamics. Here, Newtonian gravitation appears mathematically similar to subsonic flow while the other laws mathematically are comparable to supersonic flow. This evaluation advocates identifying experiments that may observe creating an inhomogeneous gravitational field that mathematically result in producing gravitational shocks or waves embedded in regions with merging different distinct strength gravitational fields. If such shocks are feasible, exploiting these gravitational shocks in a propulsion system would create thrust to possibly shadow or repel gravitation. Variations in energy to generate mass may create these distinct and separate gravitational fields for these gravitational shocks. Such an investigation is warranted for mankind to exploit developing this embryonic technology that potentially may develop an exotic space propulsor capable of moving faster than light (FTL).

Keywords: Gravitational waves; Gravitational laws; Elliptical/hyperbolic equations; Fluid dynamics

Nomenclature

B=magnetic field

c=the speed of light

E=electric field

e=electric charge

F=thrust or force

G=gravitational constant

g=gravity field

J=current

m=mass

t=time

W=weight

V=velocity or volume

u, v, w=velocity in the x, y, z directions

x, y, z=coordinate directions

Symbols

φ, Φ=potential

ρ=density

ω=rotation rate

Subscripts

e=electric

m=magnetic

Introduction

This paper will discuss some different principles that offer insights as well as discover possible views that may exist but are yet to be established. One may view this as fantasy but clearly we do not fully understand gravitational models especially at considerable distances beyond our current grasp because of too many uncertainties. For example, consider Dark Matter that may be altered by imploring a different gravitational law other than Newtonian gravitation. If these approaches are relevant, they may possibly allow for the development of a warp drive engine. The desire to traverse across the cosmos is unfortunately only a dream rather than a concrete reality.

Current realities using conventional propulsion technologies to cover such vast distances are basically impractical. What are some of the requirements to develop a warp drive? Clearly conventional rocketry where mass is judiciously expelled using either chemical or nuclear energy to generate long-term high-speed thrust is insufficient to meet the need to go to the far- beyond. There may not be an ample amount of mass to reach these high enough speeds to reach near faster than light, to economically reach a long distance necessary to exploit some cargo or information, and then return. Thus mankind would be constrained on this beautiful blue marble rock forever to only explore in the near-field solar system without outwardly discovering ventures that would create untold intellectual growth beyond our own imagination.

Are there realistic propulsion technologies to potentially achieve these incredible distances within a feasible time period? The Alcubierre drive, the Krasnikov tunnel [1,2] and other means offer some interesting and tantalizing possibilities. This also includes some work by Recami [3] and his associates investigating a simulation of using quantum tunneling by experiments with classical evanescent waves, which they claim were predicted to be Superluminal on the basis of

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extended relativity. Recami [4] defines a waveguide with a segment of a 'photonic barrier' in an undersized waveguide (evanescence region). These computer simulations are based on Maxwell equations only. In other words, they claim verifying the actual possibility of superluminal group velocities, without violating the so-called (naïve) Einstein causality. Moreover, the phenomenon of a one-dimensional non-resonant use of tunneling is analyzed through two or more successive (opaque) potential barriers, separated by intermediate free regions exploiting solutions to the Schroedinger equation [5].

The problem, despite all of these possibilities, is that most of these approaches are purely theoretical constraints with only some limited or none-existent experiments. To examine physical phenomena, these events may still *not* offer a realistic approach to move from one point to another amongst the heavens. Clearly limiting technologies let alone defining suitable experiments could definitely be the problem. Obviously mankind has not performed enough research to look at specific experimental problems for some understanding to meet these possibilities.

Two specific issues are also of concern. That is to reach beyond space either moving faster than the speed of light or to travel back and forward into time. Is this a technology transition as simple as changing a switch or does this require developing a separate apparatus with disjointed separate devices to perform these unique functions? Gertsenshtein attempted to answer these questions to look at induced singularities in the metric equations for Einstein's field equations [6-12].

The author mentioned in a technical paper about the possibility of living in a world that includes an additional dimension. We normally think of new dimensions in our mind only as a linear extension as an additional spatial extension of a coordinate system [13]. Here, we coincide and converge in a multi-verse with both linear time and exponential time simultaneously; linear time for the present while the exponential time is used for quickly reaching out into either the past or the future.

Then, there is time reversal and what do we do about it? We could believe that to prevent a chaotic universe, there must be a cause and an effect where the growth of entropy provides the 'arrow of time' to move forward. How can you use this realistically in a meaningful space-time metric with acceptable technology?

The actual physical mechanizations for these theoretical hypotheses to create these effects, however, are lacking. How can you induce a singularity in the space-time continuum? If we are talking about gravitational effects, is the problem simple enough to use several different weight scales? No. This is a trivial response and the problem is far more complex. The best we could do is to discover some 'new' possible physical phenomenon.

The issue clearly lies within the framework that we need to look at these problems but also to explore a different set of scientific instruments with specific sensitivities to support such investigations. For example, one may ask fifty years ago why a satellite would have any value incorporating an infrared or ultra violet sensor when you can easily examine the earth using only visual cameras. Why would you need or obtain more information than you already receive from visual sensors?

The differences obviously reveal details of different worlds that are totally unexpected that include information from a host of coupled sensors. This provides a better understanding of the Earth. In other words, one type of sensor may have shortcomings with a particular database whereas another sensor operating within a different spectrum may complement an initial sensor to further exploit data or cancel the initial sensor's vulnerabilities.

Such new types of sensors [14,15] will be unusual regarding finding gravitational waves per Baker. They will need to identify specific characteristics that clearly as of yet, are totally unknown. A new stage of investigations to just identify these instruments is required as a separate effort.

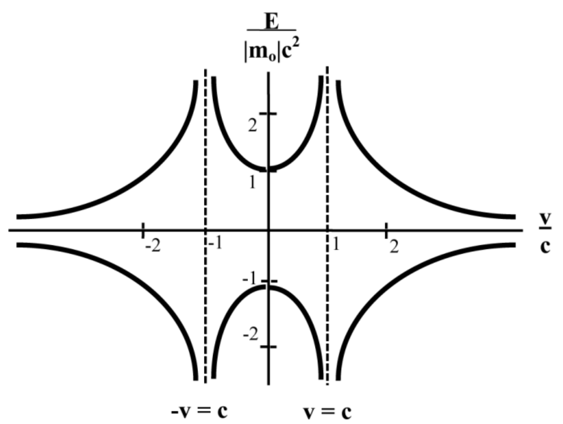
What is needed for instrumentation to go faster than the speed of light as well as go either forward or backward in time? What is a device that can calibrate such a 'solar' calendar to identify the past? The only way would be to locate the orientation of the Earth triangulated with a navigational relationship to the sun and adjacent reference stars from say, using pulsar timing, to note the location for a specific timeline in the past, present and future.

How do you use the technology, instrumentation or implementation in such a spacecraft? These are all very sophisticated questions that need examination for the future. The problem for moving faster than light is different in that you could measure different energy levels. However these energy levels would not give you unique values unless you have specific knowledge that the target was either slower or faster than the speed of light. This result concerning energy is nonlinear and self-defeating demonstrated in Figure 1 from Meholic [16]. This shows symmetry revealing several different energy levels that are the same value at different velocities. Another interesting idea would be to develop a space-time curvature sensor but this too has limitations. Obviously the point is to realistically look at gravitation and space travel with a body of instrumentation that currently exceeds our technological depth.

Clearly the problem is that before we can talk about near light speed, instrumentation technology must be developed. This is addressed only with the concept of examining gravitational problems, which is the focus of this effort.

Discussion

We need some basic ground-rules similar to ideas with Recami



$$\frac{E}{|m_o|c^2} = \frac{1}{\pm\sqrt{1-\left(\frac{v}{c}\right)^2}}$$

Figure 1: Normally the axis is used only above energy value but in reality, a possibility is also negative.

to treat with this problem regarding assumptions, and premises [17]. There are basic natural postulates with some caveats such as:

- The laws of electromagnetism and mechanics are valid not only for a particular observer but for the whole class of the "inertial" observers.
- Space and time are homogeneous and space is considered as isotropic. The exception is that the propulsion system can induce anisotropic or non-homogeneous effects to produce thrust.
- The total energy of an ordinary particle increases when its speed **v** increases except as shown by Figure 1. Energy tends to infinity when **v** tends to **c**. Thus, infinite forces occur for a particle or spacecraft to reach the speed **c**. This generates the popular opinion that speed **c** can be neither achieved nor overcome. However, as speed **c** photons exist which are born, live, and die always at the speed of light (without any need for accelerating from rest to light speed), so we will assume that objects can exist that are endowed with speeds **v** possibly larger than **c**.
- Let us add that, still starting from the above Postulates, the theory of relativity can be generalized to accommodate also Superluminal objects; such a non-restricted version of SR is sometimes called "extended relativity". (Murad [18] actually performs an analysis that extends the SR viewpoint where a particle can go faster than light without terms that are imaginary).

One real approach other than chemical energy for space travel is to raise questions about either generating a small amount of thrust such as an ion engine or using a Woodward Machian drive for an infinite amount of time. The other option is to look into generating fields that interact inherent to space. If we agree with Dirac's approach where particles are instantaneously created and annihilated continually, we would need to capture the fields of these particles when they achieve electric, magnetic, and gravitic fields that are also first created and then, somehow undergo the decaying portion of the particle's cycle of life and death. This demands understanding the frequency switching level of the ZPF, which may be a far smaller wavelength than we can possibly measure and then determine a switching technology to electronically capture the time rise or decay. This does not appear promising.

Let us explore gravity as the major concern. To do this, we need some understanding of inertia. If we use the Puthoff approach, a particle's inertia is an electromagnetic force that acts against the zero-point field [19]. The only problem is at constant speed, the force creating inertia would still exist and this violates Relativity as well as Newtonian law ignoring other forces acting on the particle. This argument would be acceptable if inertia disappeared when the particle moves at constant velocity without any other forces. Let us assume that the electromagnetic attraction acts omni-directional at constant speed with the ZPF where the attractions generally cancel in all directions similar to Figure 2. However, if acceleration or deceleration occurs, the inertia vector operates in a definable manner directly opposite to motion. This might be an acceptable option. Other explanations about inertia exist but are not as comprehensible in this author's views as Puthoff's. If we look at fields, we could talk about a Poynting motivator for a candidate Propulsor [20] where force is

$$\overline{F} = e(\overline{E} + \overline{v} \times \overline{B}) + \frac{1}{4\pi}\overline{E} \times \overline{B} = e\overline{E} + \overline{J}_e \times \overline{B} + \frac{1}{4\pi}\overline{E} \times \overline{B} \qquad (1)$$

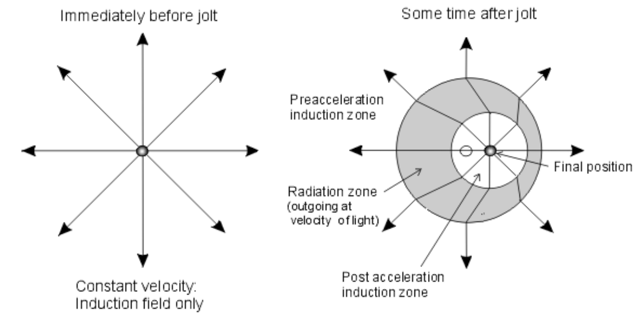


Figure 2: A directional vector form can use inertia to define what occurs during changes in acceleration.

This would ignore the first and second terms in the RHS of the equation, which also depends upon the charge and current that is dependent upon the presence of electrons or ions that produce the charge. Significant amounts of energy for the last radiation term would be required. Such a motivator, for example, depends strictly upon the Poynting contribution [20] in the last term of the RHS. This radiation term is not usually included; however, it will create a force. This would require considerable amounts of electrical and magnetic fields with sufficient orientation to generate thrust. The major point is that the device will most likely require a significant amount of electrical energy so let us presume that a spacecraft possesses an on-board hybrid nuclear reactor involved that uses a neutron generator or an aneutronic Fusor to drive a fissile reactor bed. This system uses the best conceptual efficiency to generate nuclear energy [21]. Coolants from the basic reactor would generate electricity to create these terms as well as induce the Poynting field.

Gravitational issues

A controversy exists where current understandings of some events in space do not satisfy gravitation on a galactic scale. Thus, there may be a need for either a new gravitation law or a different kind of matter. Dark matter that is essentially invisible meets some of this need and has supposedly no electric or magnetic charges. The sense is that dark matter compensates for resolving cosmological problems. An alternative view suggests that the standard Newtonian gravitational law should be altered and reconsidered to adjust for these events without resorting to using dark matter magic. Still another alternative suggests that rotation of a celestial body may alter the gravitational field for highly rotating neutron stars resident with pulsars [22]. The issues with Dark Matter involve:

- First, Einstein's field equations fail to explain the dark matter and dark energy, and the equations are inconsistent with the accelerating expansion of the galaxies [23-25].
- Second, we can prove that there is no solution for Einstein's field equations for the spherically symmetric case with cosmic microwave background (CMB).
- Third, from Einstein's equations, it is clear that R=4πG c4 T, where T=gijTij is the momentum energy density tensor. Discontinuities of the tensor T give rise to the same discontinuities of the theory of dark matter and dark energy curvature as well as the discontinuities of space-time. This is certainly an inconsistency that needs to be solved.
- Fourth, it has been observed that the universe is highly non-homogeneous as indicated by e.g., the "Great Walls", filaments and

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voids. However, the Einstein field equations do not appear to offer a good explanation of this inhomogeneity.

If additional mass that creates gravity could provide an explanation that generates the required forces to occur, there is still yet another possibility. What if matter exists that applies repulsive or anti-gravitic effects in the opposite direction? By symmetry, this is also a reasonable hypothesis for dark matter. Again, the solution is most likely a realistic change in the gravity model, which we may eventually discover when a spacecraft goes further past the Oort cloud.

If dark matter exists, one question is how would this be altered to create propulsion at high speeds? If there are no charges, dark matter could *not* possibly be excited by either electric or magnetic fields expelled at high speeds necessary to provide thrust [25,26]. It is not intuitively obvious that dark matter propulsion has any feasibility at all so we can possibly ignore this capability unless dark matter can be chemically reconstituted. The other part of the problem is if a spacecraft moves at high speed, how would the craft structurally survive in collision with dark matter? This could be a very serious structural problem that further prevents mankind going into space at superluminal speeds. Let us assume that understanding galactic problems have solutions based upon the gravitational laws in lieu of dark matter.

Analysis

If we look at gravitational relations, Newtonian gravitation is the simplest representation. Here, gravity is an inverse distance law which when involved as a force becomes a gradient that is an inverse square law dependent between two attractive bodies, say a spacecraft and a celestial body. If the mass or gravity qualifies with inertia that is altered, then this force between these two bodies would result in an adjustment. If mass could become a negative quantity, then we would experience repulsion.

The attractive force becomes:

$$\bar{F} = G\frac{m_1 m_2}{r_{1-2}^2} \quad (2)$$

Where ***G*** is a gravitational constant, the masses are for the separate bodies, and ***r*** is the difference between the two bodies and the larger mass body acts immoveable with respect to the smaller spacecraft mass.

Questions regarding gravity models

Gravity obeys certain laws and maybe we are not taking full advantage of these capabilities. We need to walk away and look at these problems with a different lens to see this challenge. Our understanding about gravity is only due to the local environment in the region of our planet and the near-term solar system. Clearly the Dark Matter hypothesis already stresses these capabilities and suggests the need for new gravitational laws. Moreover, if a study in relativity, gravity warrants a change from Newtonian gravity if gravitational waves exist. These different gravitational laws are shown in Table 1 which displays elliptical and wave equations.

In these gravitational laws, these may be considered as speculative but are offered to consider the possibility for creating gravitational waves as well as the far-field. One point should be considered for these wave equations. If other than taking part in a supernova, the transient term of these wave equations has a coefficient of $1/c^2$, which is exceptionally small. In other words, the transient term is likely insignificant regarding the temporal term with transient derivatives.

Gravity law	Assumptions	Gravitational rule
Newtonian gravitation	$\nabla\times\bar{g}=0.$ and $\nabla.\bar{g}=-4\pi G\rho_g.$	$\bar{g}=-\nabla\phi \, and: \nabla^2\phi=4\pi G\rho_g; where: g\approx 1/r^2.$
Four-Derivative theories	$\phi(r)=1-2m/r+ar+br^2,$ $\phi(r)=g^{oo}=(1-6bc)^{1/2}-\frac{2b}{r}+cr+\frac{d}{3}r^2.$	$\bar{g}=-\nabla\phi(r).$
Winterberg's rule	$\nabla.\bar{g}=-4\pi G\rho_g=2\omega^2,$ Where $\rho_g=-\frac{\omega^2}{2\pi G}.$	$\bar{g}=-\nabla\phi \; and: \nabla^2\phi=-2\omega^2; \; where: g\approx 1/r^2.$
Jefimenko's gravity and co-gravity	$\nabla\times\bar{g}=-\frac{\partial\bar{k}}{\partial t};\nabla.\bar{g}=-4\pi G\rho_g;\nabla.\bar{k}=0.$ and: $\nabla\times\bar{k}=-\frac{4\pi G}{c^2}\bar{J}_g+\frac{1\partial\bar{g}}{c^2\partial t}.$	$\frac{1\partial^2\bar{g}}{c^2\partial t^2}-\nabla^2\bar{g}=4\pi G[\nabla.\rho_g+\frac{1\partial\bar{J}_g}{c_g^2\partial t}-\frac{\nabla\times\bar{J}_c}{c}],$ $\frac{1\partial^2\bar{k}}{c^2\partial t^2}-\nabla^2\bar{k}=4\pi G\left[\frac{\nabla.\rho_g}{c^2}-\frac{1\partial\bar{J}_c}{c^3\partial t}-\frac{\nabla\times\bar{J}_g}{c^2}\right].$
Murad's modification of Jefimenko	$\nabla\times\bar{g}=-\frac{\partial\bar{k}}{\partial t}-\frac{4\pi G}{c_k}\bar{J}_k;\nabla.\bar{g}=-4\pi G\rho_g;$ $\nabla.\bar{k}=-\frac{4\pi G}{c_k}\rho_k \; and: \nabla\times\bar{k}=-\frac{4\pi G}{c^2}\bar{J}_g+\frac{1\partial\bar{g}}{c^2\partial t}.$	$\frac{1\partial^2\bar{g}}{c^2\partial t^2}-\nabla^2\bar{g}=4\pi G[\nabla.\rho_g+\frac{1\partial\bar{J}_g}{c^2\partial t}-\frac{\nabla\times\bar{J}_c}{c}],$ $\frac{1\partial^2\bar{k}}{c_g^2\partial t^2}-\nabla^2\bar{k}=4\pi G\left[\frac{\nabla.\rho_g}{c^2}+\frac{1\partial\bar{J}_c}{c^3\partial t}-\frac{\nabla\times\bar{J}_g}{c^2}\right].$
Murad's gravity law	$\nabla\times\bar{g}=\frac{i}{c}\frac{\partial\bar{g}}{\partial t}+\frac{4\pi\gamma G}{c}\bar{J}_g$ *and* $\nabla.\bar{g}=-4\pi\gamma G\rho,$ *where* $\gamma=\frac{1}{\sqrt{1-\frac{u^2}{c^2}}}.$	$\frac{1\partial^2\bar{g}}{c^2\partial t^2}-\nabla^2\bar{g}=4\pi\gamma G[\nabla.\rho_g+\frac{i\partial\bar{J}_g}{c^2\partial t}-\frac{\nabla\times\bar{J}_g}{c}]$

Table 1: Different Gravitational Laws that cover a spectrum of conditions of interest.

For this reason, Newtonian gravity is fortuitous despite that it maybe fatally flawed if gravitational waves exist.

Let us first briefly review some potential gravity models as well as Newtonian gravity. Gravity plays a crucial role and is a concern to the propulsion specialist. The simplest is Newtonian gravitation [24,25], that is adequate to predict satellite motion and traverse to other celestial bodies in our solar system. The major issue is to carefully map the gravitational potential on a celestial body to consider effects due to concentrated mountain ore, mountain ranges or the presence of oceanic liquids.

Here, the Newtonian potential is φ and ρ is density with the terms previously mentioned that account for local gravitational effects throughout the body. Since the curl is zero, the gravity vector could be represented by a potential function. Boundary conditions for gravity vanish at infinity and asymptotically go to zero due to the inverse radius solution term. Although suitable for predicting motion where planetary speed is far lower than light speed, it does not mathematically support gravitational wave phenomena because time does not explicitly appear. If gravitational waves exist, they would have to move at infinite speed using this Newtonian model.

In his initial paper on Relativity, Einstein developed a model for gravity that modifies Newtonian theory. He claimed his equation supported the existence of gravitational waves. Einstein was concerned about the premise that under the Newtonian paradigm, we should instantaneously feel effects created by stars at infinity such as super novas, which he felt was wrong. He implied that some time lag should exist. His formulation also felt that a gravitational field was self-sustaining. Einstein went in an entirely different direction

Einstein went in an entirely different direction to develop a model where curvature of space-time geometry takes into account gravitational effects. Misner provides an example of this theory in deriving a photon world line that results in predicting the bending of light by gravitational forces [25]. Petkov suggests, in deference to Einstein's space-time theory, it is the anisotropy of space- time that causes inertia and gravity that is against our initial assumptions [26]. Haisch et al. by contrast suggest gravitational wave propagation is not rigorously consistent with space-time curvature [19].

An object with negative mass would repel ordinary matter, and could be used to produce an anti-gravitic effect. Alternatively, depending upon the mechanism assumed to underlie the gravitational force, it may seem reasonable to postulate a material that shields against gravity or otherwise interfere with a gravitational force.

A Magnetar, for example in Table 1, 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. Murad looks at a laboratory analogue of a geodynamo or Magnetar that involves a rapidly rotating liquid metal [22]. Neutron stars typically have the mass of 1.40 times the sun; however, the rotation rates are considerably higher from 10 to 600 cycles per second. The source term ρ can be negative indicating a repulsive mass density.

If a gyroscope is placed at 45° on a table and let go, the gyroscope falls on the table. 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 table top. The rotation may induce a repulsive gravitational source that levitates the gyroscope according to this equation in contrast to using couples. Another way is that a gravitational field would repulse negative mass. Such a source can be considered as negative matter. If Winterberg is correct, then the inertial mass of the neutron star has to be greater than the companion star to compensate for the loss of gravitation due to spin that compensates for rotation.

The neutron star source term in a binary pulsar and weight is greater by:

$$\rho_p = \rho_c + \frac{\omega_p^2}{2\pi G}, \; W_p \approx \frac{V_p}{V_c}\left[1 + \frac{\omega_p^2}{2\pi G\rho_c}\right]W_c \text{ and}$$

$$\omega_p = \pm\sqrt{\left[2\pi G\rho_c\left(\frac{V_c}{V_p} - 1\right)\right]} \quad (3)$$

The subscript *'p'* is for the neutron star while the *'c'* is the value for the companion star; the V value is the volume for each star. The neutron star may be located on an elliptical trajectory with the companion star based upon their mutual attraction with each other. The theoretical value for the equilibrium rotation rate for both bodies assumed to have equal weight creating a circular orbit will be ω_p. The gyroscope analogy may be correct; however, for a Magnetar or a neutron star in a binary pulsar may have other attributes that need to be considered which amplifies gravitation such as the spinning magnetic field, which may have a considerable contribution to gravitic changes.

The discovery of apparent gravitational energy loss by the Hulse-Taylor pulsar, PSR 1913+16, provides indirect evidence of the existence of gravitational Jefimenko in Table 1, introduces gravitation and a cogravitation field used to predict force defined by the equation: waves. Thus other laws than Newtonian gravity show exist and support the view of gravitational waves [27-31].

Physicists normally use Einstein's field equations to discuss gravity that is mainly a main diagonal element on a tensor. A vector, usually used by engineers, could represent the main diagonal of such a tensor, which is what we will confer here. If rotational effects were to include gravity, these could appear as off-diagonal terms in this gravity tensor. This is important and makes the problem considerably more complex in Einstein's field equations.

Jefimenko, introduces gravitation and a cogravitation field used to predict force defined by the equation (Table 1) [29-31]

$$\overline{F} = m[\overline{g} + \overline{u} \times \overline{K}] \quad (4)$$

Gravity and a cogravity fields are defined similar as a Lorentz force relationship. This is a crucial analytical finding based upon Heaviside's 1893 paper where equations governing gravitation are considered somewhat similar to Maxwell's equations. Jefimenko uses cogravity field K to account for relativistic effects acting upon a rest mass and introduces time into the equations. He includes gravitational currents and sources. Mass is a gravitational source.

This equation resembles the Lorentz force acting upon an electromagnetic particle. For relativistic effects, he carries the terms one step further and defines gravity as:

$$\overline{g} = -\frac{G\ m}{r^3(1-\overline{r}.\overline{v}/rc)^3}\left[\left(\overline{r} - \frac{r\overline{v}}{c}\right)\left(1 - \frac{v^2}{c^2}\right) + \overline{r} \times \left[\left(\overline{r} - \frac{r\overline{v}}{c}\right)\right] \times \ldots\right] \approx$$

$$\overline{g} \approx -G\frac{m}{r^3}\left[\left(1 - \frac{v^2}{c^2}\right)\overline{r}_o - \frac{2rv^2}{3c^3}\overline{v}_o\right] \quad (5)$$

The leading coefficient on the RHS adjusts for Newtonian gravity while the first term in the parenthesis is a light speed correction as a function of distance and before leaving this subject, these laws also satisfy a relationship between the gravitational source term and the gravitational current. This is: velocity. Any gravitational law should asymptotically component depends upon speed and is essentially a torque. Such a torque in a field involving planets may cause planetary rotation in the direction of the orbital velocity of an adjacent planet. According to Jefimenko, this explains why the same side of the Moon always faces the Earth, which was a major motivation factor to look into developing a new gravitational model. In fact, Lavrentiev found that this was also true for all of the large planets in the solar system [32]. In the words of Mark Twain:

"Everyone is a moon, and has the dark side which he never shows to anyone."

Here, the gravitational attraction is proportional to both the radial distance and the speed of the body with respect to a planet producing the field. This model by Murad in differs upon Jefimenko's original equations due to additional source and current terms [33-40]. Differences in these equations suggest the partial differential equations are also hyperbolic or wave equations (Table 1).

The issue of self-feeding gravity can be taken one step further and may be related to the high rotational rate within the spiral arms of galaxies. If rotation induces a torsion field, a galaxy could create such fields as it spins or rotates about its axis. This torsion field could induce a cogravitation field as well as create electromagnetic radiation that, by an inverse Gertsenshtein effect and later with Forward, may induce a localized gravitational field. Once this field is established, the induced angular momentum effect may, by Jefimenko's gravitation laws, further increase the galaxy's rotation rate that increases the strength of the initial torsion field [41,42].

To extend Newtonian gravitation, let us use a simpler rationale for a new gravitational model. Here the relativistic factor operates upon both currents and source terms [43]. Because the curl does not vanish, gravity cannot be represented by a potential as in Newtonian gravitation. Thus, gravitation is not only a function of gravitational currents but is also a function of itself similar to what Einstein originally proposed.

This is surprisingly the desired wave equation. For no source or current terms and steady-state conditions, this equation asymptotically approaches Newtonian gravity. The gravitational current time derivative may be troublesome from a physical perspective due to the imaginary multiplier. If gravitational currents exist, the current acts as a complex variable having the imaginary term. Gravity currents could be a function of time as well as spatial dimensions for this model.

Before leaving this subject, these laws also satisfy a relationship between the gravitational source term and the gravitational current. This is

$$\frac{\partial \rho_g}{\partial t} + \nabla . \bar{J}_g = 0 \qquad (6)$$

Note that the first term appears but Newtonian gravitation never discusses any issues about gravitational currents.

If gravitational currents exist, then gravitational waves would exist. The current is quite interesting. It implies that time rate changes in the mass due to changes in the core or with the presence of nuclear explosions would generate changes in the current. Likewise if there were no time changes, the gradient would be equal to zero which also implies that a gravitational current could still exist and change it self upon environmental conditions.

A view of gravity and fluid flow

Thus, gravity which may obey either an elliptical or hyperbolic wave partial differential equation may be mathematically analogous to the partial differential equations obeyed by a subsonic and supersonic fluid [44-48]. The governing subsonic flow equations and Newtonian gravitation are both an elliptical partial differential equation. This implies that all solutions depend upon a closed boundary in the domain of interest. Under this circumstance, the body that is exposed to a series of several celestial or smaller bodies will, at low relative speeds be linearly additive for summing up the gravitational effects.

Gravitational waves must satisfy a wave equation that includes time. What does this mean and can phenomenon be examined that demonstrate this capability? Basically wave equations do not depend upon the entire boundary as previously mentioned for Newtonian gravity. With wave equations, this is still a viable boundary condition that gravity vanishes at distances. The boundary influences the domain only based upon a specific region that depends upon a signal zone. Again, if the boundary for both is the same, no differentiation can be found if an elliptical or hyperbolic event occurs. This is not normally considered in a space mechanic problem.

Another part of the problem is that for a propulsion device, how can we look at gravity? For example, gravitational waves have not yet been observed or are defined to date. These waves need to be defined if they are part of a propulsor.

Fontana raises an interesting propulsor using gravitational waves. Here wave generators are used at several places azimuthally aimed about the nose section of the spacecraft [49]. These generators are aimed at a single focus to a point in front of the spaceship. These gravitational waves intersect at the same point and could, theoretically create a singularity that would alter the gravitational field in this region. This singularity would tend to draw the spaceship by *pull* instead of *push*! Again this raises questions about how to generate a singularity.

Generating gravitational fields

Let us define portions of a propulsor that might be suitable into the development of a warp drive. If an energy difference can create a gravitational field, it implies that energy is converted as some form of mass. The presence of mass will induce gravity. Thus we are looking at this with a different perspective that exists and is confined within a geometric volume of the propulsor. The important part is to define the magnitudes of the energy levels required to convert different and separate gravitational fields. This is not trivial. Once within the propulsor, how does the propulsor or subsequent gravitational effects interact between its internal capabilities with its external environment to produce thrust?

A technical paper was reviewed written by an individual that lives in a prison in Illinois [50]. He interestingly raises the question of what happens with interactions between two different inhomogeneous gravitational fields. Normally we only consider a homogeneous gravitational field that exists with these laws previously mentioned. Here, the view is what occurs if there are, say holes in the field and what are any propulsion implications. When these fields merge, are they gradual or additive as one would intuitively expect if the fields that are both weak for a satellite that depends linearly between the Earth and the Moon, or what if one field is intensely stronger? This is a weak-

weak interaction in the former. The last possibility is that these fields would create unique regions with distinct boundaries if the fields were very strong similar to the gravitational field of several separate celestial bodies but with much more strength. Moreover, if these fields are distinct, what occurs if one travels along this boundary between the two different fields? Can you use this knowledge to violate moving either forward or back into time? Without any solid proof or experimental data, it is difficult to accept this premise at face value although the notion is indeed intriguing.

If Newtonian gravity is mathematically analogous to subsonic flow, and these other gravity laws obey wave equations, we have covered both edges of the spectrum. Thus it is possible that gravity can operate in a similar mathematical fashion to sustaining regions of mixed flow with subsonic flow and supersonic flow for a gas. This suggests that a body may travel at certain speeds near the region of speed propagation; say below light speed, which is comparable to the speed of sound. The interesting situation is that the speed of propagation can be altered; is it feasible that the propagation speed for gravity is not a constant but may also be altered by the propulsion specialist? Consequently gravity could also obey a similar rule of mixed flow but no such gravity law for this counterpart currently exists.

A fluid may reach transonic flow similar to regions that contain high subsonic flow where shocks are formed and this generates regions actually reaching supersonic flow. The specification for a generic Tricomi-like partial differential equation is provided as follows:

$$\frac{\partial^2 \Phi}{\partial t^2} + x\frac{\partial^2 \Phi}{\partial x^2} = f(x,t) \text{ or like } \frac{\partial^2 \Phi}{\partial t} + \left(1 - \frac{v^2}{c^2}\right)\frac{\partial^2 \Phi}{\partial x^2} = f(x,t) \qquad (7)$$

The second equation is a candidate for a new type of gravitational law. Here these equations are elliptical whenever x or the multiplier that uses velocity is positive. It becomes a parabolic differential equation when x or the multiplier (v=c) is zero and the equation becomes a wave equation when x and the multiplier is negative. This could be a crucial ingredient to using such a warp propulsor. Can we demonstrate such equations to represent gravity?

If the Pioneer satellites were altered when the electricity circuitry was changed from directing internal electricity using sensors to a heat sink, the change in motion would exhibit behaviour that indicates gravity might have changed [39]. Some views are that the heat sink radiated energy away from the environment and this created propulsion. Each Pioneer moving at different directions relative to the sun, reached a specific distance when the Newtonian gravity suddenly changed. This anomaly was a peculiar or strange deviation from the common rule. The problem is that three other long-range satellites demonstrated similar behaviour where gravitational changes were observed that did not have the same satellite architecture as the Pioneer satellites.

One may argue that this could be a function due to reaching a reference distance. Another satellite for several years stayed within the early planet regions and did not show such an anomaly. Thus, time is not a function of the phenomena. What we are presuming is that there may be a region where a satellite reaches a certain velocity or juncture distance from the sun that is like the $\boldsymbol{x}$ in the above Tricomi equation that suddenly possesses a different gravitational law.

An aerodynamic analogue

There is a rationale that may show how to deal with these different gravity laws. Each may be correct at specific locations from the sun. For example, near the Earth and within the near-term solar system, Newtonian gravity is correct; however, at considerable far-term situations, a wave equation may be satisfied in Figure 3.

There is an aerodynamic analogue that may be useful. In fluid gas flow for a rocket nozzle, the pressure increases within the combustion chamber. As the flow leaves the diverging section of the nozzle, pressure decreases while the gas particle velocity increases reaching sonic speed or transonic flow (Tricomi equation) at the throat of a converging/diverging portion of the nozzle. This point achieves a maximum flow rate. Under these conditions using no shocks that occur within the nozzle, the flow pressure decreases in the diverging portion of the nozzle further converting pressure into kinetic motion to reach supersonic speeds.

Liepman and Roshko show an ideal Prandtl- Meyer expansion in the Hodograph plane. Here, Figure 4 indicates that subsonic flow occurs from the origin to where the Mach number 1 appears and the expansion flow for a wave equation goes to infinity [52]. An Epicycloid diagram from Sears shows results using a Method of Characteristics for a similar nozzle type of event [53]. A result on the LHS is at lower speeds below sonic conditions where higher and supersonic speeds are evident in the RHS. The rationale is that the Pioneer satellites may have demonstrated a difference in gravity analogous to passing the propagation speed with the gravity wave equation formulation at further distances. This also implies the previous comment that different regions may exist near other regions with variations in the strength of gravitation.

Creating gravitational shocks and propulsion

This is the essence of the problem. Before we make a warp drive, specific experiments are needed to understand the physics of the pieces that would work within a propulsive architecture. Many have spent considerable time to nullify inertia and these look promising. However, what comes to pass after you control inertia? Does the system allow travel in a geodesic that reaches faster than the speed of light?

The issue is raised in creating a gravitational shock. Part of the problem is to discover means for either creating gravitational waves or detecting such waves. These efforts have found that the sensitivity for such instruments are far lower than currently measured and requires an investigation just to define suitable instrumentation. For example, LISA requires several satellites with sufficient separation. These are

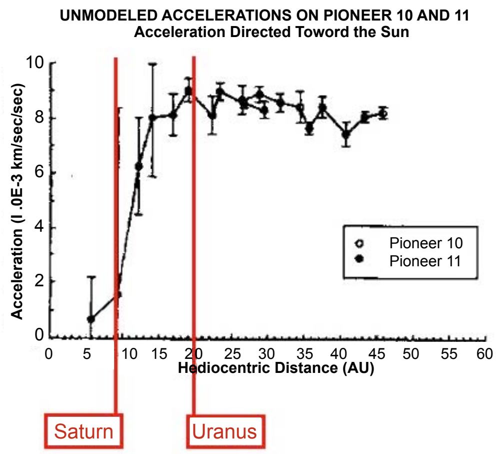

Figure 3: This could be the point where a Tricomi-like gravity equation characteristic changes for a different type of gravity law [51].

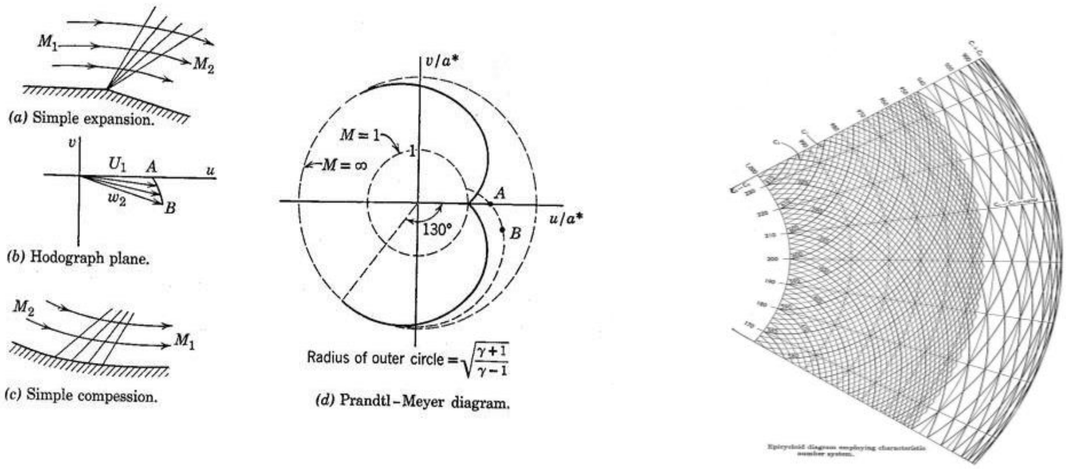

Figure 4: The effects of flow moving from subsonic to supersonic speeds or characteristics that could explain similar events with gravity.

oriented with each other using lasers. If the satellites are perturbed because of a gravitational wave, the assumption is that the laser misalignment would be sufficient to detect such events. This obviously assumes that gravitational waves move at the speed of light.

If you accept some experiments performed by Kosyrev and commentary made by Podkletnov, as well as examining black holes with no accretion disk that generates jets, it is feasible that gravity or gravitational waves might greatly exceed the speed of light [54,55]. If true, then LISA results would be fatally flawed when all of these satellites might simultaneously jump together if perturbed by a gravitational wave and therefore may show no meaningful results.

With these thoughts to create an experiment, how can we resolve this problem? The only way we currently have would be to use mass. In other words if large masses interact with each other at sufficient speed, they should generate a gravitational wave disturbance. The notion is to convert energy into mass similar to deBroglie matter waves. Such disturbances could resemble a nuclear explosion that would generate a radial expansion for creating a gravitational shock.

The notion of a shock requires some explanation. If there are wave equations within the gravitational law, they will create characteristics based upon the mathematical physics of the problem. The problem is to form characteristics to confluence or join and this would create what we are referring to as a shock. Such merged characteristics will create some response such as a radiation pressure and this may induce propulsion.

The issue of using a radial effect with these merging characteristics would allow experimentation but not really provide sufficient capabilities to develop a propulsor. The ideal model would be to have a cylinder within a propulsive duct used to create a gravitational disturbance and then allow it to move down a cylinder in a specific direction to hopefully provide directional thrust. This pumping could generate a sudden increase in a large energy input. The question is we are not expelling mass but somehow mass is consumed or altered in this process to generate energy.

The other issue for the propulsion system is if shocks are created, should they be pulses or continuous? Obviously starting on such a system, initial effects will be to examine pulses. When the technology reaches maturity, the ability to generate a continuous gravitational shock should be easier to produce.

The desired system would employ generating a normal or an oblique gravitational shock. These gravitational shocks would appear similar to signals and cones that are normally addressed in these problems. Other shocks such as a normal shock should exist as well. The effects could generate several alternatives. The body that generates the shock may appear outside of the body that will generate thrust and accelerate on a specific trajectory or geodesic. The flight path could be tailored by altering the shock's appearance especially if an intersection would occur near a celestial body. Another alternative is that the shock could be repulsive from the gravitational field of the surface on a celestial body that might create a gravitational reflection. If so, this could generate thrust away from the body into another direction. Altering the geometry of the shock where its symmetry is perturbed, the adjustments would allow control thrust changes in the trajectory.

Such issues will also assume that embedded regions can be placed near the body's shock as well as immediately in front of or behind such a shock. To do this with technology is obviously beyond our contemporary knowledge but this should be feasible. The other possibility is internal to the propulsor. What value would be achieved if a steady-state gravitational shock exists? This is an interesting problem if your propulsor generates a large stationary gravitational field in an oblique shock within a small region. This question is important as well as how to determine creating the steady-state gravitational shock.

The author apologizes for not having solutions to these questions but part of the problem is to first understand what the issues are considering new thoughts about phenomenon or feasibility. Can such a device provide propulsion based upon the proximity of other celestial bodies and what is the sensitivity that would be observed by these effects? For example, this may work in the vicinity of a celestial body but may have significant problems if there is no field to pull or push against. One such region might be in intergalactic space where motion is at considerable distances from such fields and that the fields within intergalactic space may be so weak to be less than insignificant.

Conclusion

The problem warrants investigation to generate a new type of physical phenomena such as creating a gravitational shock. Some of the previous wave equations depending upon gravitational laws, indicate that such phenomenon should mathematically exist. Can we perform experiments for investigating gravitational shocks that currently is beyond the realm of embryonic technologies as well as provide instrumentation? Moreover, we need to develop instrumentation to create a gravitational shock outside of a spacecraft or internal within a propulsor. This type of propulsion can become a critical element to develop a warp drive to travel faster than light flight. This is necessary if mankind is to achieve some semblance of both our own destiny and understand the role we play within the cosmos.

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