# GALILEAN ELECTRODYNAMICS

**Experience, Reason, and Simplicity Above Authority**

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### EDITORIAL POLICY

Galilean Electrodynamics aims to publish high-quality scientific papers that discuss challenges to accepted orthodoxy in physics, especially in the realm of relativity theory, both special and general. In particular, the journal seeks papers arguing that Einstein's theories are unnecessarily complicated, have been confirmed only in a narrow sector of physics, lead to logical contradictions, and are unable to derive results that must be postulated, though they are derivable by classical methods.

The journal also publishes papers in areas of potential application for better relativistic underpinnings, from quantum mechanics to cosmology. We are interested, for example, in challenges to the accepted Copenhagen interpretation for the predictions of quantum mechanics, and to the accepted Big-Bang theory for the origin of the Universe.

On occasion, the journal will publish papers on other less relativity-related topics. But all papers are expected to be in the realms of physics, engineering or mathematics. Non-mathematical, philosophical papers will generally not be accepted unless they are fairly short or have something new and outstandingly interesting to say.

The journal seeks to publish any and all new and rational physical theories consistent with experimental fact. Where there is more than one new theory that meets the criteria of consistency with experiment, faultless logic and greater simplicity than orthodoxy offers, none will be favored over the others, except where Ockham's razor yields an overwhelming verdict.

Though the main purpose of the journal is to publish papers contesting orthodoxy in physics, it will also publish papers responding in defense of orthodoxy. We invite such responses because our ultimate purpose here is to find the truth. We ask only that such responses offer something more substantive than simple citation of doctrine.

The journal most values papers that cite experimental evidence, develop rational analyses, and achieve clear and simple presentation. Papers reporting experimental results are preferred over purely theoretical papers of equally high standard. No paper seen to contradict experiment will be accepted. But papers challenging the current interpretation for observed facts will be taken very seriously.

Short papers are preferred over long papers of comparable quality. Shortness often correlates with clarity; papers easily understandable to keen college seniors and graduate students are given emphatic preference over esoteric analyses accessible to only a limited number of specialists. For many reasons, short papers may pass review and be published much faster than long ones.

The journal also publishes correspondence, news notes, and book reviews challenging physics orthodoxy. Readers are encouraged to submit interesting and vivid items in any of these categories.

All manuscripts submitted receive review by qualified physicists, astronomers, engineers, or mathematicians. The Editorial Board does not take account of any reviewer recommendation that is negative solely because manuscript contradicts accepted opinion and interpretation.

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Many thanks go to Mitch Emery and George Kopasakis for proofreading this issue of Galilean Electrodynamics.

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From the Editor's File of Interesting Letters:

## *Rethinking GRT*

Einstein derived Special Relativity Theory (SRT) from the assumption that light in vacuum propagates with speed $c$ regardless of the state of motion of the light source. Yet a curious mind begs for more. Should we accept the constancy of light speed as a natural phenomenon with absolutely no understanding of why or how it is so? Can it be that the fixed constant $c$ is not really a speed at all? A need for something more realistic and comprehensible was the motivation behind my alternative to SRT [1,2]. The present commentary expands on those ideas in order to read General Relativity Theory (GRT) in a new way that maintains the fundamental postulate of GRT (the equivalence principle) while bringing it together with Quantum Mechanics (QM). According to GRT, planetary orbits are described as inertial motions. Planets are not pulled into orbits by force—their paths are geodesics, or straight world lines in curved space-time. On a large scale, the ideas discussed herein are comparable to those of GRT, while on a small scale they suggest a quantum theory of gravity.

Common belief at the time of Galileo put the Earth stationary at the center of the Universe, with the sun and the other planets revolving around it. But Galileo defended the view of Copernicus, in which the Sun is central, while the Earth and other planets revolve around it. A typical argument against this idea was that if the Earth were moving we would feel the motion, and a falling object would not fall straight downward. To counter this argument, Galileo developed his original principles of inertia and of relativity of motion. According to these concepts, planets would move naturally in uniform circular motion [3]. Galileo was aware of rectilinear motion, but he argued that all such motion, even on the surface of Earth, is actually circular because the Earth rotates.

Galileo's belief was in conflict with Kepler's discoveries about planetary motion, because real planetary orbits are not truly circular; they are instead elliptical. Others therefore modified Galileo's original concept of inertia. The most refined version of inertia was codified by Newton as his first law of motion.

It is this author's opinion that Galileo's concept of circular inertia may ultimately prove correct, but his theory of planetary motion is incomplete. Let us suppose Newton's first law is only a special case of his second law, while generally everything moves about inertial frames of natural and force-free circular motion. In other words, a body acted upon by an unbalanced force tends to move in a straight line due to the force, and therefore it tends to keep moving in a straight line upon removal of that force. Yet all straight-line motions are carried by preexisting inertial frames of force-free circular motion. Based on these principles of motion, planetary orbits are described, at least in part, as a combination of rectilinear motion and circular motion.

The moon's orbit around Earth can be described according to these principles of motion. If we assume the axial rotation of the moon is force-free (as envisioned by Galileo, rather than GRT), then the moon serves as a rotating inertial frame of reference. Thus, the moon's orbit may have an underlying straight-line motion (comparable to a geodesic), but its momentum is carried and turned with the moon's rotation. As a result, the moon circles about a full orbit with each of its 360° axial rotations. In such a case the moon's orbit is force-free just as with GRT, and yet it takes place in a setting of absolute space and time.

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# A Physical Continuum Theory: Part 1, Gravity

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This paper develops a new theory that deals with the source of gravity. The evidence introduced indicates that gravity originates from quantum motions in a 4-Dimensional (4D) electric scalar potential that permeates the Universe as stationary aether (totally coupled to mass). Local-couplings of mass with this aether raise the base 4D scalar potential of the continuum. The aether couples with mass quanta constituents to develop a flux field via electrostatic resonant fluctuations at Planck length scales. The theory does not originate from preconceived ideas, but rather evolves from a certain gravitational phenomenon, and the attempts to scientifically explain this phenomenon. A stationary aether changes the fundamental notions of particles and forces in quantum mechanics, and provides a new interpretation for the geometric theory of gravity. As covered in Part II, the theory also introduces mechanics for the speed of light, new definitions for mass and for time, and introduces a Universe whereby the Big Bang is just a part of a repeating cycle. Based on this theory (Part II), manipulating time or propelling the space-time to circumvent the speed of light becomes permissible.

## 1. Introduction

This paper develops a theory of space-time continuum that encompasses gravity (Part I), matter, energy, and time (Part II). The theory offers a hypothesis about the creation of the Universe. The theory was first developed to explain observations of a certain phenomenon that turns out to involve gravity. This step-by-step development leads into a theory that is different from the standard model in saying that there is no absolute quantity in nature, and that every fundamental quantity involves some kind of mechanism.

This theory brings back the aether (ether) as a stationary aether (totally coupled to mass); a luminiferous aether made of a 4-Dimensional (4D) Electric Scalar Potential (ESP) field. This aether constitutes the space-time continuum that permeates the known Universe and beyond, which is different than the *Minkowski space-time*. The null result of the *Michelson-Morley* (M-M) *experiment*, supposedly excluded the existence of the aether as has been adapted by Physicists during the 20th century. Even though, Michelson himself did not exclude the possibility that aether that is totally motionless with respect to matter could exist, and in 1895 Poincaré argued that experiments like that of M–M show that it seems to be impossible to detect the absolute motion of matter or the relative motion of matter in relation to the aether. Einstein supported the aether theory as evident from his 1920 U. of Leiden address '*According to the general theory of relativity space without ether is unthinkable; for in such space there not only would be no propagation of light, but also no possibility of existence for standards of space and time…*" Nikola Tesla also supported this theory as evident from his lecture delivered before I.E.E., London, February, 1892, "*…and my conviction has grown strong that, to whatever kind of motion light may be due, it is produced by tremendous electrostatic stresses vibrating with extreme rapidity*."

From the derived equations, the continuum theory makes predictions that cannot be explained by the standard model. For instance, the theory through an additional gravitational component (also attractive but relatively small in magnitude) predicts that satellite galaxy orbits should over time align with their host galactic plane as recently observed. The theory also supports a highest degree of degenerate state of matter with no singularities, and black holes possessing sustained oscillations as some observations have shown. The theory explains the mechanics of the *equivalence principle* and shows that the so-called fictitious forces are actually real forces of nature.

## 2. The Phenomenon & Experimental Evidence

The phenomenon that gave rise to this theory may be controversial, but the reader is encouraged to keep an open mind. One day, back in the mid 1990's, the City engineer came to my front yard and proceeded to locate and mark a broken underground sewer line in order for a crew to dig out and repair. There were no blueprints for my old house and the only aid the City engineer had was a metallic L-shaped rod. The rod of approximately 9" - the long end and about 4" - the short end is carried like a pistol in a loose grip (free to move) like a bushing, with the arm tacked in to the side of the body, and the lower portion of the arm sticking out straight forward, parallel to the ground. The lower part of the arm is protruding forward at about the width of the body; neither shifted towards the inside of the body nor towards the outside (away from the body). He proceeded with walking motion, perpendicularly towards where he thought the line of the pipe run should have been; sewer lines usually run approximately straight or perpendicular from the house towards the street. At some point during the walk, the rod turned 90° counter clockwise (rod carried in the right hand), which occurred when motion reached the sewer line, and at that point, the rod direction was in line with the pipe. Needless to say, the digging crew found the buried line in the exact spot the engineer marked couple days before, at a depth of approximately 12 feet under.

This event left me with a profound question: What could possibly be a scientific explanation for this phenomenon? Since then I have extensively and successfully replicated this experiment, with both metallic and wood made rods, with either underground or overhead pipes or simply material interfaces, like walls, *etc*. When the rod is held by the left hand, the rotation of the rod was instead clockwise. If motion from the pipe proceeded backwards (after the rod already turned approximately 90° at the top of the pipe), the rod tended to unwind, rotating towards its initial position. So that in either the forward or the reverse motion, the rod seemingly points at the pipe or the material interface, at a point right in front of the center of the body.

Much later, I realized that the rod turning and pointing at the pipe (with either forward or reversed motion) was only possible by the existence of some gravitational attractive force, whose source location (as a gravitational source) was situated at the top of the pipe, right in front of the center of the body facing the pipe run. Since motion is involved, this gravitational force must arise from motion or velocity, inside a field gradient (dot product).

Since a pipe in this case and the body were both involved in this experiment, this field must involve material interfaces. From the latter, it is known from electromagnetic fields theory [1,2] that if an electric scalar potential, $\Phi$, is distributed in a region of space, then if material interfaces exist inside this field region, the gradient of this field at these material interfaces changes to accommodate step discontinuities in the corresponding electric field, as the electric field is related to the electric scalar potential as $\mathbf{E} = -\nabla\Phi$.

If motion into a field is also involved to produce the gravitational force observed in this experiment, it is assumed that this cannot be an isolated condition, but rather this would be a general characteristic that gives rise to the existence of gravitational forces. If so, and because we know that stationary objects exert gravitational forces, this can only be consolidated if gravity is due to quantum particle motions inside such a field. Furthermore, if an electric scalar potential exists in the local region of the pipe (this experiment can be done anywhere as it has been) and a differential electric scalar potential is generated locally due to the electromagnetic properties of materials at material interfaces, this local electric scalar potential must be a universal field. From electromagnetic field theory it is known that the infinity potential is zero, which would violate this hypothesis. If however, a coupling exists between this aether ESP field and mass, and if this coupling force is stronger at quantum scales than the electric force generated by the electric pressure of this field, then the infinity potential (at the observable quantum scales) will still be zero. Based on that, another conclusion can be made that this field must penetrate the deepest quantum scales and this coupling is generated at Planck length scales. Furthermore, such coupling should involve temporal fluctuations of the field that generates a flux at these quantum scales, which perhaps makes this into a 4-dimension field.

For the dot product mentioned before and based on field theory [3], if an observer is stationary in the presence of a field, he/she is observing the stationary rate of change of the field mgnitude (say $A$) with respect to time (*i.e.* $\partial A/\partial t$). If the observer is stationary and the field is passing through (same as if the field is stationary and the observer is moving through the field), he/she is also observing the spatial change of the field with respect to time (*i.e.* $\mathbf{V}\cdot\nabla A$). These two effects taken together constitute the so-called substantial derivative of the field, $DA/Dt$. Since motion is involved with this effect, the gravitational force observed should be a function of the substantial derivative of this unknown field as $\mathbf{F}_g = f(DA/Dt) = f(\partial A/\partial t + \mathbf{V}\cdot\nabla A)$.

The stationary time rate of change of this field will be omitted, since as it will be seen later, this component will not affect the formulations for gravity. The component of the force that involves the gradient of the field can be made to be always attractive, like gravity, if **a)** the sign of the velocity vector and the sign of the gradient of the field are always the same, regardless of the direction of motion (*i.e.*, whether approaching or moving away from the source field), and **b)** if the overall function has a sign that remains unaffected by either the velocity or the gradient of the field. The latter criterion is satisfied if this equation is multiplied by a proportionality factor that is independent of these two quantities as $F_g = a_1\mathbf{V}(\nabla A) + a_2 A(\nabla\cdot\mathbf{V})$ where the second component is the divergence of the velocity. The reason why the second component that involves the divergence of the velocity $\mathbf{V}$, or acceleration $\mathbf{A}$, is included is to reserve the possibility that this component can also produce a gravitational force (as will be covered later), and as such the formulation of gravity would be instead, described by a general formulation of the gradient dot product [*i.e.*, $\mathbf{F}_g$ is a function of $\nabla(\mathbf{V}A)$. Later, it became apparent that instead of the spatial change, the second component in the equation (*i.e.* $a_2 A(\nabla\cdot\mathbf{V})$) should involve the time rate of change of the velocity vector or the acceleration of quantum particles, as $a_2 A(d\mathbf{V}/dt)$.

Based on the experimental results and the analysis discussed, the field shapes and vectors responsible for generating this attractive gravitational force for 2 L-shaped rods (one each hand) is shown in Fig. 1. The field intensity emanating from the material interface or material discontinuity (source) is assumed to decrease away from such interface, as pictorially indicated by the thickness of the field lines. A sketch of the body is shown as the broken fill oval, with the lower arms extending out, and the L-shaped rods positioned about where the squares are shown. The differential ESP due to the presence of the material interface of the body tends to attract these field lines by pulling and stretching them (as shown in Fig. 1) into a circular pattern emanating from the source, in the direction of the body. These field lines would also be expected to vary in intensity (with diminishing intensity away from the source), but for the sake of simplicity this is not shown in Fig. 1. The vertical arrows signify the direction and magnitude of the velocity vector, which remains constant as motion proceeds towards this material interface. The dashed arrows show the gradient of the field, whose direction changes as motion approaches the interface and its magnitude increases at the same time. The solid arrows signify the dot product of these other two vectors (*i.e.*, $|\mathbf{V}||\nabla A|\cos\theta$). The result of a vector dot product is scalar, and for this field depiction to be valid the assumption is that gravity or the gravitational law is a scalar field acting as a point source, which gives it vector qualities.

Based on this drawing for the shape of these fields and directions of these vectors, the force generated will be attractive, pointing in the direction of the source field (at the point situated right in front of the middle of the body and right on top of the material interface), independent of whether motion is in the direction to the source or away.

## 3. Detailed Formulations of Gravity

By replacing the unknown field $\mathbf{A}$ with this electric scalar potential, $\Phi$, the force of gravity can be expressed as $F_g = a_1\mathbf{V}\cdot\nabla\Phi + a_2\Phi(d\mathbf{V}/dt)$. Forces in SI are expressed in Newtons, or $(\mathrm{kg}\cdot\mathrm{m})/\mathrm{sec}^2$ and the ESP has its unit in volt or $((\mathrm{kg}\cdot\mathrm{m}^2)(\mathrm{A}\cdot\mathrm{s}^3)$. Based on that, and focusing for now on the first component of this force, the units of $a_1$ would need to be $(\mathrm{C}\cdot\mathrm{s})/\mathrm{m}$ or $(\mathrm{q}\cdot\mathrm{s})/\mathrm{m}$, where C is Coulombs or units of A's (A

here stands for Amps), which can also be expressed in terms of $q$ (electric charge). However, there is a choice to be made here, as the units of $a_1$ could instead be in $\mathrm{C}$, and the units of $\Phi$ could be set to $\mathrm{volt}\cdot\mathrm{s}/\mathrm{m}$. The latter choice is more appropriate, as in such case this field will constitute a flux density, which would be a time varying field, undergoing temporal fluctuations, whose strength or density will decrease with distance away from the source. Based on that, a change in variables is introduced here, whereby $\Phi$ remains as previously defined in units of $\mathrm{volt}$, and a new variable is introduce for the flux density, $\Psi$, in units of $\mathrm{volt}\cdot\mathrm{s}$, and another variable is introduced for the flux density, $\mathbf{\Lambda}$, which is a vector field, in units of $\mathrm{volt}\cdot\mathrm{s}/\mathrm{m}$. That is, for a given gravitational field (name it $\mathrm{k}$), $\Lambda_{\mathrm{k}} = \Phi_{\mathrm{k}} t_{\mathrm{u}} / r = \Psi_{\mathrm{k}} / r$ is its corresponding gravitational flux field density , wherein $r$ is the distance from source $\mathrm{k}$, and $t_{\mathrm{u}}$ is a unit of time in seconds ($\mathrm{s}$). Note that the units of $\mathrm{volt}\cdot\mathrm{s}$ are defined as Weber, which is a magnetic flux. However, it is anticipated that in this case the source and nature of this field would be different than that of a magnetic field.

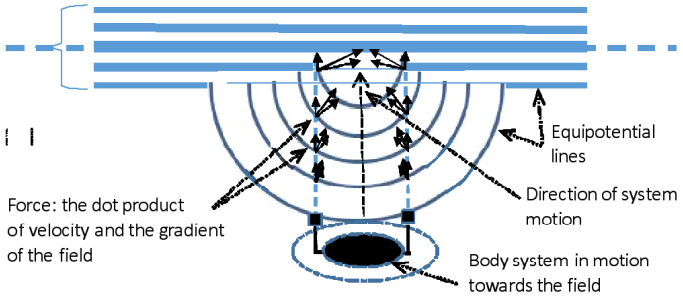


Figure 1. Depiction of the field distribution developed by the presence of a material discontinuity and the body in motion towards the discontinuity; field equi-potential lines are shown with various thickness and circular shapes; the body system in motion is shown by the broken fill oval and square shapes; velocity vectors shown by vertical arrows, the gradient of the field shown by dash arrows; the resulting force shown by solid arrows.

### 3.1. The Newtonian Component of Gravity

With these variable definitions, the first component for the force of gravity can be restated as $F_{\mathrm{g1}} = q\mathbf{V}\cdot(\nabla\cdot\mathbf{\Lambda}_{\mathrm{g}})$, with $\mathbf{\Lambda}_{\mathrm{g}}$ signifying a differential flux density (a vector field) generated by a gravitational source like the Sun or Earth, or by the material interface in the experiment, in the presence of the base aether continuum (subscript $\mathrm{c}$) with flux, $\Psi_{\mathrm{c}}$. The divergence of a vector field results in a scalar field, in which case the force direction will be along the velocity vector. This cannot satisfy gravity as an attractive force, and similarly to the prior assumption (i.e. that gravity is a scalar field), the divergence of the aether ESP flux density (a scalar quantity) is also assumed to act as a point source, which gives it vector properties due to the point source concept. It is worth noting that Einstein in his original formulations considered gravity to be a scalar field, and other subsequent theories have considered gravity as a scalar tensor vector.

This base continuum flux is anticipated to be constant, and only varying over very large cosmological distance, comparable to the size of the Universe, as the Universe is envisioned to constitute a high density expanding ether bubble inside the infinite expanse of the continuum aether cosmos. As can be seen in the last equation, this gravitational force is generated due to the coupling between this differential flux field and electrostatic charges via motion of these charges in this flux field. Since it is known that masses exert gravitational forces on each other, these charges must be the charges associated with matter of a certain mass $m$ in the gravitational influence of the differential source field generated by mass, $M_{\mathrm{k}}$. Based on that, $q$ can be redefined by dividing and multiplying by mass to develop a new definition of charge per unit mass, $q_{\mathrm{M}}$ and this equation of gravity can be restated as $\mathbf{F}_{\mathrm{g1}} = q_{\mathrm{M}} m\mathbf{V}(\nabla\cdot\mathbf{\Lambda}_{\mathrm{k}})$. The sign of the velocity vector is considered to be positive when motion is towards the source field, or towards increasing ESP, $\Phi_k$. This new definition of charge per unit mass implies that there exists a base charge, or space charge per unit mass, and since no such charge is presently observable at the resolvable quantum scales, this definition is assumed to be applicable at comparable Planck length scales.

Since the force of gravity is generated by quantum motions inside a field, this equation can also be written as the sum of the individual forces generated by quantum motions, as

$$\mathbf{F}_{\mathrm{g1}} = q_M \sum_{i=1}^{n} m_i \left[\mathbf{V}_{\mathrm{ir}}(\nabla\cdot\Lambda_{\mathrm{k}})\right] \quad ,$$

where $m_i$ is the mass of quantum particle $i$, and $\mathbf{V}_{\mathrm{ir}}$ is its quantum particle tangential orbital velocity projected into the closest radial plane of the source field. The reason for this projection is that what matters for the generation of this gravitational force is the motion of quantum particles with respect to the divergence of the vector field. Based on the velocities, abundance, and mass of particles, the force of gravity will be dominated by quark motions. If the overall mass is moving then this motion will also be reflected in the quantum particle motions therefore, the average velocity of the particles of a given mass, $m$, would be $\bar{\mathbf{V}} = \bar{\mathbf{V}}_{\mathrm{r}} + \mathbf{V}_{\mathrm{mr}}$, where $\bar{\mathbf{V}}_{\mathrm{r}}$ is this mass-weighted projected orbital velocity of quantum particles, and $\mathbf{V}_{\mathrm{mr}}$ is the overall velocity of the mass with respect to the source field. Notice that this projected average orbital velocity for individual quantum particles will be a positive number in the context of the attractive gravitational force concept.

The divergence of the source field can be computed as $\nabla\cdot\mathbf{\Lambda}_{\mathrm{k}} = \nabla\cdot(\Psi_{\mathrm{k}} / r) = -\Psi_{\mathrm{k}} / r^2$, and, by calculating the dot product with the previous assumption that this scalar aether field has vector properties, the equation for the gravitational force can be rewritten as:

$$\mathbf{F}_{\mathrm{g1}} = -q_{\mathrm{M}} m(\Psi_{\mathrm{k}} / r^2)(|\bar{\mathbf{V}}_{\mathrm{r}}|\cos\theta_{\mathrm{r}} + |\mathbf{V}_{\mathrm{mr}}|\cos\theta_{\mathrm{mr}})\hat{\mathbf{r}} \quad .$$

Notice the negative sign in this equation, which makes it consistent with Newton's universal law gravity (*i.e.*, an attractive force). If a quantum particle orbital motion is sketched in such a

projected plane, one may notice that these vectors (*i.e.* tangential orbital velocity vector & divergence of the field vector; a scalar considered here as a point source vector) sweep $0$ to $90°$ for each successive orbital quadrant. Thus, the average of this cosine sweep over a complete orbital would be the integral of the cosine function over a quadrant divided by its range, which is equal to $2/\pi$. Based on that, the equation of gravity can be expressed as

$$\mathbf{F}_{g1} = -q_M m(\Psi_k / r^2)(2|\bar{\mathbf{V}}_r|/\pi + |\mathbf{V}_{mr}|\cos\theta_{mr})\,\hat{\mathbf{r}} \quad .$$

This force would be, for instance, the force the Sun exerts on the Earth's mass, $m$, or the force the differential field in the experiment exerts on the rod mass. It may be noticed from this equation that the body with mass $m$, will exert a reciprocal gravitational force on the body $k$, and these forces will be equal, as

$$\mathbf{F}_{gm1} = -q_M m(\Psi_k / r^2)\left[(2/\pi)|\bar{\mathbf{V}}_r| + |\mathbf{V}_{mr}|\cos\theta_{mr}\right]\hat{\mathbf{r}} \quad ,$$

$$\mathbf{F}_{gM1} = -q_M M(\Psi_m / r^2)\left[(2/\pi)|\bar{\mathbf{V}}_r| + |\,|\mathbf{V}_{Mr}|\cos\theta_{Mr}\right]\hat{\mathbf{r}} \quad .$$

Except for the second components, which depend on the overall motion of the mass and these components may not be equal. The component of gravity that depends on the overall motion of a mass points in the same direction as the first component, but ordinarily it will be much smaller in magnitude, because of the differences in these velocities. However, the force observed in the experiment will be due to this component. Furthermore, this gravitational component contributes to the clumping of matter, it promotes circular orbits as the angle $\theta_{mr} = 90°$ for perfectly circular orbits, it also promotes orbit alignment with orbital planes, and it contributes to the Coriolis force.

Since there exist inherent space charges associated with a unit of mass, and they are definable or observable at Planck length scales, the ESP generated by the aggregate charge of body $k$, should obey the voltage to charge relationship in electromagnetic field theory as $\Phi_k = Q_k/(4\pi\varepsilon_0 r_u)$, where $r_u$ is a unit of distance from the center of the source $k$ (*i.e.*, 1 m in SI units). Utilizing the definition of space charge per unit mass $q_M$, the total space charge, $Q_k$ associated with source $k$, can be expressed as $Q_k = q_M M_k$, and the local differential ESP continuum potential, $\Phi_k$, can be related to the mass $M_k$, of the body as $\Phi_k = q_M M_k/(4\pi\varepsilon_0 r_u)$, or related to the flux $\Psi_k$, as $\Psi_k = \left[q_M M_k/4\pi\varepsilon_0 r_u\right]t_u$. By substituting this expression for $\Psi_k$ in the equation of gravity, this equation can be rewritten as (subscript $k$ dropped for simplicity)

$$\mathbf{F}_{gm1} = -(q_M^2 mM/4\pi\varepsilon_0 r^2)(|\bar{\mathbf{V}}_r|(2/\pi) + |\mathbf{V}_{mr}|\cos\theta_{mr})(t_u/r_u)\hat{\mathbf{r}} .$$

It may be noticed from this expression that the last factor points to a flux density, which can only be associated with the space unit charge, $q_M$, as a space charge flux density per unit mass, defined here as $q_a = q_M(t_u/r_u)$. By substituting this expression, the equation of gravity can be expressed as

$$\mathbf{F}_{gm1} = -q_M q_a(mM/4\pi\varepsilon_0 r^2)\left[(2/\pi)|\bar{\mathbf{V}}_r| + |\mathbf{V}_{mr}|\cos\theta_{mr}\right]\hat{\mathbf{r}} \quad . \quad (1)$$

with the unit vector $\hat{\mathbf{r}}$, having the same interpretation here as that defined for Newton's universal law of gravity. Note the space charge flux density, $q_a$, is a vector field. The reason that this field is stated here as a scalar is that this charge field becomes the origins of the ESP flux density, $\Lambda_k$, and for convenience the vector properties of $q_a$ are transferred to this result-ant field. This expression for the force of gravity implies that space charges, which are either inherent to mass or developed through the fundamental oscillations of mass quanta constituents with the continuum, couple trough these resonant fluctuations of the continuum aether to develop a space charge flux density, which is essential to the development of gravitational forces. Part II of the theory will identify this most fundamental constituent of matter and its origins. By equating the first term in Eq. (1) to Newton's universal law of gravity, the gravitational constant $G$, can be solved as

$$|G| = \pi^{-2} q_M q_a |\bar{\mathbf{V}}_r|/2\varepsilon_0 \quad , \text{ or } \quad |G| = (q_M/\pi)^2 |\bar{\mathbf{V}}_r|/2\varepsilon_0 \quad . \quad (2)$$

This equation satisfies the units of the gravitational constant in $(\mathrm{Nm}^2/\mathrm{kg}^2)$. Based on these definitions, one may determine that any source orientation and any quantum orbital projection should lead consistently to the same value of $G$. Since the value of $G$ is proportional to this projected mass weighted orbital velocity of quantum particles (dominated by quark orbital velocities), the gravitational constant should increase with increasing forms of degenerate matter, as the particle velocities of such matter would increase in order to obey the *exclusion principle.* However, as the collapse of a black hole approaches singularity, at some point the exclusion principal will be violated. This will cause the particle velocities to decline and in turn cause the gravitational constant to decrease, in turn causing matter to relax and particle velocities to increase, with a proportional increase to the value of $G$, in turn causing the black hole to re-squeeze. This process should cause a sustained oscillation in black holes, whose frequency is perhaps inversely proportional to the mass of the black hole. As such, singularities of matter are not possible.

### 3.2 Radial Component of Gravitational Acceleration – Radial Inertia

The original formulation of the force in terms of gradients (*i.e.*, $\mathbf{F}_g = a_1\mathbf{V}\cdot\nabla\Phi + a_2\Phi(\nabla\cdot\mathbf{V})$) suggests that an additional gravitational force component involving acceleration needs to be considered. The spatial change or the divergence of the velocity field of quantum particles should not influence gravity, but the time change of the velocity vector, $a_2\Phi(d\mathbf{V}/dt)$, should effect gravity as this would be the well-known inertia force. For this reason, the above equation was replaced by

$$\mathbf{F}_g = a_1 V\nabla\Phi + a_2\Phi(d\mathbf{V}/dt) \quad .$$

Based on earlier definitions, the second component of this equation that involves the gradient of velocity or acceleration can be expressed as $\mathbf{F}_{g2} = a_2(\Psi_K/r)(d\mathbf{V}/dt)$. By working out the units of the proportionality factor $a_2$, it can be determined that

this factor has the same units as those found for $q_a$, except for the charge per unit mass conversion factor that was also applied to this quantity. Therefore, with this adjustment applied, $a_2 = q_a$, and by computing the gradient of velocity, the equation for the acceleration component of gravity can be rewritten as $\mathbf{F}_{g2} = q_a m(\Psi_k / r)\,\boldsymbol{\alpha}_r$, with $\boldsymbol{\alpha}_r$ being the radial acceleration component of the mass $m$, inside the source flux field. Since this component of gravity is due to acceleration, it should be an inertia force, and inertia forces resist acceleration. Therefore, the sign of the acceleration vector should be positive when motion of mass $m$ is in the direction of the source field, like Earth's.

When the substitution for $\Psi_k$ is used again, this radial acceleration component of gravity can be rewritten as $\mathbf{F}_{g2} = q_\alpha^2\left[mM_k / 4\pi\varepsilon_0 r\right]\boldsymbol{\alpha}_r$. Using this equation, and considering that the force exerted on 1 kg of mass in Earth's gravity is 9.8 N ($\mathbf{F} = m\mathbf{a}$), with $a_r = g = 9.8\text{m/s}^2$, and with $|q_\alpha| = |q_M|$, $q_\alpha$ can be computed as

$$|q_\alpha| = |q_M| = \sqrt{4\pi\varepsilon_0 r_e / M_e} =$$

$$\sqrt{4\pi(8.854\times10^{-12})(6.371\times10^6)/(5.972\times10^{24})} = 1.0895\times10^{-14} \quad .$$

Thus $q_M = 1.0895\times10^{-14}$ C/kg and $q_\alpha = 1.0895\times10^{-14}$ Cs/(m·kg), which means that 1 kg of mass will possess a space charge of $1.0895\times10^{-14}$ C when this charge is viewed from the vantage point of the continuum, at Planck length scales. Using these calculated values, one can verify that the respective equation of gravity above can only be satisfied on Earth. The reason is that the base unit of mass, kg, is referenced with respect to kilograms on Earth. To make this equation universally applicable, for an accelerating mass in the radial direction on any space body, the factor $(M_E / r_E)(r_k / M_k)$ is inserted, with $r = r_k$ (E stands for Earth), and this equation for the accelerating component of gravity in a radial direction of a source body can be expressed as

$$\mathbf{F}_{g2r} = q_a^2(m / 4\pi\varepsilon_0)(M_E / r_E)\boldsymbol{\alpha}_r \quad . \tag{3}$$

This derivation proves that the inertial radial component of gravity is truly a free space inertia, as it does not depend on the radial flux field of the source at the location of the moving mass, and the factor $M_E / r_E$ compensates for referring mass to kg on Earth.a

Based on the calculated value of space charge per kg of mass, $q_M$, Earth's space charge can be calculated as $Q_E = q_M M_E = (1.0895\times10^{-14})(5.9736\times10^{24}) = 6.5082\times10^{10}$ C. The equivalent space charge at the Earth's locale should be that of the Earth superimposed on the equivalent space charge of the base continuum, $Q_c$, as $Q_{El} = Q_E + Q_c$. By utilizing the previous equation for the gravitational force between the Earth and the Sun; *i.e.*,

$$F_{gm1} = -q_M q_\alpha\left(mM / 4\pi\varepsilon_0 r^2\right)\left[(2/\pi)|\bar{\mathbf{V}}_r| + |\bar{\mathbf{V}}_{mr}|\cos\theta_{mr}\right]\hat{\mathbf{r}} \quad ,$$

and neglecting the second component because it turns out that

$$|\mathbf{V}_{mr}|\cos\theta_{mr} / (2/\pi)|\bar{\mathbf{V}}_r| \approx 1.2\times10^{-4} \quad ;$$

*i.e.* $\theta_{mr} \approx 90° - \cos^{-1}(\text{perihelion}_E/\text{aphelion}_E) \approx 75.3°$ ,

and $|\mathbf{V}_{mr}| = V_E = 3\times10^4\,\text{m/s}$ while $\bar{\mathbf{V}}_r \approx c/3$ ,

the projected mass-weighted orbital velocity of quantum particles (dominated by quark velocities) can be expressed as

$$|\bar{\mathbf{V}}_r| = 2(\pi r)^2 F_g\varepsilon_0 / (q_M q_a M_E M_S) =$$

$$\frac{2(1.503\times10^{11}\pi)^2(3.5104\times10^{22})(8.854\times10^{-12})}{(1.0895\times10^{-14})^2(5.9736\times10^{24})(1.9891\times10^{30})} = 9.8264\times10^7\,\text{m/s} \quad .$$

For normal matter (as opposed to degenerate matter), this projected mass weighted orbital velocity of quantum matter amounts to approximately 33% of the speed of light. This projected velocity is not out of bounds, for instance, with the estimated orbital velocities of quarks in protons - approximately 50% the speed of light.

### 3.3 Tangential Acceleration Component of Gravity – Free-Space Inertia

A gravitational force experienced by an object accelerating instead in the tangential direction of the source's flux field is expected to be related to the flux field generated due to the base continuum temporal oscillations, or, equivalently, to the base continuum charge, $Q_c$. Such a gravitational force should be the same as the commonly called *inertia force* or *space inertia*. It is known that the inertia force or in this case the tangential inertia force depends only on the mass of the object, and is the same everywhere, independent of where the object is located (Earth, moon, *etc.*). The presence of this base continuum field would be expected to act locally the same way as a differential flux $\Psi_k$, when it comes to gravitational effects. The source field for the this acceleration component of gravity will be at the instantaneous location of the accelerating mass, as the accelerating space charges of the mass generate an electrostatic flux that causes a local coupling with the 4D ESP continuum aether. Thus inertial forces are not fictitious; such forces also have gravitational or electrostatic origins, definable at comparable Planck length scales.

The radial acceleration component of gravity discussed in Sect. 3.2 (*i.e.*, $F_{g2} = q_a m(\Psi_k / r)a_r$) can also be utilized here to formulate the tangential space inertia force as

$$\mathbf{F}_{g2t} = -q_a m(\Psi_C / r_u)\boldsymbol{\alpha}_r \quad . \tag{4}$$

The minus sign in the equation indicates that the free space inertia is an attractive force with respect to the instantaneous position of the accelerating mass, or with respect to the location of its source field. The expression $\Psi_c / r_u$ pertains to the base continuum flux, where $r_u$ is again a unit of distance, say 1 meter. By setting this equation equal to the well-known inertia force $\mathbf{F} = m\boldsymbol{\alpha}$, and calculating the base continuum flux field, $\boldsymbol{\Lambda}_c = \Psi_c / r_u$, the following expression can be obtained:

$\Lambda_c = 1/q_\alpha$. Substituting in this equation the previous definition $\Lambda_c = \Phi_C(t_u/r_u)$, the equivalent base charge $Q_c$ of the base continuum aether can be solved as

$$Q_c = (4\pi\varepsilon_0/q_a)\left(r_u^2/t_u\right)$$
$$= 4\pi(8.854\times10^{-12})/1.0895\times10^{-14} = 1.0212\times10^4\,\mathrm{C} \quad .$$

Following, the prior ESP equation $\Phi_k = q_M M_k/(4\pi\varepsilon_0 r_u)$, can be utilized to calculate the ESP of the base continuum aether, $\Phi_c$, which turns out to be $9.1783\times10^{13}$ or $91.783$ trillion volts. Note that the calculated equivalent charge of the base continuum aether is considerably less than the Earth's differential charge, $Q_E$. Therefore, $Q_c$ could be neglected when $Q_E$ is used in the calculations for near Earth locations.

### 3.4 The Combined Equation of Gravity

In the vicinity of a body of known mass $M_k$, an accelerating mass $m$ is subjected to **a)** the Newtonian or universal component of gravity, **b)** to the gravity component associated with the overall instantaneous velocity of the mass, **c)** to the gravitational radial acceleration component, and **d)** to the free space inertia component of gravity or the tangential acceleration component. This combined gravitational force vector is the summation of all these components as

$$\mathbf{F}_g = -q_\alpha m a_t \Lambda_c \hat{\mathbf{t}} + q_\alpha(m/4\pi\varepsilon_0) \tag{5a}$$
$$\left\{-(q_M M_K/r^2)\left[(2/\pi)|\bar{\mathbf{V}}_r|+|\mathbf{V}_{mr}|\cos\theta_{mr}\right]+(M_E/r_E)q_a a_r\right\}\hat{\mathbf{r}}.$$

with the unit vectors $\hat{\mathbf{r}}$ having the same definition as that utilized in Newton's universal law of gravity, and $\hat{\mathbf{t}}$ being the tangential unit vector that points to the instantaneous location of the accelerating mass. Realizing that the base continuum can also be represented as an equivalent gravitational mass as

$$M_c = Q_c/q_M = 9.3731\times10^{17}\ \mathrm{kg} \quad ,$$

this combined equation of gravity can also be expressed as

$$\mathbf{F}_g = q_a\left(m/4\pi\varepsilon_0\right)\times\left[-(M_c/r_u)q_a a_t\hat{\mathbf{t}}+\right. \tag{5b}$$
$$\left.\left\{(q_M M_k/r^2)\left[(2/\pi)|\bar{\mathbf{V}}_r|+|\mathbf{V}_{mr}|\cos\theta_{mr}\right]+(M_E/r_E)q_a a_r\right\}\hat{\mathbf{r}}\right].$$

For the same magnitude of acceleration, calculating the value of the inertia terms in the combined equation of gravity, it can be shown that their magnitudes are equal as they should be for inertia forces ($F = ma$), which further supports the theory. Why the ratios in these terms turn out to be equal or the significance of this (*i.e.*, $M_E/r_E = M_c/r_u$), may need to be further investigated.

Based on Eq. (5), the force of gravity experienced by a free-falling body in the gravitational field of another body with mass $M_k$, (*e.g.* a mass $m$, freefalling on Earth - $a_r = 9.8\ \mathrm{m/sec^2}$) is

$$\mathbf{F}_g = q_a\frac{m}{4\pi\varepsilon_0}\left[-(2q_M M_k/\pi r^2)|\bar{\mathbf{V}}_r|+(M_E/r_E)q_a a_r\right]\hat{\mathbf{r}} = 0 \quad . \tag{6}$$

These gravitational force components, including the free space inertia force in Eq. (4) can be equated as

$$(q_a m/4\pi\varepsilon_0)(2q_M M_k|\bar{\mathbf{V}}_r|)/(\pi r^2) =$$
$$(q_a m/4\pi\varepsilon_0)(M_E/r_E)q_a a_r = q_a m(\Psi_c/r_u)a_t \ \text{ for } a_r = a_t = g_k \quad ,$$

where $g_k$ is the gravitational acceleration on a known space body. This equality constitutes Einstein's *equivalence principle* expressed in a classical sense, with the source of these forces clearly defined. Based on this equality, substituting $g_k$ in place of $a_r$ in Eq. (6), the gravitational acceleration on space body k is:

$$g_k = (2/\pi)(q_M M_k|\bar{\mathbf{V}}_r|/q_a r_k^2)(r_E/M_E) \quad . \tag{7}$$

Eq. (7) has been validated with known values of this quantity, within the accuracy of the derived parameters (*i.e.* emphasis was not placed here in deriving the value of these quantities with a high degree of accuracy). Eqs. (5a) & (5b) have been validated in part, for the individual and for some of the combinations of the gravitational force components. The gravitational acceleration on any space body k, is also known by the expression $g_k = GM_k/r_k^2$. By setting this equation equal to Eq. (7) and by substituting Eq. (2) for the gravitational constant, $G$, the equality can be solved for the permittivity of free space, $\varepsilon_0$, which results in the following expression:

$$\varepsilon_0 = q_a^2 r_E/4\pi M_E \quad . \tag{8}$$

Substituting the expression obtained in Eq. (8) for the permittivity of free space in Eq. (2), the following expression is obtained for the gravitational constant, which now becomes directly dependent on the fundamental parameters of the continuum aether:

$$G = (q_M|\bar{\mathbf{V}}_r|/q_a)(2r_E/\pi M_E) \quad . \tag{9}$$

Again, the factor of $r_E/M_E$ in these equations compensates these parameters for referencing mass to kg on Earth.

Both the permittivity of free space of Eq. (8) and the gravitational constant of Eq. (9) agree with the known units of these parameters, and their calculated values agree within three decimal figures of the known values of these quantities (remember the emphasis in this development is not to calculate these values with a high degree of accuracy). It is foreseeable that all cosmological constants and forces of Nature could be fundamentally derived based on the theory introduced in this paper.

Based on the continuum theory, inertia forces are not pseudo-forces, rather, they are real gravitational force components. In general, all pseudo forces, like the Coriolis or the centrifugal force, *etc.*, are gravitational forces according to this theory. For instance, if the instantaneous $\Delta\mathbf{V}$ vector is drawn at any given moment in time during an object's rotation, one may realize that the centrifugal or inertia force generated ($\mathbf{F} = m\mathbf{a}$) will be in the opposite direction of the instantaneous $\Delta\mathbf{V}$ vector with $a=DV/dt$, which is the same as the free space inertia force generated by an object accelerating in the base continuum, as described by Eq. (4).

## 4. Experiments

So far, experiments have been conducted to semi-quantitatively validate the theory (*i.e.*, experiments were not sci-

entifically controlled). Three different types of light gage wires were used to construct springs to measure the forces exerted on three different L-shape rods sizes (different weights). Each springs was attached to its respective L-shape rod, with the other end of the spring affixed to a stationary rod attached to the arm. The spring constants were experimentally computed using Hooke's law ( $\mathbf{F} = k\mathbf{X}$ ). Knowing the spring constants and the spring extensions in the experiment, the forces exerted on the rods were calculated.

The calculated forces are shown in Table I. These forces are relatively small, but not negligible. More scientifically control experiments will be conducted at some point in the future.

## 5. Conclusion

The continuum theory described in this paper brings back the ether (aether) theory, which prevailed during the late 19th and early 20th century, as a stationary aether, totally coupled to mass. The theory was developed as a consequence to explain scientifically a certain gravitational effect, which cannot be explained by present-day physics. The resulting theory describes gravity as an electrostatic effect; as a coupling between mass quanta constituents with a 4-dimensional electric scalar potential flux field aether, which is observable at Planck length scales. In this theory as it will be further explained in Part II, nothing is absolute, not even the speed of light. Instead, there are underlying physics principles, which should explain all universal constants and forces, including fictitious forces. In Part II of the theory the definitions of mass and time will be developed. The continuum aether mechanics that give rise to the speed of light will also be described. The origins of the Universe will be covered, including the conditions prior to the Big Bang explosion, which lead into a cycling Universe. The speed of light cannot be violated. However, the speed of light can be circumvented and the technology required to achieve this will also be introduced. This theory is not in line with the standard model. However, the belief here is that any empirically or experimentally derived model, like the standard model with 19 free parameters and so many other constants, cannot possibly be a physics-based model of Nature, despite its predictions. Such a model can make verified predictions, if such predictions are derived from less than optimum scientific arguments, or if let's say, the empirically derived model sufficiently covers the possible solution spaces. The theory that was presented in this paper does not have these limitations.

The field shapes and vectors shown in Fig. 1 also result with pure electrostatics, which does not involve quantum particle velocities. Such a formulation yields similar continuum aether properties. But this approach violated the Equivalence Principle.

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## Correspondence: *Rethinking GRT* (Cont. from p. 102)

The axial rotation of Earth's Moon can be explained in the same way. Individual particles of the Moon may indeed have underlying rectilinear motions, but each particle rotates freely so as to carry and turn the direction of its momentum with the moon's rotation. Planetary motion would be no different, except planets also have an independent daily rotation.

Force-free orbital motion creates an imbalance of momentum because one side of a body moves faster than the other. As a result, the body tends to rotate, or precess, about its point of least momentum. This off-center rotation is caused by the motion of the body itself, and so the body's force-free orbit is carried and turned with its precession. The perihelion precession of all planetary orbits may be the result of such a phenomenon. By such means, the force-free axial rotation of a planet would produce effects of gravity as well. For example, the Earth's daily rotation puts an imbalance of momentum upon everything within the Earth itself. A stone thrown to the air falls back to Earth because the stone's inertial frame moves and changes direction with reference to Earth's rotation. The direction of its path progressively turns more directly toward the Earth, and as a result the stone gains speed as it falls. The Coriolis force also plays a role in the effects of gravity. More details of this are discussed in [4].

Gravity produced by force-free circular motion may sometimes agree with Newton's Law of Gravitation, while at other times it may not. Suppose the mass of a body is increased by a factor of two. The body's imbalance of momentum will increase proportionally, and so the strength of gravity is proportional to the mass as well. Yet if the mass remains unchanged while the radius of its orbit is doubled, then the imbalance of momentum and the rate of precession become only one-half their original values. An orbit of twice the radius must move twice the distance over any given degree of precession, and so the enlarged orbit has twice the distance to shift while the rate of precession is reduced by one-half its original value. Thus, the gravity-like force becomes only one-fourth as strong and is in total agreement with the inverse-square law. Yet a galaxy in force-free circular motion has no need for gravity to hold itself together, nor is there any need for dark matter. On the other hand, exceptionally strong gravitational forces may bond the protons and neutrons together in the nucleus of an atom as they move rapidly about in force-free circular motion.

It is well known that planetary orbits are elliptical, and a planet's speed along the elliptical path changes. In order to explain planetary motion according to Kepler's laws, we may need a full picture of the Universe. An updated story of creation might go something as follows. Let us replace Big Bang theory with a cyclic Universe model, and suppose just prior to a Big Bounce there was a highly compressed singular mass. The big mass had two force-free axial rotations that were each perpendicular to the other. One spin also had twice the rate of the other. These two force-free rotations produced the effects of gravity, but their perpendicular orientation lead to a vicious cycle of self-destruction. The faster the mass rotated the more it compressed, while the more it compressed the faster it rotated. The acceleration was due to the conservation of angular momentum.

However, gyroscopic effects from the dual spin eventually put a drag on the spin itself, while the squeezing effect of gravity lost its grip. The state of its compression then caused the mass to inflate very rapidly just prior to exploding. Still, the two perpendicular spins did not stop—they continued throughout creation [4].

Based on this episode of creation, the Universe now expands with two perpendicular rotations. As a result, our solar system moves in a somewhat northerly direction perpendicular to the plane of planetary orbits. This northerly motion is not in a straight line—it is curved with the slower of the two rotating motions of the Universe. A northerly curved motion as such would cause planets to wobble as they spin, and it would cause their orbits to be elliptical rather than perfectly circular. The precession of a planet, due to its imbalance of momentum, not only carries the planet's orbital motion; it carries the planet's northerly curved motion as well. Thus, the two foci of each planetary orbit in our solar system are aligned differently with reference to the others.

Now suppose the planets of our solar system originated from the sun, while moons originated from the planets. The birth of each planet began with a massive explosion from the sun propelling hot matter into space. In compliance with Newton's third law, matter was pushed away from the sun while the sun was pushed away from the matter. As a result the sun now has a separate force-free wobble corresponding with each planet. Our moon would have originated from Earth in the same way, and as a result the Earth has a wobble corresponding with the moon's orbit. Lunar tides would then be caused by gravity of this force-free wobble and not by the moon's gravity.

Large-scale effects of gravity could be the result of force-free circular motion by itself, while small-scale effects may occur due to a body's absorption of radiation from neighboring bodies. Imagine a large mass rotating in force-free circular motion. We can assume particles of radiation emit from the body in a straight line due to force, but still they maintain the free circular motion of their source. Hence, radiation travels in a curved path due to the force-free spin of a source. The strength of gravity therefore has a connection with the rate of a body's spin and the curved path of its radiation. The faster a body rotates the stronger its gravity becomes, while a faster rotation also results in a greater curve in the path of its radiation. Now consider a satellite moving in close proximity to a planet. The satellite absorbs radiation from the planet, while angular momentum is transferred from the source of radiation to the receiver. This angular momentum has nothing to do with the intrinsic spin of elementary particles. Those spins likely cancel each other out because their directions are not aligned with one another. However, the angular momentum of radiation, due to the rotation of its source, is all of one common direction. The power of torque from this radiation is additive, and therefore it may rotate the position of a satellite, along with its inertial frame, so as to produce close-range effects of gravity. The northerly curved motion of a satellite would also be carried and turned with these gravitation effects. A change in the direction of its northerly curved motion may explain the anomalous accelerations found with many satellites after gravitational slingshot maneuvers.

A natural curve in the propagation of light may explain other mysteries as well. Type Ia supernovae are useful for cosmology because they are excellent standard candles across cosmological distances. They allow the expansion history of the Universe to be measured by looking at the relationship between the distance to an object and its redshift, which gives how fast it is receding from us. However, curved paths of light would be longer than expected, and therefore light would be dimmer than predicted over any given distance. Consequently, supernovae would appear further away than they really are, and any cosmological distance determined by their brightness would be greater than it really is. If this is true, then the expansion of the Universe could be slowing down rather than speeding up, and dark energy would be nothing but an illusion.

Figure 1 illustrates a Supernova (S1) and the Earth (E1 - E4) as the Earth moves away from a Supernova due to expansion of the Universe. The increasing distance (D1 - D4) between the Supernova and Earth is shown as four straight lines. A curved path of light is pictured by the image of a protractor. If we measure the distances D1 - D4 and make comparisons with corresponding distances along the curved path of light, we can see that the distances (D1 - D4) do not increase proportionally with the corresponding distances along a curved path of light.

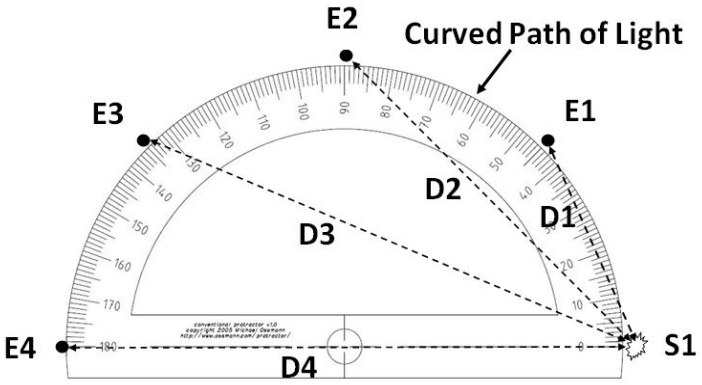


Figure 1. An effect of light path curvature.

Referring to Fig. 1, suppose that Earth recedes from the Supernova along a curved path. The speed along its curved path may indeed be constant, but the rectilinear distance between Earth and the Supernova (D1 - D4) will increase at a decreasing rate. By studying the picture, we can see that a curved path of light will increase in length at a faster rate than the rate at which Earth recedes from the Supernova. Crude measurements taken from the example above indicate that distance D4 is roughly 143% longer than distance D2, while the path of light to Earth at E4 is 200% longer than its path to Earth at E2. Expansion of the Universe therefore appears much greater than it really is.

GRT has long been on shaky ground due to its lack of compatibility with quantum theory. The ideas brought forward here are indeed highly speculative, but still they bring something curious to the drawing table. Effects of gravity produced by Galileo's version of planetary motion have striking resemblance to GRT, while those same principles of motion pave the way to a quantum theory of gravity. Can it be that Galileo was right?

**Concluded on page 116**

# On the Nature of Mass, Part 1

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In order for a scientific explanation of mass to be accurate and justified, at least three conditions should be met. First, it has to be in accord with experienced fact that is described by Newton's law: $M = F / a$ where $F$ is force and $a$ is acceleration. Second, it has to be in accord with experimentally confirmed fact that mass of artificially created particles is $M = W / c^2$ where $W$ is energy and $c$ is light speed. Third, it has to be able to explain qualitatively and prove mathematically the law of gravitation $F = GM_1M_2 / R^2$, where $R$ is separation distance. This paper explains and mathematically proves the first two conditions. As for the law of gravitation, for its theoretical and mathematical explanation it is first necessary to present the nature of ether in a more detailed manner, as space gas fluid that fills entire endless space of the Universe. That task will be done in a subsequent paper. The reader will eventually understand that efforts in explaining the material Universe with the assumption that ether doesn't exist are more futile than efforts to explain the nature of the ocean on the premises that water doesn't exist.

## 1. Introduction

Classical Mechanics was based on an intuitive assumption that mass and matter are one and the same thing, and that the amount of mass in a certain volume is determined by the amount of matter there. This intuitive assumption further allowed that mass moves in empty space throughout the Universe. This idea is consistent with the fact that a massive body will continue to move straight forward at uniform speed until it is stopped or deflected by some other massive body, or until it finds itself in a field in which different forces act.

However, we can now ask ourselves a justified and concrete question: how it can be possible to explain the movement of electromagnetic (EM) waves through an empty space, if we base our reflection upon empirical and theoretically accepted fact that waves are basically an oscillatory movement of a medium that transfers waves, and the nature of the medium determines all fundamental characteristics of the waves. Most importantly, the medium determines the speed of the waves.

## 2. From Kinetic Theory to EM Theory

A long time ago, Kinetic Theory established, and then experiments confirmed, the existence of a functional relationship between the speed of chaotic thermal movement of gas particles and the speed of waves in that gas:

$$\partial P / \partial \rho = c^2 = \gamma(P / \rho) = (\gamma / 3) v^2 \quad . \tag{1}$$

In this equation, kinetic theory gives $c$ as the wave speed, and $v$ is the mean speed of chaotic movement of gas particles. What can we say about coefficient $\gamma$ for thermal capacity of gas when ether is the medium? The only presumption that won't lead to metaphysics (in which conterporary theories do dwell) is that ether is the simplest gas fluid, in which particles are without any inner structure and have exclusevly kinetic energy, and that there are no forces that act between particles except the forces of electro-mechanical collisions. (If we would assume any inner structure of individual particles, and any forces that act between seperated particles, we would find ourselves able to explain the unexplaineable, which is a problem common to all known theories.)

If we accept the assumption that ether can be described like a gas fluid, than by Kinetic theory we have:

$$\gamma = 5 / 3 \quad . \tag{2}$$

From Eqs. (1) and (2) it follows that

$$c^2 = (5 / 9) v^2 \quad . \tag{3}$$

If we follow the suggested logic, in which there isn't anything peculiar or inexplicable, we see that the speed of chaotic movement of ether particles is definitely more than the speed of light. What is more, the speed of light loses in this way all the mystery that Special Relativity Theory (SRT) gives it. The consequence of cutting the ether out of the theory is that today no one can know or explain what EM waves are, because by definition of the nature of waves they cannot exist in empty space.

Constructed stories on how EM waves are special waves that follow special rules (on which we won't elaborate) don't explain anything, but make the problem even more vague, which opens the opportunity for everyone to fantasize according to his/her imagination. As is known, that is main characteristic of all kinds of metaphysical, esoteric, occult and religious systems, and this is also their biggest advantage, because it is the hardest thing to undermine claims that aren't clear to anyone. However, in science, which must be clear and exact, so this vagueness is not an advantage, but rather a proof that the problem in question is not understood.

## 3. Mass from Ether

A rather unusual, although quite simple, determination of the nature of the mass comes from the assumption that ether that fills all the space of the Universe. What helps most is the experimental fact that during collisions of natural particles at speeds close to light speed, a many artificial particles are created. Even more important is the fact that these particles, with definite and some-

times measured masses, are being formed in pairs of 'particles – antiparticles' which exist for a very short period of time. To be more specific, they disappear in a process called 'annihilation', while releasing the energy invested in their construction.

That last fact was probably the first proof that mass and matter weren't the same thing, although it did not solve the problem. The problem was only distinguished by, and apparently solved by, SRT. However, this explanation has started to raise doubts, and official science still invests great intellectual capacities and material means to find a valid explanation for the subject of the present paper – the determination of mass.

In preparation for that, consider the following phenomenon: in any kind of gas, if neighborhoods of increased and decreased density were to be generated, what consequences could logically be expected? First of all, balance: pairs of 'neighborhood of increased – neighborhood of decreased' density. This balance stems from the law of conservation of matter. Secondly, if these neighborhoods were to be left alone, they would quickly annihilate one another and, what is important, annihilation would be quicker if the basic pressure in the fluid were larger. If we assume this process in ether takes place at breakneck speed it means the basic pressure in ether is gigantic. This means of order $\rho c^2$, where $c$ is the speed of the light.

For determination of density we will have to make some further efforts. Unbelievable as it may sound, physics already has experimental data that supports a calculation of ether density, and it is used here. However, the full story on ether density will be presented in separate paper.

This was the first step to determine the concept of mass. Is it possible, if ether exists with its enormous basic pressure, to define a mass as an area of increased and decreased density of ether? How is it possible that areas of increased *and* of decreased density both represent masses, and what is more - masses that are mutually equal? The answer to that question was found shortly after, and thanks to simple math.

If the field of ether's changed density would appear in some spherical area, and in a way that the change of density is even in all parts of the sphere, we get this formula:

$$M = \left[ (\Delta\rho)^2 / \rho \right] \frac{4}{3} \pi R^3 \quad . \tag{4}$$

One condition is certainly fulfilled – regardless of whether density increases or decreases, in the area of changed ether density, mass is always a positive value. If we use standard terminology, we can state that the mass of field of increased ether's density correspond with the 'particle' and a mass of field of decreased ether's density correspond to 'anti-particle'.

## 4. Mechanics

The next question that comes up is: would movement of this mass through ether's medium, which stands still as a whole, correspond to the established law of mechanics mentioned in the Introduction:

$$\boldsymbol{F} = M\mathbf{a} = M\, \partial\mathbf{v} / \partial t \quad . \tag{5}$$

It seems that the analysis will be more comprehensible if we tie a coordinate system to a 'mass' and assume that mass stands still and that ether's medium moves in relation to it. Let us assume also that there is no diverting of the flow line; the movement is linear. In this case, for the law of conservation of matter to be met, the same amount of ether in unit of time flows through the field of mass and also through the section outside of mass. In this case, the following equation must apply:

$$\rho\mathbf{v} = \rho_1 \mathbf{v}_1 = (\rho + \Delta\rho)\, \mathbf{v}_1 \tag{6}$$

and

$$\Delta(\rho\mathbf{v}) = (\rho + \Delta\rho)\, \Delta\mathbf{v} = -\rho_1 \Delta\mathbf{v} \quad . \tag{7}$$

The negative sign on the right side of Eq (7) is a consequence of the fact that the speed of ether flow is decreased in the region of increased ether density.

Now we can move to the coordinate system of the ether medium, which as a whole now stands still, and field of mass moves in relation to it, in, off course, the opposite direction. According to Galileo's relativity law, the same as the mass brake the flow of ether's medium through the area of its field, in this other case when field is what it moves and medium stands still; the field pulls/entails the medium with it.

Formally, if the ether medium moves in the direction of the positive $x$-axis, in Eq. (7) in the field of mass the speed will decrease if density is increased, and grow if ether's density is decreased. In other case, the mass moves at the same speed in relation to ether's medium but now in negative direction of the $x$-axis. Mass entrains the ether medium at the speed of $\Delta v$ in the same direction in which mass moves. Because of that, the relative speed of the mass and ether's medium decreases by $\Delta v$, and if negative speed decreases, this change of speed is formally positive.

In the case where the mass in which ether's density is decreased is moving, everything is reversed: when ether's medium moves in positive direction of the $x$-axis, the speed of flow inside of the field of mass is increased.

When the field of mass is moving in a negative direction of the $x$-axis, then the field of diluted ether pushes the ether's matter in the opposite direction of its movement. If we now sum up all this we can state that the mass of the 'particle' pulls the matter of ether's medium in the same direction in which mass itself moves. The mass of 'anti-particle' pushes the ether's matter backward in relation to its direction of movement. If the changes of ether's density are equal by number, then the changes of speed of ether's matter caused by moving of this kind of masses are also equal by number.

Now consider Eq. (7) again. To make the writing easier, mark the difference in speeds on the right side with $V$, keeping in mind that this is the speed at which ether's matter moves, either in the direction in which the mass moves, or in the direction which is opposite to the mass motion, depending on whether the mass is a 'particle' or 'anti-particle':

$$\Delta\rho\mathbf{v} = -\rho_1 \Delta\mathbf{V} \quad . \tag{8}$$

The left side of Eq. (8) represents field of the mass in movement at the speed visible by naked eye, we can notice that the real movement of material ether's medium is always smaller in magnitude. How much smaller it is depends on the ratio $\Delta\rho / \rho$.

The following question then arises: is there any point in analyzing the phenomena that appear when fields of increased or decreased ether density move evenly through motionless ether medium, if we state that these fields disintegrate at breakneck speed the same moment as they appear? However, we are convinced that masses of natural particles, that continually exist and build atoms, molecules and all macroscopic bodies – protons, neutrons and electrons – have the same physical basis. Anyway, official contemporary theories accept this also, regardless of the fact they do not understand fundamental essence of it.

We cannot avoid this question also: if the masses of natural particles are represented by described fields in ether, which are basically the same as the fields of artificially created masses, how these fields can exist unlimitedly long in time? For a theory to make sense, this must be explained. However, one paper isn't enough to present a complete theory on nature of the Universe. We are forced to limit the number of problems for one paper only and leave other to deal in separate ones. Due to that circumstance let us continue to analyze the movement of the field of changed ether's density in relation to motionless ether's medium and look again to Eq. (6). It shows that the speed of ether's flow decreases in the field where density increases, and where density decreases, the speed increases. The question of utmost importance is: is it possible in this case to be established an even stationary flow of the ether, unlimited in time?

Consider what is happening if ether density is increased in the field that is placed in a line of flow. Entering that field ether thickens and its particles lose the part of kinetic energy that is spent on compression of ether to reach this increased density. The consequence of this should be that the field of increased density, in time of its formation, heats. When the final state has already established, the particles that enter in the field lose certain amount of kinetic energy, and particles that exit the field get certain amount of kinetic energy. In which case is possible to maintain continuity of this process in time? As it is obvious, if the whole process is adiabatic which means without the energy loss in surrounding space, then the process is unlimited in time. Is this possible in reality?

Now consider this same phenomenon from the other angle that Galilee's law of relativity permits: is it possible for this field of thickened or diluted ether which has been once set in motion, to continue its linear movement at even speed for unlimited period of time? If there is no energy loss from the field to the surroundings, then it is possible. If the loss is very small the movement will continue for a long time but not for unlimited period of time, depending on the amount of energy that has been lost. Does Nature give us an answer? Let's recall the sound waves in air, which are nothing other than the fields of changed basic density that moves in relation to surrounding air at the speed of the sound.

It is known that movement of sound wave is carried out approximately adiabatic, which means that the loss of thermal energy from the wave in surroundings is very small. This fact has a consequence that sound wave cannot move unlimitedly far, sooner or later it must disappear. However, in everyday experience it is impossible to notice that directly – our experience tells us that the sound spreads uninterrupted through air medium if there are no obstacles that interfere with it.

And how does the electromagnetic wave act? As in many other cases, contemporary theories say one thing, but Nature goes its own way, regardless of theories. So, official theory claims that 'electromagnetic quants' move through space without energy loss unlimitedly far in space and unlimitedly long in time. However, this theory imposes the implications of this claim: if this would be so, the whole sky above us would be the source of energy of even intensity. It wouldn't be possible to see nor register the Sun, the Moon, stars, nor any individual source of energy. How to solve this paradox?

This paradox is solved in a way we find hardly scientific and serious, by proposing an idea of 'Big Bang', from which the Universe emerged and because of which the Universe expands and all space bodies are diverging from each other in a way that the bodies which have started to move first diverge fastest, and then all other bodies follows. The consequence of this is that wavelengths of 'electromagnetic quants' are longer as the sources from which they generate are more distant from us. There is also a 'proof' for this: experimental fact indeed is that wavelengths of analogue spectral lines divert more in 'red side' if the stars from which they emit are more distant. Taking this fact as a 'proof' of 'big bang' seems imaginative but not scientific.

There is much imagination of this kind in many of today's theories, and all of it is a consequence of the same mistaken idea – that ether doesn't exist and that interstellar space is empty void without energy. But if we accept the fact that electromagnetic waves are in reality mechanical waves of ether, then for them stands everything that stands for sound waves in air. They also move through ether's medium approximately adiabatic, which means they lose a bit of its energy on its way on heating the medium through which they move. That is a simple explanation of prolonging of wavelengths on its way through the space and eventually their complete disappearing.

This assumption of waves as fields of changed density that move in relation to surroundings without directly visible energy loss gives us a valid standpoint to claim that described fields of mass can also, once being set in motion, move linear and without visible energy loss for a period of time that is long enough to experience this movement as inertial, meaning without any energy and speed loss. Here is important to notice that, in a certain sense, movement that we visually see is only apparent movement, because it is not actual movement of matter that transfers wave. This we will understand easily if we examine a water wave. The wave moves in the space at one speed, but the speed of oscillation of water molecules is a different speed, and we don't see it.

Consider again Eq. (8), in the form $\Delta\rho\mathbf{v} = \rho\mathbf{V}$. The left side involves the velocity $\mathbf{v}$ at which the field moves in space, and the right side involves the actual velocity $\mathbf{V}$ at which ether's matter moves in the field. With this equation, we can easily calculate kinetic energy of a unit volume of ether matter inside the field:

$$(\Delta\rho v)^2 / 2\rho = \rho V^2 / 2 \quad . \tag{9}$$

If we assume that the space of the field has the shape of a sphere, and that the field is homogenous in whole volume of the sphere, then total energy of the whole volume equals:

$$W_{\text{kin}} = \frac{4}{3}\pi R^3(\Delta\rho v)^2 \big/ 2\rho = \frac{4}{3}\pi R^3 \rho V^2 / 2 \quad . \tag{10}$$

Now we will describe mathematically how the energy changes in the case where this is happening in a way that the speed changes on the way through space:

$$\delta W_{\text{kin}} / \delta S = \frac{4}{3}\pi R^2 \left[ (\Delta\rho)^2 / \rho \right] \frac{v\delta v}{\delta S} = \frac{4}{3}\pi R^2 V \delta V / \delta S \quad . \tag{11}$$

It is obvious that:

$$v\delta\mathbf{v} / \delta S = \delta\mathbf{v} / \delta t = \mathbf{a} \quad .$$

So, when we set that into Eq. (11), we get:

$$\delta W_{\text{kin}} / \delta S = \frac{4}{3}\pi R^3 \left[ (\Delta\rho)^2 / \rho \right] \mathbf{a} \quad . \tag{12}$$

The fundament law of Mechanics mentioned in the Introduction is this:

$$\delta W_{\text{kin}} / \delta S = M\mathbf{a} \quad . \tag{13}$$

From Eqs. (12) and (13) the right sides are equal:

$$\frac{4}{3}\pi R^3 \left[ (\Delta\rho)^2 / \rho \right] \mathbf{a} = M\mathbf{a} \quad . \tag{14}$$

Elementary mathematics implies that mass is:

$$M = \frac{4}{3}\pi R^3 \left[ (\Delta\rho)^2 / \rho \right] \quad . \tag{15}$$

In this way, by elementary logic and elementary mathematics, we see the physical essence of *mass*. How to grasp all the consequences of Eq. (15)? We proved that it is in accord with the law (13). We are of the opinion it is also in accord with the law of inertia. Besides, if in Eq. (14) we set the change of speed to zero, we directly prove by that the fact that the mass continues to move linearly at even speed until this is changed by the action of some force.

It appears that throughout all history, no human could see the reality that stands literally in front of his/her nose. Where is that ether, if we cannot see it? However, everything that we see is ether. Our own body is ether too. And why doesn't ether give any resistance in movement of the body? Well of course it gives resistance; that is what we call the inertia of the mass. The blindness of the human mind recalls the story of E.A. Poe where the police of the whole of Paris is in search for the letter that lies on the table for everyone to see.

We have already tackled the question of how the field of changed ether density persists. In every case we must presume that Nature has the mechanism by which it accomplishes it. For the time being, we will put aside this question and move our attention to question of how much work needs to be invested to build this field. According to mechanical law, which we have already used in this paper, the change of energy is equal to the action of force in the direction in which force acts:

$$\delta W / \delta S = \mathbf{F} \quad . \tag{16}$$

The force that is produced by acting of the gas is equal to product between the surface and pressure that acts on this surface. Now let's imagine how the spherical volume forms inside of ether's medium in which ether's density is increased. This happens when the surface of some sphere moves toward inside in a way that all ether, which was in the start inside of the sphere, compresses in a smaller volume. At the beginning of the compression, the pressures outside and inside of the sphere are equal. The difference in the pressure establishes only when the surface of the sphere moves inward. During the reducing of the sphere, the difference in pressure inside and outside the sphere gradually grows so that in the end of compression has maximal value. Mean difference between the pressure outside and inside of the sphere is equal to half the maximal:

$$\delta W = 4\pi R^2 \Delta P \delta S \quad . \tag{17}$$

The law of conservation of matter demands that:

$$4\pi R^2 \rho \delta S = (4\pi / 3) R^3 \delta\rho \quad , \quad \delta S = \delta\rho R / 3\rho \quad . \tag{18}$$

Now insert $\delta S$ from Eq. (18) into Eq. (17):

$$\delta W = (4\pi / 3) R^3 \Delta P (\delta\rho / \rho) \quad . \tag{19}$$

For our conclusions to be mathematically correct we must further assume the ratio $\Delta\rho / \rho$ to be small. We have calculated this ratio theoretically for the nuclear field also, and it is on the order of size $10^{-10}$. According to this ratio, as Kinetic theory has calculated for gas when it is compressed adiabatically in a sound wave, stands this equation $\Delta P = \Delta\rho c^2$. For ether, of course, the speed of the light is in question. In this specific case we need to understand that this equation was calculated for sound wave which moves freely through the space, meaning that ether's particles in electromagnetic wave, responsible for increasing the pressure and density in gas, also move freely through the space.

However, in the situation where ether's particles remain closed in spherical volume, we can assume they bounce from the spherical surface by exerting pressure on it. In this case the impulse that is being transferred to the surface of bouncing is two times bigger, which means that the pressure on surface is also two times bigger. This gives us the right to write this equations stands: $\Delta P = 2\Delta\rho c^2$. When we set this into Eq. (19) we get:

$$\delta W = \frac{4}{3}\pi R^3 \left[ 2\Delta\rho (\delta\rho / \rho) \right] c^2 \quad . \tag{20}$$

The integral of this equation is:

$$W = \frac{4}{3}\pi R^3\left[(\Delta\rho)^2/\rho\right]c^2 \quad . \tag{21}$$

When we compare Eq. (21) with Eq. (15), we see that we have by classical mechanics the relation that made Einstein famous:

$$W = Mc^2 \quad . \tag{22}$$

We will get the same result if we assume that the force that acts on ether acts on the surface of sphere from the inside, by increasing its volume. The only difference now is that work is being carried out on ether outside the sphere, but the work needed to establish this kind of field, the field of diluted ether, stays the same. The work stays the same also in the case if the field would form in a volume in a shape of a cube. This is important to underline because it is hard to assume that artificially created particles have volume in a shape of a sphere or in a shape of any geometrically simple volume.

However, every volume, regardless of its shape, can be understood as the sum of little volumes in a shape of a cube in which every cube has homogenous field. Total mass and total energy we can get by summing of masses and energies in all these boxes, and result will be again the same as in Eq. (22). We assume that masses of artificially created particles cannot measure directly – we assume energy can, and that mass calculates by Eq. (22). That would mean we believed in accuracy of masses of artificially created subatomic particles on Einstein's 'word', because he didn't give any credible proof for accuracy of Eq. (22). The fact that energy released in atomic explosion equals to $\Delta W = \Delta Mc^2$ cannot stand as proof of accuracy for Eq. (22).

If we would, for example, write $\delta W = \delta Mc^2$, in this case is $W = Mc^2 + \text{constant}$. This constant can be zero, as well as arbitrarily large. As for artificially created particles, we have shown by our analyses that Eq. (22) marks the work invested in forming of the mass, but only of the artificially created subatomic particles. It certainly cannot be taken as a proof that the equation stands for natural particles also, because no one has ever created them, nor seen nor measured the energy of their breakdown. On the contrary, it needs to invest the enormous work, around the 1000 MeV, to break one proton. We do not know how contemporary theory solves this paradox. Our logic goes like this: if the energy in order of sizes of 1000 MeV needs to be communicated to volume in which mass of the proton is for this mass to disappear, it means that in this volume energy is decreased for this amount in comparison to the space outside of that volume. The second question is why this lack of energy is maintained by the natural way and we will speak on this subject also in one of our papers.

Eq. (21) is enough to explain almost everything that theoretical physics needs to explain:

$$W = \frac{4}{3}\pi R^3\left[(\Delta\rho)^2/\rho\right]c^2 \quad . \tag{21}$$

For instance, what will happen if we try to push two protons into the same volume? From Eq. (21) we can see that enormous work is needed, because the sum of two proton's fields would increase the energy of this new particle two times in relation to total energy which two protons had before the merging. This specifically means the invested work would be $2\times 938.28\,\text{MeV}$. Because of that the mass is 'hard', although this is, de facto, in a gas state, and why protons elastically bounce until the energy reaches the size when both crash in an impact.

Among other interesting results to which our theory of ether came is the fact that the essential nature of nuclear and electrical field is the same. They differ only in strength and topography. We will show this on the example of mass of the electron. Based on conclusions which we have established following the experimentally proven facts, the mass of electron appears like this: inside the sphere with radius of $1.408964\times 10^{-12}\,\text{cm}$ the field of electron has constant size, and beginning with the surface of the sphere and to the infinity the strength of the field decreases with the distance square from the sphere. Expressed by mathematics:

The field inside the sphere is $\Delta\rho_0$.

The field outside the sphere is $\Delta\rho_0 R_e^2/R^2$ for $R > R_e$.

Based on these assumptions, we can calculate the total mass of electron. Inside the sphere with radius $R_e$ is the part of mass that we get by multiplying the volume of the sphere with the square of the field inside of the sphere. The amount of the mass that is distributed throughout the space of the Universe we get as integral of the expression:

$$\delta M = 4\pi R^2\delta R\left[(\Delta\rho_0)^2/\rho\right]\left(R_0^4/R^4\right) \quad .$$

The calculus is simple, and it gives the following for the total mass of the electron:

$$m_e = \frac{16}{3}\pi R_e^3\times\left[(\Delta\rho_0)^2/\rho\right] \quad . \tag{23}$$

The mass is represented with the small letter $m$ because this symbol was used in previous papers. The field of an electron is negative, meaning ether in its field is diluted. One quarter of the mass of electron is inside the sphere with radius $R_e$, and three quarters are distributed throughout the whole space of the Universe. We get the total energy needed to build the mass of electron by multiplying the mass with squared speed of the light:

$$W_e = \frac{16}{3}\pi R_e^3\times\left[(\Delta\rho_0)^2/\rho\right]\times c^2 \quad . \tag{24}$$

If we write this energy in function of electron's charge and its radius we get:

$$e^2/2R_e = \frac{16}{3}\pi R_e^3\left[(\Delta\rho)^2/\rho\right]c^2 = m_e c^2 = 0.511\ \text{MeV} \quad . \tag{25}$$

Now we can realize that every body that is in the electrostatic field of an electron is practically inside of the electron's body. And two charged bodies, regardless of the distance between them, mutually permeate with their fields, or, in another words, with their bodies. Taking into account that energy depends on square of the field, it is immediately understood that convergence of the same fields increases energy and convergence of

different ones decreases energy. By that it can simply be explained the phenomenon of 'potential holes' in which particles in space situate. The fields of different signs are being pushed one into another, and the fields of the same signs are being pushed one outside of another. That is at the same time an explanation of the force which acts 'on distance' between charged bodies. The force that acts on distance does not exist and cannot exist in material world.

## 5. Conclusion

This paper proved that our determination of mass is in accord with some established physical facts. In some of the upcoming papers we will present proofs of this determination. Also, we will show how it enables us to understand the phenomenon of gravity and calculate Gravitational constant, which we pointed out as the third condition for our mass determination to be valid.

There is no evidence that ether does *not* exist. Experiments that deal with this problem boil down to the impossibility to prove that ether exists. However, let us question the premises on which these experiments were made. The majority of them start from the question of whether ether is pulled by material bodies. It was impossible to prove pulling of ether, and our Eq. (8) very clearly shows why. If the ratio $\Delta\rho/\rho = 1/8.6928\times10^{10}$ inside a proton, then use this formula to calculate the speed at which ether moves inside of proton's mass if the proton moves, let us say, at the speed of 60 km/sec.

And if we look for the speed of pulling outside of the proton's mass, on any distance from its surface, ether practically doesn't move. Consider the Michelson – Morley experiment: ask how correctly it is designed. Firstly, it doesn't prove that ether doesn't exist. It proves only that Earth doesn't move in relation to ether, and in the whole idea of this experiment there is impermissible presumption that Earth moves in relation to ether at that speed at which it moves on orbit around the Sun. And why hasn't been taken into account the possibility that the Sun moves, together with all its planets, in relation to ether?

Astrophysicists claim that the Sun moves around the center of our galaxy even faster than the Earth moves around the Sun. There is also the possibility that our own galaxy moves as a whole. When we take all this into consideration, it is even stranger that this experiment provided the mathematical trick known as 'Lorenz transformations' on the basis of which Relativity Theory declared ether to be unnecessary. Which speed of Earth's movement would someone who thinks critically set into Lorenz transformations? And in relation to which referent point would this speed be determined? If relative speed is important, Earth has as many relative speeds as there are bodies in Universe. Earth has different relative speed in relation to every one of them. We would say that even without reliable proofs that ether exists; it is a fact that on basis of ether everything can be explained, and without it nothing can be explained.

However, even before the present theory, there was evidence for existence of ether, but they weren't understood properly. For example, couldn't the Cherenkov effect be interpreted as proof that there exists medium through which the electron moves when it emits waves? Can 'relativistic mass increase' at great speeds be interpreted in a way there is a medium which resistance to body movement become visible at great speeds? The appearance of artificial masses in crashes of fast natural particles could be interpreted in that way also. And in the end, doesn't the fact that waves can run through space prove the necessity of a medium that transfers them?

When electric current of great intensity flows trough solenoid, the magnetic field is stronger when there is no iron implant placed into it. It means that at electric currents of big intensity the 'inductivity of vacuum' is bigger than inductivity of iron implant. Furthermore, 'inductivity of vacuum' grows with the increase of intensity of electric current. How to explain this, and is it possible to explain it if we presume that the space inside of solenoid is empty?

If we presume that magnetic field is consequence of ether's vortex inside the solenoid, everything is clear: at higher speeds of vortex movement, the implant of iron starts to act like a brake.

It appears possible to do an experiment that would directly prove that ether exist: we could design experiment similar to Michelson–Morley and set it into magnetic field that is strong enough for effects of ether's movement in relation to measuring instruments to be registered. The reader is asked to think critically on these subjects – the time has come to take the mask off the physical face of the Universe.

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# A Theorem of Keplerian Kinematics

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Theorem: Any particle experiencing both uniform translation and uniform rotation in a plane will follow a trajectory that respects the three laws of Kepler. This article demonstrates this Theorem, and discusses some of its consequences, one of which is Newton's postulated attraction, and the subsequent centripetal acceleration due to the rotation velocity. However, despite the fact that the reality of the geometry cannot be ignored, a stand-alone theorem cannot pretend to replace the complete mechanics.

Keywords: Kinematics, Kepler's laws, Newton's law of gravitational attraction.

## 1. Introduction

Since the time of Kepler we have known that, to first approximation, the trajectories of all celestial bodies follow three peculiar laws [1]. Kepler's laws are kinematic laws, since they do not refer to any physical consideration, such as mass, for instance. We can therefore expect to predict them from just the kinematics.

This is what we are going to achieve here by means of a Theorem that applies to all Keplerian motions. We will not postulate any physical reason to explain the existence of this Theorem in the real world, but just demonstrate its validity from a mathematical point of view.

We will note however that this Theorem predicts Newton's law of attraction as a consequence, and *not* as a mandatory foundation of Keplerian motion.

## 2. The Theorem

### 2.1 Statement

Any particle experiencing both uniform translation and uniform rotation in a plane will follow a trajectory that respects Kepler's three laws.

From a mathematical viewpoint, the velocity described by this theorem is written as follows:

$$\mathbf{v} = \mathbf{v}_{\text{rot}} + \mathbf{v}_{\text{trans}} \quad , \tag{1}$$

where $\mathbf{v}_{\text{rot}} = \vec{\omega} \times \mathbf{r}$ is rotation velocity, and $v_{\text{rot}} = |\mathbf{v}_{\text{rot}}| = \omega r$ is rotation speed, $\vec{\omega}$ is rotation frequency vector, $\omega$ is angular speed, and $\mathbf{r}$ the radius vector, $r$ is the radius magnitude, and where $\mathbf{v}_{\text{trans}}$ is the translation velocity, $v_{\text{trans}} = |\mathbf{v}_{\text{trans}}|$ is translation speed.

### 2.2 Proof

To prove the validity of this Theorem, we have to demonstrate that the relation 1 forecasts the three laws. This is what we are going to achieve, but we need first to have a word about the angular momentum and the acceleration for this type of motion.

**2.2.1 Momentum and Acceleration.** Using a definition given by R. Battin [2] we can define the massless angular momentum as $\mathbf{L} = \mathbf{r} \times \mathbf{v}$, but in the following we will refer to it simply as the angular momentum. This vector is independent of mass, and the velocities of rotation, and, translation being coplanar, it is collinear to the frequency of rotation.

Concerning the acceleration $\mathbf{a}$, since the translation velocity is a constant, there is no translation acceleration, and the derivative of Relation 1 with respect to time is $\mathbf{a} = \dot{\vec{\omega}} \times \mathbf{r} + \vec{\omega} \times \mathbf{v}$. This expression becomes $\mathbf{a} = \vec{\omega} \times \left[\mathbf{r} \times (\mathbf{r} \times \mathbf{v})\right] / r^2$, and finally:

$$\mathbf{a} = -(L v_{\text{rot}} / r^3)\mathbf{r} \quad . \tag{2}$$

Eq. (2) shows that the acceleration vector and the radius vector are collinear. This fact forces the angular momentum to be constant because its derivative with respect to time, $d\mathbf{L}/dt = \mathbf{r} \times \mathbf{a}$, is then null. Note too that this expression for $\mathbf{a}$ is also consistent with the mathematical structure of the acceleration of Newton's attraction [1]. This property is discussed further below.

**2.2.2 Kepler's First Law:** The vector multiplication of the rotation velocity and the angular momentum leads to:

$$\mathbf{v}_{\text{rot}} \times \mathbf{L} = v_{\text{rot}}^2 (1 + \mathbf{v}_{\text{rot}} \cdot \mathbf{v}_{\text{trans}} / v_{\text{rot}}^2)\mathbf{r} \quad . \tag{3}$$

It follows that:

$$L / v_{\text{rot}} = \left[1 + (v_{\text{trans}} / v_{\text{rot}}) \cos\theta\right] \text{ or } p = (1 + \varepsilon \cos\theta) r \quad . \tag{4}$$

This last equation describes a conic, where $p = L / v_{\text{rot}}$ is the so-called 'orbit parameter', $\varepsilon = v_{\text{trans}} / v_{\text{rot}}$ is its eccentricity, and $\theta$ is the angle between the directions of $\mathbf{v}_{\text{rot}}$ and $\mathbf{v}_{\text{trans}}$; *i.e.*, the true anomaly. Because $L$, $v_{\text{rot}}$ and $v_{\text{trans}}$ are constant, $p$ and $\varepsilon$ are also constant. Eq. (4) therefore agrees with Kepler's First Law, stating that the trajectory must be a conic [1].

**2.2.3 Kepler's Second Law:** The second law, or area law, derives from the constancy of angular momentum. As explained by L. Landau and E. Lifchitz [4], the momentum can also be written as a function of the position and the derivative of the true anomaly with respect to time:

$$L = r^2 \dot{\theta} \quad . \tag{5}$$

The right side of this last equation is the double of the areal velocity, and the momentum being a constant, the areal velocity must also be a constant. This is Kepler's Second Law [1].

**2.2.4 Kepler's Third Law:** The integration with respect to time of Eq. (5) , over a complete period $T$ of revolution, gives:

$$LT = \int_0^{2\pi} r^2 \, d\theta \quad . \tag{6}$$

For the case where the trajectory is an ellipse, the right side of this equation evaluates to $2\pi ab$ , where $a$ is the major semi axis and $b$ the minor one. Knowing that $a = p/(1-\varepsilon^2)$ and $b = p/\sqrt{1-\varepsilon^2}$ , it is easy to finally get the following relation :

$$Lv_{\text{rot}} = 4\pi^2 a^3 / T^2 \tag{7}$$

Because $L$ and $v_{\text{rot}}$ are constant, this last expression agrees with the Kepler's Third Law, stating that the square of the period of revolution is proportional to the cube of the major semi axis [1].

## 3. Discussion

We have so far demonstrated that Theorem 1 forecasts the three laws of Kepler. Before, the only way to explain them was through Newton's Postulate of attraction, and of course the Einstein's General Relativity Theory (GRT), which reduces to Newton's law for speeds low compared to the speed of light.

When we first state Newton's Postulate as the reason for the Keplerian motion, it is possible to demonstrate the existence of Relation 1 as a consequence. Therefore, the literature has already noticed that Relation 1 exists [5 - 11], but the authors have never presented it as a prior to the Newton's law; they always needed to set up this last first.

The kinematic viewpoint presented here inverts this assumption, as far as the Newton's law appears only as the derivative with respect to time of Relation 1. We may indeed wonder if Newton's law is prior to the Theorem 1, or if it is a consequence, because both options are receivable at a mathematical point of view. In order to decide, we can consider the problem of a sling: we may ask if the stone is rotating because the string is stretched, or if the string is stretched because the stone is rotating. Obviously the second proposal seems to be the correct one, and therefore we can consider that the Newton's acceleration of attraction is the consequence of the The Theorem 1, its derivative with respect to time, the subsequent centripetal acceleration due to the rotation velocity.

Now recall Eq. (2), $\mathbf{a} = -(Lv_{\text{rot}}/r^3)\mathbf{r}$ . Newton's Postulate of Attraction means:

$$Lv_{\text{rot}} = GM \quad , \tag{8}$$

where $G$ is the constant of gravitation and $M$ is the attracting mass. Indeed, the most remarkable part of the Newton's Postulate is usually considered to be the 'inverse square law'; *i.e.*, the dependency of the acceleration upon the inverse square of the distance to the attracting mass. However, for the kinematics this inverse square characteristic is only a geometrical consequence of Theorem 1, so it is not a Postulate any more, but rather a trivial kinematic result. Nonetheless, the other part of Newton's assumption is to state that the coefficient of proportionality should be $GM$ , instead of the strictly expected $Lv_{\text{rot}}$ , and this represents indeed a postulate with regard to the kinematics.

It should be noticed that Theorem 1, and thus Eq. (2), are always true for all masses at all scales, and so we may wonder if Newton's assumption is also true for all these conditions, as far as it is a Postulate, and the Kinematics does not fully agree with it. We know indeed that Coulomb's law, concerning the electronic charge, and so existing at subatomic scale, is also an inverse square law, but with a scale factor different from the unity of Newton. We also know that the Newton's law has some problems to explain the rotation of galaxies [12], so at large scales, and M. Milgrom already proposed to modify its dynamics [13], in case we would prefer not to use the concept of 'dark matter'.

About the mass, note that remarkably the kinematic approach is consistent with the Galileo's Principle of Equivalence, stating that the motion in a gravitational field is mass independent. Indeed Theorem 1 is also mass independent.

Of course, Theorem 1 alone does not explain all the subtleties of the gravitation (precession, nutation, many-body problem, ...), even if we can see that replacing the translation velocity $v_{\text{trans}}$ by a rotation velocity $\mathbf{v}_{\text{trans}} = \vec{\omega}_{\text{trans}} \times \mathbf{r}_{\text{trans}}$ , makes the precession appear. This theorem is only a fundamental brick describing the simple, pure Keplerian motion. It is exactly at the same position as the Newton's law of attraction before the invention of the Lagrangian mechanics. We could now wonder what would have happened if Lagrange would have taken Theorem 1 into account instead of the Newton's acceleration. It might be interesting to investigate this possibility, because so far a simple Theorem is not enough to build the Mechanics.

## 4. Conclusion

It is remarkable that the simple kinematic property described by the Theorem 1 is able to forecast the three laws of Kepler. To achieve this, the only previous proposals were those of Newton and Einstein, both of which require the use of postulates on physical concepts, such as the mass. However, we know that, as wise as it can be, a Postulate is always questionable, since it can not be fully demonstrated. At the opposite, a geometrical Theorem cannot be refuted, and that is its strength. We know however that the laws of Kepler apply to matter, and so to the physical world, and the existence of Theorem 1 opens a fundamental question: why does Nature force the matter to respect this Theorem? We have no answer so far. We understand that such a Theorem is not enough to build a physics theory; it must, however, be seen as a clue that there might exist something to modify in our physical mechanics. We must stay open to such an eventuality as the scientist, before proposing any Assumption or Postulate, has first to respect the truth of geometry, and therefore kinematics.

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# Correspondence

## *Natural Circular Motion and Projectiles*

This commentary expands on previous articles [1,2] about Galileo's original concept of inertia, looking closely at the underlying motions involved with projectiles. Space and time are here assumed absolute. Newton's first law is viewed as a special case of his second law, while generally everything moves about inertial frames of natural and force-free circular motion. In other words, a body acted upon by an unbalanced force tends to move in a straight line due to the force, and therefore it tends to keep moving in a straight line upon removal of that force. Yet all straight-line motions are carried by pre-existing inertial frames of natural circular motion.

The orbit of Earth's Moon can be described according to these principles of motion. See Fig. 1. The Moon is represented as a solid dark sphere ($M_1$). The Moon's orbit is represented as the dashed circle. If we assume the axial rotation of the Moon is natural and force-free, then the Moon serves as a rotating inertial frame of reference. Thus its orbit may have an underlying rectilinear motion, as shown by a solid arrow, but its momentum is carried and turned with the Moon's rotation. As a result, the Moon circles about a full orbit with each of its 360° axial rotations.

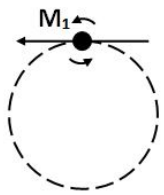

Figure 1.

The Moon's axial rotation can be explained in the same way. Individual particles of the moon may indeed have underlying rectilinear motions, but each particle rotates freely so as to carry and turn the direction of its momentum with the moon's rotation. Planetary motion would be no different, except planets also have an independent daily rotation.

Circular inertial motion creates an imbalance of momentum because one side of a body moves faster than the other. As a result the body tends to rotate, or precess, about its point of least momentum. This off-center rotation is the result of the motion of the body itself, and so the body's force-free orbit is carried and turned with its precession.

A body is pictured in Fig. 2 at two different points of an orbit, $P_1$ and $P_2$. The body has an underlying rectilinear motion as shown by the arrows. The orbit is of a counterclockwise direction, while its position is carried and turned in the same direction by an off-center twist from the body itself. A strong twist is presumed to shift the orbit one degree with every degree the body orbits. Initially the body is at $P_1$ of the orbit shown by a dashed circle. Sometime later the body is at $P_2$ where it has moved 60° about its orbit, while the position of the orbit itself has shifted 60°. A solid circle depicts the orbit. In effect the body falls to the center of its original orbit. By such means, gravitational effects are produced by natural and force-free circular motion.

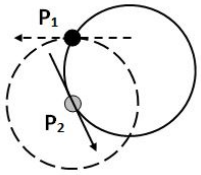

Figure 2.

The Earth's daily rotation imposes an imbalance of momentum upon everything within the Earth itself. A stone thrown to the air falls back to Earth because the stone's inertial frame rotates and changes direction with reference to Earth's rotation. The direction of its path progressively turns more directly toward the Earth, and as a result the stone gains speed as it falls. The Coriolis force and other inertial effects of Earth's rotation also play a role in Earth's gravity.

Effects produced by natural and force-free circular motion seem to agree with Newton's Law of Gravitation. Let us suppose the mass of a body is increased by a factor of two. The body's imbalance of momentum will increase proportionally, and so the strength of gravity is proportional to the mass as well. Yet if the mass remains unchanged while the radius of its orbit is doubled, then the imbalance of momentum and the rate of precession become only one-half their original values. An orbit of twice the radius must move twice the distance over any given degree of precession, and so the enlarged orbit has twice the distance to shift while the rate of precession is reduced by one-half its original value. Thus, the gravity-like force becomes only one-fourth as strong and is in total agreement with the inverse-square law.

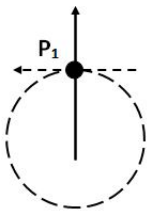

Figure 3.

Now consider a satellite launched into space from planet Earth. See Fig. 3. A satellite is represented as a solid dark sphere, $P_1$. A satellite maintains the circular motion of Earth's rotation while an external force moves the satellite into space. Rectilinear motion produced by this force is a separate and independent motion of its own. It is shown as a solid arrow pointing in an upward direction. Still, the underlying orbital motion of a

satellite creates an imbalance of momentum and will cause the orbit of the satellite to precess. Its orbital precession is caused by the motion of the body itself, and therefore it carries all underlying motions of the satellite; including its upward rectilinear motion. The satellite could very well fall back to Earth, but given the proper speeds it will fall into an orbit around the Earth.

The same principles of motion may also describe how planets revolve around a star. Suppose all planets originate from stars, while their moons originate from the planets. Each planet is created by an explosive discharge of hot matter from a star. Tiny bits of dust and gas are discharged from a star that evolve into a planet and fall into an orbit around the star. The underlying motions of a planetary orbit are illustrated in Fig. 4. A new planet is pictured at $P_1$. Its underlying motions acquired from the Sun (S1) are shown with dashed lines. At $P_2$, the underlying circular motion of the planet has precessed 60° and has carried with it the body's upward projectile motion. Given the proper speed, the planet's projectile motion will no longer move the body further from the Sun, but instead into an orbit around the Sun.

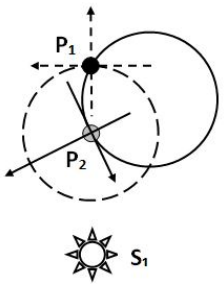

Figure 4.

Note that, contrary to typical thinking, the Sun does not need to be present to maintain a planet's orbital motion. Gravitational effects from the Sun are given to a planet at the time of its birth, and those inertial effects remain with the planet independent of the Sun. This might explain how galaxies can move in a way that disagrees with Newton's Law of Gravitation

Galaxies are observed to rotate so fast that they should fly apart, and yet they do not. They appear to lack sufficient gravity to hold themselves together. Gravity requires mass, but there is not enough visible matter in galaxies to account for their gravity. Thus dark matter is hypothesized in order to account for the missing matter. Dark matter provides a solution to the problem, but still it is possible that it may not actually exist. In truth, we simply may not have a proper understanding of gravity.

The stars of a galaxy and their orbits may originate differently than planets and their orbits. Suppose a galaxy is created from a large rotating mass that explodes into a huge cloud of dust and gas. The original mass could be totally destroyed by the explosion, and yet the creation of stars and their orbits would move independently in the absence of what is normally called 'sufficient matter' near the center of a galaxy.

The perihelion precession of Mercury's orbit deviates by approximately 43 arc seconds per century from that predicted by Newtonian theory. However, the anomalous rate of precession is explained by the curvature of spacetime in Einstein's theory of general relativity. This was a major factor leading to the acceptance of GRT. With that said, can principles of force-free circular motion, as described herein, explain the perihelion precession of Mercury's orbit?

Orbital motion creates an imbalance of momentum because one side of a body moves faster than the other. A perfectly circular planetary orbit would maintain a constant imbalance of momentum, but the velocity of a planet's projectile motion would overcome and obscure its orbital precession. In other words, a planet's projectile motion would keep the planet from falling into the Sun. But in the case of an elliptical orbit, the speed of the orbit becomes faster at its perihelion, while the curvature of the orbit becomes more. A planet's imbalance of momentum therefore becomes stronger at its perihelion, and makes the orbit precess.

The ideas described herein are indeed of a speculative nature and are in need of mathematical fomulations. Can these principles of motion then account for the motions of planets and other projectiles under the influence of gravity? Or can the perihelion precession of Mercury's orbit be explained mathematically in a better way? In other words, can the perihelion precession of Mercury's orbit be explained by just one theory? Or does it need a mix of Newtonian Theory and General Relativity Theory (GRT)?

**Sources of the precession of perihelion for Mercury**

| Arc Seconds / Century: | Cause: |
|---|---|
| 531.63 ± 0.69 | Gravitational tugs of the other planets |
| 0.0254 | Oblateness of the Sun |
| 42.98 ± 0.04 | General Relativity |
| 574.64 ± 0.69 | Total |
| 574.10 ± 0.65 | Observed |

GRT is limited to solving only one-body problems, while Newton's theory can solve two-body problems. But should not a good theory, by itself, solve *all* problems within its own domain? Moreover, can these principles of motion eliminate the need for things such as dark matter and dark energy from the cosmos?

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### *Last Words of 2017 from the GED Editor*

Without a doubt, dark matter and dark energy are ideas that can fairly be called '*ad hoc*'. We don't understand the rather flat profile of star orbit speeds in a typical disc galaxy, and we don't understand the increase with distance from us of the red shifts of stars and whole-galaxies. So we invent 'dark matter' to explain the star orbit-speed profiles, and we invent 'dark energy' to explain the star and whole-galaxy red shifts. We accept such inventions because we cannot (yet) go out there and investigate using close observation. Nevertheless, we can and should investigate in a way that uses logic and mathematics. The engineering sciences tell us a lot about systems that operate on signals that have a finite signal speed. That is exactly what Physics presents: all sorts of systems that run with the finite signal speed *c*. Many GED readers are engineers, and are well equipped to look at things in terms of signals. So please go for it!

*CKW*