Beyond Classical Physics and Relativity

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This study seeks to unveil groundbreaking concepts challenging conventional ideas, providing a fresh outlook on the underpinnings of classical physics and relativity. Employing a meticulous and systematic analytical approach, this work unearths innovative understandings that transcend the traditional constraints associated with these domains. The findings not only enrich the theoretical framework of classical physics and relativity but also carry practical implications. Embracing these novel ideas is poised to trigger a paradigm shift in the comprehension of classical physics and relativity, unlocking new avenues for exploration and advancement.

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I. INTRODUCTION

Scientific breakthroughs often stem from the inspiration drawn from well-established basic ideas. The paper commences by examining the rotating unbalance, uncovering novel aspects of classical mechanics [1, 2]. A mathematical proof is presented that anticipates motion induced by non-collinear internal forces, leading to a more profound understanding of the action-reaction principle. The gravitational redshift phenomenon from general relativity serves as a distinctive departure point for the remainder of this work, which introduces a novel concept—the varying propagation speed of light [3–14]—while maintaining the original gravitational redshift equation. This insight has a significant impact on other disciplines, including general [15] and special relativity [16], which are essential parts of a broader conceptual framework. The study advances by widening its scope to include the electrostatic forces governing charged particles. By deriving the Casimir force [17] from the non-Coulomb component of the total electrostatic force, a link to the gravitational force [1, 2] is established, enabling the deduction of the universe's properties [18–20] without relying on Hubble's constant [21]. Examining charged particles helps uncover the intricate properties of the electromagnetic field, unveiling the mysterious magnetic monopole [22] and clarifying its definition and location. Furthermore, additional forms of charges are incorporated into the standard boundaries of an electric charge. These include magnetic, gravitational, and inertial charges, as well as gravitational permittivity and inertial permeability, leading to the unification [23–28] of electromagnetism [29, 30] with the forces of gravity and inertia [31–34]. Exploring the unknown realms of electrogravity and magnetoinertia, we propose a basic experimental setup to demonstrate the magnetoinertia phenomenon, opening up new avenues for controlling gravity and inertia. The intellectual journey expands to special relativity [16, 35–44], pushing boundaries and transcending the conventional constraints of the speed of light. This paper includes an extension of the Lorentz transformation, allowing object speeds that could cross or even exceed the established light-speed barrier [39, 42, 44–60]. This scientific study is notable for its seamless integration of ideas, aimed at challenging accepted paradigms, sparking debate, and promoting more research.

II. CLASSICAL MECHANICS

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A. Strong Law of Action-Reaction

Newton's Third Law, also referred to as the strong law of action and reaction, states that every action will produce a reaction of equal magnitude and opposite direction along the same line joining the objects involved. Let us examine the interaction between two objects, A and B. According to Newton's Third Law, the force exerted by object A on object B is equal in magnitude and opposite in direction to the force exerted by object B on object A, thus

$$\sum F_{ext} \Rightarrow F_{A\to B} = -F_{B\to A}, \tag{1}$$
$$F_{A\to B} \cdot \Delta t = -F_{B\to A} \cdot \Delta t, \tag{2}$$
$$\Delta p_A = -\Delta p_B, \tag{3}$$
$$m_A = M \text{ and } m_B = 2m, \tag{4}$$
$$M \cdot \Delta u_A = -2m \cdot \Delta u_B, \tag{5}$$
$$\Delta u_A \neq \Delta u_B \Rightarrow M \cdot \Delta u_A = -2m \cdot \Delta u_B \tag{6}$$

The above scenario pertains to external forces applied to two objects that are interacting, leading to the exchange of momentum between them. Now, let's examine the scenario in which one of the objects involved is a component of a larger system. Here, we are going to address internal forces

$$\sum F_{int} \Rightarrow F_{A\to B} = -F_{B\to A}, \tag{7}$$
$$F_{A\to B} \cdot \Delta t = -F_{B\to A} \cdot \Delta t, \tag{8}$$
$$\Delta p_A = -\Delta p_B, \tag{9}$$
$$m_A = M - 2m \text{ and } m_B = 2m, \tag{10}$$
$$(M - 2m) \cdot \Delta u_A = -2m \cdot \Delta u_B, \tag{11}$$
$$\Delta u_A = \Delta u_B \Rightarrow M \cdot \Delta u_A = 0 \tag{12}$$

The action-reaction principle asserts that collinear internal forces within an isolated system do not induce any acceleration in the system. Does this also apply to forces that are not in the same line? The following section shows that this is not the case.

B. Rotating Unbalance

The graph in FIG. (1) illustrates rotational unbalance, caused by an unequal distribution of mass in a rotating part resulting in vibrations throughout the system. The analysis that follows emphasizes the critical fact that no external forces are acting on the system, such as gravity, and instead, the system depends solely on internal forces manifested by the angular momentum of the rotational components. In simple terms, the system can be considered isolated in terms of excitation. The differential equation governing the system along the y-axis is as follows

$$\theta = \omega t, \tag{13}$$
$$0 \leq \theta \leq \pi/2 \Rightarrow 0 \leq 2\theta \leq \pi, \tag{14}$$
$$\begin{aligned}(M - 2m)\frac{\mathrm{d}^2 y}{\mathrm{d}t^2} + \\ m\left(\frac{\mathrm{d}^2 y}{\mathrm{d}t^2} - r\omega^2 sin(\pi - \omega t)\right) + \\ m\left(\frac{\mathrm{d}^2 y}{\mathrm{d}t^2} - r\omega^2 sin(\omega t)\right) = -c\frac{\mathrm{d}y}{\mathrm{d}t} - ky\end{aligned} \tag{15}$$

Assuming the same stiffness (k) and damping coefficient (c) on the x-axis as in the y-axis, the system's differential equation along the x-axis is

$$\begin{aligned}(M - 2m)\frac{\mathrm{d}^2 x}{\mathrm{d}t^2} + \\ m\left(\frac{\mathrm{d}^2 x}{\mathrm{d}t^2} - r\omega^2 cos(\pi - \omega t)\right) + \\ m\left(\frac{\mathrm{d}^2 x}{\mathrm{d}t^2} - r\omega^2 cos(\omega t)\right) = -c\frac{\mathrm{d}x}{\mathrm{d}t} - kx,\end{aligned} \tag{16}$$
$$M\frac{\mathrm{d}^2 x}{\mathrm{d}t^2} + c\frac{\mathrm{d}x}{\mathrm{d}t} + kx = 0 \Rightarrow M\frac{\mathrm{d}^2 x}{\mathrm{d}t^2} = 0 \tag{17}$$

Eq. (17) shows that there is no acceleration along the x-axis because the excitation forces from the counter-rotating components cancel each other out, leading to the absence of vibrations. Vibrations arise along the y-axis due to the constructive influence of excitation forces. Using Eq. (15), we obtain

$$M\frac{\mathrm{d}^2y}{\mathrm{d}t^2}+c\frac{\mathrm{d}y}{\mathrm{d}t}+ky=2mr\omega^2 sin(\omega t) \tag{18}$$

Setting the amplitude $2mr\omega^2$ to equal F_o results in

$$F_o=2mr\omega^2 \Rightarrow F_{ext}=F_o sin(\omega t), \tag{19}$$

$$M\frac{\mathrm{d}^2y}{\mathrm{d}t^2}+c\frac{\mathrm{d}y}{\mathrm{d}t}+ky=F_o sin(\omega t)=F_{ext} \tag{20}$$

Eqs. (18) and (20) are equivalent and depict the motion of the system, demonstrating the influence of external forces on it. The centrifugal force generated by an unbalanced mass acts radially outward from the rotation axis. In the equation of motion (vibration model), this force can be described as an external force (F_{ext}) with a positive sign. When our goal is not on modeling vibrations but on studying the system's response based on the action-reaction principle, Eq. (20) simplifies to a system stimulated by an external force. This statement challenges the idea of an isolated system since there are no external forces present in our configuration. Thus,

$$M\frac{\mathrm{d}^2y}{\mathrm{d}t^2}=2m\cdot r\omega^2 sin(\omega t)=F_{ext} \tag{21}$$

By considering the excitation force as an internal force directed towards the center (centripetal force), the equation given can be interpreted based on the action-reaction principle

$$M\frac{\mathrm{d}^2y}{\mathrm{d}t^2}=-2m\cdot r\omega^2 sin(\omega t)=F_{int}, \tag{22}$$

$$-2m\cdot r\omega^2 sin(\omega t)<0 \Rightarrow M\frac{\mathrm{d}^2y}{\mathrm{d}t^2}>0, \tag{23}$$

$$2m\cdot r\omega^2 sin(\omega t)>0 \Rightarrow -M\frac{\mathrm{d}^2y}{\mathrm{d}t^2}<0 \tag{24}$$

Both equations demonstrate that the second derivative of the position leads to a nonzero acceleration of the system. Newton's third law states that in an isolated system (with no external forces), internal forces do not cause any acceleration of the system. Given the assumption we made before (no restoring and damping force), how does Eq. (22) leads to a different result? We may justify this by describing the forces acting on the isolated system in terms of action-reaction pairs, both collinear and non-collinear. With respect to the mass M, the net force acting along the y-axis is

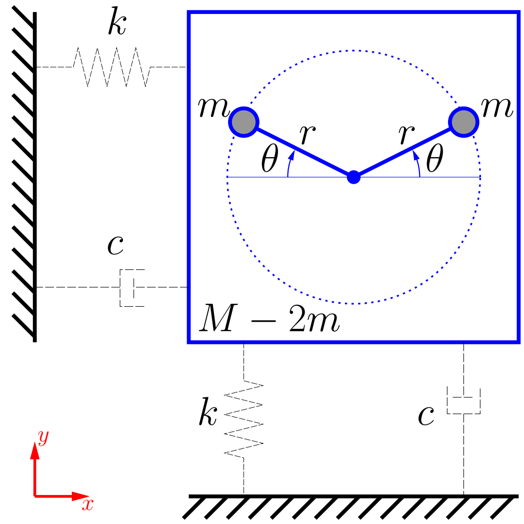

FIG. 1. Rotating Unbalance-Primal Mechanical Inertial Drive. It refers to an asymmetrical distribution of mass in a spinning component, causing vibrations and disturbances in the entire system. The graph depicts a rotating unbalance characterized by a specific configuration, including two counter-rotating masses intentionally positioned to neutralize vibrations solely along the x-axis. Without the k and c components, the illustrated rotating unbalance turns into a primal mechanical inertial drive.

$$\sum F_y=(M-2m)\frac{\mathrm{d}^2y_R}{\mathrm{d}t^2}, \tag{25}$$

$$(M-2m)\frac{\mathrm{d}^2y_R}{\mathrm{d}t^2}=-m\frac{\mathrm{d}^2y_{A_1}}{\mathrm{d}t^2}-m\frac{\mathrm{d}^2y_{A_2}}{\mathrm{d}t^2}, \tag{26}$$

$$y_R=y\pm r_o\cdot sin(\omega_o t), \tag{27}$$

$$y_{A_1}=y\pm r\cdot sin(\pi-\omega t), \tag{28}$$

$$y_{A_2}=y\pm r\cdot sin(\omega t), \tag{29}$$

$$\begin{aligned}(M-2m)\frac{\mathrm{d}^2y}{\mathrm{d}t^2}\mp(M-2m)\,r_o\omega_o^2 sin(\omega_o t)=\\ -m\frac{\mathrm{d}^2y}{\mathrm{d}t^2}\pm mr\cdot\omega^2 sin(\pi-\omega t)\\ -m\frac{\mathrm{d}^2y}{\mathrm{d}t^2}\pm mr\cdot\omega^2 sin(\omega t)\end{aligned} \tag{30}$$

$$\begin{aligned}(M-2m)\frac{\mathrm{d}^2y}{\mathrm{d}t^2}\mp(M-2m)\,r_o\omega_o^2 sin(\omega_o t)=\\ -2m\frac{\mathrm{d}^2y}{\mathrm{d}t^2}\pm 2mr\cdot\omega^2 sin(\omega t)\end{aligned} \tag{31}$$

When the excitation force is regarded as internal complying with the definition of the isolated system, the $\mp$ on the left-hand side of Eq. (31) changes to +, while the right-hand side

$\pm$ changes to $-$, thus

$$(M-2m)\,\frac{\mathrm{d}^2y}{\mathrm{d}t^2}+(M-2m)\,r_o\omega_o^2 sin(\omega_o t)= \qquad (32)$$
$$-2m\frac{\mathrm{d}^2y}{\mathrm{d}t^2}-2mr\cdot\omega^2 sin(\omega t)$$

C. Weak Law of Action-Reaction

Eq. (32) can be restated in terms of the weak law of action-reaction (some forces do not act along the line joining the objects involved), by incorporating the overall angular momentum of the system along with the angular momentum of the intrinsic components caused by the internal excitation forces (isolated system). Therefore,

$$F_R+\frac{1}{r_o}\frac{dL_R}{dt}=-\left(F_A+\frac{1}{r}\frac{dL_A}{dt}\right), \qquad (33)$$

$$F_R=(M-2m)\,\frac{\mathrm{d}^2y}{\mathrm{d}t^2}, \qquad (34)$$

$$\frac{1}{r_o}\frac{dL_R}{dt}=(M-2m)\,r_o\omega_o^2 sin(\omega_o t), \qquad (35)$$

$$F_A=2m\frac{\mathrm{d}^2y}{\mathrm{d}t^2}, \qquad (36)$$

$$\frac{1}{r}\frac{dL_A}{dt}=2mr\cdot\omega^2 sin(\omega t) \qquad (37)$$

Considering the Eqs. (33), (34) and (35), the total angular momentum induced in the system by the rotating intrinsic components, is

$$\vec{r}_{\mathrm{A}_1}=[-r_x,r_y,0]\,\mathrm{and}\,\vec{r}_{\mathrm{A}_2}=[r_x,r_y,0], \qquad (38)$$

$$\vec{F}_{\mathrm{A}_1}=[-F_x,-F_y,0]\,\mathrm{and}\,\vec{F}_{\mathrm{A}_2}=[F_x,-F_y,0], \qquad (39)$$

$$\frac{1}{r_o}\frac{dL_R}{dt}=\frac{1}{|\vec{r}_o|}\left|\left(\vec{r}_{\mathrm{A}_1}\times\vec{F}_{\mathrm{A}_1}\right)+\left(\vec{r}_{\mathrm{A}_2}\times\vec{F}_{\mathrm{A}_2}\right)\right|= \qquad (40)$$

$$\frac{1}{|\vec{r}_o|}\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ -r_x & r_y & 0\\ -F_x & -F_y & 0\end{vmatrix}+\frac{1}{|\vec{r}_o|}\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ r_x & r_y & 0\\ F_x & -F_y & 0\end{vmatrix}=|\vec{0}| \qquad (41)$$

Consequently, Eq. (33) becomes

$$\frac{1}{r_o}\frac{dL_R}{dt}=0, \qquad (42)$$

$$F_R=-\left(F_A+\frac{1}{r}\frac{dL_A}{dt}\right) \qquad (43)$$

Eq. (43) states that the system's collinear reaction force is equal to the total of rotating components' collinear and non-collinear (as projected on the y-axis) actions, but in the opposite direction. Assuming the components move solely along the y-axis, Eq. (43) turns into Newton's strong form of action-reaction principle

$$\frac{1}{r}\frac{dL_A}{dt}=0\Rightarrow F_R=-F_A \qquad (44)$$

D. Mechanical Inertial Drive

Employing Eqs. (42) and (43), Eq. (32) transforms to

$$M\frac{\mathrm{d}^2y}{\mathrm{d}t^2}=-2mr\cdot\omega^2 sin(\omega t) \qquad (45)$$

Eq. (45) shows that an isolated system can accelerate by using internal non-collinear forces. In contrast, an external observer with no understanding of the isolated system's underlying mechanics can only rely on Newton's second law of motion. As we know Newton's second law of motion is related to an external force, and for one to justify the motion of an isolated system, one has only one alternative, to postulate the existence of the system's inertia manipulation, therefore

$$F_{ext}=M\cdot a\Rightarrow F_{int}=-\frac{dM}{dt}u_{max}=-dM\cdot a_{max}, \qquad (46)$$

$$a_{max}\int_M^{M_i}dM=-\int d(F_{int}), \qquad (47)$$

$$M_i=M\left(1-\frac{F_{int}}{M\cdot a_{max}}\right)= \qquad (48)$$

Similarly, Eq. (45) can be transformed into an expression that is independent of time as follows

$$M\frac{\mathrm{d}^2y}{\mathrm{d}t^2}=dM\cdot a_{max}=-2mr\cdot\omega^2 sin(\omega t)= \qquad (49)$$
$$-2mr\cdot\omega d\omega$$

$$a_{max}\int_M^{M_i}dM=-2mr\int_0^{\omega}\omega d\omega, \qquad (50)$$

$$M_i=M\left(1-\frac{m}{M}\frac{r\omega^2}{a_{max}}\right)=M\left(1-\frac{m}{M}\frac{\omega^2}{\omega_c^2}\right), \qquad (51)$$

$$0\leq\Delta\theta\leq\pi\Rightarrow\frac{\omega}{\omega_c}=\frac{\Delta\theta}{\pi}, \qquad (52)$$

$$M_i=M\left(1-\frac{m}{M}\left(\frac{\Delta\theta}{\pi}\right)^2\right) \qquad (53)$$

Eq. (53) describes the change in the system's inertia when $\Delta\theta$ is not zero, which causes the system to accelerate. In other words, Eq. (53) is the fundamental equation that describes a primal mechanical inertial drive as depicted in FIG. (1) leaving out the k and c elements.

E. Aristotle's Law of Inertia

The author claims that the concept of the inertial drive should have been discovered much earlier. FIG. (1) illustrates a wing motion resembling that of a bird or indicates the fundamental principle by which propellers generate thrust. Put plainly, without angular momentum in the wings of birds or the propellers of a ship, thrust force cannot be generated. The force produced by an inertial drive is more closely related to Aristotle's than Newton's law of inertia. When dealing with finite quantities, Eq. (49) simplifies to

$$\Delta M \cdot a_{max} = -2mr \cdot \omega\Delta\omega = -2m \cdot u_{max}\frac{\Delta\omega}{2\pi}, \tag{54}$$

$$u_{max}\frac{\Delta\omega}{\pi} = u_{max}\frac{\Delta\theta}{\pi \cdot t_o} = \frac{u}{t_o} \Rightarrow t_o = const, \tag{55}$$

$$0 \leq \Delta\theta \leq \pi, \tag{56}$$

$$F_{Aristotle} = \Delta M \cdot a_{max} = -\frac{m}{t_o}u = -\frac{m}{t_o}u_{max}\frac{\Delta\theta}{\pi} \tag{57}$$

Eq. (57) confirms Aristotle's law of inertia, which states that an object can only be set in motion when a force is exerted on it, and this force is directly proportional to a speed. When the speed is zero, the resultant force becomes zero, resulting in the absence of any motion. But how might this work? We will use the following example to test the behavior of the system according to Aristotle's law of inertia which essentially describes the behavior of the primal inertial drive, thus

$$0 \leq t \leq t_o/2 \Rightarrow \Delta\theta = \frac{\pi}{t_o}\Delta t \Rightarrow \tag{58}$$

$$u = u_{max}\frac{\Delta\theta}{\pi} = u_{max}/2 \Rightarrow \tag{59}$$

$$\Delta p = m \cdot u_{max}\frac{\Delta\theta}{\pi} = m \cdot u_{max}/2 \Rightarrow$$

$$\Delta p_M = \Delta M \cdot a_{max}t_o = -m \cdot u_{max}/2,$$

$$t_o/2 \leq t \leq t_o \Rightarrow \Delta\theta = \frac{\pi}{2} - \frac{\pi}{t_o}\Delta t \Rightarrow \tag{60}$$

$$u = u_{max}\frac{\Delta\theta}{\pi} = 0 \Rightarrow$$

$$\Delta p = m \cdot u_{max}\frac{\Delta\theta}{\pi} = 0 \Rightarrow$$

$$\Delta p_M = \Delta M \cdot a_{max}t_o = 0$$

During the time interval of $t_o/2$, we progressively raise (e.g. through a variable resistor) the angle, and on the next time interval of $t_o/2$ gradually come to a stop (we stop varying the resistor value). The outcome in terms of the alteration in the system's momentum and the distance traveled by the system during the time interval denoted as t_o, is

$$\Delta t = t_o \Rightarrow \Delta p = 0 \Rightarrow \Delta p_M = 0 \Rightarrow p_M = p'_M = 0 \tag{61}$$

The above conclusion proves the principle of inertia as postulated by Aristotle, which states that in the absence of any force (internal, in this context), an object (or system, in this context) would remain at rest. With respect to the distance (d_{total}) covered by the system, we have

$$0 \leq t \leq t_o/2 \Rightarrow d_a = \frac{u_{max}}{t_o}\int_0^{t_o/2} tdt = \frac{u_{max}}{t_o}\frac{t_o^2}{8}, \tag{62}$$

$$t_o/2 \leq t \leq t_o \Rightarrow d_d = \frac{u_{max}}{t_o}\int_{t_o/2}^{t_o} tdt = \tag{63}$$

$$u_{max}\frac{t_o}{2} - \frac{u_{max}}{t_o}\frac{t_o^2}{8}$$

$$d_{total} = d_a + d_d = u_{max}\frac{t_o}{2} \tag{64}$$

Does Newton's law of inertia anticipate identical outcomes? According to Newton's law of inertia, it is possible to not have a deceleration phase, allowing the system to reach its maximum speed within the same total interval (t_o). Then, in the absence of any further external force, the system will maintain its maximum speed. Conversely, according to Aristotle's law of inertia and in alignment with the principle of the primal inertial drive we have just demonstrated, maintaining the angle of the rotating components unchanged leads to an abrupt halt of the system.

III. VARYING PROPAGATION SPEED OF LIGHT

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The speed at which light travels, denoted by the symbol c, is a constant value that remains the same in both special and general relativity as also in electromagnetism. The constancy mentioned in special relativity is a fundamental principle that results in time dilation and length contraction when objects move at high speeds. In general relativity, the constancy of the speed of light is integrated into the curvature of spacetime, substantially altering the gravitational behavior of large objects.

A. Gravitational Field

The gravitational redshift effect describes how photons lose energy as they go from a region of higher gravitational potential to a region of lower (or null) gravitational potential. The non-relativistic manifestation of this effect can be derived in the following manner

$$dU = -mdV_G = W_{F_{r\to\infty}}, \tag{65}$$

$$h\int_{f_o}^{f} df = -m\int_r^{+\infty}\frac{GM}{r^2}dr, \tag{66}$$

$$m = hf_o/c^2 \Rightarrow h\left(f - f_o\right) = \frac{-GM \cdot hf_o}{rc^2}, \tag{67}$$

$$r >> \frac{2GM}{c^2} \Rightarrow hf = hf_o\left(1 - \frac{GM}{rc^2}\right) \tag{68}$$

Instead of employing difficult mathematical concepts like metric tensors and geodesics to establish the relativistic version of Eq. (68), we will utilize a reverse-like approach based on the Taylor series expansion. This involves proposing a function F(r) and then determining its weak field approximation, thus

$$F(r) = \frac{1}{\sqrt{1 - f(r)^2}}(1 - f(r)^2) = \sqrt{1 - f(r)^2} = \tag{69}$$

$$\sum_{n=0}^{\infty}\frac{(2n)!}{4^n(n!)^2(1-2n)}f(r)^{2n} =$$

$$1 - \frac{1}{2}f(r)^2 - \frac{1}{8}f(r)^4 - \frac{1}{16}f(r)^6$$

$$-\frac{5}{128}f(r)^8 - \frac{7}{256}f(r)^{10} - ... =$$
$$1 - \frac{1}{2}f(r)^2 + R(r)$$
$$f(r) = \sqrt{2GM/r}/c,$$

$$hf = hf_o\sqrt{1 - \frac{2GM}{rc^2}} = hf_o\left(1 - \frac{2GM}{2rc^2} + R(r)\right), \quad (70)$$

$$r >> \frac{2GM}{c^2} \Rightarrow R(r) \to 0 \Rightarrow hf = hf_o\left(1 - \frac{GM}{rc^2}\right) \quad (71)$$

When light passes through a region of stronger gravitational field, such as near a massive object like a planet or star, its frequency decreases creating a shift toward the red end of the electromagnetic spectrum. The constancy of the propagation speed of light suggests that while the frequency of light may be altered by gravitational redshift, the speed at which light propagates remains unchanged. This concept is a key aspect of Einstein's theory of general relativity. Eq. (70) can be rewritten as

$$hf = hf_o\frac{1}{\sqrt{1 - 2GM/rc^2}}\left(1 - 2GM/rc^2\right) \cdot \frac{c}{c} \quad (72)$$

Let's explore the idea of light traveling at different speeds as it moves through a gravitational field

$$u_c = c\left(1 - \frac{2GM}{rc^2}\right), \quad (73)$$

$$hf = \frac{u_c}{c}\frac{hf_o}{\sqrt{1 - 2GM/rc^2}} \quad (74)$$

According to the above expressions, an alternative interpretation of the gravitational redshift effect suggests that the photon's propagation speed changes while passing through a gravitational field, and then on exit it returns to the known speed of light value c (in vacuum), but with altered frequency and wavelength values.

B. Electrostatic Field

While classical electrodynamics does not have a direct equivalent to gravitational redshift, we will attempt to create an analogy by applying the same derivation techniques as previously discussed. Referring to Eq. (65) and the electrostatic potential energy definition, two photons are required, hence

$$dU = -q_1 dV_E = W_{F_{r\to\infty}}, \quad (75)$$

$$2h\int_{f_o}^{f} df = -q_1\int_{r}^{+\infty}\frac{q_2}{4\pi\epsilon_o r^2}dr, \quad (76)$$

$$h\left(f - f_o\right) = -\frac{1}{2}\frac{|q_1 q_2|}{4\pi\epsilon_o r}, \quad (77)$$

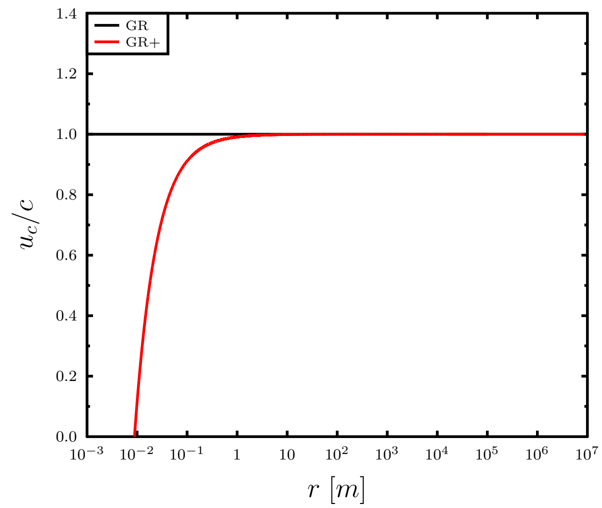

FIG. 2. Varying Propagation Speed of Light. This graph demonstrates how the propagation speed of light changes (GR+) with varying Earth radii while keeping the mass constant at the Earth's mass. While the conventional understanding posits a constant speed of light (GR), this graph showcases how the propagation speed changes with distance. At Earth's accepted radius of $5.9736 \cdot 10^6 m$, the speed of light aligns with the widely accepted measured value. However, when Earth's radius decreases to $8.87189 \cdot 10^{-3} m$, the propagation speed of light approaches zero, challenging our conventional notions of this fundamental constant.

$$\left(m_1 + m_2\right) = hf_o/c^2 \Rightarrow \lambda = h/\left(m_1 + m_2\right)c, \quad (78)$$

$$r >> \frac{|q_1 q_2|}{4\pi\epsilon_o\left(m_1 + m_2\right)c^2} \Rightarrow hf = \quad (79)$$
$$hf_o\left(1 - \frac{|q_1 q_2|}{8\pi\epsilon_o r \cdot \left(m_1 + m_2\right)c^2}\right)$$

By defining a specific function for the subfunction $f(r)$, we can derive the relativistic equation, which includes its weak field approximation, following the principle of Eq. (69)

$$f(r) = \frac{1}{c}\sqrt{2|q_1 q_2|/8\pi\epsilon_o r \cdot \left(m_1 + m_2\right)}, \quad (80)$$

$$hf = hf_o\sqrt{1 - \frac{2|q_1 q_2|}{8\pi\epsilon_o r \cdot \left(m_1 + m_2\right)c^2}} = \quad (81)$$
$$hf_o\left(1 - \frac{2|q_1 q_2|}{2 \cdot 8\pi\epsilon_o r \cdot \left(m_1 + m_2\right)c^2} + R(r)\right),$$

$$r >> \frac{|q_1 q_2|}{4\pi\epsilon_o\left(m_1 + m_2\right)c^2} \Rightarrow R(r) \to 0 \quad (82)$$

$$R(r) \to 0 \Rightarrow hf = \tag{83}$$
$$hf_o\left(1 - \frac{|q_1q_2|}{8\pi\epsilon_o r \cdot \left(m_1 + m_2\right) c^2}\right)$$

Similarly to Eqs. (72), (73), and (74), we can get the following equations for the electric field, hence

$$hf = hf_o \cdot \frac{c}{c} \cdot \tag{84}$$
$$\frac{1}{\sqrt{1 - \frac{2|q_1q_2|}{8\pi\epsilon_o r \cdot (m_1+m_2)c^2}}}\left(1 - \frac{2|q_1q_2|}{8\pi\epsilon_o r \cdot \left(m_1 + m_2\right) c^2}\right),$$
$$u_c = c\left(1 - \frac{2|q_1q_2|}{8\pi\epsilon_o r \cdot \left(m_1 + m_2\right) c^2}\right), \tag{85}$$
$$hf = \frac{u_c}{c}\frac{hf_o}{\sqrt{1 - 2|q_1q_2|/8\pi\epsilon_o r \cdot \left(m_1 + m_2\right) c^2}} \tag{86}$$

According to Eq. (85), the propagation speed of light decreases when stationary charges q_1 and q_2 with masses m_1 and m_2 respectively, move closer to one another, eventually reaching zero at the charges' surface.

C. Inertial Field (Acceleration)

Another speculative hypothesis proposes that instead of attributing the alteration in photon energy to a variation in external field potential, we could ascribe it to an alteration in photon kinetic energy. How exactly? Photons do not accelerate, but a standing wave with a controllable phase shift may. Let's consider a standing wave that has stored energy, which can be measured by its total electric field

$$E(x,t) = 2E \cdot sin(kx - \phi) \cdot cos(\omega t), \tag{87}$$
$$I_E(x,t) = \frac{1}{2}c\epsilon_o E(x,t)^2, \tag{88}$$
$$P = \frac{dU}{dt} = \int_0^{\pi/k}\int_0^{2\pi/\omega} I_E(x,t)dtdx \tag{89}$$

We may determine the number of photons denoted as N in the standing wave based on its total power, the frequency of the standing wave, and Planck's constant as follows

$$P = \frac{dU}{dt} = \frac{d\left(N \cdot h \cdot 2f\right)}{dt} \tag{90}$$

According to Y. N. Ivanov's new mechanism of motion, a phase shift ($\Delta\phi$) causes the standing wave to gain speed, resulting in the acquisition of kinetic energy. When no external forces are acting on the standing wave, the emerging force is internal because the phase is an inherent property of the standing wave itself. As a result, the amount of energy or work done ($W_{F_{int}}$) by the internal force for the standing wave to move

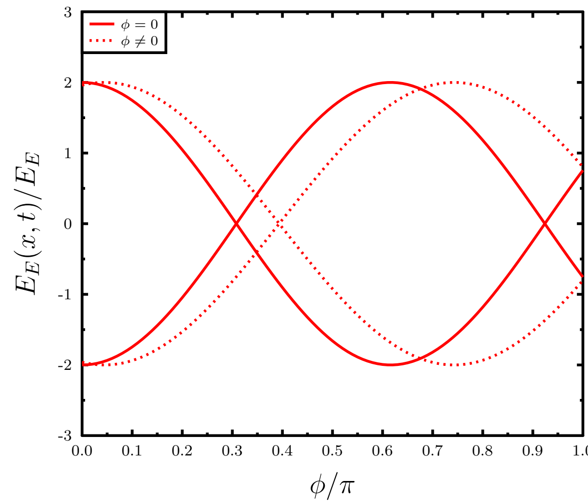

FIG. 3. EM Standing Wave Phase Shift. According to Y. N. Ivanov's new mechanism of motion, the introduction of a phase ϕ upon the standing wave forces the nodes to shift that results in the entire standing wave pattern to move in one direction. The contribution of this work to a broader understanding is that it demonstrates the necessity of reducing the standing wave stored energy when extracting and converting it into translational kinetic energy.

must be subtracted from the standing wave oscillation energy. In other words, the change in standing wave stored energy dU must be equal to the change in its translational kinetic energy dU_k, thus

$$dU = -dU_k = W_{F_{int}}, \tag{91}$$
$$d\left(N \cdot h \cdot 2f\right) = -dU_k, \tag{92}$$
$$m = N \cdot 2hf_o/c^2 \Rightarrow N \cdot 2h\int_{f_o}^{f} df = -m\int_0^u udu, \tag{93}$$
$$N \cdot 2h\left(f - f_o\right) = -N \cdot 2hf_o\frac{u^2}{2c^2}, \tag{94}$$
$$u << c \Rightarrow N \cdot 2hf = N \cdot 2hf_o\left(1 - \frac{u^2}{2c^2}\right) \tag{95}$$

Again, by giving a specific function to the subfunction $f(r)$, we may construct the relativistic equation, including its weak field approximation, following the principle of Eq. (69)

$$f(r) = f(u) = u/c, \tag{96}$$
$$N \cdot 2hf = N \cdot 2hf_o\sqrt{1 - \frac{u^2}{c^2}} = \tag{97}$$
$$N \cdot 2hf_o\left(1 - \frac{u^2}{2c^2} + R(r)\right),$$

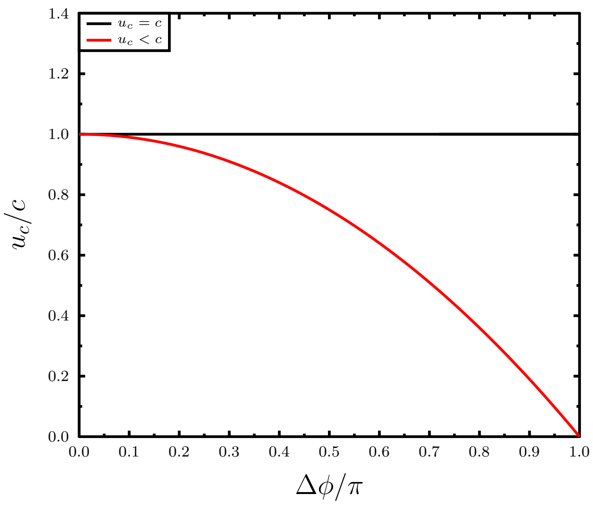

FIG. 4. Varying Propagation Speed of Light. This graph illustrates the intriguing relationship between the local propagation speed of light and the phase shift ($\Delta\phi$) applied to a standing wave. The x-axis represents the normalized phase shift, ranging from 0 to 1, while the y-axis denotes the corresponding normalized local propagation speed of light.

$$u << c \Rightarrow R(r) \to 0 \Rightarrow N \cdot 2hf = N \cdot 2hf_o\left(1 - \frac{u^2}{2c^2}\right) \tag{98}$$

By employing Eqs. (72), (73), and (74), we may derive the subsequent formulations for the inertial acceleration

$$N \cdot 2hf = N \cdot 2hf_o \frac{1}{\sqrt{1 - \frac{u^2}{c^2}}}\left(1 - \frac{u^2}{c^2}\right) \cdot \frac{c}{c}, \tag{99}$$

$$u_c = c\left(1 - \frac{u^2}{c^2}\right), \tag{100}$$

$$N \cdot 2hf = \frac{u_c}{c}\frac{N \cdot 2hf_o}{\sqrt{1 - \frac{u^2}{c^2}}} \tag{101}$$

The physics of mechanical standing waves was extensively investigated by Y. N. Ivanov [61], who made an important discovery by uncovering a novel mechanism of motion known as moving standing wave (see FIG. (3)). By introducing a phase ϕ, the nodes of the standing wave will be redeployed, resulting in moving the entire standing wave pattern in one direction. The position of the nodes of the standing wave (see Eq. (87)) is given by the well-known expression

$$sin(kx - \phi) = sin(n\pi) \Rightarrow kx - \phi = n\pi, \tag{102}$$

$$0 \le x \le \lambda/2 \Rightarrow n = 0 \Rightarrow x = \frac{\lambda}{2}\frac{\phi}{\pi}, \tag{103}$$

$$\Delta t = \frac{1}{2f} \Rightarrow u = \frac{\Delta x}{\Delta t} = a \cdot \Delta t = c\frac{\Delta\phi}{\pi} = c\frac{\Delta f}{2f} \tag{104}$$

As a result of Eq. (104), Eqs. (100) and (101) transform into

$$0 \le u \le c \Rightarrow 0 \le \Delta\phi \le \pi, \tag{105}$$

$$u_c = c\left(1 - \left(\frac{\Delta\phi}{\pi}\right)^2\right), \tag{106}$$

$$N \cdot 2hf = \frac{u_c}{c}\frac{N \cdot 2hf_o}{\sqrt{1 - (\Delta\phi/\pi)^2}} \tag{107}$$

And the internal force F_{int} is given by

$$m = N \cdot 2hf_o/c^2, \tag{108}$$

$$a = c\Delta f \Rightarrow F_{int} = -m \cdot a = -N \cdot 2hf_o\Delta f/c \tag{109}$$

Eq. (106) shows that increasing the phase shift $\Delta\phi$ of the standing wave due to the internal force (F_{int}) leads to a decrease (see FIG. (4)) in the local propagation speed of light.

IV. ELECTROSTATIC FORCE AND FIELD

Contents

The total electrostatic potential energy of a charge in the presence of another charge can now be calculated by multiplying the ratio of propagation speeds with Coulomb's electrostatic potential energy, thus

$$U_{EM} = \frac{q_1 q_2}{4\pi\epsilon_o r}\frac{u_c}{c}, \tag{110}$$

$$U_{EM} = \frac{q_1 q_2}{4\pi\epsilon_o r}\left(1 - \frac{2|q_1 q_2|}{8\pi\epsilon_o r \cdot (m_1 + m_2)\, c^2}\right) \tag{111}$$

Subsequently, the negative gradient of the potential energy with respect to position gives the total electric force

$$\vec{F}_{\text{EM}} = -\nabla U_{EM}, \tag{112}$$

$$\vec{F}_{\text{EM}} = \frac{q_1 q_2}{4\pi\epsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q_1^2 q_2^2}{8\pi^2\epsilon_o^2\,(m_1 + m_2)\, c^2}\frac{\vec{r}}{|\vec{r}|^4} \tag{113}$$

A. Total Force Between Two Electrons

The vector form and amplitude of the force between two electrons is obtained by setting

$$m_1 = m_2 = m_e, \tag{114}$$

$$q_1 = q_2 = q_e, \tag{115}$$

$$\vec{F}_{\text{EM}} = \frac{q_e^2}{4\pi\epsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q_e^4}{16\pi^2\epsilon_o^2 m_e c^2}\frac{\vec{r}}{|\vec{r}|^4}, \tag{116}$$

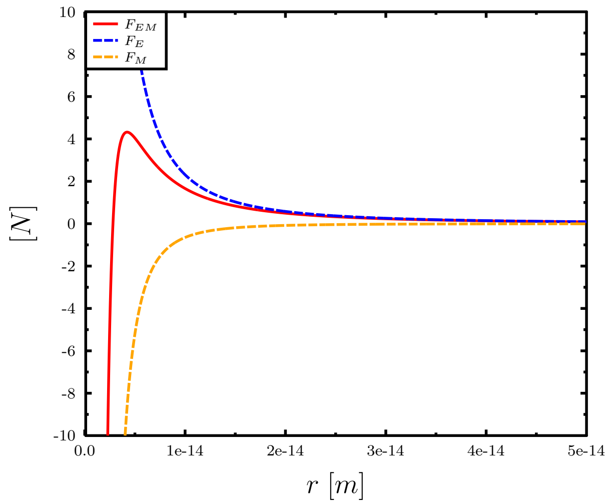

FIG. 5. Total Electric Force. The illustration comprises three distinct graphs representing the total force (F_{EM}), the repulsive (Coulomb) force (F_E), and the attractive force (F_M) between two electrons. For distances beyond 10^{-12} meters, the total force aligns closely with the Coulomb force. The x-axis of each graph corresponds to the distance (r) between the electrons, measured in meters, while the y-axis denotes the magnitude of the respective forces in newtons.

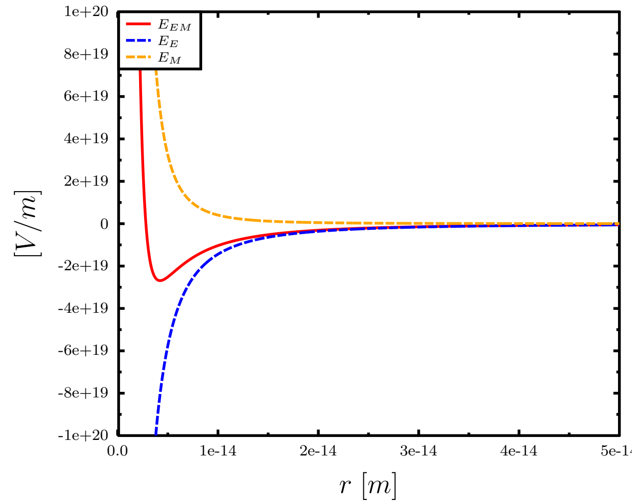

FIG. 6. Total Electric Field. The illustration consists of three separate graphs depicting the total field (E_{EM}), the Coulomb field (E_E), and the counter-Coulomb field (E_M) of the electron. For distances beyond 10^{-12} meters, the total field aligns closely with the Coulomb field. The x-axis of each graph corresponds to the distance (r) from the electron center, measured in meters, while the y-axis denotes the magnitude of the respective field in volts per meter.

$$|\vec{F}_{\mathrm{EM}}| = |\vec{F}_{\mathrm{E}}| + |\vec{F}_{\mathrm{M}}|, \tag{117}$$

$$|\vec{F}_{\mathrm{EM}}| = \frac{q_e^2}{4\pi\epsilon_o r^2} - \frac{q_e^4}{16\pi^2\epsilon_o^2 m_e c^2 r^3}, \tag{118}$$

$$r >> 10^{-12} m \Rightarrow |\vec{F}_{\mathrm{EM}}| \approx |\vec{F}_{\mathrm{E}}| = \frac{q_e^2}{4\pi\epsilon_o r^2} \tag{119}$$

B. Electron's Total Field

The electric field of an electron is the negative gradient of the electrostatic potential. By considering the Eqs. (114) and (115), yields

$$V_{EM} = \frac{U_{EM}}{q_e} = \frac{q_e}{4\pi\epsilon_o r}\left(1 - \frac{q_e^2}{8\pi\epsilon_o r \cdot m_e c^2}\right), \tag{120}$$

$$\vec{E}_{\mathrm{EM}} = -\nabla V_{EM}, \tag{121}$$

$$\vec{E}_{\mathrm{EM}} = \frac{q_e}{4\pi\epsilon_o}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q_e^3}{16\pi^2\epsilon_o^2 m_e c^2}\frac{\vec{r}}{|\vec{r}|^4}, \tag{122}$$

$$|\vec{E}_{\mathrm{EM}}| = |\vec{E}_{\mathrm{E}}| + |\vec{E}_{\mathrm{M}}|, \tag{123}$$

$$|\vec{E}_{\mathrm{EM}}| = \frac{q_e}{4\pi\epsilon_o r^2} - \frac{q_e^3}{16\pi^2\epsilon_o^2 m_e c^2 r^3} \tag{124}$$

$$r >> 10^{-12} m \Rightarrow |\vec{E}_{\mathrm{EM}}| \approx |\vec{E}_{\mathrm{E}}| = q_e/4\pi\epsilon_o r^2 \tag{125}$$

V. CASIMIR EFFECT

Contents

The established understanding of the Casimir effect comes from the quantum field theory that claims the phenomenon is caused by vacuum fluctuations of the electromagnetic field between closely spaced conducting plates or objects.

A. Casimir Effect Paradigm Shift

A different interpretation for the Casimir effect may come from the total force between two electrons (see Eq. (118)) where the latter consists of two parts, the repulsive Coulomb $\vec{F}_{\mathrm{E}}$ and an attractive force $\vec{F}_{\mathrm{M}}$

$$\vec{F}_{\mathrm{EM}} = \vec{F}_{\mathrm{E}} + \vec{F}_{\mathrm{M}}, \tag{126}$$

$$\vec{F}_{\mathrm{M}} = -\frac{q_e^4}{16\pi^2\epsilon_o^2 m_e c^2}\frac{\vec{r}}{|\vec{r}|^4}, \tag{127}$$

$$|\vec{F}_{\mathrm{M}}| = -\frac{q_e^4}{16\pi^2\epsilon_o^2 m_e c^2 r^3} \tag{128}$$

The attractive force F_M can also be written as

$$\frac{q_e^2}{4\pi\epsilon_o\hbar c} = \frac{2\pi r_e}{\lambda_{ce}} = \alpha, \tag{129}$$

$$m_e c = h/\lambda_{ce}, \tag{130}$$

$$|\vec{F}_{\mathrm{M}}| = -4\pi r_e^2 \frac{\hbar c}{2\lambda_{ce} r^3} \tag{131}$$

B. Casimir Force Derivation

The original Casimir Force expression can be obtained from the attractive force F_M (see Eq. (131)) as follows

$$|\vec{F}_{\mathrm{M}}| = -4\pi r_e^2 \frac{\hbar c}{2\lambda_{ce} r^3} \frac{2n}{2n} \frac{\pi^2}{\pi^2}, \tag{132}$$

$$A = n \cdot 4\pi r_e^2, \tag{133}$$

$$\lambda = \lambda_{ce}/2 \Rightarrow n\lambda = 2\pi r, \tag{134}$$

$$|\vec{F}_{\mathrm{Casimir}}| = |\vec{F}_{\mathrm{M}}| = -A\frac{\hbar c \pi^2}{248.0502 r^4} \approx -A\frac{\hbar c \pi^2}{248 r^4} \tag{135}$$

VI. UNIVERSE PROPERTIES

Contents

The estimated age of the observable universe, with a value of around 13.787 billion years, is determined by the analysis of the cosmic microwave background (CMB), the oldest known light in the universe, together with other astronomical observations. The age of the observable universe corresponds to a radius

$$r_{observable} = 4.4 \cdot 10^{26} m \tag{136}$$

Equating Newtonian gravitational attraction with the attractive force F_M between two electrons leads to an unexpected discovery, so

$$|\vec{F}_{\mathrm{G}}| = |\vec{F}_{\mathrm{M}}|, \tag{137}$$

$$-G\frac{m_e \cdot m_e}{r^2} = -4\pi r_e^2 \frac{\hbar c}{2\lambda_{ce} r^3}, \tag{138}$$

$$-G\frac{h^2}{\lambda ce^2 r^2 c^2} = -r_e^2 \frac{hc}{\lambda_{ce} r^3} \tag{139}$$

A. Universe Radius

We obtain the radius of the universe

$$r = r_{universe} = r_u = r_e^2 \frac{\lambda_{ce} c^3}{hG} = 1.17381 \cdot 10^{28} m, \tag{140}$$

$$r_{observable}/r_{universe} = 3.748\% \tag{141}$$

B. Universe Deceleration

The gravitational force (F_G) and the force F_M are both attractive forces. Assuming a small-scale big bang occurs, which causes electrons to expand in space. The electrons will then begin to decelerate as a result of the gravitational force (or attraction force), hence

$$a_u = -\frac{c^2}{r_u} = -\frac{hG}{r_e^2 \lambda_{ce} c} = -7.6567 \cdot 10^{-12} m/s^2 \tag{142}$$

C. Universe Period

$$t_u = \frac{2\pi r_u}{c} = 2\pi \cdot r_e^2 \frac{\lambda_{ce} c^2}{hG} = 2.4601 \cdot 10^{20} s \tag{143}$$

D. Universe Mass

$$M_u = \frac{a_u r_u^2}{G} = \frac{r_e^2 c^5}{G^2} \frac{\lambda_{ce}}{h} = 1.5806 \cdot 10^{55}\ kg \tag{144}$$

E. Universe Energy

$$E_u = M_u c^2 = \frac{r_e^2 c^7}{G^2} \frac{\lambda_{ce}}{h} = 1.4206 \cdot 10^{72} J \tag{145}$$

F. Universe Thermodynamic Temperature

The thermodynamic temperature of the universe (CMB) [20] can be determined as follows

$$S_u = 4\pi r_u^2 = 1.7314 \cdot 10^{57} m^2, \tag{146}$$

$$\sigma = 5.6704 \cdot 10^{-8} J/s^2 m^2 K^4, \tag{147}$$

$$D_u = \frac{E_u}{t_u S_u} = \frac{E_u}{t_u 4\pi r_u^2} = \sigma T^4, \tag{148}$$

$$T = T_{universe} = \left(\frac{E_u}{\sigma \cdot t_u S_u}\right)^{1/4} = 2.769 K, \tag{149}$$

$$T = T_{universe} \approx T_{CMB} = 2.726 K \tag{150}$$

G. Quantum Length and Time

By performing a dimensional analysis on the equation for the radius of the universe, we obtain the quantum length [18] and time

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$$r_q = \frac{hG}{\lambda_{ce}c^3} = 6.7648 \cdot 10^{-58}m, \tag{151}$$

$$t_q = r_q/c = \frac{hG}{\lambda_{ce}c^4} = 2.2565 \cdot 10^{-66}s \tag{152}$$

H. Fine Structure Constant

$$r_u r_q = r_e^2, \tag{153}$$

$$\alpha = \frac{2\pi r_e}{\lambda_{ce}} = \frac{q_e^2}{4\pi\epsilon\hbar c} = \frac{2\pi\sqrt{r_u r_q}}{\lambda_{ce}} \tag{154}$$

The properties of the universe mentioned, except quantum length, time, and fine structure constant, align with the findings in Laers Wahlin's work "The Deadbeat Universe" without relying on Hubble's constant.

VII. ELECTROMAGNETIC FIELD

Contents

The electron's total field, as shown in Eq. (122), is composed of a Coulomb field and an opposing field, denoted as $\vec{E}_{\mathrm{M}}$, which may be further analyzed

$$\vec{E}_{\mathrm{M}} = -\frac{q_e^3}{16\pi^2\epsilon_o^2 m_e c^2}\frac{\vec{r}}{|\vec{r}|^4}, \tag{155}$$

$$\vec{E}_{\mathrm{M}} = -\frac{q_e^2}{4\pi\epsilon_o|\vec{r}| \cdot m_e c}\frac{q_e}{4\pi\epsilon_o c}\frac{\vec{r}}{|\vec{r}|^3}, \tag{156}$$

$$\epsilon_o\mu_o = 1/c^2 \Rightarrow \vec{E}_{\mathrm{M}} = -\frac{q_e^2}{4\pi\epsilon_o|\vec{r}| \cdot m_e c}\mu_o\frac{q_e c}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} \tag{157}$$

A. Electromagnetic Field of a Charged Particle

Eq. (157) states that $\vec{E}_{\mathrm{M}}$ is a vector obtained by multiplying a tangential speed scalar with a magnetic induction vector using the cross product operation, thus

$$\vec{E}_{\mathrm{M}} = -(u_{tan} \times \vec{B}), \tag{158}$$

$$u_{tan} = \frac{q_e^2}{4\pi\epsilon_o|\vec{r}| \cdot m_e c}, \tag{159}$$

$$\vec{B}_{\mathrm{M}} = \mu_o\frac{q_e c}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} = \mu_o\frac{q_m}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} \tag{160}$$

The negative gradient of the Coulomb electrostatic potential, plus the cross product of the tangential speed scalar with the magnetic induction vector, results in the electromagnetic field of a charged particle as that of an electron

$$\vec{E}_{\mathrm{EM}} = -\nabla V_E - (u_{tan} \times \vec{B}_{\mathrm{M}}), \tag{161}$$

$$-\nabla V_E = \frac{q_e}{4\pi\epsilon_o}\frac{\vec{r}}{|\vec{r}|^3} \tag{162}$$

The cross-product was used to derive a force expression like the Lorentz force equation. What is the physical meaning of the symbol u_{tan}? When addressing the overall field of a charged particle, we are referring to a situation in which there is only one particle and no external fields are present. Eq. (159) suggests that the tangential speed u_{tan} is related to the tangential speed of electric field lines, which decreases as the distance from the charge's center increases. At a distance of one electron radius (re) from its center, the electron's total field is zero, while the tangential speed is equal to the speed of light c, hence

$$r = 10^{-10}m \Rightarrow u_{tan} \approx 8.45 \cdot 10^3 m/s, \tag{163}$$

$$r = r_e \Rightarrow u_{tan} = \frac{q_e^2}{4\pi\epsilon_o r_e \cdot m_e c} = c \tag{164}$$

B. Magnetic Monopole

P. Dirac proposed the concept of magnetic monopoles within the framework of quantum theory. In 1931, Dirac introduced a theoretical framework [22] that integrated the concept of magnetic monopoles into electromagnetism by introducing the notion of quantizing magnetic charge, similar to the quantization of electric charge in electrons and protons

$$g = \frac{\hbar}{2q_e}, \tag{165}$$

$$\vec{B}_{\mathrm{M}} = \mu_o g\frac{\vec{r}}{|\vec{r}|^3} \Rightarrow |\vec{B}_{\mathrm{M}}| = \mu_o\frac{g}{r^2} \tag{166}$$

A dimensional analysis suggests that g should have units of $A \cdot m$, whereas Dirac's monopole looks to have units of $V \cdot s$ or J/A. The proposed concept is demonstrated in Eq. (160), where q_m is a magnetic dipole, thus a magnetic monopole is half the dipole and may take generally the following values

$$q_m = \pm q_e c = \pm 4.8032 \cdot 10^{-11} A \cdot m, \tag{167}$$

$$q_{m_m} = \pm q_m/2 = \pm q_e \cdot c/2 = \pm 2.4016 \cdot 10^{-11} A \cdot m \tag{168}$$

The magnetic induction of an electron can be theoretically defined as the result of two indivisible magnetic monopoles generated by the rotation (see u_{tan}) of the electron or any charged particle

$$\vec{B}_{\mathrm{M}} = \mu_o\frac{q_m}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} = \mu_o\frac{2q_{m_m}}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} \tag{169}$$

C. Lorentz Force

The total force between two electrons is similar to the Lorentz force, with the sole distinction being the scalar u_{tan}

$$\vec{E}_{\mathrm{E}} = -q_e \nabla V_E, \tag{170}$$

$$u_{tan} \times \vec{B}_{\mathrm{M}} = -\frac{q_e^2}{4\pi\epsilon_o |\vec{r}| \cdot m_e c} \mu_o \frac{q_m}{4\pi} \frac{\vec{r}}{|\vec{r}|^3}, \tag{171}$$

$$\vec{F}_{\mathrm{EM}} = q_e \left(\vec{E}_{\mathrm{E}} + u_{tan} \times \vec{B}_{\mathrm{M}} \right), \tag{172}$$

$$\vec{F}_{\mathrm{EM}} = q_e \vec{E}_{\mathrm{E}} + q_m \frac{u_{tan}}{c} \times \vec{B}_{\mathrm{M}} \tag{173}$$

VIII. GRAVITOINERTIAL FIELD

Contents

As shown thus far, the magnetic monopoles (or as magnetic dipoles), exist within charges and are formed as a result of their rotation (see u_{tan}). Similarly, we could hypothesize that because the charge has mass and intrinsic rotational motion, it should exhibit gravitational and inertial effects. Studying such small-scale phenomena requires the creation of a new way of thinking. The approach being suggested aims to use the concept of charge to encompass both gravitational and inertia phenomena.

A. Gravitational and Inertial Charges

Starting from Eq. (167) the magnetic charge is defined through the following expression

$$q_m = \pm q_e c \Rightarrow \frac{q_m^2}{q_e^2} = c^2 = \frac{1}{\epsilon_o \mu_o}, \tag{174}$$

$$\frac{q_e^2}{\epsilon_o} = \mu_o q_m^2 \tag{175}$$

Similarly, the gravitational and inertial charges are related in the following manner

$$q_i = \pm q_g c \Rightarrow \frac{q_i^2}{q_g^2} = c^2 = \frac{1}{\epsilon_{g_o} \mu_{i_o}}, \tag{176}$$

$$\frac{q_g^2}{\epsilon_{g_o}} = \mu_{i_o} q_i^2 \tag{177}$$

We have four unknown variables: two newly introduced charges and two newly introduced constants. What is the next step? The concept posits that all types of charge originate from a single electric charge. We found that the spinning of an electric charge generates a magnetic field. Therefore, when an electric charge is associated with a mass, the electric field is responsible for creating a gravitational field. The mass's inherent rotation should lead to the creation of an inertial field. By equating Eqs. (175) and (177), may comprehend the previously stated assertions, thus

B. Charge Types Relation

$$\frac{q_e^2}{\epsilon_o} = \frac{q_g^2}{\epsilon_{g_o}} \text{ and } \mu_{i_o} q_i^2 = \mu_o q_m^2 \tag{178}$$

C. Gravitational Permittivity and Inertial Permeability

Setting the gravitational permittivity ϵ_{g_o} equals to G, yields

$$\epsilon_{g_o} = G = 6.67384 \cdot 10^{-11} Nm^2/kg^2 \tag{179}$$

Therefore, the inertial permeability is

$$\mu_{i_o} = \frac{1}{\epsilon_{g_o} c^2} = 1.6671 \cdot 10^{-7} kg^2 s^2/Nm^4 \tag{180}$$

Knowing the gravitational permittivity and inertial permeability enables us to calculate the gravitational and inertial charges through Eq. (178), thus

$$q_g = \pm q_e \sqrt{\frac{G}{\epsilon_o}} = \pm 4.3988 \cdot 10^{-19} J/kg \cdot m^{-1}, \tag{181}$$

$$q_i = \pm q_m \sqrt{\frac{\mu_o}{\mu_{i_o}}} = \pm 1.3187 \cdot 10^{-10} J \cdot m/kg \cdot m^{-1} s \tag{182}$$

D. Electrogravity and Magnetoinertia Coupling Constants

Apparently, the square root next to the charges corresponds to the electrogravity and magnetoinertia coupling constant respectively

$$g_e = \sqrt{\frac{G}{\epsilon_o}} = 2.745573 \; V/kg \cdot m^{-1}, \tag{183}$$

$$g_m = \sqrt{\frac{\mu_o}{\mu_{i_o}}} = 2.745573 \; V/kg \cdot m^{-1} \tag{184}$$

E. Gravitoinertial Field of a Charged Particle

The gravitoinertial field of a charged particle, like an electron, is similar to its electromagnetic field, thus

$$\vec{E}_{\mathrm{GI}} = \frac{q_g}{4\pi\epsilon_{g_o}} \frac{\vec{r}}{|\vec{r}|^3} - \frac{q_g^3}{16\pi^2 \epsilon_{g_o}^2 m_e c^2} \frac{\vec{r}}{|\vec{r}|^4}, \tag{185}$$

$$\vec{E}_{\mathrm{GI}} = \frac{q_g}{4\pi\epsilon_{g_o}} \frac{\vec{r}}{|\vec{r}|^3} - \frac{q_g^3}{16\pi^2 \epsilon_{g_o}^2 m_e c^2} \frac{\vec{r}}{|\vec{r}|^4}, \tag{186}$$

$$\vec{E}_{\mathrm{GI}} = -\nabla V_G - (u_{tan} \times \vec{B}_{\mathrm{I}}), \tag{187}$$

$$u_{tan} = \frac{q_g^2}{4\pi\epsilon_{g_o}|\vec{r}| \cdot m_e c}, \tag{188}$$

$$\vec{B}_{\mathrm{I}} = \mu_{i_o}\frac{q_g c}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} = \mu_{i_o}\frac{q_i}{4\pi}\frac{\vec{r}}{|\vec{r}|^3}, \tag{189}$$

$$-\nabla V_G = \frac{q_q}{4\pi\epsilon_{g_o}}\frac{\vec{r}}{|\vec{r}|^3}, \tag{190}$$

$$-(u_{tan} \times \vec{B}_{\mathrm{I}}) = -\frac{q_g^2}{4\pi\epsilon_{g_o}|\vec{r}| \cdot m_e c}\mu_{i_o}\frac{q_i}{4\pi}\frac{\vec{r}}{|\vec{r}|^3}, \tag{191}$$

$$[E_{GI}] = [kg \cdot m^{-1}/m] \tag{192}$$

F. Gravitational Displacement (Acceleration) Field

The gravitational displacement field can be defined as the multiplication of the gravitational permittivity and the gravitational field strength in direct proportion to the electric displacement field, in which the former is essentially the gravitational acceleration measured in $N/kg = m/s^2$, thus

$$\vec{D}_{\mathrm{GI}} = \epsilon_{g_o}\vec{E}_{\mathrm{GI}}, \tag{193}$$

$$\vec{D}_{\mathrm{GI}} = \frac{q_g}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q_g^3}{16\pi^2\epsilon_{g_o}m_e c^2}\frac{\vec{r}}{|\vec{r}|^4}, \tag{194}$$

$$|\vec{D}_{\mathrm{G}}| = \frac{q_g}{4\pi r^2}, \tag{195}$$

$$|\vec{D}_{\mathrm{I}}| = -\frac{q_g^3}{16\pi^2\epsilon_{g_o}m_e c^2 r^3}, \tag{196}$$

$$|\vec{D}_{\mathrm{GI}}| = |\vec{D}_{\mathrm{G}}| + |\vec{D}_{\mathrm{I}}|, \tag{197}$$

$$[D_{GI}] = [N/kg] = [m/s^2] \tag{198}$$

G. Inertial Monopole

The inertia dipole, like the magnetic dipole, is introduced in Eq. (191). An inertial monopole is half the dipole and may take generally the following values

$$q_i = \pm q_g c = \pm 1.3187 \cdot 10^{-10} J \cdot m/kg \cdot m^{-1} s, \tag{199}$$

$$q_{i_m} = q_i/2 = \pm 0.65935 \cdot 10^{-10} J \cdot m/kg \cdot m^{-1} s \tag{200}$$

The inertial induction of an electron can be theoretically defined as the result of two indivisible inertial monopoles generated by the rotation of the electron or any charged particle

$$\vec{B}_{\mathrm{I}} = \mu_{i_o}\frac{q_i}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} = \mu_{i_o}\frac{2q_{i_m}}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} \tag{201}$$

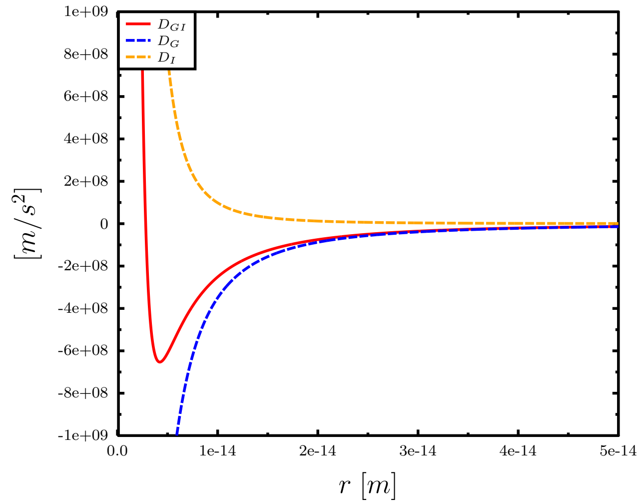

FIG. 7. Total Gravitational Displacement (Gravitational Acceleration) Field. The illustration consists of three separate graphs depicting the total gravitational displacement field (D_{GI}), the gravitational displacement field (D_G), and the counter-gravitational (inertial) displacement (D_I) of the electron. For distances beyond 10^{-12} meters, the total field aligns closely with the gravitational displacement field (D_G). The x-axis of each graph corresponds to the distance (r) from the electron center, measured in meters, while the y-axis denotes the magnitude of the respective field in meters per second squared.

H. Electrogravity

According to the charge types hypothesis, the electric charge is the causal factor in the generation of the gravitational field associated with the charge, thus from the definition of the gravitational charge (Eq. (181)) yields

$$q_g = \pm q_e\sqrt{\frac{G}{\epsilon_o}} \Rightarrow \frac{q_g}{4\pi r^2} = \pm\frac{q_e}{4\pi r^2}\sqrt{\frac{G}{\epsilon_o}}, \tag{202}$$

$$a_G = D_G = G \cdot E_G = \epsilon_o E_E\sqrt{\frac{G}{\epsilon_o}}, \tag{203}$$

$$a_G = D_G = E_E\sqrt{\epsilon_o G}, \tag{204}$$

$$E_E = a_G/\sqrt{\epsilon_o G} \tag{205}$$

The required electric field or electric displacement field strength to create or confront Earth's gravitational displacement (acceleration) field, is

$$a_G = 9.81\ N/kg, \tag{206}$$

$$E_E = 4.0355 \cdot 10^{11}\ V/m, \tag{207}$$

$$D_E = \epsilon_o E = 3.573\ Cb/m^2 \tag{208}$$

I. Magnetoinertia

Similarly, by considering the notion of the inertial charge as stated in Eq. (182), we may establish a connection between the inertial displacement (acceleration) field and the magnetic induction of an electric charge

$$q_i = \pm q_m \sqrt{\frac{\mu_o}{\mu_{i_o}}} \Rightarrow \frac{q_i}{4\pi r^2} = \pm \frac{q_m}{4\pi r^2} \sqrt{\frac{\mu_o}{\mu_{i_o}}}, \tag{209}$$

$$a_I = D_I = \frac{B_I}{c\mu_{i_o}} = \frac{B_M}{c\mu_o} \sqrt{\frac{\mu_o}{\mu_{i_o}}}, \tag{210}$$

$$a_I = D_I = B_M / \sqrt{\mu_o / G}, \tag{211}$$

$$B_M = a_I \cdot c \sqrt{\mu_o \mu_{i_o}} = a_I \sqrt{\mu_o / G} \tag{212}$$

The required magnetic field induction strength to create or confront Earth's gravitational displacement (acceleration) field, is

$$a_I = 9.81 \ m/s^2, \tag{213}$$

$$B_M = 1.3461 \cdot 10^3 \ T = 1.3461 \cdot 10^3 \ kg/A \cdot s^2 \tag{214}$$

J. Electrogravity and Magnetoinertia Tests

Assume we have no knowledge of the charge types relation (Eq. (178)) and want to establish a link between the electric field and gravitational acceleration. Let us start by looking at the energy density of the electric field, and then construct the proper equation for the gravitational field's acceleration. Thus,

$$E_E = K_E q_e / r^2, \tag{215}$$

$$K_E = 1/4\pi\epsilon_o, \tag{216}$$

$$u_E = \frac{1}{2}\epsilon_o E_E^2 = \frac{E_E^2}{8\pi K_E}, \tag{217}$$

$$[u_E] = [J/m^3] \tag{218}$$

Similarly, the energy density of the gravitational field is derived as follows

$$a_G = GM/r^2, \tag{219}$$

$$u_G = \frac{a_G^2}{8\pi G}, \tag{220}$$

$$[u_G] = [N/m^2] = [N \cdot m/m^2 \cdot m] = [J/m^3], \tag{221}$$

$$a_G = 9.81 m/s^2 \Rightarrow u_G = 5.7371 \cdot 10^{10} J/m^3 \tag{222}$$

The final stage entails defining the problem. What is the required electric energy density or electric field strength to counteract the gravitational energy density (or gravitational field acceleration) of Earth? The value of energy density is already provided by Eq. (222). Simply equating the electric energy density with that of the gravitational field establishes a connection between the two. Therefore,

$$u_E = u_G \Rightarrow \frac{E_E^2}{8\pi K_E} = \frac{a_G^2}{8\pi G} \Rightarrow \frac{E_E^2}{K_E} = \frac{a_G^2}{G}, \tag{223}$$

$$a_G = E_E / \sqrt{\frac{K_E}{G}} = E_E \sqrt{4\pi\epsilon_o G}, \tag{224}$$

$$E_E = a_G \sqrt{\frac{K_E}{G}} = a_G / \sqrt{4\pi\epsilon_o G} \tag{225}$$

Following that, the connection between the acceleration of the gravitational field and the induction of the magnetic field is obtained using the same approach

$$u_M = \frac{B_M^2}{2\mu_o}, \tag{226}$$

$$u_M = u_G \Rightarrow \frac{B_M^2}{2\mu_o} = \frac{a_I^2}{8\pi G} \Rightarrow \frac{B_M^2}{\mu_o} = \frac{a_I^2}{4\pi G}, \tag{227}$$

$$a_I = B_M / \sqrt{\mu_o / 4\pi G}, \tag{228}$$

$$B_M = a_I \sqrt{\mu_o / 4\pi G} \tag{229}$$

This finding is very important since the equations of electrogravity and magnetoinertia were derived from well-established principles of physics without explicitly taking into account the existence of gravitational and inertial charges. The sole distinction lies in the fact that the later equations incorporate a factor of 4π, which arises due to the absence of a defined relationship between the gravitational constant (G) and another constant, such as e_{g_o}, similar to the constant K_E. In other words, the foregoing tests demonstrate that our hypothesis is, at the very least, theoretically correct.

K. Gravitational Charge's Equivalent Mass

The current problem lies in reconciling the gravitational displacement (acceleration) related to gravitational charges with Newtonian gravitational acceleration. Consider a scenario with a set of n gravitational charges uniformly spread across a spherical surface with a mean radius equivalent to the Earth's radius (r_E), thus

$$a_G = D_G = G \cdot E_G = n \cdot q_g / 4\pi r_E^2, \tag{230}$$

$$F_N = GM_E m / r_E^2 \Rightarrow a_N = F_N / m = GM_E / r_E^2, \tag{231}$$

$$a_G = a_N \Rightarrow n \cdot q_g / 4\pi r_E^2 = GM_E / r_E^2, \tag{232}$$

$$n = 4\pi GM_E / q_g \Rightarrow \text{if } q_g > 0 \Rightarrow m_g = |q_g| / 4\pi G, \tag{233}$$

$$m_g = |q_e| / 4\pi \sqrt{\epsilon_o G} = 5.244788 \cdot 10^{-10} kg \tag{234}$$

The preceding results are understood as the Earth's mass being made up of an average number n of gravitational charges, each with corresponds to an equivalent mass m_g, which together constitute the Earth's gravitational field.

IX. UNIFIED FIELD

Contents

The unified field can be defined by two equivalent expressions, one of which is a general form representing the total field of a charge. In this equation, the charges are substituted by the selected charge types, as well as the appropriate permittivity and permeability constants. In contrast, the integrated form reveals all field types in a single equation.

A. General Form

$$\vec{E}_{\text{TT'}} = \frac{q_T}{4\pi\epsilon_{T_o}}\frac{\vec{r}}{|\vec{r}|^3} - \frac{q_T^3}{16\pi^2\epsilon_{T_o}^2 mc^2}\frac{\vec{r}}{|\vec{r}|^4}, \tag{235}$$

$$\vec{E}_{\text{TT'}} = -\nabla V_T - (u_{tan} \times \vec{B}_{T'}), \tag{236}$$

$$u_{tan} = \frac{q_T^2}{4\pi\epsilon_{T_o}|\vec{r}| \cdot mc}, \tag{237}$$

$$\vec{B}_{T'} = \mu_{T'_o}\frac{q_T c}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} = \mu_{T'_o}\frac{q_{T'}}{4\pi}\frac{\vec{r}}{|\vec{r}|^3}, \tag{238}$$

$$-\nabla V_T = \frac{q_T}{4\pi\epsilon_{T_o}}\frac{\vec{r}}{|\vec{r}|^3}, \tag{239}$$

$$-(u_{tan} \times \vec{B}_{T'}) = -\frac{q_T^2}{4\pi\epsilon_{T_o}|\vec{r}| \cdot mc}\mu_{T'_o}\frac{q_{T'}}{4\pi}\frac{\vec{r}}{|\vec{r}|^3} \tag{240}$$

$$TT' = EM \begin{cases} q_T = q_e, q_{T'} = q_m, \\ \epsilon_{T_o} = \epsilon_o, \mu_{T'_o} = \mu_o, \\ V_T = V_E, B_{T'} = B_M \end{cases} \tag{241}$$

$$TT' = GI \begin{cases} q_T = q_g, q_{T'} = q_i, \\ \epsilon_{T_o} = \epsilon_{g_o}, \mu_{T'_o} = \mu_{i_o}, \\ V_T = V_G, B_{T'} = B_I \end{cases} \tag{242}$$

B. Integrated Form

The unified field equation can also be represented by merging the notions of electrogravity and magnetoinertia, in the following simple and integrated form

$$a_{GI} = D_{GI} = D_G - D_I, \tag{243}$$

$$a_{GI} = G \cdot E_{GI} = E_E\sqrt{\epsilon_o G} - \left(u_{tan}/c\right) B_M/\sqrt{\mu_o/G}, \tag{244}$$

$$a_{GI} = 0 \Rightarrow u_{tan} = c \tag{245}$$

X. MEASUREMENT UNITS

Contents

Electric	Magnetic
$[E_E] = \left[\frac{V}{m}\right]$	$[H_M] = \left[\frac{A \cdot m}{m^2}\right] = \left[\frac{A}{m}\right]$
$[D_E = \epsilon_o E_E] = \left[\frac{N \cdot m}{V \cdot m^2}\right]$	$[B_M = \mu_o H_M] = \left[\frac{V \cdot s}{m^2}\right]$
$[\epsilon_o] = \left[\frac{F}{m}\right] = \left[\frac{J}{V^2 \cdot m}\right]$	$[\mu_o] = \left[\frac{H}{m}\right] = \left[\frac{J}{A^2 \cdot m}\right]$
$[q_e] = [Cb] = \left[\frac{J}{V}\right]$	$[q_m] = \left[\frac{J}{V}\frac{m}{s}\right] = [A \cdot m]$

Gravitational	Inertial
$[E_G] = \left[\frac{kg \cdot m^{-1}}{m}\right]$	$[H_I] = \left[\frac{J}{kg \cdot m^{-1}}\frac{m}{s} \cdot \frac{1}{m^2}\right]$
$[D_G = \epsilon_{g_o} E_G] = \left[\frac{N \cdot m}{kg \cdot m^{-1} \cdot m^2}\right]$	$[B_I = \mu_{i_o} H_I] = \left[\frac{kg \cdot m^{-1} \cdot s}{m^2}\right]$
$[\epsilon_{g_o}] = \left[\frac{J}{\left(kg \cdot m^{-1}\right)^2 \cdot m}\right]$	$[\mu_{i_o}] = \left[\left(\frac{kg \cdot m^{-1} \cdot s}{J}\right)^2 \frac{J}{m}\right]$
$[q_g] = \left[\frac{J}{kg \cdot m^{-1}}\right]$	$[q_i] = \left[\frac{J}{kg \cdot m^{-1}}\frac{m}{s}\right]$

XI. SPECIAL AND GENERAL RELATIVITY

Contents

Special relativity and general relativity are two foundational theories in theoretical physics, both developed by A. Einstein during the early 20th century. Special relativity, published in 1905, transformed our understanding of space and time by demonstrating that they are interwoven in a four-dimensional spacetime fabric. It presented notions like time dilation and length contraction, which demonstrated that the laws of physics apply to all observers in uniform motion. General relativity, introduced in 1915, expands upon these concepts to incorporate the force of gravity. Gravity is described not as a force, as in Newtonian physics, but as the bending of spacetime caused by mass and energy. General relativity has been empirically validated by different experiments, and its predictions, such as gravitational time dilation and the deflection of light by heavy objects, have been directly witnessed. Both theories have emerged as fundamental principles in modern physics, offering a deep comprehension of the fundamental properties of space, time, and gravity.

A. Beyond Relativity

In both special and general relativity, one of the groundbreaking principles is the constancy of the propagation speed of light c. Nevertheless, exploring the boundaries of theoretical physics has resulted in fascinating conjectures regarding the potential existence of a varying propagation speed of light, as demonstrated at the outset of this study

$$u_c = c\left(1 - \frac{u^2}{c^2}\right) = c\left(1 - \left(\frac{\Delta\phi}{\pi}\right)^2\right), \tag{246}$$

$$u_c = c\left(1 - \frac{2GM}{rc^2}\right) \tag{247}$$

Although the aforementioned equations may seem comparable, there is a distinct difference in the origin of the potential existence of the varying propagation speed of light. In the context of general relativity, the photons lose energy as they climb out of the gravitational well where the latter is external (see external force) to the photon entity and responsible for the drop in u_c. Eq. (246) was constructed to address a phenomenon that does not exist in the literature, the inertial redshift. Before we analyze this hypothetical new possibility, we set Eqs. (246) and (247) to be equal

$$c\left(1 - \left(\frac{\Delta\phi}{\pi}\right)^2\right) = c\left(1 - \frac{2GM}{rc^2}\right), \tag{248}$$

$$\frac{\Delta\phi}{\pi} = \frac{2GM}{rc^2} \tag{249}$$

Eq. (249) suggests that the gravitational field acts as an imperceptible force that permeates the structure of photons to control their phase shift. This type of description causes the external gravitational force to function as an internal force. Given these assumptions, it is possible to describe the photon energy (see Eq. (70)) and the resulting gravitational redshift effect in an alternative way while preserving the original formulation

$$u_c = c\left(1 - \frac{2GM}{rc^2}\right), \tag{250}$$

$$hf = \frac{u_c}{c}\frac{hf_o}{\sqrt{1 - 2GM/rc^2}} \tag{251}$$

Two significant observations can be made regarding the equation mentioned above. The energy of a photon can be calculated by multiplying the ratio of propagation speeds with the relativistic energy of a photon under a gravitational potential, which is similar to the relativistic energy of a mass moving at speed u in special relativity. The second observation is that, having modified nothing from the original redshift equation, if u_c is always constant c according to the postulates of special and general relativity, the photon would never lose energy while climbing a gravitational well. A thought-provoking inquiry arises from Eq. (251). Can a particle, like an electron, exhibit the properties of both a particle and a wave? Does the phenomenon of wave-particle duality exhibit gravitational or inertial redshift characteristics? Quantum mechanics accounts for the coexistence of particle-like and wave-like characteristics in particles, but it does not provide a direct prediction or explanation for the gravitational or inertial redshift. Particles can have wave-like behaviors in various situations, such as passing through closely spaced slits (interference), encountering obstacles (diffraction), or encountering electrical potential barriers (quantum tunneling). The presence or absence of wave-like behavior in particles is determined by the surrounding environment. Is it possible to establish an environment that accompanies the particle as a cohesive unit, allowing it to display wave-like characteristics at any given moment, even without the presence of spaced slits, obstacles, or potential barriers? In the next subsections, we will investigate an entity that results from the coupling of a particle to an artificial standing wave. The energy stored within the standing wave can be equal to or more than the rest energy of the particle coupled to the standing wave. An additional need is that the standing wave must be able to turn its unmanifested stored energy into system kinetic energy (standing wave-particle) by altering the standing wave's phase shift on demand.

B. Inertial Redshift

The earlier sections showed that it is feasible to get equivalent results whereby altering the phase of a standing wave eventually leads to acquiring a speed u_{sw} without the presence of external forces e.g. gravitational, thus

$$\beta = \frac{u}{c}, \tag{252}$$

$$u_{sw} = u \Rightarrow u_c = c\left(1 - u_{sw}^2/c^2\right), \tag{253}$$

$$N \cdot 2hf = \frac{u_c}{c}\frac{N \cdot 2hf_o}{\sqrt{1-\beta^2}} \tag{254}$$

Eq. (254) reveals the twin phenomenon of the gravitational redshift, called inertial redshift, with the latter likely being an artificial rather than a natural phenomenon. It is important to note that we retained the original equation for the gravitational redshift and only substituted the gravitational potential with the square of the speed (u^2). Assuming that the stored energy of the standing wave is equal to the rest energy of a charged particle coupled to the standing wave, Eq. (254) may turn into

$$mc^2 = N \cdot 2hf_o, \tag{255}$$

$$m_i c^2 = N \cdot 2hf, \tag{256}$$

$$u_{sw} = u \Rightarrow m_i c^2 = \frac{u_c}{c}\frac{mc^2}{\sqrt{1-\beta^2}} \tag{257}$$

Does Eq. (257) have a physical interpretation? Based on accepted physics, there are no experimental findings that could confirm it. However, in the case of bare particles (not coupled to a standing wave and not driven by internal forces), experiments and special relativity theory confirm

$$u_{sw} = 0 \Rightarrow u_c = c \Rightarrow u \neq u_{sw} \Rightarrow \tag{258}$$
$$\beta = \frac{u}{c} \Rightarrow m_i c^2 = \frac{mc^2}{\sqrt{1-\beta^2}}$$

We have just shown that special relativity can be considered as a part of a broader framework, which is derived from the gravitational and subsequently similar inertial redshift phenomenon. This was accomplished without the need to introduce new mathematical ideas, but instead by employing alternate interpretations of well-established physics.

C. Relativistic Inertia and Momentum

The scenario where a particle is coupled to a standing wave where the latter has a greater amount of unmanifested stored energy than the particle's rest energy; can be developed using the help of Eq. (91) as follows

$$n_s \geq 1 \Rightarrow U_{stored} = N \cdot h \cdot 2f_o = n_s^2 mc^2, \qquad (259)$$

$$dU_s = d\left(N \cdot h \cdot 2f\right) = n_s^2 dU = -dU_k = W_{F_{int}}, \qquad (260)$$

$$n_s^2 dU = -dU_k \Rightarrow n_s^2 c^2 \int_m^{m_i} dm = -m \int_0^u u du, \qquad (261)$$

$$u << c \Rightarrow m_i c^2 = mc^2 \left(1 - \frac{u^2}{2n_s^2 c^2}\right) \qquad (262)$$

The above equation represents the non-relativistic energy of the standing wave-particle. In line with Eq. (69), we will employ the Taylor series expansion by postulating a function $F(u)$ to find its relativistic counterpart ($F(u)$) through its weak field approximation, thus

$$F(u) = \frac{1}{\sqrt{1 - f(u)^2}}(1 - f(u)^2) = \sqrt{1 - f(u)^2} = \qquad (263)$$

$$\sum_{n=0}^{\infty} \frac{(2n)!}{4^n (n!)^2 (1-2n)} f(u)^{2n} =$$

$$1 - \frac{1}{2}f(u)^2 - \frac{1}{8}f(u)^4 - \frac{1}{16}f(u)^6$$

$$-\frac{5}{128}f(u)^8 - \frac{7}{256}f(u)^{10} - ... =$$

$$1 - \frac{1}{2}f(u)^2 + R(r)$$

$$f(u) = \beta_s = u/n_s c, \qquad (264)$$

$$m_i c^2 = mc^2 \sqrt{1 - \frac{u^2}{n_s^2 c^2}} = mc^2 \sqrt{1 - \beta_s^2} = \qquad (265)$$

$$mc^2 \left(1 - \frac{u^2}{2n_s^2 c^2} + R(u)\right),$$

$$u << c \Rightarrow R(u) \to 0 \Rightarrow m_i c^2 = mc^2 \left(1 - \frac{u^2}{2n_s^2 c^2}\right) \qquad (266)$$

According to Eq. (263), Eq. (265) can be expressed in a way that displays the varying propagation speed of light, as discussed in previous sections. Thus, for $u_{sw} = u$

$$u_c = c\left(1 - \frac{u_{sw}^2}{n_s^2 c^2}\right) \Rightarrow m_i c^2 = \frac{u_c}{c} \frac{mc^2}{\sqrt{1 - \frac{u^2}{n_s^2 c^2}}} \qquad (267)$$

Likewise, for $u_{sw} = u$ the relativistic momentum is

$$u_c = c\left(1 - \frac{u_{sw}^2}{n_s^2 c^2}\right) \Rightarrow p = \frac{u_c}{c} \frac{m \cdot u}{\sqrt{1 - \frac{u^2}{n_s^2 c^2}}} \qquad (268)$$

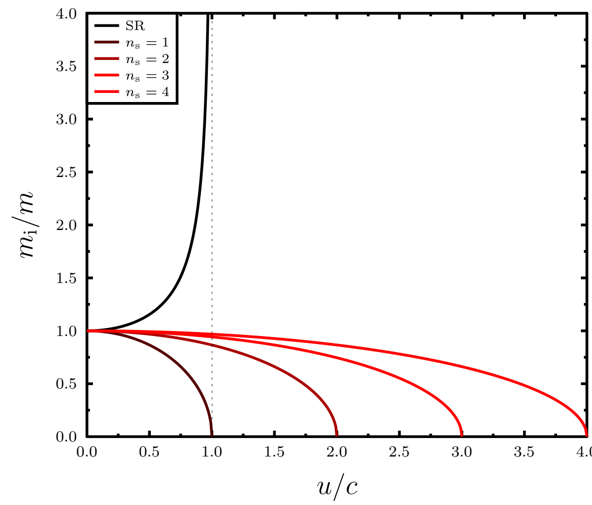

FIG. 8. Relativistic Inertia. Einstein's equation (SR) reveals an ongoing and consistent rise in relativistic mass (inertia). Conversely, the red curves portray the novel relativistic mass (inertia) formula for different upper speed limits introduced in this study. With increasing speed, relativistic mass (inertia) diminishes, eventually reaching its minimum value of zero, even at speeds surpassing the speed of light.

The new relativistic expressions (see FIG. (8) and FIG. (9)) emerged from the idea of the inertial redshift phenomenon, which is considered artificial rather than a natural phenomenon. R. Carezani [37, 38] was the first to derive the above expressions (for $n_s = 1$) in his preliminary work, combining the idea of frame reduction in Lorentz transformation with the concept of a "decaying particle", which should not be confused with radioactive decay. As we can see the weak field approximation of the new relativistic inertia has a resemblance to the formulation for inertia manipulation in the concept of mechanical inertial drive, as both employ internal forces (F_{int}) for propulsion. This result serves as the primary starting point for the broader framework in which Einstein's special relativity is viewed as a special case in which particles accelerate solely through the application of an external force (F_{ext}). Therefore, the broader framework of special relativity encompasses two separate approaches based on the mechanism of motion (through F_{int} or F_{ext})

$$F_{int} \Rightarrow u_{sw} = u = n_s c \cdot \Delta\phi/\pi = n_s c \cdot \Delta f/2f, \qquad (269)$$

$$\beta_s = u/n_s c = u_{sw}/n_s c = \Delta\phi/\pi \Rightarrow u_c/c = \left(1 - \beta_s^2\right), \qquad (270)$$

$$F_{int} \Rightarrow u_c < c \Rightarrow n_s \geq 1 \Rightarrow m_i c^2 = \frac{u_c}{c} \frac{mc^2}{\sqrt{1 - \beta_s^2}}, \qquad (271)$$

$$F_{int} \Rightarrow u_c < c \Rightarrow n_s \geq 1 \Rightarrow p = \frac{u_c}{c} \frac{m \cdot u}{\sqrt{1 - \beta_s^2}}, \qquad (272)$$

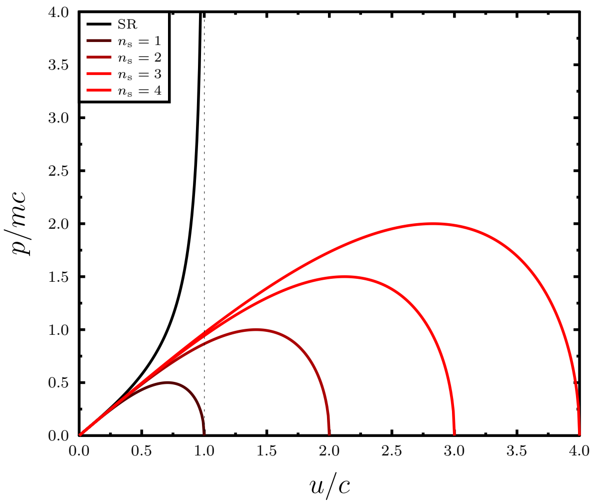

FIG. 9. Relativistic Momentum. The black curve (SR) depicts Einstein's relativistic momentum with a steady increase relative to speed. Notably, the red curves exhibit a deviation from this pattern, reaching a maximum momentum ($n_s \cdot mc/2$) before gradually diminishing to zero, even at speeds surpassing the speed of light.

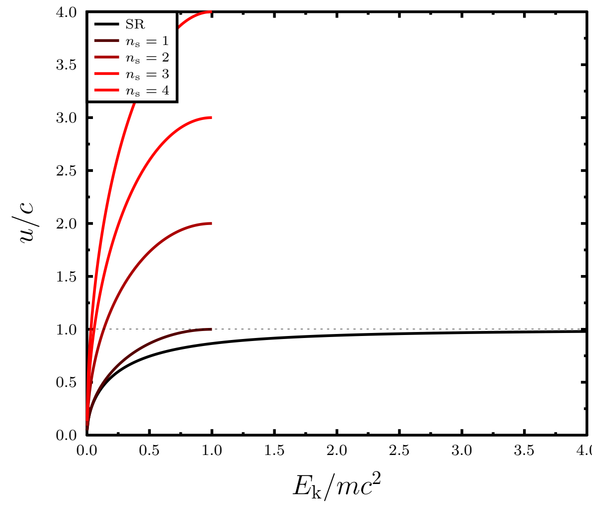

FIG. 10. Relativistic Speed. In Einstein's special relativity (SR), there is an unbreakable upper-speed limit c, which serves as a basic limitation on the motion of objects in our universe. The red curves represent the new relativistic speed expression introduced in this paper. In this case, we are presented with a disruptive insight that challenges the existing paradigm: the lack of a maximum speed limit.

$$F_{ext} \Rightarrow u_{sw} = 0 \Rightarrow u_c = c \Rightarrow n_s = 1 \Rightarrow u \neq u_{sw}, \quad (273)$$

$$F_{ext} \Rightarrow n_s = 1 \Rightarrow \beta_s = \beta = u/c \Rightarrow m_i c^2 = \frac{mc^2}{\sqrt{1-\beta^2}}, \quad (274)$$

$$F_{ext} \Rightarrow u_c = c \Rightarrow n_s = 1 \Rightarrow p = \frac{m \cdot u}{\sqrt{1-\beta^2}} \quad (275)$$

D. Relativistic Speed - Crossing the Light Speed Barrier

The relativistic speed is calculated based on the kinetic energy, which is influenced by the method of motion through either internal (F_{int}) or external (F_{ext}) forces. Additionally, it is important to note that the broader framework acknowledges only positive energies, meaning that kinetic energy and relativistic energy are always positive or zero, and never imaginary or negative. Therefore

$$F_{int} \Rightarrow u_c < c \Rightarrow n_s \geq 1 \Rightarrow -E_k = m_i c^2 - mc^2, \quad (276)$$

$$F_{int} \Rightarrow u = n_s c \sqrt{1 - \left(1 - \frac{E_k}{mc^2}\right)^2} \quad (277)$$

$$F_{ext} \Rightarrow u_c = c \Rightarrow n_s = 1 \Rightarrow E_k = m_i c^2 - mc^2, \quad (278)$$

$$F_{ext} \Rightarrow u = c \sqrt{1 - \frac{1}{\left(1 + \frac{E_k}{mc^2}\right)^2}} \quad (279)$$

Two surprising discoveries (see FIG. (10)) have been revealed within the broader framework of relativity that challenge the constraints of Einstein's special relativity. One involves the absence of an upper-speed limit, while the other involves the potential of crossing the light speed barrier.

E. Constraints

Mathematical expressions, especially those with physical significance, must include limitations to avoid misinterpretations. To clarify the applicability range of the new relativistic equations, we introduce the variables E_{sw} and E_{stored}, which indicate the system's conversion to kinetic and stored energy, respectively. Therefore, it is impossible to convert energy in quantities beyond the available or stored amount, implying that

$$m_i c^2 - mc^2 = mc^2 \sqrt{1 - \frac{u^2}{n_s^2 c^2}} - mc^2 = -E_k, \quad (280)$$

$$\frac{u^2}{n_s^2 c^2} \propto \frac{E_{sw}}{E_{stored}} \Rightarrow mc^2 \sqrt{1 - \frac{E_{sw}}{E_{stored}}} - mc^2 = -E_k, \quad (281)$$

$$E_{sw} \leq E_{stored} \Rightarrow n_s \geq 1, \quad (282)$$

$$0 \leq u \leq n_s \cdot c, \quad (283)$$

$$0 \leq \Delta\phi \leq \pi, \quad (284)$$

$$0 \le m_i \le m, \tag{285}$$
$$0 \le m_i c^2 \le mc^2, \tag{286}$$
$$0 \le p \le n_s \cdot mc/2, \tag{287}$$
$$0 \le E_k \le mc^2 \tag{288}$$

F. Extended Energy-Momentum Relation

The energy-momentum relation for a free particle is given by the well-known equation, where p_{SR} and E_{SR} denote relativistic (Einstein's special relativity) momentum and energy, respectively. To obtain the extended form of the energy-momentum equation, we insert a new element, denoted as n_s. In the framework of Einstein's special relativity (E_{SR} and p_{SR}), this factor continuously takes a solitary value of unity. Therefore,

$$p_{SR} = mu\left(1 - u^2/n_s^2c^2\right)^{-1/2}, \tag{289}$$
$$E_{SR} = mc^2\left(1 - u^2/n_s^2c^2\right)^{-1/2}, \tag{290}$$
$$m^2c^4 + p_{SR}^2c^2 = E_{SR}^2 \tag{291}$$

Multiplying both sides of Eq. (291) by the ratio of the propagation speeds squared, we obtain the extended form of the energy-momentum relation, thus

$$\left(\frac{u_c}{c}\right)^2\left(m^2c^4 + p_{SR}^2c^2\right) = \left(\frac{u_c}{c}\right)^2 E_{SR}^2, \tag{292}$$
$$\left(\frac{u_c}{c}\right)^2 m^2c^4 + p^2 = E^2, \tag{293}$$
$$p = \frac{u_c}{c} mu\left(1 - u^2/n_s^2c^2\right)^{-1/2}, \tag{294}$$
$$E = \frac{u_c}{c} mc^2\left(1 - u^2/n_s^2c^2\right)^{-1/2} \tag{295}$$

G. Extended Klein-Gordon Equation

The quantized version of the extended energy-momentum relation is developed as follows

$$\hat{p} = -i\hbar\nabla, \tag{296}$$
$$\hat{E} = i\hbar\frac{\partial}{\partial t}, \tag{297}$$
$$\left(\left(\frac{u_c}{c}\right)^2 m^2c^4 + \hat{p}^2c^2\right)\psi = \hat{E}^2\psi, \tag{298}$$
$$\left(\left(\frac{u_c}{c}\right)^2 m^2c^4 + (-i\hbar\nabla)^2c^2\right)\psi = \left(i\hbar\frac{\partial}{\partial t}\right)^2\psi \tag{299}$$

Thus, the extended version of the Klein-Gordon equation becomes

$$\frac{\left(u_c/c\right)^2 m^2c^2}{\hbar^2}\psi - \nabla^2\psi + \frac{1}{c^2}\frac{\partial^2}{\partial t^2}\psi = 0 \tag{300}$$

In the realm of relativistic quantum mechanics, the Klein-Gordon equation stands as a foundational framework for describing the behavior of particles with spin 0, such as mesons. In exploring the possible solutions to this equation, we introduce a new entity, a traveling standing wave-particle (consisting of two counter-propagating waves) propelled by an emerging force resulting from phase changes based on Y. N. Ivanov's [61] new mechanism of motion. In one spatial dimension (x-axis), the candidate wave function is given by the following expression

$$\psi(x,t) = A\sin\left(\frac{p\cdot x}{\hbar} + \frac{E\cdot t}{\hbar} - \phi\right) + A\sin\left(\frac{p\cdot x}{\hbar} - \frac{E\cdot t}{\hbar} - \phi\right) \tag{301}$$

We will now assess if the provided wave function meets the requirements of the extended Klein-Gordon equation. Hence

$$\begin{aligned}\frac{\left(u_c/c\right)^2 m^2c^2}{\hbar^2}\psi(x,t) = \\ A\frac{\left(u_c/c\right)^2 m^2c^2}{\hbar^2}\sin\left(\frac{p\cdot x}{\hbar} + \frac{E\cdot t}{\hbar} - \phi\right) \\ +A\frac{\left(u_c/c\right)^2 m^2c^2}{\hbar^2}\sin\left(\frac{p\cdot x}{\hbar} - \frac{E\cdot t}{\hbar} - \phi\right),\end{aligned} \tag{302}$$

$$\begin{aligned}\nabla^2\psi(x,t) = \\ -\frac{A\cdot p^2}{\hbar^2}\sin\left(\frac{p\cdot x}{\hbar} + \frac{E\cdot t}{\hbar} - \phi\right) \\ -\frac{A\cdot p^2}{\hbar^2}\sin\left(\frac{p\cdot x}{\hbar} - \frac{E\cdot t}{\hbar} - \phi\right),\end{aligned} \tag{303}$$

$$\begin{aligned}\frac{1}{c^2}\frac{\partial^2}{\partial t^2}\psi(x,t) = \\ -\frac{A\cdot E^2}{c^2\hbar^2}\sin\left(\frac{p\cdot x}{\hbar} + \frac{E\cdot t}{\hbar} - \phi\right) \\ -\frac{A\cdot E^2}{c^2\hbar^2}\sin\left(\frac{p\cdot x}{\hbar} - \frac{E\cdot t}{\hbar} - \phi\right)\end{aligned} \tag{304}$$

Inserting the above calculations into Eq. (300), yields

$$\begin{aligned}A\left(\frac{\left(u_c/c\right)^2 m^2c^2}{\hbar^2} + \frac{p^2}{\hbar^2} - \frac{E^2}{c^2\hbar^2}\right)\cdot \\ \sin\left(\frac{p\cdot x}{\hbar} + \frac{E\cdot t}{\hbar} - \phi\right) + \\ A\left(\frac{\left(u_c/c\right)^2 m^2c^2}{\hbar^2} + \frac{p^2}{\hbar^2} - \frac{E^2}{c^2\hbar^2}\right)\cdot \\ \sin\left(\frac{p\cdot x}{\hbar} - \frac{E\cdot t}{\hbar} - \phi\right) = 0\end{aligned} \tag{305}$$

The equation shown above can be equal to zero, when

$$\frac{\left(u_c/c\right)^2 m^2c^2}{\hbar^2} + \frac{p^2}{\hbar^2} - \frac{E^2}{c^2\hbar^2} = 0 \tag{306}$$

By multiplying both sides of the equation by c^2, we get the abstract form of the new energy-momentum relation, thereby satisfying the extended form of the Klein-Gordon equation

$$\left(\left(u_c/c\right)^2 m^2c^4 + p^2c^2\right) - E^2 = 0 \tag{307}$$

The standing wave-particle function (see Eq. (301) is a specific solution to the extended Klein-Gordon equation that may alternatively be expressed as

$$\psi(x,t) = 2A\sin\left(\frac{p\cdot x}{\hbar} - \phi\right)\cos\left(\frac{E\cdot t}{\hbar}\right) \tag{308}$$

The standard interpretation of quantum mechanics (see Copenhagen Interpretation) sees the wave function as a mathematical tool that provides probabilities for various outcomes. The wave function does not represent an objective reality, but rather our knowledge or information about the system and its relationship with the observations. Furthermore, it is a wave in the sense that it can exhibit interference and diffraction effects, just like classical waves, but it is also a probability distribution, capturing particle-like behavior. As we can see, more than one wave functions may represent a specific solution to the extended form of the Klein-Gordon equation. In our case, we chose a standing wave-particle as a solution because it has the unique attribute of storing energy that could be utilized. However, the utilization of this characteristic becomes challenging due to the wave function's inherent nature as a mathematical tool that cannot accurately depict physical phenomena, such as the motion of particles. What we propose here is an improved interpretation of quantum mechanics in which any plausible specific solution to the Klein-Gordon equation or its modifications is potentially genuine engineering real-world solutions such as the one that defines a particle's mechanism of motion. This means that for the wave function (Eq. (308)) to manifest itself, it is necessary to couple a real standing wave to the particle wave function, where all of its properties will be locked/coupled one by one.

As the above equation indicates, any change in the real-world standing wave influences the particle's wave function (Eq. (308)). According to Y. N. Ivanov's [61] new mechanism of motion, by introducing a phase ϕ to the standing wave, the nodes of the wave are compelled to move, causing the entire pattern of the standing wave-particle to shift in a given direction. A continual shift in phase or frequency leads the standing wave to accelerate. As a result, the wave function (Eq. (308)) is affected by the phase shift ϕ and the n_s component as follows

$$\sin\left(\frac{p\cdot x}{\hbar} - \phi\right) = \sin(n\pi), \tag{309}$$

$$\frac{p\cdot x}{\hbar} - \phi = n\pi, \tag{310}$$

$$0 \le x \le \lambda/2 \Rightarrow n = 0 \Rightarrow x = \frac{\lambda}{2}\frac{\phi}{\pi} = \phi\frac{\hbar}{p}, \tag{311}$$

$$\Delta t = \frac{1}{2f} \Rightarrow n_s \ge 1 \Rightarrow u = n_s\frac{\Delta x}{\Delta t} = n_s\cdot a\cdot\Delta t \tag{312}$$

$$u = n_s\cdot c\frac{\Delta\phi}{\pi} = n_s\cdot c\frac{\Delta f}{2f} = n_s\frac{\hbar\omega}{p}\frac{\Delta\phi}{\pi} \tag{313}$$

The variables x, u, and a correspond to the position, speed, and acceleration of a node within the wave function, which encompasses the entirety of the standing wave-particle pattern, as indicated in Eq. (308).

H. Lorentz Transformation

The Lorentz transformation is a key concept in special relativity, explaining how event coordinates change while transitioning between two observers in relative motion due to a change in inertial frame. It describes how the coordinates of an event, in terms of both space and time, are related when observed in one inertial reference frame compared to another frame travelling at a constant speed relative to the first. The Galilean transformations in classical mechanics are replaced by these transformations, which accurately consider the constant speed of light and the relativity of simultaneity. When working with Lorentz transformations, we are dealing with the conversion of Cartesian coordinates and temporal coordinates across different inertial frames of reference. As a result, for the Lorentz transformation to be compatible with the broader framework of special relativity, which allows particle configurations to cross the light-speed barrier, two things must be considered. The one is the local varying propagation speed of light u_c that occurs within the system; it is not reliant on the system's Cartesian and temporary coordinates, and hence cannot be included in the set of Lorentz transformation equations. The second point is that the local varying propagation speed of light u_c must be considered within the proper time, which is the time the system experiences on its own. The Lorentz transformation equations for motion along the x-axis, accounting for internal forces in the motion mechanism, are

$$F_{int} \Rightarrow \beta_s = u/n_sc \Rightarrow \gamma_s = 1/\sqrt{1-\beta_s^2}, \tag{314}$$

$$c\cdot t' = \gamma_s\left(c\cdot t - \beta_s\cdot x\right), \tag{315}$$

$$x' = \gamma_s\left(x - \beta_s\cdot c\cdot t\right), \tag{316}$$

$$y' = y, \tag{317}$$

$$z' = z \tag{318}$$

For motion resulting from the application of external forces, we obtain

$$F_{ext} \Rightarrow n_s = 1 \Rightarrow \beta_s = \beta = u/c \Rightarrow \gamma = 1/\sqrt{1-\beta^2}, \tag{319}$$

$$c\cdot t' = \gamma\left(c\cdot t - \beta\cdot x\right), \tag{320}$$

$$x' = \gamma\left(x - \beta\cdot c\cdot t\right), \tag{321}$$

$$y' = y, \tag{322}$$

$$z' = z \tag{323}$$

I. Proper Time and Length

In special relativity, proper time is the time measured by an observer moving alongside a clock or object in space. It refers to the time as measured by a clock unaffected by acceleration or gravitational forces. As an object accelerates towards the speed of light, time dilation causes time to pass more slowly for an observer at rest (object in motion). Nevertheless, its proper time remains constant for the object in motion. The broader framework of special relativity introduces a local varying propagation speed of light (u_c), which results in proper time changes for the moving object. The proper time

(dt_τ) is defined as the time measured in the rest frame of the system (standing wave-particle). From Eqs. (315) and (316) we obtain

$$F_{int} \Rightarrow dx' = 0 \Rightarrow dx = \left(u/n_s\right) dt = c \cdot \beta_s dt, \quad (324)$$

$$\frac{u_c}{c} dt_\tau = \left(1 - \beta_s^2\right) dt_\tau = dt' = \quad (325)$$

$$\gamma_s dt - \gamma_s \cdot \left(\beta_s/c\right) \cdot dx = \gamma_s dt - \gamma_s \cdot \beta_s^2 dt,$$

$$\left(1 - \beta_s^2\right) dt_\tau = \gamma_s \left(1 - \beta_s^2\right) dt, \quad (326)$$

$$dt_\tau = \gamma_s dt = \left(1/\sqrt{1 - \beta_s^2}\right) dt, \quad (327)$$

$$dt = \left(\sqrt{1 - \beta_s^2}\right) dt_\tau = \frac{\left(1 - \beta_s^2\right)}{\sqrt{1 - \beta_s^2}} dt_\tau = \frac{dt_{\tau_c}}{\sqrt{1 - \beta_s^2}}, \quad (328)$$

$$dt_{\tau_c} = \left(1 - u^2/n_s^2 c^2\right) dt_\tau, \quad (329)$$

$$dt = \frac{dt_{\tau_c}}{\sqrt{1 - u^2/n_s^2 c^2}} \quad (330)$$

For a constant local propagation speed of light, yields

$$F_{ext} \Rightarrow u_c = c \Rightarrow n_s = 1 \Rightarrow \gamma_s = \gamma \Rightarrow dx' = 0, \quad (331)$$

$$dx = udt = c \cdot \beta dt, \quad (332)$$

$$dt_\tau = dt' = \gamma \left(1 - \beta^2\right) dt = \left(\sqrt{1 - u^2/c^2}\right) dt, \quad (333)$$

$$dt = \left(1/\sqrt{1 - u^2/c^2}\right) dt_\tau \quad (334)$$

Similarly, the proper length is

$$F_{int} \Rightarrow dt = 0 \Rightarrow \frac{dx_\tau}{u_c/c} = dx' = \gamma_s dx, \quad (335)$$

$$dx_\tau = \frac{u_c}{c} \gamma_s dx = \left(1 - \beta_s^2\right) \gamma_s dx, \quad (336)$$

$$dx_\tau = \left(\sqrt{1 - \beta_s^2}\right) dx, \quad (337)$$

$$dx = \left(1/\sqrt{1 - \beta_s^2}\right) dx_\tau, \quad (338)$$

$$dx = \frac{\left(\sqrt{1 - \beta_s^2}\right) dx_\tau}{1 - \beta_s^2}, \quad (339)$$

$$dx_{\tau_c} = \frac{dx_\tau}{1 - \beta_s^2} = \frac{dx_\tau}{1 - u^2/n_s^2 c^2}, \quad (340)$$

$$dx = \left(\sqrt{1 - u^2/n_s^2 c^2}\right) dx_{\tau_c} \quad (341)$$

Considering a constant local propagation speed of light, the proper length is given by

$$F_{ext} \Rightarrow u_c = c \Rightarrow n_s = 1 \Rightarrow \gamma_s = \gamma \Rightarrow dt = 0, \quad (342)$$

$$dx_\tau = dx' = \gamma dx, \quad (343)$$

$$dx_\tau = \left(1/\sqrt{1 - u^2/c^2}\right) dx, \quad (344)$$

$$dx = \left(\sqrt{1 - u^2/c^2}\right) dx_\tau \quad (345)$$

The new relativistic momentum and energy can be obtained by using the proper time as follows

$$F_{int} \Rightarrow p = mu \frac{dt}{dt_\tau} = mu\sqrt{1 - u^2/n_s^2 c^2}, \quad (346)$$

$$F_{int} \Rightarrow m_i c^2 = mc^2 \frac{dt}{dt_\tau} = mc^2 \sqrt{1 - u^2/n_s^2 c^2} \quad (347)$$

Now, let's examine an example related to time dilation. Assuming two objects are propelled by internal forces, one approaches the speed of light, while the other exceeds it by a factor of 10. Hence,

$$u_1 = 0.999c \text{ and } u_2 = 10 \cdot u_1 = 9.99c, \quad (348)$$

$$u_1 \Rightarrow n_s = 1 \Rightarrow dt_{\tau_c} = \left(1 - u_1^2/n_s^2 c^2\right) dt_\tau, \quad (349)$$

$$u_1 \Rightarrow n_s = 1 \Rightarrow dt_{\tau_c} = 0.0019999 \cdot dt_\tau, \quad (350)$$

$$u_1 \Rightarrow n_s = 1 \Rightarrow dt = \frac{dt_{\tau_c}}{\sqrt{1 - u_1^2/n_s^2 c^2}}, \quad (351)$$

$$u_1 \Rightarrow n_s = 1 \Rightarrow dt = 22.366272 \cdot dt_{\tau_c}, \quad (352)$$

$$u_2 \Rightarrow n_s = 10 \Rightarrow dt_{\tau_c} = \left(1 - u_2^2/n_s^2 c^2\right) dt_\tau, \quad (353)$$

$$u_2 \Rightarrow n_s = 10 \Rightarrow dt_{\tau_c} = 0.0019999 \cdot dt_\tau, \quad (354)$$

$$u_2 \Rightarrow n_s = 10 \Rightarrow dt = \frac{dt_{\tau_c}}{\sqrt{1 - u_2^2/n_s^2 c^2}}, \quad (355)$$

$$u_2 \Rightarrow n_s = 10 \Rightarrow dt = 22.366272 \cdot dt_{\tau_c}, \quad (356)$$

In special relativity, the time interval dt measured by a moving observer is viewed as a spacetime phenomenon as it entails comparing time measurements taken at various spatial locations and distinct time instances. It explains how the movement of observers relative to each other impacts their experience of time. Proper time interval d_{τ_c} is a local phenomenon within the frame of the moving object or observer. It denotes the time as measured by a stationary clock about the observer or object, representing the local time perceived by that observer or object. Given these considerations, the time dilation for both moving objects or observers (u_1 and u_2) in the example remains identical despite the second item moving at a speed 10 times greater than the first. Therefore,

$$dt = 22.366272 \cdot dt_{\tau_c} \quad (357)$$

The expression indicates that the time interval dt observed by the moving observer is 22.366272 times the time interval dt_{τ_c} (proper time) in the rest frame of the moving object. Regarding the proper time of both objects, we note they are again the same, therefore

$$dt_{\tau_c} = 0.0019999 \cdot dt_\tau \quad (358)$$

How can we understand the outcome of the expression above? Consider the time interval dt_τ of the ticking of a clock in an environment (rest frame of the moving object) where the propagation speed of light is constant c. The time interval dt_{τ_c} represents a reduced time interval when the clock ticks within an environment (rest frame of the moving object) where the propagation speed of light is below c. In special relativity, the proper time dt_τ remains constant at e.g. $1s$. In the above case, the broader framework predicts that for an object driven by internal forces, the proper time is 0.0019999 times that of one second. It means, that when the propagation speed is less than the speed of light c, the experienced time (proper time) within the rest frame of the moving object is equal to 0.0019999 of a second, which is a fraction of a second. In theory, traveling at a speed of 10^{20} times the speed of light would allow us to reach the edge of the universe and come back within a second.

XII. EM INERTIAL DRIVE

Contents

In 2009, the author accidentally observed an unusual phenomenon in a ferrite (MnZn) ring when subjected to currents of different frequencies and amplitudes. As a result, the ring (see FIG. (11)), which weighed around $0.2kg$, began to travel in a specified direction. Because of the ferromagnetic material's properties, the setup was extremely sensitive to electric current changes and frequencies, making it difficult to recreate the phenomenon of motion. Therefore, the experimental setup cannot be considered for real-world applications but just for demonstration purposes. Three separate experimental setups were recorded and uploaded on the author's YouTube channel. The author of this work claims that these tests could be seen as the world's earliest attempts to demonstrate a primal electromagnetic inertial drive while sounding like an exaggeration. The experiments are available at the following link:

YouTube -EM Inertial Drive Link

The toroidal inductor comprises the following characteristics [62]

$$\begin{aligned} &\text{T87/56/13 3E6 Grade}, \\ &\rho = 4900\ kg/m^3, \\ V_e &= 42133mm^3 = 42.133 \cdot 10^{-6} m^3,, \\ I_e &= 217.5mm = 217.5 \cdot 10^{-3} m, \\ A_e &= 194mm^2 = 1.94 \cdot 10^{-4} m^2, \\ \mu_r &= 10000, \\ m_{T87} &= 0.2\ kg, \\ \sigma &= 10S/m, \\ L &= 1mH \text{ (inductance) and f} = 5694 \text{ Hz} \end{aligned} \tag{359}$$

The series resistance R_s, the impedance Z_L of the inductor, the propagation resistance R_{em}, and radiation resistance R_r are determined as follows

$$R_s \approx 0 \text{ Ohm}, \tag{360}$$

$$Z_L = L \cdot 2\pi f = 35.75 \text{ Ohm} \tag{361}$$

The computation of the radiation resistance R_r requires knowing the propagation speed of the electromagnetic waves v_{em} through the ferromagnetic medium as also the propagation resistance (ferrite loop) of the ferromagnetic medium R_{em} itself, so

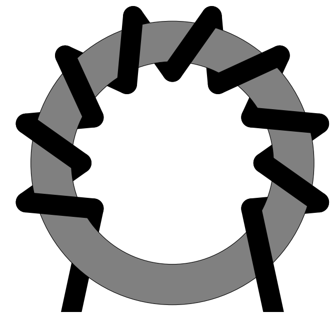

FIG. 11. Toroidal Inductor-Primal EM Inertial Drive. A ferromagnetic toroidal inductor is a closed-loop structure that allows an induced electromagnetic wave to interact with itself, creating a standing wave that captures the ferromagnetic toroid material. Applying a phase or frequency shift to the standing wave will cause the toroid inductor to rotate in the same direction as the shift. The toroidal inductor can transform into a primal electromagnetic inertial drive under specific conditions.

$$v_{em} = 1/\sqrt{\frac{\epsilon\mu}{2}\left[\sqrt{1+\left(\frac{\sigma}{\omega\epsilon}\right)^2}-1\right]}, \tag{362}$$

$$\sigma >> \omega\epsilon \Rightarrow \sqrt{1+\left(\frac{\sigma}{\omega\epsilon}\right)^2}-1 \approx \sigma/\omega\epsilon, \tag{363}$$

$$\sigma >> \omega\epsilon \Rightarrow v_{em} = \sqrt{\frac{4\pi f}{\mu\sigma}} = 754m/s, \tag{364}$$

$$\lambda_{em} = v_{em}/f = 0.132m = 0.6I_e, \tag{365}$$

$$R_{em} = \mu_o\mu_r v_{em} = 9.48 \text{ Ohm}, \tag{366}$$

$$N = 3 \Rightarrow R_r = R_{em}\frac{8}{3}\pi^3\left(N\frac{A_e}{\lambda_{em}^2}\right)^2 \approx 0.86\ Ohm \tag{367}$$

Since we are dealing with relative small energy densities, we are going to use the relativistic inertia expression that applies for n_s equals to 1, hence

$$n_s = 1 \Rightarrow m_i = m\sqrt{1-\left(\frac{u^2}{c^2}\right)^2} = m\sqrt{1-\left(\frac{p_{em}}{mc}\right)^2} \tag{368}$$

The momentum (p_{em}) of the electromagnetic energy carried by n photons traveling through the ferromagnetic material is expressed as

$$n_r = \frac{c}{v_{em}} \Rightarrow p_{em} = n\hbar\omega/(\omega/k) = \frac{U_{em}}{dz/dt}, \tag{369}$$
$$p_{em} = \frac{U_{em}}{v_{em}} = \frac{U_{em}}{c}n_r$$

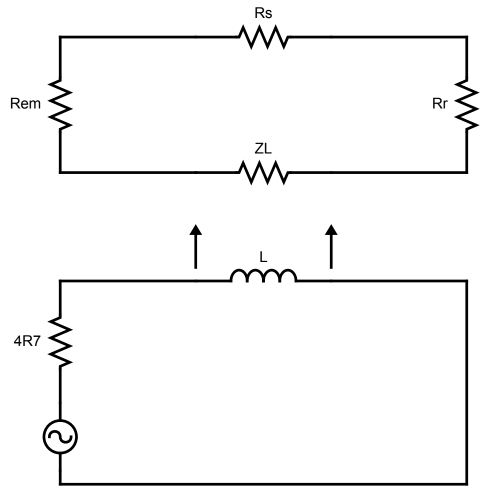

FIG. 12. Experimental Configuration. The circuit has an AC power generator connected to an external resistance of 4.7 Ohm and inductance L. The model of the inductance is made up of four resistors in series: the ac impedance Z_L, the series resistance R_s, which is considered negligible in this context, the propagation resistance R_{em}, and the radiation resistance R_r.

Eq. (368) turns into

$$m_i = m\sqrt{1-\left(\frac{U_{em}}{mc^2}n_r\right)^2} = m\sqrt{1-\left(\frac{nhf}{mc^2}n_r\right)^2}, \qquad (370)$$

$$m_i = m\sqrt{1-\left(\frac{nhf^2}{mcv_{em}f}\right)^2}, \qquad (371)$$

$$nhf^2 = aD \Rightarrow m_i = m\sqrt{1-\left(\frac{aD}{mcv_{em}f}\right)^2} \qquad (372)$$

Where a represents the average surface area of a particle in the ferromagnetic medium with an average mass of m, and D denotes the power density of the incident radiation. The power density D is calculated by dividing the power of the incident radiation by the cross-section A_e of the ferrite $T87/56/13$, thus

$$D = I_{ac}^2 R_r / A_e, \qquad (373)$$

$$m_i = m\sqrt{1-\left(\frac{a}{A_e}\frac{I_{ac}^2 R_r}{mcv_{em}f}\right)^2}, \qquad (374)$$

$$\frac{I_{ac}^2 R_r/A_e}{mcv_{em}f/a} = \frac{v_{em}B^2/2\mu_o\mu_r}{v_{em}B_c^2/2\mu_o\mu_r} = \frac{\Delta\phi}{\pi} = \frac{\Delta f}{2f} \qquad (375)$$

The mean particle mass m and the particle mean surface area a of the Manganese-Zinc composite material are currently unknown. To simplify our calculations, we will utilize the Titanium element, which has a comparable mass density of 4506 kg/m^3. Therefore, the mean particle mass and surface area are borrowed from the Titanium atom properties, thus

$$\rho = 4506\ kg/m^3 \Rightarrow m = 7.94 \cdot 10^{-26} kg, \qquad (376)$$

$$\rho = 4506\ kg/m^3 \Rightarrow r_{atom} = 1.47 \cdot 10^{-10} m, \qquad (377)$$

$$r_{atom} \Rightarrow a = 4\pi r_{atom}^2 = 2.7155 \cdot 10^{-19} m^2 \qquad (378)$$

Substituting the corresponding values in Eq. (374), yields

$$m_i = m\sqrt{1 - 4.49 \cdot 10^{-3} I_{ac}^4} = m\sqrt{1 - 0.82 \cdot B^4} \qquad (379)$$

Setting the electric current I_{ac} to a value equal to $0.39A$, we obtain

$$I_{ac} \approx 0.39A \Rightarrow B \approx 0.106T \Rightarrow \Delta f \approx 116Hz, \qquad (380)$$

$$m_i = 0.999948m \Rightarrow \Delta m = 1.04 \cdot 10^{-5} m, \qquad (381)$$

$$m = m_{T87} \Rightarrow m_i = 0.199989\ kg, \qquad (382)$$

$$\Delta m = 1.04 \cdot 10^{-5}\ kg$$

Let us apply the above calculations to the experimental setup where the ferrite ring rotates (see above YouTube Link) clockwise or counter-clockwise based on the direction of the frequency shift. Assuming the ferrite ring has overcome static friction and is rotating at a constant tangential speed, then the internal equals the average kinetic friction force, thus

$$g = 9.81 m/s^2, \qquad (383)$$

$$\mu_k = 0.5 \text{ (wood)} \Rightarrow F_k = \mu_k m \cdot g = 0.981N, \qquad (384)$$

$$F_{int} - F_k = \sum F = 0 \Rightarrow F_{int} = F_k \Rightarrow u = const, \qquad (385)$$

$$F_{int} = 0.981N = \Delta m \cdot a_{\Delta m}, \qquad (386)$$

$$a_{\Delta m} = 94.32 \cdot 10^3 m/s^2, \qquad (387)$$

$$\Delta f_{\Delta_m} = a_{\Delta m}/v_{em} \approx 125Hz \approx \Delta f \qquad (388)$$

The variables m and Δ_m denote the mass of the ferrite ring and the redistributed mass affecting inertia in the system, respectively. The redistributed mass creates an internal inertial force that propels the system forward, by the primal mechanical inertial drive principle. Moreover, the frequency shift Δf occurs continuously, similar to a frequency shift within a time range. When the frequency shift is forced to zero by the user (by simply halting altering the frequency), the ring stops rotating. The reverse frequency shift causes the ring to rotate in the opposite direction.

XIII. CONCLUSIONS

In conclusion, this paper embarks on a journey beyond the confines of classical physics and relativity, presenting a series of innovative concepts and analyses that challenge long-held conventions. From the elucidation of rotational unbalance in classical mechanics to the revelation of a varying propagation speed of light within the framework of general relativity. By bridging classical mechanics with electromagnetic, gravitational, and inertial phenomena, we have uncovered connections that not only enrich theoretical frameworks but also have practical implications. The introduction and study of new types of charges, has led to the unification of electromagnetism with gravity and inertia, opening up new avenues for controlling these fundamental forces. Furthermore, the extension of special relativity, which allows for particle configuration speeds equal to or faster than light, challenges long-held assumptions and stimulates additional investigation into the nature of spacetime and relativistic phenomena. In essence, this work acts as a catalyst for a paradigm change in our comprehension of classical physics and relativity, expanding the limits of scientific investigation and encouraging interdisciplinary collaboration.

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