Finite Theory: A Groundbreaking New Gravitational Model

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Abstract

A novel gravitational model is proposed herein, offering a comprehensive explanation for various phenomena, including perihelion precession, light bending, and galactic rotation curves, without invoking dark matter, dark energy, or contravening energy conservation laws. Additionally, a robust adjustment to the mass and radius of the universe is introduced. An experiment aboard the International Space Station (ISS) is recommended to verify this model's validity. Gravitoelectromagnetism (GEM) is employed at the macroscopic level to derive the aforementioned deductions. By conceptualizing both gravity and time dilation as particles, GEM can potentially facilitate antigravity propulsion through the generation of a gravitomagnetic field. The relative gravitomagnetic permeability exceeds the absolute one by a large factor, corroborated by domestic experiments and various entities, including the European Space Agency. In essence, this study presents a novel gravitational model and proposes multiple experiments to validate it. The implications of this model extend to future fields of study and technological advancements.

Keywords: Perihelion Shift, Light Bending, Rotation Curve, Antigravity, Gravitoelectromagnetism

1 Introduction

This is an objective reevaluation of A. Einstein's initial proposal to use the Variable Speed of Light (VSL) in 1911, which was subsequently extended by R. Dicke in 1957. In this work, we extract alternative interpretations, apply corrections, and introduce new fundamental hypotheses, resulting in a groundbreaking new gravitational theory. This theory is supported by recent observations of speed-of-light anisotropies (see: [5] and [10]).

The Finite Theory presented herein is a deductive theory that can consistently predict and explain all observations. Based on the new framework of VSL, the Finite Theory suggests new possible technologies, such as antigravity, force fields, perfect cryonics, and pre-established superluminal communications. By considering both gravity (as monopole gravitoelectric field) and time rate (as an induced monopole gravitomagnetic field) as fundamental virtual particles, it may be possible to manipulate and control them.

2 Foundation of the Finite Theory

2.1 Hypotheses of the Finite Theory

Finite Theory introduces a novel representation of the formulas derived from General Relativity that is based on the time dilation induced by the energy density, of any form (EM and GEM).

In contrast to General Relativity, where space-time is represented using non-Euclidean geometry to maintain the constancy of the speed-of-light while allowing space to vary, Finite Theory posits that the speed-of-light (and therefore the time rate) is a positive variable within a constant space.

Hypotheses of the Finite Theory are as follows:

Definition 1 A 'comoving framework' moves coherently with the source of the strongest neighboring gravitational acceleration amplitude ($G \times m/r^2$). This means if the observer and the observed object are nearby a planet then the comoving framework is set on the planet's center, rotating with the same angular speed. Note that this can be a non-inertial frame. For example, the moons, the planets, the stars, the galaxy bulges, and the black holes all have their own comoving or rotating framework. This way there can't be no absolute framework in the entire universe as they're all relative in angular velocity and gravitational acceleration amplitude to each other.

Definition 2 A 'parent framework' is the source of the 2nd strongest gravitational acceleration amplitude; the source here is a collective noun and represents the conglomeration of its constituents.

Definition 3 An 'absolute framework' is a comoving framework that has no parent framework.

Definition 4 The kinetic energy is defined as $1/2mv^2$ (classical definition), v being the speed of the object with respect to the observer as well as to the comoving framework.

Definition 5 Contrary to the currently accepted theory, Finite Theory proposes a radical view of gravitational time dilation, namely, is directly proportional to the ratio of the superimposed gravitational potentials of the observer and the observed object.

Hypothesis 1 The speed-of-light in free space has value c for any observer at rest relative to the comoving framework. However, observers in relative motion with respect to this frame will not measure the same value for c.
Hypothesis 2 The time dilation experienced by an object moving with respect to an observer at rest relative to the comoving framework is directly proportional to the ratio between the kinetic energy and the limit of the kinetic energy of the object when its speed tends to c.
Hypothesis 3 Any form of GEM or EM energy potential will induce an acceleration vector [9], time dilation / contraction and a change in temperature.
Hypothesis 4 There is a distinct mass / charge equivalence.

Below, we'll consider the consequences of these hypotheses on the time dilation effect.

2.2 Side by side comparison

Here we will study the gravitomagnetic component and the gravitoelectric component (η) respectively, both affecting the trajectory of light and bodies in our universe.

2.2.1 Gravitomagnetic component

Given from the gravitational time dilation of General Relativity:

$$t_o = \frac{\sqrt{1 - \frac{2Gm}{\|i\|c^2}}}{\sqrt{1 - \frac{2Gm}{(x+\|i\|)c^2}}} \times t_f \tag{1}$$

And from the gravitational time dilation:

$$t_o = \frac{\frac{m}{\|x-i\|} + \eta}{\frac{m}{\|i\|} + \eta} \times t_f \tag{2}$$

If we equate the aforementioned equations by using a reference point infinitely far away and letting η include the properties of the galaxy. This component represents the missing observation in half of the light bending angle and the perihelion precession disparity.

$$\left(\frac{\frac{m}{r} + \eta}{\eta}\right)^{-1} \approx \frac{\sqrt{1 - \frac{2Gm}{rc^2}}}{1} \tag{3}$$

$$\left(1 + \frac{m}{r\eta}\right)^{-1} \approx 1 - \frac{Gm}{rc^2} \tag{4}$$

$$\left(1 + \frac{m}{r\eta}\right)^{-2} \approx 1 - \frac{2Gm}{rc^2} \tag{5}$$

For the relation to be consistent, η must be defined as the following, based on the discrepancy of the observed light bending grazing the Sun:

$$\eta = \frac{m_s \int_{-\infty}^{\infty} \frac{r_s}{(x^2+{r_s}^2)^{\frac{3}{2}}} dx}{\delta} \tag{6}$$

$$\eta = \frac{2m_s}{\delta r_s} = 3.86 \times 10^{21}\, kg\, m^{-1}\, s^{-1} \tag{7}$$

Where:

- $m_s = 1.98892 \times 10^{30}\, kg$ (mass of the Sun)
- $r_s = 6.957 \times 10^{8}\, m$ (radius of the Sun)
- $\delta = 4.25 \times 10^{-6}\, rad$ (observed deflection angle discrepancy)

Thus, in retrospect, η_b is the Planck linear mass density times the angular velocity of the galaxy as we'll later see with the galactic rotation curves (Sec. 3.3.1) that this density is inversely proportional to the scale. Note that this relation is an equivalence presented by the Finite Theory.

Furthermore, the gravitational potential will be explained in Sec. 2.12.

2.2.2 Gravitoelectric component

A similar set of identities to the previous subsection can be applied to get a simpler fudge factor η similar to η. This component actually represents the gravitational acceleration used to predict half of the observed light bending angle and perihelion precession disparity.

$$\left(\frac{\frac{m}{r} + \eta}{\eta}\right)^{-1} \approx \frac{\sqrt{1 - \frac{2Gm}{rc^2}}}{1} \tag{8}$$

$$\left(1 + \frac{m}{r\eta}\right)^{-1} \approx 1 - \frac{Gm}{rc^2} \tag{9}$$

$$\left(1 + \frac{m}{r\eta}\right)^{-2} \approx 1 - \frac{2Gm}{rc^2} \tag{10}$$

In this case for the relation to be consistent, η must be defined as:

$$\eta = \frac{c^2}{G} = 1.35 \times 10^{27}\, kg\, m^{-1} \tag{11}$$

Therefore, η is simply the Planck linear mass density. Given the observed deflection angle is exactly twice as the one predicted by using solely the gravitoelectric component, then we can infer both components equate:

$$\left(\frac{\frac{m_s}{r_s} + \eta}{\eta}\right)^{-1} = \left(\frac{\frac{m_s}{r_s} + \eta}{\eta}\right)^{-1} \tag{12}$$

$$\left(1 + \frac{m_s}{r_s\eta}\right)^{-1} = \left(1 + \frac{m_s}{r_s\eta}\right)^{-1} \tag{13}$$

$$\left(1+\frac{m_s}{r_s\eta}\right)^{-2}=\left(1+\frac{m_s}{r_s\eta}\right)^{-2} \tag{14}$$

Given the aforementioned identities, we can actually easily solve Newton's gravitational variable using Equ. (11) and (13), variant for each solar system actually:

$$G=\frac{c^2}{\eta} \tag{15}$$

Furthermore, integrating Equ. (7) will result in a more applicable form:

$$G=\frac{\delta c^2\, r_s}{2m_s} \tag{16}$$

2.3 Absolute Gravitomagnetic Permeability

If we integrate the point mass at constant velocity to get the induced gravitomagnetic field then we'll end up with the following relation:

$$\frac{4\pi\rho_S G\int_d^{r_S} x dx}{c^2}=\frac{4\pi\rho_S G\left(\frac{{r_S}^2}{2}-\frac{d^2}{2}\right)}{c^2} \tag{17}$$

By equating the latter with the actual Biot-Savart Law, we'll have:

$$\frac{4\pi\rho_S G\left(\frac{{r_S}^2}{2}-\frac{x^2}{2}\right)}{c^2}=\frac{\mu_g\rho_S\left({r_S}^2-x^2\right)}{3} \tag{18}$$

Now we can solve the absolute gravitomagnetic permeability to get what the mainstream already suggests:

$$\mu_g=\frac{6\pi G}{c^2} \tag{19}$$

Or:

$$\mu_g=1.4\times10^{-26}\frac{m}{kg} \tag{20}$$

Where:

- $\rho_S=1409.822\times10^{11}\,kg\,m^{-3}$ (mass density of the Sun)
- $r_S=6.957\times10^8\,m$ (radius of the Sun)

2.4 Relative Gravitomagnetic Permeability

The preceding calculation is true in a perfect vacuum. But given the actual Cosmological Microwave Background (CMB) is a non-negligible factor if we consider it in the previous Equ. 18 in its ambiant form, or where $x=0\,m$ then:

$$\frac{2\pi\rho_S G\, {r_S}^2}{c^2}+BF_g=\frac{\mu\rho_S {r_S}^2}{3} \tag{21}$$

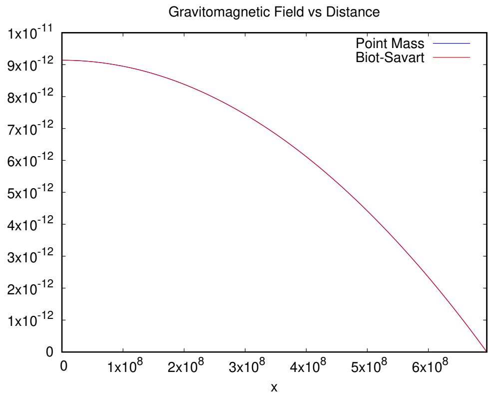

Fig. 1 Gravitomagnetic Field vs Distance

Which will give us the following relation:

$$\mu = \frac{3.0BF_g}{\rho_S {r_S}^2} \tag{22}$$

Or the following given $BF_g = 1 \times 10^{11}\,Hz$ in outer space where the energy is 250000 *times* denser than on the surface of the Earth, hence:

$$\mu = 6 \times 10^{-10}\frac{m}{kg} \tag{23}$$

2.5 Gravitational Variable and the Energy Density Limit

Newton's gravitational constant is taken into account it is an absolute constant. But is it really a constant?

If we calculate the maximum acceleration an object can be subject to at an event horizon, convert it to a gravitoelectric energy density and relate it to the maximum mass density of a neutron star then we'll have the following relation:

$$\frac{G^2\,{m_S}^2}{\mu_g c^2\,{r_S}^4} = \rho c^2 \tag{24}$$

Or:

$$\frac{c^6}{16\mu_g G^2\,{m_S}^2} = \rho c^2 \tag{25}$$

And by substituting μ_g with (19) we have:

$$\frac{c^8}{96\pi G^3\,{m_S}^2} = \rho c^2 \tag{26}$$

Thus:

$$G^3 = \frac{c^6}{\rho 96 {m_S}^2 \pi} \tag{27}$$

Which results also with a maximum mass density of:

$$\rho = \frac{c^6}{G^3 \, 96 {m_S}^2 \pi} \tag{28}$$

Or:

$$\rho = 2.05 \times 10^{18} \, kg/m^3 \tag{29}$$

Which is very close to the maximum mass density of a neutron star before it collapses into a black hole.

$$\rho = 1.84 \times 10^{35} \, J/m^3 \tag{30}$$

Where the above maximum energy density value is very important given it will be another constant and the common denominator of the event horizon where time completely halts, just like the speed limit of light.

2.6 Kinetic time dilation factor

From the aforementioned definitions, it is implied the kinetic time dilation of a clock located between 2 comoving frameworks will be proportional to the ratio of the gravitational acceleration of each distinct comoving framework with the total gravitational acceleration.

For example, given:

$$y = \frac{m_e}{\left(\frac{m_s}{{p_s}^2} + \frac{m_e}{{p_e}^2}\right)(x - p_e)^2} \tag{31}$$

Then the importance of the kinectic time dilation factor will be proportional to Fig. 2.

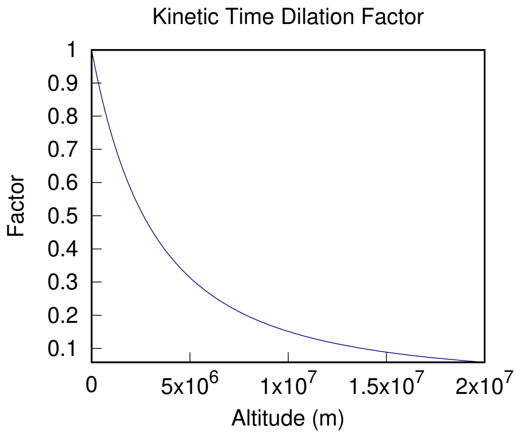

Fig. 2 Kinetic Time Dilation Factor

Where:

- $p_e = -6.371 \times 10^6\, m$ (position of the center of the Earth)
- $m_e = 5.973 \times 10^{24}\, kg$ (mass of the Earth)
- $p_s = 1.49598 \times 10^{11}\, m$ (position of the center of the Sun)
- $m_s = 1.98892 \times 10^{30}\, kg$ (mass of the Sun)

Thus in the case of the GPS satellites only 6% of the kinetic time dilation of the Earth will affect them at $20000km$ above.

2.7 Gravitational time contraction

Since in the candidate theory, the acceleration is defined by gravitons pulling the body in the opposite direction of their velocity, the net effect of the gravitational acceleration already defines the flux. Unlike kinetic time dilation this is not an incident event but the residuum of the modus operandi by the acceleration vector magnitude.

In contrast to kinetic time dilation, gravitational time contraction will be used interdependently with the non-trivial ambient gravity field of the observer or rationalized.

2.7.1 Inverse square law 1

Given that FT gravitational time dilation and the Newtonian gravity force are similar, the standard model of gravity inside a sphere cannot be directly linked with FT because factors applied in one direction will not cancel their equivalent in the opposite direction. This means no simplification can be made and all infinitesimal elements of the mass will affect the net amplitude at one particular location. First, we can represent the respective factor with a triple integral in the following way, using spherical coordinates:

$$f = \frac{2\pi \int_0^r \rho^2 d\rho \int_0^\pi \sin{(\theta)} d\theta}{r^2} \tag{32}$$

Given:

$$r^2 = \left(\cos{(\theta)} r_1 - z_2\right)^2 + \left(\sin{(\Phi)}\sin{(\theta)} r_1 - y_2\right)^2 + \left(\cos{(\Phi)}\sin{(\theta)} r_1 - x_2\right)^2 \tag{33}$$

After simplification:

$$f = \frac{2\pi \int_0^r \rho^2 d\rho \int_0^\pi \sin{(\theta)} d\theta}{-2\rho d_2 \cos\theta + d_2^2 + \rho^2} \tag{34}$$

Namely:

$$f = -\frac{\pi \left(2\left({d_2}^2 - {r_1}^2\right)\log{(r_1 + d_2)} + 2\log{(d_2 - r_1)}\left({r_1}^2 - {d_2}^2\right) - 4 d_2 r_1\right)}{2 d_2} \tag{35}$$

Where:

- r_1 is the spherical mass radius
- d_2 is the distance of the observer from the center

2.7.2 Inverse square law 2

Different means of calculating the inner gravitational time dilation factor with no relation to the aforementioned procedure can also be used. It consists of calculating the intersection between a growing sphere held within the spherical body in question.

This is done by first calculating all sphere surfaces fitting inside the largest sphere not in intersection with the spherical body.

Now for the second part, the spherical cap surface area resulting from the intersection of the two spheres will have to be considered only.

By summing up both areas we will have:

$$f = \int_{r_1 - d_2}^{r_1 + d_2} \frac{2\pi r_2 \left(\frac{d_2^2 - r_2^2 + r_1^2}{2d_2} + r_2 - d_2 \right)}{r_2^2} \mathrm{dr}_2 + \int_0^{r_1 - d_2} \frac{4\pi r_2^2}{r_2^2} \mathrm{dr}_2 \tag{36}$$

$$f = \frac{\pi \left[d_2^2 \log \left(\frac{r_1 + d_2}{r_1 - d_2} \right) + r_1^2 \log \left(\frac{r_1 - d_2}{r_1 + d_2} \right) + 2d_2 r_1 - 4d_2^2 \right]}{-d_2} + 4\pi \left(r_1 - d_2 \right) \tag{37}$$

Where:

- r_1 is the spherical mass radius
- d_2 is the distance of the observer from the center

Both of the previous method will result in the following inside and outside the sphere gravitational acceleration factor as seen in Fig 3.

2.7.3 Inside a sphere

By putting Equation (37) into the context of the gravitational potential, we will have to reduce the degree of the inverse radius down to 1:

$$f = \int_{r_1 - d_2}^{r_1 + d_2} \frac{2\pi r_2 \left(\frac{d_2^2 - r_2^2 + r_1^2}{2d_2} + r_2 - d_2 \right)}{r_2} \mathrm{dr}_2 + \int_0^{r_1 - d_2} \frac{4\pi r_2^2}{r_2} \mathrm{dr}_2 \tag{38}$$

$$f = \frac{4\pi d_2 \left(3r_1 - 2d_2 \right)}{3} + 2\pi \left(r_1 - d_2 \right)^2 \tag{39}$$

Where:

- r_1 is the spherical mass radius

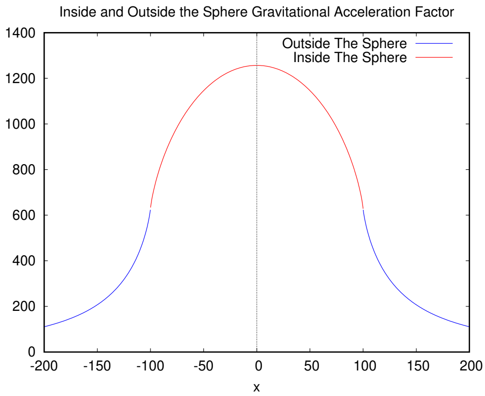

Fig. 3 Inside and Outside the Sphere Gravitational Acceleration Factor

- d_2 is the distance of the clock from the center

Or more generically for a clock at a specific position inside one spherical mass, as seen from an observer positioned in a null environment:

$$t_o = \frac{\Phi(r)}{\Phi(r_o)} \times t_f \tag{40}$$

$$t_o = \frac{2\pi\left(3r_s^2 - r^2\right)3\rho}{2\pi\left(3r_s^2 - r_o^2\right)3\rho} \times t_f \tag{41}$$

$$t_o = \frac{3r_s^2 - r^2}{3r_s^2 - r_o^2} \times t_f \tag{42}$$

Where:

- r is the location of the clock
- r_s is the radius of the spherical mass
- r_o is the location of the observer

2.7.4 Outside a sphere

We can now estimate the amplitude of the gravitational potential by sampling anchored bodies at an infinitesimal position by consequently rationalizing the measurement with the amplitude derived from the location of the observer.

Since an inertial body being subject to a specific gravitational force is responsible for gravitational time dilation and gravity is a superposable force, we will translate the same conditions of all gravitational potentials into the sum of all surrounding fields of an observed clock and the observer:

$$t_o = \frac{\Phi(r)}{\Phi(r_o)} \times t_f \tag{43}$$

$$t_o = \frac{\sum_{i=1}^{n} \frac{m_i}{\|r_i - r\|}}{\sum_{i=1}^{n} \frac{m_i}{\|r_i - r_o\|}} \times t_f \tag{44}$$

Where:

- r is the location of the observed clock
- r_i is the location of the center of mass i
- r_o is the location of the observer (typically $0m$)
- m_i is the mass i
- t_o is the observed time of two events from the clock
- t_f is the coordinate time between two events relative to the clock

2.8 Time dilation effect

2.8.1 Kinematic time dilation

We can represent time dilation using simpler techniques by interpolating dilation. Indeed if we rationalize the kinetic energy gained by the object in motion according to the maximum one it can experience at the speed-of-light then, due to Hypothesis 2, we have

$$p_v = \frac{mv^2/2}{mc^2/2} \tag{45}$$

Since the time dilation percentage is the exact opposite of the speed ratio, we define general time dilation in direct relation to the proportion as follows:

$$\frac{\Delta\tau_v}{\Delta\tau_0} = 1 - p_v = 1 - \frac{v^2}{c^2} \tag{46}$$

Here, $\Delta\tau_v$ is the interval of time between some events measured in the proper reference of the moving observer and $\Delta\tau_0$ is an interval of time between the same events measured by the static observer. v is the relative velocity of the moving observer measured by the static one and $c = 2.998 \times 10^8\, m/s$ is the speed-of-light.

We can note that the Finite Theory prediction (46) contradicts to the special relativistic result

$$\frac{\Delta\tau_v}{\Delta\tau_0} = \sqrt{1 - \frac{v^2}{c^2}} \approx 1 - \frac{v^2}{2c^2}\,, \tag{47}$$

where the last equality is valid for small velocities $v \ll c$. Nevertheless, as we will see in Sec. 2.11.2, when the kinematic time dilation effect is combined with the gravitational one, Finite Theory predicts the absolutely correct value of the time dilation cancellation altitude, which is observed by GPS satellites. In the following, we will investigate the gravitational time dilation effect in more detail.

2.8.2 The momentum of accelerated particles

The previous subsection directly implies the momentum of accelerated particles will be affected as well given the speed factor is composed of the time constituent:

$$p = m_0\, v \tag{48}$$

Thus for $v \gg c$:

$$p = \frac{m_0\, v}{1 - \frac{v^2}{c^2}} \tag{49}$$

This again contradicts the special relativistic result of:

$$p = \frac{m_0\, v}{\sqrt{1 - \frac{v^2}{c^2}}} \tag{50}$$

Now let's expand on the relativistic energy in terms of momentum:

$$c^2\, p^2 = \frac{c^4\, {m_0}^2}{1 - \frac{v^2}{c^2}} + \frac{c^4\, {m_0}^2 \left(\frac{v^2}{c^2} - 1\right)}{1 - \frac{v^2}{c^2}} \tag{51}$$

$$E = c\, \sqrt{p^2 + c^2\, {m_0}^2} \tag{52}$$

If we try the same derivation but using the Finite Theory then we'll get:

$$c^2\, p^2 = \frac{c^4\, {m_0}^2}{\left(1 - \frac{v^2}{c^2}\right)^2} + \frac{c^4\, {m_0}^2 \left(\frac{v^2}{c^2} - 1\right)}{\left(1 - \frac{v^2}{c^2}\right)^2} \tag{53}$$

$$E = c^2\, m_0 \tag{54}$$

So in the case of Finite Theory, this derivation is meaningless. But if we consider the equivalent mass of a photon relative to its Planck energy then:

$$E \equiv c^2\, m_0 \tag{55}$$

$$m_0 \equiv \frac{f h}{c^2} \tag{56}$$

Thus by using the very generic equation for momentum then:

$$p_{ft} = c\, m_0 \tag{57}$$

Which is the equivalent of the currently accepted mainstream counterpart:

$$p_{sr} = \frac{h}{\lambda} \tag{58}$$

Which will in turn conclusively result in perfectly identical results in both cases:

$$p = 7.3623 \times 10^{-28}\, kg \times m/s \tag{59}$$

2.8.3 The energy of accelerated particles

Given according to the Finite Theory that there is no mass increase caused by an accelerated particle, then we'll simply use the frequency equivalence for both Special Relativity and Finite Theory from which we'll compute their difference, as seen in Fig. 4:

$$\Delta E = \frac{fh}{1 - \frac{x^2}{c^2}} - \frac{fh}{\sqrt{1 - \frac{x^2}{c^2}}} \tag{60}$$

Where the equivalent frequency for an electron is the following:

$$f \equiv \frac{c^2\, m_0}{h} \tag{61}$$

$$f \equiv 1.2356 \times 10^{20}\, s^{-1} \tag{62}$$

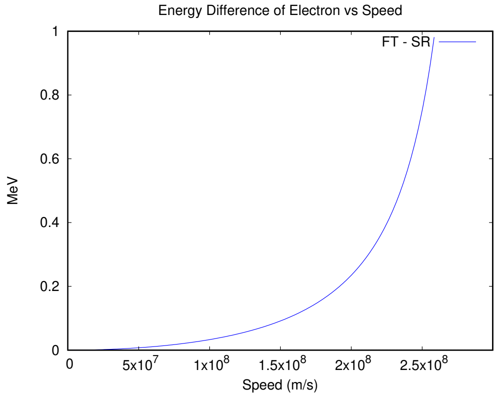

Fig. 4 Energy Difference of Electron

The actual missing transversal energy is hardly detectable at this intensity, even by using ultra-precise gravimeters.

2.8.4 Gravitational time dilation

As previously stated in Section 2.2.1, the effect of the time dilation in the gravitational field is described by the relation:

$$\frac{\Delta\tau}{\Delta t} = \frac{1}{\eta}\left(\eta + \frac{M}{r}\right) = 1 + \frac{M}{\eta r} \tag{63}$$

where, M is the mass of the gravitating object and r is the distance from its center. Under $\Delta\tau$ we mean the interval of local time at the point situated at distance r from the center of the source of gravitation. Δt is the interval of time measured by the distant observer, situated at distance $r \to \infty$.

The general relativistic time dilation effect is a particular case of (63) if $\eta = c^2/G$, where c is the speed-of-light and $G = 6.674 \times 10^{-11}\, m^3 kg^{-1} s^{-2}$ is the gravitational constant. Indeed, we know that in the weak field limit of General Relativity, the time dilation effect in the gravitational field takes the following form (see, for example, [6]):

$$\frac{\Delta\tau}{\Delta t} = \left(1 + \frac{GM}{c^2 r}\right)^{-1} \approx 1 - \frac{GM}{c^2 r} \tag{64}$$

But due to the hypotheses of the Finite Theory, factor η in (63) is not a universal constant but depends on the superimposed gravitational potentials. For example, in solar system experiments, where the gravitational potential of the Sun is the source of the strongest gravitational acceleration, we suppose $h = \eta$. The value of η is determined from the observation of the deflection angle of light in the gravitational field of the Sun, as we will demonstrate in the next subsection.

2.9 Bending of light in the gravitational field

Due to the time dilation effect, we expect to have different speed measurements of the same body by different observers. In particular, the speed-of-light traveling through the gravitational field will be different from the viewpoint of a local observer and the viewpoint of a distant watcher.

According to (63), a distant observer notes that the light beam has a velocity, which depends on the position in the gravitational field:

$$v = \frac{dr}{dt} = \frac{dr}{d\tau}\left(1 + \frac{m_{sun}}{\eta r}\right) = c\left(1 + \frac{m_{sun}}{\eta r}\right) \tag{65}$$

In this relation, the local speed $v_{local} = dr/d\tau = c = 2.998 \times 10^8\, m/s$ is constant due to our hypothesis (Hypothesis 1). Also, we neglect the effect of length contraction in the gravitational field, which results in equal values of length interval dr for both local and distant observers.

The distant observer can interpret the slow down of the light speed as the effect of some nonzero effective index of refraction:

$$n(r) \equiv \frac{c}{v} = \left(1 + \frac{m_{sun}}{\eta r}\right)^{-1} \approx \left(1 - \frac{m_{sun}}{\eta r}\right) \tag{66}$$

The last approximate relation here is due to the fact we suppose $\left\| \frac{m_{sun}}{\eta} \right\| \ll r$. As we will see later, this condition is fulfilled for the majority of real astrophysical objects.

The position-dependent index of refraction causes the bending of light, which will be measured by a distant observer. For the refractive index (66), the value of the deflection angle is as follows:

$$\delta = \frac{4m_{sun}}{\eta r_{sun}}\,, \tag{67}$$

where r_{sun} is the impact parameter, or the minimal distance from the light ray to the source of gravity. This relation is an obvious generalization of the result derived by Einstein. More detailed derivation can be found in [7].

The observed value of the deflection angle equals to (see [13], [14])

$$\delta_{obs} = \frac{4Gm_{sun}}{c^2 r_{sun}} = 0.847 \times 10^{-5}\,\mathrm{rad} \tag{68}$$

Both General Relativity and Finite Theory can adjust the theoretical result (69) with the observed value (68), but in different ways:

1. To explain the experiment in General Relativity, which supposes $\eta = c^2/G = 1.35 \times 10^{27}\, kg/m$, we have to introduce additional length contractions in the gravitational field, as is explained in [6].
2. In Finite Theory, we are decomposing the deflection angle into the time dilation and Newtonian acceleration constituents:

$$\delta = \frac{2m_{sun}}{\eta r_{sun}} + \frac{2m_{sun}}{\eta r_{sun}} = \frac{4m_{sun}}{\eta r_{sun}}\,, \tag{69}$$

No additional length contractions in the gravitational field is required in this case.

2.10 Explanation of the perihelion shift

The bending of light and perihelion shift of planets are the two classical tests of General Relativity. As we have seen in the previous subsection, the bending of light can be naturally explained by the Finite Theory without length contractions in the gravitational field. In this section, we consider the possibility of the Finite Theory to explain the perihelion shift of planets.

As we know, the radial motion of planets in the gravitational field of the Sun in Newton's gravity can be described by the relation

$$\frac{m\dot{r}^2}{2} + V(r) = \mathcal{E}\,, \tag{70}$$

where $V(r)$ is defined by

$$V(r) = -\frac{Gmm_{sun}}{r} + \frac{L^2}{2mr^2} \tag{71}$$

Here, m is the mass of the planet, m_{sun} — the mass of the Sun, E — the full non-relativistic energy of the planet, and L is the value of conserved angular momentum. Variable $r = \|\vec{r}\|$ is the distance to the Sun, which is supposed to be situated in the center of a coordinate system, and the dot means differentiation with respect to t. The second term in $V(r)$, in contrast to the attractive Newton's potential (first term), describes the action of repulsive centrifugal forces.

The general-relativistic investigation of the trajectory of a massive object in the spherically-symmetric gravitational field can also be described in terms of the effective gravitational potential (see, for example, [6]):

$$\frac{m\dot{r}^2}{2} + V_{eff}(r) = E\,, \tag{72}$$

Thus, the effective gravitational potential of General Relativity using the gravitational time dilation substitution (5), can be written in the form

$$V_{eff}(r) = -\frac{Gmm_{sun}}{r} + \frac{L^2}{2mr^2}\left(1 - \frac{2Gm_{sun}}{c^2 r}\right) \tag{73}$$

$$V_{eff}(r) = -\frac{Gmm_{sun}}{r} + \frac{L^2}{2mr^2}\left(1 + \frac{m_{sun}}{\eta r}\right)^{-2} \tag{74}$$

As is demonstrated in [6], such correction to the gravitational potential leads to the perihelion shift of the elliptical orbit per unit revolution by the angle

$$\delta\varphi = \frac{6\pi Gm_{sun}}{c^2 a(1-e^2)}\,, \tag{75}$$

where a is the semi-major axis of the orbit and e is its eccentricity.

We know (see [13], [14]) that the perihelion shift agrees with observational evidence not only for Mercury but for all planets of the solar system. Thus, the perihelion shift can be successfully explained within Newtonian mechanics if the correction (74) to the Newtonian potential energy is taken into account. This work has demonstrated that the additional term in (74) can appear as the result of the velocity-dependent correction that acts on planets in the solar system.

2.11 GPS and time dilation cancellation altitude

The gravitational time dilation and the kinematic time dilation both play a role on GPS satellites. The former is affected by the altitude whereas the latter is affected by its speed. We will study here the correct altitude where both effects cancel out.

First, we consider time dilation cancellation altitude from the viewpoint of General Relativity.

2.11.1 Time dilation cancellation altitude in General Relativity

Consider the artificial satellite, rotating around the Earth in circular orbit with radius r_{orbit}. Due to the gravitational dilation of time [see (64)], a static observer at altitude $r_{orbit} > r_{earth}$ should feel an accelerated flow of time with respect to the static observer on the Earth (r_{earth} is the radius of the Earth):

$$\frac{\Delta\tau_{orbit}}{\Delta\tau_{earth}} = \sqrt{\frac{1-\frac{2Gm_{earth}}{c^2 r_{orbit}}}{1-\frac{2Gm_{earth}}{c^2 r_{earth}}}} \tag{76}$$

But the satellite is not static, it rotates with linear velocity v, which leads to an additional relativistic effect:

$$\frac{\Delta\tau_{v}}{\Delta\tau_{earth}} = \sqrt{1-\frac{v^2}{c^2}} \approx 1-\frac{v^2}{2c^2} \tag{77}$$

Here, we are using the low-velocity approximation ($v \ll c$), which is justified for real GPS satellites. As we can see, the relativistic effect is opposed to the gravitational one, which makes it possible to find altitude, at which time dilation is canceled.

Finale relation, which takes into account both effects, can be written in the form:

$$\frac{\Delta\tau_{satellite}}{\Delta\tau_{earth}} = \sqrt{\frac{1-\frac{2Gm_{earth}}{c^2 r_{orbit}}}{1-\frac{2Gm_{earth}}{c^2 r_{earth}}}}\left(1-\frac{v^2}{2c^2}\right) \tag{78}$$

$$\frac{\Delta\tau_{satellite}}{\Delta\tau_{earth}} \approx 1+\frac{Gm_{earth}}{c^2 r_{orbit}}-\frac{Gm_{earth}}{c^2 r_{earth}}-\frac{v^2}{2c^2} \tag{79}$$

where the last approximate equality is valid in the Newtonian limit $r_{earth}, r_{orbit} \gg m_{earth}/h$. Also, under these conditions we can use the Newtonian relation for the velocity of the satellite, rotating in a circular orbit $v^2 = Gm_{earth}/r_{orbit}$, which results in the relation:

$$\frac{v^2}{c^2} = \frac{Gm_{earth}}{c^2 r_{orbit}} \tag{80}$$

Consequently, the radius of the orbit, at which cancellation occurs, is found to be

$$\frac{\Delta\tau_{satellite}}{\Delta\tau_{earth}} \approx 1-\frac{3Gm_{earth}}{2c^2 r_{orbit}}+\frac{Gm_{earth}}{c^2 r_{earth}} = 1 \quad \Rightarrow \quad r_{orbit} = \frac{3r_{earth}}{2} \tag{81}$$

which corresponds to the altitude $H = r_{orbit} - r_{earth} = r_{earth}/2 \approx 3185\, km$ [2].

2.11.2 Time dilation cancellation altitude in Finite Theory

For the same artificial satellite, Finite Theory supposes the gravitational dilation of time for static observers to be defined by [see (63) and (7)]

$$\frac{\Delta\tau_{orbit}}{\Delta\tau_{earth}} = \frac{1+\frac{m_{earth}}{\eta r_{earth}}}{1+\frac{m_{earth}}{\eta r_{orbit}}}, \quad \eta = 3.86\times 10^{21}\, kg\, m^{-1}\, s^{-1} \tag{82}$$

You'll notice above that the radii are swapped when compared to their GR counterpart (3). For the kinematic time dilation effect in Finite Theory, we have (see the explanation in Sec. 2.8.1):

$$\frac{\Delta\tau_v}{\Delta\tau_{earth}} = 1 - \frac{v^2}{c^2} \tag{83}$$

Though both kinematic and gravitational time dilation effects predicted by Finite Theory differ from those effects in General Relativity, the combined effect on the artificial satellite appears to be the same in both theories. Indeed, by combining (82) and (83) we get

$$\frac{\Delta\tau_{satellite}}{\Delta\tau_{earth}} = \frac{\left(1+\frac{m_{earth}}{\eta r_{earth}}\right)\left(1-\frac{v^2}{c^2}\right)}{1+\frac{m_{earth}}{\eta r_{orbit}}} \tag{84}$$

For the orbital velocity of the satellite we have $v^2 = Gm_{earth}/r_{orbit}$, which results in the relation

$$\frac{v^2}{c^2} = \frac{Gm_{earth}}{c^2 r_{orbit}} = \frac{m_{earth}}{\eta r_{orbit}} \tag{85}$$

Thus, we can write

$$r_{orbit} = \frac{2\eta r_{earth} + m_{earth}}{\eta} \tag{86}$$

Cancellation effect takes place at altitudes where $\Delta\tau_{satellite} = \Delta\tau_{earth}$. The corresponding altitude $H = r_{orbit} - r_{earth} = 6378\, km$ coincides with close to twice the altitude derived in Sec. 2.11.1 in the frames of General Relativity. In other words, this prediction can be upgraded into yet another experiment proposal.

2.12 Gravitational time dilation

The notion of gravitational time dilation is the simple relation between the gravitational potential energy at a given radius with the speed or time rate at that given radius.

Furthermore the gravitational potential energy versus the radius is proportional to the following relation:

$$\rho = \frac{\rho_0}{r^2 \sin\left(\operatorname{asin}\left(\frac{1}{r_S}\right)\right)^2} \tag{87}$$

$$\rho = \frac{\rho_0 \, {r_S}^2}{r^2} \tag{88}$$

Moreover the relation between energy and speed, or time rate, is given by the following formula:

$$E = \frac{m \, v^2}{2} \tag{89}$$

Then:

$$v = \sqrt{\frac{2 \, E}{m}} \tag{90}$$

Which means the actual gravitational potential energy and time rate versus the radius will be proportional to Fig. 5 and the energy is conserved, in contrast with GR.

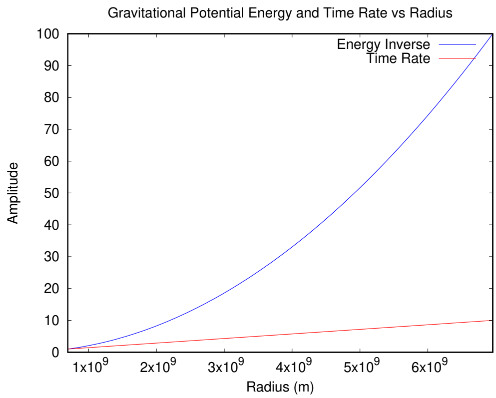

Fig. 5 Gravitational Potential Energy and Time Rate

2.13 Gravitational redshift

From the previous subsection, if there is an end gain in the kinetic energy for a photon travelling up in altitude and therefore a gain in speed, being directly proportional to the altitude or the gravitoelectromagnetic energy.

Why local observers will observe a gravitational redshift in frequency of the observed photon then? For the simple reason their own gravitational time rate factor will be accelerated as well, making the relative perception of the photon frequency accordingly altered (see Fig. 6).

Now as we know, the relativistic Doppler shift is given by the following formula:

$$f_o = \sqrt{\frac{1 - \frac{v}{c}}{\frac{v}{c} + 1}} \times f_f \tag{91}$$

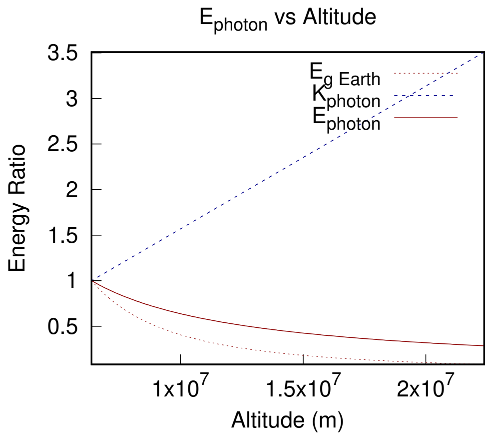

Fig. 6 Gravitational Redshift

In contrast with the Finite Theory's kinetic Doppler shift as given by:

$$f_o = \frac{1}{\frac{v}{c} + 1} \times f_f \tag{92}$$

Which will result in the divergent functions reflected in Fig. 7.

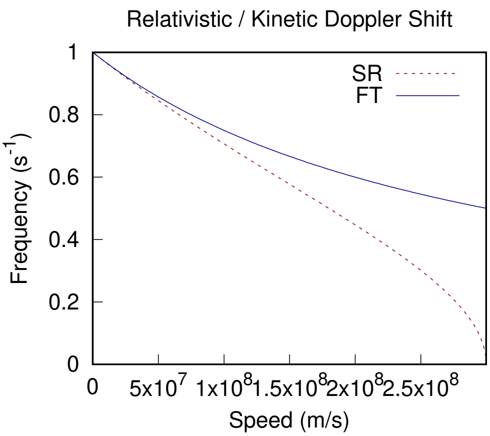

Fig. 7 Doppler Shift

Thus at low velocities, both functions are equivalent but at high velocities, they diverge. Unfortunately testing the gravitational redshift at high velocities is still a problem as of today so we'll have to restrict ourselves to testing low velocities.

To find the gravitational redshift and the relativistic Doppler shift cancellation point, we'll use the following formula:

$$\sqrt{\frac{\left(1-\frac{2G\,m_e}{c^2\,\|p_e-d\|}\right)\left(1-\frac{v}{c}\right)}{\left(1-\frac{2G\,m_e}{c^2\,\|p_e\|}\right)\left(\frac{v}{c}+1\right)}}=1 \tag{93}$$

Where:

- v is the relative velocity between the observer and the moving apparatus
- $c = 299792458\,m/s$
- $G = 6.67408 \times 10^{-11}\,m^3 kg^{-1} s^{-2}$
- $d = 22.5\,m$ (elevation of the tower)
- $p_e = -6.371 \times 10^6\,m$ (position of the center of the Earth)
- $m_e = 5.973 \times 10^{24}\,kg$ (mass of the Earth)

Or:

$$v = \frac{Gcd\,m_e}{c^2\,\|p_e\|^2 + (c^2 d - 2G\,m_e)\,\|p_e\| - Gd\,m_e} \tag{94}$$

$$v = 7.322 \times 10^{-7}\,m/s \tag{95}$$

$$v/c = 2.442 \times 10^{-15} \tag{96}$$

Now by using Finite Theory we'll have the following relation:

$$\frac{\left(\frac{m_e}{\|p_e\|}+\eta\right)\left(1-\frac{v}{c}\right)}{\left(\frac{m_e}{\|p_e-d\|}+\eta\right)\left(1-\frac{v^2}{c^2}\right)}=1 \tag{97}$$

Where:

- v is the relative velocity between the observer and the moving apparatus
- $c = 299792458\,m/s$
- $G = 6.67408 \times 10^{-11}\,m^3\,kg^{-1}\,s^{-2}$
- $\eta = 1.35 \times 10^{27} kg\,m^{-1}$
- $d = 22.5\,m$ (elevation of the tower)
- $p_e = -6.371 \times 10^6\,m$ (position of the center of the Earth)
- $m_e = 5.973 \times 10^{24}\,kg$ (mass of the Earth)

Or:

$$v = \frac{c\,m_e\,\|p_e - d\| - c\,m_e\,\|p_e\|}{\eta_b\,\|p_e\|\,\|p_e - d\| + m_e\,\|p_e\|} \tag{98}$$

$$v = 7.322 \times 10^{-7}\,m/s \tag{99}$$

$$v/c = 2.442 \times 10^{-15} \tag{100}$$

We'll notice once again that by using completely different mathematics we obtain the same factors which correspond to observations [11].

3 Cosmological implications

Herein are enumerated all consequences FT will lead to and highlights important differences from GR. Given we know the measurement of light bending, we can "reverse engineer" the entire universe to find out all its characteristics. We'll now illustrate how it can be done.

At this level, only complex computer research can be proposed to simulate modeling of the universe under this umbrella to match its behavior with measurements such as the constant of Hubble's Law. Potentially, simulators can also be used to reverse time and estimate an early universe according to the current velocities of the superclusters, solve the scaling factor of the observed universe which will lead to an estimation of the real volume of the universe, and solve local focal points of gravitational lenses.

3.1 Natural faster-than-light speed

One of the most practical and interesting goals of any research area in this field is to reach exoplanets. Unfortunately, since GR disallows any probe or ship to travel faster than c we reach an impasse because one of the closest star named Alpha Centauri is about $4.36507\,ly$ or $4.01345 \times 10^{16}\,m$ away from us. This means light rays will take $4.36507\,years$ to overtake that distance according to GR. The following section explores the consequences of FT on close distances such as the Moon that will follow the following principle:

$$t = \int \frac{\sum_{i=1}^{n} \frac{m_i}{\|x-d_i\|}}{\sum_{i=1}^{n} \frac{m_i}{\|d_i\|}} \times \frac{1}{c} dx \tag{101}$$

3.1.1 Moon

To estimate the distance of the Moon in conformance to FT, we will follow the henceforth equation that takes into account the adjoining most massive entity, or the influence of the scaling factor. We also know the time it takes for a laser to travel back and forth between the Moon and the surface of the Earth. Once again the scaling factor represents the average influence of all surrounding stars.

$$\begin{aligned} 1.25\,s = & \frac{m_s \log\left(\|x_{ft} - r_m - p_s\|\right) + m_e \log\left(\|x_{ft} - r_m - p_e\|\right)}{c\left(\frac{m_m}{\|x_{ft}\|} + \frac{m_s}{\|p_s\|} + \frac{m_e}{\|p_e\|} + \eta\right)} \\ & + \frac{\eta\,\|x_{ft} - r_m\| + m_m \log\left(\|r_m\|\right)}{c\left(\frac{m_m}{\|x_{ft}\|} + \frac{m_s}{\|p_s\|} + \frac{m_e}{\|p_e\|} + \eta\right)} \\ & - \frac{m_m \log\left(\|x_{ft}\|\right) + m_s \log\left(\|p_s\|\right) + m_e \log\left(\|p_e\|\right)}{c\left(\frac{m_m}{\|x_{ft}\|} + \frac{m_s}{\|p_s\|} + \frac{m_e}{\|p_e\|} + \eta\right)} \end{aligned} \tag{102}$$

And after numerical analysis we'll find that:

$$x_{ft} = 3.7647807986 \times 10^8 \, m \tag{103}$$

Where:

- $c = 299792458 \, m/s$
- $G = 6.67408 \times 10^{-11} \, m^3 kg^{-1} s^{-2}$
- $\eta = c^2/G = 1.35 \times 10^{27} \, kg/m$
- $p_e = -6.371 \times 10^6 \, m$ (position of the center of the Earth)
- $m_e = 5.973 \times 10^{24} \, kg$ (mass of the Earth)
- $r_m = 1.7375 \times 10^6 \, m$ (radius of the Moon)
- $m_m = 7.348 \times 10^{22} \, kg$ (mass of the Moon)
- $p_s = 1.52 \times 10^{11} \, m$ (position of the center of the Sun)
- $m_s = 1.98892 \times 10^{30} \, kg$ (mass of the Sun)

If we compare with the distance predicted by GR:

$$x_{gr} = c \times 1.25 + r_m \tag{104}$$

$$x_{gr} = 3.764780725 \times 10^8 \, m \tag{105}$$

Which is a difference of:

$$x_{ft} - x_{gr} = 7.36 \, m \tag{106}$$

Indeed we just found a discrepancy of $7 \, m$ between the prediction of FT and GR at such a low scale.

3.2 Earth's Tides and Flyby Anomaly

It is important to point out also that a deep study of the microgal as measured in various places around the Earth, gives consistent results in the residual, or the difference between the theoretical and measured gravitational acceleration as seen by Fig. 8 and 9:

Since the normalized residual is proportional to the normalized derivative of the theoretical gravitational acceleration, it suggests that there is indeed an æther wind (or comoving superimposed gravitational framework) given the preferred alignment of the gravimeter; towards or perpendicular to the Sun.

Lastly, it was recently found that the famous flyby anomaly is directly proportional to the Earth's rotation [8] which is consistent with the Earth's tides or an æther wind.

3.3 Parameters of the invisible universe

3.3.1 Galactic rotation curve

The laws of classical physics imply there is a parent framework from which rotating stars relate to in all cases. But what if we have a universe with only one black hole in it? The black hole will rotate relative to which comoving framework?

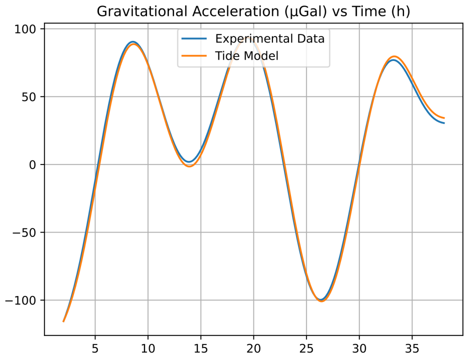

Fig. 8 Microgal vs Time

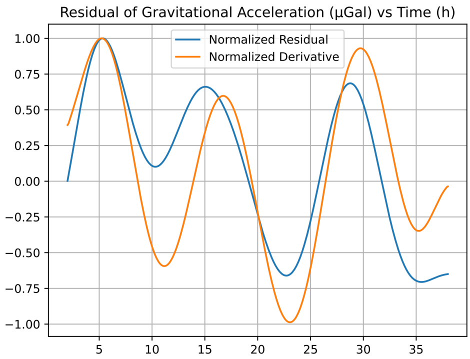

Fig. 9 Microgal Residual vs Time

We can see here that the black hole cannot rotate if it is the sole one in the universe. This singular black hole will be the one defining the absolute framework from which other stars will rotate around and their planets will rotate around each one of these stars, and so on. So the comoving frameworks simply are superimposed with the most massive body defining the absolute one.

The best example we can use to prove this property is indeed the rotation curve because of the huge mass involved at the center of galaxies. If we take for example the formula of a standard rotation curve as given by the following equation, which is the standard orbital speed but affected by the time dilation and its comoving superimposed gravitational framework:

$$v = \omega x + \frac{\eta \sqrt{\frac{Gm}{x}}}{\frac{m}{x} + \eta} \tag{107}$$

Where:

- v is the tangential velocity of the stars
- $G = 6.67408 \times 10^{-11}\, m^3 kg^{-1} s^{-2}$
- $\eta = [1 \times 10^{18}, 5 \times 10^{21}]\, kg\, m^{-1}\, s^{-1}$
- m is the mass of the bulge of the galaxy
- x is the distance from the center of the galaxy

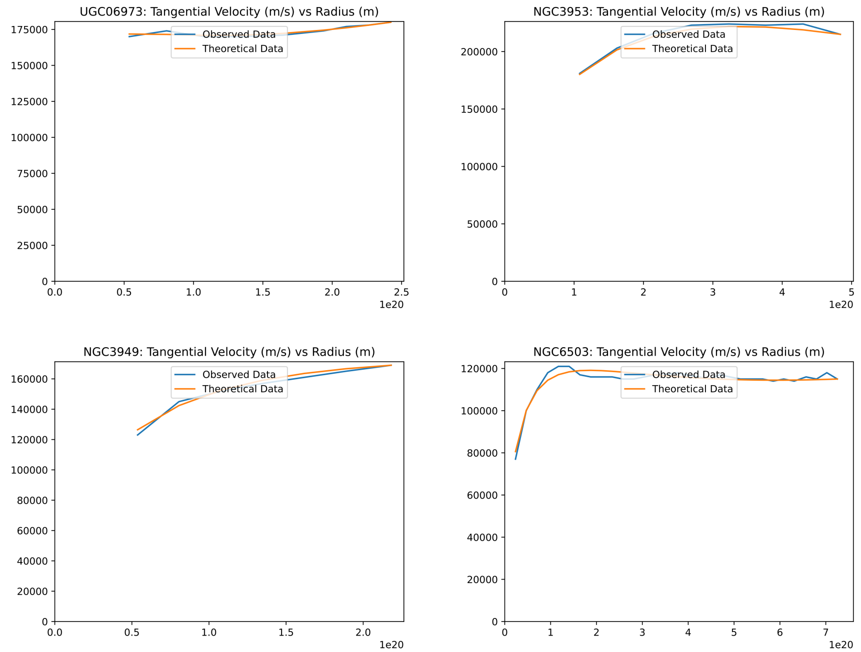

Fig. 10 Rotation Curve

So after retrofitting almost 500 galaxies (Fig. 10 & 11), with a mean standard deviation of $8000\, m/s$, we observe a linear mass density that is approximately $1 \times 10^{20}\, kg\, m^{-1}\, s^{-1}$, namely in proximity with the order of magnitude of the Milky Way.

3.3.2 Radii Range and Mass of the Visible Universe

An inside-the-sphere gravitational potential distribution formula of the entire visible universe predicts the following value of the parameter h:

$$\eta_{visible} = \frac{M_{visible}(3R_{visible}^2 - d^2)}{2R_{visible}^3} \tag{108}$$

By solving $M_{visible}$ and by dividing by the volume of a sphere, we get the volume mass density of the whole visible universe:

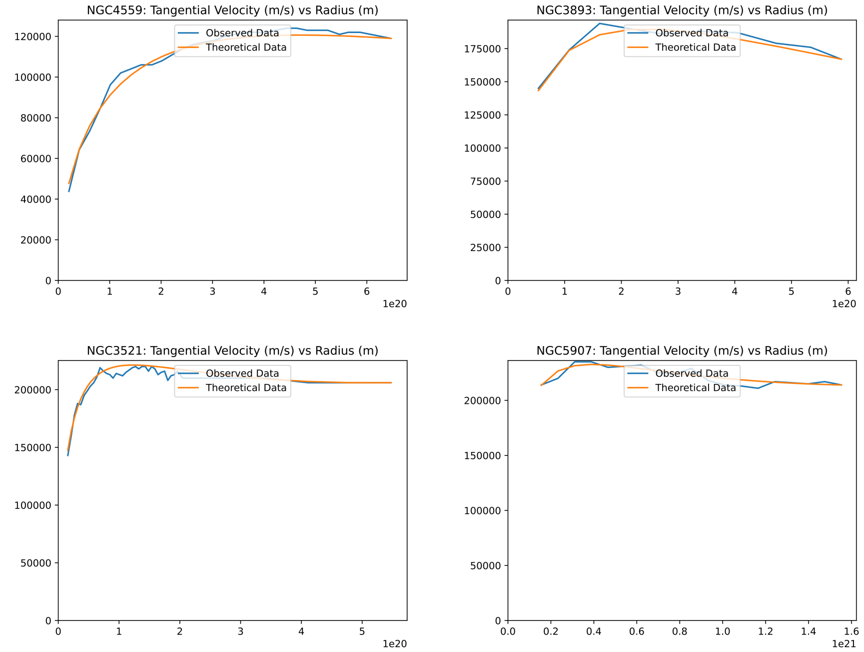

Fig. 11 Rotation Curve

$$\rho = -\frac{3\eta_{visible}}{2\pi\left(r^2 - 3R^2\right)} \tag{109}$$

Or:

$$r = \frac{\sqrt{3}\sqrt{2\pi R^2 - \frac{\eta_{visible}}{\rho}}}{\sqrt{2}\sqrt{\pi}} \tag{110}$$

Where:

- $\rho = 3.0 \times 10^{-28}\, kg/m^3$
- $\eta_{visible} < 1 \times 10^{20}\, kg/m$
- $R =$ radius of the visible universe
- $r =$ distance of the Milky Way from the center of the visible universe ($r < R$)

Now the minima and maxima of the radii will be solely based on the $r < R$ relation. This means that the minima and maxima are respectively given by:

$$r' = \frac{\sqrt{2}\sqrt{3}\sqrt{\pi}R_{min}}{\sqrt{2\pi {R_{min}}^2 - \frac{\eta_{visible}}{\rho}}} \tag{111}$$

$$0 = \sqrt{2\pi {R_{min}}^2 - \frac{\eta_{visible}}{\rho}} \tag{112}$$

$$R_{min} = \frac{\sqrt{\frac{\eta_{visible}}{\rho}}}{\sqrt{2}\sqrt{\pi}} \tag{113}$$

$$R_{min} = 2.3033 \times 10^{23}\, m \tag{114}$$

And where $r = R$:

$$R_{max} = \frac{\sqrt{3}\sqrt{2\pi R^2 - \frac{\eta_{visible}}{\rho}}}{\sqrt{2}\sqrt{\pi}} \tag{115}$$

$$R_{max} = \frac{\sqrt{3}\sqrt{\frac{\eta_{visible}}{\rho}}}{2\sqrt{\pi}} \tag{116}$$

$$R_{max} = 2.8209 \times 10^{23}\, m \tag{117}$$

Which is about 2000 times lesser than the radius estimated by mainstream science. To visualize this, we refer to the Fig. 12.

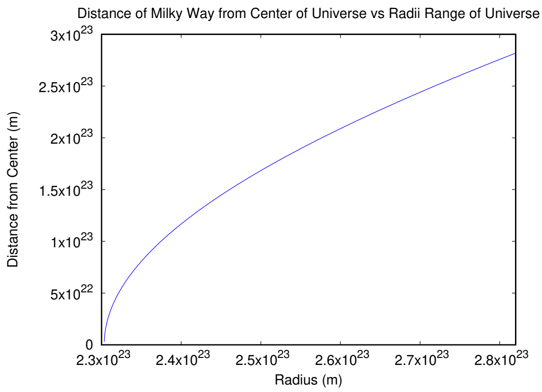

Fig. 12 Universe Radii Range

Regarding the mass, we'll base its range on the following relation:

$$\rho = \frac{3M_{universe}}{4\pi {R_{universe}}^3} \tag{118}$$

$$M_{universe} = \frac{4\pi\rho {R_{universe}}^3}{3} \tag{119}$$

$$M_{universe} = [1.5355 \times 10^{43}, 2.8209 \times 10^{43}]\, kg \tag{120}$$

Which is about 100 million times lesser than the mass estimated by mainstream science.

3.3.3 Maximum Velocity of the Visible Universe

Dark energy is a constant or scalar field filling all of the space that has been hypothesized but remains undetected in laboratories. The problem is that to do so the amount of vacuum energy required to overcome gravitational attraction would require a constantly increasing total energy of the universe in violation of the law of conservation of the energy.

Hubble's law represents the rate of the expansion of the universe with the speed of the distant galaxies $v_{apparent}$ as seen from the Milky Way with:

$$v_{apparent} = H_0\, x\,, \tag{121}$$

where $H_0 = 2.26 \times 10^{-18}$ s^{-1} is Hubble's constant and x is the distance to the remote galaxy. Hubble law is illustrated in Fig. 13.

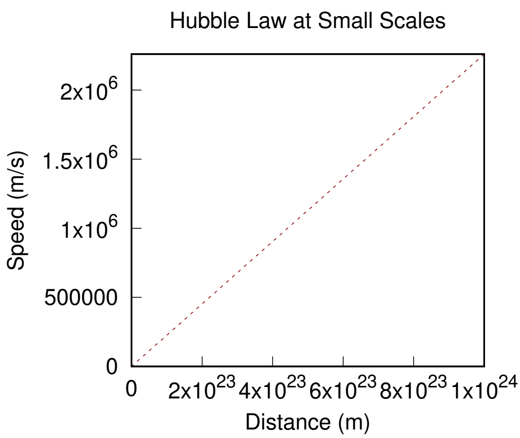

Fig. 13 Hubble law

On the other hand, Finite Theory applied on the scale of the universe proves that there is no need for such energy. Indeed if we consider the universe to be the result of a big bang then all galaxies must have a certain momentum. If we try to represent the speed of the observed galaxies using Finite Theory where h is null because the environment must not be encompassed by anything else then we will have:

$$v_{apparent} = \frac{M_{visible}/\left\|s_{visible}\right\|}{M_{visible}/\left\|x - s_{visible}\right\|}\, v_{visible} \tag{122}$$

where $s_{visible}$ is the position of the center of the visible universe, and $v_{visible} = c$.

After simplifying and subtracting the speed of the observer from his observations [the speed of the observer $v_{visible}$ needs to be subtracted because the observer himself is moving and has the same speed of the visible universe ($v_{visible}$)] we will have:

$$v_{apparent} = \frac{v_{visible} \left\| x - s_{visible} \right\|}{\left\| s_{visible} \right\|} - v_{visible} \tag{123}$$

This means $s_{visible}$, or the position of the center of the universe, is solvable by equaling (121) and (123):

$$H_0 \, x = \frac{v_{visible} \left\| x - s_{visible} \right\|}{\left\| s_{visible} \right\|} - v_{visible} \,, \tag{124}$$

which results in

$$s_{visible} = - \frac{v_{visible}}{H_0} \tag{125}$$

$$v_{visible} = - \, s_{visible} \times H_0 \tag{126}$$

Based on $R_{max} = r = - \, s_{visible} = 2.8209 \times 10^{23} \, m$, it will give us a maximum velocity of:

$$v_{visible} = 637320 \, m/s \tag{127}$$

3.3.4 Energy Density and Acceleration of the Visible Universe

The energy density of a photon is given by the following formula:

$$\frac{EF_e^2}{2c^2 \, \mu_e} + \frac{BF_e^2}{2\mu_e} = \rho \, f \, h \tag{128}$$

Where:

- EF_e = electric field
- BF_e = magnetic field
- μ_e = magnetic permeability
- $c = 299792458 \, m/s$
- ρ = volume photon density
- f = photon frequency
- h = Planck constant

Moreover, the square root gravitoelectric and gravitomagnetic permeability is thus defined by the following constant:

$$\zeta = \sqrt{\frac{\mu_e}{\mu_g}} \tag{129}$$

- μ_e = magnetic permeability
- μ_g = gravitomagnetic permeability

The amplitude of the gravitomagnetic permeability is actually proportional to the amplitude of the vacuum energy density.

The previous important relation also means that there is a distinct mass / charge equivalence as hypothesized:

$$E = q \, \zeta \, c^2 \tag{130}$$

Another important property of the photon is the electric field equals the magnetic field. So in the case of the gravitational waves, by symmetry, the gravitoelectric field equals the gravitomagnetic field as well:

$$\frac{EF_g^2}{2c^2\,\mu_g} = \frac{BF_g^2}{2\mu_g} \tag{131}$$

Or more importantly:

$$EF_g = c\,BF_g \tag{132}$$

This means the gravitoelectric field is directly proportional to the gravitomagnetic field at the top scale of the universe only, given the distance of the amplitude of Equ. (140), the angular velocity of the core must be only $2.9979 \times 10^{-18}\,s^{-1}$ to reach a maximum speed of c. So we can infer one by knowing the other and vice-versa, again, at this scale only.

Thus since Hubble's constant represents a time rate of a greater encompassing and invisible entity, we can infer the gravitational acceleration from that constant:

$$a_{universe} = H_0 c \tag{133}$$

$$a_{universe} = 6.7753 \times 10^{-10}\,m/s^2 \tag{134}$$

3.3.5 Position of the Universal Core

To find the position of the universal core the visible universe of traveling away from, we'll need to start with the following definitions, with the standard definition of Newtonian gravitational acceleration:

$$a_{universe} = \frac{G\,M_{core}}{{s_{core}}^2} \tag{135}$$

And the definition of G, according to Finite Theory:

$$G = \frac{c^2}{\eta_{invisible}} \tag{136}$$

Plus the fact that the only large-scale entity at that level is the universal core then:

$$\eta_{invisible} = \frac{M_{core}}{s_{core}} \tag{137}$$

We'll have the acceleration of the visible universe inversely proportional to the position of the universal core:

$$a_{universe} = \frac{c^2}{s_{core}} \tag{138}$$

Now by using (134), we'll have:

$$6.7753 \times 10^{-10}\, m/s^2 = \frac{c^2}{s_{core}} \tag{139}$$

Where the position of the universal core can be solved with:

$$s_{core} = 1.3265 \times 10^{26}\, m \tag{140}$$

Thus the distance we are away from the universal core is $1.3265 \times 10^{26}\, m$; which is 470 times the maximum radius of the visible universe.

4 Experiment proposal

4.0.1 Michelson-Morley Interferometer on the International Space Station

Although gravitons have not been directly detected and might not even be possible [12], we hypothesize detecting their presence indirectly by observing a variance in both c and the wavelength of a photon from the graviton field it is traveling through. We reevaluate the absoluteness of the reference frames, as is demanded by the hypotheses of the Finite Theory.

The observer is subject to time dilation relative to the surface of the Earth but the wavelength meter is also subject to the same amount of time dilation so both effects cancel out and what the observer sees is a normally functioning wavelength meter. The wavelength is relative to the spinning surface of the Earth so having an observer moving against it will change what is measured. Also, the frequency (cycles per second) will be the same in all frames of reference. The hypothesis related to time dilation has no effect here and only the hypothesis related to the frames of reference plays a role. Also, for an altitude of $400km$ only, the Earth's kinetic time dilation factor will be up to 88%, enough to relate the comoving framework of the Earth (2.6).

By sending the experiment at a speed in the vicinity of the speed of sound (in the following, we suppose the speed of the experimenter to be $88\% \times 6125.22\, m/s = 5390.19\, m/s$), it should be sufficient to detect a change in wavelength directly proportionally while energy is conserved:

$$E = \frac{h(c - v_1)}{\lambda_1} = \frac{h(c - v_2)}{\lambda_2} \tag{141}$$

Thus, if the stationary observer ($v_1 = 0\, m/s$) measures $\lambda_1 = 6.5 \times 10^{-7}\, m$, the experimenter having velocity $v_2 = 5390.19\, m/s$ measures

$$\lambda_2 = \frac{(c - v_2)\lambda_1}{c - v_1} = 6.49988 \times 10^{-7}\, m \tag{142}$$

Here, we have accepted $c = 299792458\, m/s$ for the local value of the light speed.

As the frequency will be the same in all frames of reference, the speed-of-light won't be constant, relative to the moving observer. For the stationary observer, which measures speed-of-light $c_1 = c = 299792458\,m/s$ and wavelength $\lambda_1 = 6.5 \times 10^{-7}\,m$, we have the following frequency:

$$\nu_1 = \frac{c_1}{\lambda_1} = 4.6122 \times 10^{14}\,s^{-1} \tag{143}$$

Now we can find the new speed of the light beam in motion, which will be measured by an experimenter having velocity $v_2 = 5390.19\,m/s$:

$$c_2 = \lambda_2 \nu_2 = \lambda_2 \nu_1 = 2.9979 \times 10^8\,m/s\,, \tag{144}$$

where we have combined results (142) and (143).

For a wavelength meter having an accuracy of $\pm 1.5\,pm$ we should be able to confirm whether the change in wavelength (and, correspondingly, the change of light speed) occurs for the experiment in motion. The predicted difference of $\lambda_1 - \lambda_2 = 1.169 \times 10^{-11}\,m$ is large enough to be detected [1].

5 Conclusion

As we have demonstrated in this proposal, Finite Theory is a viable candidate for the new theory of gravity, which can explain time dilation effects, bending of light, and perihelion shifts for planets in the solar system (see Sec. 2). Also, Finite Theory allows to establish new properties of the invisible part of the universe and explain some peculiar properties of late-time cosmological evolution (Sec. 3).

Though we still have some unresolved problems, we believe that the results obtained to this moment are very promising, and Finite Theory deserves further theoretical and experimental investigation. The role of the experiment we have described in Sec. 4 is crucial for the development of the Finite Theory. Possibly, it will start a new era in gravitational physics.

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7 Declarations

7.1 Ethical approval

Not applicable.

7.2 Competing interests

The authors declare that they have no competing interests related to this work. However, it should be noted that some of the authors have previously published on related topics, and may hold opinions or beliefs that could potentially influence the interpretation of the data presented in this manuscript.

7.3 Authors' contributions

P. Bouchard wrote the entire theory and manuscript from scratch.

7.4 Funding

Not applicable.

7.5 Availability of data and materials

The data, materials and the code used to analyze the data that support the findings of this study are openly available on GitHub (see [3] and [4]). The dataset includes the galactic rotation curve of almost 500 galaxies and microgal measurements of the Earth's tides. Users are free to download and use the data for non-commercial purposes, with proper attribution to the authors.

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