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Proposal of a Theory Modifying General Relativity

Marc Mignonat

Société d'Astronomie des Pyrénées Occidentales, Pau, France
Email: marcmignonat@gmail.com

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Abstract

General Relativity (GR) postulated that the speed of gravity was equal to that of light and that gravity was of the same nature as electromagnetic waves. However, this speed to be separated from that of gravitational waves, has never been directly measured. This poses theoretical problems, especially regarding the existence of gravitons and how a black hole exerts its attraction. Superluminal celerities are assumed for quantum entanglement and cosmic inflation. We present 2 paradoxes from the gravities of Newton or Einstein, allowing to say that gravity is of a different nature than electromagnetic waves and that the description by curvatures is insufficient. The speed of gravity was estimated in the early 19th century by Laplace, late 19th century, and late 20th century by Van Flandern. We have taken the Laplace method which gives values close to that of Van Flandern from the GR. One of Hawking equations might also be used to calculate this speed. The first two methods make it possible to calculate a gravitational velocity related to orbital velocities. We can see that the planets are in precise orbits, probably related to gravitational waves, responding to a precise equation. We can determine a mass beyond which attraction will no longer be exercised. Several verifications are considered: 1) The fact that exoplanets or satellites are on preferred orbits according to our equation can already be verified. 2) The measurement of the speed of quantum entanglement (or decoherence) would make it possible to link in another way quantum and gravitation. 3) If this speed varies with mass, then its measurement could be feasible in a laboratory for small masses. Finding a speed or celerity of gravity greater than that of light requires a clear distinction between gravitational signal ($>c$) and gravitational wave ($=c$) to maintain the validity of special relativity (SR) and part of GR. In order to solve the presented paradoxes, we propose a theory where the curvatures in the space-time frame are replaced by retractions that can be transmitted at very high celerity; the "predictions" of the GR are retained, the space-time frame becomes representable and is no longer a mathematical abstraction.

Keywords

Gravitational Speed, General Relativity and Quantum Mechanics, Quantum Entanglement, Cosmic Inflation, Space Time Frame

1. Introduction

The purpose of this paper is to show that in the theories of gravitation (Newton or Einstein), the ideas of graviton, electromagnetic waves (EMW) or curvatures do not allow to explain the action of gravitation.

- For this, we have, in part 2, presented, in addition to the black hole, 2 thought experiments that allow to understand the problem posed by a graviton or an EMW (no loss of energy at the level of bodies) as well as the calculation of curvature made only from the massive object (no multiplication of masses or curves).
- But previously, as this calls into question part of the GR, we have in part 1 recalled where the idea came from to compare gravitation to an EMW and insisted on the speed of gravitation because not respecting the speed of light (even if there is no mass or energy transfer) hits our thought formatted by GR and SR.

It is important to distinguish the EMWs, gravitational waves, and masses that carry energy from the "gravitational signal," which is different and acts, according to our hypothesis, through a retraction of the space-time frame.

- We have, in part 3, presented several methods to calculate the celerity of the gravitational signal and from this celerity, tried to deduce privileged orbits, a maximum mass for a black hole. These results, even if they are not conclusive due to lack of data, are important indications that suggest the celerity of the gravitational signal is much higher than that of light.
- We then, in part 4, proposed a model variant of the GR. In the space-time frame, introduced by GR, curvatures due to masses are replaced by retractions which greatly simplifies mathematics. This frame is representable because the temporal dimension and its variations are in this retraction.

Laplace and His Successors

1) Laplace [1], furthermore inventor of the theoretical concept of the black hole (BH) ("dark body") based on an idea he borrowed from Mitchell [2] in his publication of 1797 [3] tries to estimate the speed of gravity. He calculates that the travel time of the gravitational signal would bring an excess of advance in the perihelia. Starting from the secular equation of the moon, he calculates that "the velocity of the gravitic fluid would be at least 50 million times greater than that of light" [1]. He revisits this calculation in a later publication [4] to exclude an "ethereal resistance" and still arrives at a speed of 50 to 100 million times the speed of light.

The interpretation of Laplace is not valid if we consider that gravitation is like an electromagnetic wave or if we consider that the mechanism of Le Sage explains the source of gravity, and therefore the Earth orbit should spiral. But, there is no evidence to prove that gravitation is an electromagnetic wave; quite the contrary.

2) Late 19th century, Stourdza [5] proposes a speed of gravity equal to $10^{84}c$. But, it gives a very questionable and not very credible explanation of gravity with ethereal particles stemming from the corpuscular theory of Le Sage. In this continuity, Larmor argues that matter consists of elementary particles moving in the ether with electrons describing their orbits in a shorter time with a ratio of $\left(1-v^2/c^2\right)^{0.5}$ [6].

This Larmor Lorentz theory, where gravity has a finite speed but much greater than that of light, dominates the early 20th century, but it poses the problem of an ether with particles that must be non-resisting and non-heating.

3) Poincaré then poses a principle of relativity in 1904. [7] For this, he recalls that gravity is considered as an electromagnetic wave (EMW) to give coherence to the atom (mostly known at the time from the electromagnetic force and the hypothesis of Franklin of the bag of marbles). It is therefore logical that he assigns it a speed equal to that of light. He explains the absence of gravitational aberration using Lorentz transforms. "To satisfy the principle of relativity, no signal must be able to propagate faster than light" [8] "changes in the gravitational field can propagate at the speed of light, while still preserving a law of gravitation, provided that the Lorentz transformation is the basis of such a theory." [9]

Poincaré dismissed the Larmor Lorentz theory, choosing to favor the analogy with EMWs. He implicitly dismisses an argument he had previously developed: in 1902 [10], he imagines particles, especially the electron, as voids, with mass being only a "coefficient" corresponding to the "attractive power" of this body, "the corpuscle would be nothing but a void in the ether, the only real thing, the only one endowed with inertia." Replacing particles with voids avoids the two observational arguments that invalidated corpuscular theory of Le Sage Larmor (the absence of heating and the absence of ethereal resistance of Laplace).

Furthermore, the reasoning he applies to gravity considered as an EMW should also be applied to light, which should then not have any aberration. He does not explain why he uses Lorentz transforms for gravity (this removes the aberration that this electromagnetic wave traveling at speed c would have) and why he does not use them for light (thus preserving its aberration).

4) Einstein similarly poses in 1905 and 1915 a principle of relativity with a gravity postulated to travel at speed c and has the genius to change paradigm by eliminating the ether and replacing it with a space-time frame deformed by the masses. This frame is perfectly described mathematically but not representable in the world of physical reality, which is an element of incompatibility with quantum mechanics (QM).

5) Van Flandern in 1998 [11] remarks that just like Newton's gravitation, GR postulates an instantaneous speed since the advances in periastres are due to a curvature of space and not a travel time (the time for the modification of space-

time curvatures thus becomes zero). This author considers that the Larmor Lorentz theory (LR) is more valid than GR because "SR cannot explain the faster-than-light propagation of gravity, although LR readily can.".

As for Laplace, the critique from Van Flandern's point of view rests "on the basis of the similarities between electromagnetism and GR" [12], thus taking up the postulate of Poincaré.

2. Observations of Several Elements on the Nature of Gravity: The Black Hole and Two Thought Experiments

2.1. The Black Hole

The problem is to understand how it exerts attraction.

Either, we imagine a graviton; then, not exceeding the speed of light *c*, it cannot cross the horizon of the BH and cannot exert attraction. Or, for the GR, the geodesics of the space-time frame for a BH are closed on themselves; the gravitational signal cannot escape. The coalescence of 2 BHs causes gravitational waves that are interpreted as vibrations of the space-time frame, but once the fusion is done, the signal disappears or becomes very weak because it emanates from the horizon of the BH and not from the BH itself. We can say that the vibration on the frame moves at a speed *c*, but we cannot conclude on the speed of the deformation of the frame, therefore on the speed of gravity. (The distinction between the speed of EMW and the speed of gravitational transmission vg must be made in the same way as the speed of a wave on the water surface must be distinguished from the speed of sound in the water; the same medium can transmit signals at different speeds or carry fields of different natures).

Relativity postulates the speed c for light and other waves, electromagnetic and gravitational. However, we know of 3 situations where there is no matter displacement and where things move faster than light: Quantum entanglement, cosmic inflation if it exists, and cosmic expansion. Cosmic expansion appears to us to be greater than *c* (even if locally this speed is not reached).

Does this mean then that the different masses moving away from us at a speed greater than c would only exert their attractions over a limited distance? There are currently no astronomical observations that would show such a phenomenon. Note that the principle of the relativity of no displacement of an energy faster than c can be preserved if we consider that there is no displacement of energy or matter in these three cases. However, these 3 phenomena were completely unknown when Poincaré and Einstein postulated a speed of gravity equal to the speed of light. Measuring or calculating the speed of the gravitational signal is therefore essential.

2.2. Paradox of Nested Spheres or Onion: (Thought Experiment 1)

This paradox would eliminate the hypothesis of a gravitation acting through a graviton or a gravitational wave.

We start from the attraction exerted on a hollow sphere B_1 of mass m_1 and then on a very large number n of spheres of the same mass m_1 (**Figure 1**). Hypothetically, it is assumed that gravitons or gravitational waves emanate from a body, for example A, to react on body B_1. To act on sphere B_2, even if it is tiny, part of the energy of the wave is lost by acting on B_1. This energy having decreased, the interaction will be less when arriving on B_2 and then on B_n, where n can tend to infinity. This means, in the end, that the attraction force should not be proportional to Σm but to $(\Sigma m)^a$, $a < 1$.

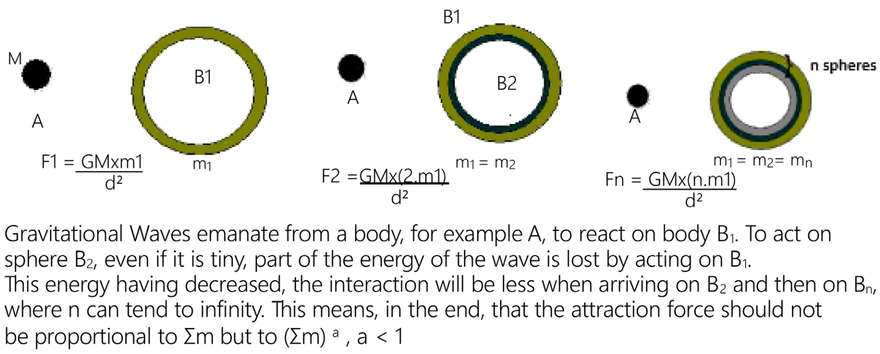

Figure 1. Paradox of nested spheres.

With GR, we can explain the attraction by the curvature of the geodesics; but this paradox could show that gravitational waves are not carriers of the attraction effect (This paradox is, in fact, intuitively perceived by all those who write that gravitational waves are only very little absorbed or diffused by matter).

2.3. Paradox of the Newton's Apple or Dust in Orbit around the Sun with Equal Attraction Force for Different Masses (Thought Experiment 2)

Let 2 bodies m_1 and m_2 of mass $m_1 = 2$ kg and $m_2 = 50$ kg then 2 bodies m_1' and m_2' of mass $m_1' = m_2' = 10\text{ kg}$. It is easy to see in Newton's universal law of gravitation that the attraction forces exerted are identical since $m_1 \times m_2 = m_1' \times m_2' = 100$. To determine the intensity of the force, it is necessary to multiply between the 2 bodies (generally by decomposing these bodies into elementary masses).

If we assume gravitons or waves to explain the equality of forces, we must imagine two aberrant solutions: either as many gravitons coming from 2 bodies of very different masses, or that the gravitons from the most massive body m_1 exert upon arriving at m_2 an action on body m_1.

This paradox is still present in the calculation generally made from the gravitational potential. For GR, the calculation of the geodesic is made from the gravitational field of the most massive body; the other body moves only on the geodesic in space-time and its mass is considered negligible. (no multiplication of masses or curvatures).

Rovelli [13] recalls that "GR is formulated in terms of fields" and interprets it by saying that "things fall towards a massive object because its mass slows down time"

2.4. These "Paradoxes" Allow Us to Deduce or Recall That

It is difficult with the reasoning derived from the GR to understand that a cosmic dust exerts a force equal to that exerted by a star on it. The attraction force should not be confused with the gravitational potential.

Conjecturing particular points proportional to the intensity of the attraction force between the 2 curvatures of the space-time frame from the 2 bodies does not seem like a good solution.

Imagining a radius of curvature resulting from the multiplication of the radii of curvature of the 2 bodies and not from their addition can be posed mathematically but is unjustifiable as it is not representable in a physical theory. It is a philosophical point of view to consider that the world in which we exist has a physical reality; physical reality implies a drawable and therefore finite world. We reject the opposite philosophical position because it considers mathematics to be the reality of the world; there are then infinities or singularities that make the world unrealistic and unrepresentable. This is the world of the movie Matrix where a mathematical creation comes to life and can kill the hero. This view is however defended by several physicists, e.g. Tegmark [14].

One way to reconcile things would be a theory derived from the ideas of 19th-century authors where the action of gravity can be greater than c, where the world remains in a physical representation which could allow a connection with QM which it, is a theory where a representation is possible. It should be noted that several authors [15] have written an alternative theory to GR, for example the quantum theory of gravity (QTG) which allows to find the predictions of GR and which, for us, has the great interest not to introduce a metric at the start, to remove the singularity and allow "information exchange" at a speed higher than c. This theory by removing the singularity, just like ours, remains in physics

On the other hand: we must add the brilliant contribution of GR which replaced the fixed ether with a deformable space-time frame. This frame is the element that will allow the attraction since it cannot be done via a particle or a wave (paradox1). The idea of geodesic must be rethought to explain the equality of forces between two bodies (paradox2). This frame must be extracted from the mathematical world to be representable in that of physics to conform to the prerequisite of Poincaré [10] where mathematics must be at the service of physics and not the opposite.

3. Methods of Calculation

3.1. According to Laplace

Just like him, we start from the secular equation of Mercury which gives an advance excess of the perihelion av of 43".

These 43" correspond to a distance d traveled by the planet

$$d = av \times 2\pi \times R / (360 \times 3600) \tag{1}$$

with R = radius of orbit of Mercury;

Δr is the distance traveled per revolution of Mercury,

$$\text{so} \quad \Delta r = d \times P_j / (365 \times 100) \tag{2}$$

(P_j = period in days), (for Mercury $P_j = 88$, $\Delta r = 25.12 \times 10^3$ m).

This distance Δr would then correspond to the delay due to the travel time of the gravitation. On this distance Δr, the planet would follow the tangent of the orbit.

Per second, the distance Δs traveled on the tangent will be:

$$\Delta s = \Delta r / P \tag{3}$$

(P = period in s)

This distance Δs is traveled by the planet which has an orbital speed v in a time t:

$$t = \Delta s / v \tag{4}$$

($t = 0.66 \times 10^{-7}$ s for mercury with $v = 50$ km·s^{-1})

We will assume that the gravitational signal travels the distance R sun mercury during this time t. The celerity V_g of the gravitational signal is then:

$$V_g = R/t \tag{5}$$

or starting from (1) (2) (3) (4) (5),

$$V_g = (v/av) \times 0.65 \times 10^{15} \tag{6}$$

with av = excess of secular perihelion advance in arc seconds being 7.57×10^{17} m·s^{-1} or $2.5 \times 10^9 \times c$ (c = speed of light)

Note that the movement of the sun in the Galaxy is not taken into account (the Coriolis force resulting from it induces a secular deviation of about 3" for Mercury which should be taken into account in the 43" excess advance of the perihelion of Mercury)

<u>The excess advance of the perihelia of the other planets</u> can be found. To compare the planets, we take the excess of advance during a revolution Av_r in arc". V_g being calculated from the time during which the planet follows the tangent at each orbit (**Table 1**).

$$Av_r = (v/V_g) \times 1.57 \times 10^{12} \tag{7}$$

Table 1. Excess advance of the perihelia of the other planets.

	Ex.av.meas"	Avr measured	V (km·s^{-1})	Av_r calcula. (7)	(GR)(/révol.)
Mercury	42.56 +/− 0.94	0.104	50	0.104	43.03 (0.104)
Venus	8.4 +/− 4.8	0.05 +/− 0.029	35	0.07	8.94 (0.055)
Earth	4.6 +/− 2.7	0.046 +/− 0.027	30	0.06	2.67 (0.0267)
Mars	1 - 2	0.02 - 0.04	23	0.04	1.42 (0.027)

Just like GR, the calculation we have done allows us to find the excess of advance of the planets. Thus, for any celestial body V_g can be calculated from the observation of the advance of the periastron per revolution:

$$V_g = v \times P / Av_r \tag{8}$$

(with Av_r in rd)

or from the advance Av_r calculated from GR

$$Av_r = 6\pi v^2 / c^2 \tag{9}$$

$$\text{Then (8) (9)} \Rightarrow V_g = c^2 \times P^2 / 12\pi^2 R \tag{10}$$

$$\text{or } V_g = c^2 a^2 / 3\mu \tag{11}$$

(Equation (10) at the level of the Earth-Moon system allows to find a speed V_g of about 5×10^{10} c)

The fact that the advances of the perihelia can be found from V_g makes a random result less likely.

3.2. Van Flandern [11]

Emphasizes the frequent confusion between gravitational waves and gravitational field, (the force of attraction being wrongly associated with gravitational waves). He thus questions the concept of "frozen gravitational field" of relativity, takes up the problem of the attraction exerted by a BH to deduce the need that "entities" move much faster than light. Starting from the observed periods around pulsar 1534 + 12, he poses an equation, (where we find, as for Laplace and for GR, the ratio v/c). The speed of the gravitation V_g is then in the solar system, at the level of the Earth's orbit, of $10^9 c$ (consistent with the calculation of Laplace); it is at the level of the pulsars 1534 + 12 of $2 \times 10^{10} c$.

It can be noted that the values of the velocity of the gravitational signal calculated by Van Flandern are variable with mass and close (to a factor of 10) to that of Laplace for the earth.

This idea of variable speed with the velocity of the object is found in the Quantum Gravity Theory (QTG) [15] which even predicts the nullification of gravity when the object acts like a particle and tries to measure this effect [16]. This could be an explanation for the high uncertainty of our results, but just like our theory, QTG requires experiments to measure the velocity of the gravitational signal in order to be confirmed or rejected.

3.3. Temperature of Hawking

The equation of Hawking

$$Th = \hbar c^3 / 8\pi k_B G M \tag{12}$$

(Th = the evaporation temperature of the BH, $\hbar$ = reduced Planck constant, c = the speed of light, k_B = Boltzmann constant)

would allow to find a gravitational speed identical to those of Laplace and Van flandern. If the entire universe is considered as a black hole, with a mass of 2.78×10^{54} kg (for an observable mass of 1.25×10^{53} kg) [17] and a temperature of 2.73˚K, it would then be possible to calculate the value of the coefficient of relativity c_g, usually equal to the speed of light in the vacuum c.

$$(12) \Rightarrow \quad c_g = 2\left(Th \times \pi k_B GM / \hbar\right)^{1/3} \tag{13}$$

$$(13) \Rightarrow \quad c_g = 1.18 \times 10^{19}\ \mathrm{m \cdot s^{-1}} \quad \text{or} \quad 3.93 \times 10^{10} \times c$$

However, it must be noted that there might be an incorrect assumption in considering the temperature of the cosmos as an evaporation temperature, and that this equation should be applied to the entire universe and not to a more restricted area. Thus, a result related to chance cannot be entirely excluded.

3.4. Planetary Resonances

Measurements of the speed of gravitation by Laplace and Van Flandern start partly from the orbital velocities.

We can write an empirical relationship obtained from the orbits of the planets and the orbits of the satellites of Jupiter and Saturn which allows verifying that the speeds of the planets are quantified (nv = constant). From this integer value n attached to an orbit, we determine a length L equal to the perimeter divided by n,

$$L = 2\pi r / n \tag{14}$$

and we notice that

$$L_n = nL_1 \tag{15}$$

An equation providing a length as a function of the distance r to the central star and as a function of the mass of this central star can thus be posed (see Appendix):

$$L = r^{0.5} M^{0.3497} / 7.89 \times 10^4 \tag{22}$$

It is then possible to deduce an equation specifying the radii R_n of the privileged orbits of rank n around any central body of mass M in the solar system:

$$R_n = n^2 M^{0.6993} / 2.49 \times 10^{11} \tag{24}$$

For exoplanets, privileged orbits can be found starting from Equation (17) $R_n = n^2 \times R_1$; n is determined from 2 planetary orbits supposed to be neighbours with radii R_a and R_b, ($R_b > R_a$), R_1 is thus equal to

$$R_1 = R_a + R_b - 2\left(R_a \times R_b\right)^{0.5} \tag{25}$$

$$(17, 25) \Rightarrow \quad R_n = n^2 \times \left(R_a + R_b - 2\left(R_a \times R_b\right)^{0.5}\right) \tag{26}$$

In **Table 2**, we show that there is a good correlation between the theoretical radius Rn and the observed radii for Uranus and 3 examples of multiple exoplanets, even if the ignorance of all orbits of these systems introduces a great uncertainty. The existence of an equation where a length L is contained an integer number of times reinforces the idea that planets are on particular orbits. Without drawing any conclusion, it should be noted that this idea of privileged orbits already exists in the theoretical work of L. Nottale. [18] on gravitation and his "fractal relativity".

Table 2. Correlation for Uranus and 2 exoplanetary systems between the radii predicted by Equation (24) and the observed radii.

n	**1**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
(24) $R_n.10^6$	5.48	87	137	197	269	351	444	548				
obs.dist.10^6		86	130	192	267		438	586				
$n.v$ (v in km·s^{-1})		32.9	33.5	33.06	32.7		32.85	31.54				
(26) trappist.10^7	5.03		126	181	245	322	407	503	605	724	845	980
ob.dist.10^7 [19]				173	225	330	420	554		700		930
$n.v$ (v en km·s^{-1})				470	481	454	453	438		467		473
(26) gliese581 × 10^7	10.77		269	387	527	689	872	1077		1550		2111
ob.dist.10^7 [19]				450	600			1050				2190
$n.v$ (v in km·s^{-1})				574	580			626				607
n	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**17**
HD10180 × 10^9 (26)	1.71	6.8	9.9	27.4	42	62	84	109	139	171	206	494
ob.dist.10^9 [19]	(3.33)		9.6 (13.5)	19.4	40.5 (50)		74				213	510
$n.v$ (v in km·s^{-1})	−206		363 (306)	340	295 (263)		306				283	289

( ) unconfirmed exoplanets.

There is a good correlation between the distances calculated by Equations (24) or (26) with the observed distances. Applying Equation (24) to Uranus gives as privileged radii R_u: $R_u = n^2 \times 5.48 \times 10^6$ m, almost identical results as with equation (26). For exoplanets, R_a and R_b are the radii of the 2 nearest known exoplanets to the star. It is necessary to take the results from (26) with a lot of caution because the values can be further away if R_a and R_b are different. (We do not know initially, the number of planets or if they are truly neighboring, those in parentheses are uncertain). A prediction of orbits of planets not yet discovered can be attempted but must then be confirmed by observation."

3.5. Estimation of a Mass beyond Which the Attraction No Longer Occurs

Similar to estimating the mass of a black hole knowing the distance to the horizon and the speed *c*, it is possible to estimate the mass *M* of an object that will no longer exert attraction beyond this "gravitic" horizon of radius *R*.

Applying Equation (24), if we assume a radius of 13.8 billion LY, gives a mass of 4 × 10^{53} kg, which corresponds to a mass of the order of magnitude of the Universe [17].

From this mass, with an approximate velocity V_g of $10^{10}\times c$, we deduce a horizon radius of 2964 km ($R = \mu/V_g^2$).

Thus, we can say that a velocity of the order of $10^{10}\times c$ would explain why all black holes, even galactic ones, exert a distant attraction.

From this calculation, that the primordial universe could not exert its attraction beyond a horizon; we can venture a conjecture about the triggering of the Big Bang: this horizon could be the finitude of this universe, any object located outside it by evaporation or otherwise would escape attraction and would trigger an expansion by displacing the finitude. The maximum mass of a black hole would be of the order of 10^{51} to 10^{54} kg, mass beyond which an expansion would be triggered.

4. Model of a Frame with 3 Dimensions of Space and One Dimension of Time Representable in the Physical World (3D + T Frame = Alternative or Complementary Model to GR?)

A representable model in the physical world would have the advantage over an abstract GR but it is necessary to verify (as we do below) if this theory where gravity (i.e. the deformation of the frame) occurs at a speed much higher than c allows us to find the predictions of the relativity of Einstein and its compatibility with QM.

4.1. We Simply Pose

That this retraction corresponds to the force of attraction:

$$\Delta r = (1/2)\, g \Delta t^2 \tag{27}$$

It is thus possible to speak of shortening of the frame near the masses (**Figure 2**), instead of talking about deviations due to geodesics. The attraction is proportional to the total retraction due to the two bodies A and B and this explains that the force exerted by the small body B is equal to that of the large body A. As the two bodies get closer, the retraction of the frame increases, F, g increase and accelerate the approximation.(The curvature of geodesics explains why the large body exerts an attraction but does not explain why the small body exerts an attraction of the same intensity on the large body).

The retraction r will occur in a time Δt, which leads to a total of forces Ft,

$$Ft = mr/\Delta t^2 \tag{28}$$

or

$$F = (1/2)\, mr/\Delta t^2 \tag{29}$$

for each of the bodies.

Saying that F is equal to the force of attraction Fa allows us to recover the formula

$$(27) \quad \Delta r = (1/2)\, g \Delta t^2 .$$

(we remain in conformity with the principle of equality between grave mass and inert mass).

The force of attraction can thus be interpreted as a movement of retraction linked to a mass; this movement is permanent, the ET frame is thus dynamic unlike the space-time frame of the GR which is frozen [11] (**Figure 2**).

This is a way of saying that the existence of mass and its action is in the shift of the frame. Or that the mass at rest is proportional to the retraction of the frame.

$$r = kM/d \tag{30}$$

(k is here a constant. The proximity of Equation (30) with the equation giving the potential energy is reassuring for the hypothesis). It is then possible to understand that a proper movement at speed v can induce an additional shortening and thus an increase in mass.

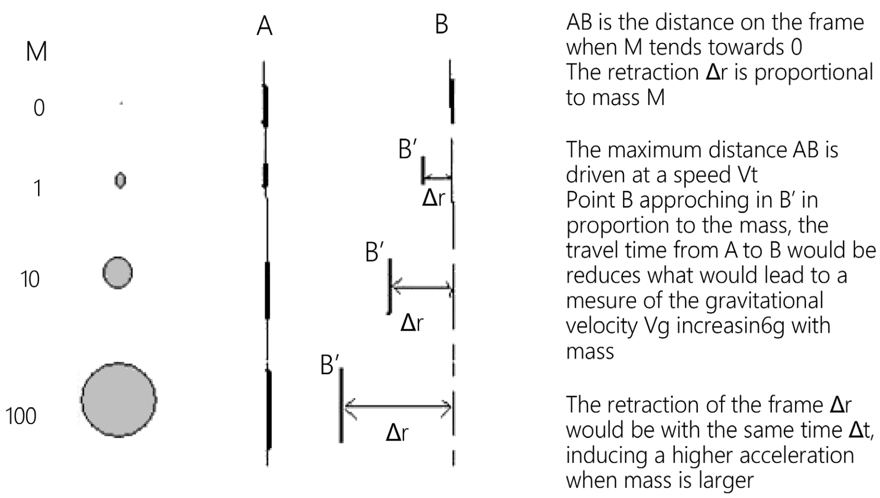

Figure 2. Retraction of the frame as a function of mass at a distance *d*.

4.2. The Retraction of the Frame Allows to Find the Deviation of Light

We pose that the retraction corresponds to the force of attraction:

$$\Delta r = (1/2) g \Delta t^2 \tag{27}$$

The total angle A of light deviation can be deduced from this. The angle of deviation α at a point is

$$\alpha \approx tg\alpha = \Delta rp/d \tag{31}$$

where Δrp is the retraction perpendicular to the initial direction,

$$\Delta rp = \Delta r/d \tag{32}$$

since α is extremely small, d is the distance between a point at infinity and the point of the trajectory tangent to the sun.

The time Δt of the deviation is:

$$\Delta t = 2d/c \tag{33}$$

since the deviation is done on a distance $2d$ between $-\infty$ and $+\infty$; c speed of light.

With (27) and (33), (32) can be replaced by

$$\Delta rp = (1/2)GM/d^2 \times (1/d) \times (4d^2/c^2) \quad \text{or}$$

$$\Delta rp = 2GM/dc^2 \tag{34}$$

and the deviation angle α (31) becomes

$$\alpha = 2GM/d^2c^2 \tag{35}$$

the total angle A of deviation is given by integrating (35) between $-\infty$ and R and between R and $+\infty$, R distance from the point tangent to the sun of the trajectory or solar radius.

$$A = 2 \times \int_{-\infty}^{R} (2GM/d^2c^2)\,\mathrm{d}d$$

or $A = 4GM/c^2R$ as for the calculation made with GR.

4.3. The Observation of Time Slowing by Mass (RG) and Due to Speed (SR) Can Be Explained

For this, we take again the starting hypothesis that the retraction r is done in a time Δt (28) it is necessary to assume that the duration t (duration defined by Einstein as the distance between two events t_1 and t_2 whose coordinates do not change on the frame of space-time) is proportional to r.

$$t = r/V_T \tag{36}$$

(V_T is the speed of movement on the frame).

(Be careful not to confuse time and duration. When a clock slows down and then stops, we can say that time stops or that the time interval, so the duration between two beats becomes infinite).

$$(30)(36) \Rightarrow \quad t = kM/d \times V_T \tag{37}$$

which means that if $M = 0$, there is no time.

(NB: this result is consistent with the philosophical principle of the Descartes scientific method where space and time can only exist between objects (no object = no space, no time))

The displacement of the mass induces in the direction of the displacement an increase in the shortening δr of the frame (and therefore an increase in the mass). 2 points A and B of the frame will be closer according to Lorentz transformations. Just as mass is correlated with retraction, speed induces additional shortening of the frame. It is important to note that this hypothesis of frame retraction provides the same explanation for both observations of duration increase due on the one hand to mass, on the other hand to speed. (Relativities of Einstein give two different explanations for these two observations: the curvature of space for one, the maximum speed of light for the other).

Thus, we have the 3 dimensions of space carried by a frame whose distances between the points are determined by the presence of the masses and one temporal dimension carried by the retraction. (drawing Figure 3) (It is a bit like, the more space is retracted, the more time will replace it). This time, being linked to space by a retraction, cannot be considered as an independent dimension of the others: the Minkowski equation therefore does not seem to apply here.

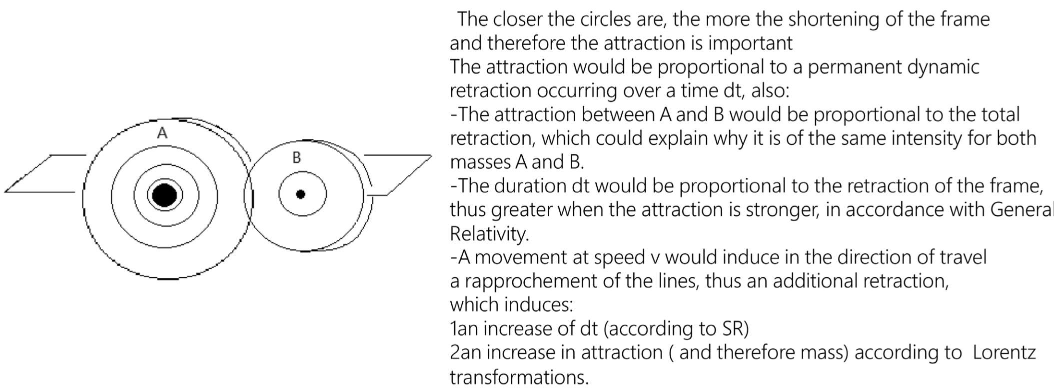

Figure 3. We can represent a space with 3 dimensions of space and one of time (3D + T).

4.4. The Relativistic Shift Related to Gravitation

We can recall that it can be calculated from the loss of energy corresponding to the potential energy. Let a photon leaving the ground with an energy $E = h\nu$; at an altitude H (considering g constant), it will have lost a potential energy $\Delta E = h\nu gH/c^2$; the ratio $\Delta E/E$ will be $\Delta E/E = gH/c^2$.

The link with the frame is immediate since we posed

$$\Delta r = (1/2) g \Delta t^2 \tag{27}$$

4.5. In Total

The predictions of GR can be recovered. For GR the advance of the perihelion is explained by a curvature of the space and assumes an instantaneous speed of modification of the space-time frame. For the 3D + T Frame, the excess of advance of the periastra is explained by a non instantaneous speed; there is no curvature but a retraction that allows to preserve a space time with the variations on time, the mass, "relativistic" shift, light deviation, previously explained by SR and GR. This theory because it is of physical nature and not mathematical is more compatible with QM.

The velocity v_g of the gravitation can be calculated for any celestial body from Equation (8) derived of the inspired calculation from Laplace

$$V_g = v \times P/Av_r \quad \text{or (10)}$$

$$V_g = c^2 \times P^2/12\pi^2 R$$

4.6. Relation with QM

Several ways of research seem possible to us by avoiding starting from the equations specific to EMW where h and c intervene since we say that gravity is not an

EMW.

1) If the speed of the gravitation V_T on the frame is of the order of 10^9c, it would be useful to measure at what speed quantum entanglement is undone. Assuming an infinite speed is an aberration from the point of view of physics or from the philosophical point of view (what Newton had already recalled). Infinity exists only in the mathematical world which is not representable and therefore not real.

2) Planets are in privileged orbits according to $L_n = 2\pi r_1 n$ (18), which is a formula analogous to that of Bohr on electronic orbits. A coincidence cannot be totally excluded and would perhaps be the most sensible hypothesis. But if we postulate that relativity and quantum mechanics are related then it is logical to try to apply Equation (24) to the atom. The first privileged radius R_p is for the proton: $R_p = 7.23\times10^{-31}\,\text{m}$ and for the electron $R_e = 3.73\times10^{-33}\,\text{m}$. These values are higher but relatively close to the length of Planck (1.61×10^{-35} m)

5. Discussion on the Celerity and Nature of Gravitation and Conclusion

5.1. Discussion

By different methods, we can find that the celerity of gravitation (not to be confused with gravitational waves) is much higher than that of light. This result and the observation of paradoxes (e.g., nested spheres) make it possible to reject the idea of graviton, that the gravitational effect is due to a wave, and thus that the gravitational wave carries the attraction effect. Attraction is then only due to a modification of the space-time frame.

Just like the method derived from the Laplace calculation, that of Van Flandern on pulsars by GR and that on privileged orbits, the results suggest that the celerity of the gravitation would not be constant but variable with the mass.

This high speed would explain, an aberration of perihelia tiny and difficult to measure on the scale of a century. It would also explain how a BH can exert an attraction as long as its mass does not exceed an approximate mass of 10^{54} kg.

The theory of planetary resonances is based on the idea of quantified orbits with wavelengths for a gravity about which we know nothing regarding its nature. However, this theory is verifiable since it induces an equation $R_n = n^2 M^{0.6993} / 2.49\times10^{11}$ predicting around each celestial body privileged orbits. We have given several examples that seem to verify this equation (orbits of Uranus satellites, orbits of exoplanets) but the number of examples is still insufficient. The mass of the observable universe can be found (although a result related to chance cannot be completely excluded due to the great uncertainty about the value of this mass).

Poincaré did not question calculation of Laplace but sought an explanation in a relativity effect. And it is not because we find another interpretation of the excess of advance in the perihelia that the interpretation of GR is false. The same phenomenon can be described in 2 different ways. (This is a remark we had already made when we note that Soldner had calculated the deviation of light for a half trajectory, a photon arriving in the observer's eye. It is not because a perfectly correct calculation can be made by the Newtonian method that GR is false) [20]).

Cosmic inflation is not measurable but may never have existed [21] [22].

In the field of quantum gravity, perhaps a great theoretical step will be taken when we can measure if quantum entanglement occurs at this gigantic speed. The hypothesis of a speed of gravity equal to that of quantum entanglement would open the possibility of relaunching "quantum gravity". (especially if, in addition, we note that the equality posed for gravity $L_n = 2\pi r_1 n$ (18) is the same as that of hypothesis of Bohr on atomic orbits. The other possibility of a celerity of the gravitation variable with mass and distance would open the possibility of laboratory verification for small masses. Some studies propose such a verification [15].

5.2. Conclusion of the Discussion

In the geometric theory of the 3D + T frame, the retraction of the frame is due to mass and induces attraction. This retraction corresponding to the gravitational signal is done with a very great celerity, probably without energy transport and does not contradict the SR which concerns EMW and gravitational waves. The retraction of this frame makes it possible to explain the observations of GR (redshift, curvatures of the trajectories, temporal modifications of the SR and of the GR).

Speaking in terms of retraction rather than geodesics, it allows to build a representable, deformable and dynamic space-time with a 3D metric structure where retraction contains the temporal dimension. This space with 4 dimensions is thus representable (unlike that of GR purely mathematical) and can exist in the physical world, which makes it compatible with the field of quantum theories. Mathematics, much simpler, is at the service of physics according to the prerequisite of Poincaré, and only serves to describe the changes on this frame. GR could be modified but preserved with a gravitational signal celerity greater than *c*. On the other hand, if a theory allows a physical representation and is compatible with quantum mechanics, the theory only mathematical and out of the real of GR must be discarded. Measuring the celerity of the gravitational signal is essential to understanding gravitation and can constitute a test for GR.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix: Observation of the Quantification of Orbital Velocities Speeds, Privileged Orbits

We can find a numerical sequence at the level of the solar system: it can be fixed, empirically, a number n at each planetary orbit (**Table A1**) so that the product $n.v$ is constant; v is the velocity of the considered planet. By setting $n = 3$ to Mercury, $n = 4$ to Venus, etc., the product nv is the most constant, $nv = 145 \pm 5$ or 145% ± 3.5% with v in km·s^{-1}.

Table A1. Empirical attribution of a number n to each planetary orbit.

	V km·s^{-1}	n'	$n'.V$	$\mathbf{n}$	$\mathbf{n.V}$	n''	$n''.V$
Mercury	48	2	96	**3**	**144**	4	192
Venus	35	3	105	**4**	**140**	5	175
Earth	30	4	120	**5**	**150**	6	180
Mars	24	5	120	**6**	**144**	7	168
Jupiter	13	10	130	**11**	**144**	12	156
Saturne	9.6	14	134	**15**	**144**	16	154
Uranus	6.8	20	136	**21**	**143**	22	150
Neptune	5.4	26	140	**27**	**146**	28	151

From this cte $nv = 145$, we can determine the radii of the orbits of rank $n = 1$ and 2. ($v_1 = nv/n = 145$ km·s^{-1} and $r_1 = GM/v_1^2 = 6.35\times10^9$ m ; $v_2 = 72.5$ km·s^{-1} et $r_2 = 0.25 \times 10^{11}$ m) (For Nottale 0.042UA and 0.170UA or $r_1 = 6.30 \times 10^9$ m et $r_2 = 0.255 \times 10^{11}$ m [14]).

Now that n has been fixed, we determine a length L equal to the perimeter divided by n, $L = 2\pi r/n$. (14)

We observe that $L_2 = 2L_1$; $L_3 = 3L_1$ and more generally $L_n = nL_1$ (15), $L_1 = 2\pi r_1$, $2L_2 = 2\pi r_2$, $nL_n = 2\pi r_n$ (16), $n \in N$ (**Table A2**).

Or, $r_n = r_1 n^2$ (17), or $L_n = 2\pi r_1 n$ (18).

Table A2. Finding a quantification of orbital lengths $L_n/n = 2\pi r_1$.

	n	dist.Sun (×10^{11} m)	Orb.perimet. (×10^{11} m)	$L = 2\pi d/n$ (×10^{11} m)	L_n/n (×10^{11} m)
-	1	0.064	0.40	0.40	**0.40**
-	2	0.25	1.57	0.78	**0.39**
Mercury	3	0.58	3.64	1.21	**0.40**
Venus	4	1.08	6.78	1.69	**0.42**
Earth	5	1.50	9.42	1.88	**0.38**
Mars	6	2.28	14.32	2.39	**0.40**

These mathematical observations allow us to say that the planets are located on particular orbits; on these orbits, this length L is contained an integer number n of times in the perimeter.

In the same way, the product nv can be calculated for the satellites of Jupiter and Saturn, respectively 52.105% ± 5.48% and 97.695% ± 4.56% with v in km·s^{-1} (Table A3).

Table A3. Empirical attribution of a number n to each orbit of the satellites of Jupiter and Saturn.

Sat.Jupiter	V km·s^{-1}	n'	$n'V$	n	nV	n''	$n''V$
V	26.43	1	26.43	**2**	**52.86**	3	79.29
I	17.33	2	34.66	**3**	**51.99**	4	69.32
II	13.74	3	41.22	**4**	**54.96**	5	68.7
III	10.88	4	43.52	**5**	**54.4**	6	65.28
IV	8.20	5	41.05	**6**	**49.25**	7	57.47
Sat.Saturn	V km·s^{-1}	n'	$n'V$	n	nV	n''	$n''V$
X	15.54	5	77.7	**6**	**93.24**	7	108.8
I	14.34	6	86	**7**	**100.35**	8	114.69
II	12.64	7	88.5	**8**	**101.12**	9	113.76
III	11.35	8	90.8	**9**	**102.15**	10	113.55
IV	10.04	9	90.32	**10**	**100.35**	11	110.39
V	8.49	10	84.9	**11**	**93.39**	12	101.88

We calculate L using (16), and we verify that Equation (15) $L_n = nL_1$ is respected.

Thus, we have the elements to empirically write the equation fixing L as a function of the orbital distance r and the mass M of the central star:

1) We notice that

$$L^2/r = \text{constant} \tag{19}$$

2) Relationship between L and M: we calculate the length L_x for the same distance r from the Sun, Jupiter, and Saturn. We take for this reference distance $r = r_{1\odot} = 6.31\times10^9\ \text{m}$ and $L_{1\odot} = 39.66\times10^9\ \text{m}$. For Jupiter since $L^2/r = \text{cte}$ (19), let's pose

$$L_{1j}^2/r_{1j} = L_x^2/r_{1\odot} \tag{20}$$

hence $L_x = 3.41\times10^9\ \text{m}$

((19) $\Rightarrow$ $r_{1j} = 0.0467\times10^9\ \text{m}$ and $L_{1j} = 0.2935\times10^9\ \text{m}$). For Saturn $L_x = 9.95\times10^8\ \text{m}$ (with $r_{1s} = 3977\times10^3\ \text{m}$ and $L_{1s} = 24988\times10^3\ \text{m}$).

We notice that $\log M / \log L_x$ is approximately constant (**Table A4**), which, considering the 3 results, gives a constant of 2.90, and thus $L_x = M^{0.345}$, or more simply $L_x = M^{0.35}$ (21) considering a precision close to 5%.

Table A4. logM/logL_x is constant.

	M(kg)	L_x at dist. r	log$M$	logL_x	log$M$/logL_x = cte
Sun	1.99×10^{30}	39.66×10^{9}	69.77	24.40	2.86
Jupiter	19×10^{26}	3.41×10^{9}	62.81	21.95	2.86
Saturn	5.69×10^{26}	9.95×10^{8}	61.61	20.72	2.97

3) Ratio between L, d and M: (19) (21) $\Rightarrow \quad L = \left(r^{0.5} \times M^{0.35}\right) / K$. K = constant equal to 7.89×10^4 if we take $M^{0.3497}$ or 8×10^4 if we take $M^{0.35}$.

The equation giving the length L as a function of d and M is thus:

$$L = r^{0.5} M^{0.3497} / 7.89 \times 10^4 \quad (22)$$

Or:

$$L = r^{0.5} \times M^{0.35} / 8 \times 10^4 \quad (23)$$

The radius of the privileged orbits will be:

$$(16)\ (22) \quad \Rightarrow \quad R_n = n^2 M^{0.6993} / 2.49 \times 10^{11} \quad (24)$$