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About Space-Time Warping in Rotating Objects and Gravity Origin

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ABSTRACT

Objects with angular momentum (rotation) are known to exhibit an effect called Lense Thirring (LT) precession whereby locally inertial frames are dragged along the rotating spacetime. Such effect has been usually associated to celestial bodies, and especially studied in the case of black holes and neutron stars, but I show here that Lense Thirring precession can be also very relevant for small objects under some specific conditions. The precession effect is calculated for any object rotating around of one of its axes of symmetry, regardless of its rotation speed, mass and moment of inertia, showing that the influence of Lense-Thirring in such objects allows to create concavities and convexities in space-time around them. As consequence, the gravity effect over them can be counteracted or reinforced, experimenting effects equivalents to partial gravity, zero gravity and even anti-gravity. Kerr spacetime metric is applied with some limitations. Relevance of LT effect in function of morphology, colatitude, size, number of rpm and even kind of material is showed and an analysis of the results obtained is done. Consequently it's proven that LT effect should be also taken on account to be applied not only to small objects but to space crafts designs. This study applies the same concepts involved in the Special Zero Gravity Theory but counteracting in this case the gravity with the consequences of applying Lense-Thirring effect instead simply spin. As consequence 1) A new generic concept is introduced: General Zero Gravity. 2) We also introduce a new view about Gravity and its origin based in accepting that Gravity can be considered to all effects an energy and that Gravity has evolved over Time till reach its current balance state. A close relationship among Gravity and kinetic energy is analyzed in detail. Then we compare the origins of concavities-convexities reached by rotation and "conventional" Gravity. We also analyze the relationship among Light and Gravity and Light and Quantum. Finally, we show the importance of QED (Quantum Electro Dynamics) and Einstein field equations for understanding the proposed relationship among electromagnetic Energy, Matter and Gravity.

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Introduction

I refer to the mentioned bibliography for a more detailed development of the formulas used here, since I consider unnecessary to repeat fully documented previous reasonings.

Earlier analyses of the Lense Thirring (LT) effect assume slowly rotating and weakly gravitational effect [1].

As result, the simplified formula for LT precession in the "weak gravity" field for celestial bodies is reached [2]:

$$\Omega_{\mathrm{LT}} = \frac{2}{5}\frac{GM\omega}{c^2 R}\cos\theta.$$

where G is the Universal Constant, M the mass, ω the rotation speed, R the radius, c the light speed and Θ the latitude (in our case reduced to the equator, therefore Θ =0).

But this simplified expression in the "weak-gravity field" is not valid for our case, because although our objects of study create a very tiny newtonian gravity effect around them, they have a high rotation speed when compared with their mass, therefore weak-field should not be applied by default. We must apply strong-field instead. We're also going to find out such need later from a mathematical side.

For using LT in a generic way for any kind of object with any rotation speed, we're going to use Kerr metric (although our rotating object is not in vacuum, but this fact has hardly any influence over the precession rate) [3].

LT precession rate in Kerr spacetime & Boyer-Lindquist coordinates can be expressed as [4-6]:

$$\vec{\Omega}_{LT}^{K} = 2aM\cos\theta\frac{r\sqrt{\Delta}}{\rho^3(\rho^2-2Mr)}\hat{r} - aM\sin\theta\frac{\rho^2-2r^2}{\rho^3(\rho^2-2Mr)}\hat{\theta}. \quad (1)$$

Where a is the Kerr Parameter, defined as, $a = \frac{J}{Mc}$ J is the angular momentum, M the mass and c the speed of light, but usually is simplified (when applied to black holes, neutron stars …) using c=1.

But in our case, focused to the study over small rotating objects, we must consider the real value of c.

The module/magnitude of the vector (1) is our first goal. It is:

$$\Omega_{LT}(r,\theta) = \frac{aM}{\rho^3(\rho^2 - 2Mr)} \left[4\Delta r^2 \cos^2\theta + (\rho^2 - 2r^2)^2 \sin^2\theta\right]^{\frac{1}{2}} \quad (2)$$

Where a=J/M (known as Kerr parameter, the angular momentum per unit mass), and Θ the collatitude, being

$$\rho^2 = r^2 + a^2\cos^2\theta, \quad \Delta = r^2 - 2Mr + a^2. \quad (3)$$

This is the LT precession rate in a generic way, where no weak gravity presumption has been done.

In the case that r >> a (r >> M) → the Kerr metric is almost reduced to Schwarzschild metric ($\rho^2 = r^2$, a=0) [7]. In fact the equation (1) would be reduced to the weak-field:

$$\vec{\Omega}_{LT}(r,\theta) = \frac{J}{r^3}\left[2\cos\theta\hat{r} + \sin\theta\hat{\theta}\right]$$

We're going to use the weak field **only** when general way can't be used due to the presence of the singularity represented by a negative value of **Δ** (discriminant).

I insist again in the fact that we're going to use the a Kerr parameter in its generic form, not in its simplified form with c=1.

In our particular case, the Kerr parameter is relatively high, because **J=I.ω** where **I** is the moment of inertia and **ω** the angular speed and we're managing large angular speeds and light masses. Therefore we're going to use weak-field ***only when strictly necessary***.

We're going to focus calculations in Equator (for spherical objects) although the precession effect changes slightly from Equator to Poles, as we're going to study later.

Scope of Application to Rotating Objects

To apply LT effect to any rotating object, we're going to base our work on the premise that the concavity produced by a celestial body over any object can be counteracted by the convexity in spacetime produced by the object speed, lineal or angular (just as exposed and proven by Special Zero Gravity Theory [8,9]). Then Gravity could be also counteracted by the spacetime convexity created by LT effect (when the object spins counter-clockwise) or generated/reforced by the spacetime concavity created by LT effect (when the objects spins clockwise).

With the goal of knowing the real impact of LT over different kind of objects and spin speeds, we're going to apply the formula (1) at first time to very small objects (with morphology of disk) which were used along of most of my Zero Gravity experiments [8]. Then we're going to apply it to more large objects with different morphologies (sphere, disk), sizes, materials and rotation speeds.

I would like to remark that the sign of **Δ** (discriminant) parameter (3) deeply determines the range of application of the formula (1) for not-weak fields. That is, when **M*r > (r^2+a^2)** then **Δ** < 0 . This scenario is more suitable for low values of **a** and for denser materials. In such cases we're going to apply weak-field solution.

In fact an strict application of such range (**Δ** > 0) would limit the application of Kerr formulas to an specific and bounded interval of rotation speeds.

From the obtained results (exposed in the following chapter) a close relation (especially for light materials) can be found among the range of rotation speed needed for applying Zero Gravity effect (ZG) and the range of rotation speed needed for applying LT effect.

Applying simultaneously both effects (ZG and LT), space crafts based on both technologies could achieve partial zero gravity, total zero gravity and anti gravity effects of different magnitudes.

Application to Different Morphologies, Sizes, Rotation Speeds and Kind of Materials

I've built simple Python programs to show the results of the Theory for different morphologies, sizes and kind of materials.

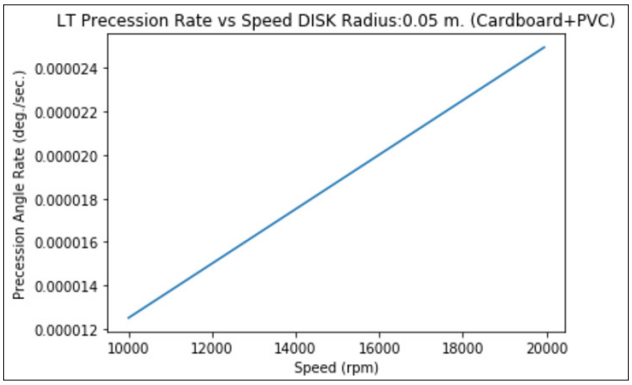
Disks of Different Materials (Cardboard, Wood, PVC, Aluminum, Steel, Carbon Fiber)

Just I told before, I've applied the Theory at first time to small objects that were used to prove my Zero Gravity Theory. These light objects with disk morphology have a high rotation speed (from 10.000 rpm to 20.000 rpm), radius from 5 cm. to 10 cm. and very slightly thickness (from 2 to 3 mm.).

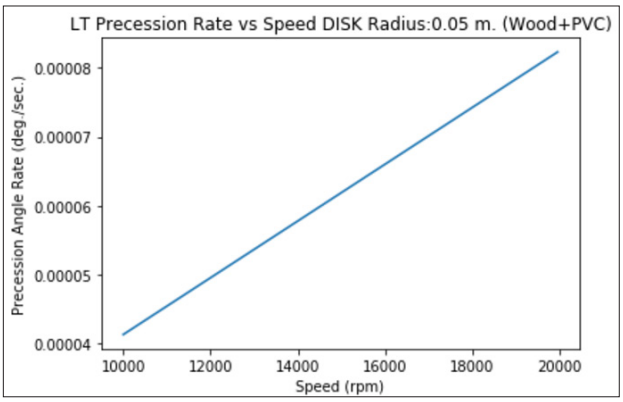
For such cases, I (moment of inertia of a disk)=1/2*M*R^2. Therefore simplified **a** Kerr parameter (J/M) =1/2*R^2*ω, being ω values included between 10.000 rpm*2* Π /60=1047 rad/s and 20.000 rpm*2* Π /60=2094 rad/s.

We're going to use the Kerr metric also for disk morphology taking on account that a disk could be simplified as a slice of mass at the equator, with the poles flattened so the latitude is reduced to a very small range of angles.

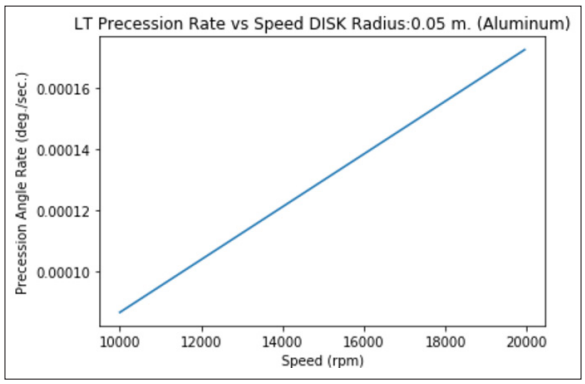
In other words: we're going to apply the formulas for the sphere but reduced to the equator.



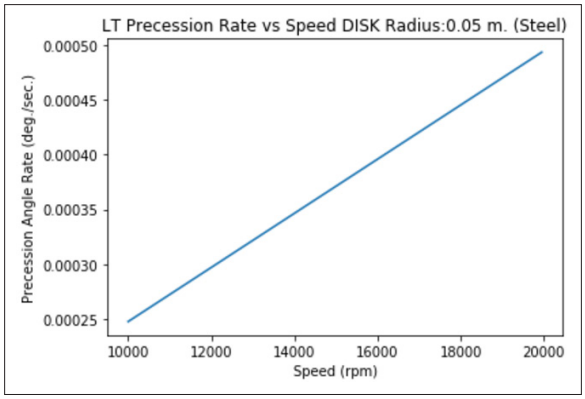
a1. Disk of Radius=5 cm., Mass=5 g. (Cardboard+PVC)



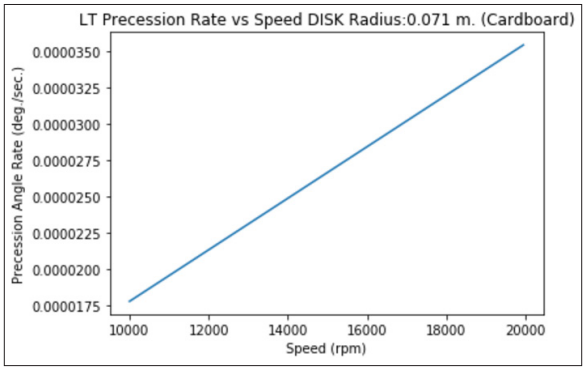
a2. Disk of Radius=5 cm., Mass=11.3 g. (Wood+PVC)



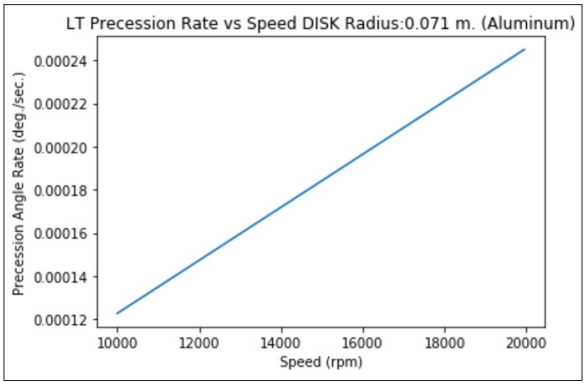
b. Disk of Radius=5 cm., height=2 mm. (Aluminum)



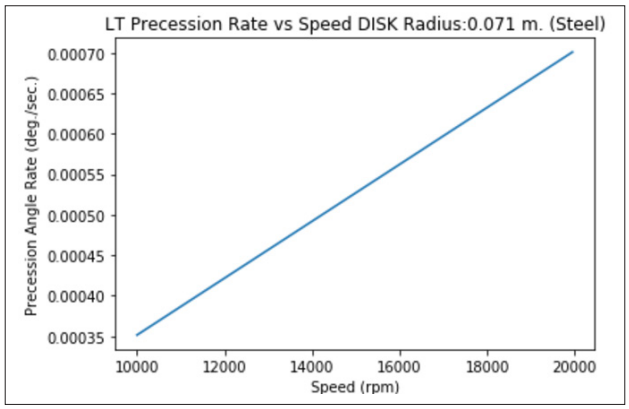
c. Disk of Radius=5 cm., height=2 mm. (Steel)



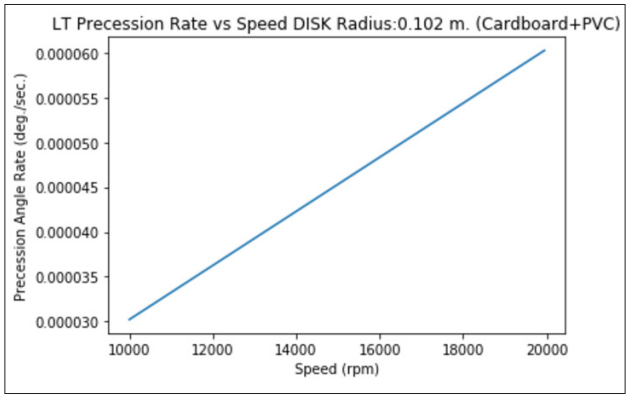
d. Disk of Radius=7.1 cm., Mass=9.3 g. (Cardboard)



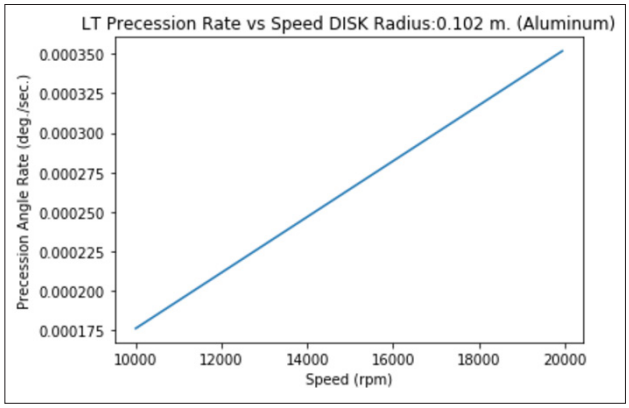
e. Disk of Radius=7.1 cm., height=2 mm. (Aluminum)



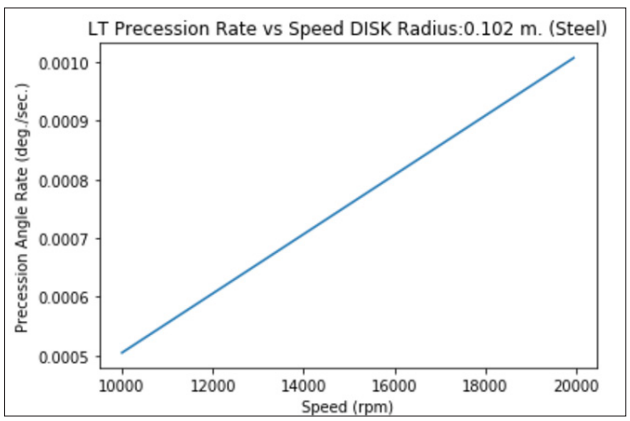
f. Disk of Radius=7.1 cm., height=2 mm. (Steel)



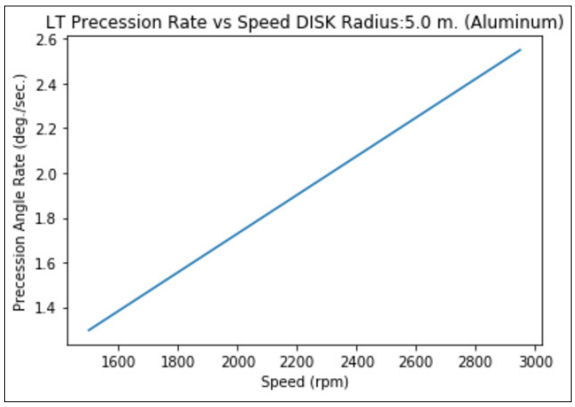
g. Disk of Radius=10.2 cm., Mass=19.2 g.



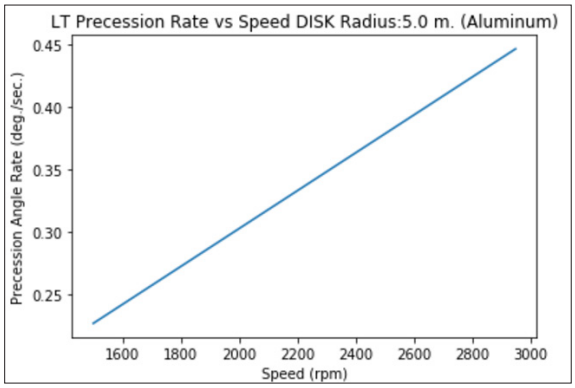
h. Disk of Radius=10.2 cm., height=2 mm. (Aluminum)



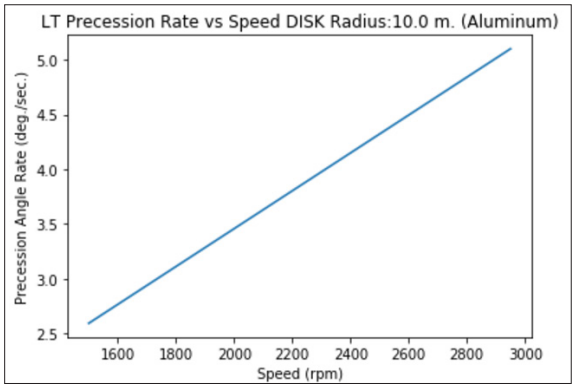
i. Disk of Radius=10.2 cm., height=2 mm. (Steel)



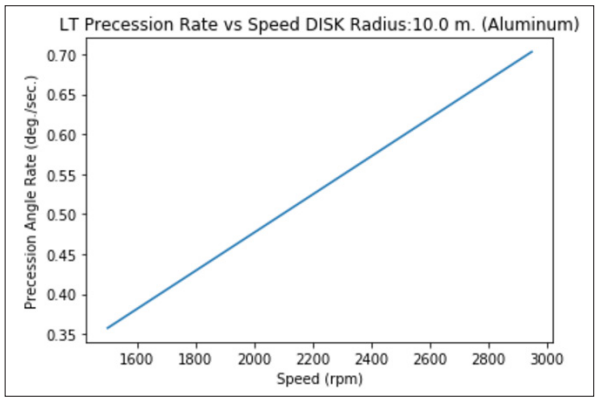
j.a. Disk (solid) of Radius=5 m., Height= 2m. (Aluminum)



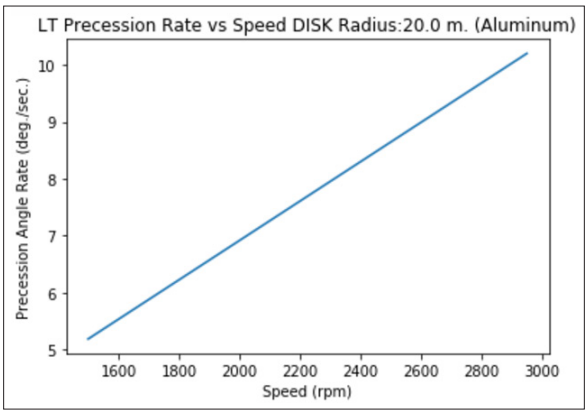
j.b. Disk (hollow) of Radius=5 m., Height= 2m. (Aluminum)



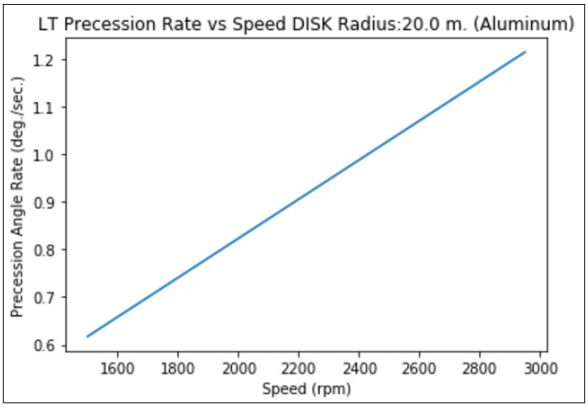
k.a. Disk (solid) of Radius=10 m., Height= 2m. (Aluminum)



k.b. Disk (hollow) of Radius=10 m., Height= 2m. (Aluminum)



I.a. Disk (solid) of Radius=20 m., Height= 2m. (Aluminum)



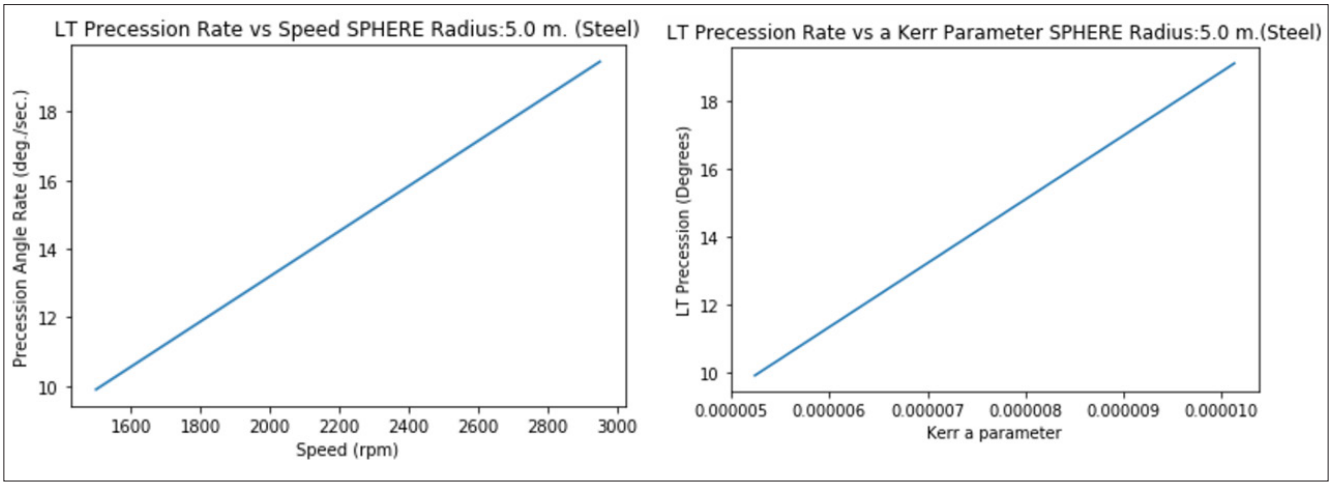
I. b. Disk (hollow) of Radius=20 m., Height= 2m. (Aluminum)

Spheres (Equator)

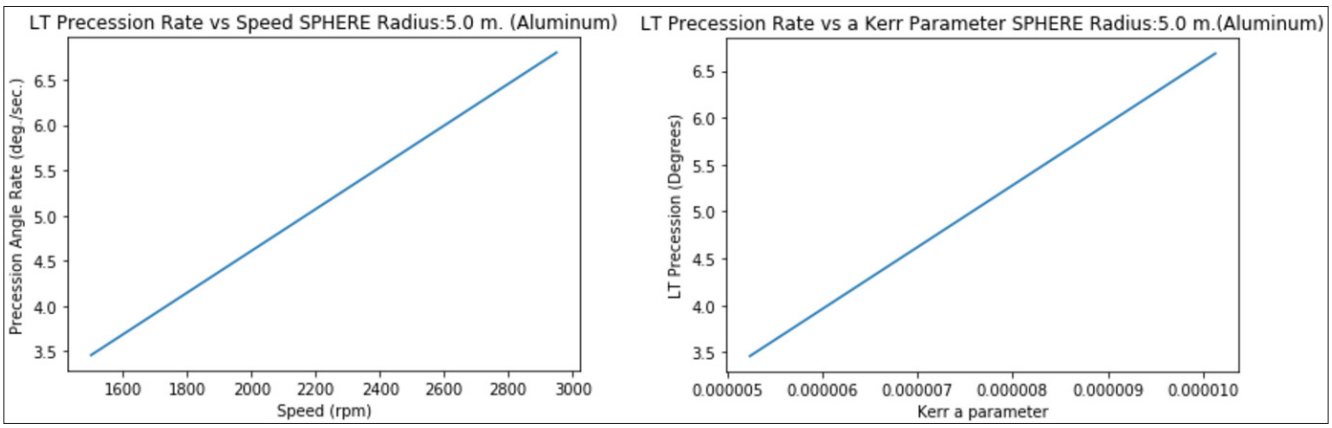
In this case, I (Inertia momentum)=2/5*M*R^2 (solid), 2/3*M*R^2 (hollow).

Therefore **a** Kerr parameter (solid)=J/(M*c)=2/5*R^2*ω/c

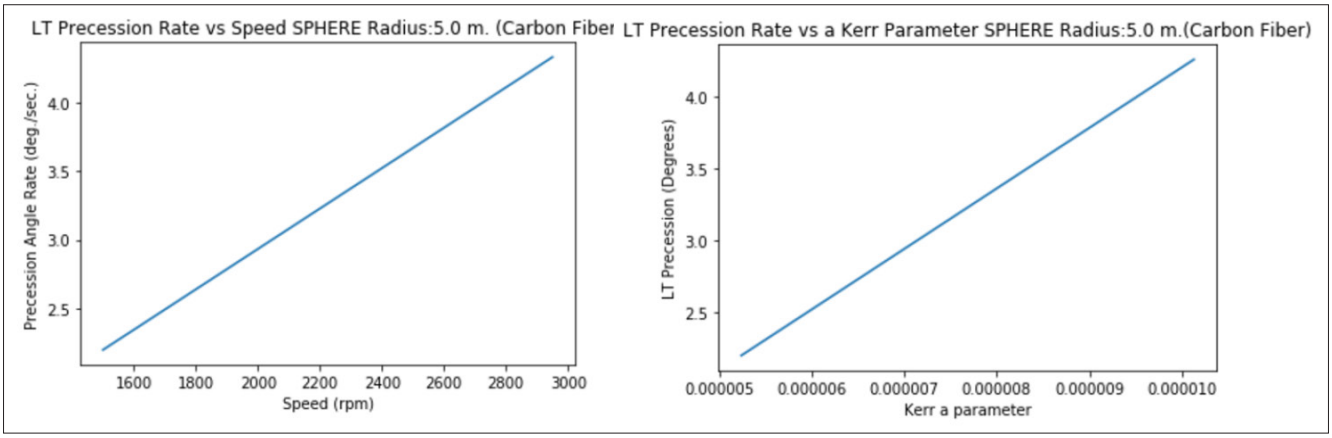
Graphics show not only Precession vs Speed but Precession vs **a** (not simplified) Kerr Parameter.



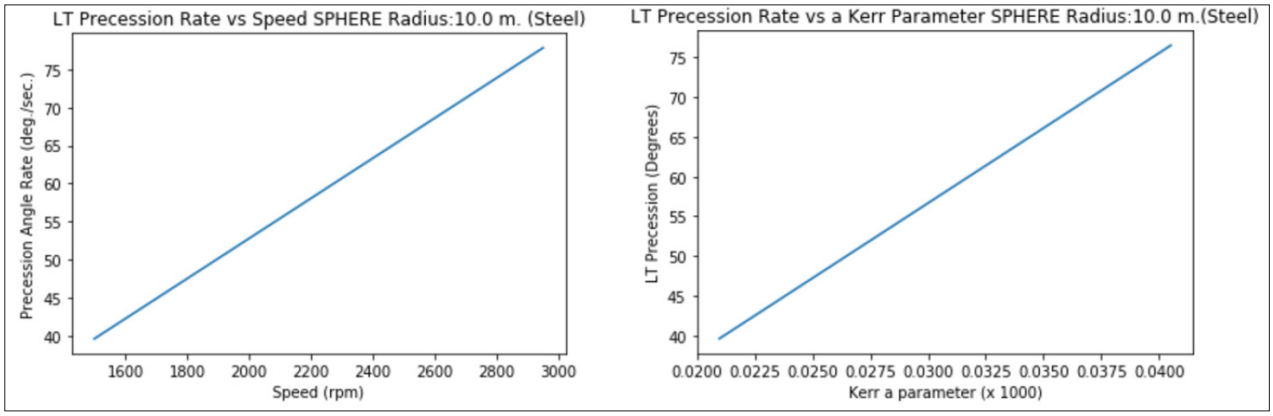
a. Radius 5 m. (Steel, solid)



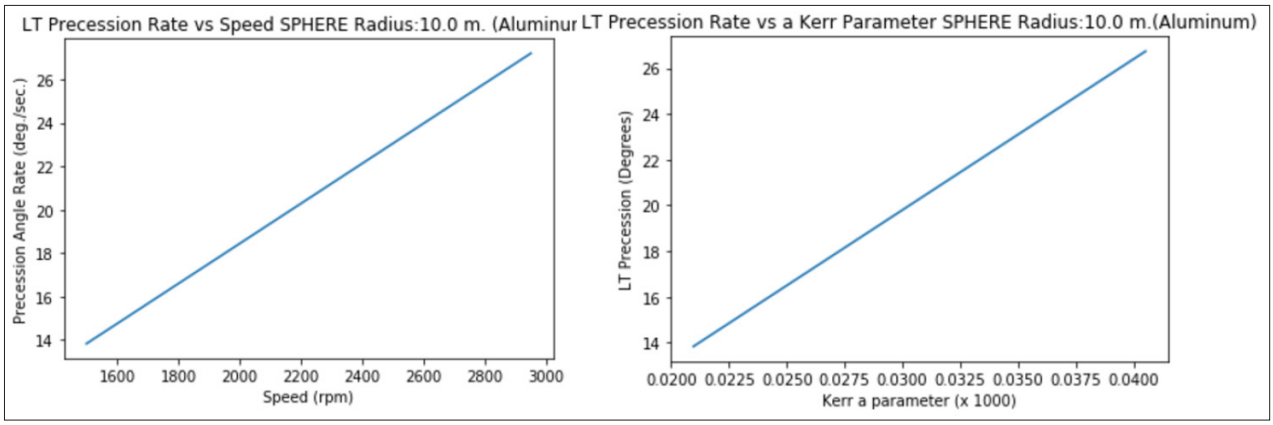
b. Radius 5 m. (Aluminum,solid)



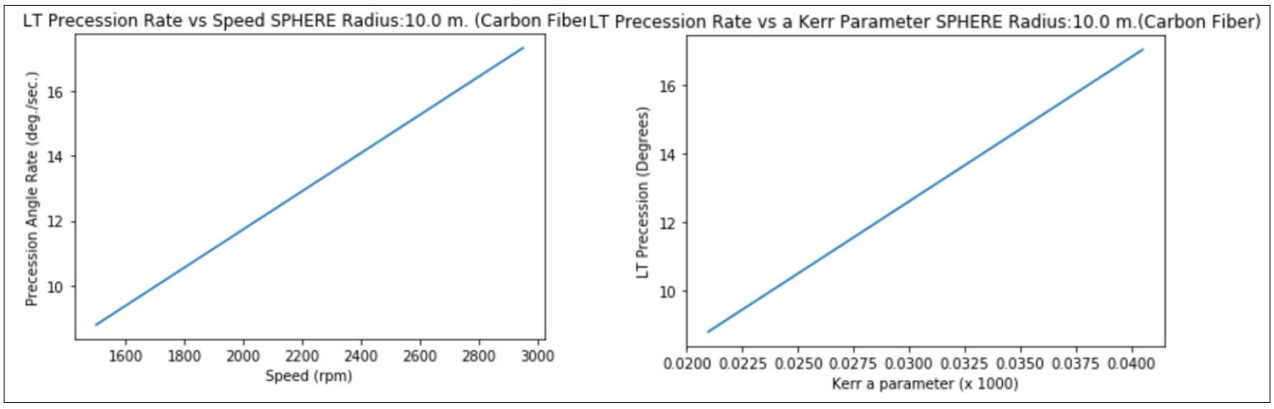
c. Radius 5 m. (Carbon Fiber, solid)



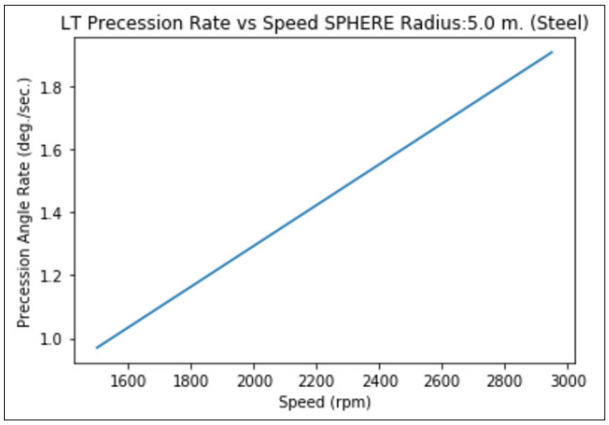
d. Radius 10 m. (Steel, solid)



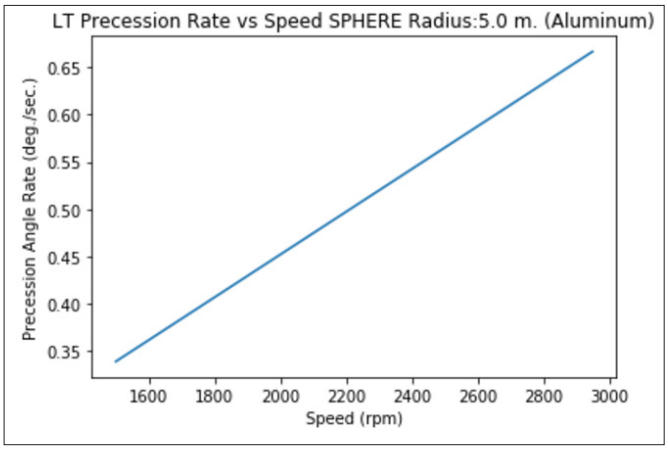
e. Radius 10 m. (Aluminum, solid)



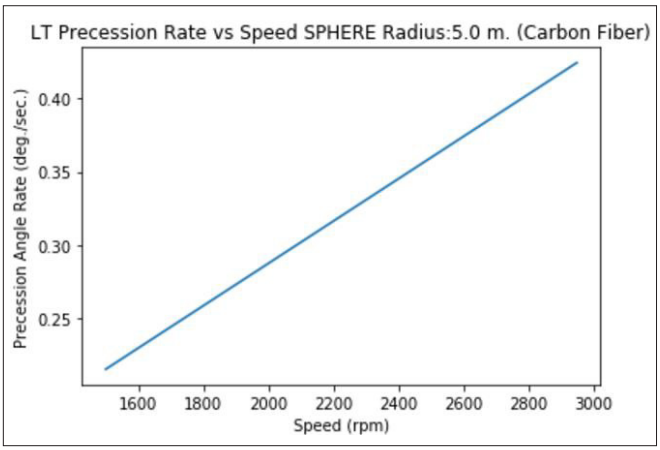
f. Radius 10 m. (Carbon Fiber, solid)



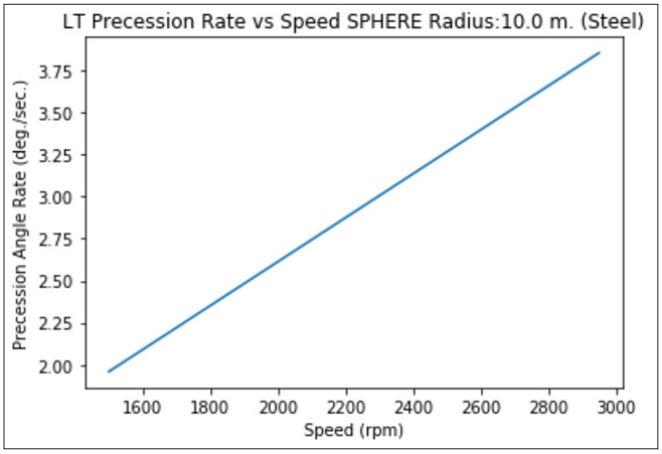
g. Radius 5 m. (Steel, hollow)



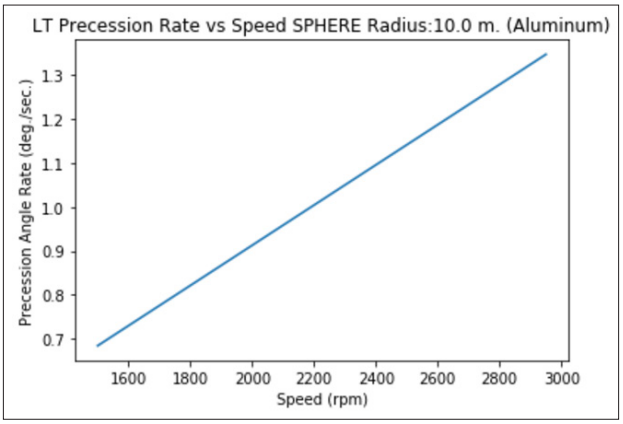
h. Radius 5 m. (Aluminum, hollow)



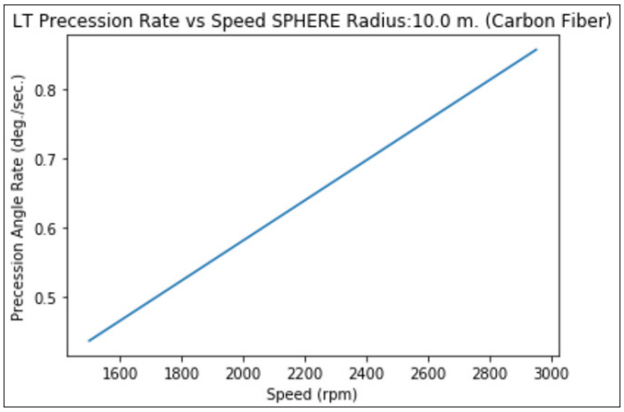
i. Radius 5 m. (Carbon Fiber, hollow)



j. Radius 10 m. (Steel, hollow)

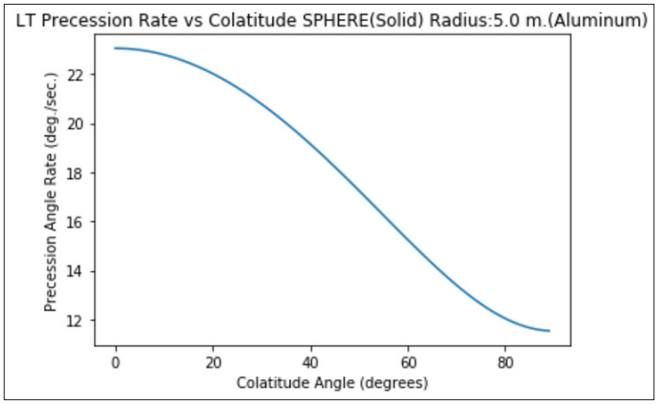


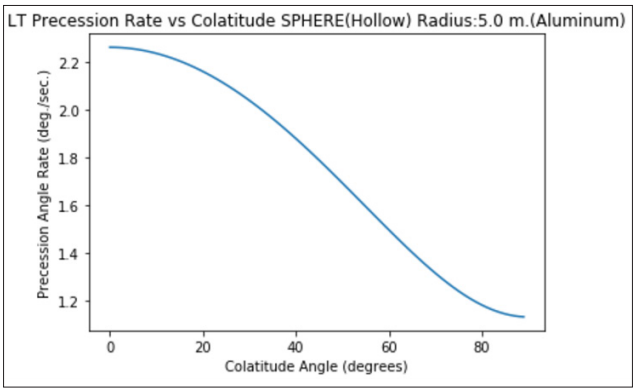
k. Radius 10 m. (Aluminum, hollow)



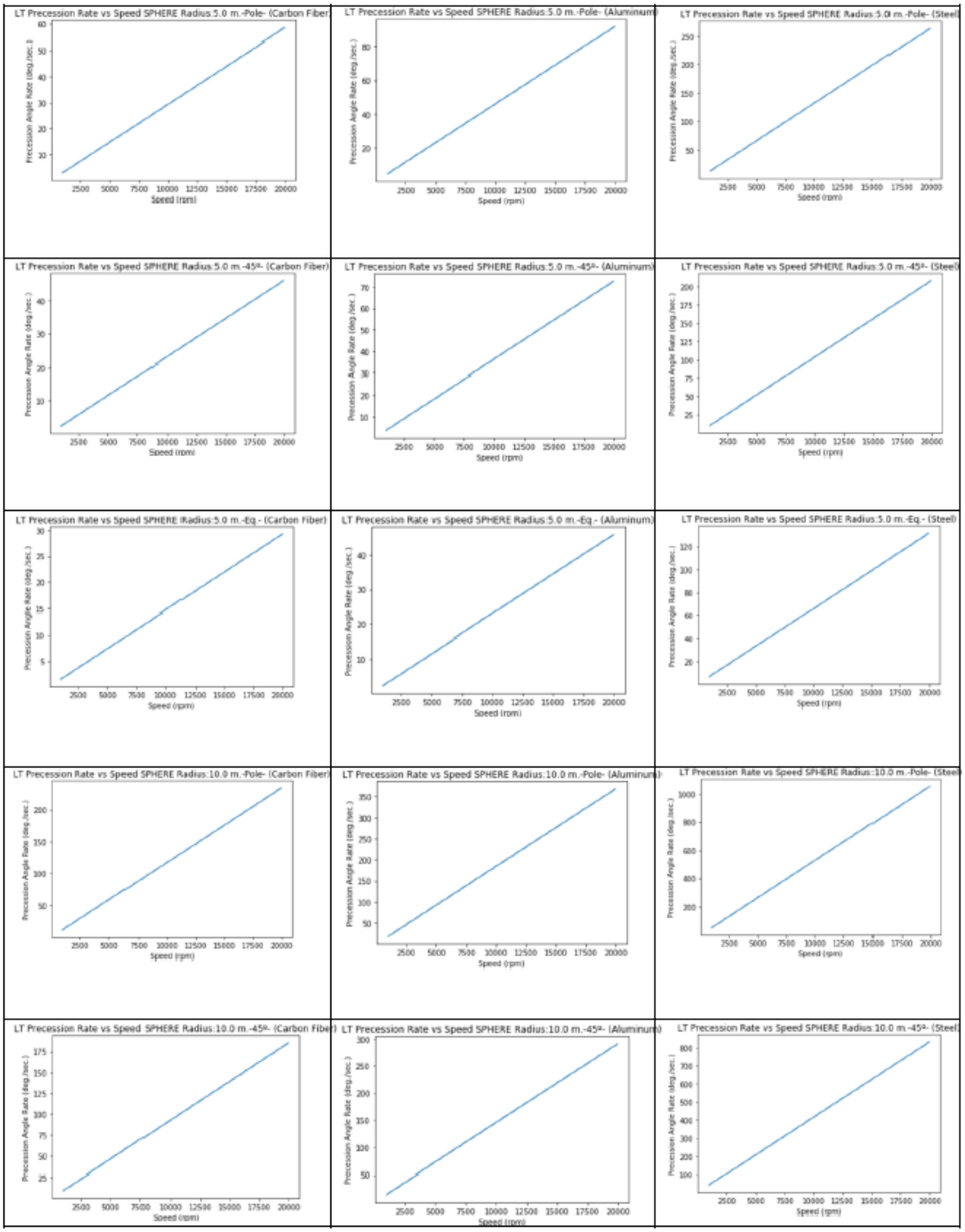
i. Radius 10 m. (Carbon Fiber, hollow)

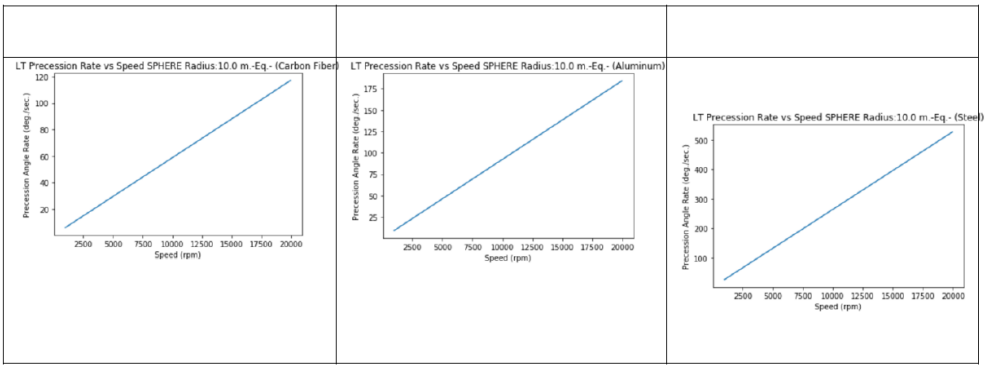
Precession Rate vs Colatitude Angle
Speed: 5000 rpm





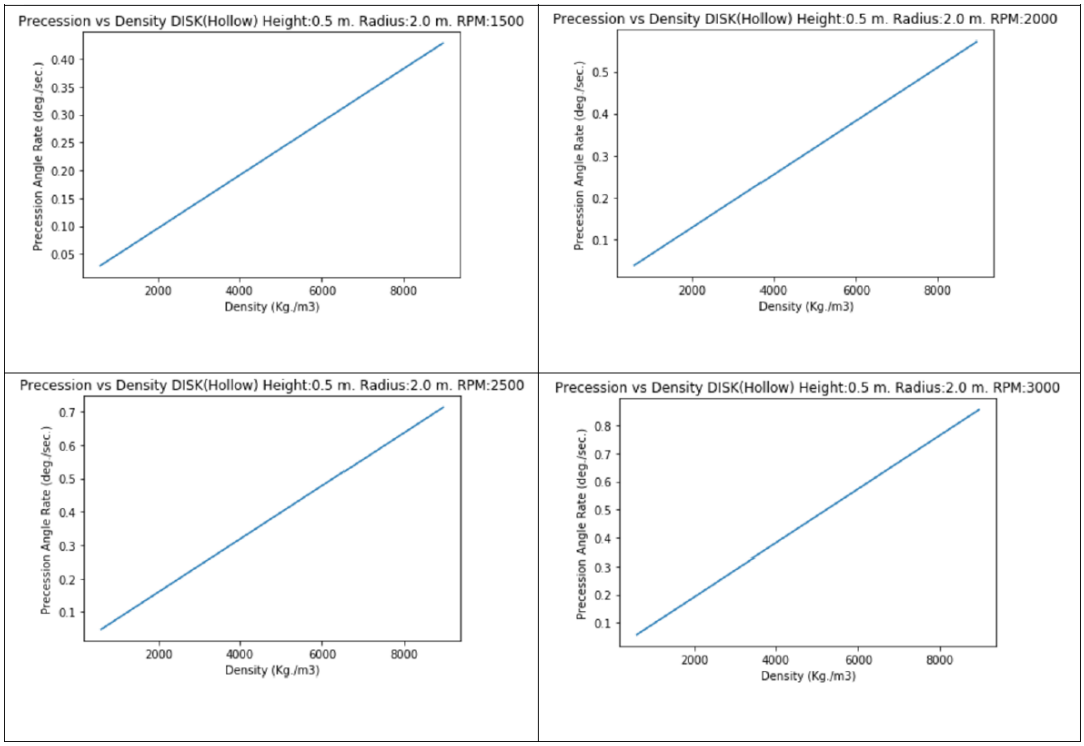
Precession Rate (Solid Sphere) vs Colatitude & Material

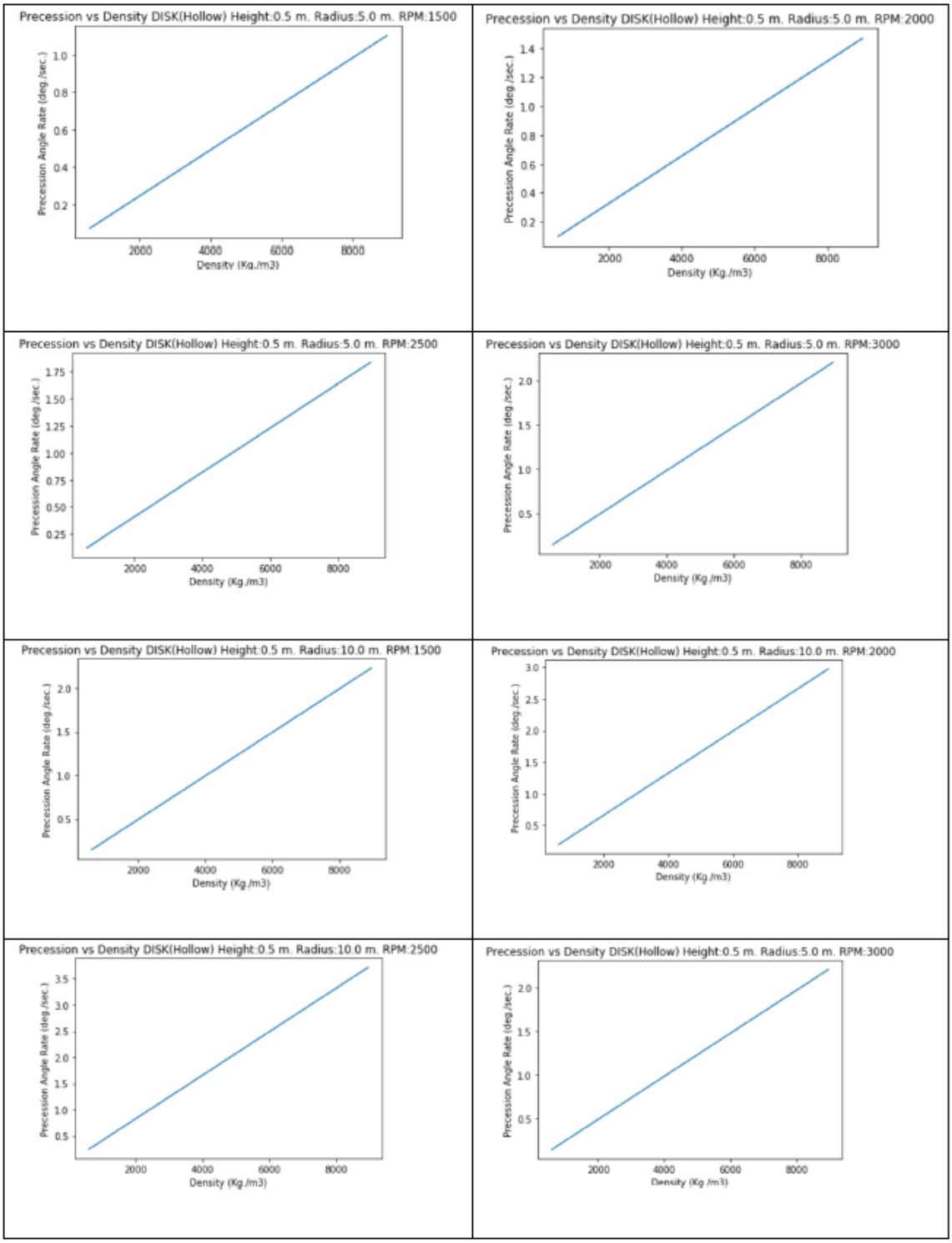


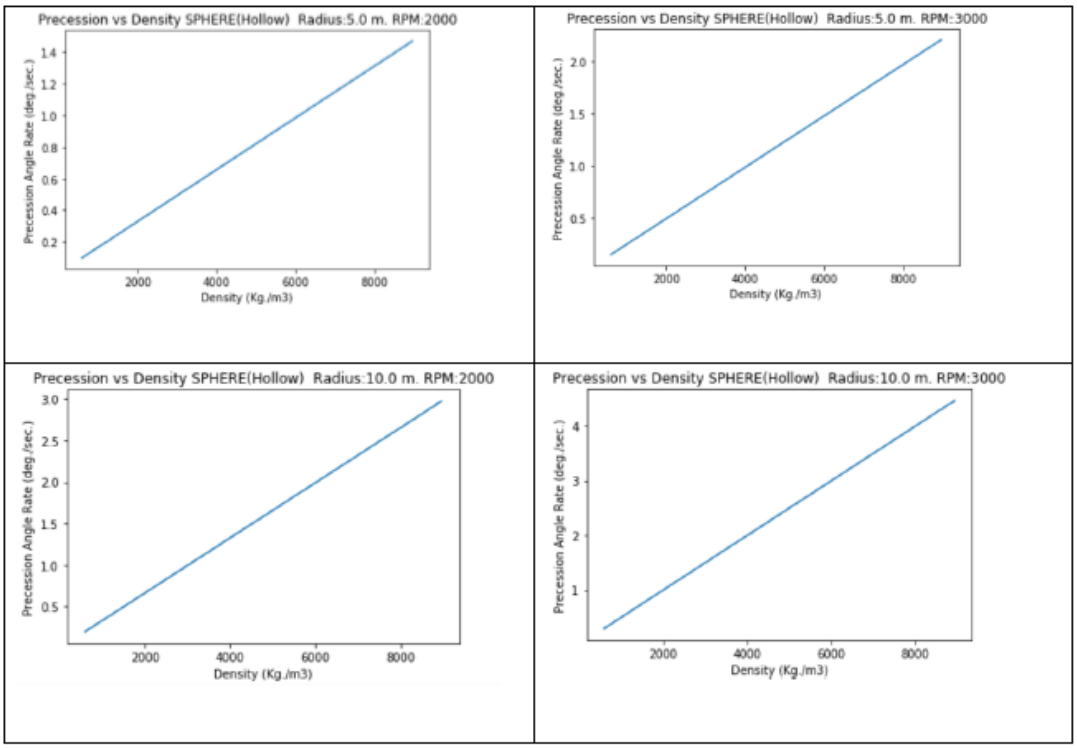


Precession Rate vs Material Density

Although relation among precession rate vs density could be easily infered from previous graphs, the following graphs show such relation in detail.




Precession vs Density DISK(Hollow) Height:0.5 m. Radius:5.0 m. RPM:1500
Precession Angle Rate (deg./sec.)
Density (Kg./m3)
Precession vs Density DISK(Hollow) Height:0.5 m. Radius:5.0 m. RPM:2000
Precession Angle Rate (deg./sec.)
Density (Kg./m3)
Precession vs Density DISK(Hollow) Height:0.5 m. Radius:5.0 m. RPM:2500
Precession Angle Rate (deg./sec.)
Density (Kg./m3)
Precession vs Density DISK(Hollow) Height:0.5 m. Radius:5.0 m. RPM:3000
Precession Angle Rate (deg./sec.)
Density (Kg./m3)
Precession vs Density DISK(Hollow) Height:0.5 m. Radius:10.0 m. RPM:1500
Precession Angle Rate (deg./sec.)
Density (Kg./m3)
Precession vs Density DISK(Hollow) Height:0.5 m. Radius:10.0 m. RPM:2000
Precession Angle Rate (deg./sec.)
Density (Kg./m3)
Precession vs Density DISK(Hollow) Height:0.5 m. Radius:10.0 m. RPM:2500
Precession Angle Rate (deg./sec.)
Density (Kg./m3)
Precession vs Density DISK(Hollow) Height:0.5 m. Radius:5.0 m. RPM:3000
Precession Angle Rate (deg./sec.)
Density (Kg./m3)



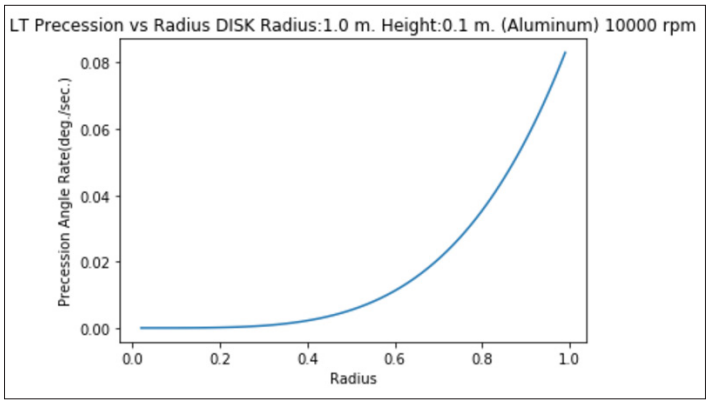
Evolution of the Precession Rate along Radius

Spheres

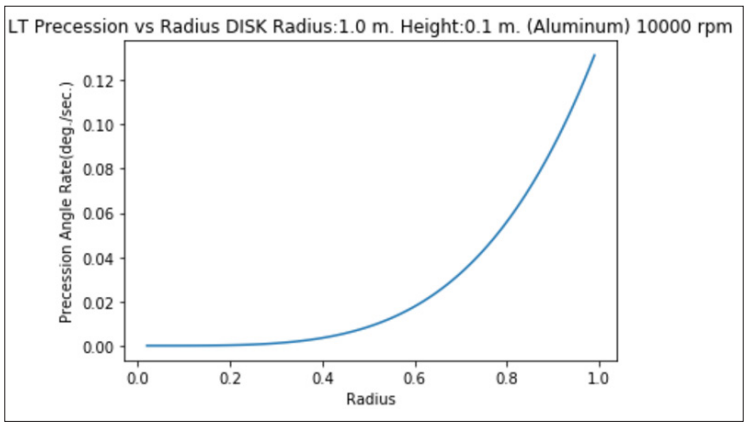
The precession rate increases from radius=0 to radius=R. Here are the graphs along Equator, Pole and for a 45 degrees colatitude.

For very heavy and large objects (e.g. black holes), there's a lack of continuity for very low values of the radius ($0 < R < 3$ cm.) which can be identified with the known Kerr singularity [10]. We've found a relevant fact: such singularity has not been found for the small objects of our study.

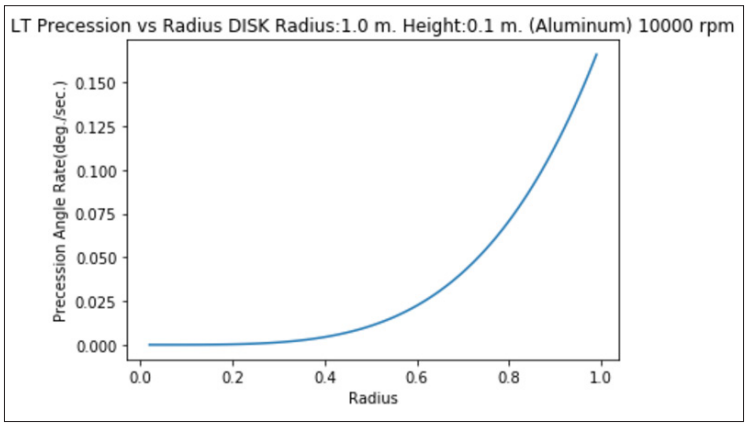
Just like an example, here is the graph for the evolution, according always to Kerr spacetime formulas, of the LT precession along the radius (Equator) for an sphere of 1 meter of diameter.



Equator

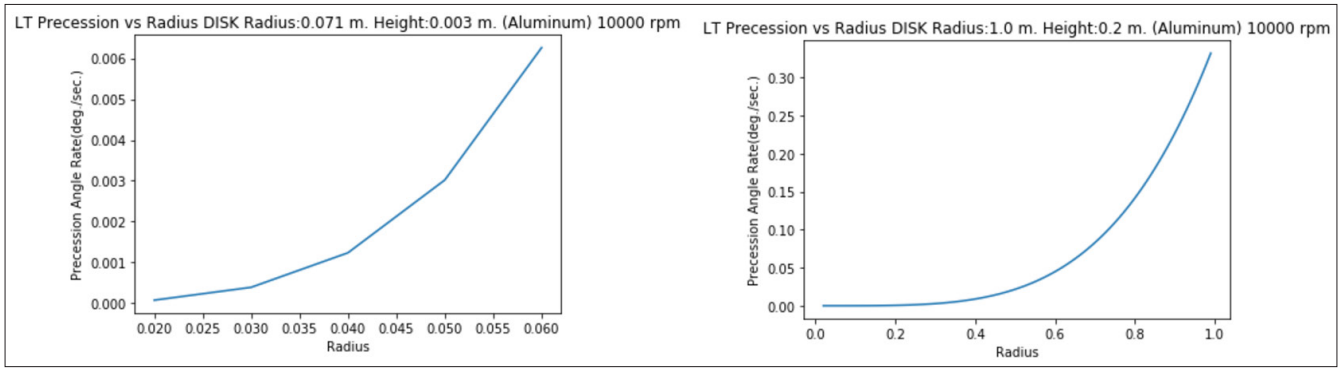


Colatitude 45 degrees



Pole

Disks



Results Analysis

Relevant conclussion can be reached from the previous results:

- LT precession rate effect can be very relevant for small objects with high speed of rotation and therefore it should be taken on account to be applied for future space crafts. E.g. For a disk of steel (solid) of 20 m. diameter and 2 m. of height, with a rotation speed of 2000 rpm (33.33 Hz.), that is, 210 rad/s=12032 degrees/sec., the precession rate is 52 degrees/sec., 0,4% of the rotation speed.

We can observe that order of magnitude is very relevant and, as consequence, the according impact over the space-time around the object. Therefore a partial zero gravity effect is reached for counter-clockwise rotations and a partial increase of gravity is reached for clockwise rotations.

- The precession rate for the same rotation speed, diameter and kind of material is larger for solid materials than hollow ones.
- The precession rate for the same rotation speed and diameter increases with the density of the material.
- The precesion rate decreases from Poles to Equator.
- The precession rate increases from the center (0) to radius.
- The greater the moment of inertia, the greater the precession.
- For the same radius, the precession rate reached by an sphere is notably greater that the reached by a disk.
- The results show the values of the module of the LT precession vector, but not the vector components and therefore its direction. In any case, the vector will be oriented towards convexity of space-time for counter-clockwise spins, therefore counteracting the gravitational effect (decreasing the piece weight) and towards the concavity of space-time for clockwise spins (increasing the piece weight).

Influence of Precession Rate over Gravity

I miss some studies about new advanced metrics along last decades. Such lack of research in this field lead us to very limited options when studying environments of a minimum of complexity. Most of current metrics have a lot of limitations and in fact they're applied only in vacuum. But we have currently very powerful tools (computing, AI) to solve any complex system of differential equations regardless their degree.

It's a pity that nobody has cared yet about getting metrics involving two or more bodies at least. They could be very useful in every way, including a right space-time interpretation of the great information coming from JWST and Hubble. My view is relying always everything in classic Gravity when we have a theory so powerful (Relativity) is a huge error.

This case is a good example of the previously exposed: we're not applying Kerr metrics to a black hole or a neutron star. We're applying it to a simple spinning body but that can't be considered in vacuum, because it's subject in this case to Earth Gravity.

Therefore the following study about the influence of the precession rate over Gravity is limited and we must assume some error margin.

We're going to apply the following limitations:
Kerr metric is going to be used:

$$ds^2 = \left(1 - \frac{2GMr}{\rho^2}\right)dt^2 + \frac{4GMr\,a\,sen^2\theta}{\rho^2}dt\,d\varphi - \frac{\rho^2}{\Delta}dr^2 - \rho^2\,d\theta^2 - \left[r^2 + a^2 + \frac{2MGra^2sen^2\theta}{r^2 + a^2cos^2\theta}\right]sen^2\theta d\varphi^2$$

Taking into account the symbols values as explained previously in (3) [11]

- The object will have spheric geometry. We'll apply colatitude $\Theta = 0$ because of the second term $dt\,d\varphi$ relationing disappears (=0).
- We'll suppose a relationship among dt^2 and Gravity close to linearity just as it's explained in [8].

With such suppositions, the time component of the tensor is reduced to $\left(1 - \frac{2GMr}{\rho^2 c^2}\right)$

In our case $\rho^2 = r^2 + a^2$ Therefore the time component for a=0 (spinning=0, J=0) reduces the previous expression to Schwarzschild metric:

$\left(1 - \frac{2GMr}{r^2\,c^2}\right)$, that is, $\left(1 - \frac{2GM}{c^2\,r}\right)$

This leads us to that the square of the time difference ***simplified to this case*** among an object spinning around one of its symmetry axis attributable to frame precession and the same object in rest state would be:

$$\Delta Ts^2 \quad \frac{2GMr}{c^2r^2} - \frac{2GMr}{(r^2 + a^2)c^2}$$ that can be expressed for a more intuitive interpretation as

$$\Delta Ts^2 \quad \frac{2GMr}{c^2}\left(\frac{1}{r^2} - \frac{1}{(r^2 + a^2)}\right) \qquad (9)$$

As can be observed, the Kerr parameter a influences directly over the difference of times.

On the other hand, the object is subject to a gravitational field (Earth in our case).

Therefore there're a difference of times **ΔTe** (by Gravity) in function of altitude, that can be expressed (being in this case Me the mass of the Earth, **re** the Earth radius and **h** the altitude) like [8][9]:

$$\Delta T_e^2 = \frac{2GM_e}{r_e c^2} - \frac{2GM_e}{(r_e+h)c^2} \qquad (10)$$

The difference of times by precession/LT effect (ΔTs) will add to the difference of times by Gravity (ΔTe) if the object is rotating clockwise (increasing the "weight" of the object) and it will substract from ΔTe if the object is rotating counter clockwise (decreasing the "weight" of the object). In such case, equalizing ΔTs= ΔTe and simplifying the resulting equation we could know the value of **a** needed for reaching an state of Zero Gravity at altitude h:

$$Mr\,(1/r^2 - 1/(r^2 + a^2)) = Me\,(1/r_e - 1/(r_e+h)) \qquad (11)$$

From this equation we can calculate easily the value of **a** for getting a "Zero Gravity" effect (**a_z**):

Doing $K_1 = h/(Re*(Re+h))$ and $K_2 = M/(Me*r)$ ➔ $a_z^2 = K_1\,r^2 / (K_2 - K_1)$ (12)

From (11) we can calculate the value of the rotation speed **(J=Iω=aMc → ω=aMc/I)** for any object of mass M and moment of inertia I for reaching a full Zero Gravity effect and the value of such rotation speed for increasing/decreasing (in function of the direction of rotation) the partial gravity effect over an object.

We also could extrapolate Zero Gravity partial effects from (12) for specific **a** values.

I insist once more that this is a simplified way. Therefore the results obtained are only an approximation. We should create (and obviously use) more advanced metrics for getting an exact solution.

General Zero Gravity Theory and Application to Space-Crafts
As first conclusion, a General Zero Gravity Theory is concluded as well as its associated technology to be applied to new space crafts, which includes both ZG effect and LT effect. It's widely explained in other work of this author so we're not going to address it in detail here [9].

Experiments
Some experiments have been done to show the influence of both effects (Zero Gravity (ZG) effect and Lense Thirring (LT) effect), showing that ***both effects (ZG and LT) are added or substracted depending if the rotation of the object is counter-clockwise or clockwise*** [1,8]. That is, ZG does not depend of the direction of rotation (creating always a convexity in space-time) but LT yes. LT creates a concavity in space-time (clockwise rotation) or convexity (counterclockwise) [12].

Gravity Origin
As second conclussion, Gravity acts in the Universe in two apparently very different ways:

- "Classical" gravity, previously interpreted by Newton as a force and later by Einstein as the consequence of the deformation of space-time (13).
- Gravity "by dragging" the fabric of space-time in rotating bodies (Lense-Thirring effect) (14).

This work shows that even bodies with a small mass but subjected to a high rotational speed relative to their mass deform the space-time around them, causing not only concavities ("gravity effect") but also convexities ("antigravity effect") in the fabric of space-time. Of course, this is also valid for any celestial body.

It would be wrong to consider that both (13) and (14) share the same script, that is, that relativistic gravity is produced by the mere presence of a mass and that in turn the rotation of such mass also generates a gravitational effect by the Lense-Thirring effect. One could think in a simplified way that (13) would be a question of a "static" gravity and (14) of "dynamic" gravity, in the sense that both its intensity and direction depend on the rotation of the body. But considering that "conventional" gravity (13) is directly linked to the mass due to some particle at the quantum level which is able to generate a warping of space-time would not be coherent. Such warping must have another previous origin.

There is nothing pointing out that Gravity is produced by a particle, in any of its possible forms (wave, string). Neither the graviton exists, nor can String Theory (despite its undeniable merit) explain reality.

It makes even less sense to think that (14) has an origin based on any particle. No quantum deformation of matter occurs when it's subjected to rotation (at least not if we are not talking about extreme cases).

My work proves the close relationship between gravity and energy. Gravity can be considered an energy for all purposes, interacting in both directions with kinetic, shear, and, undoubtedly the most important because it is the key, electromagnetic energy [9].

Just as we've seen before, small rotating objects generate their own concavities and convexities in the space-time around them. Obviously, it is meaningless to think of "reversible" deformations of space-time at the quantum level, let alone of "gravitational" particles.

On the contrary, it tells us that in this case (14) kinetic energy is the only one responsible for the deformation of space-time.

In fact, the expression of time difference due to Lense-Thirring effect in rotating objects according to the relativistic Kerr metric (with the simplification of colatitude 0, i.e. applying it to the poles) as expressed in shows that it's directly related to the parameter a or, in other words, to the rotation speed and therefore to the rotational kinetic energy of the object (or celestial body) [6].

On the other hand, the time differences due to the altitude differences in a "conventional" gravitatory field is expressed in [8][9].

By comparing expressions (9) and (10) we observe their enormous similarity. It's also showed how (10) can be counteracted by kinetic energy.

$\Delta g = \frac{v^2}{2}\left(\frac{1}{r} + \frac{1}{(r+h)}\right)$ In fact, an object traveling at speed v and altitude h could compensate the difference of gravities Δg among the surface and its altitude h in function of its kinetic energy (expressed by unit of mass) as expressed by this equation [9].

Therefore it gives us another clue to understand how gravitational potential energy was created.

The Bow, the Archer and its Hands
Gravitational energy is actually potential energy, so it must have been produced by another energy source. We could apply the metaphor of the archer and the bow. Gravity is the bowstring, but there must be (or has been) an archer whose hand drawed it. We might even think that another hand of the archer (probably the same one) could also have some influence on the bowstring tension. ***Both hands of the archer, in its final expression, only can be kinetic energy*** [9].

The most recent discoveries from JWST and other telescopes suggest that Gravity has not been the same or worked in the same way over Time. This is consistent with the authors theory of artificial biointelligence, which indicates that gravity has evolved over time (we will reflect on the meaning of this word later) [13]. Electromagnetic energy would be the archer that has shaped Gravity over Time [9]. But the archer has used an arch (matter). The hand of the archer would ultimately be kinetic energy. So I think that research should be focused on finding how this interaction between electromagnetic energy (in its different forms, including the primordial energy from the Big Bang) and matter has come to warp the fabric of space-time along its different stages. I think that QED studies, and especially those developed by Feynman, should serve as a starting point [14].

If kinetic energy (coming from rotation), although acting as "shear energy" is capable of deforming the fabric of space-time by "dragging" effect, it is conceivable that electromagnetic energy (which ultimately is also kinetic energy) can also do so. A fundamental difference is that, once the rotation is finished, the "gravity" effect (we should rather call it concavity-convexity in space-time depending on the direction of rotation) disappears for small objects (*), while "conventional gravity" remains in the form of potential energy being inherent to the mass.

Therefore, a creation energy that has been maintained over Time is required so that this deformation is not easily reversible.

(*) In reality, we do not know whether the deformation in space-time produced by the Lense-Thirring effect over a long period of time on a celestial body would also be “irreversible” or would tend to disappear, since the experiments have been carried out on small rotating objects for a limited time [12].

Light could, in turn, act like the another archers hand, influencing in some degree the bows tension. In fact, if electromagnetic energy is primarily responsible for the creation of gravitational energy, it could slightly modify it by continuing to act on the exposed matter. In other words, although gravity remains currently stable, it could still continue to evolve, albeit imperceptibly. Future gravity could continue to warp space-time.

This fact could explain one of the most striking cosmological phenomena observed recently: the "decrease of dark energy" over time. This "dark energy" would not exist as such; instead, gravity, having evolved—that is, deepened the deformation of the fabric of space-time over time—would be the responsible for the slowing of the expansion of the universe. And, if this deformation continues to increase, there would come a time when the expansion of the universe would not only stop, but it would reverse, becoming an irreversible contraction.

This apparently “strange” interrelation between Gravity and electromagnetic radiation would even explain some phenomena that currently lack of explanation: it also could explain the strange link between changes in cosmic radiation and seismic activity or the relationship between solar activity and volcanic activity: relevant changes in electromagnetic radiation would affect in some degree the Gravity producing some little (but enough) changes in the movements of the tectonic plates.

It should be noted that, although the relationship between matter and light is the most obvious, it is not the only relationship between matter and electromagnetic energy. The best example is the electromagnetic energy within the Earth, which produces its magnetic field, or rather, its electromagnetic field.

Gravitational energy would not have been created "instantly," and there would be no need to seek any explanation of the type of Quantum Gravity or equivalent at the quantum level that would have allowed its creation. What would need to be understood is the influence of the relationship between quantum world and electromagnetic energy. Electromagnetic radiation is continuously interacting with matter. This is the case currently and has been the case throughout Time, influencing it. What I propose is that ***this interaction would be the responsible for the warping of the fabric of space-time***.

On the other hand, this deformation of space-time would be as "necessary" as it is critical, in the sense that it allows to reach states of equilibrium between different celestial bodies, being the current one represented by the Theory of Relativity. According to the Theory of Artificial BioIntelligence, it would be a consequence of the Darwinian self-learning processes whose objective was, and is, to reach states of equilibrium. These states of equilibrium are achieved thanks to the principle of minimum action, the basis of the Hamiltonian and/or Lagrangian that describe physical states. ***The principle of minimum action would be a direct and common consequence of all Darwinian self-learning processes that have shaped the Laws of Nature*** [13].

In summary, Gravity is not an intrinsec property of matter. It’s an expression of the state of balance reached by matter in space-time [13].

Logically, gravity, as energy, is directly proportional to the amount of matter with which it interacts, but ***it does not arise directly from the quantum world, but from its interrelation with it***.

Well discuss forward about the interaction between the quantum world and electromagnetic radiation. We should consider whether this interaction has also caused a distortion of the fabric of space-time at the quantum level.

Quantum Warping

As Einstein Relativity Theory implicitly expresses, Time is not only relative but it adapts (stretches/shrinks) according to different environments (***space-time geometries***).

My view is everything points out that the “Gravity” effect (warping) is usually minimal at Quantum (likely excepting entanglement, I’m going to talk a little bit about it forward).

According Relativity (simplifying), ***if Gravity --> 0 then Time --> 0 for an external observer***.

Therefore ***Quantum Timeline has nothing to do with our Timeline*** [14].

As consequence, observation of some quantum phenomena are distorted by this fact. That is, the fundamental uncertainty principle of Heisenberg would be consequence not only of the high energy of particles-waves but of the absolutely different Timelines among our reality and quantum reality.

Therefore ***time dilation practically does not exist***.

As consequence, some quantum phenomena act instantaneously and for an indefinite period of time before our eyes as long as the circumstances that led them to such state are not altered.

Everything happens as if Time did not exist (delocalization). In other words, quantum world would follow almost non-locality principles.

Superposition would be also a logic consequence of it. A particle could be really almost at the same time (our time) in two different positions.

Quantum would be in fact the expression of the balance state closer to the Big-Bang.

But, what about entanglement?... How could it be explained according to it?...

My view is the only "Gravity" that we can find in Quantum is related with rotation (14). The "conventional" gravity (13) would have no sense at the Quantum level.

In reality we should talk about "concavities" and "convexities" in space-time instead of simply "gravity". Particles have a huge rotation spin (compared with their size). Then the gravity effect caused by Lense-Thirring relativistic effect around them must be very relevant.

Entanglement would be the consequence of bringing two particles with different direction of rotation (positive-negative angular momentum) close enough to create a wormhole effect.

Such micro wormhole ("entanglement") would work independently of distance and time, because it would not be affected at all for other Universe Laws (Relativity). Time almost would not exist in Quantum, therefore it happens instantly before our eyes (non-locality).

Light and Gravity

Light counteracts the Gravity effect (gravitational potential energy) due to its own energy in shape of electromagnetic radiation (which also can be considered ultimately kinetic energy). The light loses energy as it travels through intense gravitational fields, but it does not loose speed. As light loses energy along its way due to the gravitational fields, its tendency towards the red spectrum increases (redshift) [9].

In the quantum world, time happens as if it doesn't exist; everything happens as if it were instantaneous. Why? Because there is hardly any deformation of space-time. Therefore, light barely bends in such space-time; it follows a practically Minkovsky space: the space that existed at the beginning of the Universe. Despite the theory that most of the laws of the Universe have evolved over time, none of the observations suggest that the speed of Light has done so. The speed of Light, like the laws of thermodynamics, would be the same in any Universe [13].

Light has, and always has had, a fixed speed; this has been the first objective measure of time in the history of the Universe, and the basis on which we make our measurements.

But quantum time didn't exist at the beginning of the Big Bang, nor does it nearly exist due to the minimal warping at the quantum level. Therefore, any interaction between light and matter occurs between a fixed and defined time (light) and another, almost nonexistent from our point of view (quantum). Hence, we must rely on probabilistic methods (QED, Quantum Field Theory) to study these interactions.

The interaction of electromagnetic energy (and Light) with matter is continuous and has always existed.

But... can the interaction of light (or other types of electromagnetic energy) warping the space-time?... And if so, how does it do it or has it done it?...

The deformation produced by electromagnetic energy over the fabric of space-time has been a matter of… Time, so it is very difficult to carry out experiments to verify that such deformation occurs, for the simple reason that such deformation, measured in our units of time, is negligible.

We could infer that the deformation of space-time was carried out by an "electromagnetic catalyst," and is directly related to the amount of matter. The greater the density of matter in a region of space, the greater the slowdown of time, with black holes being the limiting case. And vice versa, in regions of space where there is hardly any matter, time would flow very quickly, almost instantaneously. Or to put it another way, time runs at a different pace in different regions of space, depending on the density of matter and, therefore, on the deformation of space-time we know as gravity.

The quantum world would follow another script, with time flowing almost instantaneously.

Light and Quantum

The current relationship among Light and Quantum could give us the key for understanding how Gravity (as energy) has taken shape and how it's maintained over time.

This relation is studied by QED (Quantum Electro Dynamics) being Richard Feynman who was deeper by far in the QED subject.

Feynman asserted that Quantum is not deterministic at all. Therefore relationships and behaviors among photons and electrons follow a probability calculation (as everything related to Quantum), very well explained and defined by Feynman.

My view (just I told before) is Quantum fabric of space-time is almost not warped, as consequence any particle can be in any position at the same time (understanding "time" as our time). Therefore, when Light hits matter, relationship among electrons and photons only can be studied as probabilistic ("amplitude") calculus as it happens in Quantum Field Theory in a general way. Perhaps the most relevant difference is Feynman prefers to use his famous diagrams and arrows which are more associated to particles than waves instead using Schrodinger wave function.

From all Feynman theory, perhaps the most relevant part for us is related with the absorption and emission of photons by electrons when they're hitted by a photon. The way followed by a photon in the Quantum world can be more winding that we might think.

He even talks about unfathomable paths such as "the electron emits a photon, then travel backwards in time to absorb a photon and then proceeds forwards in time again".

My view is the work of Feynman shows us implicitly the way to understand how Gravity could have been born from the relationship among Light and Matter. In fact I think he perceived that something "hidden" and unknown in such relationship happened, not only as consequence of the least action principle. It's nor strange that he titled his more famous book as "The Strange Theory of Light and Matter".

We should deep in Feynman QED studies, promoting new researchs for improving QED because QED would be the key for understanding how gravitational energy was created and shaped over Time.

Photons have the kinetic energy needed for being the archer's hand to warp space-time at our Universe scale supported by some Quantum particles (e.g. electrons) without almost producing any warping space-time effect at Quantum level.

In any case, Feynman phenomenally explains the multiple possibilities of the different interactions between electrons and photons, that is, at the particle level, concluding that they follow ***the principle of least action***, whose expression in Minkowski space would be the path that leads to minimum time.

Although Feynman diagrams (or Feynman path integrals) are extraordinarily useful for understanding the relationships between electrons and photons, I consider it more appropriate to turn to an energetic perspective to understand ***how electromagnetic radiation, always following the same universal principle of least action, is capable of warping the fabric of space-time when interacting with matter***, specifically electrons. Therefore, one should turn to QED expressions based on the Hamiltonian or Lagrangian that define the system.

Either the Hamiltonian or the Lagrangian could be used for it. Expressed in terms of the Hamiltonian:

Free electron Hamiltonian
Electrons are fermions described by the Dirac field. The Hamiltonian for free electrons is:

$$H_{\text{elec}} = \int d^3x\psi^{\dagger}(x)(-i\alpha\cdot\nabla+\beta m_e)\psi(x)$$

$\psi(x)$ is the electron spinorial field (an operator that creates or annihilates electrons and positrons).

α and β the Dirac matrix.

m_e is the electron mass.

The integral is performed over three-dimensional space.

This term represents the relativistic kinetic energy and the rest energy of electrons and positrons.

Hamiltonian of the Free Electromagnetic Field (Photons)
Photons are massless bosons that constitute the quantized electromagnetic field. The Hamiltonian for the free field is:

$$H_{\text{phot}} = \frac{1}{2}\int d^3x\left[E^2(x)+B^2(x)\right]$$

Where:

E and B are the electric and magnetic fields, respectively.

These fields are expressed in terms of the vector potential Aμ(x) (the photon field), which is a quantum operator in QED.

These fields are expressed in terms of the vector potential Aμ(x)

Note: This Hamiltonian could also be written in terms of the photon creation and annihilation operators.

Interaction Term between Electrons and Photons
The interaction occurs because electrons, being charged particles, couple with the electromagnetic field. This term is derived from the principle of least action in QED and is written as:

$$H_{\text{int}} = -\int d^3x j^{\mu}(x)A_{\mu}(x)$$

Where:

$j^{\mu}(x)=-e\psi^{\dagger}(x)\,\gamma^{\mu}\,\psi(x)$ is the electromagnetic current generated by electrons (e > 0 is the magnitude of the electrons charge, and the negative sign reflects its negative charge).

$A\mu(x)$ is the vector potential of the electromagnetic field (the photon field).

γ^{μ} are the Dirac matrix.

This term describes processes such as the emission or absorption of photons by electrons, or the scattering between them.

The total Hamiltonian in QED for electrons and photons is the sum of the above terms:

H=Helec+Hphot+Hint

that is,

$$H = \int d^3x\psi^{\dagger}(-i\alpha\cdot\nabla+\beta m_e)\psi+\frac{1}{2}\int d^3x\left[E^2+B^2\right]-\int d^3x(-e)\psi^{\dagger}\gamma^{\mu}\psi A_{\mu}$$

Hamiltonian which is the representation of the interaction between electrons and photons in QED.

The fields ψ and Aμ are quantum operators that obey anticommutation (for fermions) and commutation (for bosons) relations.

The Hint interaction term is what enables physical processes such as radiation (photon emission) or the Compton effect (electron-photon scattering).

This one (or the equivalent expressed in Lagrangian format) should be the starting point for finding the connection between the kinetic energy resulting from the interactions between electrons and photons and the relativistic deformation of space-time that it produces.

Discussion. QED, Relativity and Gravity
QED was considered the "jewel of physics" by Feyman. Not only because it had been sufficiently proven, but also because ***it is consistent with both quantum mechanics and the theory of relativity***. This fact also allow us to study the relationship among electromagnetic energy and matter under both sides: QED and Relativity:

We could create a model based on a new Einstein metric tensor for a body subjected to an electromagnetic energy source which absorbs part of the electromagnetic energy and emits another part of the energy received as kinetic energy. Then we could easily deduce the times difference ΔTs induced by the kinetic energy emitted and, as consequence, the energy amount needed for getting a Δg gravity effect. On the other hand, we could deduce from QED how such amount of kinetic energy can be reached at Quantum level in function of the time and the intensity of the electromagnetic radiation.

We're going to do a first approach to such model. Although Gravity has evolved over Time (and not always in a "continuous" way but in different stages by sure), Einstein field equations could be valid for any Universe time doing some changes (e.g. the curvature tensor), because they really define the relationships among matter,

energy, momentum. Just as example, the stress-energy tensor for Earth in Schwarzschild metric is directly related with mass (and density) of Earth because it explains the Gravity in the current state, but what would happen in an initial stage?... The matter contribution to the tensor would not have sense in such initial stage, because Gravity did not still exist, but there could be other energy contributions instead.

We're going to do the following supposition for understanding the huge importance of the electromagnetic energy specially in the early stages of Gravity creation. We could imagine a body equivalent to the Earth very close to the Sun (e.g. 100.000 Km.) which is receiving the according radiation over a billion of years. We're going to suppose that such body reflects 50% of the radiation. And for getting an equivalence to current conventional Gravity, we're going also to imagine that the kinetic energy reflected from such radiation is converted to mass along a very tiny shell around Earth with a thick of 0.10 m (which would generate a very high density shell).

I'm going to avoid the maths for not extending so much this paper, but doing the according calculus, we would reach to an equivalent mass (from the kinetic energy) for the stress-energy tensor very close to that of the Earth which would produce as consequence a curvature of space-time in the according Einstein field equations very similar to the current one. (*)

Of course, this model only tries to show the importance of the relationship between electromagnetic radiation and Gravity. If we think in terms of the first atoms instead Earth and the primitive electromagnetic radiation instead the Sun in the very early Universe, we can easy infer that a first expression of Gravity arose very early on. Consequently, the first stars, galaxies and even young black holes could have emerged within the first hundred of millions of years, just as JWST is showing us.

(*) If we apply this model to the current status of Gravity on Earth (respecting of course all parameters, distance to Sun, radiation absorbed approx. 70%, reflected 30% …), we can deduce that the current influence of the Light (in usual circumstances) over the warping of space-time really exists although it's very little, almost insignificant (but obviously persistent over time).

That is to say, ***the theory that electromagnetic energy in its interaction with matter has been shaping the Gravity till as we currently know it, is well supported from a physical, mathematical and cosmological point of view***.

That is, Relativity and QED would also allow us to decipher and verify how gravity arises as a consequence of quantum processes of interrelation between electromagnetic energy and matter, or, in other words, the long-awaited origin of gravity.

Feynman claimed that all of physics can be constructed through QED, except for the interactions in the nuclei of atoms and Gravity [14]. Perhaps the time has come to expand the possibilities of QED, offering us an explanation of how the interaction between electromagnetic energy and matter has been able to "bend the bowstring", that is, to deform the fabric of space-time. This would represent the long-awaited unification of physics.

If we find a final detailed model that can explain it, we would have a huge bonus: we also might be able to find our own way ***to harness electromagnetic energy to warp space-time for our own benefit and design new ships based on that technology*** [15].

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