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Is the Growth of the Astronomical Unit Caused by the Allais Eclipse Effect?

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Abstract

In addition to the Pioneer anomaly and the Earth flyby anomaly for spacecraft, other unexplained anomalies disrupt the solar system dynamics, like the astronomical unit. We show in this paper that the Allais eclipse effect causes the major part of the growth of the length scale for the entire solar system. It is the rough disturbance on the barycenter Earth-Moon implying the Sun that was recorded in the movement of the paraconical pendulum. Earth and Moon revolve around their common center of gravity, which in turn orbits the Sun, and the perturbation of the eclipse hits this double, coupled Kepler's movements. The thesis of the tidal friction supports that oceanic tidal friction transfers the angular momentum of the Earth to the Moon and slows down the rotation of the Earth while taking away the Moon. However, we think that there are not enough shallow seas to sanction this interpretation. The Earth-Moon tidal system might be inaccurate or unreliable in determining the Earth's actual rotational spin-down rate. Our assertion is that the change in the Earth's rotation is caused by a repulsive gravitational interaction during solar eclipse. The perturbation would submit to variations and distortions the region of the barycenter of the Earth-Moon system which revolves around the Sun, with the dual secular effects that the Moon spirals outwards and that the Earth-Moon system goes away from the Sun.

Keywords

Solar Eclipse, Allais Effect Eclipses, Barycentre, Repulsive Force of Gravity, Overgravity and Antigravity, Cosmologic Casimir Effect

1. Introduction

It seems that everything does not go well in the solar system dynamics. In addition to the Pioneer anomaly and the Earth flyby anomaly for spacecraft, there are

anomalies in the Moon's outward drifts amounting to about 3.8 cm per year (cm/yr), and the length scale for the entire solar system, *i.e.* the average Earth-Sun distance called the astronomical unit (AU), is increasing at an unexpected rate of approximately seven cm per year. Accurate measurements of the AU affect all our measurements of distant objects.

The analysis of radiometric measurements of distances between the Earth and the major planets from 1961 to 2003, including observations from orbiters and landers placed on Mars by the space mission Viking and Pathfinder at the end of the seventies, allowed the astronomers to measure exactly its remote and deduce from it the value of the AU: 149597870.691 km ± 30 m. According to the measures made by the Martian probes, the AU would increase about 10 meters per century (m/cy) [1] [2]. These estimates were made from many measurements with sources of errors, so they were likely to vary. Around 2004, three different research groups analyzed the radio echoes from planets. By compiling over two hundred thousand observations, astronomers G.A. Krasinsky and V.A. Brumberh concluded that the AU was growing at about 15 ± 4 m/cy. Elena Pitjeva of St. Petersburg found: AU: 149597870.696 km ± 0.1 m. Independently, E.M. Standish estimates the change as about 5 cm/yr [3] [4] [5]. Later estimates based on both radiometric and angular observations lowered this estimate to +7 ± 2 m/cy. The International Astronomical Union (IAU) currently accepted best estimate (2009) of the value of the AU is 149,597,870,700 m.

What could be the cause of the secular increase of the AU at a marginally detectable level? The loss of the solar mass due to the solar wind and light emission weakens its gravity and increases the distance between the celestial body and the Earth [6]. However, the effect of the ejected matter seems to be too weak to accuse our star: ~1 m/cy. What about the expansion of the Universe, which tends to move the stars away from each other? Even there, its impact is insignificant towards the increasing distance noticed between the major planets and the Sun. It seems that no classic interpretation still succeeded in lighting this anomaly.

Many cosmologists think that the gravitational constant decreases secularly in time. Or that light slows down as age of the Universe increases. Based on the equation $GM = tc^3$, they guess that change in the rate of time is mathematically equivalent to a changing speed of light. If c slows down, the return time of the radio waves increases, which makes the Moon recessive, makes the AU appear longer, and makes the Universe appear to be accelerating. We rather think that light "fatigues" over cosmological time, losing part of its energy in the form of frequency without its speed decreasing.

Then ensue some exotic explanations, such as any drift in the time of atomic clocks likely to introduce an apparent variation in AU. The modern measures of the AU rest on the measure of time (the one that puts a radar signal to propagate between the Earth and the probes). An explanation all the more attractive as the necessary drift to resolve this problem is of the same order as the one who would allow to explain the acceleration of probes Pioneer. It could also be due to the *brane cosmology* postulating that our Universe in four dimensions is set in a

Universe possessing supplementary dimensions. The gravity would escape there, would weaken, producing an increase of the AU [7].

At present, there are no explanations able to accommodate such an observed phenomenon, either in the realm of classical physics or in the usual four-dimensional framework of the Einsteinian General Relativity. For our part, we believe that the anomaly of the AU is in great part due to eclipses. This paper consists of two parts. In the first, we show that the slowdown in the Earth's rotation and the lunar recession are mainly attributed to the Allais effect eclipses and to a lesser extent to the ocean tides. It would be particularly the unexpected repulsive side of the gravitational force that manifests itself during eclipses. With the concept of "negative mass", we calculate the abnormal spontaneous acceleration of the Moon during the solar eclipse in June 1954 (paraconical pendulum of Maurice Allais), which gives a result similar to the one recorded by a gravimeter during the solar eclipse of 1997. In the second part, we claim that it is also the eclipses which contribute to increase the distance between the Earth and the Sun. The strange behavior of the gravity during eclipses—alternation of overgravity and antigravity, "coherence" and "decoherence"—suggests it has a quantum character.

2. Allais Effect and Increase of the Earth-Moon Distance

2.1. Mechanism of the Breaking Effects of Tides

Planets are subjected, by virtue of their mutual action, to disparities which disturb the ellipticity of their orbits. Some are periodic and depend on the position of these bodies, either between them, or towards their aphelion; they are little considerable with regard to the equation of the center, and recover of themselves after a small number of years. Others alter the elements of orbits by almost insensible nuances in every revolution of planets, but these changes, by accumulating ceaselessly, eventually change completely the nature of the positions of orbits; as the sequence of centuries makes them very remarkable, they have been called "secular inequalities".

Modern observations of the Moon in the 18th century, compared to ancient eclipses, had indicated to astronomers an acceleration of lunar motion. An attentive examination of Pierre-Simon Laplace of the ancient and modern observations and of the intermediate eclipses observed by the Arabs showed him that this acceleration was indicated with a big probability. He recognized that the secular equation of the Moon is due to the action of the Sun on this satellite, combined with the secular variation of the eccentricity of the Earth's orbit [8].

At the beginning of the twentieth century, astronomer George Darwin develops a theory of evolution for the Sun-Earth-Moon system based on mathematical analysis in geophysical theory. His analysis of tides, published in 1884, was established on the methods developed by P.-S. Laplace and Lord Kelvin. In *The Tides and Kindred Phenomena in the Solar System* (1898), he discussed the effects of tidal friction on the Earth-Moon system. He concludes that the slowing

down of the Earth, produced by the loss of energy due to tides, increases the Earth-Moon distance and decreases the Moon's linear speed [9].

It has been realized since that time that the orbit of the Moon undergoes acceleration effects due to the friction of lunar tides and solar tides in a lesser extent, which slow down the Earth's rotation. The wave of tide lifting waters of oceans moves the other way around of the rotation of the Earth; so that it produces a friction that slows down the rotation and is responsible for a gradual increase in the length of the day. As the Earth's rotation slows, the planet loses angular momentum. However, the angular momentum of the Earth-Moon system is conserved, and so that what is lost by the planet is won by the Satellite. The Moon undergoes an action contrary to that of the tide, gaining angular momentum, losing speed and constantly moving away from the Earth. Calculations indicate that the tidal gain on the Moon's angular momentum adds approximately 0.04 seconds to the length of the month per century.

However, the evolution of the theory of the tides seems to lead to a nonsensical contradiction between the true oceanic friction and its real effect on the rotation of the Earth. The vertical constituent of the force of Newton's static theory produces only minimal disturbance. The horizontal constituent of the force of the dynamic theory produces more impressive effects on the liquid mass but the influence of the oceanic friction can only be considered in regions of shallow depth and strong tides, which is the exception rather than the rule. Furthermore, atmospheric tides in resonance with the current rotational period tend to accelerate the rotation and compensate for the braking due to ocean tides. Thus, no absolute conclusion can be formulated and it would be possible that this theory contributes only very partially to the slowing down of the Earth [10].

2.2. The Allais Effect during Solar Eclipses Would Have Contribute More than the Oceanic Tidal Friction to Produce the Slowing Down of the Earth and the Recession of the Moon

So, no one really knows why the Moon's actual orbit is off its calculated course by about 3.8 cm a year. Our suggestion is that the slowing rotation of the Earth, the increasing length of the day associated to the wider lunar orbit, are above all caused by eclipses perturbations rather than by oceanic tidal friction.

The listed total solar eclipses were always the only "historic witnesses" of the non uniform change of rate of the rotation of the Earth and of the day length. In the past, the Moon was closer to the Earth, which was verified by calculating the distance Earth-Moon from the Assyrian-Babylonian chronicles describing the precise time and location of eclipses 1000 years BC [11]. We think that eclipses were more than witnesses; they were also the *perpetrators* of these changes in Earth dynamics [12].

We suppose that the strengths of repulsion of eclipses (and those of the tides, but in a contribution lower than the one who is usually conferred on them), determined by the action of the Moon, not only slow down the axial rotation of the Earth, but also entail the increase of its distance R from the Earth and the de-

crease of its linear speed *v*. According Newton's law of conservation of angular momentum, the total angular momentum of the system Earth-Moon always has to remain constant. We presume that, under the influence of the disturbing eclipses, the slowing down of the Earth brings about an equal increment of the angular momentum of the Moon in its orbital movement around the Earth. To see how, let us see what is going to be the effect of this increase on the movement of the Moon. The angular moment of the Moon's orbit is

$$I = M_M v_M R_{E-M} \tag{1}$$

(M_M is the mass of the Moon, v_M its linear speed and R_{E-M} the radius around the Earth).

On the other hand, Newton's law of gravitation combined with the formula of the centrifugal force gives

$$GM_E M_M / R_{E-M}^2 = M_M v_M^2 / R_{E-M} \tag{2}$$

M_E is the mass of the Earth. So by simplifying

$$GM_E / R_{E-M} = v_M^2 \tag{3}$$

and by eliminating v_M between (3) and (1), we have

$$GM_E M_M^2 R_{E-M} = I_M^2 \tag{4}$$

By reporting R_{E-M} in (1), we obtain

$$v_M = GM_E M_M / I_M \tag{5}$$

The two previous formulae indicate that the augmentation of angular momentum of the Moon in its revolution around the Earth drives the increase of its distance from the Earth and the decrease of its linear speed [9].

All studies show that the orbit of the Moon is slowly getting larger, so that our satellite is receding from its planet. Of the value given by the observation of the slowing down of the Earth we can calculate the value of the recession of the Moon: it is less than a centimeter by revolution. Modern studies of the Moon`s motions, such as the *Lunar Laser Ranging Experiment* during the last decades, establish the current rate of retreat of the Moon from Earth at 3.82 ± 0.07 cm/yr [13]. A more recent study claims that the Moon's actual orbit is off its calculated course by about 7 ± 2 cm/yr.

There is between 4 and 7 eclipses by years (lunar and solar; total, partial, annular). By examining these digits, we notice that they can easily be in compliance with the measures made beyond the last forty years indicating that the orbit of the Moon goes away from the Earth at a ~4 cm rate a year.

2.3. Force of Repulsion

We conjectured that the Allais eclipse effect instead of tidal friction is what causes the Moon to recede from Earth. Maurice Allais recorded an anomalous pendulum motion of about 13 degrees during a partial eclipse over Paris in 1954. He repeated the experiment in 1959 [14] [15]. It seems that all the proposed conventional explanations either qualitatively or quantitatively fail to explain the

observations of anomalous behaviour of mechanical systems during solar eclipses, including the works of Allais with the paraconical pendulum, those of Saxl and Allen with a torsion pendulum and measurements with gravimeters [16] [17].

It has been pointed out that the pendulum effect during solar eclipses relies on the unknown properties of gravity. Over the years, many researchers have proposed ideas, such as gravitational shield of shielding or focusing. If such shielding does exist, it could be due to a partial blocking of gravitational particles—assuming such particles exist [18] [19]. Another mechanism might be blocking of gravitational waves from the Sun by the Moon. But if the Sun's gravity is blocked, then shouldn't the result be an increase in the Earth-pointing component of gravity? Research has not shown this to be the case. However, we could also easily speculate that, for any reason, the combined attraction of Sun and Moon would weaken the pull of Earth. A reasonably well-made series of measurements, taken during the 1997 total eclipse in China, showed a decrease in gravity at the beginning and end of the eclipse. The amount of decrease was about 0.7 millionths of a percent of the normal gravity value [20].

A tentative explanation founded on the fact that an eclipse produces a cone of shadow through the atmosphere, moving at least 1600 to 3200 ft per sec. This, in turn, might create changes in temperature, wind and barometric pressure. While there is evidence of a change in barometric pressure during the 1999 European eclipse the effect of the moving shadow in air is still 100,000 times too small to explain the retrograde motion of a pendulum, such as that measured by Allais [21].

Others prefer to put a conceptual difference between the gravitational force and the inertial force in an accelerated frame (non-inertial system) to explain gravitational abnormalities, like earthquakes, volcanoes eruptions, changes in the intensity of oceans currents. Inertial force becomes an action force like gravity force. The direct consequence of this logic is that the tidal pumping of angular momentum from Earth to Moon does not exist [22].

The Iasoberg Model which locates the "general" Allais effect within, on and near the Earth, is an interesting new approach. The structure-geometry of this model has links with severe wind events and the investigation of this relationship led to findings that support the existence of this effect [23] [24]. It is in the logic of thinking of the post-Einstein gravitational effects alleging that, when celestial bodies line up, it can superposes some kinds of abnormal resonances on some resonance regions on Earth, which have triggering effects on many natural disasters [25].

In the "specific" case of eclipses, we think that it would be particularly a gravitational force of repulsion, and not so much friction of tides, that would cause the recession of the Moon. The Allais eclipse effect exists and has to do with a property of gravity that is unimagined. The forces of repulsion act in the interactions of the electric charges of the same sign and decrease in reason of the inverse square of the distance. Analogically, in times of total eclipse, everything is

going on as if there was a kind of antigravity when the gravitational charges have no more the same sign. Although so far there is formally no change of sign for the mass, the Allais eclipse effect allows the introduction of the repulsive force of gravitation into the reasoning. Without referring to the alleged force of repulsion which propels the galaxies in cosmology (and without either denying a relationship) [26], we consider the forces of repulsion as a reality for physics.

The situation of eclipse would be a bizarre situation in line with quantum cosmology and in violation of the theorem of positive energy. The body sandwiched between the others would become to some extent, by quantum tunneling, a "negative-mass" which would be attracted by the "positive-mass" bodies, while he would repel them. This would explain the antigravity captured by the pendulum. The hypothesis that the Earth and the Moon are moving away from each other because of anti-gravitational effects may seem a speculative attempt to integrate the classical physics into the quantum mould and ignore the dynamics and the logic of the first one. We do not necessarily need the quantum substrate to shake the common sense of the Newtonian theory and General Relativity. It has long been known, in both theories, that the effect of "gravitational energy" is negative; in other words, that the total asymptotic mass of a star is in general less than the sum of the masses of the particles making it up because of the negative gravitational binding energy [27]. If the Moon during a particular phase of the eclipse turns negative, so that the gravitational binding energy becomes more negative, the possibility is higher that its total mass becomes negative. The Moon would exert antigravity: inserted between two positive bodies it would repel them while they would attract, with the result that the three would accelerate outside.

2.4. Anomalous Acceleration of Moon during Solar Eclipse, Calculated with the Concept of "Negative Mass"

A possible antigravity effect of the Sun-Earth-Moon system's gravity while the Moon is in front of the Sun was first noticed by Prof Maurice Allais over 65 years ago when its paraconical Foucault-type changes its plane of swing by up to 13.5˚ [14] [15]. What corresponds to an acceleration of the gravity on the Earth's surface of 9.4554 m/s^2 [12]. The repulsive action of the Moon seems to project and create an empty sphere inside the Earth. An "empty hole with a negative energy", which is consistent with the difference between the acceleration before the eclipse and the one occurring during its maximum effect.

We are going to calculate this "negative mass" of the eclipse of June, 1954, as well as its negative acceleration, that is to say outwards. We emphasize that the order of magnitude agrees with that measured with a gravimeter in 1997 during the total solar eclipse in China.

So during the solar eclipse of June 1954, the acceleration of gravity from the Earth *decreased about* 0.3546 m/s^2 (9.81 m/s^2 - 9.4554 m/s^2), as if the Moon had provoked an antigravity on Earth.

Let us say that, during the eclipse, the radius of Earth is longer (*Earth mass*: 5.98×10^{24} kg)

$$GM_E/R_E^2 = 9.4554\ \mathrm{m/s^2}\ . \tag{6}$$

Radius during eclipse is 6.495889×10^6 m. The decrease 0.3546 m/s^2 of the acceleration (a_g) corresponds to a longer radius (R_R)

$$6.495889\times10^6\ \mathrm{m}\left(\text{for } 9.4554\ \mathrm{m/s^2}\right) - 6.3774\times10^6\ \mathrm{m}\left(\text{for } 9.81\ \mathrm{m/s^2}\right) = 118490\ \mathrm{m}\ . \tag{7}$$

The negative mass (or the residual mass) M_R on Earth coming from the repulsive Moon during the eclipse would be

$$GM_R/R_R^2 = a_g \tag{8}$$

$$GM_R/118490^2 = 0.3546\ \mathrm{m/s^2}$$

$$M_R = 7.461834816\times10^{19}\ \mathrm{kg}\ .$$

The gravitational interaction Earth-Moon during this total solar eclipse would be (*Moon mass*: 7.36×10^{22} kg) interaction Earth-Moon without eclipse—anomalous interaction Earth-Moon during eclipse

$$GM_TM_L/R_{T-L}^2 - GM_RM_L/\left(R_{T-L}-R_R\right)^2 \tag{9}$$

$$G\left(5.98\times10^{24}\ \mathrm{kg}\right)\left(7.36\times10^{22}\ \mathrm{kg}\right)/\left(3.8\times10^8\ \mathrm{kg}\right)^2$$

$$-G\left(7.46183\times10^{19}\ \mathrm{kg}\right)\left(7.36\times10^{22}\ \mathrm{kg}\right)/\left(3.8\times10^8\ \mathrm{kg}-118490\ \mathrm{m}\right)^2$$

$$2.033610814\times10^{20}\ \mathrm{N} - 2.5391196\times10^{15}\ \mathrm{N} = 2.033585423\times10^{20}\ \mathrm{N}$$

The residual gravity of the Earth-Moon interaction would be 2.5391196×10^{15} N. Let us find the residual acceleration (a_R) of Moon during total solar eclipse:

$$GM_T/R_{T-L}^2 - \left[GM_T/R_{T-L}^2 - GM_R/\left(R_{T-L}-R_R\right)^2\right] \tag{10}$$

$$G\left(5.98\times10^{24}\ \mathrm{kg}\right)/\left(3.8\times10^8\ \mathrm{m}\right)^2 - \left[G\left(5.98\times10^{24}\ \mathrm{kg}\right)/\left(3.8\times10^8\ \mathrm{m}\right)^2\right.$$

$$\left.-G\left(7.461834816\times10^{19}\ \mathrm{kg}\right)/\left(3.8\times10^8\ \mathrm{m}-118490\ \mathrm{m}\right)^2\right]$$

$$= 3.44989\times10^{-8}\ \mathrm{m/s^2}$$

We conclude that during the solar eclipse of June 1954 there was an anomalous spontaneous acceleration of the moon outward of approximately 3.45×10^{-8} m/s^2. In recent years, the gravimeter was used in order to explain the change of the period of oscillation of the Allais pendulum that sometimes appears during the eclipses. It will be noticed that this unmodeled spontaneous deceleration of Moon towards Earth is not far from the exact dimension of the effect measured with a high-precision LaCoste-Romberg gravimeter during the March 9, 1997 total solar eclipse in Mohe region in Northeast China. Two "gravity anomaly valleys" were found with near symmetrical decrease of ~6 - 7 μGal at the first and at the last contact [28]. Or ~6 - 7×10^{-7} m/s^2 [Gal is 1 centimeter per second squared (1 cm/s^2); μGal is one millionth of a gal; the acceleration of gravity at the Earth's surface is ~1000 cm/s^2]. Same similarity with the solar eclipse on 24 October 1995 when D.C. Mishra and M.B.S. Rao recorded temporal variation in the gravity field continuously for approximately 12 h. before and after the eclipse: a

highly significant variation of 10 - 12 μGal occurred at the onset of the eclipse [29]. If one can thus note that the acceleration of gravity from the Earth decreases during solar eclipses by ~1 - 10 × 10^{-7} m/s^2, it does not seem incoherent to claim that there could be a "negative mass" effect and that these reductions corroborate the Allais effect.

NOTE: This "empty hole with negative energy" can also illustrate the concepts of "dark energy" and of gravitational "negative mass". The theory of the Relation considers the "dark energy" as a negative energy which is transformed into positive energy and which is immediately materialized, either directly in an ordinary mass, or in a kind of intermediate state called "dark matter". When antigravity occurs during the eclipse, a part of the ordinary matter becomes again a gravitational "negative mass" equivalent to the negative energy called dark energy [30].

3. Allais Effect and Increase of the Earth-Sun Distance

3.1. It Would Also Be the Allais Effect during Solar Eclipses That Would Contribute to Increase the Earth-Sun Distance

It is on the basis of the alignment Moon-Earth at the time of the antique eclipses that it was possible to conclude that—as a tendency—the rotation of the Earth slows down. For more than a century the official theory says that the Earth is slowing down due to tidal friction. We do not deny that water and solid tides affect the Moon in virtue of the law of the conservation of angular momentum. But we are convinced that the accelerating effect of the Moon outwards is mainly caused by the disturbance of lunar and solar eclipses which acts on the center of mass of the Earth-Moon system.

The barycenter of the Earth-Moon system constitutes the common axis of rotation and it is represented in Figure 1 by a theoretical *point* on which the Earth and its satellite revolve around the Sun. In fact it is a "fulcrum" for the Earth-Moon system; the rotation of the two masses is about this point. Briefly, as with a lever, there is balance when the mass of Earth times its distance to their barycenter is equal to the lunar mass times its distance to said barycenter [31]. This theoretical point varies regarding its own placement in relation to the Earth and to the Earth's Moon. This occurs because even though the *center-points* of the Earth and the Moon are at some 384,405 km apart, the distance itself varies.

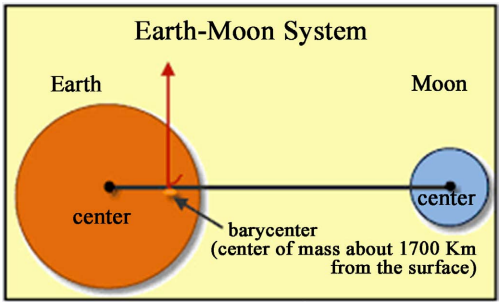

Figure 1. The tip of the arrow indicates the barycenter of the dual Earth-Moon system about 1700 km below the Earth's surface.

The Earth-Moon relationship varies in distance from thousands of kilometers from apogee to perigee. Even the distance referring to the barycenter is changing. At times it is cited as being 4727 km from the center of the Earth or 1650 km below the surface of the Earth, at other times, 4641 km and 1707 km respectively. There are even quotes of it being 1440 km below the Earth's surface.

In the ordinary case of the Earth-Moon interaction, the distance r_E from the geometric center of the Earth to the center of gravity is provided by

$$r_E = aM_M/(M_E + M_M) = 384000 \text{ km} \times 0.0123/(1+0.0123) = 4666 \text{ km}. \quad (11)$$

(*Mass of Earth*: 1; *Mass of Moon*: 0.0123; *Earth-Moon mean distance*, a: 384,000 *km*; *Radius of the Earth*, R_E: 6380 *km*).

The Allais eclipse effect referring to the weird motion on the paraconical pendulum relies on the unknown properties of gravity. It is the global Earth-Moon system which is disrupted with a repulsive gravitational force. During the antigravity phase, we assume that the masses remain reduced in the same proportions. We saw in paper [12] that the radius of the Earth seemed more along Δr_E, bringing the Earth-Moon distance to $a + \Delta r_E$. The center of gravity is farther from the Earth's geometric center:

$$\left[r_E + \Delta r_E = (a + \Delta R_E) M_M/(M_E + M_M)\right] > 4666 \text{ km}. \quad (12)$$

As the Earth turns on its axis, it undergoes the frictions of the barycenter and slows down. As the Earth loses some energy, the Moon gains this energy and its orbital period as well as its distance of the Earth increase. This secular acceleration imposed by the disturbing gravitational attraction of the eclipses of the Sun and that, in a lesser measure, of the Moon, transfers gradually the angular moment of the Earth towards the Moon.

But when we talk about the orbit of the Earth around the Sun in **Figure 2**, it is the movement of the barycenter of the Earth-Moon system that describes the elliptical orbit. The orbit of the center of the Earth is sinusoidal around this ellipse.

The real alignment is Sun-Moon-Earth at the time of the eclipses and it would be on the center of mass of this system that the disturbing gravitational attraction acts. On the whole we believe that the antigravity outrivals the overgravity

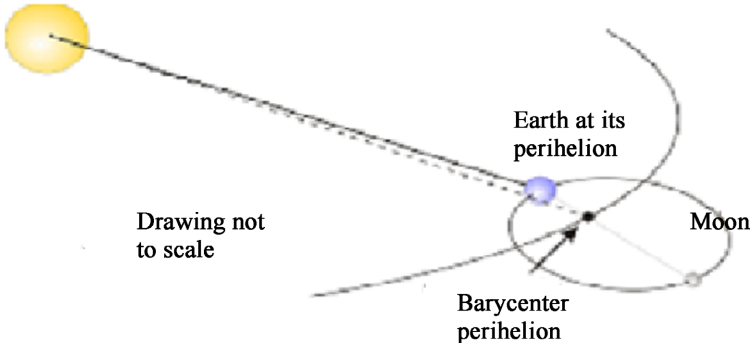

Figure 2. Drawing is not to scale for understanding. Earth is at its perihelion. The movement of the barycentre of the Earth-Moon system describes the elliptical orbit around the Sun. The orbit of the Earth's center is sinusoidal around this ellipse.

during eclipses. The perturbations of the barycenter imply the system Earth-Moon, and the secular acceleration transfers also gradually the angular moment of the Earth-Moon towards the Sun. Therefore, the resultant of the displacement of the Earth-Moon center of gravity outwards makes grow similarly the distance Earth-Moon and the distance Earth-Sun. In the long run, the Earth-Sun distance increases ($AU + \Delta R_E$).

Here are the possible effects on each of the implicated bodies:

Earth: Our hypothesis suggests that the perturbation of the eclipse touches the barycenter near the fluid motions in the core of the Earth, which are responsible for its magnetic field, and are coupled electromagnetically or possibly topographically with the surrounding mantle. The rotation of the mantle is disturbed and such disturbances would then be communicated to the Earth`s surface [32]. These fluctuations on the barycenter would alter the planet`s moment of inertia and so affect its rate of rotation [33].

Sun: It seems incredible to think that the perturbation of the eclipse on the barycenter of the system Earth-Moon can have an impact on the dynamics of the Sun. If, during a total eclipse, a gravitational force of repulsion showed itself next to the gravitational strength of attraction, it is the action of the Sun on the Earth which would be perceptible, the Sun having a mass approximately 333,432 times stronger. It is perceive by the rough disturbance recorded in the movement of the paraconical pendulum. The action of the Earth on the Sun would be perceptible with difficulty, even if both celestial bodies are subjected to a force of the same intensity. In the ordinary case of the Earth-Sun interaction, the distance r_S from the Sun geometric center to its center of gravity is provided by

$$r_S = aM_E/(M_E + M_S) = 151000000\ \text{km} \times 1/(1 + 333000) = 450\,. \qquad (13)$$

(*Mass of Earth*: 1; *Mass of the Sun*: 333,000; *Earth-Sun mean distance*, a: 151,000,000 *km*).

However, we have already shown [12] that this action could appear under the shape of a long time reported residual arc never explained. The observations gave a deviation about 10% larger than the theoretical value of General Relativity. It does not mean an overgravitation but, on a contrary, an antigravitation. The deflexion of light rays that pass near the Sun is not a pure gravitational phenomenon, it is an interaction between electromagnetic phenomena and gravitation, and it is due to the fact that an electromagnetic field possesses energy and momentum, hence also mass [34]. In a way, we can say that, since the Sun loses some gravitational energy and slows down, the Earth-Moon system gains this energy in turn. Effects of the gravitational and radiative mass loss by the Sun-(Earth-Moon) system due to the Allais eclipse effect would explain the secular increase of UA. The center of gravity during the antigravity is slightly farther from the Sun's geometric center:

$$\left[r_S + \Delta r_S = (a + \Delta R_E) M_E/(M_E + M_S) = (151000000 + \Delta R_E) \times 1/(1 + 333000)\right] > 450\,. \qquad (14)$$

Moon: If our hypothesis of a kind of antigravity of the whole system Sun-

Moon-Earth at the time of the eclipses is right, the lunar gravity should decrease when pendulums on Earth register a decrease of gravity during eclipse. At the same moment, radio signal from the Moon should be longer, the intervals longer between the pulsations (contrary to the Pioneer effect), indicating less gravity on Moon. The same result could be obtained by using the ongoing Lunar Laser using laser ranging which measures the distance between the Earth and the Moon. Lasers on Earth are aimed at retroflectors previously planted on the Moon, and the time delay for the reflected light to return is determined. Since the speed of light is known with very high accuracy, the time delay should be shorter [12] [35] [36] [37].

3.2. Another Elementary Calculation Showing the Allais Effects for a Self-Gravitating System

Consider a self-gravitating system (Earth-Sun where Earth and Moon form a single system) of two bodies, M and m orbiting around a barycenter C as shown in Figure 3.

Then, the distances to the center of mass D and d are

$$D = \frac{mR}{m+M}, \quad d = \frac{MR}{m+M} \tag{15}$$

For the minor mass m:

$$m\omega^2 d = G\frac{mM}{R^2}; \quad m\omega^2 \frac{MR}{m+M} = G\frac{mM}{R^2}$$

Obviously:

$$R^2 = G\frac{m+M}{\omega^2},$$

derivative with respect to time, then

$$3R^2 \frac{\mathrm{d}R}{\mathrm{d}t} = -2G\frac{m+M}{\omega^3}\frac{\mathrm{d}\omega}{\mathrm{d}t}.$$

Using Kepler's third law here, we get

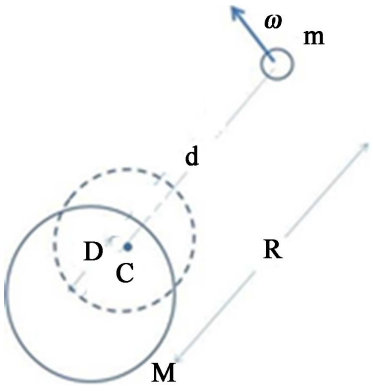

Figure 3. M: Sun; m: Earth-Moon system; ω: angular velocity; C: barycenter (far from the center of the Sun to facilitate understanding); D: distance from the Sun to the barycenter; d: distance from the Earth-Moon system to the barycenter; R: Earth-Sun distance.

$$\frac{\mathrm{d}R}{\mathrm{d}t} = -\frac{2R\mathrm{d}\omega}{3\omega\mathrm{d}t}. \tag{16}$$

We suggested above that fluctuations on the barycenter during solar eclipses alter the Earth's moment of inertia and affect its rate of rotation. Then, it is clear that a decrease in angular velocity (ω negative due to the antigravitational aspect of the Allais eclipse effect) implies $\mathrm{d}R/\mathrm{d}t > 0$) and consequently an elongation of R.

3.3. Discussion

The Allais eclipse effect could reveal that antigravity mechanisms would be likely to produce "cosmological leaps" and "leaps of cosmological second" (different from the *intercalary second* filling the split between the Earth's rotation second and the atomic clock second) and be so the main cause of the deceleration in the Earth's spin rate and, simultaneously, of the receding of the Moon.

The theory of Relation implies that our Universe is made of two complementary and interpenetrated structures, one for condensation the other for expansion. The first represents the positive solution of Dirac's equation of energy while the structure of expansion expresses its negative energy solution. The principle of Compensation allows the conversion of the two structures in each other. Since the Big Bang, the electromagnetic structure of expansion is decreasing giving up its energy to the positive gravitational increasing structure of condensation. A perpetual annihilation of the negative energy-mass is transformed into a continual creation of positive energy-mass. In fact, this complexity explains the physics of the expansion of the Universe which is compensated with the gravitational attraction of the particles which constitute it [38].

In the theory of the Relation, we associate the attractive force of gravity with the structure of the condensation, and the repulsive gravity with the structure of the expansion. The structure of condensation is related to the system of gravitation, with the inertial forces inherent to the gravity. The structure of the expansion is associated with the inertial system, itself linked to electromagnetism. There would be an electromagnetic current parallel to the gravity and, in virtue of the principle of compensation, the addition of gravity will cause an attenuation of electromagnetism, and *vice versa*.

During the eclipses and, the syzygies, to a lesser measure, there would be a kind of macroscopic spontaneous broken symmetry. A split in the geometry of spacetime. These phenomena are often accompanied by an alternation of *overgravity* and of *antigravity*. One can not help but assimilate this contradictory behavior to a particle (boson or hadron) which, confronted with Young's double slit experiment, reveals its wave-corpuscle duality, becomes both energy and ponderable mass. We may suppose, in the antigravity phase, a change of charge, parity and time. The charge, which is the mass, seems lighter, the direction stopped or reverse like if time was going backward.

Thus, the effect of Allais eclipse constitutes an abrupt passage towards quan-

tum gravity with spontaneous broken symmetry of spacetime, which interrupts the cosmological time and induces a decrease of mass. A sort of violation of CPT invariance at the macroscopic level, although this kind of violation has never been observed in particle physics. Quantum leaps of antigravity or overgravity which would break the Keplerian-Newtonian laws, would make variable the Einsteinian geometry of spacetime, and would affect electromagnetism associated with gravity. Leaps associated with the "macroscopic Casimir effect".

3.4. Overgravity and Antigravity: Cosmologic Casimir Effect

The Earth and the Moon describe elliptic trajectories around their common center of gravity. Accordingly to the Newton's interpretation of Kepler's third law, the Earth goes through a near elliptic trajectory around the Sun. It is the center of gravity of the Earth-Moon which covers the ellipse called Earth orbit. The revolving motion is governed by the Earth-Sun attraction which attract each other with a force of gravity, set out by Newton in 1687, which counteracts the centrifugal force

$$\frac{GM_S M_E}{R_{S-E}^2} = \frac{M_E v^2}{R_{S-E}} \tag{17}$$

As shown in Figure 4, due to the elliptical nature of the Moon's orbit, the barycenter is not always in the same place. To complicate things further, the Earth follows a wobbly path around the Sun.

During a syzygy, the center of gravity of the Earth-Moon system is shifted about 4500 km from the center of Earth. Therefore, the distance of the Earth from the Sun changes of about ±4500 km and the distance of the Moon from the Sun of about ±300,000 km. Gravitational force between the Sun and the Earth-Moon system during new Moon or full Moon, when Sun and Moon are in conjunction or opposition, is

$$F_{S-E} = \frac{GM_S\left(M_E + M_M\right)}{\left(R_{S-E} \pm 4500\ \text{km}\right)^2} = \frac{\left(M_E + M_M\right)v^2}{R_{S-E} \pm 4500\ \text{km}}. \tag{18}$$

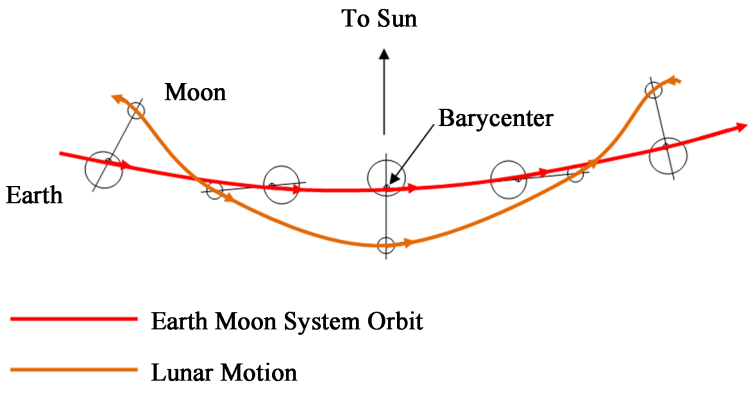

Figure 4. (Ed Oberg) The center of gravity of the Earth-Moon system wobbles due to the elliptical nature of the Moon's orbit. The Earth follows an oscillating elliptical orbit around the Sun.

In classic theory, when the Moon goes between Sun and Earth there is supposed to have no change. However, when it occurs, the behavior of matter seems radically different from the one associated with the classic concepts. Eclipse provides an "entanglement" of the Earth-Moon-Sun, which separates it from the environment of the rest of the solar system. In quantum terms, gravity is "coherent" and therefore becomes quantum gravity. It could be due to the existence of certain types of dark energy which violate the principle of equivalence, according to which the result of a local and not gravitational experiment is independent from the referential, from the place and from the time when it is realized. Violation of this principle would exert a variation of the time indicated by the pendulums and also, notably, by the atomic clocks based on the moment of measurement.

During the eclipses of the Sun, the pendulum indicates frequently successively an *overgravity* and an *antigravity*. Although this alternation is current, the intensity of the oscillations often differs from one time to another. Difference largely attributable to the variety of places where meet the centers; it practically never happens that the line of centrality of the Earth is completely on the Sun-Moon centerline; it would require that the total eclipse occurs at the observer's local noon, and simultaneously that his latitude is equal to the Sun's current declination. Depending on the quality of the eclipse, the quantum mechanics would then apply to the total system globally constituted by the Moon and its environment, on the line uniting the Earth with the Sun [39]. These last two would look like "cosmological plates" between which would rush the Moon. The three celestial bodies would behave like "wave functions" and we can speculate a scenario with a "quantum coherence" which manifests itself in a phase of overgravity and a phase of antigravity, or *vice versa* [40] [41].

Overgravity phase. When the Moon arrives, it pushes out the minimal energy (considered as a negative energy) of the vacuum between Sun and Earth. The void so created induces a surplus of gravity causing an anomalous precession of the plane of oscillation of the paraconical pendulum. The Moon acts suddenly as wave function, and is affected both by this volatilized dark energy and by the *gravitons* of the radiation between Earth and Sun which hit it harder, and reciprocally. Even though, gravitons and gravitational waves have not been observed, it has been believed that gravitation should also possess the wave-particle duality. Notice that the gravitational interference occurs at the point of arrival on Earth (recorded by the Allais pendulum) because the "wave functions" of the *gravitons* of the "macroscopic Casimir environment" interfere constructively to allow it. This quantum coherence ensures that the minimum dark energy (negative energy in the theory of the Relation) is decreased, what strengthens the gravitational wave, or the gravitons, between Earth and Sun.

The Moon, by interfering, pushes away the environmental minimal energy. We assist at the cosmological equivalent of a Casimir effect which produces a force attraction between the plates when the structure of the quantum vacuum in the perturbed space between them is forced to adopt longer wavelengths [42] [43]. Under the principle of Compensation, there is less electromagnetic energy

and more gravity. This phase tends to illustrate the profound significance of this principle alleging that, when there is reduced energy in the structure of the expansion which follows the direction of the cosmological arrow of time, there are proportionately increase of the attractive mass-energy into the structure of the condensation [38]. The plates of the Casimir experiment, represented by the Sun and the Earth, are merely an image to indicate that the Allais eclipse effect, like the Casimir forces, with their respective magnitude, verify the reality of a sea of energy in the vacuum.

In other words, we can say that when arises a solar eclipse there is a cosmological spontaneous broken symmetry along the alignment of the three celestial bodies in the same gravitational system, a Newton's violation of Kepler's Laws creating an inequality between the gravitational force before the eclipse and the one during the eclipse (without affecting the equality between the gravity and the inertial forces that are inherent). During the overgravity phase we have roughly in classic terms

$$F_{S-E} = \underbrace{\left\{ \frac{GM_S\left(M_E+M_M\right)}{\left(R_{S-E}-4500\text{ km}\right)^2} = \frac{\left(M_E+M_M\right)v^2}{R_{S-E}-4500\text{ km}} \right\}}_{\text{(during eclipse)}} > \underbrace{\left\{ \frac{GM_SM_E}{R_{S-E}^2} = \frac{M_Ev^2}{R_{S-E}} \right\}}_{\text{(before eclipse)}} \quad (19)$$

Antigravity phase. On the other hand, we often observed a spontaneous reversal of the plane of oscillation of the pendulum: as if a sort of tunnel effect allowed a body to pass suddenly from one state to another by quantum leap. The Moon seems suddenly invested with a repulsive "negative energy". It exhibits some "wave-like" properties while the moment before, deprived of this energy, it showed some attractive "particle-like" properties. Duality which can evoke the wave-particle of the atom crossing a leaky screen of two slits.

The Moon on the line between the Sun and the Earth acts as a negative energy which repulses them. It behaves like an energy (the electromagnetic energy of the vacuum) introduced between the plates of a macroscopic Casimir apparatus: if one adds energy instead of removing some, the effect is a repulsion rather than an attraction. Under the principle of Compensation, when there is an additional electromagnetic energy in the structure of expansion—what is equivalent going towards the past against the arrow of cosmological time—there is more electromagnetic negative energy-mass, more quantum gravity and, conversely, less classic gravitational energy-mass: an antigravity. This time, the force of the system of three planets during eclipse would be gravitationally lower than the same system without eclipse

$$F_{S-E} = \underbrace{\left\{ \frac{GM_S\left(M_E+M_M\right)}{\left(R_{S-E}-4500\text{ km}\right)^2} = \frac{\left(M_E+M_M\right)v^2}{R_{S-E}-4500\text{ km}} \right\}}_{\text{(during eclipse)}} < \underbrace{\left\{ \frac{GM_SM_E}{R_{S-E}^2} = \frac{M_Ev^2}{R_{S-E}} \right\}}_{\text{(before eclipse)}} \quad (20)$$

In quantum term, we could say that the wave function of the Sun-Moon-Earth gravitational system with its antigravity phase during the eclipse differs mathematically from the wave function of the same system without eclipse, or still that its mathematical function is different from the same system with eclipse at the

moment of its overgravity phase.

Same approach during a lunar eclipse for the force of gravity between the Sun and the Earth-Moon system, except that the distance Sun-Earth will be $\left(R_{S-E}+4500\text{ km}\right)$.

During the solar eclipse, there is thus a spontaneous cosmological broken symmetry on the line between the Sun and the Earth-Moon system, so that there would be not only violation of Newtonian Kepler's laws, but also of the charge-parity-time invariance (CPT). This overgravity-antigravity oscillation, even if it does not last long, shows that a body in eclipse condition can have a wave-particle duality or even a behavior which reminds at the same time an electron which follows the arrow of cosmological time and a positron which goes back. Then the Moon continues on its orbit, and loses gradually of its quantum behavior, of its large-scale wave function which allowed her in this eclipse environment to act as a massive particle or as a wave of energy. As a result of the destructive interferences of *bosons* which come back and recover their state of minimal energy behind the Moon—the micro-interferences of these bosons kill the macro-interferences, the movement of the Moon becomes classic again. There is "decoherence" of this three-body system which takes back its classic behavior of macroscopic objects.

But this decoherence is closely associated with the existence of energy dissipation or, if you will, to a disturbance almost insensible on the barycenter of the system at each eclipse. These alterations, in accumulating constantly, form secular disturbances that ultimately disrupt the ellipticity of the orbits and change their positions. This coherence in two phases and this decoherence were seized for the first time by the paraconic pendulum of Professor Maurice Allais in 1954.

4. Conclusions

No one knows why the Moon's actual orbit is off its calculated course by about 3.8 cm a year and why the AU grows by about 7 cm a year. Our explanation is that both anomalies are due to eclipses. We have showed in this paper that the Allais eclipse effect causes not only the recession of the Moon from the Earth but also that of the Earth from the Sun. The disturbance caused by this effect on the barycenter of the Earth affects the Earth's rotation speed, takes away the Moon from the Earth and, at the same time, the Earth-moon system from the Sun, since it is the center of gravity of this system which describes an ellipse around the Sun.

Some will argue that oceanic tidal effect is still the best hypothesis to clarify the slowing down of the Earth and the recession of the Moon. One thing is sure, unlike the Moon's drift from Earth, the enigma of the growth of the UA cannot be resolved by tidal effects [3], but both phenomena can be explained by the Allais eclipse effect. Although none of the experiments to verify this last one satisfies completely, we have the certainty that there is something which perturbs the gravitation. Some "small abnormal facts", impossible to solve within the frame-

work of the "classic" conceptions, which predispose to postulate a gravitational force of repulsion manifested during eclipses, and not so much tidal friction, as being the main cause of these two secular inequalities.

Other experiments and fewer preconceptions will tell if the Allais effect is real. In the event, a modification of the conceptual field will shake the certainty of the dominant ideas while driving to the emergence of a potential major breakthrough in the fundamental laws of the Universe. Gravity will not be anymore regarded simply like a distortion of the metric of spacetime or an attractive gravitational force. The antigravity element would have propelled it to the rank of other fundamental forces that have both attributes, and it would become therefore possible to describe gravity in the framework of quantum field theory.

Conflicts of Interest

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

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