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Could Electricity be a Gravitational Effect?

Halley's comet, Elenin's comet, Bohr's atom, a free digression throughout gravitation

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ABSTRACT

Although electricity and electrical forces have for a long time been used by mankind as natural resources, it is interesting to notice that in fact no one knows exactly what they are. Some curious-minded people have asked themselves if electric forces could result from gravitational interaction between subatomic particles. The usual argument to avoid such an hypothesis is based on the computation of the gravitational force by means of Newton's equation, to verify that the force between a proton and an electron is nearly 10^{40} times weaker than the electrical force computed by Coulomb's equation. In this article we ponder on such an argument, since we have the impression that Newton's gravitational force does not hold at very small distances, and probably also not in highly eccentric orbits. By analysing the cases of Halley's and Elenin's comets (Elenin is now very close to Earth), and proposing the use of an orbital constant (G_0) alongside the universal constant (G), we will later question if the gravitational force in Bohr's atom could perhaps turn out to be of the same magnitude as that of the electrical force obtained by Coulomb's equation. And this naturally leads us to wonder whether electricity could result from some kind of gravitational effect propagating through certain types of materials, like a pressure wave, for example. If in fact gravitational forces would be much stronger at very small distances than what is usually accepted, the need for a "dark matter" concept to justify the overall cohesion of our universe would perhaps be unnecessary too.

1. Introduction

"*Either we have failed to see 99% of the universe, or we are wrong about how the universe began*" (Stephen Hawking). When reading this remark for the first time from Hawking, we could not avoid thinking that we have probably failed to see even more than that. Many standard theories are simply crowded with little contradictions, little things people do not want to talk about, and little excuses. But, even so, it is interesting to notice that they are frequently presented as the ultimate models, the very truth of the moment, and the direction to follow. It has forever been confusing to us, that "standard model" scientists insist so much upon the hypothesis of there being "dark matter" crowding the universe, yet they apparently refuse to question the models we use for gravitational force. In order to sustain itself, either the universe needs more mass, hence we have to invent the idea of "dark matter" coexisting, or could it simply be that the forces between masses are much stronger than what has been suggested, thus accounting for this "dark matter"? This case, amongst many others, needs to be considered. Another example is the apparent eternal search for the "graviton", where here it seems that the more negative the results become, the more the scientists seem to believe it is just very difficult to detect it. Couldn't we simply advance in parallel with some other hypothesis?

Maybe our thoughts on these matters will be seen as marginal to those who seriously protect the standard models, but we still believe it is preferable to question any aspects that may seem relevant. Such work we started in the article[1] concerning the

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[1] J. Manuel Feliz-Teixeira, "*Deducing Kepler and Newton from Avicenna* (ابن سينا)*, Huygens and Descartes*", first published at http://www.fe.up.pt/~feliz, and YouTube, April 2010

derivation of gravitational forces based on two basic premises: the general validity of the law of conservation of angular momentum; and the fact that bodies fall into their centre of mass. From these, we could deduce that, since *area speed* ($\underline{A} = \underline{r} \times \underline{v}$) is a true *constant for any orbit*, more appropriate than using Newton's universal gravitational constant (G) would perhaps be to express the gravitational force in terms of an <u>orbital constant</u> (G_0) given by:

$$G_0 = A^2 / (M+m) \tag{1}$$

Here, ($M+m$) is the total mass involved in the process. In this way, a general expression for the gravitational force between masses M and m would be:

$$F_{feliz} = m \cdot M \cdot G_0 / r^3 \tag{2}$$

Since Newton's force is given by:

$$F_{newton} = m \cdot M \cdot G / r^2 \tag{3}$$

Therefore, for nearly circular orbits we have:

$$G = G_0 / r \tag{4}$$

What does this mean? It means that gravitational forces may be viewed as depending on $1/r^3$ along the trajectory of a certain and specific orbit, no matter its shape; and it means that Newton's universal constant (G) should perhaps be used only for nearly circular orbits, as we will see. In other words, F_{feliz} seems to hold for any situation of motion, while F_{newton} seems to make more sense for nearly circular orbits. We will address this issue by comparing data from the most important planets of our solar system along with Halley's and Elenin's comets.

2. Our planets and Halley's comet

In the following tables we present relevant data about the principal planets of our solar system, most of which orbit the Sun with almost circular orbits (maximum eccentricity is 0,2 for both Mercury and Pluto), and Halley's comet, which orbits the Sun along an ellipse of 0,97 eccentricity, out of the *ecliptic plane* (inclination=162º). Due to the obvious differences in the orbital characteristics, we have chosen this data in order to test the two different

concepts of gravitational force previously referred to. Notice that in the case of Halley's comet three rows are presented, in order to distinguish the *perihelion*, the *aphelion*, and the *average* orbit computed by an average radius and the time for an entire circulation around the Sun. This average radius is given by $(89+5267)/2 = 2678$ (units of table 1); and the average velocity was computed based on the fact that its period is around 74 years (i.e. 2397 x 10^6 s):

$$v = 2\pi \cdot r / T \tag{5}$$

The Sun's mass was considered to be 1989100000 x 10^{21} kg, and $G = 6,67$ x 10^{-11} SI.

	m x 10e+21 kg	r x 10e+9 m	v x 10e+3 m/s	ω=v/r x 10e-9 rad/s
Mercury	330	58	47.9	825.9
Venus	4869	108	35.0	324.1
Earth	5974	150	29.8	198.7
Mars	642	228	24.1	105.7
Jupiter	1898600	778	13.1	16.8
Saturn	568460	1429	9.6	6.7
Uranus	86832	2871	6.8	2.4
Neptune	102430	4504	5.4	1.2
Pluto	13	5913	4.7	0.8
Halley (perihelion)	0	89	54.6	616.9
Halley (aphelion)	0	5267	0.9	0.2
Halley (average)	0	2678	7.0	2.6

Table 1 Some basic astronomical data for the planets of our solar system and Halley's comet. The International System of Units (*SI*) is used. From left to right: mass (m), average distance to Sun (r), orbital velocity (v), and angular speed (ω). Although Halley's comet mass appears null in this table, in all calculations we have used an approximate mass of 10^{14} kg.

	r x v x 10e12	G0 x 10e+3	[G = G0/r] x 10e-6	[v2/r] x 10e-3
Mercury	2778	0.004	6.6902497566133E-005	39.5588
Venus	3780	0.007	6.6512330292454E-005	11.3426
Earth	4470	0.010	6.6967774350864E-005	5.9203
Mars	5495	0.015	6.6575153219415E-005	2.5474
Jupiter	10192	0.052	6.7058098383394E-005	0.2206
Saturn	13718	0.095	6.6190243574550E-005	0.0645
Uranus	19523	0.192	6.6738346476245E-005	0.0161
Neptune	24322	0.297	6.6024773557109E-005	0.0065
Pluto	27791	0.388	0.000065667	0.0037
Halley (perihelion)	4832	0.012	0.0001326392	33.6854
Halley (aphelion)	4740	0.011	2.1446206827208E-006	0.0002
Halley (average)	18792	0.178	6.6306406189806E-005	0.0184

Table 2 Append to the previous table. From left to right: area speed ($r \times v$), Feliz's orbital constant (G_0), Newton's universal constant ($G=G_0/r$), and Huygens centrifugal acceleration (v^2/r). Notice the similarity between Halley's average orbit with Uranus orbit.

This data[2], and explicitly the data of Table 2, confirms that G can be computed by dividing the

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[2] Most of it collected from the Internet sources, mainly Wikipedia.

orbital constant G_0 by the mean orbital radius. The *average* Halley's orbit must obviously be considered a circular orbit too, therefore G can be found the same way. But in this case Halley is being modelled as if it were an asteroid following an orbit very similar to that of Uranus. And this is not the reality. If we consider a more realistic situation, and use Halley's *perihelion* and *aphelion*, such simplifications seem not to be valid.

A demonstration of this naturally arises if we calculate the <u>gravitational acceleration</u> expected at Halley's *aphelion* by Newton's model:

$$a_{a\text{-}newton} = 6,67 \times 10^{-11} . 1,99 \times 10^{30} / (5267 \times 10^9)^2$$
$$= 4,78 \times 10^{-6} \text{ m/s}^2 \tag{6}$$

and compare it with that calculated by Feliz's equation (using an average value for $G_0 = 11,5$ from Table 2):

$$a_{a\text{-}feliz} = 11,5 . 1,99 \times 10^{30} / (5267 \times 10^9)^3$$
$$= 0.000156624956 \times 10^{-3}$$
$$= 0,157 \times 10^{-6} \text{ m/s}^2 \tag{7}$$

The results are obviously different, and confirm that equation (7) leads to practically the same value of the *centrifugal acceleration*[3] acting upon Halley at its *aphelion*, as shown in Table 2. Newton's estimation is around 30 times larger than this, making us wonder if there could be a point somewhere in the orbit, *before its aphelion* where Newton's force would exactly match Huygens centrifugal force. And, if this is true, why doesn't the comet start to invert its motion from there? Could there be a force associated with movement itself, which keeps the comet moving in space for some more time? Of course all could be explained in terms of the exchange of kinetic and potential energies, but we would like to use the concept of force.

Let us now make the same calculations for Halley's *perihelion*. By Newton, we have:

$$a_{p\text{-}newton} = 6,67 \times 10^{-11} . 1,99 \times 10^{30} / (89 \times 10^9)^2$$
$$= 16,8 \; 10^{-3} \text{ m/s}^2 \tag{8}$$

Whilst by Feliz we will get:

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[3] The term *centrifugal* is usually demonized, but here you may find why we use it again: http://paginas.fe.up.pt/~feliz/e_paper30_in-defense-of-centrifugal-force-revised.pdf

$$a_{p\text{-}feliz} = 11,5 . 1,99 \times 10^{30} / (89 \times 10^9)^3$$
$$= 32,46 \times 10^{-3} \text{ m/s}^2 \tag{9}$$

Again, our equation gives practically the same result as that expected in Table 2 for the *centrifugal acceleration* at *perihelion*, which, in our opinion, means that the comet is in effect in a stationary orbit. Newton, on the other hand, expects less gravitational pull, meaning that Halley is at *perihelion* with an "excess" of *centrifugal acceleration*, which in effect is responsible for sending it away from the Sun again and in the direction of its external orbit: *aphelion* (r_a). This seems reasonable. In his demonstration of elliptical orbits, Newton considers a radial term for non-circular trajectories, but it seems there are some mysteries here, or at least two different ways of looking at things. By Newton, what moves the comet away from the Sun at *perihelion* is this "excess" of speed compared to that needed to maintain a circular orbit at *perihelion*. In our point of view, it may also be that the comet has a *centrifugal acceleration* exactly matching the *centripetal pull* from the Sun (thus, $1/r^3$ dependency), but it cannot stay in a circular orbit there otherwise the total energy of the system (of the entire orbit) would suddenly jump. This cannot occur, at least naturally, and the system has to continue oscillating between its two extreme states: *aphelion* and *perihelion*. It's as if the comet is continuously jumping from one circular orbit into another, butt always being in orbit in each of these orbits:
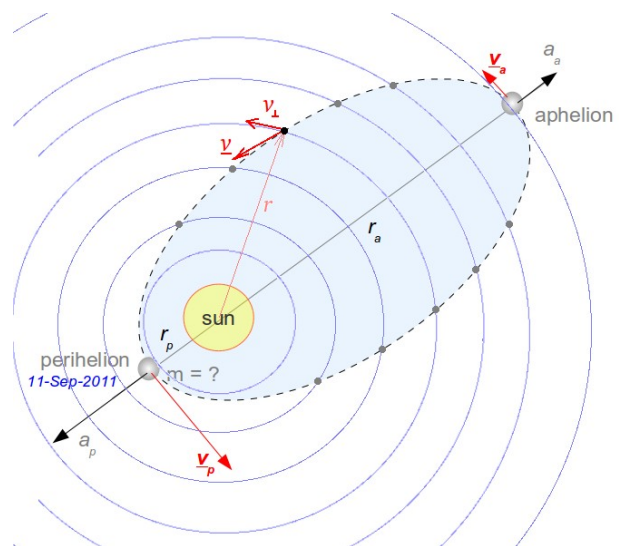

Fig. 1 Ellipse as a continuous jump into different circular orbits.

Thus, we may consider that at each point of the trajectory the gravitational *centripetal pull* is always balancing the comet's *centrifugal push*, so we may really think of a *1/r³* dependency for gravitational forces[4]. Notice that the *centrifugal push* is only dependent on the *perpendicular* component of the *velocity*, and not on its *radial* component. In other words, the *gravitational pull* needed to maintain the object in each circular orbit, and therefore throughout the whole trajectory, is only that which compensates such a *centrifugal push*. If we consider the fact that *area speed* is conserved along the whole trajectory, no matter its shape, that is:

$$r_a . v_a = r_p . v_p = r . v_\perp = const = A \qquad (10)$$

then we can represent the centrifugal acceleration[5] at *aphelion* in terms of the acceleration at *perihelion* as:

$$a_a = v_a^2 / r_a = (r_p/r_a)^3 . a_p \qquad (11)$$

Also, for a generic position (r) in the generic orbit, we may in fact expect a cubic dependency:

$$a(r) = (r_p/r)^3 . a_p = r_p^3 . a_p / r^3 \qquad (12)$$

$$a(r) = A^2 / r^3 \qquad (13)$$

Of course there is a mechanism of angular acceleration and deceleration along any non-circular orbit, but it's possible that this could be the result of a mix of *centrifugal* and *Coriolis* effects. *Centrifugal* produced by changing $v_\perp$, and *Coriolis* produced by changing r.

Interestingly, for long distances the gravitational pull from Newton's model seems to be larger than what we propose, while for "short" distances it seems to be lower than that. The two models agree at a distance equal to the average radius of the elliptical orbit. That is, when r = *semi-major-axis*, a

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[4] If we use only the concepts of energy (E) and angular momentum (L), knowing that L will be conserved in all circular orbits: thus, $v_\perp = L /(m.r)$. And $E_\perp = \frac{1}{2} m.v_\perp^2 = \{L^2/(2.m)\}.1 / r^2 = const1 / r^2$. This is the energy of the orbit at radius r.

[5] We mean Huygens centrifugal acceleration projected into the position vector (radial component).

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condition always true for circular orbits. In that case, G can again be computed from dividing G_0 by r, as Table 2 shows.
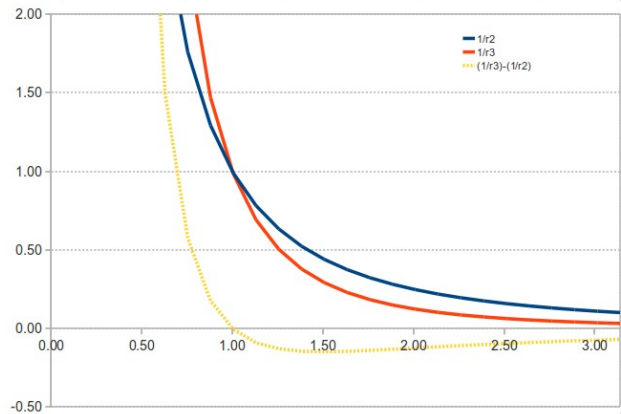

Fig. 2 Comparing the mathematical functions $1/r^2$ and $1/r^3$ and the difference between them. Only at $r = 1$, which corresponds to the case of circular orbits, the two functions coincide. For long distances, $1/r^3$ will be smaller than $1/r^2$, but the difference tends to zero; while for very small distances $1/r^3$ gets much larger than $1/r^2$, and the difference tends to infinity.

3. What do G and G_0 actually mean?

There are many ways for interpreting the meaning of physical constants, depending on the physical quantities we want to enhance. For example, G is usually presented with dimensions [$m^3.kg^{-1}.s^{-2}$], but may also be seen as an *energy per unit of mass* times a *distance per unit of mass*, that is, a *specific energy* times a *specific distance*. In that way, the constant G_0 would be seen as a *specific energy* times a *specific area*, since we can say that $G_0 = G.r$. We prefer, however, to look at the constant G_0 as a sort of a *gravitational index* which gives us the idea of how much a certain orbit is bounded to the gravitational system. It does not depend on the distance, as we can deduce from comparing the data of Halley's *perihelion* and *aphelion*, which have the same value for G_0, but instead on the power of the angular momentum and the total mass involved in the motion. In that sense, we can say that a low value of G_0 means a low degree of freedom within the gravitational system, or highly bounded[6]. By inspecting Table 2 again, not only can we deduce that the planet most bounded to the system is Mercury ($G_0 = 4$), as we would expect, but that Halley's comet ($G_0 = 11$) is only slightly less

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[6] Thus, G_0 means the level of freedom.

bounded than our Earth (G_0 = 10). The least bounded to our solar system is obviously Pluto (G_0 = 388). Such a result means that it would be much easier to force any of the outer planets out of the solar system than Halley itself. In this way, G is simply the linear density of G_0.

4. The surprising visit of comet Elenin

When no one was expecting it, a little known Russian amateur astronomer, named Leonid Elenin, recently discovered in the skies a new visitor to the core of our solar system: the comet C/2010 X1. This happened on the 10th of December 2010, and, on that date, a certain eccentricity (e) was computed for its orbit; which was expected to be either parabolic ($e=1$) or hyperbolic ($e>1$), meaning that this asteroid would be an occasional visitor, not some body bounded to us. Analysing data obtained by means of simulation prior to the discovery of the comet, some people have published their calculations on the Internet. There is a case of a chart showing a sudden change on Elenin's orbit eccentricity (previously estimated by NASA to be $e=1.000064048145741$) which after the *perihelion,* transformed this interesting celestial visitor into something that is bounded to our solar system, now describing an ellipse... The new eccentricity is said to be near $e=0,999$, therefore the question of the possibility of Elenin being on a return journey to its star arises. Some information is already published in Wikipedia about the event, although most of it seems to be the result of some speculation. The *aphelion* is a rough estimation of ~1037 AU; and the *perihelion* is said to have happened on the 10-Sep-2011, but NASA's dynamic chart obviously shows it occurred precisely on 11-September-2011; mysteriously, since this was the 10th anniversary of the strange 11-September-2001 New York's World Trade Centre attacks that shook our world.

The most accurate data (as it was measured), however, seems to be the *perihelion* distance (r_p), the three-dimensional velocity (v_x, v_y, v_z), and the actual eccentricity (e). To this day, no one seems to have been able to estimate the real mass of Elenin, which is fast approaching Earth[7], and is believed to be around 3-4 Km in diameter. Some people, however, are also relating this visit to the surprising high

number of catastrophes of the recent times, including the abnormally strong earthquakes, tornadoes, floods, etc., thus suspecting the comet to have a mass of the order of a planet or more[8]. A scientist who seems to agree with such a perspective is Mr Mensur Omerbashich, as described in his recent article on the "*Astronomical alignments as the cause of ~M6+ seismicity*"[9]. We notice, curiously, at the time when this important event is taking place, no one seems to know what to say. Perhaps fascination is more powerful than science, making us simply astonished. In the scope of this article, however, what matters is to verify if the observed Huygens acceleration of Elenin at its *perihelion* and *aphelion* matches (or not) the gravitational pull imposed by the Sun. That was the condition Newton used in order to deduce his gravitational force equation. Starting with the known parameters[10]:

r_p = 0,482430958137433 UA = 72,4 x 10^9 m
v_{px} = 48027,11773370915 m/s
v_{py} = 36972,12924493306 m/s
v_{pz} = 1874,218585052105 m/s

and that

e = 0,999
From http://en.wikipedia.org/wiki/File:Elenin_Ecc2011-03-25.gif

We compute the speed at *perihelion*:

$$v_p = \sqrt{\{v_{px}{}^2 + v_{px}{}^2 + v_{px}{}^2\}}$$
$$= 60,6387 \times 10^3 \text{ m/s} \tag{14}$$

Therefore the orbital constant G_0 for Elenin is:

$$G_0 = (r_p . v_p)^2 / (M+m)$$
$$= 0.0096809 \times 10^3 \text{ S.I.} \tag{15}$$

By our previous considerations, this means that Elenin ($G_0=9,7$) is not only more bounded to our solar system than Halley ($G_0=11,5$), for example, but, once again curiously, it is practically as bounded as our own Earth ($G_0=10,0$). It is not surprising then, that many people on the Internet, express the

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[7] This text was written before 16-Oct-2011, when Elenin was expected to be at the closest distance to the Earth, at near 0,2 AU from us.

[8] Video showing an example of a curious view on what is happening based on a challenging perspective: http://youtu.be/RnG8Pa0u-4U

[9] Ful text (pdf): http://lanl.arxiv.org/pdf/1104.2036

[10] Based on data from the source: http://ssd.jpl.nasa.gov/horizons.cgi?CGISESSID=f40a36e9863e959034348bb998f81273#results

feeling that this comet may be some sort of a biblical visitor. The real centrifugal acceleration of Elenin at *perihelion* will, nevertheless, be:

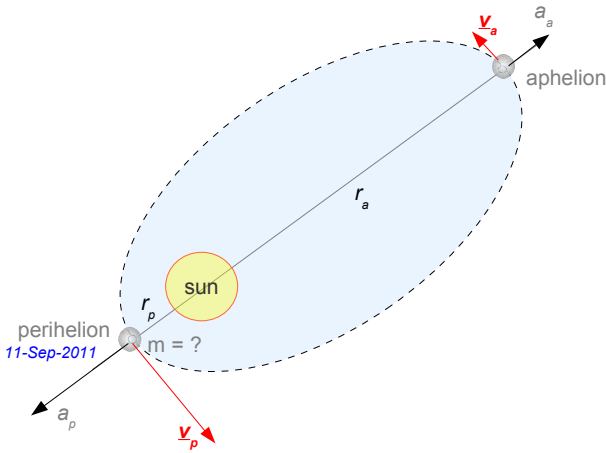$$a_p = v_p^2 / r_p = 50{,}7881 \times 10^{-3} \text{ m/s}^2 \qquad (16)$$

Fig. 3 A simplistic representation of a previously unexpected elliptical orbit for Elenin, showing the centrifugal acceleration (*a*) and the velocity (*v*) both at *perihelion* and *aphelion*. The real trajectory will be much more eccentric than the represented here, as r_a is suspected to be around 2000 times larger than r_p.

But let us compute the gravitational acceleration at *perihelion*, due to the Sun. By Newton's method we have:

$$a_{p\text{-newton}} = 6{,}67 \times 10^{-11} \cdot 1{,}99 \times 10^{30} / (72{,}4 \times 10^9)^2$$
$$= 25{,}3 \times 10^{-3} \text{ m/s}^2 \qquad (17)$$

Again, it is obviously not enough to keep Elenin in a circular orbit at that point, being only <u>half</u> of that required to do so. From the point of view of Newton, Elenin would stay in a circular orbit[11] at *perihelion* if it would have a speed $v_p = \sqrt{\{G.M/r_p\}} = 42{,}8 \times 10^3$ m/s, but in reality its speed is much higher: $v_p = 60{,}6 \times 10^3$ m/s. At that same point, the speed needed to escape from the Sun (*escape velocity*) will be $v_{esc} = \sqrt{\{2.G.M/r_p\}} = 60{,}528 \times 10^{-3}$ m/s, which suggests that Elenin is not bounded to the Sun.

Using our method, however, we get:

$$a_{p\text{-feliz}} = 0.0096809 \times 10^3 \cdot 1{,}99 \times 10^{30} / (72{,}4 \times 10^9)^3$$
$$= 50{,}76 \times 10^{-3} \text{ m/s}^2 \qquad (18)$$

which is the same as the centrifugal acceleration, of course, since G_0 was computed by means of the

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[11] Notice that Newton derives all his theory of gravitation from proposing a central force of the same magnitude of the Huygens force (centrifugal).

perihelion data. In order to do the same calculation for the *aphelion*, let us start by estimating r_a by means of the eccentricity relation:

$$(1 - e)/(1+e) = r_p/r_a \qquad (19)$$

Which leads to:

$$r_a = 1999 \cdot r_p \qquad (20)$$
$$= 144656{,}96 \times 10^9 \text{ m} = 964.38 \text{ AU}$$

Wikipedia presently gives an estimation of r_a of around ~1037 AU. In any case, these are really astronomical distances, around 24 times the distance to Pluto! Light would need 5,6 days to travel such a distance. It is therefore expectable that the influence of our Sun will be practically null there. The predictions are:

$$a_{a\text{-newton}} = 0{,}000006 \times 10^{-3} \text{ m/s}^2 \qquad (21)$$
$$a_{a\text{-feliz}} = 0{,}000000006 \times 10^{-3} \text{ m/s}^2 \qquad (22)$$

This suggests that Newton's gravitational acceleration at *perihelion* is roughly 1000 times stronger than the comet's centrifugal acceleration. Thereby, once again, making us wonder why... Would not a point much *before aphelion* where such a strong gravitational attraction would match Huygens force, make the trajectory start to deviate towards the Sun again? One also wonders if this may be due to the inertia of the motion, but, could it also be that this is tending towards the idea of a gravitational field that is dependent on $1/r^3$?

Elenin's orbital period:
In order to estimate the period of Elenin we must first imagine it travelling in a *circular orbit* with a radius given by the *average radius* of the real orbit. That is:

$$r_{avr} = (r_p + r_a) / 2 = 1000 \cdot r_p = 72400 \times 10^9 \text{ m}$$

Since we are now dealing with a circular orbit, we will use Newton's equation again. And, by imposing that the now *imaginary* centrifugal force equals the *imaginary* gravitational pull, we find the average orbital speed:

$$v_{avr} = \sqrt{\{G.M / r_{avr}\}} \qquad (23)$$

$v_{avr} = 1,3540047 \times 10^3$ m/s

Thus, we expect Elenin to have a period of:

$$T = 2\pi . r_{avr} / v_{avr} = 335970221566 \text{ s}$$
$$= 10645 \text{ yr} \tag{24}$$

If this is correct, the last time Elenin would have visited the Earth would have been around 8600 BC, when humans were in the early neolithic period of their collective history, and starting to develop agriculture and a sedentary civilization, in the way of a superior being based upon intellect.

5. Bohr's atom

The previous results make us wonder if the gravitational force between two masses, if in fact it exists, can be correctly estimated in all these cases by means of the equation proposed by Newton. It seems not. Perhaps either G is not a universal constant or there are other forces "adding" up to Newton's centripetal force. It makes us also wonder on the possibility of movement itself being the source of some kind of force, which may send comets into longer *aphelion* distances than those expected by Newton's gravitational force. Curiously, in our article on the Geometric Law of Motion[12] we have proposed that a kind of *Coriolis* acceleration may also exist in the case of non-circular orbits, which may also be responsible for part of the *acceleration* while moving into *perihelion* and the *deceleration* when heading to *aphelion*. Could such a non-gravitational interference justify what seem to be some deviations from Newton's expectations? Perhaps we will address this issue another time.

Nevertheless, we have verified in this article that considering gravitational forces to be dependent on $1/r^3$ could perhaps be an interesting possibility. So, we have decided also to test such an idea for very small distances in the atomic world. As Bohr's atom (Hydrogen) is such a classical academical example for atomic mechanics, we will make use of it here. In this instance, however, we will consider that the electron is describing a circular orbit around the proton, therefore Newton's universal constant should

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[12] J. Manuel Feliz-Teixeira, "*The Geometric Law of Motion*", first published at http://www.fe.up.pt/~feliz, and YouTube, 25 July 2011

also hold. Knowing the proton mass ($M=1,7\times10^{-27}$ kg), the electron mass ($m=9,1\times10^{-31}$ kg), and the radius of Bohr ($r=5,3\times10^{-11}$ m), the gravitational acceleration expected by Newton is:

$$a_{bohr-n} = 6,67\times10^{-11} . 1,7\times10^{-27} / (5\times10^{-11})^2$$
$$= 0,45\times10^{-16} \text{ m/s}^2 \tag{25}$$

This produces a centripetal force on the electron of the order of $4,1\times10^{-47}$ N. This is an extremely weak force, usually said not to be enough to explain the atomic robustness observed in nature. This is also the standard argument used for rejecting any hypothesis proposing that matter could perhaps be maintained in cohesion in the atomic world due to gravitational interactions, instead of electrical forces. In effect, for such an hypothesis to be valid it should be demonstrated that gravitational forces could be as strong as the actual electrical forces observed in practice, which are well predicted by means of the Coulomb equation, as we know:

$$F_{coulomb} = q_p . q_e . K_e / r^2 \tag{26}$$

where the electric constant $K_e = 8,99\times10^9$ SI, the proton electric charge $q_p = 1,6\times10^{-19}$ C and the electron charge $q_e = q_p$. The electrical force acting on the electron will therefore be:

$$F_{coulomb} = (1,6\times10^{-19})^2 . 8,99\times10^9 / (5\times10^{-11})^2$$
$$= 9,2\times10^{-8} \text{ N} \tag{27}$$

which in fact is $2,24\times10^{39}$ times (!) stronger than the gravitational force previously estimated by Newton. Coulomb's force, however, is computed based on the concept of *charge* and some other electrical parameters. It is not based on *masses* and the usual concepts of gravitation. It is another paradigm, thus another type of force.

Let us, nevertheless, try to apply our gravitational equation of force:

$$F_{feliz} = G_0 . m . M / r^3 \tag{28}$$

where G_0 in this case is given by:

$$G_0 = (r_b . v_b)^2 / (M+m) \tag{29}$$

r_b and v_b being Bohr's radius and electron speed respectively. Or, in terms of angular momentum:

$$G_0 = (L_b/\text{m})^2 /(M+m) \qquad (30)$$

But, since we now may use Bohr's proposal for the quantification of angular momentum in atomic physics, which must always be an integer (n) related to Planck's constant ($h = 6{,}62606957 \times 10^{-34}$ J.s):

$$L_b = n . h/(2\pi) \qquad (31)$$

Then we may generalise our G_0 expression for the subatomic world, for the nth electronic orbital:

$$G_{0\text{-}n} = \{n . h /(2\pi.m)\}^2 /(M+m) \qquad (32)$$

And now we may compute the gravitational force by means of equation (28), considering only masses and the usual gravitational concepts.

$$F_{feliz} = (1/4\pi^2) .\{(n.h/m)^2/(M+m)\} .m.M/r_n{}^3 \qquad (33)$$

Or, using the reduced mass ($\mu = m.M/(M+m)$):

$$F_{feliz} = (1/4\pi^2) . \{n . h /m\}^2 . \mu / r_n{}^3 \qquad (34)$$

This will give a gravitational force between the proton and Bohr's electron ($n=1$) of the order:

$$F_{feliz} = (1/4\pi^2) .(6{,}63 \times 10^{-34}/9{,}1 \times 10^{-31})^2 . 9{,}095 \times 10^{-31} /(5{,}3 \times 10^{-11})^3 = (1/4\pi^2) . (7{,}29 \times 10^{-4})^2 . 6{,}109$$

$$F_{feliz} = 8{,}22 \times 10^{-8} \text{ N} \qquad (35)$$

That is, <u>a gravitational force of the same order as Coulomb's electric force</u>. But this was expected, since this deduction is based on an indirect circular computation. Interesting would be to test it with elongated types of orbitals (*p-type*, for example). In any case, it is interesting to notice that Planck's constant lets us compute the force between an electron and a proton based on an equation involving gravitating *masses*, instead of gravitating *charges*. Could this mean something else? The first reaction is to ask ourselves if electricity could somehow be a kind of gravitational pressure which propagates in certain materials (conductors) through its valence electrons. The second reaction is to

wonder if all forces, including nuclear forces, could simply turn out to be different realisations, or states, of a single source of power: the gravitational interaction? It seems that, between protons ($2{,}3 \times 10^{-28}$ m), nuclear forces are also 10^{39} times stronger than gravitational forces. Then they seem to remain constant along a quark distance. Could it be that there is *another constant* similar to that of Planck's constant for the nuclear world? It would be nice to dedicate some time to these questions, if possible, in the future.

Notice that our gravitational force can also be expressed as a function of the angular speed (ω) of the electron (or orbiting mass, in general), and the mass relation $\eta = M/(M+m)$ and be written in a form that brings to mind harmonic motion, but with an *elastic constant* (κ) dependent upon r, if ω depends on r:

$$F_{feliz} = - m . \eta . \omega^2 . r \qquad (36)$$

$$F_{feliz} = - \kappa . r \qquad (37)$$

6. A naturally unstable universe?

So, in our perspective, for orbital motion to be perfectly "stable" it would be necessary that the *centripetal* force matches the *centrifugal* force in any point of the trajectory. This means that equation (36) must be equal to Huygens centrifugal force $m.v^2/r = m.\omega^2.r$ acting upon the orbiting mass. That is, for any position on the trajectory:

$$F_{feliz} + F_{centrifugal} = 0 \qquad (38)$$

$$m . \eta . \omega^2 . r = m . \omega^2 . r \qquad (39)$$

$$\eta = M/(M+m) = 1 \qquad (40)$$

Would this be the condition for ensuring an 100% stable orbit? It may eventually also be seen as the *probability* that mass m establishes an orbit around mass M. If that is true, it means our universe is naturally unstable, since $\eta = 1$ is not possible in practice. It also may explain why masses of the same order ($\eta=0{,}5$) are rarely observed rotating about each other. From equation (38) we should expect that their capacity of attraction is only half of that required for an orbit, therefore equal masses rotating

would tend to repel due to centrifugal forces, instead of attracting each other. A proton would repel a proton, an electron would repel an electron, galaxies would not easily collapse into each other... since they have a low probability of orbiting each other. Sufficiently stable systems seem to have $\eta > 0,95$, as is the case of electrons orbiting protons, for example, moons orbiting planets, planets orbiting stars, a star orbiting a galaxy, etc.

7. Curiosity about *G, h* and Avogadro's number

Another interesting exercise is to try to connect atomic mechanics with our world's macroscopic and planetary mechanics, by somehow comparing the two fundamental constants of these worlds: Planck's constant (h) in the atomic world, and the universal constant of gravitation (G) in the macroscopic world. From that we will find out that multiplying the minimum angular momentum allowed by Planck in the atomic world $L_0 = h/(2\pi)$ by Avogadro's number $Av = 6,022 \times 10^{23}$ mol^{-1} will result in a number very near Newton's universal constant of gravitation, even if not with the same units:

$$L_0 \cdot Av = 6,354 \times 10^{-11} \text{ S.I.} \tag{41}$$

While,

$$G = 6,67 \times 10^{-11} \text{ S.I.} \tag{42}$$

Could somehow Newton and Planck be talking about the same thing, but at very different spatial scales and units?

8. Conclusion

Sometimes a simple digression around a subject may result in some interesting questions and ideas. That was the aim of this article. It is not a publication of results in order to confirm a theory, or even the presentation of a complete theory; it is more a sequence of thoughts taken by the natural curiosity on these subjects that from now on will be open to discussion. We hope it may at least contribute for a better collective reasoning in what concerns the origins of all those forces we daily experiment and use, but we don't really know where they are coming from. A theory is a way to approach

an objective, therefore several theories can lead to the same objective, just as *all roads lead to Rome*. We like these questions, so we are even planning to question the so called *Big-Bang* in the next article dedicated to these matters.

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http://youtu.be/hZOekFFSoWI

clic-to-contribute

The Perfect Time for the Perfect Democracy?

Some thoughts on wiki-law, wiki-government, online platforms in the direction of a true direct democracy. KEYWORDS: electronic law and governance, people laws, direct democracy, obsolescence of parliament, democratic citizenship, wiki-sites.
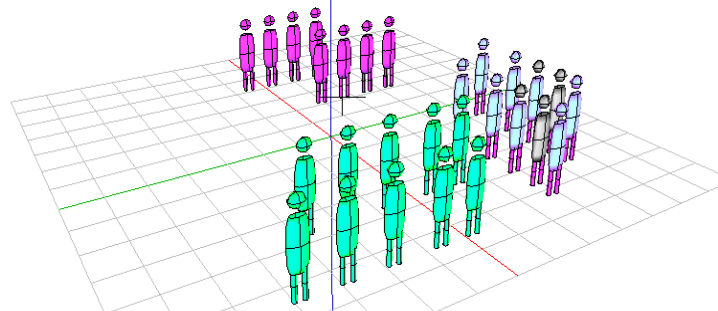
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11 March 2012

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1. Introduction

Due to its exceptional characteristics of intelligence and creativity, a modern human society should be an emergent system, not the result of the wish or dictatorship of some. Such a society should be for all those who may be interested in it. Not just for some. Although this may sound slightly utopian, these are the main lines of thought followed in the *wiki-system* of *law* and *governance* which draft we propose in the present text. Such a system, based on the continuous participation of free and well identified citizens in the proposal, the drawing, discussion and referendum of all the laws of their State (inspired by the excellent achievements reached from citizen's collaboration in *wikipedia.org* project) would probably extend the activity of "politician" to everyone of us. Would that be less damaging to our collective living than the present activity of professional "politicians"? More and more people seem to be convinced the answer is "yes", since in fact recent history obviously shows that many of our professional politicians have behaved as professional abusers and even criminals.

"We're at an incredible crossroads right now. They're demanding the right to wiretap the entire population. It's unprecedented. This is a technology that can be used to give everybody a voice. But it can also be used to build a Big Brother society so dystopian that if someone had written a book about it in the 1950s, it would have been discarded as unrealistic."[1] (The Guardian, 22Jan2012)

2. The need for a change

We will try to be concise, direct, and clear in exposing our views, in order to avoid spending too much time upon this subject, as there are so many other things we would like to write with respect to Physics. But the present issue is urgent, thus we feel almost a duty to address it: the establishment of a *Constitution* in a true democratic State should always result from a referendum agreed by its citizens. That should be the principle. Thus, theoretically, in any other case it is a non-supported *Constitution*, or, if we want, an incomplete or illegitimate law, since it was not completely legitimated.

On the other hand, we know that politics has been transformed into a kind of club for some. So, it is frequent in the so called democratic societies of our times that the destiny of those millions of citizens who own the State is left in the hands of just a few members of such a club, who may then almost freely decide in the name of the citizens even when they do not possess enough competencies, credibility, and knowledge of the subjects on which it has to decide. These subjects are often linked to technical issues, therefore the need for external advisers arises... and the external interference on the "democratic" process of decision softly starts. And this interference is usually not coming from the citizens' sphere. It is coming from the club, or from those who finance the club. Therefore it is, in its essence, the seed of an undemocratic interference.

But even surrounded by their external advisers, our politicians usually do not have arguments capable of confronting the power of arguing from those millions of citizens who own the State, as these are by themselves advisers, researchers, professors, technicians, workers, etc. These citizens are in effect a powerful sea of knowledge which is waiting to emerge and be established as the legitimate source of all the laws of the State. It is a fact that there are in general much more people with knowledge in the citizenship than in the governance; but at the moment legislation is still proposed, idealized and established in society by people who frequently are less skilled than many in that society. That is why certain laws seem so strange and nonsensical. The biased rationalism of certain lawmakers lately became so poor that it even lead the lawmaker's figure into darkness, for in many cases the logic of the law is a joke, and what matters is forcing it onto society, to impose it.

Some moralists have sometimes the courage to call this "progress". For example, one of the recent achievements of such a strange "progress" was the strange orthographic pact with Brazil imposed on our countries by our recent governments, about which the citizens of both countries now laugh and obviously reject[2], as a serious attack on both the Brazilian and the Portuguese versions of our language. People have the impression that such a process was mainly driven by the strong lobby of certain editors, which have "democratically" decided to bypass the opinion of the citizens. And this kind of influence and interference happens in practically all matters of the State. We think, therefore, that it is now the proper time to evolve and give voice to the intelligence citizenship carries in itself. It is the proper time for laws to start to emerge directly from the citizenship, as long as the technical aspects to enable such a radical jump in democracy are resolved. There are now too many sinister proposals coming from certain politicians. Therefore the same technological resources they are trying to use to control entire populations must urgently be used to build the antidote, and a new society for all.

3. The need for a parliament

We should never forget that "*democracy*" in its essence means the "*government of the citizens for the citizens*". So, in the concept of *democracy* there is absolutely no assumption that representatives of the citizens must exist. Of course, for too long there was no other alternative than to implement "*democracy*" by delegating the power of the citizens owners of the State into a small group of citizens, and call these "*representatives*", and from them and by them expect a governance which would in principle represent, or at least respect, the wishes of the nation, or the State. We prefer to use here the term State, as it is more

[1] Carole Cadwalladr , "*Rick Falkvinge: the Swedish radical leading the fight over web freedoms*", The Guardian, 22 January 2012.

[2] Reaction from Ivo Miguel Barroso, professor at the Faculty of Law of Lisbon University (in Portuguese): http://www.publico.pt/Cultura/professor-de-direito-diz-que-novo-acordo-ortografico-e-inconstitucional-1533456

connected to the idea of governance.

In practice, as we know, such a process has forever implied the existence of a structure of institutions and positions which had to be separated from the citizens as a whole. Thus, when the moment of the election is over, the representatives of the citizens are physically separated from their own fellow citizens, and democracy is frequently over as well. The representatives are invited to enter another dimension of society: the dimension of governance,   power and narrative. So, they are now a kind of elected *primus inter pares*, who have the right to populate the "*houses of the parliament*", and meet and make laws and decrees at the *parliament*.

But, are these true "representatives" of the citizens? In fact most of the times not. Due to limitations of resources and management, and underground political interests, in most of our countries these representatives are in fact chosen by their "political mothers", that is, their political parties, without citizens having any say on such a process, and citizens are only allowed to vote in *political parties*. This is "*representative democracy*", of course. But from hereon representatives will do whatever their "mother" tells them to do, not what citizens want them to do. This is the first serious deviation from the original principal of *democracy*, and obviously the beginning of the great assault on the State and its citizenship. The representatives should always be chosen *directly* by the citizen owners of the State, not by any intermediaries, which in this case are called *political parties*, but of course they are groups of people organized with particular agendas and intents, not with the intents of the citizen owners of the State. Political parties should perhaps not even exist in a true democracy.
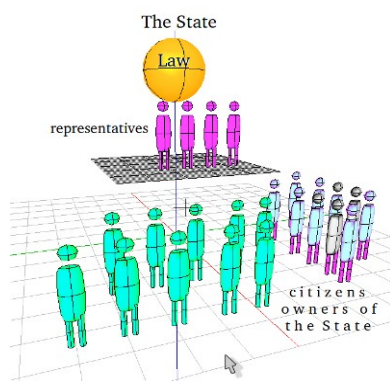

Fig 1. Basic structure of the *democratic* system, with *citizens* and their *representatives*.

But let us focus for a while on the figure of the *representative*. Some of them now start to think they own the State, therefore they can make any decisions they want about citizens' lives. Even without consulting citizens' opinions. Some will also suddenly assume the position of educators of the citizens, and start to emit laws governing all little aspects of life while absolutely forgetting the essentials, the real needs of the population. They spend their precious time in regulating the ridiculous, every little aspect that can be used to charge more and more the citizens for their little "deviations from the law". Meanwhile, towns degrade, buildings collapse, people in the streets have to search for food in the garbage in full view of everyone, and old, forgotten people die alone inside their homes, all of which are currently happening in our country.

Separated from the citizens and with their lives now freed from the need of executing a normal job in order to sustain themselves and their families, as they are paid by the easy public money, *representatives* soon became people in exceptional positions, subjects of deep envy, special interests, secret missions, influence, etc. But the worse of this is that they also attract the more pervert spirits of the kingdom, who, by means of highly effective techniques of parasitism, and crocodile tears rhetoric, approach them with their own proposals, admirable promises, special offers of all kinds, and eventually with even subtle threats directed at them or their loved ones. By means of such an undemocratic activity, this obviously slowly spreads throughout *parliament* the seeds of corruption, from the lower to the upper ranks. At the first level, the novice representative will be simply invited to join certain meetings, associations, causes, etc... most of them with a clean and shining face of unreprehensibility, usually of the charitable, philosophical, humanitarian or philanthropic type. Then, the representative may have to face more serious situations, like swear fidelity, make promises, etc. And so, the *democratic parliament* "elected" in the name of the citizens becomes the centre of attraction for an invisible parasitic cloud, and a silent storm which invisibly ruins *democracy*. The representative of the citizens is, in this way, slowly diverted more and more into the wishes and problems of those associations who contact him/her, or give advice, or finance other activities, than of the world of the citizens who in fact have trusted him/her. The representative of the citizens is therefore hijacked, the citizens are being attacked, while the so called *democracy* that existed for a moment on the day of the polls suddenly gives rise to a completely different system: we may call it "*demoncracy*", since it is the indirect governance of the *demons*. The beauty and fascination of the word "*democracy*" will still be used and maintained in all the institutions belonging to the citizens, as a flag for "progress". It will serve more than ever to celebrate, to propagate, perpetuate, advance, explore, and even export such a beautiful system named *democracy* even when it has became a fallacy. And *parliament* becomes the first stage of such a fallacy.

Some defend that the State should be fronted and ruled as an enterprise, a company, and as such, be based on economical variables. But in fact the State can never be managed or ruled like that, since every person naturally passes through productive and non-productive phases, but only productive phases are of interest to the economy. It depends on the conditions the person is living under at each moment. And one of the conditions could be related to age, another health, these are just two examples. For an enterprise, old people, mentally ill people, diseased people, disabled people, unhealthy people, weak people, etc., are accounted as costs. This is because there is no *humanity* in finance or economy. These should be simply tools, not rulers. So, a State that would start to be ruled based on such principles would no longer deserve respect from its population. It would be a fake and a failed State.

4. **Why is the *representative* so important?**

But why have so many of our representatives become disappointments? Why are the *demons* so much attracted to the *representative*? Why is he/she now so important? Due to a simple and unique reason: the *representative* owns the power for legislating, the power for making the laws, for deciding things, the narrative. And this power for "*creating the law*" is the true vehicle for progress. Money is only the fuel, like gasoline in a car. The representative is the driver of the vehicle. It is therefore of prime importance for the "*demoncrats*" to quickly jump inside that vehicle when a new driver has been elected. Only in that way, will they be able to control the vehicle without even the need of driving it, indirectly, by simply whispering in the ears of its driver.

The big tree of influence begins here, and it will tend to silently spread everywhere. Lifted by the vehicles of the citizens, *demons* now know they can go everywhere. It is a parasitic behaviour. One of its serious results is the financial disease presently attacking the Occidental world, which has lead to the collapse of several institutions and countries, indirectly inducing suffering and premature death to millions of people. In my town, for example, misery is now spreading surprisingly fast. Today, I saw another old and solitary lady, dressed as a ruined noble, begging for a coin near a street of arts. Unfortunately, she was not a part in any artistic installation. Even arts, in these times, seem somehow perverted too, even prostituted in a certain way, since they commonly focus on intellectual digressions and fantasies, while obviously ignoring the misery everyone sees in the streets and the real causes of it.

5. Demons games

Unlike the *democrat*, the "*demoncrat*" is not interested in politics, in the sense of a political debate. It is simply interested in *power*. It needs the *power* to further its own objectives. But, since *demons* know very well how to hijack *democracy*, they happily support any democratic aspirations of people if that is to become an advantage. We have often seen it happening for some time in our world. And the old technique of "divide-to-conquer" is being systematically applied in many cases and places, almost synchronously. Here, most of the population are not aware of it or don't even understand it, but people and institutions feel highly stressed because of it. Constant changes in educational directives without any consent of the citizens; constantly focusing into secondary and ideological issues while avoiding to address citizens' most relevant needs and aspirations; ridiculous orthographic pacts that create unnecessary tensions in the society, without the consent of citizens; forcing gentrification in the best places of towns without respect for its original citizens, without the consent of the citizens; supporting of and participation within invasions and wars against the will of the citizens; political and economical bullying of foreign countries without the consent of citizens; introduction of biometric identity cards without a serious debate for listening to the voices of the citizens; signing under-the-table pacts criminalizing downloads on the internet (A.C.T.A.)[3], without listening to the opinions of the citizens; use and abuse of poisonous geoengineering in the airspace, without the respect or consent of the citizens, etc.; these are only some of the cases that could probably be classified as clear abuses to the citizen owners of the State, if not crimes.

But there are many other cases, as we know. The utilization of public institutions, including the military, to pursue their agenda, as it happened at least during the last decade in the *democratic* USA, in the opinion of Mr General Wesley Clark[4], can be pointed out as another terrible case. In many countries, people now also realise that *public* enterprises or companies have been seized and then invaded by *private* interests, slowly weakening the State not only in its heritage but also in a way that the money generated by those companies will be mainly diverted into private pockets, during the process of a "*public*" exercise. These attacks are usually so slow that several years pass before most of the population realizes that these companies are not *public* any more, they do not belong to them any more. Also Foundations, Associations, Institutes, based on the concept of a *public-private* partnership, usually degenerate into assaults on the owners of the

State, assaults which are planed to be slow, in order not to destroy the elusive impression that those resources still belong to the citizens. Trying to seize the water resources of a country seems to be one of the latest fashions of the "*demoncrats*". And yes, management could be privatised, but never the *public heritage,* as seems to be the tendency. Private managers could even be excellently rewarded for their performances, but the flow of money from a *public company* should never be allowed to cross into private pockets. Otherwise, the *narrative* is not any more the citizens' narrative, since the State now belongs to those who have the power of the money[5]. So the State is not a State any more, but instead a kind of feudalistic system. Our democracies have recently been sold and have been bought, again without the consent of their citizens, and, if such a tendency spreads, citizens will be no more than slaves of their owners, in a kind of a technological feudalism.

Of course, both the *markets* and the usurious *bankers* are in the centre of the storm. They have enjoyed crashing the global economy with their nasty bets and financial games. Then, they crashed. Then, citizens had to be attacked by their *representatives* in order to help bankers to recover. As a compensation, *bankers* have decided to mock the citizens and punish them once again by keeping on paying excessive salaries and bonuses to their "excellent" managers. The *markets*, in turn, decided to point the inquisitive fingers of their *rating agencies* to the citizens, in order to punish their countries again and again, forgetting that the money they have been rescued with was the money of the citizens. Citizens have then almost asked them the favour to try being fair and correct, but their answer was once again implacable, and the citizens were punished again. Citizens have then furiously complained, made demands, threatened them; but they answered with police force, thereby physically punishing the citizens this time. Citizens have started to show symptoms of confusion, ill health, expecting compassion, solidarity, some help; but the *demons* even continued to poison their skies...

6. The reaction

In reaction to this, more and more people are organizing themselves worldwide, both on the streets and online. People seem to have finally understood that "*demoncracy*" is obviously and definitely not in favour of Mankind. Thus, there is a big wave of indignity and hope growing everywhere with the sentiment that citizens are being attacked not only with respect to their money but also on their rights, their health, and their

patrimony. And a *democracy* in which the citizens have to continuously organize and demonstrate their indignation against the decisions of their *representatives* is not any more a healthy democracy. It shows, instead, that democracy has been attacked by those who do not care about citizens. So, the future democracy cannot be in the streets. It must naturally and silently emerge from all of us.

Fig 2. A mask of Guy Fawkes, one of the symbols of the worldwide *hacktivist* group "anonymous". This group is presently very active on the Internet, and is popular for its hacking activity and dramatic online messages.

Mankind now has to think. We are at a crossroads. Progress should never again be imposed or dictated by the wishes of some, it must be decided by what citizens themselves believe in. Even if some insist upon imposing their own *narrative*, diverse *narratives* should naturally exist. Mankind is now thinking on developing its societies based on their own beliefs and cultures, and principles of good relations with the other societies of the planet. After all, we are already connected to each other, not just through *facebook*. Legislature and even decisions (executive) in a State can already turn to be *public*. The *parliament* is in effect obsolete.

7. How to start?

The final objective should be approached carefully, step by step, but the three usual branches of governance, legislature, executive, and judiciary, should be considered to be put completely under citizen control. We would suggest that the first phase be dedicated to giving citizens the ability to redraw (rewrite) the *Constitution* of their State. The second phase should be focused on giving citizens the ability to decide as a *virtual parliament* (legislature), and then declare the dissolution of the parliament due to its obsolescence. The third phase would be to enable citizens to become the *judiciary system*. And in a fourth phase citizens would even be enabled to decide on *how to manage* the State, in order to control decrees and direct the executive (the governors). Of course some governors and figures like the *Head of State* (the president or the king) should be maintained, as well as the military, but in fact all these would be under direct citizens observance and control.

We believe that such objectives can easily

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[3] *Anti-Counterfeiting Trade Agreement* (ACTA)
[4] A video: http://youtu.be/amDKQJS8uJ0

[5] An interesting article on "The Guardian", UK: http://www.guardian.co.uk/society/2012/feb/24/why-super-rich-love-uk

be achieved once citizens start to organize and build by themselves the following *wiki-sites* as the platforms for enabling such an evolution, which must give free access to every registered citizen of the State:

The *wiki-law*: (legislature)

An online and interactive platform which allows registered citizens to create, criticize, propose and vote for any paragraph of the law presently being updated. This same platform may contain the *State's Constitution*.

The *wiki-government*: (executive)

An online and interactive platform which allows registered citizens to criticize, propose and vote for any decision to be made by the government, in terms of paragraphs of decrees or other documents.

The *wiki-justice*: (judiciary)

An online interactive platform which allows registered citizens to argue and vote for decisions concerning judiciary issues, based on the present law. There should always be law specialists who should propose decisions and moderate citizens debate.

In order not to exclude any opinion or participation of a citizen even if considered unacceptable, thus ensuring a high degree of visibility, each of theses platforms should include a little corner or place into where all the inappropriate messages would be sent, instead of being deleted. It could be named the "***wiki-trash".*** In this way even that kind of information would still be available to the community, who could understand the reasons why they have been rejected.

Wiki-paragraph, the base for interaction:

Since all the interactions with the citizens will be based on an *interactive paragraph* (due to some lack of imagination we will call it "*wiki-paragraph*"), the first important step for implementing this system is to define all the *properties* and all the *functionality* of such a *paragraph*, including the mechanism for voting it. Only after this is resolved can all the existing texts of the present laws be reorganized based on this *base entity* of interactivity, and then be transferred into the online platforms. Citizens are to access, discuss, propose and vote, *paragraph* by *paragraph*, all the law. Technically this is not a difficult thing to achieve. There will be thousands of experts on Information Technology out there capable of designing and implementing a system like this. It is perhaps time to start doing it. And the funny thing is that no one needs any permission of anyone to do it. The State belongs to the citizens, so, it can even start tomorrow, by a group of skilled and well organized citizens, ewithout even the need to interfere with the ongoing activity of the present *representatives.* These will govern

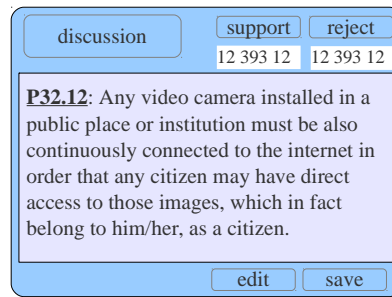till the proper time comes for them to be dismissed.

Fig 3. A simplistic example of the interactive unit named **wiki-paragraph**, by which citizens propose, compose and vote all the laws governing the State. LAs with any other document, an association of **paragraphs** may become a **section**, an association of sections a **chapter**, and so on. All the text of a law can be organized in this simple form in order to allow citizens to manipulate it very easily. Students could even be taught on how to use this in their secondary schools.

8. **Continuous referendum**

One of the most interesting aspects of this method for legislating is the fact that the law is always in a state of *referendum*, and it could be easily updated year by year, on the last day of the year, for example. People would know they had an entire year to discuss the various aspects of the law, and propose changes, and vote on them, but on the last day of December, the most voted *paragraphs* would be collected, and the law for the new year would be chosen and transferred to another internet site to become the definitive law for that year. People could then restart the process of debating it, but they would have to comply with it for a whole year.

Another interesting aspect is that the State would not have to spend any money on the complex process of elections, or to guarantee the fairness or legality of that process. The attentive citizen would already be informed of the results. It would not be a game of luck any more, but a simple process of evolution, constantly observed by the citizen owners of the State. The last day of December every year would be the day of *confirmation*, not the day of *choice*.

There are several other advantages in this system. It would for example, lead to a smoother democracy, but the most interesting advantage is the fact that suddenly there are no more *representatives* any more in *parliament*. In fact, *parliament* is now empty. A museum of democracy could be installed there. Thus, no more underground political groups or well organized political parties are needed, because citizens already draw and chose directly their laws, as they believe they

express their wills better. Perhaps, for a short while, there will be the need for *executives*, the government, of course, but these will have to comply with the law chosen by the citizens, so they would also be immune to the activity of the *demons*. And *demons* would have no other chance than trying hard to seem saints... it would even be funny.

9. **So, what to do now?**

Thomas Morus and Plato had their times. But we should not forget we also have ours. Many utopias have inspired human beings, but it is also important to act... The "perfect" democracy can only be achieved when the majority of citizens have become aware, educated, and sufficiently instructed about what is really happening in the world. So, education is of the utmost urgency, but it must be conducted in parallel with the implementation of a real democratic system. So, what to do now? Implement an interactive system of law and governance:

1) Translate the present law into a *wiki* style site system, organized by chapters, sections and subsections; but in a way that the minimal text element is the *law-paragraph*. This base entity of text must be an interactive entity, that can be edited by the *proposing* registered participant and also voted upon by any registered user online. Each registered user will be uniquely identified through the use of their own identity card number (ID). The first step is, therefore, to structure the actual law into the form of a *wiki-law* that allows any citizen to continuously vote it.

2) The second step is to transform each *law-paragraph* into a commented text, similar to what is already being done in many articles of online newspapers. The *law-paragraph* would be the "article" with a single 1-paragraph statement. And comments would be associated with it as a discussion. This would replace the depressive present day "parliamentary sessions". Parallel to these comments would be the new and clean *law-paragraph-proposals*. The most voted *law-paragraph-proposals* would naturally emerge from the others and be kept in visibility. And these emerged *law-paragraph-proposals* (of course in the form of *law-paragraph* entities) would be the natural candidates to replace the present *law-paragraph* when the great-day-of-confirmation finally arrives. On that day, the whole law would change, by simply replacing the old *law-paragraphs* with the new ones. As for the *Constitution,* perhaps a revisionary period of four years would be more appropriate.

Let Democracy begin!

By J. Manuel Feliz-Teixeira
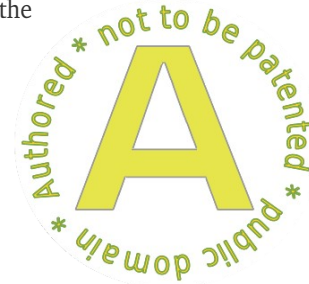*Porto, 11 March 2012*

clic-to-contribute

Authored & no-patent

A method for classification of intellectual, creative and industrial works, based on the idea that the author may want to offer its property to the public domain, while maintaining the authorship rights.[1]

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30 January 2012

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1. Introduction

The aim of this text is basically to explain the meaning of the "*no-patent*" (older) and the "*authored & no-patent*" (more recent) symbols that for some time we have been using in our texts and ideas. It is based on the belief that the author of an idea or system may want to offer that idea or system to the public domain and thus to humanity in general, while obviously keeping the moral rights as an author, frequently associated with *copyright*, for example. We believe that such a system, which can at the same time be used with industrial and intellectual works, contributes to a much better dissemination of knowledge throughout society, since it obviously forbids the possibility of anyone owning a certain idea or work and obstructing it from others, as exclusive publishing and patents commonly do. Anyone can freely use this symbol, since it is itself "*authored & no-patent*".

2. The need for a new system

The idea of developing our own system of classification of works resulted mainly from two situations that we had to face: firstly, each time we wanted to publish an article in a new magazine, for example, that magazine would ask of us the boring extra work of formatting our text following their format criteria and secondly, would require a declaration transferring to them the exclusive rights of replication of that text (copyright). Thus, in compensation for the publication of our text and our ideas in their magazine, we would receive the amazing "right" of having to ask them permission for reproducing our own text, and the "right" of not to give it to any other publisher for dissemination. If we were to decide to publish a subsequent text in another magazine, we would again have to format it according to the directives of this new magazine, to transfer to them the copyright, and again we would feel blocked in our own territory. Thank you! After understanding such

a curious game, we have decided to publish our works only by ourselves or through a publisher accepting a "shared copyright" philosophy. That is: the copyright is not transferred to the publisher, but instead shared. The publisher may therefore use the work as he wants, but not in an exclusive way. With the emergence of the Internet, however, people are now finally free to publish by themselves and this became our preferred option. It is simple, it is good, the ideas are made available to all those who may want to discuss them, or even use them, and even the text format is our own, whatever we like. Production really turns into something much more personal, and universal, and is open to everybody, and much more interesting. Even in what concerns the form, the work has a lot to do with the personality of the producer, and that may be kept as a mark of his/her own style.

Some argue that peer review is important in order to confer credibility to what is published, but that is a fallacy in two acts: firstly, we know very well that many magazines are in effect groups of people defending a certain point of view in a certain domain of knowledge, therefore they basically accept what they like, not what is good. Secondly, peer review can become global, and any article openly published to all on the Internet may be reviewed and discussed by anyone and with the author, if it is of interest to anyone. The idea, however, is openly there, obviously available to everyone. A third aspect is that the author must even be free to publish crazy thoughts and ideas on the Internet, an idea that usually would be completely rejected by the magazine. But that is still a part of his/her experience of living and production, and those who do not want to spend time to peer review it are free to move away from it. The result of the peer review of the "crazy" Galileo Galilei was pointing him the direction of the fire.

Patents: in our opinion, patents may even

turn into a more sinister game than a textbook or art work, for example. And that is because the concept of *patent* is much more related to the idea of obstructing others to producing something than to the idea of ensuring the owner the right to produce. Thus, often there are people who buy patents with the simple objective of blocking its production, ignoring that humanity as a whole should have the right to its creations. The idea produced by an human being is, suddenly, crystallized for 20 years.

But it is not only this. Surrounding a patent there suddenly appear lots of processes demanding time and money from the author. First, the author has to pay several thousand Euros to register the patent. Then, year by year he/she has to feed the patent, in order to keep it "alive". Then, basically each country has its own system of patents, differing from others, therefore the author has to be prepared to support that same torture now multiplied as many times as many regions in the globe where he/she wants to protect the "rights". Till now there were no rights, only duties. The poor inventor struggles, many times for 20 years, and if he/she does not give up before, the idea naturally falls into the public domain, and... bye-bye patent. Those who have the business of patents are now rich, while also anybody may produce the system. The only thing that remains is the *authorship*, for an old and deluded inventor who simply has given something new to mankind.

3. The offer

But what would have happened if the poor inventor would have simply offered the *property* of his/her invention to mankind, or to the public domain, and be happy only with the fact that mankind now knows he/she was the author of that idea, system, or art work? The first thing that would happen is that mankind could promptly start to use that new idea and evolve it, instead of waiting 20 years to do it. Secondly, the inventor would not spend a

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[1] First notice: *"Intellectual Property is commonly divided into two categories: Industrial property, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source; and Copyright, which includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as drawings, paintings, photographs and sculptures, and architectural designs. Rights related to copyright include those of performing artists in their performances, producers of phonograms in their recordings, and those of broadcasters in their radio and television programs. For an introduction to Intellectual Property for non-specialists, refer to: http://www.wipo.int/freepublications/en/intproperty/909/wipo_pub_909.html"* (text origin: http://www.wipo.int/about-ip/en/)

significant amount of his/her time and lots of money in order to support the patent, with the illusion that someone, who knows when, would buy it for much more than that. Only very special patents are bought, for the others it is usually preferable to wait 20 years to see them falling in the street. The voracity of certain human beings is strange. But, and thirdly, since now no one has to pay for an expensive patent in order to produce the system, probably some people around the world would start to produce it, freely, with no other duty than that of sending back to the author a little insignificant percentage of the income of the business made with that idea or system. We live in a globalised word, where a little contribution of a few Euros coming from a large number of people (in fact it could be a huge number of people) can eventually result in a compensation to the author even bigger than if he/she were to have received the payment from the patent. It is simply a case of a mindset, that needs to be switched on in our societies for all this to become possible. In fact, for a long time now, some institutions like the *Red Cross*, certain universities, and associations, etc., and even the candidates of political parties, have been using the technique of begging as a legitimate source of income. Couldn't this be used also to ensure at least the provision of a dignified life to an artist, a writer, an inventor, or any other creative being?

The other symbol we commonly use in our works is the "*clic-to-contribute*" symbol, which is dedicated to receive feedback, and also any donations in order to help maintain our work. When someone offers something to society, it is probable that the society will naturally balance back with an offer too. Of course most people seem not yet prepared to use such a type of relationship with the creative minds of their society, unless the work is shown in the street, which is connoted with *begging*. Nevertheless, for some time now, some inspiring pioneers, mainly from various central European countries, have been using a similar idea even in the production of fruits, vegetables, flowers, for example. There is also a very interesting technical article dedicated to a similar "*pay-what-you-like*"[2] system. And it seems that in many cases the results are even more interesting that when asking something directly to the "client". Presently, the system of exchanging goods and services is based on a kind of a tacit *right to ask* a certain amount of money for the merchandise. On the contrary, our system is also open to the possibility of the "client" to give what he or she thinks is fair for the merchandise. The idea of *offering* is surpassing the idea of *charging*. And we could in effect

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[2] Ju-Young Kim, Martin Natter, & Martin Spann, "*Pay What You Want: A New Participative Pricing Mechanism*", Journal of Marketing , Vol. 73 (January 2009), 44–58 .

say that it is somehow inspired from the street artists: first they act, then people give what they can or what they think is the fair classification for what the artist did. If this mindset would be expanded to the globalised online community it would be like a huge explosion of possibilities. Potentially, any person could explore themselves in the creative sphere and simply live from it. As a little example, if only 70 people out of the 800 million people within the European Union would each offer you 30 Euro per month to support your work, then you would receive 30x70 = 2100 Euro at the end of the month, which is perfectly fine for anyone to live a reasonable life. This would be the same as receiving 1 Euro per day from each person.

Now we may estimate how much we would receive if someone out there decided to produce one of our turbine models, for example, in order to sell it for, say, 100 Euro each. If at the end of a month he were to have sold just 10, then he would receive 1000 Euro. Usually the authorship rights lie between 10% and 20% of the sales, therefore he could perfectly send back only 10% to us, the ridiculous amount of 100 Euro. But in fact that it is not ridiculous if either the number of producers increase or the volume of sales increase or even if the turbine will be a more powerful and expensive one.

4. A*uthored & no-patent*

It is now more clear what the "*author & no-patent*" system we use is about. Since it is based on letting the property fall into the public domain, it can be used not only with literary and art works, for example, but also with any other works, including prototypes, inventions, and even industrial property. Since we only keep the original moral rights and invite copyright sharing, the only aspect that must be rewarded is the *authorship*. And the authorship is well defined at the moment of publication of the idea or system. Some will argue, however, that some problems would arise in the case where someone produces something using ideas from several authors. In effect, with "*author & no-patent*" the situation will be naturally and easily resolved. As an illustrative example: suppose that a certain author invented the *bicycle wheel*, and a different author invented the *chair*. Suppose now that the designers from *Mercedes-Benz* decided to build something new based on 4 bicycle wheels and 2 chairs, as shown in the next figure. Since this is a new product, *Mercedes-Benz* would obviously own the authorship of this product, under "*author & no-patent*". So, even if *Mercedes-Benz* didn't produce any of these cars for marketing, if someone else were to produce them, then they would send a cheque for 10% of the sales to *Mercedes-Benz*. And there would only need to be 10 producers interested in producing this

car in order that, without doing anything else, *Mercedes-Benz* would receive the same amount as if it were to have sold a car. With the advantage that it didn't need to produce it. This is a very simple case, concerning only a single car. We may try to imagine what would happen if each of those producers were to produce 100, 1000 or more cars per month. And, not forgetting that *Mercedes-Benz* may also produce its own cars.

Fig 1. *Mercedes-Benz* electric roadster.

Now we have to think on the other side, what would happen to the original authors of the *wheel* and the *chair*? Very simple: *Mercedes-Benz* would send back to them the appropriate amount, which can be easily calculated by taking into account the number of times each of those inventions have been used for the new invention, the new *Mercedes-Benz*. The total amount of external invention is 4 wheels + 2 chairs = 6 inventions. So, to the author of the wheel, would be sent (4/6)x 10% of what *Mercedes* has received from the other producers, while to the author of the chairs, would be sent (2/6)x10%. The sum of the two is of course 10%, the overall author's rights. This is a way, it could be others.

The more recent symbol of "*author & no-patent*" has been inspired by some libertarian ideals of Anarchism, although we are not anarchist since we believe both in the need of a *State* and the existence of *God*. But the present issues about piracy policies on the internet, for example, relating mainly to the "unauthorised" downloading and sharing of videos and music produced for the public by certain companies, which recently even led to the *Wikipedia.org* blackout protest, is a case of interest in respect of what we are addressing here. Please feel absolutely free to copy this and use it for your own advantage. Humans can only invent new things because other humans are there to support the adventure. The products of a human in fact belong to the whole of mankind, not to just a few.

By J. Manuel Feliz-Teixeira
Porto, 1 February 2012

clic-to-contribute
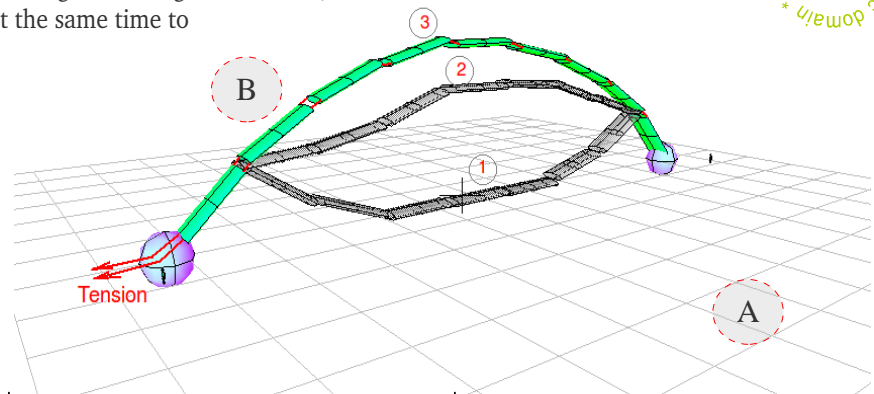
Concept: Arc-in-tension Bridge

A method for elevating and building arc bridges in a single movement, based on the idea of applying tension at the same time to all the individual sections of the arc.
not to be patented

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12 August 2011

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1. Introduction

When an arc of a big bridge is being built, everyone is impressed by the extraordinary amount of mass being elevated against gravity in that process. There are several methods for achieving this in practice, but most of them rely on a continuous process of measuring and compensating the torque induced in the structure at each phase, in order that the net result will always be null, at any instant of time. Arc bridges can be loaded in basically two ways: into *compression*, or into *tension*, as next figures suggest. This characterizes the way the *bridge's deck* is to be suspended from the ground. In the first case the weight of the deck (and its traffic) is transferred into the arc by means of a compression process, while in the second case it is done by means of a process of tension.
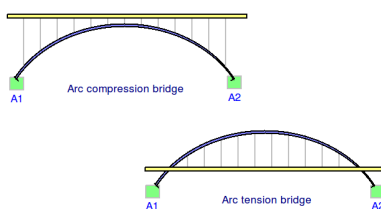
Fig 1. Compression and tension arc bridges

During construction, however, in both cases the elevation of the arc is the primary objective and this is usually the biggest challenge in the construction itself.

The emblematic *Arrábida bridge* (Porto, Portugal, 1963), was for me the first inspiring bridge on the elevation and construction of a *béton* arc between two places distanced by around 600 meters, across the *Douro* river. As is represented in the next figure, after the elevation of the first two lateral sections of the mould of the arc by means of the usual process of construction, a third and central section of this arc (also a mould), previously installed on boats at the centre of the river, was elevated directly from the river by means

of tensile cables, until it reached the point of being able to be joined to the lateral sections. These cables were obviously capable of supporting the weight of the central structure.
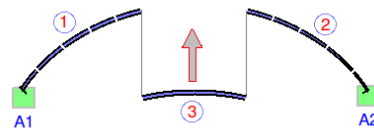

Fig 2. Process of building the mould of the arc of the *Arrábida bridge*, Porto, Portugal, 1963.

Once this operation was finished, *béton* was finally be injected into the structure and the final arc built.

2. Arc-in-tension, the new proposal

The proposal presented herein, which I have named the "arc-in-tension" method, gets its basic principle from the fact that the resistance of a structure, like in the molecular world, comes from an internal mechanical tension, and from how such a tension is distributed throughout the structure. It is therefore an idea that stems from the microscopic world and is being extrapolated to the world of civil engineering. And it makes possible the elevation of the whole arc of a bridge as a single and complete structure, at the same time.

The first aspect to have in mind is that the arc must be divided into a reasonable number of unit sections previously interconnected to each other, perfectly aligned by means of at least two cables, as the next figure suggests. These little unit sections, once aligned, will naturally build up the structure of the mould of the arc, where later the *béton* will be injected. This structure may first of all be mounted at the ground level, between the two sides of the bridge. Its elevation will be made by means of a slow application of an increasing tension between its sections. I wonder if *Arrábida bridge* could not have been built by means of this method...
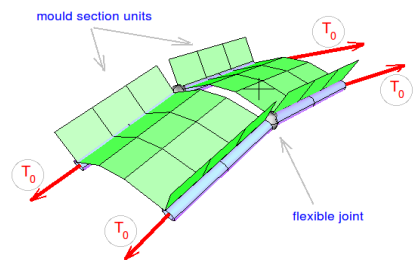

Fig 3. An example of the connection of two mould section units by means of tension (T_0).

This tension can be applied to the cables by several methods, but the simplest way is to use a mobile support at one end of the bridge, while the second support is maintained fixed. This obviously implies some extra space available perpendicular to the bridge, but this space is only needed during the process of construction, as shown in the next figure.
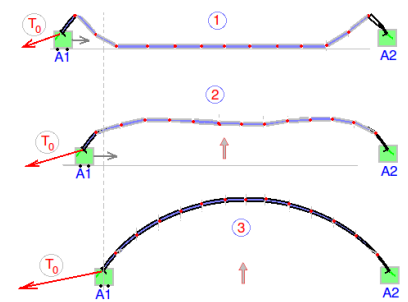

Fig 4. Three distinct phases in the process of elevating the mould structure of the arc, by moving the support A1.

The mobile support (A1) could be a giant block of *béton* that would slowly be made to move along rails, thereby tensing the cables step by step till the moment that the arc becomes completely elevated to its proper position. After that, the mobile support will be made fixed and the *béton* injected into the structure of the arc.

By J. Manuel Feliz-Teixeira

The Geometric Law of Motion

Prospects for a perspective of motion. A vision from planetary orbits to electronic orbitals

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clic-to-contribute

July 2011

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KEYWORDS: Torque, angular and radial energies, centrifugal force, Galileo's and Newton's laws, geometric algebra, Geometric Law of Motion, *spinor* state modifier, Euler's *action*, angular-momentum/energy pair, Quantum Mechanics.

ABSTRACT

In a previous article, related to the discussion on the centrifugal force, we presented the *Geometric Law of Motion*[1] which has naturally emerged from expressing motion based on the fundamental entities *position*, *mass* and *velocity*, and the proposal that the *torque equation* be generalised to the inner product operation. This automatically leads to a new equation describing the radial energy of the system. Motion would therefore take place in a kind of continuous exchange of energy between the angular and the radial dimensions of the space, relative to an observer. This article is solely dedicated to such a law, which we now present with more detail and with some extra remarks, in a bid to also place it alongside previous proposals and, in particular, the Quantum Mechanical description. We will also try to travel from the *infinitely large world* into the *infinitely small world*, while never abandoning the *Geometric Law of Motion*.

1. Introduction

By looking at things in our day-by-day experience of life we frequently notice that the same thing can exhibit completely different properties, as if by magic. More frequently than not, this magic comes from the way things project themselves into our eyes and senses, and interact with the world. I can perfectly show a circle to a friend and tell him it is a line, and I am sure he will see it as a line. I can perfectly cut a piece of wood with a piece of paper; I may perfectly deposit a little stick of wood over a handkerchief, then obviously break it, and then "obviously" resurrect it. This is the basis of what is more commonly known as illusionism. In serious science, however, it is commonly considered and agreed that there must be no illusionism. But in fact there is, and there will always be an illusion in which the scientist plays the part of the audience instead of the part of the *performer*. Thus, the destiny of the scientist will always be to try to unveil the tricks of the *performer* in order to be able to understand the reality as it really is.

Similarly, when in Physics one looks at the several laws of motion, for example, the conservation of momentum, the conservation of angular momentum, the conservation of energy, and several more conservations, an obvious question arises to the curious mind: if the thing, the universe, the motion, is in fact a single thing, why is there the need for so many laws to describe it? Could there be a single law to include all those several properties of motion and simply look at them as different projections onto our 3D space plus time reality[2]? We like to think on the *Geometric Law of Motion* as a kind of probable seed for such an achievement and, in particular, for a renewed interest for the study of non-recommended effects, like the *centrifugal* effect, for example.

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[1] J. Manuel Feliz-Teixeira, "*In Defence of the Centrifugal Force and the Geometric Law of Motion*", first published at http://www.fe.up.pt/~feliz, and YouTube, June 2011

[2] At this moment is seems quiet obvious that reality is not only a 3D+1 reality: I am in the *space-time* and I am *thinking*, so, at least one more dimension is needed to "*thinking*".

2. The Geometric Law of Motion

In order to better perceive this "law" it helps to start by considering motion as being described based on the following three fundamental entities[3]: *mass (m), position (r)* and *velocity (v)*. All will be derived from them. We believe this is preferable than using *position* and *momentum* (*p=m.v*), since it obviously separates mass, which we like to see as an *inertial property*, from velocity, which is a *cinematic entity*. We have the feeling that motion is in fact a sort of a geometric thing, which is maintained by the power of the *mass* involved in it. Large masses keep such a geometry more stable and able to resist changes, while small masses are obviously more affected by external interactions. This would perhaps explain why the microscopic world is much more reactive and always changing than the macroscopic world. Molecular and atomic world versus planetary and cosmological world, is an example.

Then, we considered that motion must always be described relative to an observer, who we imagine is located at the center of the coordinates system. Thus, any law governing change in motion will have to explicitly contain the *position* vector. And finally, although we consider *space* as an homogeneous three-dimensional entity, in the presence of motion it tends to transform into an abstract two dimensional entity, being governed by certain tendencies for movement, or for *action*: the *radial dimension* (that we also call parallel $_{//}$ to the observer) which tells us how far or near the body is from the observer and how it approaches or moves away form it; and the *angular dimension* (perpendicular $\perp$ to the observer) which represents the tendency for the body rotating around the observer. Since these dimensions are obviously interconnected, it is easy to understand motion in terms of an exchange between radial and angular dimensions, even if these are ruled by apparently different equations. We know, anyhow, that the equation governing the angular motion is the well known "torque equation":

$$\underline{r} \times \underline{F} = d\{\underline{r} \times m.\underline{v}\}/dt \qquad (1)$$

Torque is what changes the angular momentum vector ($\underline{L} = \underline{r} \times m.\underline{v}$). However, the law governing

the radial dimension is usually based on the Newtonian concept of force, given by $\underline{F} = d\{m.\underline{v}\}/dt$, together with some other concepts like the conservation of mechanical energy, and, in certain cases, also the consideration of Huygens centrifugal force as a sort of "fictitious" force[4]. In this way, the radial and the angular dimensions are in fact treated as being separate, and from a perspective which is dispersed for several different laws that must hold. Our proposal is to try express these two aspects of motion simply as two different projections of the same general law: one into the *angular* dimension, and the other into the *radial* dimension. By this assumption, it means that both motions would have to be ruled by equations containing not only the same fundamental entities, but also the same "logic" for interconnecting these entities. Driven by the idea that a projection into the radial dimension should naturally be associated to an *inner product* between vectors, it seemed reasonable to propose precisely the same "torque equation" for describing the radial law, but with the *cross product* replaced by the *inner product*. These two laws could therefore be written as the conjunction of two similar equations expressing a single law of motion:

$$\begin{cases} \underline{r} \times \underline{F} = d\{\underline{r} \times m.\underline{v}\}/dt & \text{- angular law} \quad (2) \\ \underline{r} \cdot \underline{F} = d\{\underline{r} \cdot m.\underline{v}\}/dt & \text{- radial law} \quad (3) \end{cases}$$
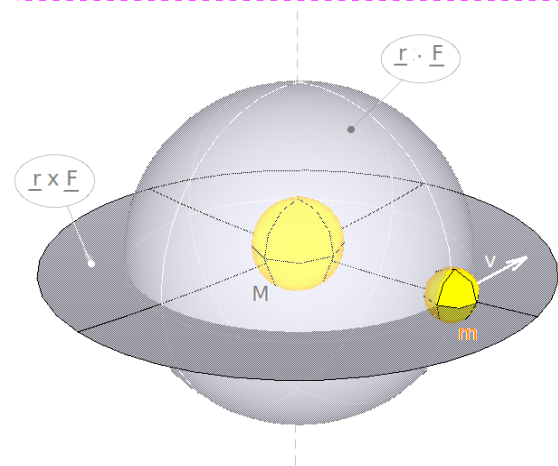

Fig. 1 The intrinsic geometry of motion, based on what we have expressed in the previous thoughts: a spherical surface (radial dimension) driven by the term $\underline{r} \cdot \underline{F}$, crossed by a rotating plan (angular dimension) dominated by the term $\underline{r} \times \underline{F}$. These two dimensions are, however, interconnected by the centrifugal force and the angular momentum mechanism, as we will see.

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[3] As it is our practice, here we represent vectors as bold underlined letters, to substitute the usual arrow. So, vector *v* = *v*.

[4] J. Manuel Feliz-Teixeira, "*Apparently Deriving Fictitious Forces*", first published at http://www.fe.up.pt/~feliz, and YouTube, June 2011

This is a possible representation of the *Geometric Law of Motion*.

This happens to be a coupled system. Notice that the sphere shrinks or expands as mass *m* approaches or moves away from the center of rotation. But this also tends to be accomplished by an increase or a decrease in the speed of rotation depending on the case. What drives the changes in the perpendicular (angular) dimension is $\underline{r} \times \underline{F}$. What drives the changes in the parallel (radial) dimension is $\underline{r} \cdot \underline{F}$. However, the two dimensions are obviously not independent, but interconnected by *radial* and *angular* forces which transfer angular dimension into radial dimension and vice-versa. In fact, if we develop the derivatives, we will get the more explicit expression (obviously, we consider $\underline{a} = d\underline{v}/dt$):

$$\begin{cases} \underline{r} \times \underline{F} = m \cdot [d\underline{r}/dt] \times \underline{v} + [dm/dt].\underline{r} \times \underline{v} + m.\underline{r} \times \underline{a} \\ \underline{r} \cdot \underline{F} = m \cdot [d\underline{r}/dt] \cdot \underline{v} + [dm/dt].\underline{r} \cdot \underline{v} + m.\underline{r} \cdot \underline{a} \end{cases}$$
(4)

Where, from several forces that can already be identified in terms of the associated energy, we have:

Coriolis energy = $m \cdot [d\underline{r}/dt] \times \underline{v}$
Euler energy = $m \cdot \underline{r} \times \underline{a}$
Centrifugal energy = $m \cdot [d\underline{r}/dt] \cdot \underline{v}$
Potential energy, radial = $m \cdot \underline{r} \cdot \underline{a}$
Energy due to variations of mass = $[dm/dt].\underline{r} \times \underline{v}$
Energy due to variations of mass = $[dm/dt].\underline{r} \cdot \underline{v}$

From this, let us try to imagine, for example, what happens when a space station or satellite is suddenly loaded with additional mass. From Newton's point of view, the orbit does not depend on the mass orbiting (in first approximation, of course), only on the orbiting velocity, therefore the sudden appearance of new mass inside the space station would change nothing in its motion. But at the same time, a force in the direction of motion is also predicted by Newton[5] due to a change in mass, with intensity $[dm/dt].\underline{v}$. And this force should therefore accelerate the body...

From our equations, the torque $[dm/dt].\underline{r} \times \underline{v}$ will try to increase the angular momentum of the system. However, if the system has already a strong angular momentum, it will try to keep it by slightly declining

its orbit and decreasing its speed. Apparently this will not *directly* affect the radial energy, since in the case of a presumed circular orbit we have $\underline{r} \cdot \underline{v} = 0$, but only indirectly, due to such a variation of speed.

For simplicity, however, here we consider that no mass variations are allowed, as we are dealing with solid objects. Thus, our law can be simplified to:

$$\underline{M} = \begin{cases} \underline{r} \times \underline{F} = m \cdot [d\underline{r}/dt] \times \underline{v} + m.\underline{r} \times \underline{a} \\ \underline{r} \cdot \underline{F} = m \cdot [d\underline{r}/dt] \cdot \underline{v} + m.\underline{r} \cdot \underline{a} \end{cases}$$
(5)

Notice that $\underline{M}$ can be seen as a kind of an abstract vector responsible for "modifying" the state of the system, the reason why we called it "*modifier*"[6]. It has an angular (perpendicular) component, and a radial (parallel) component, therefore we can also write it like this:

$$\underline{M} = (\mathcal{M}_\perp , \mathcal{M}_{//}) = (\underline{r} \times \underline{F} , \underline{r} \cdot \underline{F})$$
(6)

If this state modifier is *(0, 0)* the system will be in a stationary state. Something can change internally, but only as a sort of an internal redistribution of movement, or energy, and not more than that; like when a planet describes a stationary elliptical orbit while passing by several and repeated transferences of energy along its trajectory, for example. Probably, the most stationary orbit is in fact the circular orbit[7].

If we use Geometric Algebra, however, all this can be described as the *geometric product* of the vector $\underline{r}$ by the vector $\underline{F}$, which is simply written as[8]:

$$\underline{M} = \underline{r}\,\underline{F} = \underline{r} \cdot \underline{F} + \underline{r} \wedge \underline{F}$$
(7)

where the cross product has been replaced by the outer product only for convenience. Those expert in Geometric Algebra consider this a single entity which they call a "*spinor*": the conjunction of a *scalar* and a *bivector*, which is a n-dimensinal *rotator* of vectors; in this case a two dimensional rotator. So, we may now express this equation in terms of our

---

[5] By Newton we may write: $F = d\{m.v\}/dt = m.dv/dt + [dm/dt].v$

[6] This is not a real vector, since the first component is a *vector* while the second is a *scalar*. In Geometric Algebra it is called a *spinor*.
[7] It is funny that Galileo had this same perception, when defending that perfect orbits would be circular.
[8] You may learn more about the geometric product in:
Jaap Suter, (March 12, 2003), "*Geometric Algebra Primer* ":
http://www.jaapsuter.com/2003/03/12/geometric-algebra/

fundamental "entities" as a true *Geometric Law of Motion*:

$$\underline{\mathcal{M}} = \underline{r}\,\underline{F} = d\{\underline{r}\,.\,m.\underline{v}\}/dt \;+\; d\{\underline{r} \wedge m.\underline{v}\}/dt$$
$$\underline{\mathcal{M}} = \underline{r}\,\underline{F} = d\{\underline{r}\,.\,m.\underline{v} \;+\; \underline{r} \wedge m.\underline{v}\}/dt \qquad (8)$$

Or, if we want it in a more compact form, using only the *geometric product* of vectors:

$$\underline{\mathcal{M}} = \underline{r}\,\underline{F} = d\{\underline{r}\,m.\underline{v}\}/dt \qquad (9)$$

3. Possible interpretations

Since $\underline{\mathcal{M}}$ means change, and systems in general seem not to have a special interest in changing unless their feel in danger or forced to, as if good life would mean a sort of a dream of tranquillity, it seems reasonable to imagine that all motion advances in a way that $\underline{\mathcal{M}}$ can be kept a minimum. It is interesting to notice, at this point, that Euler also used the concept of *action*[9] and stated that the path or trajectory of a system would be in such a way that *action* is minimized. It could be called the "laziness law", but in fact it is more than that: it is a very intelligent law for spending the minimal amount of energy in a process. People in general should learn much more about planets and particles, instead of wasting so many resources and their precious time in producing "noise" and "agitation" for nothing. All things are, of course, interconnected. But it is also interesting to notice that *action* has been defined by Euler as $dS=m.\underline{v}.d\underline{r}$, as a measure of the projection of the velocity into the direction of motion, precisely what our term ($\underline{r}.m.\underline{v}$) means, in the radial equation. On the other hand, Lagrange and Hamilton used *action* based on the time parameter ($dS=\mathcal{L}.dt$), thus related to the energy in the form of the Lagrangian ($\mathcal{L}$). So, knowing this, our $\underline{\mathcal{M}}$ seems also a kind of *generalised Lagrangian* which includes both *angular* and *radial* dimensions. Therefore we have:

$$\underline{\mathcal{M}} = d\{\underline{r}\,m.\underline{v}\}/dt$$

And we can possibly write it as:

$$\underline{\mathcal{M}}\,dt = m.\underline{v}\,d\underline{r} = dS \;=> dS = \underline{\mathcal{M}}\,dt \qquad (10)$$

---

[9] Euler defined action as $dS = m.\underline{v}.d\underline{r}$, while later Lagrange and Hamilton used it in the form $S = \int L.dt$ being L the Lagrangian of the system = (Kinetic energy – Potential energy).

Could we from this say that $\underline{\mathcal{M}}$ is equivalent to a generalised Lagrangian representing not only the energy component, as the normal Lagrangian does, but also the angular momentum component, and thus be even seen as a kind of seed for some sort of quantum states? In effect, from this it seems natural the idea of representing the states of motion of a system based on *energy* and the *angular momentum*, precisely as it is commonly considered in Quantum Mechanics. This is very interesting. As long as we also include in the *Geometric Law of Motion* both the *spin-orbit* interaction and the *magnetic moment interaction*, then maybe also the states of *spin* and *magnetic moment* could be part of this new description of motion; just like the quantum numbers *(n, l, m_s, s)* do in the universe of the infinitely small. Perhaps we will return to this issues in a future work. For now, anyhow, it seems we have something in our hands which includes and relates *linear action* and *angular action*, if we can say this way, where *angular action* is in fact the same as *angular momentum*.

4. Radial and angular exchange of motion

In our standard way of thinking it is expected that a displacement of a body in a certain direction will be related to, if that will be the case, a force or an acceleration in that same direction, but not in the perpendicular direction. In fact, that would happen in processes of stress or deformation of materials[10], and in friction forces, for example, but these are structures highly bounded to internal forces in all directions. An interesting thing introduced by the *Geometric Law of Motion* is the possibility for a displacement be related to a force perpendicular to it. A radial displacement produces an angular force (Coriolis); and an angular displacement produces a radial force (centrifugal). Thus, the two dimensions are obviously coupled, therefore they may exchange energy and momentum between them.

Let us try to rewrite our equations in a form so that these forces can easily be identified. Starting by:

$$\underline{\mathcal{M}} = \begin{cases} \underline{r} \times \underline{F} = m\,.[d\underline{r}/dt] \times \underline{v} \;+ m.\underline{r} \times \underline{a} \\ \underline{r}\,.\,\underline{F} = m\,.[d\underline{r}/dt]\,.\,\underline{v} \;+ m.\,\underline{r}\,.\,\underline{a} \end{cases}$$

we may represent these vectorial operations by

---

[10] In Mechanics of Materials, with the stress and the deformation, for example.

the proper projections onto their angular (⊥) and radial (//) dimensions, using the angle β between $d\underline{r}/dt$ and $\underline{v}$, and we may look at $\underline{\mathcal{M}}$ as a real vector with components $(\mathcal{M}_\perp, \mathcal{M}_{//}) = (r \cdot F_\perp, r \cdot F_{//})$:

$$\underline{\mathcal{M}} = \begin{cases} r \cdot F_\perp = m \cdot (\sin\beta) \cdot [dr/dt] \cdot v + m \cdot r \cdot a_\perp \\ r \cdot F_{//} = m \cdot (\cos\beta) \cdot [dr/dt] \cdot v + m \cdot r \cdot a_{//} \end{cases}$$

(11)

Notice that some more interesting things come out from this fact. For example, if we divide both equations by $r \neq 0$, we find the following coupled equations that describe the motion in terms of forces:

$$\begin{cases} F_\perp = m \cdot (\sin\beta) \cdot [dr/dt] \cdot v/r + m \cdot a_\perp \\ F_{//} = m \cdot (\cos\beta) \cdot [dr/dt] \cdot v/r + m \cdot a_{//} \end{cases}$$

(12)

In the case of a body moving in a circular orbit with a large radius it holds that $\beta = 0$, thus only a *centrifugal* force with intensity $(m \cdot [dr/dt] \cdot v/r)$ will act in reaction to the curved restriction imposed by the orbit, while the angular velocity will be constant. But in the case of an elliptical orbit, for example, most of the time $\beta \neq 0$ and, by the angular equation, the body will also be acted upon by an *angular* force (⊥) given by $m \cdot (\sin\beta) \cdot [dr/dt] \cdot v/r$. This force ($F_a$) will tend to increase or decrease the orbital speed, depending on the direction of $[dr/dt]_{//}$, while the centrifugal force (F_c) tries to keep the body away from the centre of gravitation, see (Fig. 2).
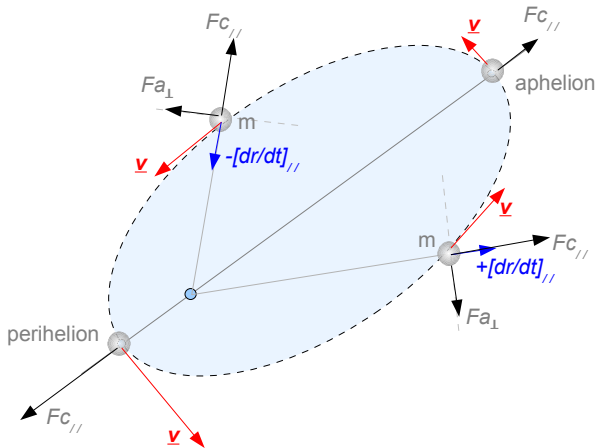
Fig. 2 Example of an elliptical orbit showing the roles of the centrifugal force (F_c) and angular force (F_a) on some points of the trajectory. To these, one must also add the gravitational force $-m.g_{//}(r)$ which maintains the closed orbit, of course.

As we know, as long as the body crosses the aphelion[11], the (⊥) force starts to contribute to the increase of the orbital speed, which will achieve a maximum at the *perihelion*: precisely where this force will be null again. Then, slowly it will increase again, but now reducing the orbital speed till it reaches the next minimum, which will be at the *aphelion* again. And the process repeats eternally if no energy is lost or exchanged with the "external world". That is, while $\underline{\mathcal{M}} = (\mathbf{0}, 0)$, meaning that the system is in a *stationary state*. It is also interesting to perceive from this that the only parameter maintained constant during all the elliptical trajectory[12] is the *angular momentum*. And this means that we can think of a *stationary state* having a *fixed* angular momentum but *different* levels of intrinsic body energy (kinetic). If we would be in the primordials of Quantum Mechanics we would probably feel tempted to look at $\underline{L}$ as the first quantum number, instead of "energy". In effect, $\underline{L}$ is what seems to define not only the geometry of motion but also the "determination" which keeps the stationary state stationary. In this perspective, the energy seems to be a secondary issue.

Another interesting aspect resulting from this description of motion is that at very long distances from the centre of observation these *angular* and *centrifugal* forces tend to be null, the motion reduces to a rectilinear motion, and equation (12), written in its coordinates, will reduce to:

$$(F_\perp, F_{//}) = (m \cdot a_\perp, m \cdot a_{//})$$

Or, in a different vectorial notation:

$$\underline{F} = m \cdot \underline{a}$$

(13)

This makes us look at Newton's definition of force as more appropriate to describe motion as a sequence of rectilinear contributions, where the concept of centrifugal force has obviously no place. But such a definition also implies several other definitions, as we know; one of them is the representation of kinetic energy as $(\frac{1}{2} \cdot m \cdot v^2)$,

---

[11] The position in its orbit more distanced from the center of gravitation. The opposite point is called *Perihelion*.

[12] In true, $\underline{L}$ is a constant in any "natural" trajectory, even in the simplest rectilinear motion. This means $\underline{L}$ is strongly associated with the geometry of the orbit.

something that also seems at odds with the $(m.v^2)$ term on the present approach[13].

5. Some basic examples of states of motion

In our perspective, any type of motion satisfying the equation $\underline{\mathcal{M}} = (\underline{0},\ 0)$ is to be considered a *stationary state*. Otherwise, it is a *transitory state*, that can even be an *equilibrium state*. A stationary state may therefore be described by the following "energy" equations (valid for all r):

$$\begin{cases} \underline{\mathcal{M}}_\perp = m\ .[d\underline{r}/dt] \times \underline{v} + m.\underline{r} \times \underline{a} = \underline{0} \\ \underline{\mathcal{M}}_{//} = m\ .[d\underline{r}/dt]\ .\ \underline{v} + m.\ \underline{r}\ .\ \underline{a} = 0 \end{cases}$$

Or alternatively by the force equations (for $r \neq 0$):

$$\begin{cases} F_\perp = m.\ (sin\beta).\ [dr/dt]\ .\ v/r + m\ .\ a_\perp = 0 \\ F_{//} = m.\ (cos\beta).\ [dr/dt]\ .\ v/r + m\ .\ a_{//} = 0 \end{cases}$$

(14)

As an exercise on the utilization of this *Geometric Law*, let us try analyse some simple cases of motion.

Circular uniform motion:

Since in this case, for a sufficiently large radius, we have $\beta = 0$ and no source of angular acceleration, it must hold that $[dr/dt] = v,$ and the previous equations (14) will naturally reduce to:

$$\begin{cases} F_\perp = 0 + 0 = 0 \\ F_{//} = m.v^2/r + m\ .\ a_{//} \end{cases}$$

(15)

from where we deduce that the condition for a stationary state is $(m.v^2/r = -m.a_{//})$. This is obviously the condition for orbiting, as we know. The centrifugal force is what compensates the centripetal force which restricts the motion to a circle. In the case of a gravitational system, the centripetal force is the gravitational force, given by $-m.g_{(r)}$. In this case, the restrictive force is acting on the body at distance, and it is compensated by the centrifugal force, thus the orbiting body will feel as if being acted upon by absolutely no force at all, similar to the situation of free fall or of moving in a

rectilinear path with a constant speed. Orbiting means tranquility, a kind of protection from the source of the "attractive" force[14]. Once the body orbits its attractive source, it is as if this source would have ceased to exist, at least while the body will be able to maintain its level of speed. And this is interesting, since in this way any laboratory in orbit can be considered an exceptional place for experiments in the absence of gravity, as in fact they are.

But there is a completely different situation of circular motion if the circular restriction is imposed not by a real force but instead by a spatial constraint, like a wall, for example, as in the curious wall of death, the Finnish fling, or the death loop by car, amongst others. Contrary to what happens during orbiting, in these cases the body feels a kind of rotation on the gravity vector acting upon it, which is simply the vectorial sum of the *normal gravity* (g) with the *centrifugal acceleration* induced by the circular restriction. And so, instead of feeling no forces, it feels a deformed gravitational field powerful enough to keep it from falling in the usual direction. Due to the reaction of the wall, the body feels in a situation of contact with the wall, as if it were being smashed into it. It is a state of *equilibrium*, not a *stationary state*, because there is tension. And this is precisely the opposite sensation of floating while orbiting. The force equations for these cases could generally be written as:

$$\begin{cases} F_\perp = 0 + 0 = 0 \\ F_{//} = m.\ v^2/r + m.\ g_{//} \\ F_z = -m.\ g_z \end{cases}$$

(16)

Notice that in the "*death loop by car*" the z equation does not exist[15], while in the other two cases we have $m.g_{//} = 0$ and only $m.g_z$ exists. Next figure (Fig. 3) helps to better visualize these forces. Since in the "*death loop by car*" the plane of rotation is parallel to the gravitational field (g), and no z direction is relevant due to the symmetry of the case, the radial equation will be

---

[13] The derivation of the formula for the kinetic energy starts by assuming *Work = F.dx = [d(m.v)/dt].v.dt = v.d(mv)*. . . thus, it considers generally valid *F = d(m.v)/dt* ... at odds with the present perspective of motion.

[14] Since there is no net acceleration, and $\underline{\mathcal{M}} = (\underline{0},\ 0)$, there will be no irradiation in the case the mass m is of an electron and the attractive source is coming from a proton, for example. Emission and absorption of radiation would only occur when passing from a stationary state to another (and different) stationary state, that is, while $\underline{\mathcal{M}} \neq (\underline{0},\ 0)$.

[15] The direction z is assumed here pointing in the same direction as the angular momentum.

$$F_{//} = m. v^2/r \ + \ m. g_{//} \qquad (17)$$

With $g_{//}$ obviously depending on the car's position: at the top ($g_{//} = -g$), at the sides ($g_{//} = 0$) and at the bottom ($g_{//} = +g$). This is the total radial action, so, in order to maintain the circular path the wall must be rigid enough to react with an opposite reaction ($\underline{R}$) and ensure it holds:

$$R_{//} = F_{//} \qquad (18)$$

In that case, we may write:

$$0 = m. v^2/r \ + \ m. g_{//} - R_{//} \qquad (19)$$

making the case apparently similar to a stationary state. However, it cannot be considered a stationary state since there is tension in the body. There is the reaction of the wall, and there is energy being dissipated through the wall due to it. Of course at the top position this reaction is minimal, and may even be null (the car would for an instant float) if the intensity of the centrifugal acceleration will exactly match gravity.
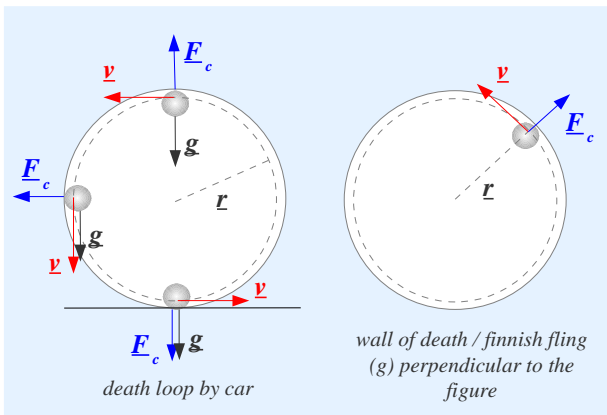
Fig. 3 Circular motion constrained by a wall and the rules of the centrifugal force (Fc) and gravity (g) at several points of the trajectory. Notice that for enough large radius the vector d$\underline{r}$/dt is at all times parallel to $\underline{v}$, thus b = 0.

In the second case (*Finnish fling*), gravity has only component in the z direction, no component in the plane of circular motion, so its parallel component is always null and the equations of motion may be written as:

$$\begin{cases} F_{\perp} = 0 + 0 = 0 \\ F_{//} = m. v^2/r \\ F_z = -m. g_z \end{cases} \qquad (20)$$

Again, the system will only be in equilibrium if the wall will be rigid enough to generate a force of reaction $\underline{R} = -(0, F_{//}, F_z)$, transforming the previous equations into something like an equilibrium state:

$$\begin{cases} 0 = 0 + 0 \\ 0 = m. v^2/r \ - \ R_{//} \\ 0 = -m. g_z \ + \ R_z \end{cases} \qquad (21)$$

Obviously, R_z is the *friction force*, which is very dependent not only on the type of wall but also on the intensity of the centrifugal force, through its *coefficient of friction*. The body will fall into the wall instead of into the normal gravitational field while it holds ($R_z > m. g_z$) of course, which is a very easy situation to achieve given the fact that centrifugal forces are very intense. As in the previous case, this must not be considered a stationary state. The reaction $\underline{R}$ cannot be compared to a force acting at distance, it is a force acting only on the surface of contact between the body and the wall. An electron in any of these situations would probably irradiate energy due to friction, or in the form of *phonons*.

Rectilinear uniform motion:
Rectilinear motion is a very interesting state of motion (Fig. 4). There are some mysteries. And the first question we could ask ourselves is: is there any angular momentum? And then we notice that not only is there angular momentum but the angular momentum is conserved along all the trajectory; like the area speed $\underline{r} \times \underline{v}$, precisely as in the circular motion case, for example. The shaded areas in the figure are equal. Thus, in what concerns angular momentum, a circle is the same as a straight-line.
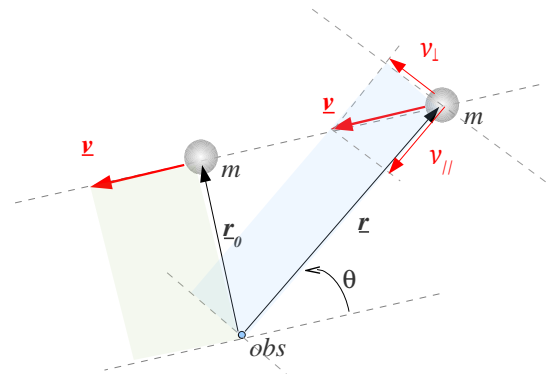

Fig. 4 Linear uniform motion, and its two components of velocity, *radial* and *angular*. At any point of the trajectory d$\underline{r}$/dt is parallel to $\underline{v}$.

The second question we may ask ourselves is: are there any forces involved? Before answering this question let us manipulate some concepts. From figure 4 we can say that the velocity is the vector $\underline{v}$ = $(v_\perp , v_{//})$, which we may write in terms of angle θ as:

$$\underline{v} = (v.\,sin\theta, -v.\,cos\theta) = v\,.\,(sin\theta, -cos\theta) \qquad (22)$$

Therefore, the acceleration $d\underline{v}/dt$ is given by:

$$
\begin{aligned}
d\underline{v}/dt &= [d\underline{v}/d\theta].[d\theta/dt] \\
&= v\,.\,[d\theta/dt].\,d(sin\theta, -cos\theta)/d\theta \\
&= v\,.\,[d\theta/dt].\,(cos\theta, sin\theta) \qquad (23)
\end{aligned}
$$

Since $[d\theta/dt]=\omega$ and we know that $\omega = v_\perp /r$, and $v_\perp = v.\,sin\theta$, we may write:

$$\underline{a} = d\underline{v}/dt = (v^2/r).\,sin\theta.\,(cos\theta, sin\theta) \qquad (24)$$

This is a vector always perpendicular to $\underline{v}$ with a magnitude of a *centrifugal acceleration*. It has a maximum along the radial dimension for $\theta = \pi/2$, when its angular component is null, and will be null at infinitum at both sides of the observer. This is obviously the vectorial sum of a centrifugal effect with an angular effect. And it is somehow funny that the same effect can precisely be computed (now in terms of force) by the equation:

$$\underline{F}_0 = (\underline{v} \times \underline{L})/r^2 \qquad (25)$$

So, what is the exact answer to the previous question? We haven't decided yet. But we can already imagine that the observer may probably put the body into orbit if he is be able to act upon the body with a force of the same magnitude as $\underline{F}_0$ projected onto $\underline{r}$.
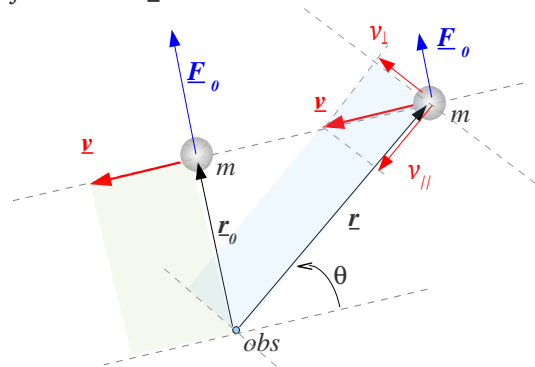

Fig. 5 Strange force in a linear motion due to $d\underline{v}/dt$.

But now we need to also include the effects of the derivatives of $\underline{r}$ in our equations of motion. For that, let us remind ourselves that the vectorial product of two generic vectors $\underline{a}$ and $\underline{b}$ can also be written as:

$$
\begin{aligned}
\underline{a} \times \underline{b} &= (\underline{a}_\perp + \underline{a}_{//}) \times (\underline{b}_\perp + \underline{b}_{//}) \\
&= \underline{a}_\perp \times \underline{b}_\perp + \underline{a}_\perp \times \underline{b}_{//} + \underline{a}_{//} \times \underline{b}_\perp + \underline{a}_{//} \times \underline{b}_{//} \\
&= \underline{a}_\perp \times \underline{b}_{//} + \underline{a}_{//} \times \underline{b}_\perp \qquad (26)
\end{aligned}
$$

And it holds, for the inner product:

$$\underline{a} \cdot \underline{b} = \underline{a}_\perp \cdot \underline{b}_\perp + \underline{a}_{//} \cdot \underline{b}_{//} \qquad (27)$$

Starting again from the general expression of the *Geometric Law of Motion* (5), we can write:

$$
\begin{cases}
\underline{r} \times \underline{F} = m.\{[d\underline{r}/dt]_\perp \times \underline{v}_{//} + [d\underline{r}/dt]_{//} \times \underline{v}_\perp + \underline{r} \times \underline{a}\} \\
\underline{r} \cdot \underline{F} = m.\{[d\underline{r}/dt]_\perp \cdot \underline{v}_\perp + [d\underline{r}/dt]_{//} \cdot \underline{v}_{//} + \underline{r} \cdot \underline{a}\}
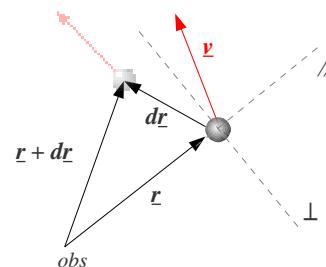\end{cases}
$$
$$(28)$$

And, in a scalar form[16]:

$$
\begin{cases}
r\,.\,F_\perp = m.\{[dr/dt]_\perp\,.\,v_{//} - [dr/dt]_{//}\,.\,v_\perp + r\,.\,a_\perp\} \\
r\,.\,F_{//} = m.\{[dr/dt]_\perp\,.\,v_\perp + [dr/dt]_{//}\,.\,v_{//} + r\,.\,a_{//}\}
\end{cases}
$$
$$(29)$$

In the case of linear motion it simplifies to:

$$
\begin{cases}
r\,.\,F_\perp = m.\{v_\perp\,.\,v_{//} - v_{//}\,.\,v_\perp + r\,.\,a_\perp\} \\
r\,.\,F_{//} = m.\{v_\perp\,.\,v_\perp + v_{//}\,.\,v_{//} + r\,.\,a_{//}\}
\end{cases}
$$
$$(30)$$

Using now the results from equation (24) and making a few mathematical manipulations:

---

[16] Some will argue that $d\underline{r}/dt$ always equals $\underline{v}$, therefore some terms we use in the *Geometric Law of Motion* would vanish. That is not true. Take for instance the *area speed*, given by $\underline{r} \times \underline{v}$, which is a constant of motion for a stationary or equilibrium state. Kepler noticed in the planetary case, and stated his *Law of the Areas*. If we take the derivative, we will have: $[d\underline{r}/dt] \times \underline{v} + \underline{r} \times [d\underline{v}/dt]$. From the figure, we can see that the first term of the derivative considers $\underline{v}=const$ and $\underline{r}$ changing; while in the second term $\underline{r}=const$ and $\underline{v}$ changes. It is therefore obvious that $[d\underline{r}/dt]$ does not have to be always parallel to $\underline{v}$.

$$\begin{cases} r \cdot F_\perp = m.\{ \ 0 + v^2. \sin\theta. \cos\theta \ \} \\ r \cdot F_{//} = m.\{ \ v^2 + v^2. \sin\theta. \sin\theta \ \} \end{cases} \tag{31}$$

$$\begin{cases} r \cdot F_\perp = m.\{ \ v^2. \sin\theta. \cos\theta \ \} \\ r \cdot F_{//} = m.\{ \ v^2 \ (1 + \sin\theta. \sin\theta) \ \} \end{cases} \tag{32}$$

$$\begin{cases} F_\perp = m.\{ \ v^2. \sin\theta. \cos\theta \ \}/r \\ F_{//} = m.\{ \ v^2 \ (1 + \sin\theta. \sin\theta) \ \}/r \end{cases} \tag{33}$$

$$\begin{cases} F_\perp = m. \sin\theta.\{ \ v^2. \sin\theta. \cos\theta \ \}/r_0 \\ F_{//} = m. \sin\theta.\{ \ v^2 \ (1 + \sin\theta. \sin\theta) \ \}/r_0 \end{cases} \tag{34}$$

We get to:

$$\begin{cases} F_\perp = m. \ (v^2/r_0) \ . \sin\theta.\{ \ \sin\theta. \cos\theta \ \} \\ F_{//} = m. \ (v^2/r_0) \ . \sin\theta. \ (1 + \sin\theta. \sin\theta) \end{cases} \tag{35}$$

And these are the components of the total force **_F_** acting the body, which can also be expressed as:

$$\underline{F} = m. \ (v^2/r_0) \ . \sin\theta. \ (\ \sin\theta. \cos\theta, \ 1 + \sin\theta. \sin\theta) \tag{36}$$

Mysterious... it seems there is something like an intrinsic "force" acting on the body even *before* the body is captured by the observer, dependent only on the speed of the body and its coordinates relatively to the observer. This force will have an intensity $2.mv^2/r$ (double the *normal* centrifugal force) when passing by the observer, which will then be reduced to mv^2/r if captured by the observer. If there is no observer there will be no force. So, the simple presence of the observer interferes with the state of motion of the body? It reminds us of the double slit experiment in the beginning of Quantum Mechanics. Could such a *very strange* behaviour be already impregnated in our macroscopic world? It is difficult to give an answer. Quantum Mechanics accepted such a *very strange thing* as a fact without explaining it, wouldn't it be equally correct to accept this strangeness too? Could Aristotle also be right, in some way? Perhaps this is not a force, but instead a potential? But it is neither a stationary state or an equilibrium state. It is the *free state of motion*. With some little manipulation we may deduce that the intensity of such a "force" is given by:

$$|\underline{F}| = m. \ (v^2/r_0 \ ). \sin\theta. \sqrt{\{1 + 3.\sin^2\theta\}} \tag{37}$$

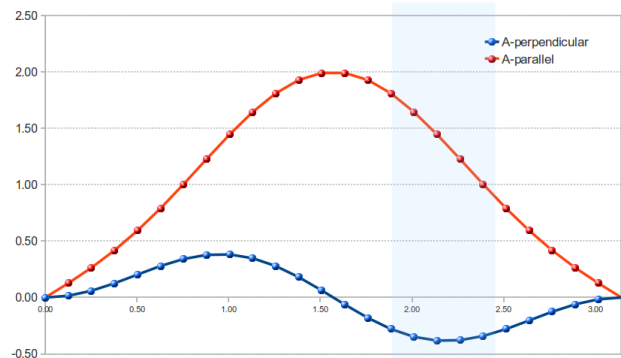while its components for $0 < \theta < \pi$ behave as:

Fig. 6 Strange *radial* and *angular* forces in a linear motion?

Intuitively, this graph seems to suggest that the best moment to capture the body into orbit would be around $\theta = 2.2$, the shaded zone in the figure.

Simplistic free fall (under gravity):

Free fall makes no sense, in our opinion, without first considering the entire movement of the body, including the way up through the space. The apple of Newton did not only fall. It was first of all slowly pushed up in order to rise in the gravitational field, and only after so doing did it fall. The whole process is one process. But it is not a simple process. In truth, it may be as complicated as elliptical orbiting, for example. So, let us start to simplify it and assume that, contrary to what figure 7 shows, there is only an impulse in the radial direction[17] with the objective of elevating the body against gravity ($g_{//}$). So, $v_\perp$ will be null and only $[dr/dt]_{//} \neq 0$, and our equations will reduce to:
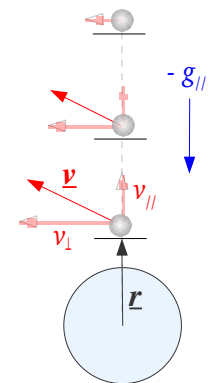

Fig. 7 Simplistic rise.

$$\begin{cases} r \cdot F_\perp = m.\{0 - 0 + 0\} = 0 \\ r \cdot F_{//} = m.\{[dr/dt]_{//} \ . \ v_{//} - r \ . \ g_{//}(r)\} \end{cases} \tag{38}$$

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[17] In effect, things are more complex since from the beginning. In the initial condition (at rest), the body is acted upon by a centrifugal force due to the spinning of the Earth which is not enough to compensate the gravitational attraction, so the equilibrium is only achieved by blocking its "fall" by means of a reaction ($R_{//}$) from Earth's surface. The equations:

$$\begin{cases} r \cdot F_\perp = m.\{ \ 0 + 0 \ \} = 0 \\ r \cdot F_{//} = m.\{ v_\perp . v_\perp - r . g_{//}\} = -r . R_{//} \end{cases}$$

From where we can say (since in this rectilinear case we have $[dr/dt]_{//} = v_{//}$) that the body is acted upon by a force $(m.v_{//}^2/r)$ surpassing gravity but decreasing with the distance. The body will stop and invert its motion when this force will precisely match the gravitational force of the actual position of the body, that is, when $F_{//} = 0$:

$$\begin{cases} F_\perp = m.\{0 - 0 + 0\} = 0 \\ F_{//} = m.\{v_{//}^2/r - g_{//}(r)\} = 0 \end{cases} \quad (39)$$

What is to say, when:

$$v_{//}^2/r = g_{//}(r) \implies v_{//} = \sqrt{\{r \cdot g_{//}(r)\}} \quad (40)$$

This is the condition for transporting the body from $r = 0$ till a generic r along the radial dimension through the gravitational field. It is interesting to notice that this will not free the body from the source of attraction (gravitational), nevertheless, it is precisely the same value as the condition for orbiting at the same distance, which is:

$$v_\perp^2/r = g_{//}(r) \implies v_\perp = \sqrt{\{r \cdot g_{//}(r)\}} \quad (41)$$

Since in the orbiting situation the body is already "angularly" free from the source of attraction, it is not difficult to imagine that it will get *completely free* from the attractive source when these two conditions hold: free in the *angular* sense and in the *radial* sense (here we consider only two degrees of freedom). That is, when it moves with a velocity (v) with the same radial and angular components, that is, when:

$$\mathbf{v} = (v/\sqrt{2}, v/\sqrt{2}) = (v_\perp, v_{//}) = (v_{orb}, v_r) \quad (42)$$

This velocity is usually called the *escape velocity* (v_{esc}) and from here it becomes obvious it must hold that:

$$v_{esc} = \sqrt{2} . v_{orb} \quad and \quad v_{esc} = \sqrt{2} . v_r \quad (43)$$

$$v_{esc}^2 = \tfrac{1}{2} v_{esc}^2 + \tfrac{1}{2} v_{esc}^2$$

$$\begin{cases} m. v_{orb}^2 = \tfrac{1}{2} m. v_{esc}^2 \\ m. v_r^2 = \tfrac{1}{2} m. v_{esc}^2 \end{cases} \quad (44)$$

$$m.v_{esc}^2 = m. v_{orb}^2 + m. v_r^2 \quad (45)$$

Could this equation be more simply stated as: "the total mechanical energy needed to free a body from a source of attraction is the sum of the energies needed to free it from each of the degrees of freedom".

When it reaches the maximum distance on its trajectory, the body has lost all its centrifugal power, and from then on it will be acted upon only by the gravitational force, which will bring it back to the Earth's surface. It is like an elastic with an elastic constant dependent on r. Since in the process of *free fall* no tension exists in the body (no contact forces of reaction[18]), the body will have again the impression of floating. But only till it reaches the surface, where suddenly it will feel the force of the impact ($R_{//}$) as being precisely the same as that with which it was launched upwards ($m.v_{//}^2/r$). So, during the free fall, the motion is simply governed by:

$$\begin{cases} F_\perp = m.\{0 - 0 + 0\} = 0 \\ F_{//} = m.\{- g_{//}(r)\} \neq 0 \end{cases} \quad (46)$$

And when it hits the ground, this equation must be converted into an equilibrium equation by means of the reaction of the Earth's surface:

$$\begin{cases} F_\perp = m.\{0 - 0 + 0\} = 0 \\ F_{//} = m.\{- g_{//}(r)\} = - R_{//} \end{cases} \quad (47)$$

If there is no loss of energy, we will have:

$$R_{//} = m.v_{//}^2/r \quad (48)$$

If the Earth would be a *ghost mass[19]*, however, the body would continue into the centre of the Earth, traverse to the other side, and then return, and it would eternally oscillate between the positions $+r$ and $-r$ almost as an harmonic oscillator. That already would be a *stationary state*. And if we now imagine a certain amount of angular force acting on the body during that period of time, it is not difficult to visualize an elliptical trajectory being described around the centre of attraction. All types of movements seem simply different expressions of the

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[18] If the body is inside a case, both the case and the body accelerate from zero speed, thus, no forces will exist between them.

[19] We like to use this term to mean a gravitational effect produced by a mass which does not create any material restrictions to motion.

same thing.

In reality, the free fall is more complex than this, there is also a centrifugal energy due to the angular velocity of the rotating Earth, which also contributes to the elevation of the body in the gravitational field [20], and the Coriolis effect that helps to ensure the constancy of the total angular momentum.

6. The Geometric Law in matrix format

There may be several forms for representing these geometric equations of motion. We have already mentioned the Geometric Algebra representation, which compacts them and reduces them to the concept of a *spinor*[21], but also they can be written in the form of an abstract vector $\underline{M}$ with *angular* and *radial* components, and use the usual algebra. The matrix notation, however, seems also interesting, at least because it shows the system in a clearer perspective. In effect, we may also write these equations in the general form:

$$\underline{M} = r.\begin{bmatrix} F_\perp \\ F_{//} \end{bmatrix} = m.\begin{bmatrix} v_{//} & -v_\perp \\ v_\perp & v_{//} \end{bmatrix}\begin{bmatrix} [dr/dt]_\perp \\ [dr/dt]_{//} \end{bmatrix} + m.\,r.\begin{bmatrix} a_\perp \\ a_{//} \end{bmatrix}$$

(49)

In which $\underline{M}$ is now a vector related to the sum of the acceleration vector ($\underline{a}$) with the vector resulting from the operation of the actual *velocity matrix* over the displacement vector ($d\underline{r}/dt$). Notice that Newton is only related to the shaded part of this equation. We can now clearly see that the *modifier* of the state of a system can be computed as long as we know the actual velocity ($\underline{v}$), the acceleration ($\underline{a}$), the distance to the observer (r) and the displacement tendency ($d\underline{r}/dt$) due to any sort of actions. We may therefore represent the *new state* ($\mathbb{S}$) of our system as:

$$\mathbb{S}(\underline{L},\, \boldsymbol{s}) = \mathbb{S}_0(\underline{L}_0,\, \boldsymbol{s}_0) + \int \underline{M}.\, dt$$

(50)

where ($\underline{L}=\underline{r}\times m\underline{v}$) is the angular momentum (or angular action) and ($\boldsymbol{s}=\underline{r}.m\underline{v}$) is the same concept of action used in the Lagrangian mechanics (radial action). In this way we would represent the state of a system based on a single and generic concept of *action*, instead of based on angular momentum and

energy, as Quantum Mechanics does, for example. Such a perspective seems also interesting when we review the elliptical motion: if what defines a state is *action*, then a stationary state implies a constant action in each dimension, or degree of freedom. That is, a state is stationary only if it holds $\underline{L}=\underline{r}\times m\underline{v}=const$ and $\boldsymbol{s}=\underline{r}.m\underline{v}=const$. When this is not true[22], we may consider the system evolving from a state to another state. In the elliptical motion, $\underline{L}$ is a constant along all the trajectory, but not $\boldsymbol{s}$. In fact it happens that $\boldsymbol{s}$ = 0 at the *perihelion* and the *aphelion* (see Fig. 8) and it changes between these points. In the case of a pure circular orbit, however, pointed by Galileo as the ideal orbit, both $\underline{L}$ and $\boldsymbol{s}$ are kept constant along all the trajectory. This would make us look at the elliptical trajectory as a kind of a degenerated circular motion which continuously oscillates along two different *pure* stationary states, $\mathbb{S}_0$ and $\mathbb{S}_1$, which in fact are circular orbits, as shown in the figure:
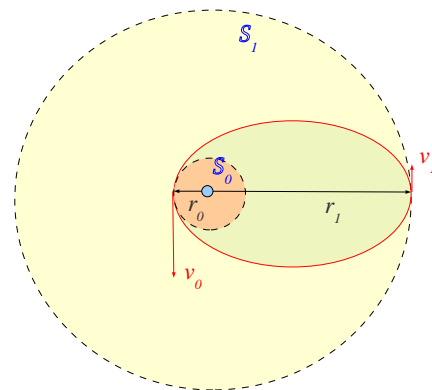

Fig. 8 An elliptical orbit as a perpetual oscillation between two circular states, $\mathbb{S}_0$ and $\mathbb{S}_1$, of different kinetic energies but the same angular momentum.

If for some reason we are not interested in the parametric trajectory but instead on its geometry, and on the distribution of the probabilities of finding the body in the space around the gravitational centre, we can expect such probabilities $Pb(\mathbb{S}_i)$ to be proportional do the radius of each pure state. So, we would approximately write:

$$\mathbb{S}(\underline{L},\, \boldsymbol{s}) = Pb(0)\, \mathbb{S}_0(\underline{L}_0,\, \boldsymbol{s}_0) + Pb(1)\, \mathbb{S}_1(\underline{L}_0,\, \boldsymbol{s}_0)$$

(51)

which is a superimposition of those two pure

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[20] In reality, this velocity is around 1800 Km/h, but the centrifugal effect is very small due to its long distance to the center of the Earth.

[21] A *spinor* in the conjunction of a *scalar* and a *bivector*, which is a n-dimensinal *rotator* of vectors, in this case a two dimensional rotator.

[22] It is interesting to notice that if we consider m constant, $\underline{L}$ = *const* and $\boldsymbol{s}$ = *const* means $\underline{r}\times\underline{v}$ = *const* and $\underline{r}.\underline{v}$ = *const*, which again shows that the the pair $\underline{r}$ and $\underline{v}$ are a kind of "conjugate" rulers of all motion.

states. To each pure state obviously corresponds a different kinetic energy of the body. Now, since the angular momentum is constant, we must have:

$$r_0 . m . v_0 = r_1 . m . v_1 \tag{52}$$
$$v_0 / v_1 = r_1 / r_0$$
$$m . v_0{}^2 = (r_1/r_0)^2 . m . v_1{}^2$$

$$E_1 = (r_0/r_1)^2 . E_0 \tag{53}$$

Or, using the proper angular speed ω:

$$\omega_1 = (r_0/r_1)^2 . \omega_0 \tag{54}$$

which leads us to conclude that it makes real sense to use energy (E) and the pair (L, E) to represent the states of a system, instead of the pair (L, s) as we previously thought. If now $Pb(1)/Pb(0) = r_1/r_0$, as we have suggested, the elliptical state may be written in terms of the kinetic energies of its *pure states* as:

$$\mathbb{S}(L, E) = (r_0/r_1).Pb(1). \mathbb{S}_0(L_0, E_0) + Pb(1). \mathbb{S}_1(L_0, E_1) \tag{55}$$

Or, equivalently, in terms of their angular speeds:

$$\mathbb{S}(L, \omega) = (r_0/r_1).Pb(1). \mathbb{S}_0(L_0, \omega_0) + Pb(1). \mathbb{S}_1(L_0, \omega_1) \tag{56}$$

This, of course, reminds us of Quantum Mechanics. Of course there are many ways and models that can be used for representing motion, but this seems a very simple way for representing it geometrically, if needed. Such as when very high velocities or very strong forces are involved that make us lose our usual perception of time, for example. In that case, each *pure state* (a circle) would simply be governed by a force equation of the type[23]:

$$\begin{bmatrix} F_\perp \\ F_{//} \end{bmatrix} = m. \begin{bmatrix} 0 & -\omega \\ \omega & 0 \end{bmatrix} \begin{bmatrix} [dr/dt]_\perp \\ [dr/dt]_{//} \end{bmatrix} + m. \begin{bmatrix} a_\perp \\ a_{//} \end{bmatrix} \tag{57}$$

with $F = (0, 0)$. That is, we would live in a world of an infinite number of circles, with masses jumping from the present circles to the next circles.

But, what would happen if a gravitational wave of the same period of the orbit (circular) of the body would for some time induce a forced movement into the body? Since that would be a resonant process, we could expect the body to quickly absorb such an interference and transform it into a positive angular acceleration, and kinetic energy, which would make it jump into a more external orbit where a new equilibrium could be established for the system. Since this was a gain of energy coming from the "external world", the total angular momentum of the system would increase accordingly. But we know that there are two ways of increasing angular momentum: by maintaining the orbital radius and increasing the orbital speed; or by maintaining the orbital speed and increasing the orbital radius. The *Geometric Law of Motion* seems to allow both mechanisms to exist. It may in fact be regarded as a kind of a *state-like-machine*, as shown in the next figure (for the simplest cases of circular orbits).
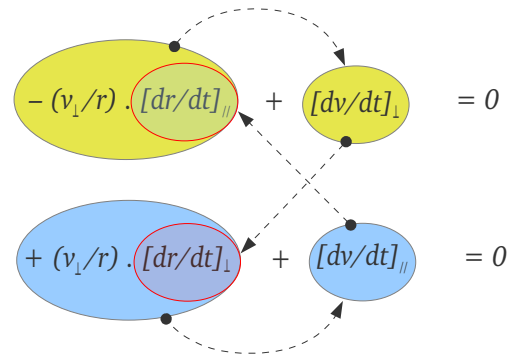

$$- (v_\perp/r) . [dr/dt]_{//} + [dv/dt]_\perp = 0$$
$$+ (v_\perp/r) . [dr/dt]_\perp + [dv/dt]_{//} = 0$$

Fig. 9 *Geometric Law of Motion* as a cinematic *state-like-machine*. Here representing the acceleration exchanges in the case of circular orbits.

Thus, in the case we are describing, the external interference would have entered the system through the $[dv/dt]_\perp$ *state*. This *state*, also called *activity*[24], is responsible for increasing the angular velocity and then passes the control to the *centrifugal-activity*, which forces the body to change its orbital radius against the attractive gravitational force (this, a negative $[dv/dt]_{//}$). While these two forces do not cancel each other, the $[dv/dt]_{//}$ activity is producing a certain change in $[dr/dt]_{//}$, and then the control is passed to the *Coriolis-activity*, which will produce an

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[23] Assuming the pure state as a circle, $v_{//} = 0$ and $w = v_\perp / r$.

[24] The word "state" is used in cybernetics to mean a particular form of *activity* in a *process*; a *state-machine* operates by establishing cycles through those *activities* or *states*. But here we will use the word *activity*.

acceleration in the opposite direction of the external interference, on trying to compensate it. And the process will continue till the moment the *centrifugal-activity* plus the *gravitational-activity* result in an null outcome. At that moment, all the energy received from the "external world" will be stored in the system in the form of potential energy. And the system is now in an *excited state*. Probably the mass is even moving at the same orbital velocity as before, since the strategy used for conserving angular momentum was the changing of *r*, instead of the changing of *v*.

If in reality this works like this or not we do not know yet. But if this mechanism happens to be true, much can be understood on the stability of orbital motion. In effect, in this way the system would naturally fall again into the previous orbit if such a stored potential energy would be lost by some sort of interaction, or even by the emission of energy into the "external world". Another very interesting thing is that by such a theory of motion electrons should not be considered accelerated particles while moving in their orbitals.

7. From the world of the astronomic slow into the world of the microscopic fast

This last section we reserve to some discussion and exercises of imagination. We first will try to imagine us flying around our solar system, where distances are enormous and time and motion are apparently slow, and then dive from such an astronomic world into the inside of matter and the domains of atomic and electronic speeds and forces, where Quantum Mechanics rules. Why are there *p-type* orbitals in the atomic world, while they seem not to exist in the planetary world, for example? That is still under study, but who knows if these thoughts will help someone resolve such a mystery.

Earth and the solar system:

It does not seem so strange that many people sometimes compare our solar system to a kind of a giant atom of astronomical dimensions, with the Sun at the center of its narrative. In the core of this atom is this star with a mass of more than 300 000 times the mass of the Earth. In fact, practically 99,9% of the mass of this atom belongs to the Sun. Mean distances from the centre of rotation to the principal

planets vary from 0,4 *Astronomic Units* (AU)[25] in the case of Mercury, to 34UA in the case of Pluto. The Sun rotates with an equator velocity at its surface of near 2 km/s, while the other principal planets follow the tendency presented in figure 10. The orbital speeds, however, vary from near 48Km/s in the case of the faster Mercury (0,02% of the speed of light), to 30Km/s for the Earth, and 4,5Km/s for Pluto. So, this already can give us an idea of the distances and velocities that will be involved in our equations of motion. Even if Earth, for example, moves through the space at the incredible velocity of 30Km in a second!, in that second, however, there is practically no increase in the vector position of the planet, due to its long orbital radius. This means that at all times the term $d\underline{r}/dt$ is parallel to $\underline{v}$ and $v_{//}$ is basically null. So, orbits around the Sun tend to be mainly circular. A solar system is an "atom" principally made of *s-type* "orbits".
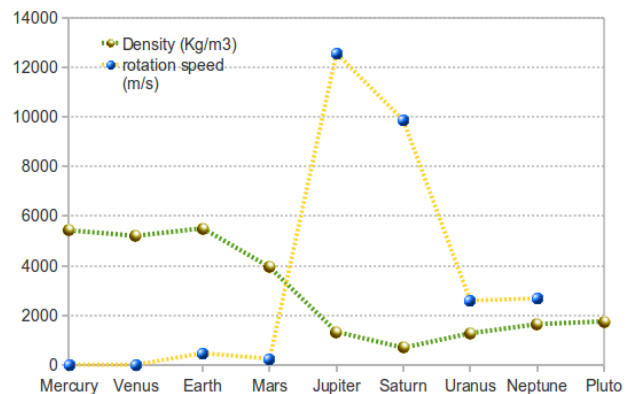

Fig. 10 Density and rotation speed (at the equator) of the principal planets of our solar system. Denser planets orbit more near the Sun, and have smaller spins than outer planets. All the orbital angular momenta are approximately perpendicular to the ecliptic, except that of Pluto. We wonder if these celestial bodies could have been expelled by our Sun, and our solar system would be a kind of mother with their children moving around, contrary to what *Capture Theory* defends, for example. Some have a view of the universe as a kind of world of debris that slowly reorganize after a sequence of explosions, in order to return to order again; but we have a vague intuition that the universe is nothing like that. It is much calmer and subtle. It is even an intelligent process, something evolving by means of a superior logic based on mechanisms of subtleties, instead by the continuous disorder induced by explosions. But that is already Cosmology.

And what happens when gravitational forces get extremely strong and the radius of the orbits are only some thousand kilometres, as in the centre of a

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[25] 1 AU is the distance from Earth to the Sun, near 150 000 000 Km.

galaxy, for example? Is it wise to expect orbits to still be either circular or elliptical? The simple fact that the gravitational forces become extremely intense makes such a region approach a highly bounded structure (more in the direction of a liquid, for example), therefore more the motion will resemble that of the interior of a [rotating sphere] under an intense internal gravity, like in the case of a star, for example. In such an ambience, more and more the centrifugal, Coriolis and Euler forces will be strong, and will interfere in the motion of the bodies and drive them into trajectories that would never been expected in the case of planetary motion. The laws, though, are the same. But in such an extraordinary situation, motion becomes much more diversified and [strange], precisely as it happens in the interior of a "rotating world". Thus, probably even *p-type* orbits will exist near the center of a galaxy. In effect, we even believe that the *orbit regulatory scheme* is the same scheme responsible for these complex types of orbits.

A question of perception:

But we may also question ourselves about how much do we perceive from such an astronomical world. In the period of a second, practically nothing happens for a human in the state of motion of a solar system. Things seem to happen so slow that it would be needed an incredible amount of memory to record all such a motion, and most of the time with very similar data, therefore uninteresting from the point of view of a human being. We know from day-to-day experience that we have some difficulties for perceiving very slow motions.

But, how much do we really perceive in what concerns oscillation, timed events, frequency? Events under 0.01Hz, for example, became so slow that our brain seems to get bored and gives up the attention. Extremely slow movements are almost undetectable by most people. Our brains only start to capture pressure oscillations (sound) above, say, 0,1Hz, and when it reaches 20KHz it is already to much stimulus to process. Dolphins and some other animals are more "intelligent", in that sense. So, if humans are not able to process a sound above 20KHz, it is also difficult to believe it would be able to process some other kind of stimulus above this same frequency. After this frequency, perhaps our cells still be able to feel something, but not our main processor. This,

seems instead to start relying on indirect effects, like intensity, destruction, etc. Humans are systems that perceive frequency from say 0.1Hz till 20KHz.

But, for the sake of this exercise, let us compute the ratio of a *typical velocity* over a *typical radius* and call it *typical-frequency*. For the Earth moving in its orbit we have:

typical-frequency = (1/2π).(30 Km/s)/(150 000 000 Km)
typical-frequency = 3 x 10⁻⁸ Hz = 0,03 μHz

This frequency is so small that we could never "dedicate our time" to it. It would be a waste of time. Even the *typical-frequency* related to the spinning of Earth is only around 10 μHz. And of course it is even more difficult for us to capture the details of the motion of the years, and even worse of the decades, and centuries, and millennia. We have absolutely no mental structure to even guess what millions of years of existence means, we have no time for it. Neither to absorb the dimensions of even a single galaxy. We cannot even undoubtedly perceive that our ancestors were in fact real. We live in an illusion, an illusion which is real, in our time. Time, as humans sense it, seems not to be an important parameter for the universe of the infinitely large, neither for the universe of the infinitely small, which, in fact, are the same... as ours. This magnificent circularity is what always confuse human beings.

Bohr's atom and *p-type* orbitals:

As long as we dive into the matter and approach the atomic world, velocities substantially increase while masses are millions of times reduced[26]. But distances are reduced millions of times more than masses[27]. The big change is in fact in space; perhaps it is really curved. The *typical-frequency* for Bohr's atom is around:

$f_{typical} = (1/2\pi).(2 \times 10^6 \ m/s) / (10^{-10} \ m) = 3 \times 10^{15} \ Hz$

Something which is not understandable from the human perspective. If in a simulation process each

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[26] Surprisingly, the velocity of Bohr's electron (2 x 10⁶ m/s) is only around 67 times the orbiting velocity of the Earth. And that represents 0,7% of the speed of light. But the mass of the electron (9,1 x 10⁻³¹ Kg) is already around 1,5 x 10⁷ times smaller than the mass of the Earth.
[27] The Bohr's radius (10⁻¹⁰ m) is around 58 x 10¹⁶ times smaller than Mercury's orbital radius.

rotation of the Borh's electron would last 1 second, we would need 100 000 millennia to simulate only 1 second of the real time of the atom! When we enter the subatomic world our concept of time also loses meaning. Therefore it seems an excellent idea to forget time and try understand things in terms of geometry and the possible evolutions of state of such a geometry. Quantum Mechanics is, without doubt, fascinating because of that.

So, in the case of the atomic and subatomic world, orbits are so small and being processed so fast that in all situations our equations of motion will have to be considered in their general form, even in the case of circular orbits. This is because dr/dt will have components both parallel and radial, as well as in many cases v will have both components too. The description of the atomic world naturally allows more possibilities of motion than the astronomic world. And, in these possibilities it is also included all those strange behaviours detected in the interior of spinning platforms, where particles can in fact be found describing orbits not even crossing the centre of rotation, precisely as it happens in the *p-type* and *d-type* orbitals, in the quantum description. This is due to the high intensity of the centrifugal, Coriolis and Euler effects, acting in those circumstances.

The singularity of $r = 0$:

In the present description of motion, $R = 0$ is a very special point. It is a *singularity*. This singularity is expected, not from the force equations, which are only valid for $r \neq 0$, but from the original torque and work equations, represented in the matrix format as:

$$\underline{\mathcal{M}} = r. \begin{bmatrix} F_\perp \\ F_{//} \end{bmatrix} = m. \begin{bmatrix} v_{//} & -v_\perp \\ v_\perp & v_{//} \end{bmatrix} \begin{bmatrix} [dr/dt]_\perp \\ [dr/dt]_{//} \end{bmatrix} + m. \; r . \begin{bmatrix} a_\perp \\ a_{//} \end{bmatrix}$$

(58)

From these, we can see that $\underline{\mathcal{M}}$ vanishes at $r = 0$, and the equation leads to the obvious true $0 = 0$, a *null singularity*. We would expect, therefore, that a sort of exchange in dimensions exist in the centre of a system with an intense gravitational field, as if both the *radial* and the *angular* dimensions would collapse and transform into a single *linear dimension* along the angular momentum vector, the z direction. Any particles entering this zone (which must be a zone of very low density, almost a vacuum, since less dense matter also tends to move into the centre of

rotation) will experience a constant oscillation back-and-forward perpendicular to the plan of the matter, as in a kind of gravitational *maser*. Due to the need of conserving energy and matter, we may expect this to be a kind of an oscillator for matter and energy where from eventually a beam can emerge. The centre of a galaxy would, in this way, be a powerful gravitational *oscillator* operating along z direction, which in certain conditions will be able to expel *matter* and *energy* into both sides perpendicularly to the galaxy:
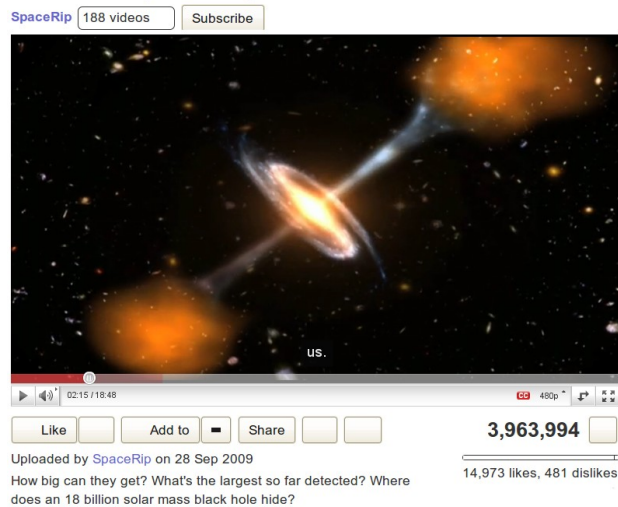

Fig. 11 A suggestive image of a galaxy with a "black-hole" at its centre expelling matter and energy along both sides of z direction, the direction of total angular momentum. Screenshot taken from the *YouTube* video: http://youtu.be/cW7BvabYnn8

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5. Jaap Suter , (March 12, 2003), "*Geometric Algebra Primer* ", published at http://www.jaapsuter.com/

6. The airplane test with coffee and ice tea:
http://youtu.be/tOZEgKXJMCE

7. Cars and motorbikes driving around a curved wall:

http://youtu.be/hZOekFFSoWI

Apparently Deriving Fictitious Forces

Centrifugal, Coriolis and Euler forces. Their meaning and their mathematical derivation

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clic-to-contribute

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ABSTRACT

Since neither Galileo's Law of Inertia nor Newton's Second Law hold true in an accelerating frame of reference (which here we call the "accelerated world"), several challenges arise when trying to describe the movement of bodies in such a type of referential. In simple cases, mainly when the acceleration of the referential is a constant vector in the "inertial world", that is, when there is no acceleration on the acceleration, things become simple because such a vector can be seen by the accelerating observer as coming from a "fictitious" external force in the opposite direction to the force he feels. Why fictitious? Simply because he does not know where it is coming from or what causes it. But, in cases where this referential is subject to an acceleration that accelerates, when seen from the inertial space, things get much more complex to interpret, and all sorts of "fictitious" forces are usually evoked to explain the physics of the accelerating world. Perhaps the case with most academic debate since olden times is the spinning world, from which the concepts of centrifugal, Coriolis and Euler forces result. These are usually considered "fictitious" forces, in order that the laws of physics can be minimally understood from the point of view of the two worlds. This article is not only a discussion on these concepts but also an effort to explain them better, and reclassify them as real and not fictitious. We also argue that the centripetal force which spins the accelerated world is, in fact, a fictitious force.

1. Introduction: the accelerating train

Although our final objective is to study the spinning world, we find it somehow useful to start with the simple case of a linearly accelerating train, where we imagine an observer looking at a mass suspended from the ceiling by a string. The train is running in complete darkness outside, therefore the observer has no means of knowing what is happening in the exterior world (which for simplicity we consider as being an inertial world).

It is usually argued that the observer sees the string making an angle with the normal of the compartment during a period of acceleration. We believe, however, that the observer will not notice any difference between the normal of the compartment (which is given by the direction of his own body standing) but instead a kind of rotation of the whole compartment through an angle θ, as figure 1 suggests, making him feel as if he is standing under gravity on an inclined plane (with a very slight increase in gravity).
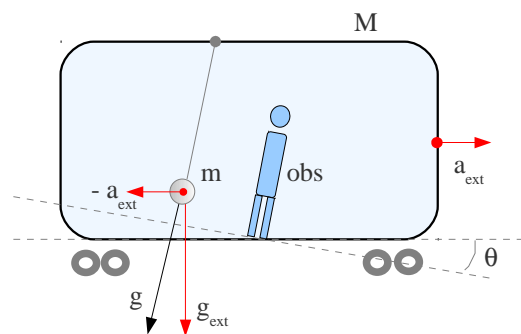

Fig. 1 A wagon of a train accelerating (a_{ext}) with a mass m suspended from the ceiling by a string, and an internal observer, as seen from an inertial world (outside world). M is the total mass, including the wagon, the observer and the mass m.

Thus, for this observer any external forces acting upon the objects surrounding him, and himself also, may all be classified as "fictitious", since they cannot even be distinguished from the situation of someone running up a mountain and with a small increase in the force of gravity. This means that in a certain sense, a rotation and a linear acceleration can be thought of as almost equivalent. Notice that when the net gravity (g) of the accelerated world will be null, the accelerated observer will obviously float, whilst accelerometers would measure zero gravity (0G). When the observer starts levitating, the internal g must be negative, the new gravity is now coming from the ceiling, it is inverted; however, that is not a good sign: it means the wagon is falling even faster than in a free fall situation. That would cause a local *anti-gravity* effect, but not a very interesting one. The exceptional one would be to produce *anti-gravity* in the inertial world.

Focusing on this case, we must notice, however, two interesting things: 1) the string with the mass is inclined to its left, while the observer is inclined to its right. Who is pointing in the direction of the "true" force? While some experiments with rotating objects use a candle (flame) to highlight the "centripetal" force acting on the object, others use a suspended mass to indicate the "centrifugal" force acting on the object. In fact, they are both inclined to the same side. The differences are apparent and only due to the fact that in the first case the fixed point is up, and in the second case it is down, relative to the "free" object[1]. 2) The force acting on the train ($M.a_{ext}$) is, in the perspective of the inertial world, the true force, because it is obvious that it makes the train gain space along its direction of application. But, would it still be considered a true force if the train would not gain space in that direction? We don't believe so. In that case we would call it a fictitious force.

So, in the perspective of the observer inside the train all these "fictitious" external forces that he does not feel are reduced to an inclination of the plane of the train and a small increase in gravity. Of course, if after the journey this observer meets with an inertial observer and tells him: "at some time, you must have seen that the train was inclined upwards...", the

inertial observer would think that maybe he was a bit tired. But only if he was not aware of the subtleties of Physics, of course. The relevant question is: was there anything fictitious in the experience of the first observer? Of course not. What he felt different from the inertial observer was the accelerated world as it is, while the other had been standing in an inertial world as it is. But, could they ever manage to understand each other's narratives after some conversation? Yes, absolutely.

2. Going with the carousel, under gravity

We suppose now that our accelerated world is a carousel spinning horizontally, in an inertial world with g_{ext} gravity, and made from a series of masses m interconnected along its radius as suggested in the next figure (Fig. 2). There is an observer inside the rotating world and there are two observers in the inertial world. The rest of the inertial world is again in complete darkness, therefore only these elements can be seen.
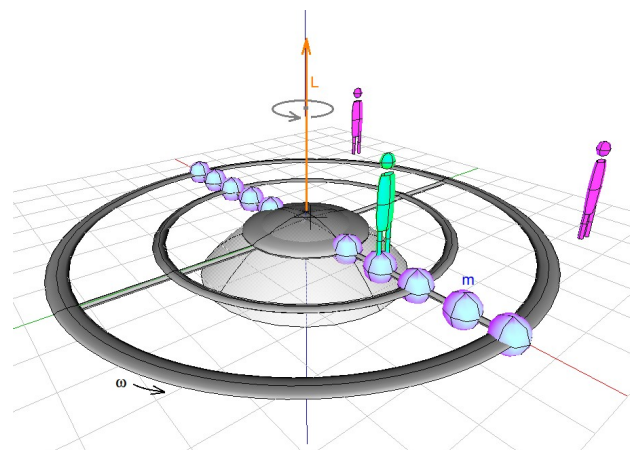

Fig. 2 The spinning world moving around with an angular velocity **ω**, under gravity g_{ext}, observed by two observers in an inertial world. Each sphere of the rotating world has mass m, while the rest of the structure has no mass. The moving observer is considered to be allowed to move only from sphere to sphere.

Let us now try to imagine how the observers see the two worlds. For each of the inertial observers the spinning observer is simply rotating around an axis if distant from the centre of the carousel, or rotating about himself in the case of being located at the centre. Both the inertial observers agree on what they see, although they cannot really understand which world is rotating. The same impression would be felt if the spinning world would be stopped and

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[1] A simple video we have made to demonstrate this effect can be watched at: http://youtu.be/KWvJHdNaPV4

their world rotating with the angular speed $-\omega$. If the spinning observer is moving back and forth between spheres, the inertial observers will see him moving in a kind of an oscillatory motion inscribed on a circumference. But they still do not know which world is responsible for such an oscillation. The situation is ambiguous. And they feel nothing special in their bodies that may help resolve such an ambiguity.

The spinning observer, standing on a sphere, in principle feels precisely the same ambiguity, even if what he sees is quite different: the two "inertial" observers are rotating to the right with an angular speed $-\omega$, but if he fixes his eyes in their direction they will appear oscillating radially, or even running in circles with radius dependent on their speeds, precisely as if each of them would be on his own carousel. But, could the spinning observer feel something in his body that leads him to resolve such an ambiguity? Usually it is argued that the answer to this question is "no". We believe the answer is "yes", as long as none of the observers are located at the centre of rotation: firstly, as in the case of the train, the spinning observer will feel inclined as if the path to the centre of rotation would be upwards, as if he were on a cone:
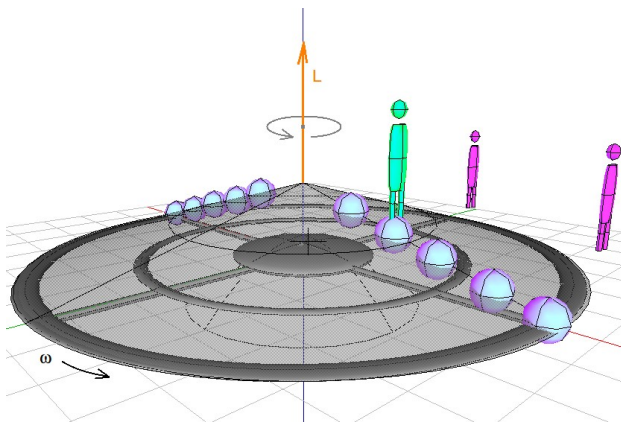

Fig. 3 The spinning world as a creator of "potential energy".

But, since he will also notice an incline in the bodies of the other two observers, the ambiguity is maintained. The new question he asks himself is: are they inclined or is it me that is inclined? And he finds a way to resolve this: if such an inclination makes them feel pushed into changing their distance in respect to the centre of rotation, but not me, then they are rotating and I am not. In the opposite case,

I am rotating and they are stationary. If such a push is felt by all of us, then all of us are rotating[2]. But then he finds even another way to resolve it: if while moving to an adjacent sphere he feels a lateral force acting on his body, he at least knows he is rotating. More aware of the subtleties of physics, but still confused anyhow, he asks himself a final question, while remembering the accelerating train situation: is the centripetal force, acting on the sphere where I am standing, a real force? And he finds yet another answer: since such a "force" does not make the sphere gain space in its direction, it will obviously be considered an apparent force; which may even be replaced by a circular restriction to motion. The other force, that is, the one pushing him out of the carousel, as could even be confirmed by the inertial observers, is a real centrifugal force. So he concludes that in this case the centrifugal force is a real force, and is a reaction to a radially constrained motion. On returning to the inertial world, he may also conclude that spinning under gravity creates a kind of deformation in the net gravitational field with the opposite tendency of a gravitational attraction: a gravitational repulsion. Satellites probably move in between these two types of fields. But, in reality, is the rotational field of conical shape? In fact it is a parabolic surface, precisely as in the case of the gravitational field[3]. Of course under no-gravity only the horizontal components of these feelings would exist.

Since the two observers in the inertial world did not undergo any special gravitational effect, it seems reasonable their insistence that such a "centrifugal" force is nevertheless a fictitious force. The only force applied to each sphere, even if the sphere was not moving in direction of it, was a force pushing into the direction of the center of rotation. This force was what was able to move mass away from its tendency to move rectilinearly, as each sphere would do in the absence of such a force. The sphere, animated by the velocity $\underline{v}$, would tend to continue in that direction, should this centripetal force not exist.

The other observer, however, not so convinced by

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[2] Here we consider only static observers in relation to their world. This would obviously turn much more complex if we consider them able to move around freely.

[3] There is an important difference between a spinning world and an orbiting world, of course: in the first case the angular velocity ω is constant along r, while in the second case this is not true, it depends on the centripetal acceleration.

these arguments, has decided to propose one last experiment, this time under no gravity, and the apparatus of the carousel was modified as shown in the next figure:
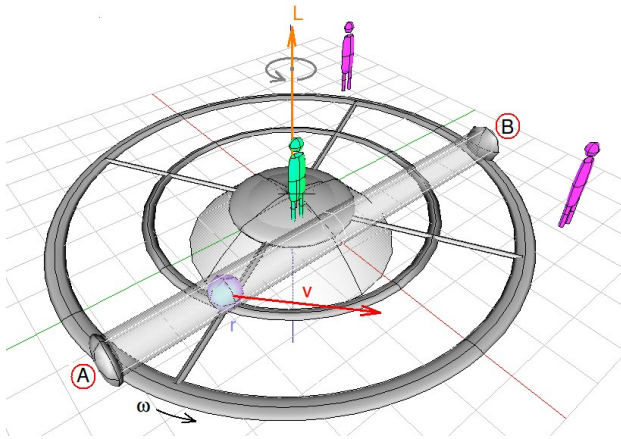

Fig. 4 A single sphere restricted to move (with no friction) inside a transparent tube fixed to the spinning world. Instead of positioned along the radial direction, this tube is inclined, in order to allow the observers to understand better the forces acting on the sphere, which is free to move either to the centre of rotation (to the B side of the tube) or away from it. The sphere is initially at a distance r from the centre, and the carousel starts spinning with very small increments of speed. At the beginning, the velocity $\underline{v}$ of the sphere is perpendicular to its position vector $\underline{r}$, but it has already a component along the tube pointing to B, and the centre. However, the sphere will never move in such a direction, as it would happen in the case of being acted upon by a *centripetal* force. In truth, as the speed of rotation increases, all observers will understand that the sphere will always move into the A side of the tube, away from the centre, as it is acted upon by a real *centrifugal* force.

3. **Feeling the centrifugal, Coriolis, Euler forces**

Before mathematically deriving these forces, let us try to understand physically what in fact happens in a spinning world. Thus, let us forget mathematics, as a way to avoid the tendency of adapting the reality to the model, instead of trying first to understand the reality[4]. For that, we consider again our observer rotating in the spinning world, standing on one of its spheres (Fig. 5), under external zero gravity (0G). The first question now arising is: should the mass of the observer be considered, or not? If we want to talk of a constant angular speed

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[4] Equations should not be the motto, instead, the intuition, experience and sensibility should; otherwise, fictitious elements may be introduced into our world and an astonishing amount of resources, time and human intellect may be wasted in searching Nature for the existence of such fictitious elements. Science is, of course, a war of models and schools of thought, but it should always be open to questions.

ω, in order not to make things too complex, the movement of the observer around the spinning space should not interfere with ω, as it does if he has mass, due to the need to conserve angular momentum. On the other hand, if we consider him as being a ghost, such a being would feel no force at all acting on it, since its mass is null. So, we decide to let the mass of the observer enter in our thoughts. We must therefore understand that we are dealing with two systems: the *observer* and the *carousel;* and we are trying to infer what is happening in the *carousel* by means of what happens to the *observer*. We must be careful enough not to forget this important fact. Besides, we must avoid studying the mechanics of such a spinning world by any sort of movement of the observer that is not at all times connected to the spinning structure. Any moment that the observer leaves the platform base he will move in a straight-line path. At a certain speed of rotation, it would be enough that the observer jumps vertically such that he would be automatically projected in a straight-line out of the carousel. Why in a straight-line? Because at that precise moment, the circular constraint disappears (and its "centripetal" force) and also the centrifugal force disappears, and Galileo (or should we say Aristotle?) rules again.
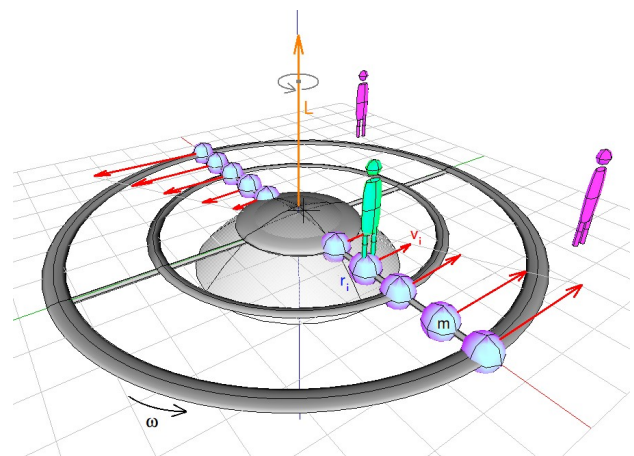

Fig. 5 The spinning world moving around with an angular velocity $\underline{\boldsymbol{\omega}}$, with an observer located at the sphere i at a distance r_i from the centre of rotation, with velocity $\underline{v}_i$. The overall system has an angular momentum $\underline{L}$.

Under these conditions, our observer will be subject to three types of forces: 1) <u>a force due to the position where he stands and its current linear velocity</u>. 2) <u>a force due to moving between spheres along $\underline{r}$</u>. 3) <u>a force due to any acceleration of the</u>

angular speed $d\omega/dt$. Of course, in a gravitational system we would also add to these forces that of the centripetal gravitational force.

1) Centrifugal force:

By the simple fact that it is not positioned at the centre of rotation, the sphere where our observer stands, which moves with a velocity v_i at a distance r_i form the centre, will be acted upon by a force given by $m.v_i^2/r_i$ usually called the *centrifugal force*. This is the main force that was debated in the previous section.

2) Coriolis force:

As shown in figure 5, and by applying the basic relation $v = \omega . r$, we know that the outer spheres will have a superior velocity than the ones nearer the axis of rotation. This is naturally due to the fact that the platform is considered solid and all the points from it will have to rotate with the same angular velocity ω. When the observer at the sphere i moves to the sphere $i+1$, he will of course notice a change in its velocity from v_i to v_{i+1}, which acts as a lateral force while he moves. This a fact and not fiction. It is obvious that the observer will have to feel such a difference of real velocities, also dependent on how fast he moves radially. The reaction of his body to this force is in the opposite direction, thus contrary to the direction of rotation. Since this force results from a real increase in the velocity of the observer it is not an apparent force. It is usually called the Coriolis force.

3) Euler force:

This is the force naturally resulting from any change in the velocity of rotation of the platform, therefore dependent on $d\omega/dt$. In many academic dissertations it is considered null, since it is easier to study situations where ω is constant in time. In the present case, however, we may notice that when the observer moves from the i sphere to the $i+1$ sphere, not only his velocity increases but also the angular momentum of the whole system tends to increase due to the mass of the observer. But, since angular momentum must be conserved, this would tend to slow down the spinning, decreasing ω, and the Coriolis effect would not be as intense as expected. To maintain the system rotating at a constant ω, an external torque would be needed, supplied by an

electrical motor, for example. This decrease in the spinning when mass moves outward from the centre and the corresponding increase in speed when it moves towards the centre can be thought of as an Euler force. In reality, however, all these effects are interconnected as a single entity.

In a previous article we presented what we called the *Geometric Law of Motion,* where all these components of force have been condensed in a single expression of geometric algebra, where $\underline{F}$ is the net force and $\underline{\mathcal{M}}$ is the "*modifier*" of the state of the system[5]:

$$\underline{\mathcal{M}} = \underline{r}\,\underline{F} = d\{\underline{r}\,m.\underline{v}\,\}/dt \qquad (1)$$

which can also be written as:

$$\underline{\mathcal{M}} = \underline{r}\,\underline{F} = d\{\underline{r}\,.\,m.\underline{v}\ +\ \underline{r} \wedge m.\underline{v}\}/dt \qquad (2)$$

or, more explicitly:

$$\underline{\mathcal{M}} = \begin{cases} \underline{r}\,.\,\underline{F} =\ m\,.\,[d\underline{r}/dt]\,.\,\underline{v}\ + m\,.\,\underline{r}\,.\,\underline{a} & (3) \\ \underline{r} \times \underline{F} = m\,.[d\underline{r}/dt] \times \underline{v}\ + m\,.\,\underline{r} \times \underline{a} & (4) \end{cases}$$

Notice that it is easy to identify in these equations what may be interpreted as the energies associated with all these forces. In fact, we have:

Centrifugal energy $= m\,.\,[d\underline{r}/dt]\,.\,\underline{v}$
Coriolis energy $= m\,.[d\underline{r}/dt] \times \underline{v}$
Euler energy $=\ m\,.\,\underline{r} \times \underline{a}$
Any other radial energy $=\ m\,.\,\underline{r}\,.\,\underline{a}$

4. The common derivation of the fictitious forces

There are several methods for deriving the forces associated with rotational motion, and most of them use the concept of angular velocity vector $\underline{\boldsymbol{\omega}}$, which in itself is already a "fictitious concept", since $\underline{\boldsymbol{\omega}}$ is a *pseudo-vector*, not a real vector. Thus, here we present a more general derivation, similar to that presented in Wikipedia[6], which we consider simpler and clearer than any other. Of course we will

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[5] J. Manuel Feliz-Teixeira, "*In Defence of the Centrifugal Force and the Geometric Law of Motion*", first published at http://www.fe.up.pt/~feliz, and YouTube, June 2011
[6] Detail: http://en.wikipedia.org/wiki/Fictitious_force#General_derivation

suitably adapt it to the concepts previously referred. So, let us begin by defining a coordinate system in the rotating world where a vector is represented by its three components along an orthogonal base of versors $\hat{u}_1$, $\hat{u}_2$ and $\hat{u}_3$. Thus, the position of a generic particle (*P*) will be given by the position vector $\underline{r} = (r_1, r_2, r_3) = r_1.\hat{u}_1 + r_2.\hat{u}_2 + r_3.\hat{u}_3$, in the rotating world. Now, we consider another coordinate system which is fixed to the inertial world, with base *versors* $\underline{\hat{o}}_1$, $\underline{\hat{o}}_2$ and $\underline{\hat{o}}_3$, so that the position of the same generic particle will now be given by the vector $\underline{s} = (s_1, s_2, s_3) = s_1.\underline{\hat{o}}_1 + s_2.\underline{\hat{o}}_2 + s_3.\underline{\hat{o}}_3$. Finally, the *origin* of the rotating coordinate system, when seen from the inertial system, as shown in the next figure, is $\underline{s}_0 = s_{01}.\underline{\hat{o}}_1 + s_{02}.\underline{\hat{o}}_2 + s_{03}.\underline{\hat{o}}_3$.
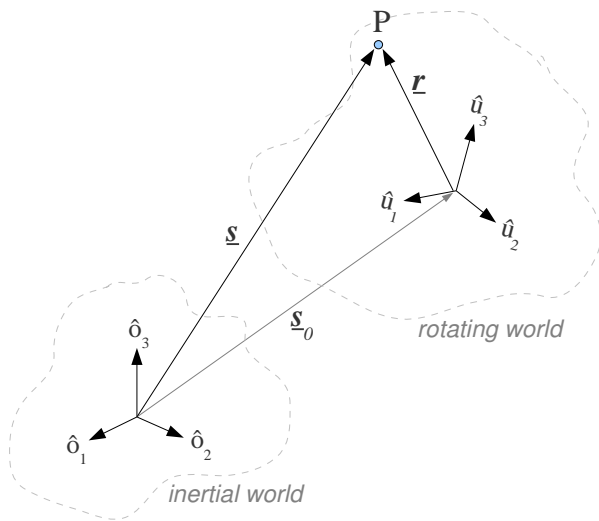
Fig. 6 Two coordinates systems and their interconnection.

Based upon this, we may now verify that the position of the particle in the <u>inertial world</u> may simply be found from the vectorial sum:

$$\underline{s} = \underline{s}_0 + \underline{r} \qquad (5)$$

From now on, all we have to do is a cinematic manipulation. The velocity of the particle as seen from the inertial world will be:

$$\begin{aligned}
d\underline{s}/dt &= d\underline{s}_0/dt + d\underline{r}/dt \\
&= d\underline{s}_0/dt + [d/dt]\{r_1.\hat{u}_1 + r_2.\hat{u}_2 + r_3.\hat{u}_3\} \\
&= d\underline{s}_0/dt + [d/dt]\{r_i.\hat{u}_i\}
\end{aligned}$$
$$(6)$$

Using the Einstein convention for summation. Now we must evaluate the derivative of the product

related to the components of $\underline{r}$ in the rotating world, and write:

$$d\underline{s}/dt = d\underline{s}_0/dt + (dr_i/dt).\hat{u}_i + r_i.d\hat{u}_i/dt \qquad (7)$$

The first term of the second member ($d\underline{s}_0/dt$) is simply the velocity of the centre of the coordinate system of the rotating world when seen from the inertial world. In the case of our carousel this is obvious null, since the carousel itself does not move along the inertial world, it only spins. The second term ((dr_i/dt).$\hat{u}_i$), is the velocity of the particle as seen from the spinning world. Finally, the last term ($r_i.d\hat{u}_i/dt$) represents a velocity dependent on how the spinning world rotates, which is also dependent on the distance of the particle from the centre of rotation. One may easily link this term to the $v = \omega.r$ relation, of course. Some say, however, that this is an *apparent velocity*, but honestly we do not understand why, or to whom it is apparent. On the one hand, all this computation is done from the perspective of the inertial world, so it is not apparent for the inertial observer. On the other hand, it is obvious from our previous examples that the inertial observer also feels it, when moving radially in the spinning world, for example. So, in our opinion, to classify it as "fictitious" is ignoring that the coordinate system inside the *spinning world* is not isotropic in what concerns velocity, at least in the plane of rotation. The spinning space introduces in itself a *source of speed*, which is a property dependent on the distance to the axis of spinning. This does not happen in the homogeneous[7] *inertial world;* no speed is gained by simply moving from one place to another. Therefore, the inertial observer should not look at himself as the proper *describer* of a world he cannot even feel, but only observe from afar. So, when he states that these forces that may be felt by the spinning observer are fictitious, he is merely fantasizing. Of course it is mainly a strategy to maintain the use of Newtonian mechanics in the study of accelerated systems; it works, but it would be good not to confuse a strategy with what the reality is. The two worlds are different spaces. In one all the properties are considered homogeneous, whilst in the other, they are not. The term $r_i.d\hat{u}_i/dt$ seen by the inertial observer is in fact embedded in the properties of the rotating frame, and it will be

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[7] Here we use *homogeneous* and *isotropic* almost in the same sense. In fact, *isotropic* means the same property along all directions; while *homogeneous* means the same property in all regions of the space.

the source of most of those "fictitious" forces really acting on the spinning observer.

So, let us continue with the mathematics, in this apparent derivation of fictitious forces. To compute the acceleration we have to apply once again the time derivative to equation (7), resulting in:

$$d^2\underline{s}/dt^2 = d^2\underline{s_0}/dt^2 + [d/dt]\{(dr_i/dt) . \underline{\hat{u}}_i\} + \\ + [d/dt]\{r_i.d\underline{\hat{u}}_i/dt\} \quad (8)$$

Notice that $d^2\underline{s_0}/dt^2$ is simply the acceleration of the centre of the spinning world in the inertial world, so we will call it $\underline{a_0}$. On the other hand, dr_i/dt is the velocity of the particle measured from the rotating world, so we will call it $\underline{v_i}$. And this equation can be written in a more compact form:

$$\underline{a} = \underline{a_0} + [d/dt]\{v_i.\underline{\hat{u}}_i\} + [d/dt]\{r_i.d\underline{\hat{u}}_i/dt\} \quad (9)$$

By expanding again the derivatives, the second term on the right can be written as:

$$[d/dt]\{v_i.\underline{\hat{u}}_i\} = (dv_i/dt).\underline{\hat{u}}_i + v_i.d\underline{\hat{u}}_i/dt \\ = a_i.\underline{\hat{u}}_i + v_i.d\underline{\hat{u}}_i/dt \quad (10)$$

While the third leads to:

$$[d/dt]\{r_i.d\underline{\hat{u}}_i/dt\} = v_i.d\underline{\hat{u}}_i/dt + r_i.d^2\underline{\hat{u}}_i/dt^2 \quad (11)$$

So, adding everything together, we get:

$$\underline{a} = \underline{a_0} + \boxed{a_i.\underline{\hat{u}}_i + 2.v_i.d\underline{\hat{u}}_i/dt + r_i.d^2\underline{\hat{u}}_i/dt^2} \quad (12)$$

In this expression, the terms inside the dotted area represent the accelerations existing in the rotating world, in the perspective of the inertial observer. The term $a_i.\underline{\hat{u}}_i$ is the "usual" linear acceleration, of the type of those acting the inertial world. The second term $2.v_i.d\underline{\hat{u}}_i/dt$ is dependent on the velocity of the rotating world and the *velocity* of the particle in it, and it is named *Coriolis* acceleration. The last term, obviously dependent on the *position* of the particle and the acceleration of the rotating frame, is a single term that includes both the *centrifugal* and *Euler's* accelerations, which in fact can be considered a single mechanism for exchanging energy between the angular and radial dimensions, in order to adjust the motion to the

conservation of angular momentum. These two terms, however, will explicitly come out from this equation when we enter with the concept of angular velocity vector $\underline{\omega}$. In affect, by definition we may say that:

$$d\underline{\hat{u}}_i/dt = \underline{\omega} \times \underline{\hat{u}}_i \quad (13)$$

So, when we substitute this into the previous equation (12), we get:

$$\underline{a} = \underline{a_0} + a_i.\underline{\hat{u}}_i + 2.v_i.\underline{\omega} \times \underline{\hat{u}}_i + r_i.[d/dt](\underline{\omega} \times \underline{\hat{u}}_i) \quad (14)$$

Notice that the last term can now be separated in two, since we can compute another derivative of a product, so, the centrifugal and Euler's accelerations will be separated from each other; taken in account that it holds:

$$[d/dt](\underline{\omega} \times \underline{\hat{u}}_i) = (d\underline{\omega}/dt) \times \underline{\hat{u}}_i + \underline{\omega} \times (d\underline{\hat{u}}_i/dt) \\ = (d\underline{\omega}/dt) \times \underline{\hat{u}}_i + \underline{\omega} \times (\underline{\omega} \times \underline{\hat{u}}_i) \quad (15)$$

We will have:

$$\underline{a} = \underline{a_0} + a_i.\underline{\hat{u}}_i + 2.v_i.\underline{\omega} \times \underline{\hat{u}}_i + \\ + r_i.(d\underline{\omega}/dt) \times \underline{\hat{u}}_i + r_i.\underline{\omega} \times (\underline{\omega} \times \underline{\hat{u}}_i) \quad (16)$$

And finally, after some tricks, we can write:

$$\boxed{\underline{a} = \underline{a_0} + a_i.\underline{\hat{u}}_i + 2.\underline{\omega} \times \underline{v} + \\ + (d\underline{\omega}/dt) \times \underline{r} + \underline{\omega} \times (\underline{\omega} \times \underline{r})} \quad (17)$$

And, resuming:

$\underline{a_0}$ = *acceleration of the centre of the rotating world*
$a_i.\underline{\hat{u}}_i$ = *linear acceleration in the rotating world*
$2.\underline{\omega} \times \underline{v}$ = *Coriolis acceleration (intrinsic)*
$(d\underline{\omega}/dt) \times \underline{r}$ = *Euler acceleration (intrinsic)*
$\underline{\omega} \times (\underline{\omega} \times \underline{r})$ = *centrifugal acceleration (intrinsic)*

What is usually argued is that only the term $a_i.\underline{\hat{u}}_i$ is perceived by the rotating observer, since the others are fictitious accelerations that do not exist in his spinning world. This is not true, in our perspective. He feels the effects of these accelerations as being *intrinsic* to the world he is living in. One of the most interesting examples of

this is the going around in circles due to the concurrence of the *Coriolis* and the *centrifugal* forces when a ball (or disc) is pushed from the exterior into the interior of a spinning world[8]. Unlike what happens in the case of the train, a rotating observer knows he is rotating; thus these forces should never be called fictitious (also because they do *work* on the bodies). These forces should instead be called *intrinsic*, in order to better express the kind of deformation they introduce in the space metrics, similarly to what has been proposed by Einstein. So, we would say that the only fiction is that of an inertial observer expecting the rotating world to behave homogeneously, as the inertial world does. This, however, does not reduce the importance of the admirable mathematical work that has been done, in order that such a complex world can still be described by Newton's laws.

5. Conclusion

We think we have clearly demonstrated that the *centrifugal*, *Coriolis* and *Euler* forces are real forces, therefore they should not be called "fictitious", since this term induces obvious confusion even to the early student of Physics. Such a seed of confusion tends to spread with the time even to those with some common sense, and in that way contributes to the maintenance of a myth. We wonder how many novel systems and ideas have probably not been allowed to develop, emerge and materialise, through frustration, due to the simple fact that these forces were considered "fictitious", and people who thought on them were simply ridiculed. It is urged, in our opinion, that these kinds of myths are not maintained in science, in order that science will always be an open field for revisionism and evolution.

We believe it will be sufficient that people start to consider these forces as real, so that new studies and proposals in the scientific and technological domains will naturally emerge, and, by the nature of these forces, probably in the field of gravitation. Could it be that the centrifugal force may even be used to produce some kind of centrifugal propulsion or "anti-gravitational" effect? The truth is that probably we will never know the answer if the scientific community continues to intellectually obstruct the

study of these effects because of such choices of nomenclature.

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Jaap Suter , (March 12, 2003), "*Geometric Algebra Primer* ", published at http://www.jaapsuter.com/

J. Manuel Feliz-Teixeira, "*In Defence of the Centrifugal Force and the Geometric Law of Motion*", first published at http://www.fe.up.pt/~feliz, and YouTube, June 2011

The airplane test with coffee and ice tea:
  http://youtu.be/tOZEgKXJMCE

Cars and motorbikes driving around a curved wall:
http://youtu.be/hZOekFFSoWI

Rotating reference frame: "*Students rolling a bowling ball on a rotating platform*" : http://youtu.be/PLe2AmmoJjs

Disks and rotating table - round and round: "*The Toledo Imagination Station (used to be Toledo COSI) has a fascinating table with a large rotating circular section. Various disks are provided to get them 'running' around the table.*" :
http://youtu.be/G_lmuI95Kyw

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[8] A nice example in the video: http://youtu.be/G_lmuI95Kyw

In Defence of the Centrifugal Force and the Geometric Law of Motion

An old discussion for some new perspectives

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clic-to-contribute

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ABSTRACT

After a brief introduction and some discussion on the academic conflict that has forever surrounded the idea of a *centrifugal force*, there will be presented in this text the mathematical concepts that may lead us to believe in the real existence of this force. Some of the probable implications arising from this fact are then addressed, in particular the possibility of describing the laws of motion as a single *Geometric Law of Motion*.

1. The centrifugal dilemma

More than 300 years have passed since Huygens unveiled his famous equation for the *centrifugal force* ($F_c = m.v^2/r$), and no consensual opinion has yet been reached by the academic community about the true meaning of such a force. Newton used it as a fundamental tool in order to derive his Theory of Gravitation, where he manipulated it as a force[1]. However, by his second law of mechanics, which generally states $\underline{F} = d(m.\underline{v})/dt$, it is a fact this force should not exist[2]. It seems there is, somehow, an incongruence in Newton himself concerning this fundamental issue, which was never resolved by his school of thought. Newton considered Huygens force as the force that compensates the gravitational attraction between bodies when they describe orbits, but, on the other hand, Newton says such a force is not real and must therefore be seen as a kind of "fictitious" force, or "apparent" force, coming from the inertia of the moving body. Nevertheless, Newton did not seem "against" the centrifugal force in the same way Newtonians of our days obviously are. The main reason for this, however untold, seems simple: Huygens force obviously challenges the general principle established by Newton's second law, as we will soon explain. Thus, the only logical option to legitimise such an excellent theory of mechanics (no doubt that it is) is to definitely "negate" the existence of the centrifugal force. Newtonian scholars and schools have therefore not only assumed their laws as unquestionable, but even seem to have invested in lobbying against the term "centrifugal force" in the classrooms and universities around the world, pointing those who do not agree with them as merely pathetic. Indirectly associated to such a subject was also the discussion on the existence or non-existence of a universal inertial frame of reference, in which Newton seemed to believe in - an idea challenged by the arguments of Ernest Mach and George Berkeley, amongst others, who were more convinced that inertia was due to some gravitational effect induced in each mass by the outer part of the universe. Einstein himself was

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[1] An example of how Newton was deriving his Gravitational force may be found in: J. Manuel Feliz-Teixeira, "Deducing Kepler and Newton from Avicenna (ابن سينا), Huygens and Descartes", first published at http://www.fe.u.pt/~feliz/ and YouTube, April 2010.

[2] Herein we will represent vectors as bold underlined letters, a substitute for the usual arrow. So, vector v = **v**.

expecting his theory of General Relativity to confirm Mach's principle, but to date, this has not happened. Of course, there is a lot of literature about this, even on the Internet. But let us definitely show why Huygens forces seem not to be compatible with Newton's beliefs: Newton's second law equation states:

$$\underline{F} = d(m.\underline{v})/dt \qquad (1)$$

or, if we consider m to be *constant* in time, as one usually does in mechanics of solids:

$$\underline{F} = m\, d\underline{v}/dt$$
$$\underline{F} = m.\underline{a} \qquad (2)$$

which is the well known relation between *force* and *mass*. This means, however, that when the total forces $\underline{F}$ acting on the body are null, then $d\underline{v}/dt$ must also be null, which is the same as saying that vector $\underline{v}$ must be constant in time. But, since an orbiting $\underline{v}$ is obviously not a *constant* vector, as it constantly changes direction, Newton infers that the resultant force in an orbiting body cannot be null. If it would be null, the body would simply run along a straight-line[3], as also expected by Galileo Galilei, not along a curve. Thus, in Newton's perspective, imagining a Huygens force compensating the gravitational force in the case of an orbit would be not only against the basis of his theory but also against Galileo's expectations. The way of resolving the conflict was to declare it "apparent", calling centrifugal forces fictitious, and stating that a body while orbiting is simply being subjected to the *centripetal force* needed to curve its natural rectilinear trajectory (in the next images we will denote the gravitational acceleration by $\underline{g}$ and the Huygens centrifugal acceleration by $\underline{c}$). Some centuries later, *centrifugal forces* have even been stigmatized, even though they are believed to be responsible for the Earth's bulge and many other effects, for example, the drying of clothes by centrifugation in our washing machines. The next figure basically represents Newton's model for an orbiting body.

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[3] In fact, in our perspective the body can still be seen moving in a straight-line as predicted by Newton, but the direction of such a "straight-line" is also constantly changing according to the constant change in direction of the gravitational force. These directions are always kept perpendicular. So, in each instant of time the centrifugal force does not contradict Newton. Instead, is there to support him.
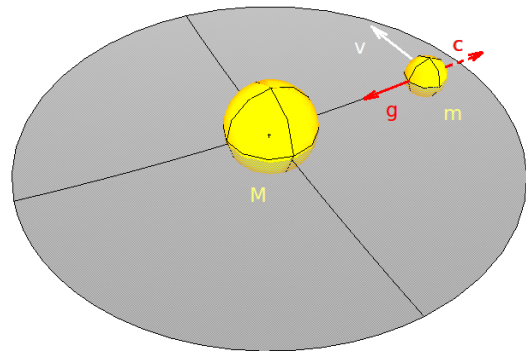

Fig. 1 Newton's model for a body of mass m orbiting another massive body (M) with a velocity $\underline{v}$. The scale of the drawing is obviously exaggerated. By Newton, $\underline{g}$ is the real acceleration due to the attraction between the two bodies (gravitational), while $\underline{c}$ is a centrifugal fictitious acceleration due the inertia of m.

As classical mechanics evolve to more generalist formalisms with Lagrange and Hamilton, who do not explicitly use the concept of force, but instead of energy associated with certain degrees of freedom, or generalised "directions" of movement, the centrifugal force conflict seems also to become diluted. After all, these formalisms also don't use vectors, as we try to represent in the next figure.
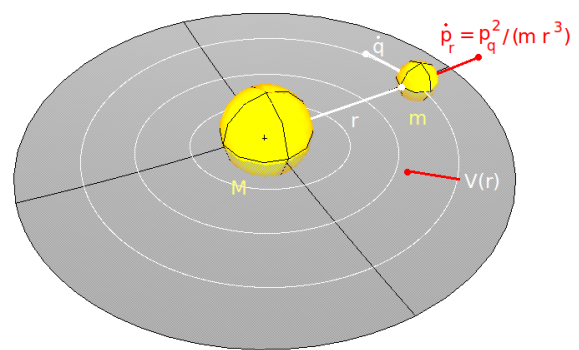

Fig. 2 Lagrange and Hamilton describe the system in terms of kinetic energy and potential energy $V(r)$, and compute momenta (p) and forces $[d/dt]p$ from it. Here, the generalised coordinates q and r are used. A dot over a letter means time derivative $= [d/dt]$. So, $[d/dt]p_r$ is in fact the centrifugal force.

In the example of the previous figure (Fig. 2), q represents the generalised coordinate which is the angle of rotation in the orbit (usually denoted by θ), while $V(r)$ is the gravitational potential "due" to

mass M, and $[d/dt]q$ the speed of m along q. Therefore, the quantity $[d/dt]p_r = p_q^2 / (m.r^3)$ is Huygens centrifugal force, where p_q^2 is the angular momentum of the mass m. This force, however, appears naturally from the natural manipulation of cylindrical coordinates, which of course are indirectly associated with the spatial type of "constraints" of geometry imposed by the gravitational field.

But, what did Einstein think about this issue? We really don't precisely know. But Einstein knew there were some curious facts that seem to contradict the Newtonian model. For example, accelerometers in free fall do not measure any acceleration. And orbits seem independent of the mass orbiting (in this case m). Einstein was well aware of this, therefore we suppose this was what made him decide looking at gravitation as being due to a deformation of space, not a force. He avoided Newton. For Einstein, the gravitational field results from a deformation of the *space-time* centred at each mass (Fig. 3), therefore masses fall into each other naturally along such a deformation. The intensity of the deformation is obviously proportional do the mass of the body.
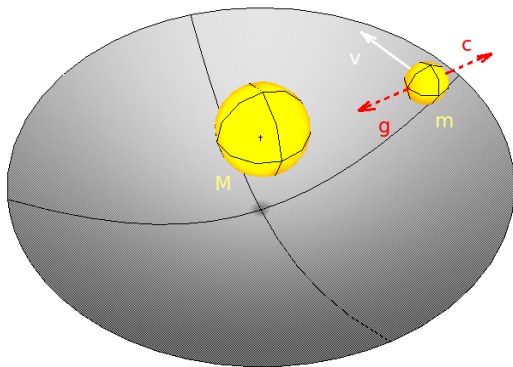
Fig. 3 Einstein's curvature of *space-time* due to mass M. Notice that in this model both **g** and **c** could be seen as "fictitious" accelerations resulting from *space-time* deformations. We may in fact say that Einstein's principle of equivalence positions these forces in the same category.

In this sense, the gravitational acceleration may also be seen as a "fictitious" acceleration, although it can perfectly be compared with any other kind of acceleration; for example, with the acceleration of a spacecraft in the empty space[4]. Free fall is, for Einstein, the same as orbiting, even the same as

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[4] You may refer to Einstein's Equivalence Principle at: http://en.wikipedia.org/wiki/Equivalence_principle

floating in the empty and free space, since in any of these cases the body feels no forces acting on it. That is why accelerometers in free fall or in orbit measure no gravitational force at all. If there would be no atmosphere, a person falling under gravity would simply feel as floating (till the moment of the crash, of course). Forces are obviously dependent on the state of motion of the observer. And Einstein seems to classify forces by their effects on bodies, not by their probable origins.

Thus, talking of centrifugal forces is acceptable again, since Einstein has legitimised them while comparing them even to gravitational forces. Notice, by the way, that Einstein was somehow suspecting the *inertia* that keeps masses moving in straight-lines in the absence of external forces could even result from the gravitational effect coming from all the mass existing in the outer part of the universe. So, Einstein seemed to believe that external masses might act upon the internal masses too. And this would also contradict what was claimed by Newton, who elegantly demonstrated that the field inside a hallow sphere must be null. So, any of these effects expected by Mach and Einstein would have to be null. The mathematical demonstration of a null field inside a sphere, however, starts by another assumption taken as unquestionable: *masses attract each other*. Could such a principle be somehow not perfectly defined yet? We expect to return to this subject some other time. For now, let us focus on the description of motion.

2. Radial and angular coordinates

By observing our reality it is easy to recognise that motion generally tends to be constrained by a certain circular geometry, that is, motion is usually made around an axis, which, in reality, happens to be the axis of the angular momentum. A closer look into the motion of the bodies in space will reveal that even rectilinear motion may in fact be described in terms of an angular movement with a radial component, where angular momentum is still preserved[5]. We therefore think it is in good compliance with the laws of nature to describe motion based on a referential with the two basic components: radial and angular. We will call them parallel $_{//}$ to the observer and perpendicular $\perp$ to the

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[5] An simple demonstration of this can also be found in: "Deducing Kepler and Newton from Avicenna (ابن سينا), Huygens and Descartes".
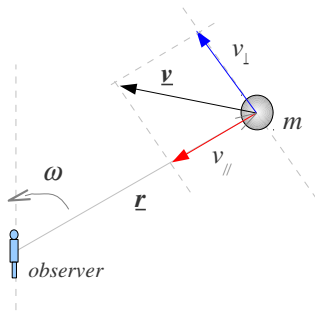
observer, respectively:

Fig. 4 Vector $\underline{v}$ expressed in terms of its (parallel, perpendicular) coordinates, belonging to the plan defined by $\underline{r}$ an $\underline{v}$. Notice that the angular momentum relatively to the *observer* (who does not have to be the center of curvature), is given by the cross product $\underline{L} = \underline{r} \times m\underline{v}$, which is a pseudo-vector perpendicular to the same plan.

Of course any vector can be represented in these "natural" coordinates (plus a coordinate z for the three-dimensional space, seen as a constant in many gravitational systems); but also kinetic energy, being a scalar, can be seen in terms of a <u>parallel energy</u> and a <u>perpendicular energy</u>. That is, energy can somehow be associated with a certain direction, as in the case of the Hamiltonian[6], for example. In effect, from the figure we have:

$$\underline{v} = (v_\perp , v_{//}) \tag{3}$$
$$v^2 = \underline{v} \cdot \underline{v} = (v_\perp , v_{//}).(v_\perp , v_{//})$$
$$v^2 = v_\perp^2 + v_{//}^2 \tag{4}$$

Multiplying both members by $\tfrac{1}{2} m$ to compute the kinetic energy, we get:

$$\tfrac{1}{2} m.v^2 = \tfrac{1}{2} m.v_\perp^2 + \tfrac{1}{2} m.v_{//}^2$$
$$K = K_\perp + K_{//} \tag{5}$$

On the other hand, if we multiply (4) by m/r in order to compute Huygens force (F_c):

$$m.v^2/r = m.v_\perp^2/r + m.v_{//}^2/r$$
$$F_c = F_{c_\perp} + F_{c_{//}} \tag{6}$$

Could this mean that even the centrifugal force (usually considered always pointing along $\underline{r}$) can be the result from two contributions?: the contribution

from the perpendicular component of the velocity, and the contribution from the parallel component of the velocity. This let us wonder about the concept of *centrifugal force* in a wider perspective: a force due to the movement itself, perhaps inertial, therefore intrinsic, which could be either positive or negative (repulsive/attractive) in respect to the observer, depending on its radial ($_{//}$) contribution. Even if the angular contribution ($\perp$) is assumed to be always positive, as it points towards the increase of $\underline{r}$, in a wider sense the force applied to elevate a spacecraft into the atmosphere at a constant velocity could also be seen as a centrifugal force, relatively to the centre of the Earth. Thus, a centrifugal force could exist even with no angular motion at all. Could this be the force responsible for the existence of non circular orbits, for example? And for the movement in a straight-line under null external forces? Could Aristotle[7] somehow be also right, even if Galileo and Newton were right? We will address these questions soon. For now, all motion must be seen in relation to an observer, assumed located at the centre of the coordinate system, and we will always count on that.

3. **The angular law: angular momentum**

Let us consider $\underline{r}$, m and $\underline{v}$ as the fundamental "entities" for the description of motion. It would be also possible to consider linear momentum $\underline{p} = m.\underline{v}$, for example, as a fundamental "entity", but it is our preference to maintain the separation between *mass*, considered an inertial property, in the present context, from *velocity*, which is a cinematic entity. We will also consider here mass as a constant in time, since we are obviously dealing with motion from the perspective of solid objects. Once we establish this, we should be able to derive the laws governing the state of motion based only on these fundamental "entities", plus an eventual interference which we will describe as the total force $\underline{F}$. The only way for changing the state of motion of our system, which in part can be identified by the constancy of its angular momentum $\underline{L}$, will be through the action of such a force. The next figure will help us to visualize the idea:

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[6] In the Hamiltonian $H = p_q \cdot [d/dt]q - L$, where L is the Lagrangian, the terms $p_q.[d/dt]q$ can be seen as 2 times the kinetic energy in the direction of the generalised coordinates q.
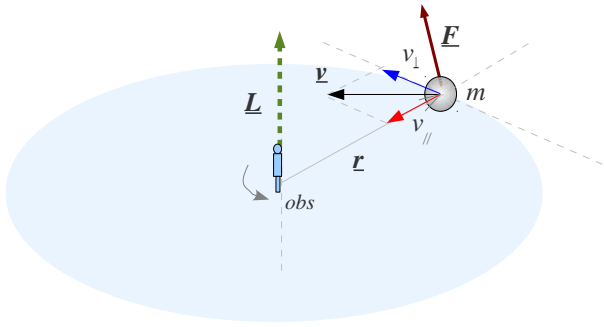
[7] We may remember that Aristotle defended "something" should be responsible for the movement of a body through the "free" space, a kind of "engine" intrinsic to the body, that should push it forward in the space. As we know, Galileo rejected such a view and stated that no force at all is needed for a body to move at a constant velocity. Around 50 years later this turned to be the first law of Newton.

Fig. 5 The fundamental "entities" m, $\underline{r}$ and $\underline{v}$ expressing the present state of motion of mass m, and the respective angular momentum $\underline{L}$ as an "entity" representative of such a state. A generic force $\underline{F}$ applied to m is the only way for such a state to be changed.

We know from the very beginning that the general law of conservation of angular momentum must hold. This means that in the absence of a component of $\underline{F}$ perpendicular to the observer, angular momentum $\underline{L}$ will not be changed. That is, we need $\underline{r} \times \underline{F} = (r \cdot F_\perp) \cdot \hat{u}$ not to be null if we want to induce a change into the angular momentum of the system. Notice that $\hat{u}$ is a *versor* perpendicular to the plane defined by $\underline{r}$ and $\underline{F}$. We may of course synthesize all this through the well known equation of torque:

$$\underline{r} \times \underline{F} = d\,\underline{L}\,/\mathrm{dt} \tag{7}$$

or, more explicitly:

$$\underline{r} \times \underline{F} = d\{\underline{r} \times m.\underline{v}\}/dt \tag{8}$$
$$= [d\underline{r}/dt] \times m.\underline{v} + \underline{r} \times [d(m.\underline{v})/dt]$$
$$= m \cdot [d\underline{r}/dt] \times \underline{v} + m \cdot \underline{r} \times [d\underline{v}/dt]$$
$$= m \cdot [d\underline{r}/dt] \times \underline{v} + m \cdot \underline{r} \times \underline{a}$$

Obviously, $\underline{a}$ is the acceleration; and the term $[d\underline{r}/dt] \times \underline{v}$ does not have to be null, so it must be kept in the equation. In a pure circular motion, however, this term is $m.\underline{v} \times \underline{v} = \underline{0}$ and this equation reduces to:

$$\underline{r} \times \underline{F} = m \cdot \underline{r} \times \underline{a} \tag{9}$$

Since only the perpendicular components of $\underline{F}$ and $\underline{a}$ and the variation of $\underline{r}$ perpendicular to $\underline{v}$ contribute for these cross products, we may obviously write:

$$r \cdot F_\perp = m \cdot [dr/dt] \cdot v \cdot \sin\beta + m \cdot r \cdot a_\perp \tag{10}$$

Where β is the angle between $d\underline{r}/dt$ and $\underline{v}$. Finally, by dividing by $r \neq 0$, we will deduce the general expression:

$$F_\perp = m.(\sin\beta). [dr/dt].v / r + m \cdot a_\perp \tag{11}$$

Force equals mass times acceleration. That is, we may expect the angular motion to accelerate not only by an amount $a_\perp$ due to some angular force, but also by the amount $(\sin\beta).[dr/dt].v/r$ when moving the mass perpendicular to its present velocity vector. This last behaviour results in an *angular* force produced by a radial movement (somehow the opposite effect of a centrifugal force being produced by an angular movement). This is obviously part of the mechanism of conservation of angular momentum. By means of this term, the two dimensions ($_{//}$) and ($\perp$) become interconnected, thus dependent on each other. One can from now on exchange radial energy with angular energy and vice-versa. In a pure circular motion this force will be null, of course.

From this we understand that angular momentum conservation allows us to sense how the plane state of motion defined by $\underline{r}$ and $\underline{v}$ may be stable. It depends on the mass involved, of course. Masses seem not to have any special property responsible for defining orbits, but masses do obviously have something that makes them <u>maintain</u> those orbits, or their states of motion. We suspect this is why the idea of attributing the mass as the origin of gravitational forces have forever been questionable and, in certain cases, replaced by the idea of a constraint or deformation of space or *space-time*. Could it be that masses have no such property as that of attracting each other?

4. The radial law: deriving the centrifugal force

From the last section we have understood the effects of the perpendicular component of the total force $\underline{F}$ applied to our system, while considering $\underline{r}$, m and $\underline{v}$ the only "entities" needed for describing its motion. We may now wonder about the effects of the other component of $\underline{F}$, parallel to the observer. Such effects, however, in order to be consistent with

the previous considerations, should be also expressed based on the same fundamental "entities", that is $\underline{r}$, m and $\underline{v}$. Also, they should express the same law of physics, even if this time "projected" onto the radial dimension. We assume, therefore, that both the <u>angular law</u> and the <u>radial law</u> must in effect come from a more general and <u>single law</u> of motion, which in the first case is projected through the "angular" dimension, while in the second case onto the "radial" dimension. And, since the mathematical principles should be the same, also the equations expressing such principles should be the same. In the "radial" case such an equation must represent a "projection" onto $\underline{r}$, an operation which is obviously related to the <u>dot product</u>, therefore we simply decide to use again equation (8) but this time with the <u>cross product</u> replaced by the <u>dot product</u>. That is, with the "rotational" effect replaced by a "projectional" effect. Our radial law will consequently be written in the form:

$$\underline{r} \cdot \underline{F} = d\{\underline{r} \cdot m.\underline{v}\}/dt \qquad (12)$$

Which can be interpreted as: the projection of $\underline{F}$ along the radial dimension will be responsible for the variation of the projection of the linear momentum ($m.\underline{v}$) along the same dimension. It does not sound bad, at least. So, let us now develop this equation using the same steps of the previous case.

$$\begin{aligned}\underline{r} \cdot \underline{F} &= [d\underline{r}/dt] \cdot m.\underline{v} + \underline{r} \cdot [d(m.\underline{v})/dt] \qquad (13)\\ &= m \cdot [d\underline{r}/dt] \cdot \underline{v} + m \cdot \underline{r} \cdot [d\underline{v}/dt]\\ &= m \cdot [d\underline{r}/dt] \cdot \underline{v} + m \cdot \underline{r} \cdot \underline{a}\end{aligned}$$

This, of course, is a scalar equation that we may also write in the following form, in order to use our definition of perpendicular and parallel components:

$$r \cdot F_{//} = m.(cos\beta). [dr/dt].v + m \cdot r \cdot a_{//} \qquad (14)$$

Where β is again the angle between $d\underline{r}/dt$ and $\underline{v}$. We would dare to interpret this as: the total energy of the mass m along $\underline{r}$ is the potential energy ($m.r.a_{//}$) plus a term related to the kinetic energy given by $m.(cos\beta). [dr/dt].v$, which reduces to $m.v^2$ in the case of a circular motion ($\beta=0$). Somehow this reminds us of Hamiltonian. Also, such an equation and such a definition seem to suggest that kinetic energy could have the form $m.v^2$ instead of

the standard $\frac{1}{2}m.v^2$. It could be an interesting proposal too: the total energy contained in a mass m suddenly transformed into light, therefore travelling at the speed of light (c), would simply be given by:

$$E = m \cdot c^2$$

But let us now divide equation (14) by $r \neq 0$, as we did in the previous case, to obtain:

$$F_{//} = m.(cos\beta). [dr/dt].v / r + m \cdot a_{//} \qquad (15)$$

From which we can obviously deduce that the total parallel force comes from two contributions: a radial force $m.(cos\beta).[dr/dt].v/r$ coming from an angular displacement in respect to $\underline{r}$, and a force due to an acceleration parallel to $\underline{r}$. Both terms can of course be either positive or negative, thus centrifugal forces can also be perceived as negative. In the case of gravitation, the second term is obviously negative, and due to Newton's gravitational force (centripetal).

5. **Some other interesting consequences**

The first surprise resulting from equation (15), which seems to contradict both Galileo and Newton, is the fact that a force may exist even in the absence of a real acceleration imposed to the mass. The simple fact of moving at a constant velocity, no matter where to, implies the existence of a force acting on the body along its position vector with an intensity given by $m.v^2/r$. This force is in truth an *energy per unit of length* moving along the direction connecting the body to the observer. Could Aristotle be somehow right too? Notice that this force could also be positive or negative, depending on the relative intensities of $v_\perp$ and $v_{//}$, as can be found if we count with the fact that $v^2 = v_\perp^2 + v_{//}^2$ and rewrite equation (15) like this:

$$F_{//} = m \cdot v_\perp^2/r \pm m \cdot v_{//}^2/r \pm m \cdot a_{//} \qquad (16)$$

Interesting is also the fact that for an observer located at infinity, these "centrifugal" components vanish and equations (15) and (16) reduce to Newton's second law. This makes us think that perhaps Newton's second law is somewhat incomplete in the sense that it is a simple derivative

of the linear momentum ($m.\underline{v}$), thus valid only in the case of a very distant observer, that is, in those cases where angular momentum reduces to linear momentum due to the "lack of $\underline{r}$".

A third consequence, for example, is related to the case of absence of total forces ($F_{//} = 0$), which can be achieved in the situation of orbiting; that is, when the centrifugal force compensates the centripetal force resulting in:

$$0_{//} = m . v^{2}/r + m . a_{//} \implies m . v^{2}/r = - m . a_{//}$$

This, of course, justifies the sensation of absence of gravity in orbiting bodies. No accelerometer will measure any acceleration while orbiting. When a body starts an orbit, the body around which it is orbiting automatically "disappears". In a certain way, orbiting is like getting safe from falling into that body. Thus, orbiting means tranquillity, we wonder.

6. The Geometric Law of Motion

From these results we notice that motion can be seen in a certain geometric perspective, which here we try to represent with the help of the next figure. In a certain sense, motion seems to follow the geometric space of a spheric surface crossed by a rotating plane, with the angular momentum as its axis of symmetry.
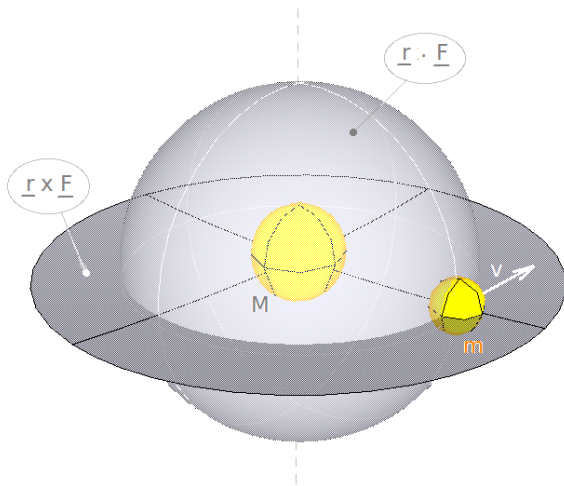

Fig. 6 The intrinsic geometry of motion, based on what we have expressed in the previous sections: a spheric surface driven by the term $\underline{r} . \underline{F}$, crossed by a rotating plan dominated by the term $\underline{r} \times \underline{F}$. The two dimensions are, however, interconnected by the centrifugal force and the angular momentum. This may perhaps be seen as a single Geometric Law of Motion.

Notice that the sphere shrinks or expands as mass m approaches or moves away from the center of rotation. But this also tends to be accomplished by an increase or a decrease in the speed of rotation depending on the case. What drives the changes in the perpendicular (angular) dimension is $\underline{r} \times \underline{F}$. What drives the changes in the parallel (radial) dimension is $\underline{r} . \underline{F}$. However, the two dimensions are obviously not independent, they are interconnected by the *centrifugal* and the *angular* forces, which transfer angular dimension into radial dimension and vice-versa. This happens to be a coupled system, where both dimensions are thus coupled by means of the mechanism of angular momentum. Thus, motion is a single thing, happening at the same time.

We may also infer from this that a spinning object will tend to be more stable than a non spinning one, since its radial dimension is a constant and its structure is protected against any changes by its own angular momentum. From this we infer that the two laws previously referred should be joined together. We may try to write them as the conjunction of the two equations:

$$\begin{cases} \underline{r} \times \underline{F} = d\{\underline{r} \times m.\underline{v}\}/dt \\ \underline{r} . \underline{F} = d\{\underline{r} . m.\underline{v}\}/dt \end{cases}$$

(17)

Or, in another manner, if we want to see it as the components of a new abstract "modifier" vector:

$$\underline{M} = (\mathcal{M}_{\perp} , \mathcal{M}_{//}) = (\underline{r} \times \underline{F} , \underline{r} . \underline{F}) \qquad (18)$$

If we use Geometric Algebra, however, all this can in fact be described as the *geometric product* of vector $\underline{r}$ by vector $\underline{F}$, which is simply written as[8]:

$$\underline{M} = \underline{r}\,\underline{F} = \underline{r} . \underline{F} + \underline{r} \wedge \underline{F} \qquad (19)$$

Where the cross product has been replaced by the outer product only for convenience. Curiously, those expert in Geometric Algebra consider this a single entity which they call a "*spinor*": the conjunction of a *scalar* and a *bivector*, which is a n-dimensinal *rotator* of vectors, in this case a two dimensional rotator. So, if we now express this equation in terms of our

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[8] You may learn more about the geometric product in:
Jaap Suter, (March 12, 2003), "*Geometric Algebra Primer* ":
http://www.jaapsuter.com/2003/03/12/geometric-algebra/

fundamental "entities", could the following equation represent the *Geometric Law of Motion*?:

$$\underline{r}\,\underline{F} = d\{\underline{r}\,.\,m.\underline{v}\}/dt \; + \; d\{\underline{r} \wedge m.\underline{v}\}/dt$$
$$\underline{r}\,\underline{F} = d\{\underline{r}\,.\,m.\underline{v} \; + \; \underline{r} \wedge m.\underline{v}\}/dt \qquad (20)$$

Or, in a more compact form, using only the *geometric product* of vectors:

$$\underline{r}\,\underline{F} = d\{\underline{r}\,m.\underline{v}\}/dt \qquad (21)$$

7. Conflicting concepts of centrifugation?

From what we have said, everything suddenly seems to turn beautiful and clear. But we must, even so, remain sufficiently critical in order to test this against other concepts. Even if broking the peace between Aristotle, Galileu and Newton in a 300 years war would sound great, some questions arise, for instance concerning the usual definition of the centrifugal force due to Huygens. Is the centrifugal force really given by $m.v^2/r$? Or is there any other expression more precise for it? Huygens force comes from empirical science. Could it express only a particular aspect of the effects of centrifugation forces? Here we present two different perspectives leading to different conclusions, and we could not yet decide which to choose.

Frequently the centrifugal force is described in vectorial terms as a double crossed product related to the angular speed vector $\underline{\omega}$:

$$\underline{F}_{c1} = - m\,.\,\underline{\omega} \times \{\underline{\omega} \times \underline{r}\} \qquad (22)$$

Since $\underline{\omega}$ is a pseudo-vector, $\{\underline{\omega} \times \underline{r}\}$ is a real vector, so, $\underline{\omega} \times \{\underline{\omega} \times \underline{r}\}$ is again a pseudo-vector. The centrifugal force defined this way seems not to be a real thing. But if we try representing it in terms of our fundamental "entities" of motion, which are unambiguous vectors, we will find out, with little manipulation, that a centrifugal force can also be expressed as a *real vector* by means of the equation:

$$\underline{F}_{c2} = \underline{v} \times \{\underline{r} \times m.\underline{v}\} / r^2 \qquad (23)$$

$$\underline{F}_{c2} = \underline{v} \times \underline{L} / r^2 \qquad (24)$$

However, by this definition $\underline{F}_{c2}$ will always be perpendicular to $\underline{v}$, that is, pointing away from the

center of curvature of the "space" in that moment, supposing $\underline{v}$ as being always tangential to such a "curvature". So, this is a centrifugal force in respect to the center of curvature (CC), independent of the observer, as shown in the next figure. Its intensity is the same as the previous one, and given by:

$$F_{c2} = F_{c1} = m\,.\,v.v_{\perp} / r \qquad (25)$$

Notice that this force $\underline{F}_{c2}$ can have components not only along the $\underline{r}$ direction (contrary to the common sense, and $\underline{F}_{c1}$) but also along the angular dimension. This seems to express quite interestingly the idea of depending solely on the "space curvature" induced in the movement by whatever types of forces or constraints. The direction of this centrifugal force is only dependent on the curvature, and not on the location of the observer, for a fixed distance to the observer. This is at odds with the previous formulation. Of course both descriptions only match Huygens force intensity when the *observer* is located at the CC. It seems there is a conflict somewhere...
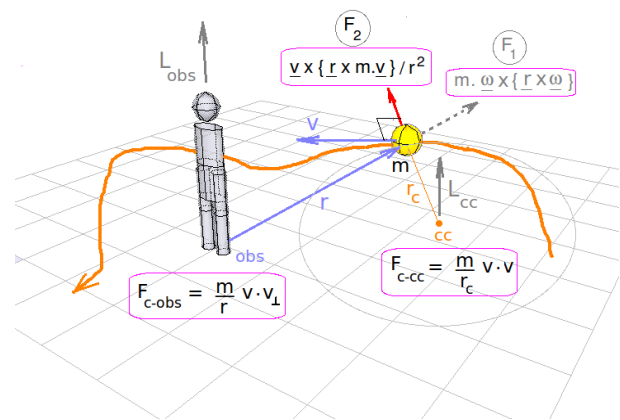

Fig. 7 Conflicting concepts of a centrifugal force?

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References (additional):
1. Jaap Suter , (March 12, 2003), "*Geometric Algebra Primer* ", published at http://www.jaapsuter.com/
2. The airplane test with coffee and ice tea:

http://youtu.be/tOZEgKXJMCE

3. And some comments:

http://www.wired.com/wiredscience/tag/centrifugal-force/

4. Cars and motorbikes driving around a curved wall:

http://youtu.be/hZOekFFSoWI

Home Noise and Electric Grid Induced Ultrasounds

A text aimed at documenting a particular case that raises questions concerning public health

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ABSTRACT[1]

For some years now we have been trying to identify and localise the sources of several ultrasound signals that we have detected in the building in which we live, and inside our individual rooms. These signals were first detected while preparing a lesson for students about sound mixing. We had chosen a very simple but reliable open source application named "Audacity" to record, mix and analyse some sounds. But when these signals were spectral analysed we were surprised by the amount of ultrasonic energy we may often, silently, be living under. We have detected them also in other places, even in our classrooms. After nearly two years of investigation to determine their probable origins, and an unfruitful session of contacts, both with the Electrical Company (EDP) and the public institution responsible for tcommunication and regulation of spectra (ANACOM), we decided to simply publish this article in order to let the subject be exposed to the public domain and conscience. Herein, we present several aspects of the issue, which we think should be addressed by public health officers as a probable long term threat to citizens health, noting that a significant amount of these ultrasounds are probably due in part to the new low consumption gas filled light bulbs along with ultrasonic repellents of animals and people.

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[1] This article forms part of a series of articles we expect to intercalate with our normal scientific production in order to give the appropriate visibility to subjects which may be of public interest but hardly would be reaching the public domain by other means.

1.Introduction

We live in a society of noise. Ambulances, fire engines and police cars scream at us everyday. There are days when every ten minutes the extremely intense sirens of these vehicles pound the ears of citizens as if driven by hallucinated drivers, apparently having fun with their high-tech high pitch tones, some of them resembling howling and vomiting! It seems like a game of torture[2], which was not necessary a decade ago; so, why is it necessary now? This is what people in general are asking themselves. Then, there has been the almost ten years of constant building through the town. People were promised that there would be only a few harsh months during the rehabilitation of the town's centre, but these few harsh months have transformed into many harsh years. And, even now, it continues, with the sudden decision to renovate several more buildings in parallel, after thirty years of day by day letting them fall into ruins; once again, there are drills, hammers, engines, in such an urgency that induces an atmosphere of continuous noise and stress in several parts of the town, and interferes with our capacity to do work. Such manner of "forced progress" has even started to look futile, due to the stress that it has induced in people. We often wonder whether citizens are being stressed on purpose. Why do our leaders seem not to understand that the results of a society of noise will turn into little more than noise itself, and that it is

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[2] Sounds have been used to torture prisoners, in many situations and in many places of the world; as well as a demoralizing weapon during scenes of war. Could the constant usage of such irritating sounds be planned to controlling the impetus of our societies? We want to believe this is pure fantasy.

essential for the creative minds to afford a natural silence? Is there any interest in forcing people out of town centres by any means, for some reason? For those who may be aware of what gentrification means, the answers to these questions are obviously not linear.

In addition to these, amid the noise of extractor fans and air-conditioning units, another type of noise seems to be there, often pounding our brains and bodies, even during periods of rest and sleep: an ultrasound noise. And most of the population has no choice other than to live in ignorance of such a fact, since this happens to be an "invisible" noise. These are often not strong signals, but sometimes they are persistent and may perhaps subtly interfere with our bodies and minds. Could they induce any kind of DNA degeneration, for example, after long periods of exposure? Standard channels should be fast in leading an assessment of such a phenomenon, and more importantly, on eliminating its probable sources. Unfortunately, at the moment, this is not what happens in practice. And this is why we have to spend "our time" in dealing with such kinds of matters, which, in principle, should be of the responsibility of someone in the public administration of our State.

2. Ultrasounds?

Ultrasounds are sounds of very high tones (high sound frequencies) which cannot be perceived by the normal human ear. Nevertheless, dogs, bats, whales, and several other animals can detect them, and in certain cases even use them for communicating. The dangers of these sounds depend on several factors, but always on their frequencies and intensity. Some ultrasounds make dogs go crazy, for example. So, the question we should ask ourselves is very simple: is there any danger in the type of ultrasonic noise we detect in our homes? Although the answer cannot be linear and definitive, we will try to address it here. The main objective of this text, though, is to document our observations and contribute to the general awareness on the subject. The interested reader may further research health aspects related to ultrasounds, and we recommend starting with the wikipedia website. We can say, nevertheless, that the ultrasounds we are talking about are known to eventually interfere with animals internal structures, cells, solutions and bones, and that their

wavelengths belong to the range 0,5-2cm. The medium exposed to these sounds may enter into a sort of a millimetric or sub-millimetric vibration which tends to create little bubbles of vacuum, leading to the formation of zones of cavitation. Such an effect is frequently used in industry and in medicine as a method for cleaning materials, as is also commonly used by dentists, for example. The technique is named sonoporation. Although this kind of effect is common under high intensity ultrasounds (100dB), we suspect that it may also take place under the levels we detect (10-50dB) in the case of a constant exposure to them.

The effects induced by these sonic waves on us depend on the amount of energy our systems absorb from them. Only intense signals are usually studied because it is easier to understand that they may become destructive. But here we challenge such an opinion, since the same amount of energy can be absorbed from a very intense signal acting during a short period of time, as from a low intensity signal acting for a very long time. The signals we are detecting belong to a middle category, but their presence may remain for several hours, during the day or night, and sometimes persist for the whole twenty four hours. Could the continuous exposure to these signals during weeks, months and years, contribute to disturbing our systems in a "subliminal" manner, and, in certain cases, induce some manner of cellular degeneration? Just as a continuous drop of water may sometimes transform into a torture, intensity is obviously not the only factor that matters in a wave interfering with living systems.
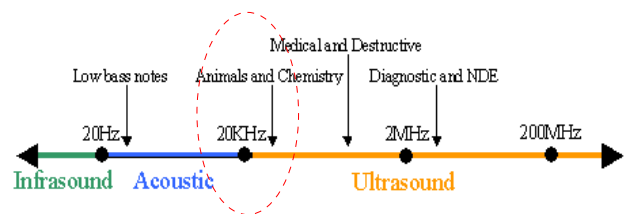

Fig. 1 Rough ultrasound scale of frequencies and some ultrasound applications. The type of ultrasonic signal detected with "audacity" belongs to the thin range signalled by the dashed ellipse, and may interfere with animals and chemistry. For a a wider scope, other type of scientific instrumentation should be used. {image credits to the wikipedia user LightYear}

An interesting aspect of all this is that we have perceived that most of these ultrasonic signals are detected while the house is physically connected to

the public network of energy. So, they mostly enter our buildings throughout the complex net of electrical wires of the mains supply. Turning off the main electric board of our homes will most of the times make the ambient fall into "silence" again. Therefore, should they suspect some kind of interference, we recommend that people disconnect their homes from the mains during periods of sleep. The second recommendation is to detect and document these signals and send them to both the electrical company and those responsible for the spectra regulation, asking them for a declaration of risks or simply to eliminate the source of possible problems.

3. How to detect these ultrasounds[3]

It is very easy to discover if there are any ultrasound signals around a certain place, as long as they belong to frequencies below 48KHz. This is the maximum frequency detectable with "Audacity". For a wider picture, more advanced instrumentation would be needed. Here we give a fast step-by-step explanation on how to start measuring such signals:

1) Download the program "Audacity" from the Internet. If you use Windows you will find it here, for Macintosh you will find it here, and for Linux click here. The example we show is in Linux, but under the other operating systems the procedures are similar.

2) Once installed, open "Audacity" and you will see a window like this:
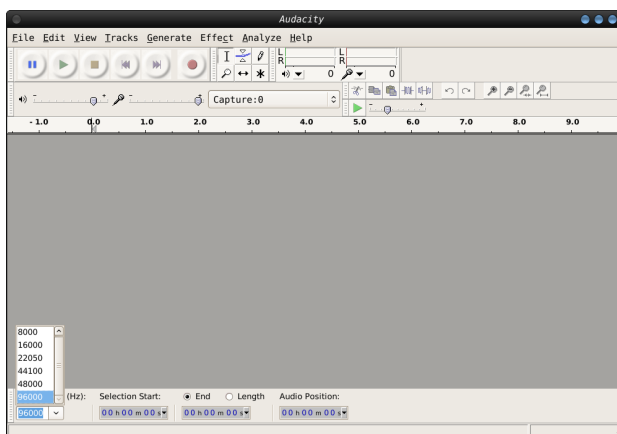

Fig. 2 Audacity main window.

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[3] Important: surprisingly, the most recent computer audio systems (2010 onwards) have started to include audio drivers that deliberately cut-off all the sound information above 20KHz. This means one needs a computer older than that to be able to perceive the existence of these signals.

3) At the bottom left-hand corner, configure the sampling rate of the detector for the frequency 96000 (Hz). This will let you analyse signals up to a half of that frequency, that is 48000 Hz = 48KHz.

4) Connect any reasonable ambience microphone to the computer (ceramic if possible), and adjust it and be sure it is working properly.

5) Press the record button of "Audacity" to start recording the silence of the place. It is enough to record only a few seconds. In our example we obtained:
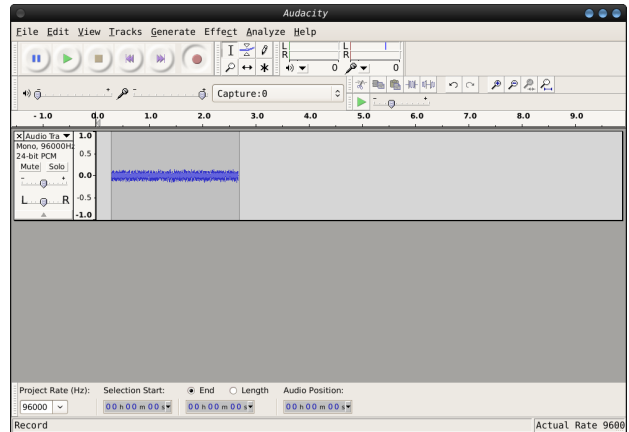

Fig. 3 Audacity after recording some seconds of "silence".

6) With the mouse, select the portion of the signal you want to analyse, and then use the "Audacity" menu command Analise->Plot-spectrum to get its spectral information. In our example we obtained:
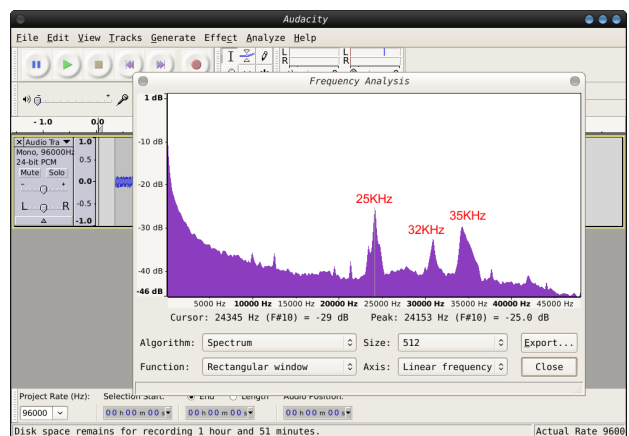

Fig. 4 Spectral information of the "silence" previously recorded, already revealing the existence of 3 spikes of ultrasounds. The text in red was appended afterwards.

7) In the example, three different ultrasound sources have been detected, not very intense, but already with some energy above what should be the required silence. An idea of the *intensity* of these signals can be retrieved from their *amplitude* (dB) above what should be the "true silence"

spectrum (Fig. 5), and also the *width* of the signal. By multiplying both parameters one gets the *power* contained in the signal. To have an idea of the *energy* delivered by them, one has to multiply this *power* by the *duration* (in seconds) of the exposure, which can be several hours per day. Notice, however, that any healthy place should give a "silence" spectrum of the form:
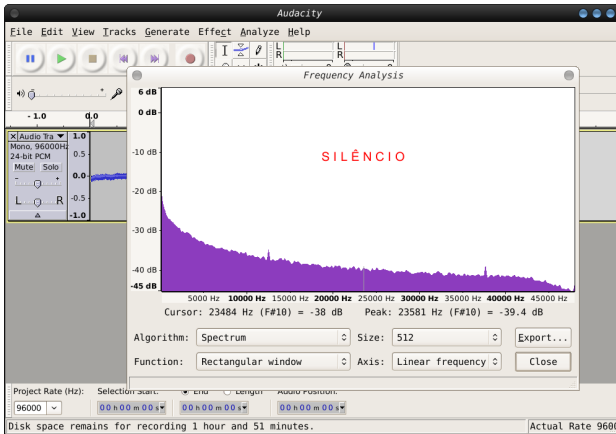

Fig. 5 Spectral information of a "true silence".

8) To relatively estimate the *intensity* of the detected signals, it is useful to first record the sound of an *event of reference* in the place to be analysed. All subsequent spectra may then be compared against this *reference sound*. Figure 6 shows an example, where our reference signal was chosen to be the sound of a ceramic plate falling into the floor:
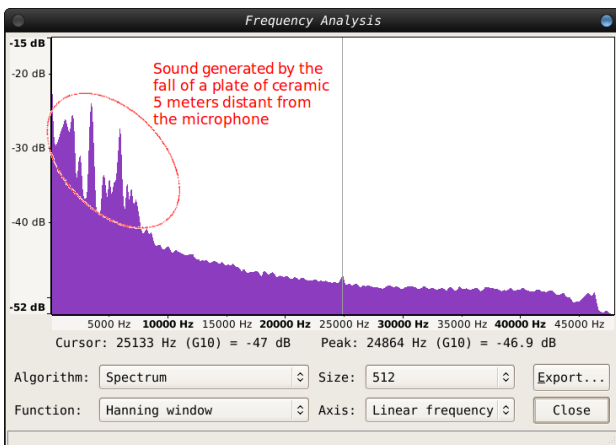

Fig. 6 Spectral information of an example of a "reference sound".

9) From now on we have enough resources and information to form an empirical idea of the power of the sounds surrounding us. This, in our opinion, should be done in all those places where people may be exposed for several hours, mainly places of work, homes, hospitals, etc. The responsibility of analysing and filtering such signals should first be directed to the underlined electrical company, for the service they provide to the community (50-60Hz electric power) should never include such "high

frequency" noises. They should ensure the citizens receive a completely "clean" electrical signal. And that may simply be achieved by regularly inspecting power lines, detecting the sources of noise, and eliminating the noise at the source by means of some advise or proper electrical regulations. In several cases, this noise may be induced into the grid due to a probable malfunction of a machine, for example, or due to insufficient isolation or filtration of certain electrical and electronic instrumentation. The absence of such a process of detection and regulation results in a permanent exposure of citizens to these frequencies, which we suspect may be dangerous enough to interfere with their health. We therefore hereby apply for the electrical company to quickly address this problem.

4. How intense are these ultrasounds?

A precise estimation of the amount of energy involved in these signals could be computed by standard mathematical means. However, since this is an informative text, we think it is more useful to have an idea of this energy by estimating it visually, by simply comparing the *acquired spectra* against the *reference spectrum* of the previous figure (Fig. 6). It is, in this way, possible for everyone to "imagine" the "quantity" of noise detected. Here we present several examples of the "silence" signal we have detected in our homes at different times of the day, week and year, as a small sample from the large collection of data we accumulated over a period of two years. In the next figure (Fig. 7) we show the first example.
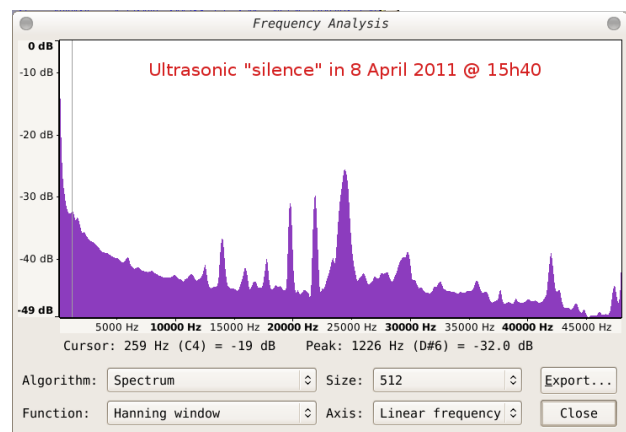

Fig. 7 The "silence" spectrum of 8 April 2011, at 15h40.

By simply comparing this figure against figure 6 we may deduce that the "amount" of noise detected corresponds to almost double the noise of a ceramic plate falling onto the ground. But the worst thing is: the duration of the sound in the first case was near a second, the duration of this ultrasound noise is in

the order of several hours. We would therefore roughly say that on the 8th April of 2011 we were exposed for *several hours* to an ultrasonic noise with an "intensity" nearly double that of a plate falling onto the ground. Although our ears do not allow our conscience to completely detect such a sound (in effect the 15KHz part would still be noticed as a kind of a very thin tinnitus), the fact is our cells, muscles, bones and brains could well be exposed to their influence.
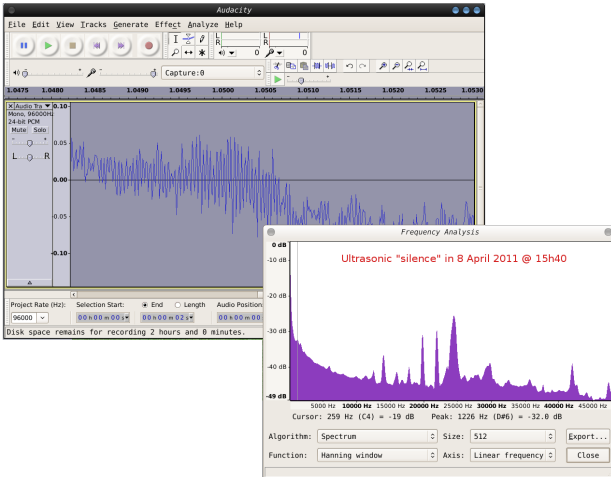

Fig. 8 The same "silence", also displayed in the time window, showing the ultrasonic oscillation around the zero level line.

Is this what we expected from the "silence" of our houses and buildings? Definitely not. A spectrum of a "true silence", like the one of figure 5 should always be detected. On the contrary, several types of signals appear to be there, depending on something we could not yet fully identify, as they are not constant in time and frequency.
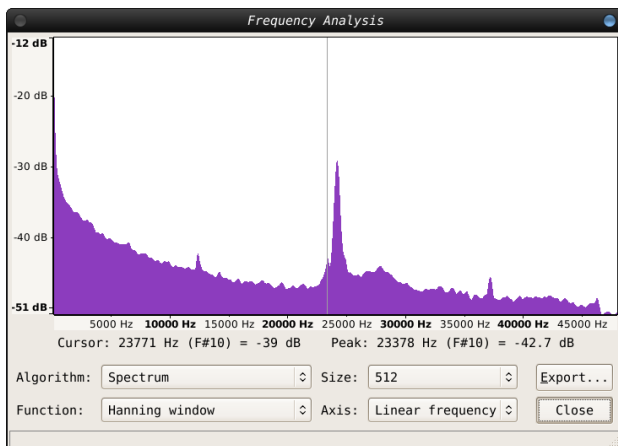

Fig. 9 Ultrasonic signal (>15dB) sometimes detected, with a central frequency near 24KHz. Since it is practically a single frequency, it approaches a pure sound, like those typically produced by an oscillator.

The previous signal (Fig. 9), for example, regularly stays on for several hours during several days. Then it disappears, to reappear again who knows when. It is probably not an artefact, or some indirect effect produced by some machine, but instead a signal deliberately generated for some kind of objective. As in the other signals detected by us, it seems not to have any relation with the time of the day, or day of the week. It is absolutely possible to detect most of these signals both at 3 a.m. of a Sunday and at any other time or day of the week. Nevertheless, the signal of 35KHz of the next figure was absolutely due to the low consumption 7Watt light bulb shown here.
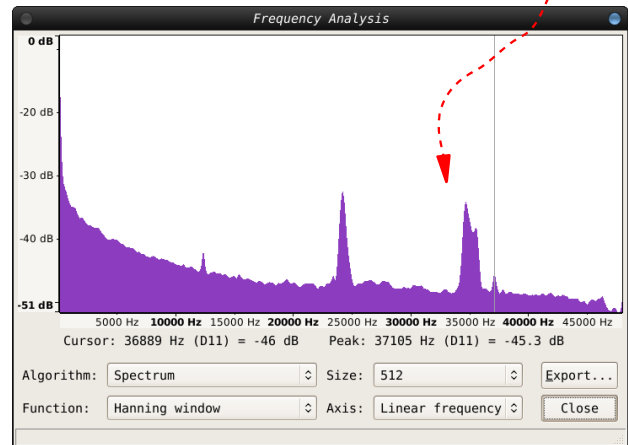

Fig. 10 Signals detected in 27 April 2011, at 19h35. Central frequencies of 24KHz and 35KHz. The latter was produced by a 7Watt low consumption gas filled light bulb, and as a consequence, we decided not to use it any more.
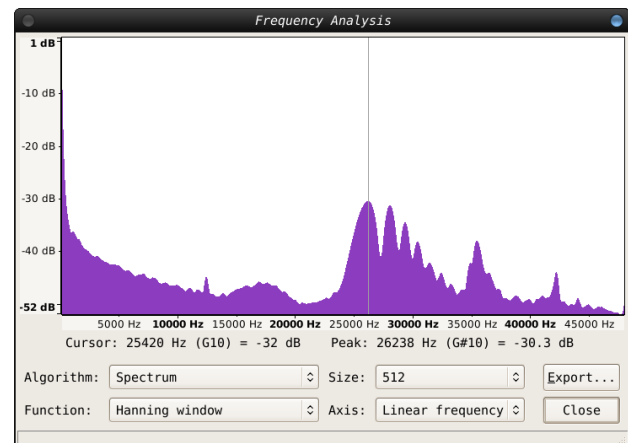

Fig. 11 Another type of ultrasonic signal frequently detected during long periods of time, with peak near 26KHz. This spectrum is wider, meaning it "contains" more energy than the previous cases.

As we can see, it is sufficient enough to visually

compare these spectra with the *reference* spectrum to obtain a rough estimation of their power, and to subsequently become perplexed. It is important to have in mind, however, that normally, the wider the spectrum the more energy it carries, and, since this energy is distributed by several frequencies, the effects of it tend to be related to the rising of temperature on the "target". On the other hand, very "thin" spectra may carry less energy, but they are much more efficient in inducing forced oscillations into the "targeted" system. And it is these subtle vibrations that may subtly interfere with our bones, cells, brain, articulations, etc. This seems not to be scientifically studied yet, but we would prefer that the proper experimentation would be done in some scientific institution, not directly on people, if that may be the case, and that these signals be eliminated from our homes, offices, universities, etc., in order to let us live our lives in peace. Certain plays of piano can interfere with people's well-being even if their "sounds" are the same as those of other plays of piano which are meant to relax them. So, imagine what these "constant" *very high-pitch* sounds can do to us during an entire night of sleep, for example, or during days and days at work; and even at certain places in the streets, as we will see soon in this article.
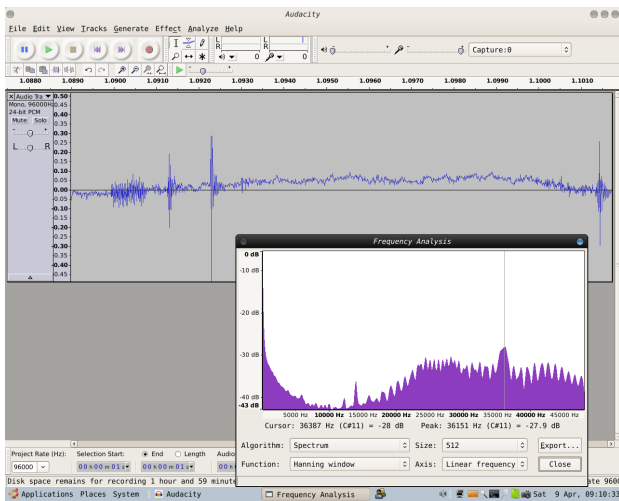

Fig. 12 One of the widest cases of ultrasonic noise detected by us. It was Saturday, the 9th of April 2011 at around 9h30. Ultrasonic pulses are generated near the "zero volt" line, and some of them are very intense.

By carefully inspecting these signals on the time window we have noticed that they all seem to be synchronous with the 50Hz of the electric grid, and more precisely that they are created when this signal crosses the "zero level" voltage. This is a common

and simple strategy for generating pulses: the usage of a *zero detector* electronic circuit. As also shown in figure 13, the ultrasonic bursts are visibly transported by the mains signal, and seem to be triggered by crossing the "zero voltage". Notice that this signal was detected around 5h30 a.m.
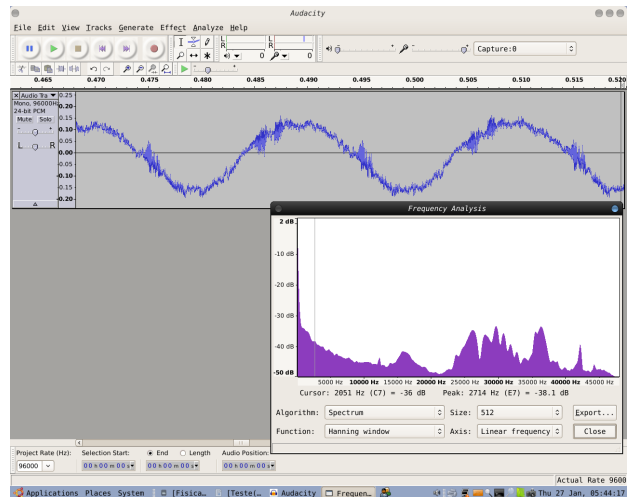

Fig. 13 Another case of ultrasonic noise detected in the 27th of January 2011, Wednesday, at around 5h30. The sinusoidal signal is the 50Hz mains electrical signal, with an excessive amplitude also.

We also noticed that usually there is an increase in the 50Hz at the detector when these ultrasounds appear. It is a curious fact that seems to point to an increase of the impedance of the network on those occasions.
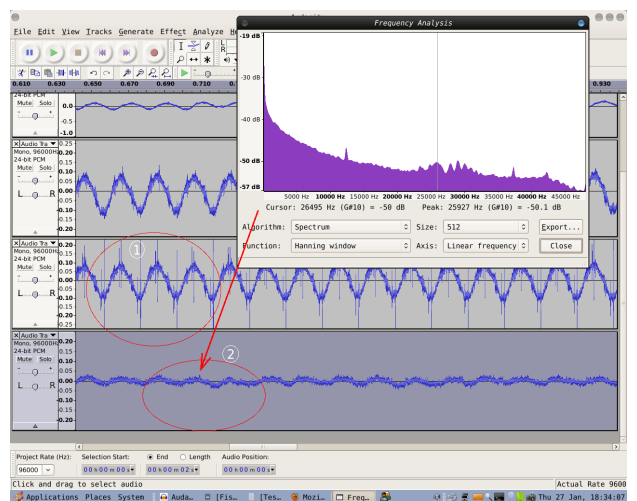

Fig. 14 Diverse signals detected in the 27th of January 2011 at around 18h30. The sinusoidal signals are again the 50Hz. This case was curious because coincidentally we were sending an email to ANACOM when detecting signal 1 for long time, and few minutes after sending the email the ultrasounds disappeared and the signal became signal 2. Also the 50Hz were drastically reduced, as one can see, possibly meaning a drastic reduce on the impedance seem by the microphone.

This automatically makes us think on a "capacitive circuit" somewhere, which may act as a receiving antenna, or an inductance in series with the electric signal? And this makes us think on those light bulbs again, which are based on light emitted by a gas, where the electronic current is smaller and thus the impedance is higher. Could gas bulbs be the main source responsible for these ultrasonic noises? The spikes superimposed on the 50Hz signal are the ultrasonic noise. The next figures show other types of spectra usually detected.
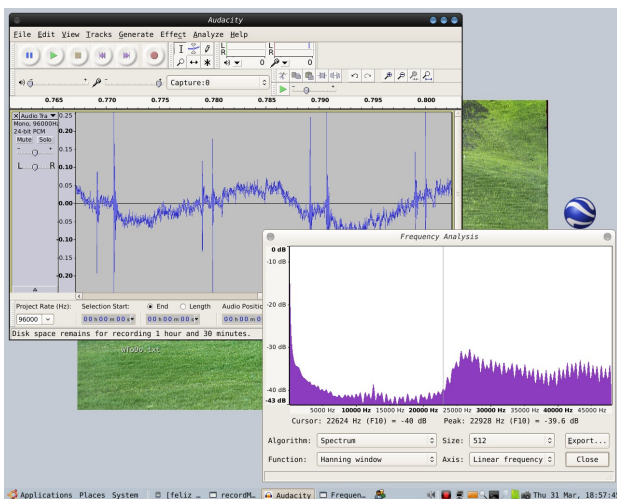

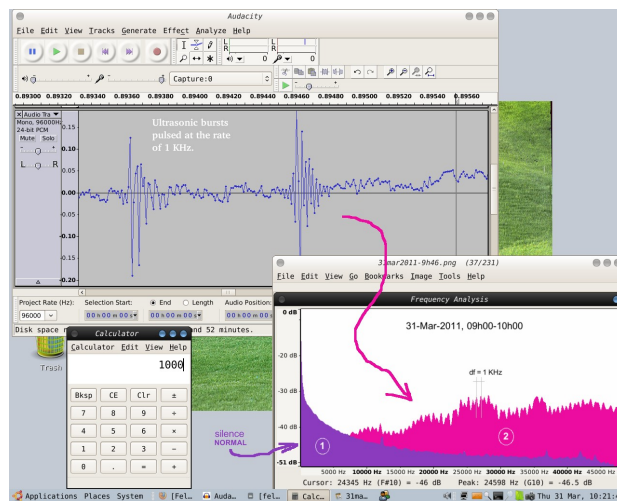**Fig. 15** Intense ultrasonic spikes with a spectrum above 20KHz.

Fig. 16 Visual estimation of the energy of the ultrasonic signal. Spectrum 1 is of the "true silence", while the red spectrum is related to the pulses shown in the time domain. This is a strange and large quantity of ultrasonic energy, resulting from a wide mixing of frequencies.

It is interesting to notice that rarely these types of signals (Figs. 12, 15 and 16) are present for more than several minutes, maybe 15 minutes maximum, after what they seem to be "switched off". Some dozen minutes after, however, they frequently appear again, as if they would be part of a very slow pulsed process. It resembles, somehow, the wide spectrum of emission of a powerful computer, for example. Probably these spectra are not due to gas filled light bulbs. But the new *low consumption gas filled bulbs* are in fact some of the most intense sources for these ultrasonic signals. As we have advanced in this article, more information has been collected leading to such evidence. We decided to make a test using three different compact gas filled bulbs at a distance of around 1 meter, and the next figure shows the astonishing spectrum (42 dB peak!) obtained with a 23W bulb:
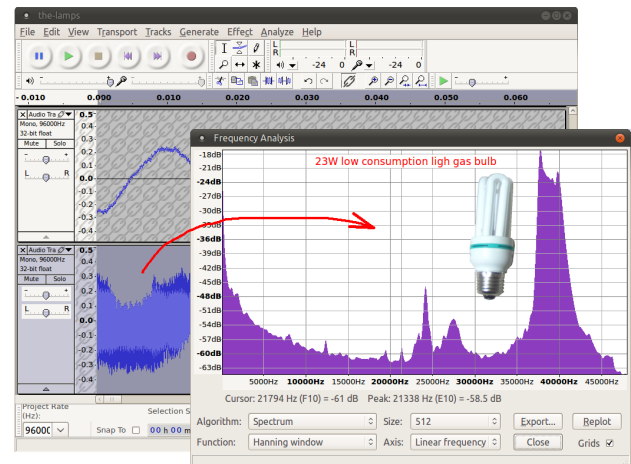
Fig. 17 Spectrum of a 23W gas light bulb at 1 m distance. Notice that although the density of energy crossing the air decays with distance, like with normal sounds, most of it propagates around the place, and through the building, along the electric wires, therefore reaching other places and even other houses.

Fig. 18 Comparison of the "clean" signal emitted by a 25W incandescent bulb, with the "extremely dirty" signal emitted by a 23W gas light bulb. The boldness of the bottom signal results from the astonishing quantity of ultrasound spikes it generates. This is not only bad for the people but also for any sensitive electronic device. It has the contours of an abuse. And we expect it to at least provoke tinnitus in

some time.

Fig. 19 Another example, now of a 18W gas bulb, with a peak of 36dB at a frequency near 28KHz.
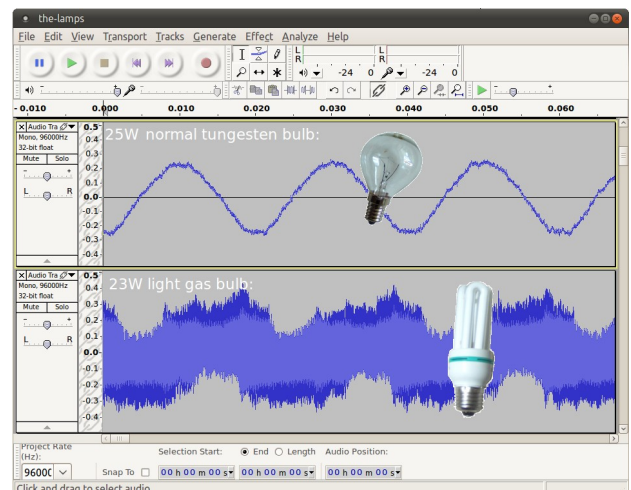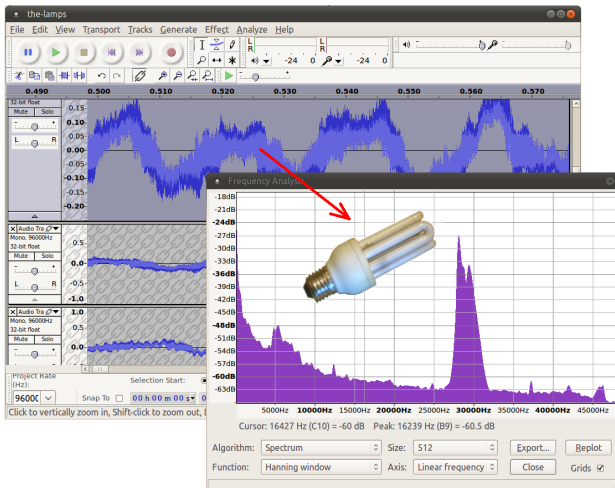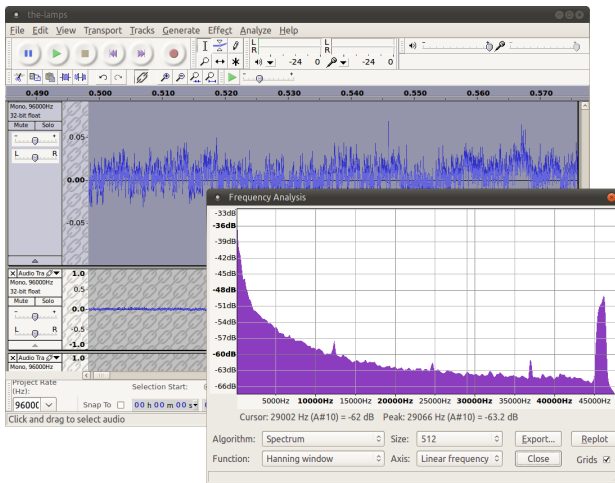

Fig. 20 Certain signals detected with "Audacity" may also be of a software origin, as it seems to be the case presented in this figure. This signal of near 45KHz was emitted by the "mouse pad" of our computer when it was being touched, but it was only "visible" while using only the battery to power the machine. Everything seems to indicate it was produced by some sort of software routine, or mechanism, responsible for scanning and interpreting the "touch" on the "mouse pad". Probably, this signal dissipates to the electric wires when the computer is connected to the mains supply. Anyhow, it is not comfortable to know that an ultrasound buzz of the order of 20dB may probably be emitted to us whenever we use the "mouse pads" of our computers. This do not seem to happen while operating an "external mouse".

Notice, however, that these spectra result from the sum of the direct spectrum propagating through the air (less intense) with the spectrum that propagates around along the electric wires (more intense) and then reaches the microphone. The worst of this is therefore not the direct sounds emitted by the bulbs, but any indirect effects these lamps may induce throughout the interference with the mains signal. It seems we frequently live under

an ultrasonic wave that subtly and continuously surrounds our ambience, and may even act as a source of a *capacitive coupling* between those signals and our bodies.

5. **Ultrasonic repellent type of spectra**

Ultrasonic devices have, for some time, been used to repel mainly rodents from certain places, houses, caves and properties in general. But up until now, we would never have been expected to ask ourselves if anyone could use such an ultrasonic device to interfere with people. In the past, if we had been asked, the answer would have been *absolutely not*. It is sad to say, but now we have to assume we were wrong. The present day answer is *yes*! For example, the "Mosquito device"[4] developed by the British inventor Howard Stapleton, which has been applauded by some around the world and promoted to reduce "anti-social" behaviour, and violence, and since then has been installed without public consultation in certain shops, near transport hubs, etc., is a sonic electronic repellent of people, firstly directed to repel groups of youngsters out of certain places. Exactly!, as it is done with rodents.
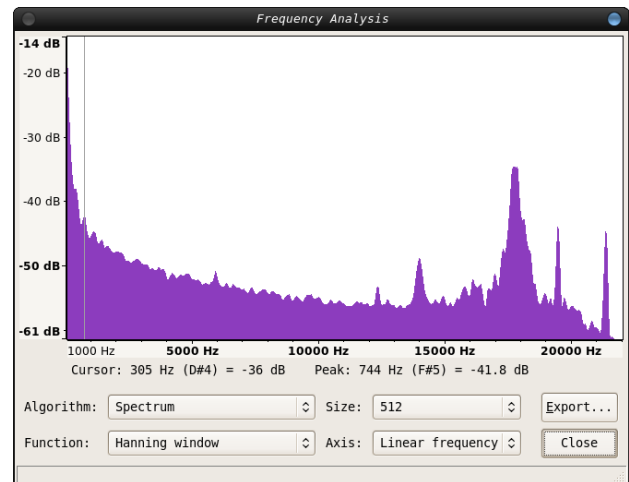
Fig. 21 This is the spectrum of a relatively intense signal (>25dB) that coincidently has the same peak frequency (17,4KHz) and shape as the "mosquito system". It was the first signal detected in our homes, and the reason for the first contacts with the electrical company. Only after around a year of complaining, has the signal "disappeared". It was a pulsed signal, for several times detected 6 minutes on, and then around 12 minutes off, and repeated like this for hours and even days. Part of the information sent to the electrical company can be inspected here[5]. It has not been detected again since then, therefore we suspect of someone trying to install a "mosquito system" near us, or in a monument or Metro station nearby. We suspect this to be the origin of a little sensation of tinnitus we acquired around the same time.

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[4] More about "The Mosquito": http://en.wikipedia.org/wiki/The_Mosquito
[5] Sequence of signals: http://paginas.fe.up.pt/~feliz/ultrasons.gif

The "Mosquito" device uses the frequency of 17,4 KHz to deter youngsters, but also can produce a sound of 8 KHz detectable by most people of all ages as a sort of annoying high-pitch tone[6]. The same device may be adjusted to generate many other frequencies. Of course those who advocate for the installation of such type of devices know that several questions would rise from citizens against such a practice, so, what seems to happen here is to hide the issue from public debate. Unfortunately, things are frequently managed this way, and the news and standard media either ignore the issue or appear to talk of it only after it is already installed on the ground, taking citizens by surprise. In such an ambience of "trust" it will be acceptable to raise other questions, like for example: "*can anyone be also using the mosquito device to try forcing people out of their homes, either for gentrification purposes or any other reason?*" Some countries have already issued some legislation about this, and the tendency in Europe is to prohibit the use of such devices, and even consider them as an assault. The German Federal Institute for Occupational Safety and Health, for example, in a report about "The Mosquito", states:

The results of the examination are now available. The auditors were not able to certify this device as completely safe. The risk to the target group of teenagers and young adults is relatively low. They can leave the area when they hear the sound. On the other hand small children and infants are especially at risk, due to lengthy exposure to the sound, because the adults themselves do not perceive the noise. Moreover, the ultrasound *affects not only hearing. Disruption of the equilibrium senses, as well as other extra-aural effects are well known. With the sound levels that can be reached by the device, the onset of dizziness, headache, nausea and impairment is to be expected. This is not the limit of the total risks to safety and health.*[14]

Some other people and advertisers of ultrasonic systems, however, seem to be convinced that as long as these waves are not detected by our ears they are safe! That is almost like saying Ultraviolet Radiation is safe because one cannot see it! This sort of reasoning is a danger, since most of the people who

have access to these technologies do not even have an educated idea on the consequences of such processes. It is not surprising, therefore, that meanwhile several websites have appeared on the Internet offering "mosquito ringtones" for youngster mobile phones, since they may use those rings even in the classroom without the teacher noticing. But at least these websites alert people not to listen to these tones with headphones or near speakers...

Rodent repellents, on the other hand, usually use frequencies in the range 20-40KHz, since they are designed to mainly interfere with the ears and the psychology of these animals. That probably explains why we have detected for several days the visit of a rodent to the exterior of our place during the night, while we were using a 7Watt gas filled bulb as a "presence light" inside one of the windows of our home, and that this animal was frequently surrounding it and trying to reach it from the outside. At the same time, he (or they) has presented the exterior floor with several little demonstrations for sizing territory, perhaps he (they) was afraid of the probable invader who was shouting from behind the window throughout the whole night! We would not be surprised that these light bulbs would also repel or attract rodents depending on their frequency of emission.

We suspect the spectrum of the next figure is probably due to a rodent repellent, not from a bulb, since we expect electronic repellents to be sharper and more symmetrical around the peak frequency. It has been detected sometimes in our homes too:
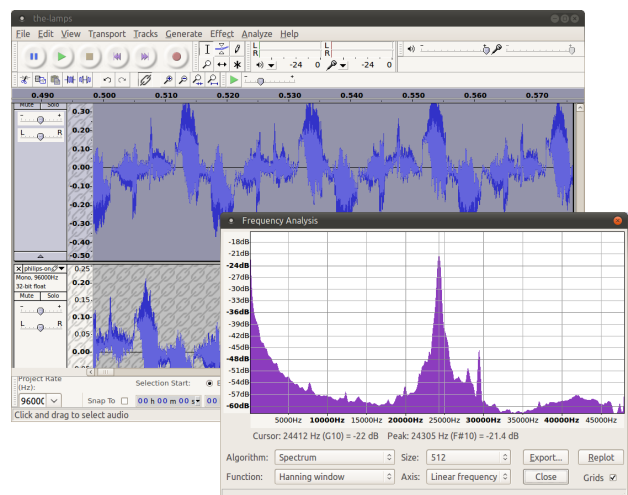

Fig. 22 This is an intense signal (~40dB) with a peak frequency of 24KHz, sometimes detected in hour homes. We suspect this may be due to an ultrasonic repellent of rodents, although it is frequently off during several days and nights, which would not be expected in that case.

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[6] Some Mosquito sounds may be tested at:
http://www.freemosquitoringtones.org/hearing_test/

6. **How these noises may reach our bodies**

As said before, we see two main processes for these ultrasounds to reach our bodies: 1) propagating through the air or materials, as normal sounds do, but with slightly higher attenuation[7]. 2) by capacitive induction between the electrical wires and our bodies, which tends to be higher in places without the proper installation of an "earth" conductor.

The route diagram for the first case is represented in next figure:
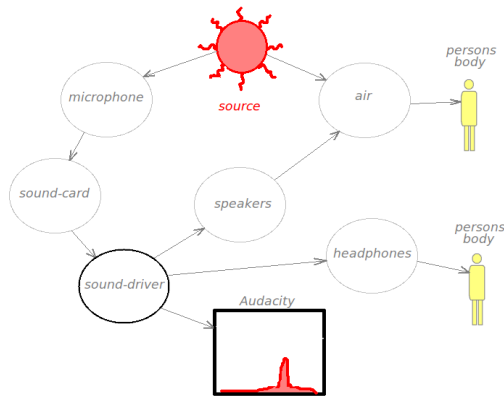

Fig. 23 How a source of ultrasounds may reach our bodies, in what concerns its normal propagation through the air and materials. Notice that using headphones may result in a dangerous exposure, since the person may not perceive these sounds while they are passing directly from the microphone into the ears. Headphones may attenuate them, but even so it is not recommended. The person should also avoid staying near speakers. This may explain why most recent sound-drivers are obviously cutting off ultrasounds. We don't want to believe it can also be for us not to perceive them, mainly those generated by gas filled bulbs...

The second case of interference is not so easy to explain. However, the next figure should help.
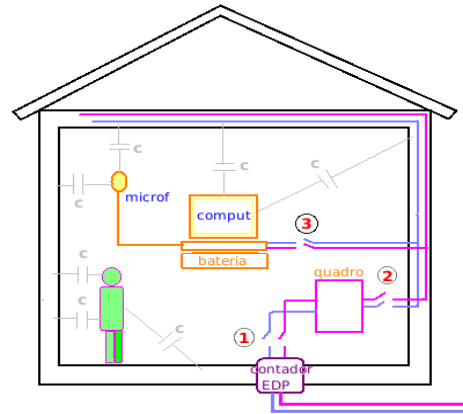
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[7] Notice that at these "low" frequencies the attenuation of ultrasounds is not so different from the attenuation expected for "normal" sounds.

Fig. 24 How the ultrasound induced into the mains may also interferes with our bodies by means of a capacitive induction. Our bodies are part of the dielectric that separates these signals from the "ground", which means that small effects of electric polarization can be induced into our cells, bone structures, brain, etc. These effects may eventually be reduced if the electrical installation is properly "shielded" by means of good "earth" conductor.

7. **Comments and conclusion**

The first thing coming to our mind is the number of things that insidiously may be imposed upon our democratic societies, not chosen by its citizens but by the interests of only some. Two obvious cases are the "*mosquito*" device and the *low consumption light bulbs*, about which several health institutions have exposed serious issues concerning the health of the population. In the list of references we give several examples of this, but some words must be said in particular about *gas filled light bulbs*, since we learned it is the intention of several organizations not only to promote their usage but even to impose a *phasing out of incandescent lamps*! This means that there is, from within these organizations, a serious pressure being forced upon society such that normal incandescent and clean lamps are being made to disappear from the market and be urgently substituted by another technology, which is, in this case, more dirty and more expensive! It is, for us, very difficult to understand, based on a scientific versus economic reasoning, that such a huge change is being imposed with the simple argument that gas bulbs consume significantly less energy than "normal" bulbs. It seems a charade, since this is a decision based on a single aspect of the issue, instead of on a wider view on the subject. The decision should take into account the facts that these new lamps contain mercury, that they need electronics that consume energy, and resources to be

manufactured. Also, during their use, they are dangerous to people and animals[8], and that at the end of their life-time, danger awaits in the re-capture of their mercury and electronic circuitry, along with several other aspects. In contrast, normal bulbs are very simple to produce and very clean throughout their life-cycle. A good report about this which corroborates with our results and our opinions was published in the magazine "Baubiologie Maes", under the title "*In the Cold Light of Day: Energy-Saving Lamps - The End of the Light Bulb - The End of Healthy, Natural Lighting?*".

Once again, mainstream media keeps silent while all these processes develop in background. Can we still be sure that these people are wishing good to the general population, with such kind of sudden solutions and "urgent" impositions on our societies? Aren't they mainly focused on commerce and sales, and new businesses? Isn't it surprising and strange that a huge pressure is being applied in order to exchange the tranquillity and cleanliness of normal incandescent lights for the "invisible" noisy and dirty light of the new compact light gas bulb? Can we still be sure those forcing the usage of these dirty lamps are truly "friends of the environment"? Excuse the forwardness, but we are starting to believe that they are not. The impression we have, as scientists and people used to logical reasoning, is that our societies are being forced to follow certain directions traced not by the power of logic but by the power of certain lobbies, which by all means, are trying to avoid submitting their proposals to the general population for scrutiny, where large numbers of scientists and technicians exist, skilled enough to give valuable and independent opinions about all matters. We don't want a society of decisions made by those who have no competence on the subjects, even if they are politicians or lobbies of pressure, and where the issues are presented to the public by the perspective of the salesman, obviously hiding all other perspectives and the list of inconveniences. In our point of view, the reduction of consumption achieved with these new gas bulbs does not justify the "subliminal" attack on the health of millions of

citizens and animals around the world, neither the exchange of a very simple and clean industry already well established and stabilized, for a more complex industry, needing more energy and resources, from which the last output is a very dirty product in the several phases of its life-cycle. We prefer to maintain the same clean and tranquil incandescent lights, even if we have to switch them all off to save our planet.

"The economic anarchy of capitalist society as it exists today is, in my opinion, the real source of evil. Private capital tends to become concentrated in few hands, partly because of competition among the capitalists, and partly because technological development and the increasing division of labor encourage the formation of larger units of production at the expense of the smaller ones. The result of these developments is an oligarchy of private capital the enormous power of which cannot be effectively checked even by a democratically organised political society. This is true since the members of legislative bodies are selected by political parties, largely financed or otherwise influenced by private capitalists who, for all practical purposes, separate the electorate from the legislature." (Albert Einstein's thoughts on "The Source of Evil")

Author's Biography:

J. Manuel Feliz-Teixeira graduated in Physics in the Faculty of Sciences of University of Porto, Portugal, and received an MSc in Mechanical Engineering and a PhD from the Faculty of Engineering of the same university. His work has been related to various matters, from optical communications, solar energy and seismology, to the simulation of complex systems, warehouse, supply chain, urban traffic, metro networks, etc. His doctoral thesis is on "*Flexible Supply Chain Simulation*". More recently he dedicated to researching new approaches for renewable energy, and presently is focused on lecturing Physics and study *gravity* phenomena by means of classical Mechanics.

References (additional):

- Sociedade Portuguesa de Acústica:
http://www.spacustica.pt/; email: spacustica@lnec.pt

- Important contacts for ultrasound health:
http://www2.warwick.ac.uk/services/healthsafetywellbeing/contacts/

- A Japanese study "for the most hateful mosquito sound":
http://eproceedings.worldscinet.com/9789814299312/preserved-docs/9789814299312_0052.pdf

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[8] Hundreds of whales and dolphins are strangely committing collective suicide; could it be that these ultrasonic signals generated by gas filled bulbs enter the electric network and propagate into the water (ultrasounds propagate good in water) and interfere with their systems? Of course this would make them go crazy!

- Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR):
http://ec.europa.eu/health/scientific_committees/emerging/index_en.htm; email: Sanco-Sc1-Secretariat@ec.europa.eu

- Publication about the dangers of compact fluorescent lamps:
http://www.baubiologie.de/downloads/english/energy_saving_lamps.PDF

- Ultrasonic scaler dentist:
http://www.link.vet.ed.ac.uk/clive/cal/dentistry/website/workplace/powered/ultrasonic.html

- Ultrasonic cleaning systems (cavitation effect):
http://en.wikipedia.org/wiki/Ultrasonic_cleaning

Some Facts and Comments on the Strange Clouds
People Around the World Call "*Chemtrails*", and Their
Probable Relation to the HAARP System

Includes some directives for a possible scientific research plan

J. Manuel Feliz-Teixeira

March 2011

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ABSTRACT

Near 10 years have passed since my eyes could for the first time observe one of those abnormal trails crossing the entire sky. It was a clean day of a wonderful blue sky. And, over our heads, a first line of a constant width hundreds of kilometres in length was splitting such a blue ceiling into two parts. Only a single flight did it, in the dozens of flights crossing our skies on that day. It seemed almost absurd, and an abuse, at the time. It was around the beginning of the Autumn of either 1998 or 1999, I don't recall exactly. Until then, our eyes used to find the skies naturally either clean and of a transparent blue or with clean normal clouds. It could rain or be a sunny day, no matter the atmospheric conditions, the trails of the aircraft had always been of the same kind: a little white tail of around 10 or 20 times the aircraft length, which in some seconds would dissipate into the atmosphere, leaving the sky completely clean as before. Curiously, since that day, the number of flights leaving abnormal trails have slowly been increasing, and, along the last 10 years, we have also seen many things degrading from the sea water which slowly started to frequently exhibit a sort of bad smelling foam fluctuating along the coast, to the falling of thousands of bees dead before our feet, the

sudden weakening and darkening of certain trees, which frequently died, like the pine and the eucalyptus, for example, to the mass deteriorating of citizens' health due to persistent respiratory problems and "strange" illnesses. In 2007, near 30% of the population of my country were already suffering chronic rhinitis[1]. In this article we give a testimony of our own empirical observations and comment on some aspects that may be related to the phenomenon. We hope this may be seen as a contribution to those in the Sciences of Health and Environment who probably might like to investigate the issue by means of a truly scientific perspective. In that sense, we will also make some references to the project known as *High Frequency Active Auroral Research Program* (HAARP)[2], which many people on the Internet suspect of also being related to such abnormal aircraft trails.

1. Introduction

During the last months I have frequently thought of Einstein. This time not because of his work on Physics and challenging theories, but instead due to something that deeply impressed me in the story of his life: the fact that a man like him, a lover of these things, has finally been driven into deep sadness due to the *infinite stupidity* of certain human beings. War was, once again, obviously and ominously, at the centre of such a disappointment.

Sadly too, one can nowadays observe a tendency

[1] Todo-Bom A, Loureiro C, et al, "*Epidemiology of rhinitis in Portugal: evaluation of the intermittent and the persistent types*", SPAIC- Portuguese Society of Allergology and Clinical Immunology, Portugal, PubMed.gov, 2007 Sep; 62(9): 1038-43. Summary here.

[2] HAARP official website: http://www.haarp.alaska.edu/

of a growing number of people falling into what I imagine an *Einsteinian disappointment*. An unusual number of people is getting deeply worried about what is happening in our world, and disappointed with what they see and feel, in such a way that many are even thinking either on giving up their jobs or urgently asking for retirement; lawyers, technicians, teachers, scientists, are being so exposed to this *strange stress* and deteriorating environment that even human relations seem to be seriously affected. It is probably a case of a faster than usual evolving human universe, and too much aggression, perhaps, but a lot of it is, in our opinion, due to the constant degradation of the environment we are living in. Could such a degradation provoke a sort of "sensation of extinction" which may also be felt by certain animals and justify their collective suicide, like dolphins and whales, for example? And even humans? How much will be needed for human beings to decide to give these issues the appropriate importance? Are we waiting for enough statistical relevance, or clear *evidence*, as some would say, which in practice means the previous death of millions, in order to take a move or to question what we are doing? The artificial clouds people around the world have started to call "*chemtrails*" are a good example of a reality which largely exceeds our expectations about humanity as a community of intelligent beings. Ten years have passed since the first day we have detected these abnormal trails in the sky, but, since then, not even a single reference to them have we seen in newspapers, or on TV. While we are almost daily informed of almost everything concerning the nails of a musician or of a star, for example, no information about this is given to the citizens. Instead, the word "pollens" was for long time being systematically launched into the media as an explanation for the astonishing rate of people developing respiratory illnesses. Strangely too, in the only place where the subject seems to be strongly debated and documented for years, the Internet, one may realise there were also groups aggressively playing with disinformation tactics, as if a real war, albeit silent in the media, would be on.

Of course any scientific mind will notice some strangeness around this subject, and it will also ask about what kind of a sinister and unexpected thing is going on in our times? Toads, for example, were seen frequently exploding in Germany at night

during 2005, as reported worldwide, and a rise of 200 times in the rate of extinction of these animals have been observed recently[3]. News report about suspected mass suicide of dolphins[4], groups of birds falling dead from the sky in New Jersey[5], and in England[6], and around the world. Thousands of dead octopus suddenly appeared on a Portuguese beach[7]; other times it happens with fishes. Again, in January 2011, 5 thousand birds fall dead from the sky in Arkansas while 100 thousand fishes appear dead 200Km away from that same place, in Arkansas river. Then, one could also mention the extinction of the bees, which are being badly affected[8]. All this, however, seems not to be enough to make those who *decided without citizens' permission* to cover our skies with artificial clouds to address the issue frankly and openly with the populations. And the universities seem not to have enough curiosity too, curiously. Instead, a game of hide and seek, ambiguity, cat and mouse, seems to go on implacably, even cruelly, we would say, leading most of the people on the Internet to suspect a large military project[9].

Fig. 1 Abnormal aircraft trails slowly turning into artificial clouds, observed all over the world and very well documented on the Internet.

[3]McCallum, M. L. 2007. *Amphibian Decline or Extinction? Current Declines Dwarf Background Extinction Rate*. Journal of Herpetology. 41(3):483–491

[4]Steven Morris, "*Dolphin deaths: Expert suggests 'mass suicide'*", guardian.co.uk, Wednesday 11 June 2008 12.37 BST

[5]Carly Rothman / The Star-Ledger, *Hundreds of dead birds fall in Somerset County town*, New Jersey Real-Time News, January 25, 2009, 9:47PM

[6]Daily Mail Reporter, *Grisly mystery after scores of starlings fall out of the sky and lie dying... in a SINGLE front garden*, Last updated at 8:12 AM on 11th March 2010

[7]*Thousands of dead octopuses wash up on Portugal beach*, BBC News, Sun, 03 Jan 2010 16:51 EST

[8]Michael Leidig, *Honey bees in US facing extinction*, Telegraph.co.uk, 14 Mar 2007

[9] Search the internet for the article "*Global Warming and Ice Ages:*"

The first thought coming to our mind is: are not our military and our weapons being paid by our taxes? Second: are not our military a fundamental part of our proud *democracies*, which we once have thought on to export to the rest of the world? Would our righteous and courageous military be able to damage their own people?

Taking into account the silence and the lack of trust created by such a practice and such a silence, it is legitimate to wonder on some other side effects probably due to this activity, and ask some more questions which may, directly or indirectly, be related to the falling onto earth of some dangerous particulate that may be used in the process: why are our fruits and vegetables lately getting abnormally old and soft on the inside? Why are our ocean waters often covered with a smelling-like-bacteria foam that was not there before[10]? Why do PM10 particulate levels seem to rise when such an activity is going on in the skies? Why have tap water become terribly unpleasant and tasting almost dangerous, at least to our instincts, and do people often associate it with problems of their health? I may, for example, confirm that only after giving up drinking tap water could I get better, and almost free, of some abnormal involuntary movements that frequently were shaking my body for almost two years. And that was a time of intense activity of these aircraft, curiously. Could any chemical have entered the public water supply network? In the days of more intense spray, also the vision seems more affected for those who already have difficulties seeing; things appear defocused both from near and far. Unexpected muscle weakness, dizziness, headache and brain blockage are also common effects. The nose obstructed for weeks and even months and almost continuously running, or even bleeding, as if affected by some sort of strange bacteria, fungus, or virus, makes many people despair, while pharmacies go on selling *anti-histamines* like bread. Other times, one feels a little impression of burning around the eyes, and red in the skin. Some people frequently complain of pains and sensation of burning in the gorge. Curiously, once again, when there is such an activity going on. Sometimes one wakes up during the night with a strange taste and an extremely dry mouth, as if being poisoned by something in the air. And lately, the spray is being made during the night, curiously, probably for people not to notice it so

easy? How could Einstein live the rest of his days with the tranquillity any human being deserves, after being so much disappointed in his fellow human-beings' ability to create suffering?

2. What is that what people call "*chemtrails*"

One should not loose too much time discussing issues of nomenclature, since these often lead to a lack of perspective. In effect, they may put too much emphasis on something that may even be irrelevant: the name one gives to certain things. We could call those abnormal trails "*poisonous trails*", or "*long clean water-vapour trails*", on the other hand, but that would not add anything to the problem which is urgent to resolve. We will, therefore, call them like most of the people around the world decided to call them: "*chemtrails*"[11], since they obviously interfere with people's health and spread the fear that they may contain chemicals and even other sorts of dangerous particulate.

Chemtrails begin as abnormally long and thick aircraft trails, which can even extend for hundreds of kilometres. They usually stay almost static in the atmosphere, but slowly they get diffused side-ways, obviously depending on the action of the wind, that way first transforming into a sort of haze. Usually, this first veil of particulate already lost the form of a trail, so, less attentive people will hardly recognize it was caused by a trail. This veil of haze will slowly capture water from the ambience, and, in some time, it will be transformed into a cloud.

Fig. 2 Man-made type of clouds observed all over the world, which citizens started to call "*chemtrails*" due to the suspicion that they contain metallic particulate, salts and barium, among other "chemicals". Many people also fear they may be used as vehicles for spreading virus, bacteria, and even genetically modified organisms or material.

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[10]Click to see a video: http://www.youtube.com/watch?v=cF4_7PJFBe4

[11]Some insist on calling them "*contrails*", since they say it is a normal effect: http://www.ucar.edu/news/features/clouds/

Figure 2 showed a very interesting case of those *static clouds*[12]. These clouds, in fact, contrary to what happens with most of the normal clouds, were not taken to that place by the wind. Instead, they were formed by inflation and dispersion around where those trails have previously been left. This is a fact that anyone can observe. These artificial clouds are usually seeded locally. They have been created there, and frequently will stay in the same place for long time, while getting thicker and thicker by means of the water they are able to absorb from their surroundings. Properly dumped, these artificial clouds may even transform into heavy rainy clouds, depending, once again, on the intensity of the aircraft activity and the products people suspect they are using[13]: metallic particulate, mainly aluminium and barium, "dry ice", and silver iodine. During late afternoon, evening and night, these clouds look of an "unreal" luminescent orange, or yellow, while normal clouds still look grey or grey-blue. It seems also curious that the recent *Swine Flu* (H1N1) "pandemic" (2009) was by many on the Internet being linked to this activity, and "suspicious" connections between some elements of the *World Health Organization* (WHO) and some top vaccine manufacturers later became known to the public[14].

It is very interesting, however, to realise that a sort of "*chemtrails solution*" has already been proposed a decade ago by Edward Teller, the father of the Hydrogen Bomb, and others, in an article presented during a conference[15] in Italy in the Summer of 1997. In that article, some methods for controlling the effects of a possible "*global warming*" provoked by human CO_2 emissions were discussed. One of the solutions was inspired by the cooling effect observed during the eruption of the Mount Pinatubo volcano in Philippines[16] (1991); so, they

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[12]Image source: the Internet. Lost address, but thanks, anyway.
[13]Personal conversations also raise the fear of depleted uranium and other metallic waste being used as remnant from recent war efforts.
[14]"*Report: WHO overstated H1N1 threat*", Al Jazeera online, 4 June 2010.
http://english.aljazeera.net/news/americas/2010/06/201064850 35915742.html
[15]E. Teller, L. Wood, R. Hyde, "*Global Warming And Ice Ages: Prospects For Physics-Based Modulation Of Global Change*", 22nd International Seminar on Planetary Emergencies, Erice (Sicily), Italy, August 20-23, 1997. Download article full text from:
http://www.osti.gov/accomplishments/documents/fullText/ACC0 229.pdf
[16]Pinatubo eruption, 1991:
http://en.wikipedia.org/wiki/Mount_Pinatubo

propose (pp. 9-10) spreading into the upper atmosphere large amounts of sulphuric compounds like SO_2 and SO_3 (in fact highly responsible for acid rains), and even H_2SO_4 (sulphuric acid), as well as reflective substances like alumina. The idea was to cool our Earth in order to protect us from our CO_2 emissions. It gets obvious from their text that, instead of attacking the causes and in that way promoting evolution in the society, evolution in terms of energy production and consumption, their option was to attack the effects, therefore provoking other kinds of perturbations that will produce more effects, which they obviously did not address in the article. And this we consider worrying too. The mentality of managing effects while systematically ignoring their causes is not appropriate to the survival of humankind, in our opinion. We live in a feedback system, so we must comply with the situation and analyse these important issues in terms of feedback too. Couldn't we instead use our imagination, our time, our resources and money, directed to curve down CO_2 emissions[17] if that is the problem[18]? Couldn't we instead think on reducing such a warming effect by simply transforming the solar energy reaching the Earth into electricity? At least a part of that energy would directly be consumed by humans, instead of warming the planet. Couldn't that be a good source of energy for indirectly powering our future electric cars, for example? What are the costs of mounting huge solar systems in desert zones for such a purpose, compared to what we have to pay for a continuous *chemtrails* project running for decades and bringing with it the degradation of the environment and people's and animals' health? It is so strange that these issues seem not to enter into the calculation of "costs" for those "scientists" who unilaterally have decided to go ahead with such a sinister adventure, even if we so often hear the "*we are saving lives*" rhetoric.

What about painting our houses and buildings white, for example? What about at the same time abandoning the usage of fossil fuels, as even the actual president of the United States of America

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[17]Doesn't it seem an outrageous non sense that part of the particulate mix with which these clouds are being made is "dry ice", which is CO2?
[18]Couldn't most of the "planet warming" be simply due to the current very intense activity of the Sun, as it is known? Levels of UV are now extreme. If there would be a "green house" effect, wouldn't UV levels be reduced?

seems to defend[19], and financing the research on electric transportation, promoting daily personal transport based on the decency of a bicycle, for example, perhaps electrical, and build good and decent public transportation? What about stopping the astonishing and irrational production of plastic, which nowadays surrounds everything and nothing: in order to take home a simple *flash-drive* we have to carry it in a complex plastic envelop which is 10 times its dimensions. What about starting to think on reducing the armament and mainly the number of bombs in the Earth? Isn't there enough bombs yet in the world? Why not to think on distributing them, if they really have to exist, instead of producing more and more[20]?

We may notice that Edward Teller et al, in the same document, did however advise: "*We believe that, prior to any actual deployment of any scattering system aimed at full-scale 1% insolation modulation, completely transparent and fully international research in sub-scale could result in public opinion conducive to a reasonable technology-based approach to prevention of large-scale climatic failures of all types. International cooperation in the research phase, based on complete openness, is necessary and may be sufficient to secure the understanding and support without which any of these approaches will fail*". So, why is this not being done yet, while instead people are kept in stress, fear and ignorance for a decade now?

We could, anyhow, realise that the technology used to seeding these clouds has obviously evolved during the last 10 years of experimentation, and it seems it is still evolving now. At the moment, one may notice that the aircraft only need around 1 or 2 hours in order to transform a clean and blue day into a grey day of winter, at least near the ocean. Rain is available, say, in some hours, if needed. This makes us wonder if a constant seeding of a large area of these clouds over the land and the ocean would not

be enough to give people the impression that there is a *climate change* going on in the planet. It would, surely, be a man-made climate change. This should be addressed by people of science, in our opinion, since such a practice is also recently being transformed into a growing and massive business[21]. And, for those who would not even suspect, water is now a *commodity* traded in the *stock market*[22].

The letter recently presented to the *European Parliament* questioning our representatives about these man-made clouds[23] is an obvious and strong indication on how important this subject became to European citizens. As a structured collection of thoughts and observations, the present article has also been inspired by this letter. It may be seen as our contribution for the propagation of the urgency of protecting citizens from what is happening in their skies[24], their water[25] and their environment without their knowledge and permission. Please, feel free to spread it.

3. **The power of the HAARP machine**

Almost no one talks of *chemtrails* today without relating them to something even more fascinating: the HAARP machine. That is the *High Frequency Active Auroral Research Program,* which basically is an array of 180 high-frequency radio transmitters disposed in an area of 13 hectares, as shown in the next figure (Fig. 3). Such an array is at present[26] prepared to emit around 3,6MW of power in the form of radio waves (electromagnetic) in the 2-10MHz frequency range. It seems that one of the ideas is to focus a powerful beam of energy into the upper atmosphere, the ionosphere, around 100Km high, and experiment with it. These 3,6MW roughly correspond to the power consumed by 360 homes with all lights and machines switched on.

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[19]Barak Obama, "*Full text of Obama oil spill speech*", Al Jazeera online, June 16, 2010. Full text available at: http://english.aljazeera.net/news/americas/2010/06/201061603015784580.html
[20]Maybe in the future all the available armament should be kept by an international institution where all countries of the world would have a sit. Once two countries decide to go to war, they choose the weapons form the list of weaponry available, and then they are allowed to go to war. The winner should then pay the reconstruction of its opponent's country, by the principle: the loss of life is of superior importance than any war. Those who don't understand this are yet too rude to deserve humankind's respect.

[21]A cloud seeding company: http://www.nawcinc.com/photos.html
[22]James E. McWhinney, "*Water: The Ultimate Commodity*", Investopedia, 2006. Read at: http://www.investopedia.com/articles/06/Water.asp
[23]Letter from Erik Meijer to the EU Commission, *European Parliament: question on aircraft condensation trails which no longer only contain water* (full text), Strasbourg, France, World Aeronautics Press Agency (online), 2007-07-30 04:03 pm.
[24]Good video example: http://www.youtube.com/watch?v=nSK9iie3eAo
[25]Video example: http://www.youtube.com/watch?v=DG_h77PDayU
[26]This part of the text was written during 2010, but the article was finished only during 2011.

Fig. 3 The main element of the HAARP project[27]: a powerful array of 180 radio emitters, capable of generating 3,6MW of electromagnetic power in the 2-10MHz frequency range (2010). Alaska, USA. Coordinates = (63º32'30"N, 145º09'03"W).

Such a power concentrated into a beam of 50m diameter, for example, gives a power density of near 2 times the normal sunlight intensity. If focused into a beam of 20m diameter, the power density rises to 11 times the power received from sunlight, which would be more than enough to start burning a forest in a second, for example. As the beam is restricted into a smaller area the power density sharply rises in a squared proportion; focused into a 2m diameter, for example, that would be like receiving there the energy of 1150 suns! Enough to vaporise a missile, and probably one of the reasons why this machine is being financed by the United States Air Force and Navy[28].

We may wonder (ignoring the absorption in the atmosphere) what would happen if such a power would for a second be focused into a forest in any place of the world. We may also wonder what would happen if a beam of some a dozen metres diameter would be pointed down to Earth into a lake crowded of toads living their lives, for example. But we may also think on what would happen to birds crossing it in the sky, and to the bees, or on what would be the result of using this power for suddenly warming a certain place in the planet, a town, for example. If we think on some of the possibilities emerging from a system like this we naturally get worried. But even more worried we become if we think on the effects this machine can probably produce by using the powers behind "frequency" and induced oscillation. For a better understanding of all these possibilities, we reserve the next section for a brief explanation of the basic physics behind this system.

27Image taken from the following address (we thank the contribution):
http://www.bibliotecapleyades.net/ciencia/echelon/images/haarp_6.jpg
28HAARP official website: http://www.haarp.alaska.edu/

4. **The Physics available to HAARP**

Probably, most of the people look at HAARP as a sort of a gigantic heater, or radiator, therefore able to produce strong power density effects, like rising temperature, or even burning, for example. But, that is only half its potential. Wave mechanics have something very particular which seems to be at odds with our usual tendency of thinking of power, named *oscillation frequency*. For those who are not familiar with wave physics, *frequency* is simply the rate of the oscillation of a *periodic phenomenon*, which may be measured in seconds per period, or in terms of its inverse, named cycles per second, the same as *Hertz* (Hz). The electromagnetic radiation emitted by the HAARP machine may oscillate in the range between 2 million cycles per second and 10 million cycles per second. Since it is an energy made of electromagnetic waves, it propagates in space with roughly the speed of light, that is, 300 000 Km in a second. Which means, for the average person, instantaneously. We are, therefore, talking about a machine that "instantaneously" would be able, at least in theory, to transfer the energy of 360 homes operating at their maximum power into a single place in the ionosphere, as well as into a place of our world if some type of reflection is imposed on the beam:
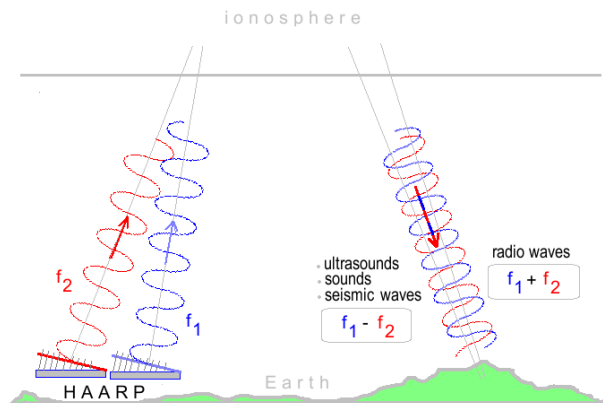
Fig. 4 The HAARP emitter as a powerful antenna capable of generating diverse frequencies, generically represented here by f_1 and f_2. The superimposition of these two signals may generate two different waves: one of an higher frequency, given by the sum (f_1+f_2), and one of a lower frequency, given by the difference (f_1-f_2).

Figure 4 tries to illustrate the concept of HAARP, which basically acts as a gigantic antenna able to transmit energy in several frequencies, in the figure represented generically by f_1 and f_2. This probable

"ability" of HAARP is, in our opinion, one of the most perturbing aspects of the system. Frequency may induce forced oscillation into a variety of structures, since each structure has some *proper frequencies of vibration*. Once it is excited in one of these frequencies, it rapidly starts to absorb energy from the source of excitation and suddenly the amplitude of the vibrations rises till the point that the structure either burns or breaks. This is what happens, for example, when someone forces a crystal glass to "sing" by means of rotating a wet finger around it, as well as what happens in the interior of a laser. It is called *resonance*. Thus, frequency is a very "selective" method for inducing perturbations in many structures, either of material or biological or even of the psychological kind. The universe is in itself a vibrating structure, of an infinite dimension. Even information can be seen as a vibrating phenomenon, since we feel perturbed with the repetition of certain images and sentences frequently used in propaganda and advertising, for example. Humankind should think very seriously before allowing its scientists to play with *resonance* effects, because that is playing with the strings of Nature, which can be seriously damaged, or even destroyed, if not played gently.

Still based on the previous figure, it is known that if two beams of slightly different frequencies are mixed, the result can be seen as producing two different waves: one of a higher frequency ($f_1 + f_2$) and another of a lower frequency ($f_1 – f_2$). If, for example, we would decide to emit a wave of 3,00MHz with half of the HAARP system and one of 3,05MHz with its other half, then we would be able to generate a "lower" wave of 3,05 - 3,00 = 0,05MHz = 50KHz, which is a frequency typical for dolphins and whales to communicate, for example, and also able to interfere with certain bones of the animals[29]. This would be possible using emitters with a frequency precision of 0,05/3,00 = 1,7%. So, very easy to achieve. However, since we know the machine can generate audio signals of 15 Khz = 0,0015MHz by proper modulation[30], we believe that at least it is able to operate with a frequency precision of 0,0015/3,00 = 0,05%, which seems a good precision for electronic instrumentation. This

means that HAARP can in fact be used to produce *ultrasonic* and *sonic* waves, which interfere with a wide range of material and biological systems, and also with the activity of the brain[31]. An example of sonic interference with the human brain is the anti-loitering security system know as "*mosquito*", which emits high-pitch noises of around 17,5KHz in order to disperse youngsters[32]. HAARP may theoretically be capable of interfering with people's and animals' minds and bodies, in our opinion, or even to be used as a sonic weapon[33].

To generate typical seismic waves, however, of 0,3Hz = 0,0000003MHz, HAARP would have to emit with a frequency precision of 0,0000003/3,00 = 0,00001%, which means at least 7 digits. We suppose this is not so simple to achieve. But, avionics, marine, military and important scientific instrumentation often use 6½ digits of precision, so, even if it may not be a simple task, it may at least theoretically be feasible. In that case, HAARP would probably be capable of triggering earthquakes, volcanic activity, etc., by these means. We will see soon that some practical issues may in fact reduce the capabilities of this machine.

Pulsed emission:

We have talked about *continuous emission*, till now. But there is also the possibility of operating this machine by using *pulsed emission.* Since this is a text for people in general, with average knowledge of technology, we will not distinguish here the various types of modulation used in pulsed systems. But notice that the emitter will be now operating in a single frequency (f_2), which is pulsed in a time interval *T*. The basic schema is depicted in the next figure (Fig. 5).

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[29]Killer whale reception of sounds, as a didactic example: http://www.seaworld.org/infobooks/KillerWhale/senseskw.html
[30]See http://www.haarp.alaska.edu/haarp/gen1.html

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[31]Not only brain blockage, but also a sort of a strange sleeping mood. A general bone "weakness" and a little pain in the ears are frequently referred to by some people too.
[32]Example of a *mosquito* system: http://www.compoundsecurity.co.uk/
[33]Jack Sargeant, "*Sonic Weapons*", forteantimes online (www.forteantimes.com), December 2009. Available on Internet at: http://www.forteantimes.com/features/articles/256/sonic_weapons.html
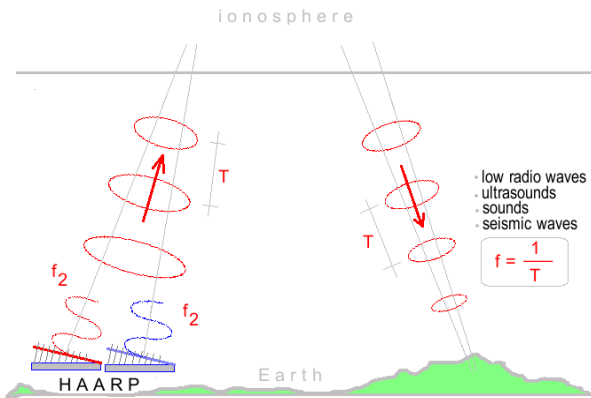
Fig. 5 The HAARP emitting in a pulsed mode. In this mode, a single frequency of emission f_2 should be capable of exciting another system with diverse frequencies ($f = 1/T$) by simply adjusting the time separation between pulses (T).

That is, the emitter is switched <u>on</u> during a certain period of time, sends energy into the target, and then it is switched <u>off</u> during a certain time. Roughly, the frequency with which it excites the target is given by $f = 1/T$. This frequency can be adjusted with great precision by simply adjusting T.

Thus, by choosing different values of T (in truth, the intensity of the pulses can also be adjusted), it is theoretically possible to generate a wide range of output frequencies to excite the target, going from the low-radio waves to the ultrasounds, the sounds and even the infra-sounds. That would be a very powerful and versatile machine. Nevertheless, to directly interfere with matter it would be necessary to transmit enough *momentum* by this method. And that is not possible. The force of the impact on the target by each of those pulses of energy is extremely weak. It is given by the amount of power over the speed of light[34]. For instance, the total force exerted on the area receiving 3,6MW would only be around 0,012 N, that is 0,0012 Kg = 1,2 g. And this is ridiculously weak for inducing any seismic effect, for example. It rests, in our opinion, the possibility of inducing *indirect effects*, as suggested in figure 6:

Suppose the machine is switched <u>on</u> during, say, 1,5 seconds. During this period it transfers a huge amount of energy into the place of the target. The materials in that place will absorb such energy and react, by expanding, for example. Then, the machine is switched <u>off</u> for, say 1,5 seconds. The materials in

the place release the energy into the surrounding medium and contract. Then, the machine is switched <u>on</u> again, and the process is repeated. Everybody knows that a wet finger going around a glass of water is a ridiculous effect; but a wet finger going around a glass of water *repeatedly* may even explode the glass, since it interferes with its internal structure. In the example we gave, the period of repetition is 3 seconds, so, the target would mainly be excited with a frequency of 0,3Hz. This could perhaps be a very simple method to generate seismic frequencies, which are in the range from 0,001Hz to around 1Hz, and associated with phenomena with periods of oscillation between 1 and 1000 seconds.
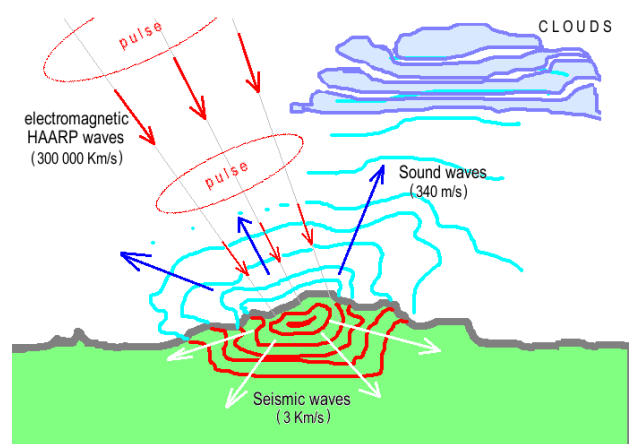

Fig. 6 HAARP emitting in pulsed mode and some of the indirect effects probably observed in the place of the target.

The previous figure (Fig. 6) tries to give an idea of some indirect effects probably observed during an HAARP pulsed activity. Basically, the *seismic waves* indirectly generated may transform into very-low frequency *sound waves* while changing of medium of propagation and entering the air[35]. This, at least theoretically, and depending on the amount of energy involved, could probably induce *wave-like effects* in some clouds, mainly if those clouds contain some sort of heavy particulate.

We may not forget, however, that *wave-like clouds* called "*altocumulus ondulatus*"[36] can also be naturally formed under certain <u>rare</u> atmospheric conditions, apparently as a result from a process of pressure and wind interference. But during these last years, such a <u>rare</u> phenomenon has not only become <u>frequent</u> but also <u>intense</u>, and many people have

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[34]You may refer to: "*Electromagnetic momentum*", in Richard Fitzpatrick, "*Classical Electromagnetism: an intermediate level course*", Institute for Fusion Studies, University of Texas at Austin, 2006. Accessible at:
http://farside.ph.utexas.edu/teaching/em/lectures/node90.html

[35]What would be the effects of such waves on people and animals? Some dogs during these periods seem not to be able to stop barking, for example.
[36]In wikipedia:
http://en.wikipedia.org/wiki/Altocumulus_undulatus_cloud

registered it and questioned it worldwide. Studying these effects which meanwhile have become common in our skies, instead of rare, together with an accurate and appropriate measurement of *radiation levels* received on the Earth's surface in a *wide range of frequencies*, could perhaps be an interesting start for a scientific project of research on this subject. Small mobile platforms with sensors prepared to collect such data would be extremely versatile and useful.

Fig. 7 Some *altocumulus ondulatus* recently registered by an internet user[37]. The strange hole in the centre of the image resembles some kind of beam of energy traversing the cloud surface, but it is not a commonly observed effect, however. No consensual explanation has yet been presented for these strange holes. The rest of the clouds seem an interference pattern from several wave fronts, which makes people suspect they may be created during HAARP operation.

It is important to remember, though, that all these cloud formations seem to appear below 10-11km of the Earth's surface, since they seem not to be seen above commercial flight routes. They persist below such a level, so, they obviously do not belong to the <u>upper atmosphere</u> layer (60-200Km), as expected from the scientific proposals for reducing the amount of light absorbed by the planet. That is, in our point of view, an unexpected contradiction.

Example of a curious coincidence:

Although it may not be considered a scientific confirmation of any thesis, we leave here some rough calculations we did the first time we observed statical and *extensive wave-like* clouds suspended over our town. It was around February 2007. In the absence of a camera, we recorded that image in the

[37]Image source: the Internet. Thanks to the address:
http://www.weatherwars.info/pages/images/holes/holes_alto_!.jpg

form of a drawing (included in the next figure). These clouds seem, in this case, not to be very distant from the ground, and a rough calculation, comparing them with the dimensions of an aircraft meanwhile traversing them, led us to estimate a fringe separation of the order of 100 meters.
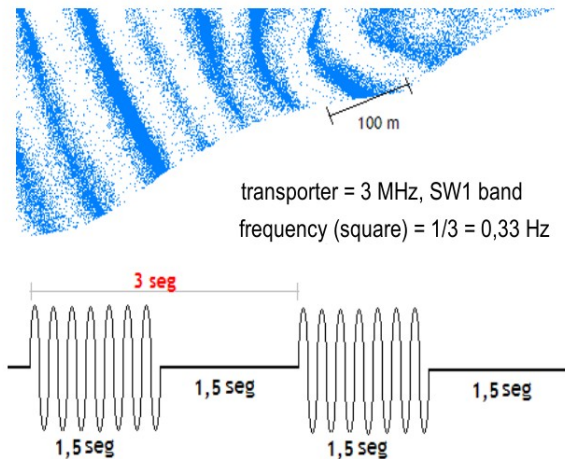

Fig. 8 Some *altocumulus ondulatus* observed in the town, estimated dimensions and possible frequencies related to them.

So, we have decided to formulate the 3 following hypotheses: **1**) <u>the phenomenon was due to the wind</u>; **2**) <u>the phenomenon was due to a wave propagating in the air (sound)</u>; **3**) <u>the phenomenon was due to an electromagnetic wave</u>.

Then, since we had obviously observed not only that these clouds where completely static but also no wind was blowing in the place, we rejected the first hypothesis. Naturally, we then turned the attention to the basic equation of wave motion relating *wavelength* and *frequency,* in order to test the other hypothesis:

$$wavelength = speed \ . \ (1/frequency) \qquad (1)$$

From which we deduce that, if the phenomenon was due to a sound wave, where *speed* = 340 m/s, then its source should be something oscillating with the *frequency = speed / wavelength* = 3,4Hz. This is an infra-sound frequency, can be of the seismic type, inaudible to humans, and some doctors could use it

to stimulate a certain type of brain activity[38].

We did not conclude anything yet, however. Instead, we used again the same equation for testing the third hypothesis. Since in that case the speed of propagation would be the speed of light (300 000 km/s) the frequency of oscillation of the electromagnetic source would have to be 300 000 000 / 100 = 3×10^6 Hz = 3MHz. To confirm if there was in fact any 3MHz wave crossing our skies, we switched on an old radio and searched for signals in the SW1 band of frequencies (short waves). We were really surprised when we found a signal at precisely 3MHz being emitted by pulses separated by 3 seconds, as is also depicted in the previous figure (Fig. 8).

Conclusion: was the estimation of the fringe separation accurate enough so that these results confirm the electromagnetic hypothesis? We will never know. The interesting fact is: at that time we didn't even suspect that HAARP existed, only a year later we learned about it on the Internet. And we where yet more surprised when we found it was commonly emitting around 3MHz!

5. Opening ionosphere holes?

As we know, HAARP is said to have been built with the idea of experimenting with the ionosphere. We therefore reserve some apprehension concerning the level of such experiments, and if they could be able to substantially interfere with the ionospheric plasma, which protects us from the direct incidence of the sun's deadly radiation. Some rough calculations already presented in this article lead us to suspect that the amount of energy available to HAARP could probably disturb the ionosphere locally. If the electromagnetic beam will be focused onto an area of some square meters, in a continuous mode of operation, the probability of locally altering the distribution of the electronic plasma, and so the "transparency" of the electromagnetic shield, may be significant. If that is possible, it means HAARP could also "indirectly" be used to "directly" expose a certain region of the planet to the unfiltered light coming from the sun, that is, to expose it to a very

high radiation level, including to the dangerous *cosmic rays* and u*ltra violet* (UV). It would be as if "holes" could for a moment be opened in the ionosphere, as the next figure suggests. People in that region would feel an abnormal strength in the sunlight (burning), some effects on the vision[39], the number of fire ignitions would sharply rise, grass fields and several types of soft vegetation would suddenly dry, etc.
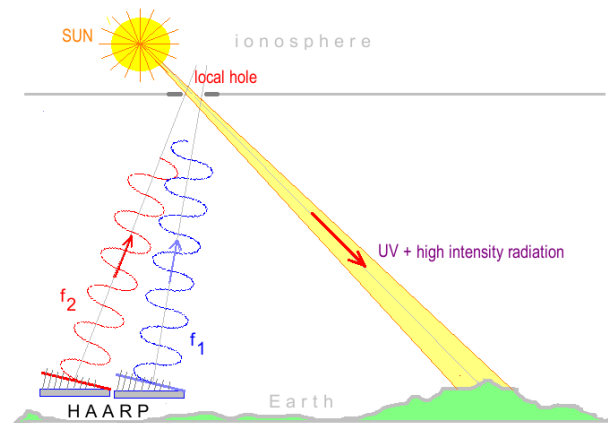

Fig. 10 Could HAARP open "holes" in the ionosphere?

Curiously, observed UV intensity is sometimes very high for some years. It may frequently be found between 8 and 11 on a scale of 0-11, or even surpassing the scale's maximum. This is usually explained as being due to an abnormal activity of our Sun[40]. We wonder, however, if it may also be due to some kind of HAARP experiment. A possible fragility induced in the ionosphere by the detonation of nuclear devices in the upper atmosphere[41] during the 1970s also makes us wonder. Einstein, Nikola Tesla, and many other great scientists are for sure rolling in their graves. Another interesting aspect of this machine is that these several modes of operation are not mutually exclusive. HAARP could be operating in any of these modes, and change mode whenever necessary.

6. Any obstructions to a terrifying weapon?

Although any sinister mind could transform a

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[38]T. H. Emara et al, "*Repetitive transcranial magnetic stimulation at 1Hz and 5Hz produces sustained improvement in motor function and disability after ischaemic stroke*", European Journal of Neurology, 2010. Search in: http://onlinelibrary.wiley.com

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[39]It seems very intense radiation may result in a higher risk of developing cancer, as well as cataracts, for example.
[40]NASA site: http://science.nasa.gov/science-news/science-at-nasa/2003/17jan_solcon/
[41]Nuclear tests: http://en.wikipedia.org/wiki/Nuclear_weapons_testing

system like HAARP into a terrifying weapon[42], both the scattering and absorption of its electromagnetic energy in the atmosphere, and its antenna aperture angle (*antenna pattern width*), seem to reduce such a potential in certain aspects. Together, these effects will establish the limits for the maximum *radiation per unit of area* available at the target, that is, the amount of effective power density[43] achievable with the machine. Most of what we have said in the previous sections would be achieved from a ground facility[44] only if the system would be highly directional. But these antennas are said to emit (presently) within a 5º *minimal pattern width,* as depicted in the next figure (Fig. 10), thus, the radiation will disperse over a larger area as the wave gets away from the source. A beam of 5º aperture will be around 870m diameter at a distance of 10km from the source, for example. If 25% is absorbed, the power density at such a distance will be 75% of $3,6MW/\{\pi.(435)^2\}$ = $0,005kW/m^2$, which is ridiculous compared with the $1kW/m^2$ normally reaching the earth on a sunny day.
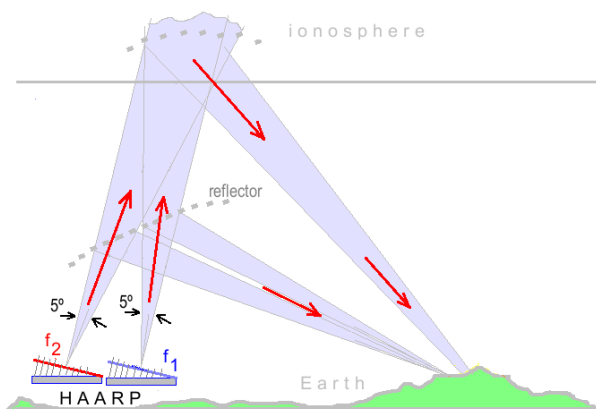

Fig. 10 Aperture of HAARP antennas, and its implications.

We may also notice that a much larger "reflector" would be needed in order to redirect an appreciable amount of energy back into a point on Earth, unless the ionosphere could be used as a reflector too. Thus, in principle the effective power of such a machine would be severely reduced in practice.

Recent data, however, seems to indicate that the power available to HAARP at the moment (2011) may be 270 times the power considered here, which means it may be reaching the astonishing objective of 1 GWatt[45]. If this is true, our impression is that few obstructions may still exist in order for HAARP to be used as a terrifying weapon.

7. *Chemtrails+HAARP, some thoughts*

We may now wonder about what could be the possible connections between HAARP and *chemtrails*. Could, for example, HAARP be used also as a mixer for *chemtrails*? Although the two systems seem to be distinct and independent, could they be operating in conjunction in some cases? Imagine, first one spreads metallic particulate into the atmosphere, together with some catalyst (Barium?); then a net of humidity will form around these particulate; but, since artificial clouds are normally static, some "mixer" is needed in order to disperse and mix them more efficiently, and HAARP radiation properly modulated could perhaps do it. To create dense zones of clouds over the ocean, for example, and moving them by artificially managing pressure at their boundaries in order to bring high intensity precipitation into a place or zone, or deliver it for long periods of time, could that also be done?
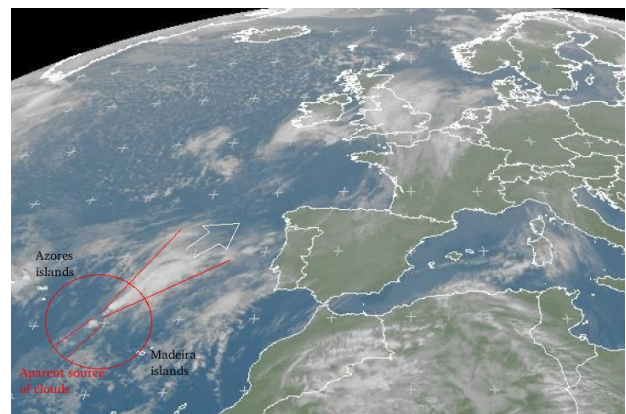
Fig. 11 A continuous observation of some satellite images seem to indicate that artificial clouds may also be produced at the ground, or some appropriate locations in the ocean (from boats?), which then inflate and disperse along the natural air currents. In the present image, the centre of the circle was practically fixed, while it continuously was producing clouds which were then moving north-east.

Other thoughts: could the climate apparently be changing due to a systematic usage of HAARP and

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[42]Nick Begich, Jeane Manning, *"Angels Don't Play This Haarp. Advances in Tesla Technology"*, 1995; ISBN:0-9648812-0-9. Video about at:
http://www.youtube.com/watch?v=dNrL9o7mh-M&feature=related
[43]Notice that, instead of *power*, it is the power density = power / area that usually matters to interfere with matter.
[44]Would be much easier with a facility fluctuating in the space, or in the ocean if focused into underwater targets.

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[45]As mentioned in:
http://www.haarp.alaska.edu/haarp/prpeis.html

chemtrails? And what about creating depressions into certain cloud formations to try giving rise to storms, for example? Could the system be used for making tests in the population, either for health purposes or military interests? Hardly a healthy mind would think on the need for a healthy solution being delivered to the population secretly... And those "waving" clouds, could they result from *chemtrails*+HAARP activity? Will the complaints of people, of all ages around the globe[46], about *chemtrails* and strange clouds formation, and how they interfere with their lives, be in fact relevant and justified? From what is shown in this article, we think there are enough reasons for a serious investigation to be directed to such matters, instead of constantly relying on unilateral explanations from experts who simply ignore these hypotheses, as is practice now. But let us point out some other interesting aspects that should perhaps be part of such investigation:

Annihilation of clouds:

Since clouds are seeded and produced, some kind of technique is also supposed to exist in order to achieve the opposite: disperse and annihilate clouds. Frequently, very dry air is being detected in places where *chemtrails* experiments take place. In the case of our town, for example, instead of the typical 60-70% of humidity of January, there are days we measure in January only 20-30%. It is not a surprise that people talk about a very dry mouth and tongue, and even of strange involuntary movements. These can be symptoms of being poisoned, by the way. Are *chemtrails* technicians using any kind of dispersant in the air, similar to what oil companies seemed to do in some of the recent oil platform disasters? And, could a practice such as that contribute to the "extinction" of normal clouds? With the advance of artificial clouding and its continuous and insistent usage, we also notice that we may hardly see normal clouds now, as if the artificial process would be eliminating or weakening the natural process. This can of course turn into a serious and nefarious interference with Nature. Probably, normal clouds are not given enough time and conditions to form, and that should be seriously investigated too.

People's rate of ageing:

The rates of ageing in towns usually under *chemtrails* should be compared with those where this activity is weak or does not exist (some say China and most Muslim countries seem not to be affected, since this activity is commonly said to be restricted to places of NATO influence). We would suggest as an index for ageing the number of people with white air within a certain sample of the population. In my country (heavily pounded by *chemtrails* for several years) it is being a surprise that not only has the skin of the people started to exhibit rapid ageing symptoms but also that white hair became almost an "imposed" fashion, affecting youngsters as well. Could *chemtrails* activity be more intense in places near the ocean, so that more water can be captured from the environment? Could this strange ageing effects be more intense in places under aircraft routes, and towns with airports and airfields? The truth is our biological system often feels under the attack of something undefined. It is instinctive. And the worrying rate of children with allergic symptoms and respiratory illnesses, and the 30% of our population suffering from allergic rhinitis are unequivocal signals that these already are the first visible victims of such a practice.

Chemtrails falling from the sky:

Recently, there has been on the Internet the discussion about the possible contamination of water supplies, soil and oceans due to the intensive spraying of *chemtrails* in certain locations around the world. Reports of abnormal animal diseases, probably due to ground contamination, and a substantial number of reports in pictures and videos showing a kind of strange foam floating on ocean waters, are leading people to suspect *chemtrails* particulate may in fact fall out of the skies and produce a substantial number of effects and "indirect" victims. This foam seems to appear after periods of intense *chemtrails* activity, and its structure and smell resemble a certain bacteria-like culture. There are some places where this foam has submerged entire beaches[47], to the astonishment of the people. Once again, even if this repugnant and yellowed foam is floating on our ocean waters since around four or five years ago, no news or debate have been shown or proposed about the issue in the mainstream media. Any investigation on *chemtrails*

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[46]On the Internet many people say these sort of effects are only being observed in places of NATO influence.

[47]Video from Cap Town: http://www.youtube.com/watch?v=Hc4w1bdbZNM

should take into account this phenomenon, since it may well pose a threat to the health in general, also because this foam can easily spread around taken by the wind. Could this poison rivers and natural water resources, and then enter the public network? What kind of tests are being done on our water supplies? Are levels of Aluminium, Barium, Silver Iodine, for example, being monitored? And what about radioactive elements? (maybe water tests should be done randomly, without previous notice to the water operators). Could technicians be using too much Hydrogen Peroxide in order to compensate the obvious decline of the public water quality during last years?

8. Very important recent events

An entire treaty could be written about HAARP and *chemtrails*. But our particular interest at the moment goes to gravitation and classical mechanics, which are matters slightly distant from weather manipulation. So, we can say the present article results more from a "call to duty" than from any special fascination for these matters, therefore we will not further expand this text. We will finish, anyhow, by presenting some very significant events observed recently, and leave the rest of the work to the interested reader.

A large number of animal deaths:

The weather has recently been very rainy and harsh for nearly two consecutive months both in Europe and the Americas, most of the time with a sky covered in dense clouds which would not let people detect any special activity linked to *chemtrails*. Attentive people, however, any time the clouds dissipated and let the upper layer of the atmosphere be visible, could have noticed there was in fact very intense *chemtrails* activity going on. For a "*chemtrails* observer" it became obvious that this long period of harsh weather was mainly due to such an intense and prolonged activity, maybe in conjunction with some artificial clouds produced in the ocean. Orange clouds, sometimes almost red, moved in during the night to the sky of our town. The interesting thing, however, was that during January (2011) the media was suddenly reporting what seemed to be absurdities: first, a rain of thousands of birds falling dead out of the sky in the

USA and hundreds of thousands of fish dead[48] in a river nearby. Some days after, 8000 doves fell dead with blue beaks in Italy[49]; while, on the same day, 2 million more dead fish were found in Chesapeake Bay[50], Maryland, USA. A geographic distribution of these types of events can be followed *online* in *Google-maps* here: dead animal events. Some days later, 200 cows died suddenly in northern Europe. It is not surprising that people are more and more not just worried but also getting angry about the issue[51].

Building up storms?:

During this same January, strong storms of rain have pounded the Atlantic islands of Madeira and Azores, and then Brazil, resulting in the killing of almost half a thousand people in the latter country. These periods of rain seem excessive to the common citizen, although the media always insists in passing the "climate change" or "global warming" message, two expressions meanwhile surpassing fashion and obviously falling into discredit. Citizens see those aircraft spraying the skies and seeding the clouds, so, what are these people talking about?

Recently, also some little *tornados*[52] have been forming in our country, where they absolutely did not belong before. We could already suspect that something was wrong with the weather, but we still needed some kind of special event as a confirmation of what is happening behind *chemtrails* activity. On the 21st of January 2011 such an event has finally happened. Two aircraft have been captured on video while flying in circles over a previously prepared blanket of clouds, meanwhile dispersed by the wind. This video can be seen on *YouTube*[53], and obviously shows a pair of aircraft flying parallel to each other while spraying circular trails over a *chemtrails* cloud.

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[48]Summary video: http://www.youtube.com/watch?v=0xin20GiJEI

[49]http://www.dailymail.co.uk/news/article-1344913/Animal-death-mystery-Two-MILLION-dead-fish-wash-Maryland-bay.html?ITO=1490

[50]http://www.mediaite.com/tv/armageddon-moves-to-maryland-two-million-dead-fish-found-in-chesapeake-bay/

[51]Youtube: "Former FBI Chief Ted Gunderson Says Chemtrail Death Dumps Must Be Stopped"

[52]Video showing the effects of a recent little tornado in the center of the country (Dec 2010): http://www.youtube.com/watch?v=stFpAmc1rpc

[53]Video showing a pair of aircraft flying in circles and producing artificial clouds (Jan 2011): http://www.youtube.com/watch?v=QKFMxvXcw3E

Some other clouds already in the form of circles, naturally resembling the beginning of a circular storm, are obviously visible too. Curiously, once again: this was roughly being made above the same place where thousands of octopus have been found dead recently on the beach, to which the authorities gave the explanation: "*excess of fresh water going from the river into the sea*"... Could something else have killed those animals, maybe an intense wave of electromagnetic radiation? In the next figure (Fig. 12) we try to represent what we think could be the entire process going on by means of those two aircraft: 1) slowly, along the day, a blanket of artificial clouds is created by a localized spray of *chemtrails*, in order to hide the rest of the process from people's sight. This is done by aircraft spraying only when they are flying over the targeted zone, by switching their trails on and off. 2) Once such a carpet is ready, pilots start to fly and spray in circles in order to build circular clouds, which then assume the form of a tornado-like storm. 3) We suppose that there will be a third step in the process: to create a depression in the centre of the circle in order to induce a rotation on it; could that be done by somehow focusing HAARP radiation there? Could it be possible that satellites are being used not only to focus such a radiation but also to switch the spraying on and off? Interesting aspects to be investigated too.
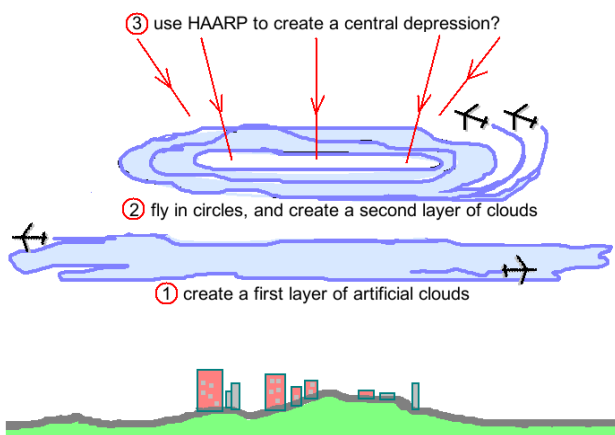

Fig. 12 Diagram trying to describe what was observed in the video footage previously referred to (21Jan2011), which resembles the creation of an artificial storm out of people's sight. Curiously, this was happening above the same place where thousands of octopus have been found dead, recently.

Meanwhile, perhaps due to the alerts coming from the Internet, through *emails*, *Facebook*, *Twitter*,

etc., those aircraft gave up the job and have abandoned the place (are there observers on the Internet who monitor citizens' reactions during such operations?). A second video of *YouTube*[54] shows what resulted from such an activity: a very dirty sky for people to breathe during the night.

With this sort of activity often going on, it does not seem so strange that levels of PM10 frequently rise when *chemtrails* are being sprayed. Could this also explain why data from pollution sensors[55] is often "*not available*" during periods of spraying? We were observing carefully what was happening since the day of the two aircraft. The skies became entirely blue again. The trails of those aircraft normally responsible for spraying (we already know their routes) became normal, almost innocent. But a few days later they lost the innocence again and started to re-spray over the ocean, mainly during later afternoon and evening. The result was, once again, more of those dirty clouds for the citizens to breathe. It looked like air-poisoning operations, played like a game. PM10 levels were rising during midnight. Then, in the early afternoon of Thursday our sky was traced with several parallel trails, people started to complain of heavy flu like symptoms, while the pollution sensors were again turned "*not-available*" as figure 13 shows.
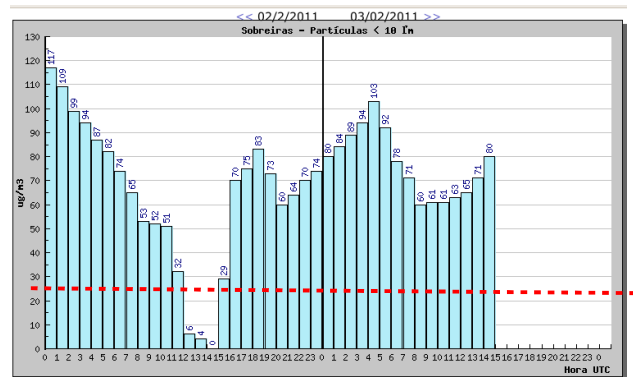

Fig. 13 PM10 levels 2-3 February 2011. During periods of intense *chemtrails* spraying, PM10 sensors are often found in a "not-available" state. Only several hours later the charts appear "completed", making people suspect data manipulation. The red line in the graph is the maximum level that should be acceptable for PM10. Source: Agency for the Ambience.

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[54]Air contamination, the result:
http://www.youtube.com/watch?v=ovhSGD-2HcQ
[55]Pollution sensors data-base for Portugal, where PM10 and other indexes may be monitored:
http://www.qualar.org/INDEX.PHP?page=2

Fig. 14 Early morning of 4 March 2011 (8 a.m.), and the image form EUMETSAT showing two almost perfect circular formation of clouds of the same type and dimensions, one near Portugal and another near France. This image should be compared with the previous video of the two aircraft.

In our opinion, the astonishing level of around 30% (we suspect nowadays is much more) of population of all ages living with chronic rhinitis and several other respiratory problems is mainly due to withstanding, almost daily, such an aggressive atmosphere, as well as the lack of interest of our officials about the subject. Of course the dark pollution due to urban traffic rises if there will be no rain, these experiments may even be ordered to *chemtrail enterprises* in order to help reduce carbon in the air, but citizens have to be consulted first, and that will not explain why most of the times they spray when the air is clean. We understand that several "projects" are going on, and c*hemtrails* seem to be a multi-purpose project.

9. An emotional discussion

From all this, it is fair enough to ask ourselves "are our governments allowing or participating in the poisoning of their own people from the air, and hiding it?" *Chemtrails* are slowly poisoning people all over the word and making them weak, less resistant to virus, bacteria, etc. What a sinister experiment is this, a slow extermination process? Governments have the duty of explaining to the owners of the State (the citizens) what precisely is going on, and open the issue for public debate, in order to know what will be the citizens' choices about such an important matter. Governments are paid by citizens' money, therefore they must be prepared to respect such a sacred contract. There are many scientists and

people of knowledge in the social crowd, so these issues have to be opened to the scrutiny of the society instead of being kept in the secrecy of some, most of them not even elected. The logos of the *chemtrails project* is not only an attack on the public health but also an attack on our democracies and on the future of our children. Desperate people have tried to ask for help from their governments about the issue, here an example of 2008, but nothing seems to be enough so that substantial action be started.

Fig. 15 Early morning spraying of *chemtrails*, while most of the people are still sleeping. When people wake up they will simply find another artificial cloudy day, instead of the natural blue sky.

More than 10 years have passed, and only now some TV networks are sometimes addressing the issue, although seemingly trying to joke with it, once again as if a sinister game was being played out there. More than 100 whales dying in a beach of New Zealand (4Fev2011); major Earthquake has hit Christchurch, New Zealand (21fev2011); more and more citizens start to be aware of what is going on, although there are still people ignoring[56], or poised to maintain in secret what is happening: these are usually called *disinformation agents* on the Internet.

Of course people are worried, and investigating[57]

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[56]Strange fact: a high percentage of citizens could not yet notice the differences in the skies and think nothing abnormal is going on. What can they expect to see and understand, if they are not even able to see what is obviously presented in front of their eyes?, is a question we pose to ourselves. Which kind of being are we, a single specimen, several specimen, what does this mean...

[57]The movie "*What in the World Are They Spraying?*" is an important resource to understand the level of people involved against *chemtrails*: http://www.youtube.com/watch?v=jf0khstYDLA

the problem, but they are also angry about these activities[58]. The United Nations (UN) is asked to freeze *geo-engineering* projects[59], some are naming them *geo-piracy[60]*, and citizens in general are asking themselves questions like: "why is our air force letting those aircraft do it? The answer can only be: because either the air force is under the control of the *deliverers* or the air force forms part of the *deliverers*. Why do air-traffic controllers not say anything either; as well as the media? The answer can only be: because either they are under the control of the *deliverers* or they make part of the *process*". By expanding this logic, we will suddenly find out that *the project* may in fact be related to several big institutions and organizations, which of course makes it assuming the contours of a possible "conspiracy".

In that moment we decide to question such a possibility, however. It seems not to be proper of minds of our times to imagine such sort of things. So, we made a pause, and researched a bit more to find out what David Keith, a prominent *geo-engineer* from ISEEE Energy and Environmental Systems, would have to say: we found it summed up in a *youtube video* apparently related to a conference before 2007. People may change their ideas with time, but, the impression we felt was not of tranquillity. David Keith seems to be following the same lines of thought previously pointed out by Edward Teller, and mainly gave us the impression that people around the world should be happy and support such *geo-engineering* experimentations, even if these may cause several other problems (one of which is to ruin the Ozone layer), since such research is very important in case there will be a future climate failure on the earth... In case, of course... To us, this "in case" seemed obviously sinister. His logic seemed extraterrestrial, in the sense that it seemed not to be from the humans we know... and that was the strangest impression we had. But, since it is also not decent for a mind of our

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[58]WACFrankfurt, "29 05 2010 We Are Change Frankfurt interviews a geoengineer about Chemtrails at a Symposium in Belgium", YouTube, 9-June-2010. Video: http://www.youtube.com/watch?v=bUopcG6DMwY
[59]From Reuters: http://af.reuters.com/article/commoditiesNews/idAFTOE69K02U20101021
[60]A PDF document defining what is being done as *geo-piracy*: http://www.etcgroup.org/upload/publication/pdf_file/ETC_geopiracy2010_0.pdf

times to be guided by this type of impression, we decided to research a bit more, to find someone we suppose to be one of the most influential personalities on these matters, John Holdren, the advisor to President Barack Obama for Science and Technology, Director of the White House Office of Science and Technology Policy, and Co-Chair of the President's Council of Advisors on Science and Technology (PCAST), about whom we found the following text in *wikipedia.org*:

"Overpopulation was an early concern and interest. In a 1969 article, Holdren and co-author Paul R. Ehrlich argued that, "if the population control measures are not initiated immediately, and effectively, all the technology man can bring to bear will not fend off the misery to come."[21] In 1973 Holdren encouraged a decline in fertility to well below replacement in the United States, because "210 million now is too many and 280 million in 2040 is likely to be much too many."[22] In 1977, Paul R. Ehrlich, Anne H. Ehrlich, and Holdren co-authored the textbook Ecoscience: Population, Resources, Environment; they discussed the possible role of a wide variety of solutions to overpopulation, from voluntary family planning to enforced population controls, including forced sterilization for women after they gave birth to a designated number of children, and recommended "the use of milder methods of influencing family size preferences" such as access to birth control and abortion.[12][23]"

Of course all this is somehow perturbing, even if we obvious understand that these subjects have to be addressed, but it makes us feel that someone out there is thinking on *managing* our lives. It was not comfortable to know it, and meanwhile exploring further the Web we suddenly entered a site about something absolutely new for us, that we have never suspected: a really strange and almost esoteric monument of stones named "Georgia Guidestones". We invite the reader to learn more about it, mainly because it does not at all seems at odds with what we are talking about here.

In the sequence of all this, we had to ask ourselves the honest question: is there anything in science, a principle, a rule, a postulate, which forbids conspiracies to exist? If not, why would a scientific mind have to ignore such a possibility? There is no scientific reason for that. It is perhaps time to start testing some "conspiracy" hypotheses against experimentation. Therefore we suggest three simple procedures to be implemented as soon as possible by our governments: **1**) randomly force the landing of some aircraft which leave those trails in the sky, known as *chemtrails*. **2**) let these aircraft be

inspected by an independent panel of citizens and scientists from the United Nations (UN). **3**) make all the raw data available to the public, on the Internet.

From what we have said, we have only to agree with the recent UN *geo-engineering moratorium*[61], and with Mrs Silvia Ribeiro, the Latin American Director of ETC Group, who stated: "*Any private or public experimentation or adventurism intended to manipulate the planetary thermostat will be in violation of this carefully crafted UN consensus*".

It is important and urgent to stop such temptations to interfere with Nature, and to inform citizens about who are doing it, why are they doing it, and to whom have they asked permission to do it and subvert our democratic principles? It is urgent, because day by day it is getting more difficult not only to live under such circumstances, but also to applaud and stay engaged with a society where these kinds of things should not be allowed. For us, this explains that a fast growing number of citizens is already facing an *Einsteinian disappointment*. And this can only be a symptom of decadence, not of progress.

Very recent events:

japan whirlpool tsunami 11th March 2011

Fig. 16 In the 11 of March 2011, after a very strong 8,4 quake hit Japan, a tsunami followed, creating an impressive whirlpool. There was massive devastation, which also provoked a serious nuclear disaster.

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[61] http://foodfreedom.wordpress.com/2010/10/28/un-votes-to-ban-chemtrails/

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