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From Kepler to Newton and beyond
(What Newton owes to Kepler)

We obtain here, Newton's ULG, using Kepler third LAW, bearing in mind that at the times of both Kepler and Newton, knowledge was extremely limited and what here seems matter of fact was totally hidden and had to be laboriously uncovered.

Kepler third LAW applies to a system whose main feature is a central Large Gravitational Mass (M_{LGM}) around which masses are in elliptic orbits, and does not qualifies mass values since is a purely geometric-temporal relation (I am presenting it in its banal form (considering the orbit of circular shape) but one must keep in mind that it was deducted for variable radiuses belonging to elliptic orbits):

T (orbital period), r_0 (average radius orbital over the period T), v_0 (average orbital velocity over the period T),

For: $T_{orbital} = \frac{2\pi r_{orbital}}{v_{orbital}}$ 1) $\frac{(r_{orbital})^3}{(T_{orbital})^2} = \text{Const}$

The 1) applied to all the satellites of the system having the Sun in the center, (or universally, to systems having a mass M_{LGM} in the center surrounded by satellites), becomes:

$$2) \quad \frac{(r_{orbital})^3}{\left(\frac{2\pi r_{orbital}}{v_{orbital}}\right)^2} = \left(\frac{v^2_{orbital} \cdot r_{orbital}}{(2\pi)^2}\right) \cong (3.374 \cdot e18)$$

Kepler's credit was in demonstrating that in a system within a context of variability of v and r the above ratio between the cube of the average orbital radius and the square of the revolution time of the planets remained constant.

Now takes over Newton who realized that in orbit the mass Force acting over the unit of mass had to be opposed by another Force of equal value generated by the inertial reaction to change of direction of orbital velocity:

$$a(r) = \omega\, v_{orbital} = v^2_{orbital}/r \ \ m/sec^2$$

The above expression 2) , is valid for the **satellites of the Sun, for the Moon as satellite of Earth** and extendable and universally applicable to all the satellites of a system.

Applied to Earth as satellite of the Sun (representing here the central mass M_{LGM} of the system) becomes: $(v_{E-0} = 29800 \ \frac{m}{sec} \ ; \ r^{Sun}_{E-0} = 1.5e11 \ m$

$$3) \quad v^2_{E-o} \cdot r^{SUN}_{E-o} \cong 1.332e20$$

For Earth considered now the central M_{LGM} and supposing he made reference to the Moon as satellite we have:

$$(v_{Moon-0} = 1023 \ \frac{m}{sec} \ ; \ r^{Earth}_{Moon-0} = 3.84e8 \ m \ )$$

$$3bis) \quad v^2_{Moon-0} \cdot r^{Earth}_{Moon-0} = 4e14$$

But when applied to Earth the 3bis above (applied to the Moon) could be compared analogically and scaled down to an apple hanging from a tree subjected to the gravity of Earth.

Since Newton could measure the specific Force a(r) or acceleration of gravity at Earth level and a reliable value of Earth's radius was common knowledge in the Scientific community of his time the 3bis on Earth then becomes:

$$4) \qquad a(r)^{gravity}_{acceleration} \cdot r^2_{Earth} = 9.81 \cdot (6.3567e+6)^2 \cong 4e14$$

Note: this is a necessary comment since lack of knowledge of **a(r)** and **r** to be substituted in 3bis, at Earth level, would have impeded any advance).

Note: this is a reconstruction a-posteriori based on knowledge of phenomena whose value was refined over the intervening centuries, (since Newton's times) but one must remember that the data regarding the Earth radius, the distance of the Moon and the distance of the Sun from Earth had been investigated since antiquity and in the new times (Newton's times) with the use of the telescope, reliable measurements had taken place.

From 4) comes out that the Force a(r) over the unit of mass depends from a constant term and from the square of the radial distance r of the unit of mass from the center of the system, and this was a concept which had some diffusion in Newton's times.

Presently only hypotheses can be made regarding the manner in which Newton arrived to the Universal Law of Gravitation (ULG), I personally presume that after a long search there was a moment of breakthrough which gave him the insight.

The above formulations, *3 for the Sun and 3bis for Earth* are analogous since referred to two similar systems (subjected to Kepler's Law in regard of satellites orbiting the Large central gravitational mass of each system), it was acceptable to consider the Earth a massive body if compared with an apple but in the times of Kepler and Newton there was still controversy in regard of the size of the Sun when compared to Earth, Newton solved the problem through the formula 3 and 3bis since he understood that the constants obtained had to depend respectively from the central mass of the system i.e. Sun and Earth, the ratio between the constant in 3 and the one in 3bis was :

$$1.332e20/4e14 \cong 333000$$

This could only be a ratio of effects due to physical presence (mass) establishing that the Sun had a massive size (333000 times that of Earth) but didn't establish the mass value of the Sun and of the Earth therefore the ratio had to be expressed in the following manner (a pure number):

$$\frac{(G \cdot M_{SUN})}{(G \cdot M_{EARTH})} \cong 333000$$

The evaluation of the average density of Earth ~5.5 Ton/mc , could be inferred only through later laborious efforts, and from the knowledge of its radius r_E was obtained a value:

$$M_E \cong 5.9\ e21[Ton]$$

from the knowledge of the constant value above in 3bis:

$v^2_{Moon-0} \cdot r^{Earth}_{Moon-0} = 4e14 = G \cdot M_E$, the Universal constant G was deducted:

$$5) \qquad G = \frac{4e14}{5.9e21} \cong 6.78 \cdot e-8$$

(confirmed later through more refined measurements).

Note: in Newton times, the values used for these formulations were hard to obtain (and in some cases controversial) and my *reconstruction* is just a didactic attempt made using values present in today's textbooks.

A pure number G, then, is determining what was called the Universal constant and the constant calculated in 3) divided by G gives the mass of the Sun in Ton:

$$6) \qquad M_S = \frac{1.332e20}{6.78e-8} \cong 1.97e27 \ [Ton]$$

Kepler picked up a secret of geometric temporal nature and rightly called it a "LAW" and from this LAW directly descended the Universal LAW of Gravity of Newton, the necessary steps were (as mentioned) the determination of the distance Earth-Sun, the orbital velocity of Earth, the radius of Earth the distance Earth-Moon, the orbital period of the moon, the Static-Dynamic value a(r) of gravity on Earth together with an approximate value of density ρ of the Earth (values which at the time were difficult to measure and since then, the values he had at the time, were subjected to refinement).

For the unit of mass in circular orbits around the Sun and around Earth, we can write:

$$7) \qquad v_o^2 \cdot r_o = 1.332e20 = G \cdot M_{SUN}$$

$$8) \qquad v_0^2 \cdot r_0 = 4e14 = G \cdot M_{EARTH}$$

From which more familiar expressions can be deducted (since 7 for the Sun and the 8 for the Earth are both valid in orbit for Earth around the Sun and for the Moon around the Earth), they can be used to represent the Static mass Force over the unit of mass, in equilibrium over the orbital circular path of radius r, whilst pitted against the inertial mass Force against the same unit of mass, opposing the change of direction of velocity.

In regard of a mass M [Ton], resting over the surface of Earth or in fall along the radial line whilst opposing the inertia of its own mass to radial acceleration, we use the 4 above (revealing the property that $\mathbf{a(r) \cdot r = v(r)_0^2}$:

a(r) = dv/1" [sec] (*Static Force over the unit of mass = Starter Force over the unit of mass*), that for a mass M becomes:

$$9) \qquad F(r) = M\ a(r_{Earth}) = M\ \frac{G \cdot M_{Earth}}{r^2_{Earth}}$$

This formula can be extended to a central mass M_{LGM}.

Or more consistently in orbit the Newton's LAW gives a Force over the mass M:

$$10) \qquad F(r) = M\ \frac{G \cdot M_{LGM}}{r_0^2} = M\ \frac{v(r)_0^2}{r_0}$$

The fact is that in the 7 and 8 there is constant proportionality with the central mass of the system and that terms like r, a(r) and $a(r)r=v^2_{orbital}$ are constant, this puts us before a situation in which the phenomenon is directly related to the central mass of the system M_{LGM} .

G (universal constant) has dimensions justified by absorption over the unit of time of the surrounding Ether/ESF proportional ($k=4\pi G$ factor of proportionality or constant of absorption) to the gravitational central mass M_{LGM}.

This absorption is described as the cause of a flow that whilst **crosses the mass M in quiet** generate in it the static mass Force and this reveals the temporal nature of the Force (since, by definition, absorption happens in time).

At this point the Newton's Universal Law of Gravity (ULG) is *explained* with the existence of a flow of mass-energy ESF crossing M whilst absorbed by the gravitational activity of the central M_{LGM} (and transformed into gravitational m-e adding to its mass value) through a process that being always present hides the fact that the G (in Newton's formula) is dependent from time.

Then, a constant flow of ESF per unit of surface is crossing over the spherical surface distant r>R (for R the radius of the M_{LGM}) and is represented by a percentage k of the value of the central mass M_{LGM}) this flow can cross the mass M afflicting it with a mass Force directed towards the center of the M_{LGM} , the 10 above then becomes:

For $G= k/4\pi$ and r> R

$$11) \qquad F = M\ \frac{k \cdot M_{LGM}}{4\pi r_o^2} = M\ a(r_o) \quad [kN]$$

Duly opposed by an inertial mass Force, as in 10, if the mass M is in circular orbit, or by a static contact Force if the mass M is resting over the surface of the M_{LGM}.

From Einstein to the UDS

If now we reflect about the presence of a Universal constant G binding through the space (apparently empty) another object with a Force, certainly we have to suppose that the space is a medium through which that binding effect takes place and the Universal Dynamic Science (UDS) is the result of the search for answers, it may never be complete since its field of study is large, but certainly represents a big step forward.

In the light of the Law of equivalence of Mass-Energy (m-e) to Energy (postulated by Einstein) is possible to give a new and more advanced interpretation to Newton's LAW that transforms it into a Law of flow of the substance (mass-energy) contained inside the Space, this substance is also called Energized Space Fabric ESF (or Ether/ESF) and is continuously absorbed by the central M_{LGM} .
This new interpretation attributes to it the capacity to react with the physical mass encountered along its passage permitting it to undergo an open cycle of transformations-degradations, all of gravitational character, and each transformation-degradation being cause of dynamism (releasing a force causing movement), straight inside the Euclidean space along the radial distance joining the center of the masses or cyclical elastic ruled by a temporal phenomenon of unstoppable nature that eventually ends into dissipation.

The above relation 11 shows that the expression of the Newton's Force is in reality a Force generated by passage of a flow of ESF at the origin of which is a transformation-degradation inside the M_{LGM} of the m-e Ether/ESF absorbed and transformed into more gravitational m-e which adds to the mass M_{LGM} (we do not realize it since the phenomenon is continuous and Universal and the addition is very small and beyond our capacity to measure it).
The first of the effects of transformation-degradation of the ESF absorbed by the M_{LGM} is that the mass M crossed by the flow of ESF is affected by a continuous value of Force F in (kN).

The LAW of absorption of the Ether/ESF as mass-energy in pristine status by the central Large Gravitational Mass M_{LGM} can be expressed in the following manner as a value of constant flow of ESF valid for r>R (for R the radius of the M_{LGM}):

$$12) \qquad \frac{\Delta_{ESF}}{sec} = \frac{k}{c^2} M_{LGM} = \left[\frac{Ton}{sec}\right]$$

Considering the Ether/ESF as fluidic substance made up of m-e in a status that can, in continuous basis, cross the mass M whilst flowing at distance r>R from the center of the system containing the M_{LGM} absorbing it and transforming-

degrading it into neutron m-e, we have for M= ρV that the following amount of m-e Ether/ESF per unit of time flows through M:

$$\frac{\delta_{ESF}}{sec} = M \cdot \frac{k}{c^2} \frac{M_{LGM}}{4\pi r^2}$$

And to that value of flow, if movement of M is impeded, corresponds an opposing Static Force of continuous nature over M:

$$F(r) = M \cdot \frac{k\, M_{LGM}}{4\pi r^2}$$

Note: the fluidic character of the ESF that permits it to cross the physical mass should not surprise anybody since the m-e M_{Heat} , which is basically a degraded status of the ESF, can also (mutatis mutandis) cross the physical mass and is evidence that the fluidic character is still there.

The whole theory on which the Universal Dynamic Science (UDS) is based benefits of the discovery of the opportune behavior of the m-e that from the status of Ether/ESF is subjected to a chain of successive transformations-degradations (as each of them, whilst takes place, changes the status of existence of the m-e and is associated to a particular Force related to the phenomenon).

This chain of transformations-degradations eventually reaches a last stage (or status) in which the original Ether/ESF becomes M_{Heat} (also a fluidic substance) and comes out of the physical mass degraded and in dissipation through the Ether/ESF from which was originated (absorbed by it).

A long way from Kepler Third Law …..

Note: the phenomenon regarding the behavior of the M_{Heat} produced through gravitational internal transformation by a large enough mass and coming out at the maximum allowed speed c from it is treated in the UDS only as far as dissipation is concerned, we then have that the M_{Heat} hitting a mass whilst dissipating away from its source (the M_{LGM}) is cause of another myriad of phenomena, *treated in physics and in quantum mechanics*.

As it is the UDS (though mostly restricted to small velocities of the masses $0< v <<c$ is still at the base of a dramatic enlargement of the present knowledge since the two transformations-degradations one caused by absorption of ESF by a central M_{LGM} of a system (producing the gravitational field of depression and flow of the ESF) and the other caused by absorption by the ESF of m-e M_{Heat} coming out in dissipation from the M_{LGM} .

Note: M_{Heat} is m-e present free inside the M_{LGM} but compressed in the gaps between its atoms, at the end of the internal gravitational cycle of transformations-degradations and is continuously produced internally to it and continuously absorbed by the ESF surrounding the M_{LGM} .

Mass-energy undergoing inside the gravitational mass M_{LGM} (and M) the open cycle of transformations-degradations, justifies its presence through phenomena,

gravitational, geometric, temporal hitherto observed (and these effects can in some circumstances be exploited, like in the case of the GPS).

Apart the internal production of M_{Heat} in large masses, the phenomena just mentioned are including temporal retardations and geometric precessions and whilst in some cases are known and measurable only some of them have been physically interpreted.

We then can conclude that through the conjunct use of the two basic Laws, the ULG of Newton and the Law of equivalence of energy to m-e introduced by *Einstein* a new and more advanced paradigm comes to the fore, I gave to the grouping of the phenomena (mainly gravitational) that I could gather under it, the name "UNIVERSAL DYNAMIC SCIENCE" .

Note: the Law of increase of inertial m-e with the increase of velocity of a physical mass M, is a corollary of the Law of equivalence.

Note: To increase of inertial m-e in a mass M is associated internal retardation of the physical-temporal phenomena, as perceived from an external observer in absolute status of quiet, and then with the interpretation of these phenomena we are crossing the line and enter into the interpretation of relativistic phenomena (those at least within the range of the UDS).

Kepler Newton and after them Einstein are to be credited to have open the doors to a new age of thinking in which the physical phenomena taking place in the Universe are at first *described through basic formulations* (of course they are in the forefront but the number of Scientists to be credited of major advances whilst following the same path is large) we are to be thankful since their efforts are permitting us to advance.

The introduction of the characters of the Ether/ESF in this paper is only seminal since this substance in its pristine status of existence as m-e is firmly associated with the description of properties belonging to it whilst it occupies the Euclidean space, most of these properties are hidden and difficult to understand, and the progress of physical Sciences and to great extent also of achievements in the Engineering fields, very necessary at present, is bound to the discovery of its behavior.

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