Non-Conservativeness of Natural Orbital Systems

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The Newtonian mechanic and contemporary physics model the non-circular orbital systems on all scales as essentially conservative, closed-path zero-work systems and circumvent the obvious contradictions (rotor-free 'field' of 'force', in spite of its inverse proportionality to squared time-varying distance) by exploiting both energy and momentum conservation, along specific initial conditions, to be arriving at technically more or less satisfactory solutions, but leaving many of unexplained puzzles. In sharp difference to it, in recently developed thermo-gravitational oscillator approach movement of a body in planetary orbital systems is modeled in such a way that it results as consequence of two counteracting mechanisms represented by respective central forces, that is gravitational and anti-gravitational accelerations, in that the actual orbital trajectory comes out through direct application of the Least Action Principle taken as minimization of work (to be) done or, equivalently, a closed-path integral of increments (or time-rate of change) of kinetic energy. Based on the insights gained, a critique of the conventional methodology and practices reveals shortcomings that can be the cause of the numerous difficulties the modern physics has been facing: anomalies (as gravitational and Pioneer 10/11), three or more bodies problem, postulations in modern cosmology of dark matter and dark energy, the quite problematic foundation of quantum mechanics, etc. Furthermore, for their overcoming, indispensability of the Aether as an energy-substrate for all physical phenomena is gaining a very strong support, and based on recent developments in Aetherodynamics the Descartes' Vortex Physics may become largely reaffirmed in the near future.

Keywords: gravity, anti-gravity, orbital motion, open systems, aether physics, vortex physics

1. Introduction

Following the Newton's fitting of elliptical planetary orbits to the single central force inversely proportional to the square of its distance to the Sun, all natural systems - from atomic to galactic scales - have been treated as non-conservative (work over closed loop in the field of potential force equaling to zero). The exclusive reliance on gravitation as the only central force does not allow for the formally exact prediction of the planet's trajectories in accordance with the Kepler's First law [1], and furthermore orbit fitting to an elliptical shape is contingent on the initial conditions [2]. The basic shortcoming of Newton's theory of orbital motion is the presumed absence of the tangential acceleration component, quite contrary to well established observational results, which is deduced either from the 'naive' interpretation of the Kepler's Third law, which actually is related to the average values of the orbital radius and elapsed time, or from the improper interpretation of Kepler's Second law as angular momentum, its presumed constancy implying only the circular motion.

For theoretical foundations and practical calculations the factual time-dependence of the force (thus non-zero rotor field) is neglected and one proceeds from the constancy of the sum of kinetic and potential energies, on one side, and the constancy of the angular momentum, on the other, although in actuality neither of the two is the case. Only recently, within explorations of biological molecular systems, as well as in certain domains of particle physics, the need starts arising for looking at such systems as non-conservative, the so-called "open systems", which within the classical formalisms turn out to become the "non-integrable" orbital systems (inability to be reduced to "circular coordinates" by even applying the time-varying transformations of the coordinate systems). This has led to modifications and specializations of the formalisms of the classical axiomatic mechanics having been developed by Euler, Lagrange, Hamilton, Noether and others for essentially conservative systems to be applicable to the non-conservative ones. However, a critical analysis of the matters suggests that all the natural orbital systems are open, that is non-conservative (including the planetary, atomic and galactic ones), and that neither the energy nor the (angular) impulse is constant over the time, so that the very basic foundations turn out to be erroneous.

Although epistemologically quite appealing, the Le Sage's theory of gravitation as an effect of the objects'mutual shadowing from a postulated isotropically acting energy-agent could hardly pass the test of producing the well-entrenched Newton gravitational law, and the fairly successful reproductions of its mass-depended form [3] may only have hindered wider appreciation of its intrinsically dynamical nature. As the matter of fact, the Newton's gravitational law was derived in a rather tautological (circular) manner, relying on the ‘larger’ object's mass also in the definition of the gravitational constant. The incorporation of his third law of action and reaction, which even Newton himself had been reluctant to rely on explicitly (and despite many objections — notably Leibniz's statement that they cannot be simulateneously applied to the same body) into the theory of orbital motion, has been another misdeed, both with detrimental impact on the further development of physics, and the almost insurmountable difficulties it has been facing, including the forces' unification. On the other side, in the concept of Thermo-Gravitational Oscillator (TGO) [4] developed by combining Le Sageian gravitational and thermal as anti-gravitational changing of permittivity to the mutual shadowing ‘pushing’ effect, the central acceleration results in the form of two-components $(-a/r^2 + b/r^3)$ that Leibniz had proposed within his critique of the Newton's orbital dynamics, and without any reliance on the Newton's third law, by using M. Milanković's (one over r-squared) law of planets'warming. Besides an overview of the TGO concept, here are provided results of simulation which produce the non-zero minimal work for the nominal Keplerian ellipse, serving as a clear indication of invalidity of the traditional assumptions of the energy and angular momentum (erroneously related/identified to/by the Second Kepler's Law) time-constancy, that is ‘conservation’.

The orbital trajectory is produced by direct minimization of the Work needed to be done over the ‘closed’ path, without any reliance on initial conditions (commonly considered as even a part of natural laws in the context of traditional minimization of variation of the Action - time-integral of difference of the kinetic and potential energies of an orbital body). While the gravitational constant (a, above) is considered as not the “universal” one (introduced as ratio of Kepler's constant and mass of the Sun, and measured on Earth by two metal balls!?) and basically dependable on actual configurations, the mass get entirely dropped-off from the considerations, and in place of it (in b, above) comes the body's thermal capacity (or its specific heat). As further support for righteousness of this approach can be offered that the same form of the central accelerations, i.e. the ‘attractive’ and ‘repulsive’ forces are manifested within the thoroidal vortex atomic-level structures, respectively for the ring (electric field related) and thoral (magnetic field related) streaming of the (gaseous Aether with viscosity nd compressibility) particles [5]. For the TGO-apprach it comes as a true ‘miracle’ that the vortexes related attractive and repulsive forces, in the context of the Aether as gaseous substance with viscosity and compressibility, along the lines of the pressure/velocity/temperature gradients and their impacts decrease and increase, respectively have exactly the same $(-a/r^2 + b/r^3)$ forms. Based on this is established groundlessness of the postulation of “dark” both matter and energy at the cosmological level as pursued by the conventional astrophysics, and the road is opened toward understanding the omnipresence of the Golden Mean relationship in nature at all scales. (While the formula for gravitational attraction derived by Atsukovsky in [5] supports gravitational constant's non-universality and involves thermal coefficients therein, its first approximation for relatively small distance reveals similarity with the Milgrom's MOND theory conjecture on attraction force proportional to inverse of the relatively large distance. It might be quite interesting to note that the first approximation of the GTR, as well as of its counterpart proposed as an enhanced form in [6] turn out to formally have the same form as the two component central force in TGO (when taking out the inverse distance squared part), but in both parts then figures the same “universal gravitation constant” only, along the velocity of light in the anti-gravitational counterpart of b.)

In the following, firstly a related historical and philosophical account has been provided, followed by direct critical remarks to the Newtonian theory of orbital motion. Subsequently, the overview of derivation and conceiving of orbital motion as a dynamical equilibrium is provided, along the utilization of the formulation of the planetary temperature dependence in line with the Milutin Milanković's one-over-distance-squared-law, which leads to the two-component radial acceleration of the form proposed by Leibniz. Finally, along the conclusions, relevance to the outstanding problems and anomalies are provided, with a certain outlook to all natural systems.

2. A historical and philosophical perspective

By conceiving gravitation as Le Sageian effect of mutual shadowing, the room opens for both Aristotle's Unmoved Mover realm (which may have an analogon in the Aether substrate with both spontaneous and inducible structuring) and for his concept of ‘virtual-’ or ‘hidden-forces’, a form of (conditionally) contactless dynamic, for which the equality of Action and Reaction in terms of the Newton's Third Law may by far not hold. The reliance on this principle as applied in the Newton's non-circular orbital motion Leibniz had criticized on the ground of untenability of its object be the same body, as the‘equilibrium’ between the centrifugal and centripetal forces/accelerations imply, the stance he had supported by the two-component central acceleration, derivable (in case of the presumed constancy of the angular momentum) from the consistent vector calculus based dynamics of curvilinear motion.

To (it turns out virtually, due to still present central position of mass notion in modern physics, and in particular the postulated equivalence between its “gravitational” and “inertial” ‘forms’) refute the Aristotle's doctrine on falling bodies (the heavier ones fall ‘quicker’ than the lighter) it has needed a very long time-span - from Lucretius (cc. 99 - 55 BC, De Rerum Natura: “ - wherefore all things carry on through the calm void, moving at equal rate with unequal weights”, over quite numerous experimenters in 16-th century (Djuzepe Moletti, 1576 in Padova; Jakopo Maconi, 1579 in Pisa; Simon Stevin 1583 with Jan Koret Glot, in Delft), to Glileo Galilei's (in 1586) confirmation of those findings by inclined plain experiments, which have led to $s = 0.5 \cdot g \cdot t^2$.

In light of the subsequent TGO concept development overview, the same way the Aristotle's falling-body assertion was the “progress hampering” hypothesis, such was the Newton's concept of Gravity as the result of bodies's “mutual attraction”. The Nikolas Fatio de Duillier's (1690) and Georges-Luois Le Sage's (1748) gravitation as effect of bodies mutual ‘screening’ (shadowing) from isotropic and homogeneous energy substance (ultra-mundane corpuscles) - a hypothesis which Newton (1642-1726) could have had an opportunity to (still) consider (vs. “Hypotheses non fingo”), kind of served to ‘open’ the particular orbital motion system towards its environment.

For the path that has led to the current unsatisfactory situation in physics of most importance seems to be the Newton's, and in particular of his followers, derailing of its development from the Descartes'Vortex Physics tracks. In that context the most symptomatic is the Newton's notebook, by him explicitly banned to be published [7], with his comments and apparent frustrations during the reading of Descartes' “Principles of Philosophy”. Another resurfacing of the work not intended for publication is Feynman's scrutinizing and attempting to overcome the noticed week point in Newton's geometrical fitting of elliptical orbits to the central force inversely proportional to the squared distance is the above first cited [1], where Feynman had attempted to correct the inconsistency of Newton's geometrical fitting of the elliptic path to the squared distance inverse central force. It is deplorable indeed, that Feynman did not persevere and was not able to apply his favorite Least Action Principle to that problem, instead of stepping into the further support the otherwise unsoundingly set-up quantum mechanics by calculation of the (notably non-zero!?) works on all possible paths of an electron and assigning their reciprocal values to the probabilities, and further going into quite controversial development of the “Qauntum Gravity”.

3. Critique of the conventional approach in solving the Kepler's/Newton's problems

When it comes to determining the intrinsic feature of an orbital system, that is whether is it conservative or non-conservative, by all means of prime importance is the topic of a system energy balancing — evaluation of difference between the de-facto performed work and the (knowingly) available applied energy (re)sources. If the former exceeds the latter, or if the traditionally conceived and established law of sum of kinetic and potential energy conservation does not ‘hold’, we must be missing the awareness of the true nature mechanisms and the availability of the unaccounted for ‘environmental’ effective energy input(s).

As the historically firstly considered, the Sun's planetary orbital system should indeed be the right one for these considerations, in particular that the established theory and its further developments have detrimentally affected all other physics' and in general science domains — form the atom- to galactic-levels, and from chemistry to biology. In direct relation to the orbital energy balancing stands the concept of energy conservation with the related work over a closed-path being equaled to zero, as intrinsic feature of the so-called potential fields (the ‘central’ force vector field having form of gradient of a scalar potential field).

Since the time-dependent central forces (or better, accelerations) for non-circular orbits evidently (due to the non-zero curl of the related force field vector) cannot basically belong to this category, for the commonly conducted analysis and the contradictions involved it is symptomatic that every effort has been made to avoid explication of the essential time-dependence of the orbital central force(s). In the following, in form of a ‘dialog’ with the critique (by Gerhard Bruhn) of the most famous critic (G. Bourbaki, alias of Goerges von Brauning) of the established practices of simultaneous use of both the energy and the momentum conservation principles [8] (with the translation from German by the author of this paper), evidence and comments will be provided towards debunking of this misleading approach, relying indeed on two erroneous and untenable premises — the (sum of kinetic and potential) energy conservation in the sense of its time-independence, on one, and the conservation of the angular momentum in spite of its factual non-constancy, that is the identification of the distance-squared-times-phase-first-derivative, $r^2\dot{\varphi}$, with the surface of area swept by the radius vector, on the other side. The very notion of potential energy as a negative ‘quantity’, while formally acceptable in static situations, has been largely ‘misused’ in the dynamical context with the mere (apparently, up-front intended) effect to trade it for the kinetic part over a closed path (or, rather, only the radial direction) to produce balance proclaimed for the feature of conservativeness, without any intentional (besides Feynman's purposeful) back-checking for the validity of such assumption by the evaluation of actual closed-loop work need/done on the same closed path.

"Central forces $\mathbf{F}(\mathbf{x},t)$ are always directed to a fixed point $\mathbf{x}_0$, wherein we place the origin **O** of the coordinate system:

$$\mathbf{F}(\mathbf{x},t) = \frac{\mathbf{x}}{r} f(\mathbf{x},t) \tag{1}$$

Newton's movement equation for a solid punctual mass m then is:

$$m\ddot{\mathbf{x}} = \frac{\mathbf{x}}{r} f(\mathbf{x},t) \tag{2}$$

with $r = |\mathbf{x}|$. Vector multiplication with $\mathbf{x}$ gets

$$\frac{d}{dt}\left(m\mathbf{x} \times \dot{\mathbf{x}}\right) = m\mathbf{x} \times \ddot{\mathbf{x}} = 0, \tag{3}$$

so that

$$m\mathbf{x} \times \dot{\mathbf{x}} = \mathbf{C} \tag{4}$$

with a constant vector **C**. Therewith one has Angular momentum conservation:

The angular momentum of a punctual mass m stays exactly then constant, when on it acting force $m\ddot{\mathbf{x}} = \mathbf{F}$ is a central force."

sn — This very first step predetermines (strict) co-linearity of the overall acceleration with the direction of (central) force, although in general (non-zero curling and/or time varying force fields) that has not to be the case. Here (4) already forces the trajectory to be circular, by suppressing 'freedom' of having acceleration components not collinear with the radius vector.

"Central force movements always happen in one plane through **O** perpendicular to the (constant) angular momentum vector **C**. Then from (4) follows

$$\mathbf{C} \cdot \mathbf{x} = m(\mathbf{x} \times \ddot{\mathbf{x}}) \cdot \mathbf{x} = 0.$$

We give to the z-axis of a Cartesian coordinate system the direction of the angular momentum. In x,y-plane normal to it, the plane of movement, let (r,φ) be the polar coordinates. Then it follows for the points $\mathbf{x}$ in the plane of movement the representation

$$\mathbf{x} = r \cdot \mathbf{e} \tag{5}$$

with $\mathbf{e} = (\cos\varphi, \sin\varphi)$. Differentiating $\mathbf{e}$ on φ produces the to $\mathbf{e}$ perpendicular unit-vector

$$\dot{\mathbf{e}} = \left(-\sin\varphi, \cos\varphi\right). \tag{6}$$

Therewith, for the velocity of a central movement one gets

$$\dot{\mathbf{x}} = \dot{r} \cdot \mathbf{e} + r \cdot \dot{\varphi} \cdot \mathbf{e}$$

and

$$\dot{\mathbf{x}}^2 = \dot{r}^2 + r^2 \cdot \dot{\varphi}^2." \tag{7}$$

sn — For the subsequent discussion it will be necessary to state the general (planar) form of the material point's acceleration as time-derivative in he upper part of (7), with C defined as in (9)

$$\ddot{\mathbf{x}} = a_r \mathbf{e} + a_t \mathbf{e}'$$

$$a_r = \ddot{r} - r\dot{\varphi}^2$$

$$a_t = r\ddot{\varphi} + 2\dot{r}\dot{\varphi} = \frac{1}{r}\frac{d}{dt}(r^2\dot{\varphi}) = \frac{1}{r}\dot{C}. \tag{8}$$

"That produces

$$\mathbf{x} \times \dot{\mathbf{x}} = r^2 \cdot \dot{\varphi} \cdot \mathbf{e} \times \dot{\mathbf{e}} = r^2 \cdot \varphi \cdot \mathbf{k}.$$

Therewith the law of conservation of the angular momentum goes over into the known surface-law

$$r^2 \cdot \dot{\varphi} = C = |\mathbf{C}|, \tag{9}$$

since $r^2 \cdot \dot{\varphi}$ is the surface swept per unit-time by the trajectory vector, which therefore is constant"

sn – As expected based on (8), constant C implies $a_t \equiv 0$, thus absence of non-zero transverse, that is (by its projection on the tangential line) the tangential acceleration, which means the (pre-assumed) zero work on any path's segment, as well as the trajectory in the whole. On the other hand, evidently (by evaluation on the parametrized ellipse, or the subsequent solution this derivation results in) this quantity C is differing from constant (as seen in Figure 1 bellow), and it at all does not correspond to the 2-nd Kepler's sectoral surface-law.

"For the kinetic energy

$$K = \frac{m}{2}\dot{\mathbf{x}}^2 = \frac{m}{2}\left(\dot{r}^2 + r^2 \cdot \dot{\varphi}^2\right). \tag{10}$$

applies as following from the Newton's movement equation $m \cdot \ddot{\mathbf{x}} = \mathbf{F}$ the general Energy law: The change in kinetic energy is equal to the work done by the force **F**

$$\frac{dK}{dt} = \mathbf{F} \cdot \dot{\mathbf{x}}. \tag{11}$$

In integrated form that means that between two arbitrary time-instants t_o, t_1 along a path $\mathbf{x}(t)$ applies the relationship

$$K_1 - K_0 = \left(\frac{m}{2}\dot{\mathbf{x}}^2\right)_{|t=t_1} - \left(\frac{m}{2}\dot{\mathbf{x}}^2\right)_{|t=t_0} = \int_{t_0}^{t_1} \mathbf{F} \cdot \dot{\mathbf{x}} \cdot dt." \tag{12}$$

sn - The expression on the right-most side of (12) is figuring as definitional form of the work done over a path, which here becomes related to the change of kinetic energy by (implicit) avoidance of explicitly accounting for the time-dependent central force, that is the related acceleration

$$m \cdot \ddot{\mathbf{x}}(t) = \mathbf{F}(\mathbf{x},t),$$

in that the sub-integral expression

$$m \cdot \ddot{\mathbf{x}}(t) \cdot \dot{\mathbf{x}} \cdot dt$$

is replaced, by using the chain rule

$$\frac{d}{dt}\left[\dot{\mathbf{x}}^2(t)\right] = \frac{d}{d\dot{\mathbf{x}}}\left[\dot{\mathbf{x}}^2(t)\right] \cdot \frac{d\dot{\mathbf{x}}}{dt} = 2\dot{\mathbf{x}}(t)\ddot{\mathbf{x}}(t),$$

by

$$\frac{1}{2}\frac{d}{dt}\left[\dot{\mathbf{x}}^2\right] dt = \frac{1}{2} d\left[\dot{\mathbf{x}}^2\right].$$

While this seems to be correct, except that the time-variable/ility is entirely hidden, it should be noted that the scalar product in the sub-integral function implies only the work over the radial direction.

"Consequence: By taking of a mass m with the angular momentum **C** from the orbital path $r = r_0$ into the orbital path $r = r_1$ by means of a central force (1), the central force does the work

$$K_1 - K_0 = \frac{m}{2} C^2 \left(\frac{1}{r_1^2} - \frac{1}{r_0^2}\right). \quad (13)$$

Since along the path applies the angular momentum conservation, that is in accordance with (9) $r_0^2\dot{\varphi}_0 = C = r_1^2\dot{\varphi}_1$, and besides that for the orbital paths $r = r_0$ and $r = r_1$ are $\dot{r}_0 = \dot{r}_1 = 0$, due to (10)

$$K_1 - K_0 = \left(\frac{m}{2}\dot{\mathbf{x}}^2\right)_{|t=t_1} - \left(\frac{m}{2}\dot{\mathbf{x}}^2\right)_{|t=t_0} =$$

$$\left(r^2 \cdot \dot{\varphi}\right)_{|t=t_1} - \left(r^2 \cdot \dot{\varphi}\right)_{|t=t_0} = \frac{m}{2} C^2 \left(\frac{1}{r_1^2} - \frac{1}{r_0^2}\right).''$$

sn - For those two particular instants, since (also in general) $C_o = r_o^2\dot{\varphi}_o \neq C_1 = r_1^2\dot{\varphi}_1$, one gets $\mathrm{K}_1 - \mathrm{K}_\mathrm{o} = \frac{m}{2}\left(\frac{C_1}{r_1^2} - \frac{C_o}{r_o^2}\right)$. It should be noted that (usually) these energy terms are associated with the so called virtual potential (related) energy parts. To the extent to which it 'debalances' the sum of total (kinetic and potential energy) in the sense of the "conservation of their sums", that is their independence on the position of the orbit, it should possibly be attributed to essentially "anti-gravitational" central force.

In Figure 1 is shown the variation of the angular momentum on the Keplerian ellipse as function of time, along its average value. It can clearly be seen that the assumption on its constancy is not tenable.

(By 'allowing' for the $C = r^2(d\varphi/dt)$, incorrectly taken for the (constant) sectorial speed, to be time-variable, it is possible to arrive at the radial velocity needed in the astrophysics to determine presence of planets in the distant stars, as shown in [11]), the result that on its practical merits can be considered as an indirect refutation of the angular momentum conservation law validity.)

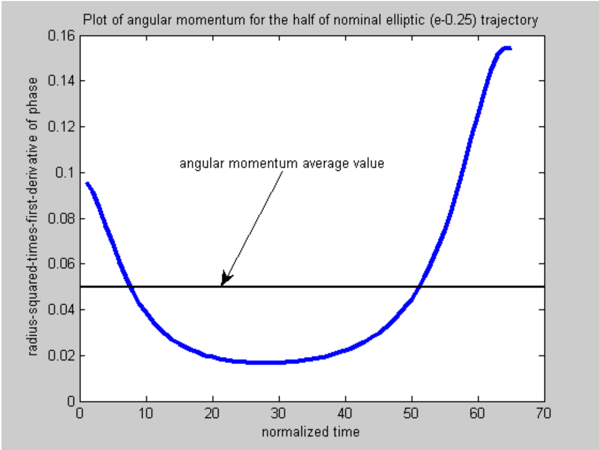

Figure 1. Dependence of the angular momentum on (normalized) time (for the first half, starting from the perihelion) for Keplerian ellipse with excentricity factor of e=0.25, along its average value.

"Example 1; Central force with time-independent potential: This example is treated in detail in [Friedhelm Kuypers: Klassische Mechanik, 4. Auflage, VCH 1993, S. 85 ff.]. Required and sufficient condition for the existence of a potential V of the central force (1) is the condition

$$rot\,\mathbf{F} = rot\left(\frac{\mathbf{x}}{r} f(\mathbf{x})\right) = \mathbf{0}. \quad (14)$$

After differentiation that produces

$$rot\left(\frac{\mathbf{x}}{r} f(\mathbf{x})\right) = -\frac{\mathbf{x}}{r} \times grad\left(f(\mathbf{x})\right) = \mathbf{0},$$

that is $f(\mathbf{x})$ can only be dependent on $r = |\mathbf{x}|$. Therewith we have

$$\mathbf{F} = -grad\left(V(r)\right). \quad (15)$$

This condition gives for the work-integral in (12)

$$\int_{t_0}^{t_1} \mathbf{F} \cdot \dot{\mathbf{x}} \cdot dt = -\int_{\mathbf{x}_0}^{\mathbf{x}_1} grad\left(V(r)\right) \cdot d\mathbf{x} =$$

$$-\int_{r_0}^{r_1} \dot{V}(r) \cdot dr = V(r_0) - V(r_1).$$

The energy-law (12) thus takes the form of a/the law of energy conservation:

$$\frac{m}{2}\dot{\mathbf{x}}^2 + V(r) = E, \quad (16)$$

with a constant E, or due to (7) and with accounting for the angular momentum conservation law

$$\frac{m}{2}\left(\dot{r}^2 + \frac{C^2}{r^2}\right) + V(r) = E. \quad (17)$$

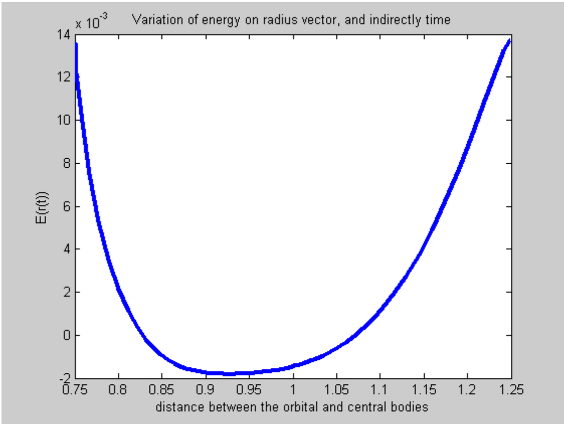

Figure 2. Total classically evaluated energy of the Keplerian elliptic trajectory with e=0,25 with the factually time-varying angular momentum.

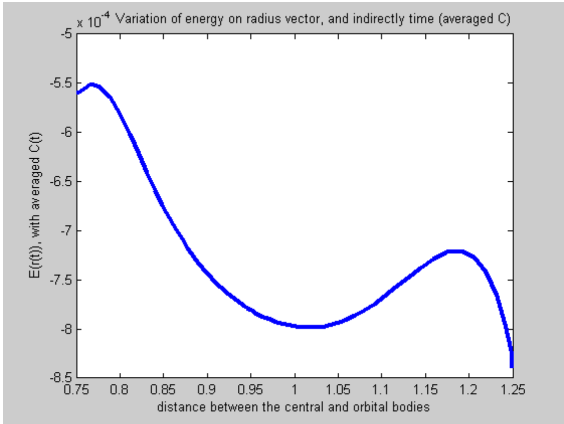

Figure 3. Total classically evaluated energy of the Keplerian elliptic trajectory with e=0,25 with the factually time-varying angular momentum replaced by its average value, as per Figure 1.

The radial movement $r = r(t)$ thus takes part under influence of the "effective potential" $V_{eff}(r) = V(r) + \frac{m}{2}\frac{C^2}{r^2}$. One should consider that the effective potential depends on the constant of the angular momentum C. The energy conservation law now becomes

$$\frac{m}{2}\dot{r}^2 + V_{eff} = E.'' \qquad (18)$$

sn — While under the presumption of the angular momentum conservation $r^2\dot{\varphi} = constant$, the energy conservation may hold (?!?), that is not the case in actual situations, so that

$$\frac{m}{2}\left(\dot{r}^2_{|r=r_1^2}\right) + \frac{m}{2}\cdot C_1^2 \cdot \frac{1}{r_1^2} + V(r_1) \neq$$

$$\frac{m}{2}\left(\dot{r}^2_{|r=r_0^2}\right) + \frac{m}{2}\cdot C_0^2 \cdot \frac{1}{r_0^2} + V(r_0),$$

and $m/2r + Veff(r) = E(t)$!?!

Direct refutation of the validity of the law of energy conservation in terms of its constancy over time, that is time-independence, can be made based on evaluations on the nominal Keplerian ellipse. As the results shown in Figure 2 and Figure 3 suggest, where respectively the E(t) is respectively plotted (for the first half of the trajectory, starting from the perihelion) in the considered case with excentricity e=0.25, for the factually time-varying angular momentum and its average value, as per Figure 1. This undoubtedly means that the assumption on the time-independent orbital energy is not tenable either. The plot of the effective potential itself is shown in Figure 4.

"Points of the path with $\dot{r} = 0$ are named reversal points. They satisfy the condition

$$V_{eff}(r) = E, \qquad (19)$$

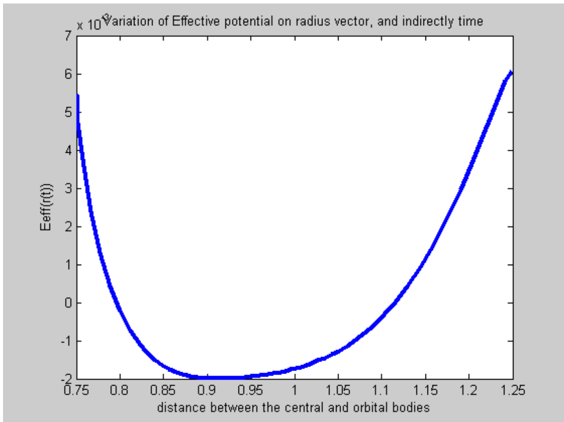

Figure 4. Plot of the effective potential with the factual angular momentum shown in Figure 1.

A movement is possible only in the r-ranges in which

$$V_{eff}(r) \leq E, \qquad (20)$$

In general, these get limited from bellow and up."

sn — In the light of the above observations, at these points (perihelion and aphelion positions) besides of the radius(es) also derivatives of the angle(s) are zero, meaning $C_1 = C_2 = 0$, so that only potential energy terms (m/r_1 and m/r_0) remain, invalidating (19) and the essentially time- (i.e. position-) invariant total energy $E(t)$ undermines the importance of the condition (20), and leaves it only as relevant for ensuring non-negative values of the argument of the square-root part in (21) bellow.

"The differential equation (18) can be solved on dt/dr and (subsequently) integrated. For the initial condition

$r(0) = r_0$ one gets

$$t(r) = \frac{2}{m} \int_{r_0}^{r} [E - Veff(\rho)]^{-1/2} d\rho, \qquad (21)$$

what determines the trajectory $r(t)$. Note: There are laypersons who hold that the angular momentum and energy conservation are not commensurate with each other, see for example [12]; (this link is unfortunately replaced by another content, comment by sn), [13]. Based on the above example one though can see, that the movement under central force is determined by the potential's part of the energy-law (21), whereas the angular momentum law in form of the area-law (9) with known $r(t)$ through differential equation

$$\dot{\varphi} = \frac{C}{r^2(t)}, \qquad (22)$$

determines the angular velocity of the closed path movement. Here, both of the two conservation laws are responsible for one of the two degrees of freedom (respectively, radial and azimuthal). Therefore, about a contradiction cannot be a question at all."

sn — It rather turns out that the 'conciliation' of the angular momentum and the energy conservations has (implicitly) been forced due to the inconsistencies related to the essentially time-varying nature of the central acceleration/force and its adoption to represent potential fields. In that way, the incorrect presumption allows for the rather awkward evaluation firstly of the time as function of distance in (21) by solving (18) with subsequently inversing $t(r)$ into $r(t)$, and then to use the alleged angular momentum conservation in (22), which, along (9), actually represents nothing else but $\dot{\varphi}(t) \equiv \dot{\varphi}(t)$!?! Also, reversing the functional relationship in (21) is not straight forward, and generally should not allow for the closed form expression for the $r(t)$.

There are various methods for overcoming of the intrinsically deficient foundations of the Newtonian gravitation and orbital motion theories towards solution of the so-called Kepler's/Newton's problem (for example, [9]) which, if (again, erroneously) rely on the angular momentum conservation, they do not explicitly involve the energy conservation 'law'. All of them, however, are less or more sensitive to the properly selected initial conditions, and the resulting quite miraculous reconstruction of elliptical trajectories with manifested (contrary to the presumed only radial) presence of non-zero tangential accelerations must be the result of essentially redundant elliptical geometry?! By all means the separate use of the two conservation laws as respectively "responsible" for the radial and azimuthal degrees of freedom appears to be quite artificial, and in light of the offered empirical proofs for essential invalidity of these laws, they should be deemed as inappropriate and largely misleading.

An at least more proper way to approach the orbital motion problem should be to consider two counteracting central acceleration (gravitational and thermal) components [4], and the conventional methods have been scrutinized in retrospect, after setting up of the TGO concept. It turns out that the $1/r^2$ proportional dependence of the planets temperature with distance goes over into $-1/r^3$ (or with reversed signs, as anti-gravitational terms) to account for to it proportional component which (with alleged constancy of angular momentum) corresponds to the "virtual potential", or (scaled by a constant) to the Leibniz's second central acceleration term. Besides a (non-Newtonian) gravitational constant, role plays also the body's thermal coefficient.

4. Orbital motion as a dynamical equilibrium — Thermo-Gravitational Oscillator

The following considerations are based (in the phenomenological sense) on dynamical equilibrium between the Le Sage-like gravitational and the postulated thermal components of the effective 'force' driving the planet around the Sun over certain path (by co-author of [4], Vujo Gordić *www.tdo.rs*). In essence, the gravitational component itself could be viewed at as essentially thermal, and what is exposed here is more like an outline of an ultimately thermo-dynamical theory of orbital motion. Here it goes about the extension and specialisation of the Gordić's quasi-dynamical, differential formulation.

With the reference to Figure 5, starting from the radial components of the Lesage's and the postulated colinear thermal 'force' components, their projections on the tangential line to a non-predefined orbital trajectory path bear the same ratios (as those very components) due to the sameness of the opposite angles made by crossing of two straight lines. Starting from the elementary work done on the elementary segment dr of a trajectory, the work done is the result of two components - a work component from the gravitational ('field') force, that is the corresponding acceleration towards the Sun (γ representing the gravitational, not necessary "universally valid" Newtonian constant)

$$dE = m \cdot \frac{\gamma}{r^2} \cdot dr, \qquad (23)$$

and the component (energy) of the 'thermal field', which actually acts as a kind of counter-force to the former one (the centrifugal force, generally differing from the centripetal one), that is (with δ representing the thermal coefficient of a planet's body)

$$dQ = m \cdot \delta \cdot dT. \qquad (24)$$

In order to represent the two field force components by the same variable, the actual dependence of the planet's global temperature (T) on its distance from the Sun is

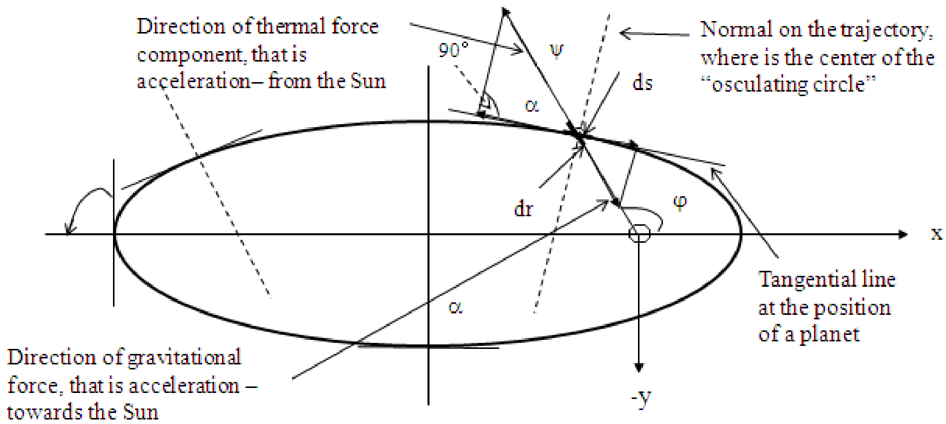

Figure 5. Illustration of thermo-gravitational equilibrium in the motion of a planet around the Sun.

needed. What is required is the related function

$$T = f(r), \tag{25}$$

so that (24) goes over to

$$dQ = m \cdot \delta \cdot f'(r) \cdot dr, \tag{26}$$

where the prime mark denotes the first derivative over the argument r.

Based on (23) and (24), the dependence of the effective force (per unit mass) of the composite thermo-gravitational field on the planet-Sun distance can be represented as

$$F(r)/m = \frac{\gamma}{r^2} + \delta \cdot f'(r). \tag{27}$$

It will be interesting and possibly insightful to mention here two things: first, the term 'force' — differently from its use by Newton - has been used in only a descriptive, and not the causative sense; second, although the (Earth) body mass is figuring in such a formal elementary works definition, it falls-out from considerations due to equating the total work over the trajectory to zero (for conservative system premise), or in the alternative, and possibly more appropriate application of the Principle of Least Action (as minimization of work done over a closed path).

This is how the mass becomes totally irrelevant for the orbital motion consideration/explanation, in quite a good agreement with the observations from well before the Galilean time, which support full independence of the acceleration caused by the Earth and other planets on the objects's mass. Actually, even in conventional determination of the orbital path the mass appears on the both sides of the differential equations and it essentially becomes irrelevant. For the energy balance evaluation within the TGO approach, the mass is to be used in product with acceleration to determine the classically defined work over the path, and the total thermal energy received from the Sun can then determine the efficiency factor, that is the extent to which there is a 'surplus' of energy! When the function $f(r)$ is not known, in particular the one that characterizes the effective radial component that is counteracting the Le Sageian gravitational push, one possibility is to arrive at it by starting from the known trajectory's elliptical equation and some sort of combined numerical/analytical determination of it, based on evaluation, that is minimization of expression

$$\oint \left\{ \left[\frac{\gamma}{r^2} + \delta \cdot f'(r) \right] \cdot \cos(\alpha) \right\} \cdot dr, \tag{28}$$

where the integration is done on the given (known) ellipse equation. (The value of this closed-path line integral is given by the area of the vertical wall 'erected' on the two-dimensional trajectory as its basis, with the height defined by the sub-integral function.)

Considering that radial acceleration $\ddot{r} = -\gamma/r^2 + C^2/r^3$ (which results from the conventional derivations, being exclusively the one with assumption of constant C) is same one (given by $\ddot{r} = -a/r^2 + b/r^3$) proposed by Leibniz [4] ([16] and [17] therein) in place of just the first one that figures in Newtonian set-up, the fact that might be telling a lot regarding the historical controversy over priorities in founding the differential calculus. On the other side, the planetary temperature dependence on the separation from Sun, found in Milanković's "Solar Cannon" book (reference 9 in [4]) being proportional to $1/r^2$, inserted into (5) casts the right-most term into $-\xi/r^3$, so that (with looking at the accelleration towards center) one gets $\ddot{r} = -\gamma/r^2 + \xi/r^3$, which very well matches the two expressions referred to immediately above. (The evident non-constancy of C would hint to somewhat position-dependent ξ. However, non-constant C essentially retains the transverse acceleration as a utmost important part, and its very presence might have largely accounted for the observed - for example, Mercury-perihelion 'anomalous' precession phenomenon.)

In order to corroborate the validity of the TGO approach as a way towards arriving at the general orbital motion theory, evaluation of the work over the closed elliptical path has been evaluated with variation of the nominal Keplerian ellipse with excentricity e=0.25 over its vertical axis. With the definition of thermal dependence as per the Milanković's planetary warming 'law', the work over the varied quasi-elliptical paths is numerically calculated by using the following two expressions (the second one, angle between the radius vector and tangential line, is taken from [14]).

$$\oint \left| \left\{ \left[-\frac{\gamma}{r^2(t)} + \frac{\xi}{r^3(t)} \right] \cdot \cos[\alpha(t)] \right\} \frac{dr(t)}{dt} \cdot dt \right|, \quad (29)$$

$$\pi/2 - \alpha(t) = \psi(t) = arctng(\frac{dr(\varphi(t))/d\varphi(t)}{r(\varphi(t))}). \quad (30)$$

(Of general interest might be the fact that the minimization of work - in this evaluation, hopefully justifyingly not making difference between the positive and negative tangential accelerations/de-accelerations - turns out to be the same as minimization of the closed-path integral of differentials of the kinetic energy or, equivalently, the closed-path integral over time of the time-derivative of the kinetic energy ($K = \frac{1}{2}\upsilon^2(t)$), as shown by the steps bellow.

$$\oint \frac{d}{dt}\left\{\frac{1}{2}\upsilon^2(t)\right\} dt = \oint \upsilon \cdot \frac{d\upsilon}{dt} \cdot dt = \oint \upsilon \cdot d\upsilon =$$
$$= \oint \frac{d\upsilon}{dt} \cdot \upsilon \cdot dt = \oint \mathbf{a}(t) \cdot d\mathbf{s}(t).$$

While the conventional Lagrangian formalism makes use of time integral of difference between the kinetic and the potential energies, with the actual path being supposed to minimize its variations, it should be noted that no explicit involvement of time variable is needed when the work over the closed path is evaluated. The importance of this can be in the again long time ago 'closed' issue over the relevance of the Newton's momentum or the kinetic energy itself, i.e. Leibniz's "vis-viva" (product of mass and velocity squared). In the sequel are also given some comparative evaluations of Lagrangean approach in the same nominal Keplerian ellipse 'variations'.)

The four figures (Figure 9, Figure 10, Figure 11 and Figure 12) present the work over the half of the vertically scaled elliptic trajectories, the scaling factors indicated on the horizontal axes.

In the Figure 13 is evaluated time-vise integral of time derivative of the kinetic energy, as per last (non-numerated equation).

For comparison, conventional variational approach of time-vise integral of the randomly varied/perturbed Lagrangian L=K-E is illustrated in Figure 14.

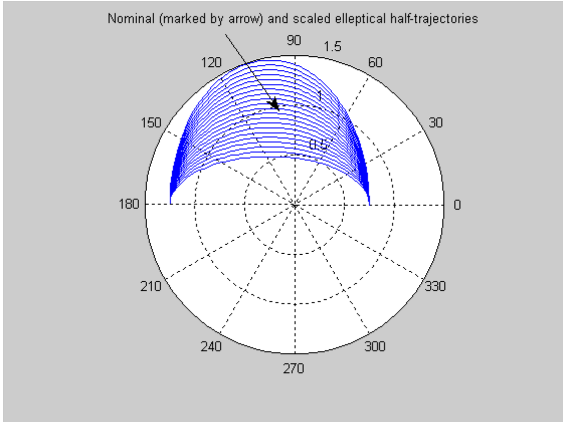

Figure 6. The first half of the paths used for the evaluations: shapes of scaled nominal (marked by the arrow) ellipse (with e=0.25).

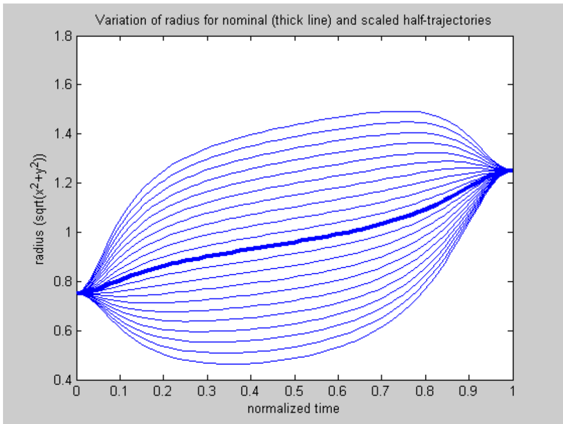

Figure 7. The first half of the paths used for the evaluations: variation of corresponding radiuses.

From the above results it can be seen that the paths corresponding to the nominal Keplerian ellipse correspond to the minimal work needed to be done for its traversing or the minimal integral of the time-variations of the orbital body kinetic energy. (It should be noted that in the latter case there is no involvement of calculation of the angle between the radius vector and the normal to the tangential line, with exhibited rather peculiar variations related to the method of its calculations in polar coordinates of (30), highlighted in Figure 12). Through the calculations of integrals of Lagragians, it has been to some extent indicated soundness of the conducted evaluation (although the minimal variance of the random values in Figure 8 falls at the scale 3 rather than (visually) expected value of 1. (Only with Vujicić's [10] modified Lagrangian L=2K-E it comes closer to 2; it might be worthwhile noting that the doubled kinetic energy corresponds

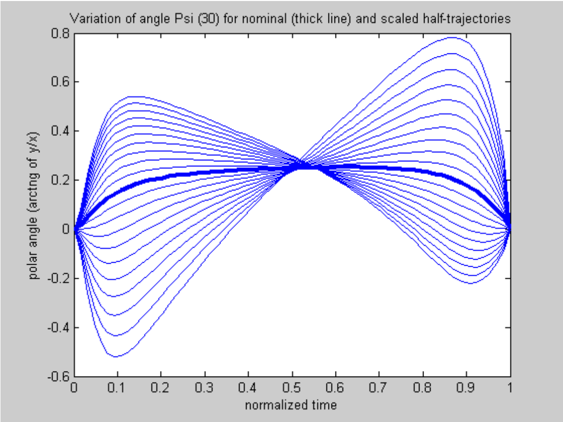

Figure 8. The first half of the paths used for the evaluations: variation of the related angles between the radius-vector and the tangential line at the position of the orbital body (angle ψ in Figure 5) and the equation 30.

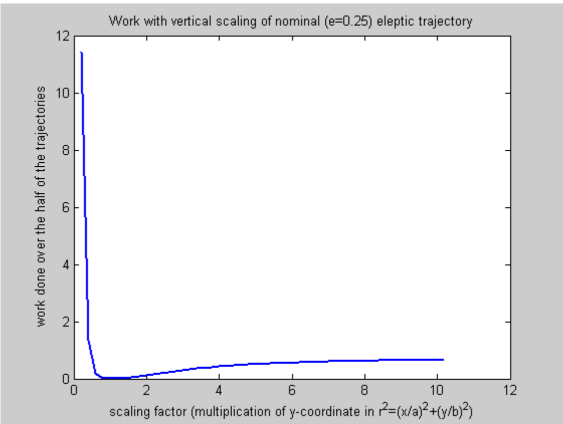

Figure 9. Evaluation of work done over the vertically scaled nominal Keplerian ellipse: the overall shape of the work resembles the conventionally evaluated potential energy "well".

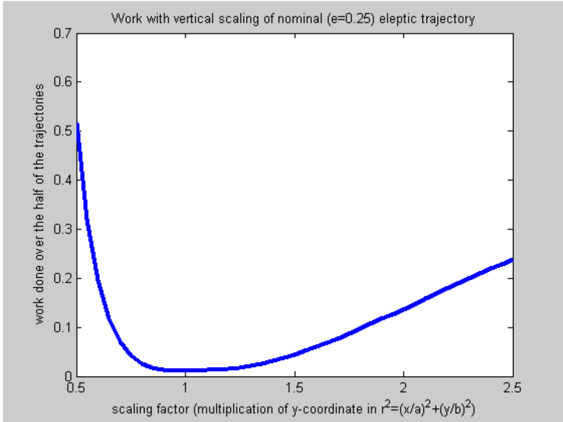

Figure 10. Evaluation of work done over the vertically scaled nominal Keplerian ellipse: hile the overall shape of the work resembles the conventionally evaluated potential energy "well", the minimum of work is of a positive value and correspond to the nominal ellipse - scale factor equaling 1.

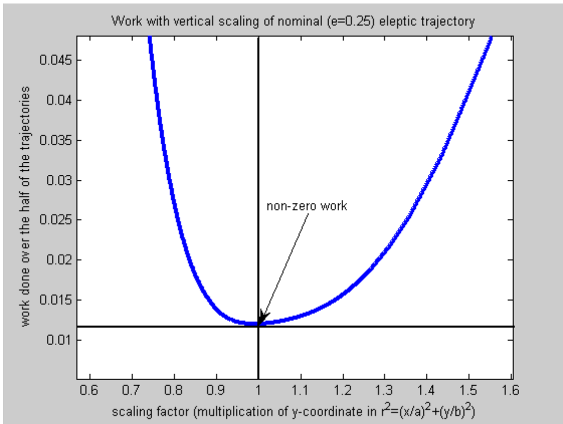

Figure 11. Evaluation of work done over the vertically scaled nominal Keplerian ellipse: the minimum of work is of a positive value and correspond to the nominal ellipse - scale factor equaling 1.

to the Leibnizt's "vis-viva" related squared velocity).

Based on these evaluations, it is to be expected that inherently stable orbital paths can be produced just by minimization of the work integral, instead of minimization of its variation, and that may bring profound changes regarding the abandoning or greatly modifying the traditional methodologies.

5. Concluding remarks and wider implications and the relevance of Aether for physics

From the above developments and evaluations it follows that it is not true that the concurent use of the two separately and unjustifyingly established laws of energy and angular momentum conservations are indispensable for the determination of stable orbital paths. Direct minimization of work done over the closed path can determine the path which is likely to be inherently stable since its derivation was not tied to any initial conditions. By virtue of this, and the demonstrated essential untenability of the traditionally obeyed 'laws', it can be concluded that all natural orbital systems are essentially non-conservative, and that the quest for the non-accounted (outside) forces/effect should be directed towards revealing the hidden resources and structuring potential features of the very Aether substrate. The commonality of the two constituent central forces $-a/r^2$ and b/r^3 with the attracting and repulsive forces related to electric and magnetic phenomena respectively, suggests that by taking all the possible four combinations of the

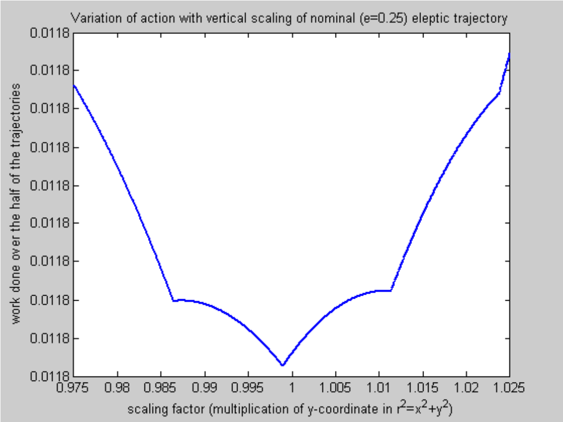

Figure 12. Evaluation of work done over the vertically scaled nominal Keplerian ellipse: the deep zoom-in in this drawing reveals peculiarity in using the polar coordinates in calculating the angle ψ based on (30).

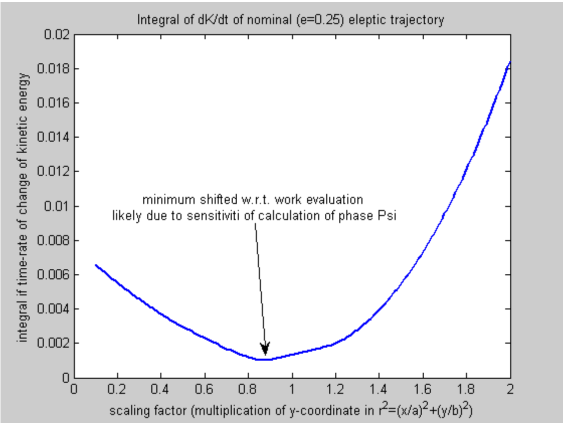

Figure 13. Evaluation of integral of rate of change of kinetic energy: minimum near the nominal ellipse.

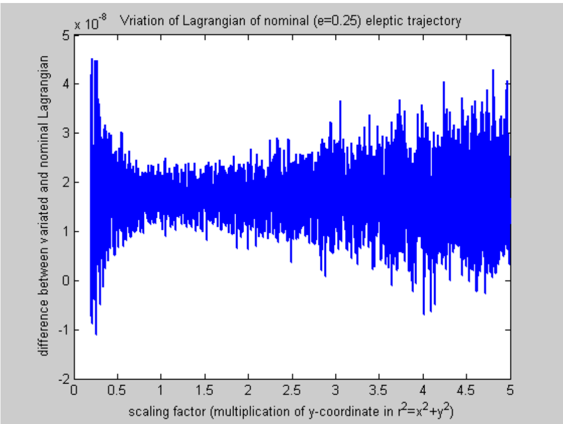

Figure 14. Indication of optimal path by calculation integral of the Lagrangian, L=K-E.

signs and appropriate constants delimitations of different nature forces ("the four forces of nature") shall be abandoned along the traditional efforts to their "unification", and all the systems - from chemical to biological ones be treated by relying on such two force/acceleration dependencies.

The way the TGO is formulated, along the critic of the shortcoming of the very Newton's law of gravity (Appendix I in [4]), besides established irrelevance of mass hinting to wrongly postulated so-called "Dark Matter", the actual (large) cosmological objects heat can be substituted for the missing "Dark Energy". The non-conservative nature of orbital systems put under big question-mark the very foundation of the modern Quantum Mechanics, related to explanation why electron does not fall into nucleus of an atom that emits energy. Since the basic electrostatic and magnetostatic laws have been formulated following the essentially circularly derived and largely miss-leading Newton's Gravity law, the very electromagnetism and electrodynamics would need certain extensions and modifications, as already to an astounding extent conducted in [5]. Numerous gravitational anomalies, geostationary satellites "dancing", Lunar paradox and in general three- and many-bodies'problems appear to be solvable by adopting the principle formulation of TGO and the implied reliance on the Aether. As an example, the so-called Pioneer 10/11 (reference 14 and Appendix III in [4]) anomaly is solvable by considering the heat generated by the nuclear reactor situated on the side turned towards the Solar barycenter actually de-balancing the purely gravitational equilibrium, in that the effect of the Ether push in-between the vehicle and the Solar system is reduced, thus the anomalous acceleration "towards the Sun" (having been) taking place. (The currently accepted solution is based on direct violation of the conservation of the linear momentum of the closed system, in that the heat is 'hitting' the co-located dish-antenna and pushes the vehicle in the 'anomalous' direction.)

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