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Deciphering forces of celestial mechanics

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A draft calculation of the balance of forces, which determine mean orbital distances of rocky planets in the spirit of Beeckman, Bullialdus, DesCartes and Newton leading to logical results. Short history of the topic has been discussed.

keywords: celestial mechanics, forces, solar vortex, Beeckman, Bullialdus, Descartes, Hooke, compounding the celestiall motions of the planetts of a direct motion by the tangent & an attractive motion towards the central body, Newton, inverse square law

There has been near-to-zero interest in astronomy in understanding the background of planetary orbits in the more than three hundred years, which have passed since Bernoulli told Newton that [the elliptic shape of orbits] cannot be explained by the inverse square law for gravitation (Pourciau, 1997).

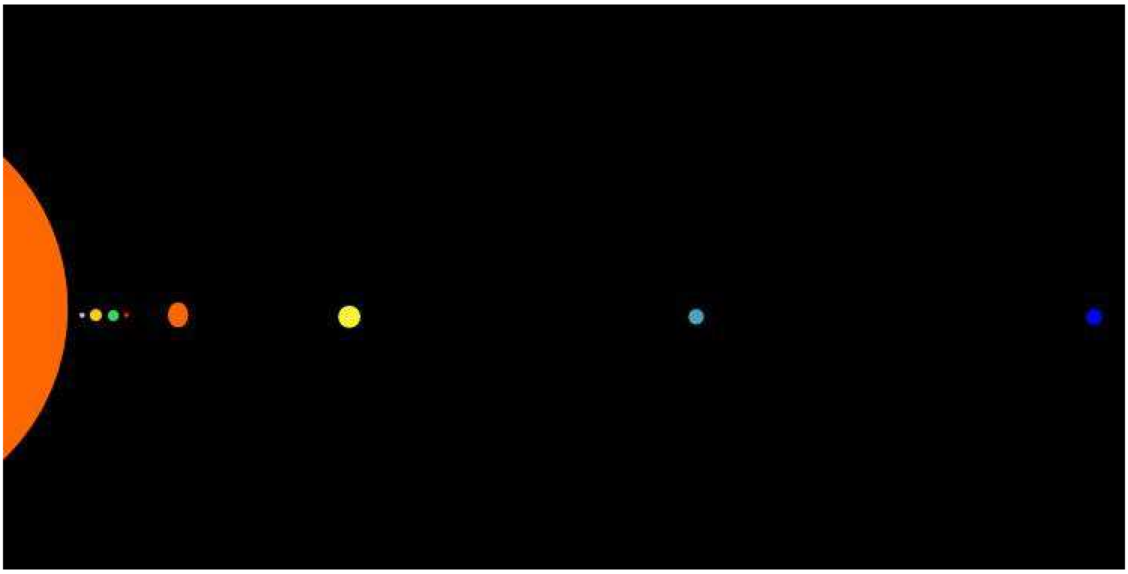

Fig.1 Solar system in approximate scale. *Credit: Liam Burnett and Duncan Lloyd*

The universal nature of Kepler's laws was so narcotic, that astronomers easily made long-standing errors in the following ways:

1. They assume that Newton's modification of Kepler's 3rd law is "universal" despite obtaining densities of primaries like 0.7,
2. They assume, that Newton's modification of Kepler's 3rd law works well also for the highly inclined orbits of secondary's,
3. They mix gravitational attraction with non-mainstream gravitomagnetic forces. The strange equation

$$mv^2/R = GmM/R^2$$

tells us, that there is a connection between the spin of the primary and orbital movement of the secondary. The big **G** from this equation does not pertain to attraction between two objects along straight lines,

4. They cannot explain origin of formula $F = G\frac{m_1 m_2}{r^2}$. The mainstream typically tries to derive this formula from orbital motion, not the attraction of the spheres*. The thoughts of dissidents I have come across were not much better(Unzicker, 2008; Wang, 2008; Khaidarov, 2004; Nikitin, 2015; Albers, 2015; Hassani, 2015A, 2015B; Richter, 2015; McDowell, 2009; Droescher and Hauser, 2011),

5. They use "Newton's formula" on any scale despite it being loosely proved and other factors tending to interfere with measurements (Unzicker, 2007).

Thinking logically, the inverse square law for gravitation could hardly be deduced from astronomical observations or from monitoring falling stones in the middle of the 17th century. The actual chain of reasoning perhaps can be restored in such an order:

a) The understanding of a central force, which diminishes according to a certain rule, comes from Gilbert's experiment with a magnetised needle and an iron piece,
b) The concept of the inverse square law for gravitation has been speculated by Bullialdus in 1645 using an analogy with the rule of diminishing of light by distance,
c) After Huygens's work „On Centrifugal Force" (1659) the inverse square law was usually deduced from combining Huygens's formula $\mathbf{a=v^2/r}$ for the centrifugal acceleration with the Kepler's third law. This „inverse square law" characterises only solar vortex geometry,
d) The calculations of Hooke around 1679 gave something like **[Big number]/$\mathbf{R^2 = v^2/R}$** which, according to Gal (2002), Newton knew about,
e) So it is clear why Newton newer used this "equation". Newton formally attached "gravity" to Kepler's laws. The words of Newton: "If I have seen further, it is by standing on ye shoulders of giants" (letter to Hooke in 1676) thus correctly characterise the situation at that time,
f) Then came mathematicians, who described orbits only as mathematical objects,
g) Einstein wanted to move out of this obscurity and made a theory, in which only the properties of the central body are important.

Recently I have proposed a "five-force" model for celestial mechanics (fig.2):

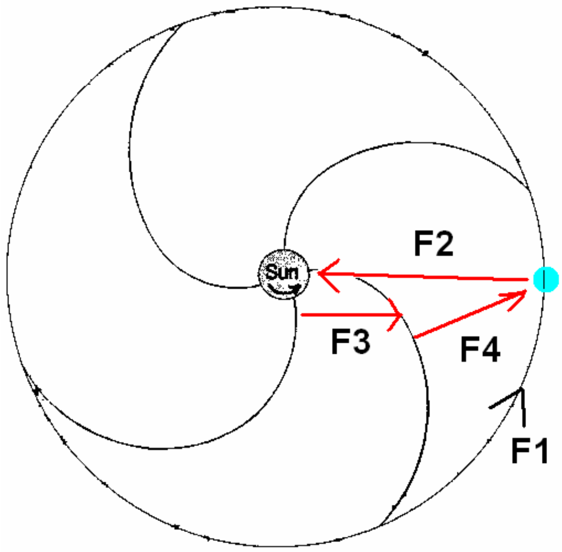

Fig.2 „Five-force" model of celestial mechanics. **F1**- gravitomagnetic force, **F2, F3**- effects from Unified field, **F4**- radial interaction from solar vortex. Forces, which are supposed to make solar system relatively flat, are not shown. Photonic pressure is ignored.

F1 is the force, which classics noticed first. Today we can call it non-mainstream gravitomagnetism or mass-dynamic forces.
F2 and **F3** are forces from Unified field (Mathis), **F3** being known as a „tidal force". It is hard to measure the mentioned forces in a lab experiment, because they are always present in interaction between two masses.
Thus, for short distances we cannot really investigate gravity alone, but also need to look at the Unified field. If we consider the hot Jupiter, circling in a highly inclined orbit around a parent star as a two- body problem (Fig.3),

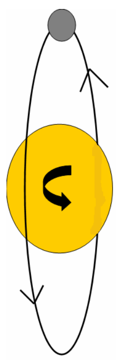

Fig.3 Hot Jupiter, circling in a highly inclined orbit around a parent star.

its orbital distance, in the spirit of Newton, can be described with equation

$$\mathbf{GMm/R^2 = BMm/R^3}$$

as a balance within Unified field. **B= GR**. If we put as R the typical orbital distance of hot Jupiter- $3x10^9$ m, and for **G** – the value from textbooks, we get **B**=0.2. This route leads to, so to speak, relatively big **G**, the correct value of which should be deduced from effects like solar control over the Öpik- Oort cloud. For this analysis we will use **G**=1, **B**= $3*10^9$ (in case of Jupiter and Uranus, value of **B -** $3*10^9$*/ **Mpl/Ms**, where **Mpl** and **Ms** – masses of the planet and the Sun, respectively).

On the other hand, for two body problems of small bodies a proportion

$$\mathbf{0.5S*0.5s/R^3 \sim const}$$

better fits in observation (Alksnis, 2015), where **0.5S** and **0.5s -** half of the surface area of the primary and the secondary, respectively, and **R** – the distance between bodies.
Finally, non-gravitational interaction between the Earth and satellite has been aproximated as

$\mathbf{G*D*M*m/R^3}$**,** where **D-** diameter of satellite.

Within our concept, tidal forces **F3** can push the planet only until some 0.05 AU from the Sun, and for obtaing a stable orbital distance, the imagined force of equatorial repulsion **F4** from solar vortex is necessary (which is applied to half of the surface area of the secondary).
If our reasoning is correct, there should exist a simple relationship between the angular momentum, as representantive of strenght of the central vortex, half of the surface area of the secondary, to which the vortex force is applied, and gravitation interaction between the two masses:

$$\mathbf{M*м \approx К*[AM]*0.5s}$$

$$\mathbf{К \approx M*м / [AM]*0.5s}$$

where **[AM]** - angular spin momentum of the primary, **0.5s-** half of the surface area of the secondary, **K** - coefficient.

Primary	**Mass, кg**	**Angular momentum**	**Secondary**	**Mass, кg**	**Half of surface area, м^2**	**К**
Sun	$1.99*10^{30}$	$1.92*10^{41*}$	Mercury	$3.30*10^{23}$	$3.74*10^{13}$	$9.1*10^{-2}$
Jupiter	$1.90*10^{27}$	$6.83*10^{38}$	Io	$8.93*10^{22}$	$2.10*10^{13}$	$2.3*10^{-2}$
Saturn	$5.69*10^{26}$	$1.36*10^{38}$	Mimas	$3.75*10^{19}$	$2.45*10^{11}$	$6.4*10^{-4}$
Uranus	$8.68*10^{25}$	$2.29*10^{36}$	Oberon	$3.01*10^{21}$	$3.64*10^{12}$	$3.1*10^{-2}$
Neptune	$1.02*10^{26}$	$2.69*10^{36}$	Proteus	$4.40*10^{19}$	$2.77*10^{11}$	$6.0*10^{-3}$

Table 1. Proportional calculation with main vortices of solar system.
*- value from data of helioseismology (Iorio, 2011).

We can indeed see, that such a simple relationship exists (table 1.) and that Saturn and Neptune are not really liquid planets (the action of their vortices is weaker than formal calculation shows. This may also explain the weak pseudomagnetism of Saturn - in comparison with that of Jupiter).

I have argued for some time that values of the „interplanetary magnetic field" can be used for understanding the radial effects of the solar vortex. Khabarova (2013) summarises the decline of interplanetary magnetic field as $\mathbf{3.8/R^{5/3}}$, where **R** is distance from the Sun (fig.4).

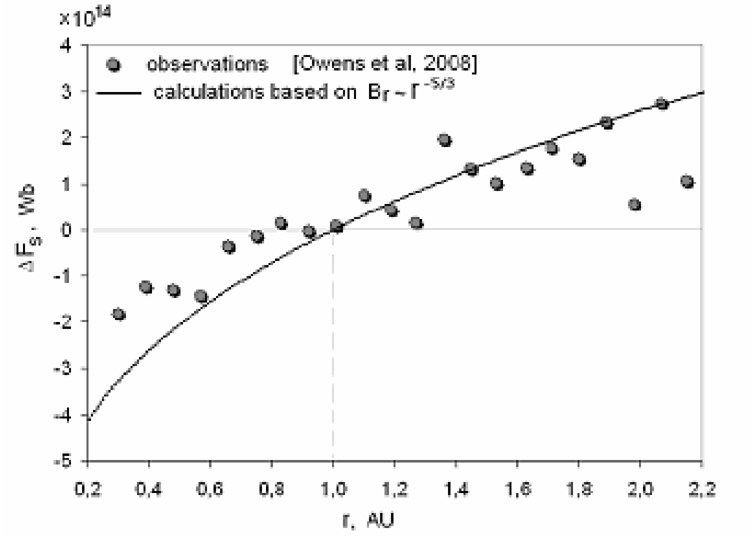

Fig.4. Observed changes in IMF with distance from the Sun.

So the challenge was to show that we can get a glimpse of the balance of forces, which are behind the orbits we see, without philosophy about nature of gravity and vortices. Within my model for mean orbital distance for low inclined orbits

$$\mathbf{F2 = F3 + F4}$$

Deciphering,

$$\mathbf{GMm/R^2 = BMm/R^3 + [AM]*K*0.5A*3.8/\ R^{5/3}}$$

where **K-** coefficient, which binds spin angular momentum with the radial pressure from vortex.

The question however remains how can we deal with the fact, that gravity is connected with mass **m** (cube of radius **r** of celestial body), while vortex repulsion - with area **A** (square of radius of celestial body).

$$\mathbf{m= 4/3*\pi*r^3*d}$$
$$\mathbf{0.5A= 2*\pi*r^2}$$

As we remember, in DesCartes' philosophy a planet finds its place in the vortex according to its volume and surface area. The concept of mass comes with Newton and is too complex in certain cases according to Mathis. So we need to use the radius of our first example- Mercury ($\mathbf{r_M}$)- as a proportionality coefficient when analysing the orbits of other planets. Omitting for our draft analysis the effect of densities,

$$\mathbf{m/\ 0.5A = 0.67*r_M}$$

$$\mathbf{GMm/R^2 = BMm/R^3 + [AM]*K*0.5A*3.8*0.67r/\ r_M*R^{5/3}}$$

We can calculate the value of **K** for an overall check of our reasoning (table 2).

Interaction between the Sun and	**F2**	**F3**	**F4**	**K**	**Semi-major axis, m**
Mercury	$1.96 * 10^{32}$	$5.88 * 10^{31}$	$1.94 * 10^{37} * K$	$7.1 *10^{-6}$	$5.79*10^{10}$
Venus	$8.39 * 10^{32}$	$2.34 * 10^{31}$	$1.05 * 10^{38} * K$	$5.8 *10^{-6}$	$1.07*10^{11}$
Earth- Moon system*	$5.56 * 10^{32}$	$1.13 * 10^{31}$	$9.98 * 10^{37} * K$	$5.4 *10^{-6}$	$1.47*10^{11}$
Mars	$2.46 * 10^{31}$	$3.23 * 10^{30}$	$5.31 * 10^{36} * K$	$4.0 *10^{-6}$	$2.28*10^{11}$
2 Pallas **	$2.45 * 10^{27}$	$1.8 * 10^{25}$	$8.46 * 10^{32} * K$	$2.9 *10^{-6}$	$4.14*10^{11}$
4 Vesta	$2.75 * 10^{27}$	$1.9 * 10^{25}$	$8.40 * 10^{32} * K$	$3.2 *10^{-6}$	$4.33*10^{11}$
10 Hygiea	$7.81 * 10^{26}$	$5.0 * 10^{24}$	$5.80 * 10^{32} * K$	$1.3 *10^{-6}$	$4.70*10^{11}$

Table 2. Speculative forces for two body problems.

*- for the Earth- Moon system the perihelion value is used, **- the value of **K** was influenced by the fact, that orbit of Pallas has inclination

Similar results have been obtained by calculation with moons of Jupiter and Uranus (table 3.)

Interaction between the Jupiter and	**Semi-mayor axis, m**	**Mass, кg**	**Half of surface area,м^2**	**F2**	**F3**	**F4**	**K**
Io	$4.21*10^{8}$	$8.93*10^{22}$	$2.1*10^{13}$	$9.5*10^{32}$	$6.3*10^{30}$	$2.62*10^{38}$ *K	$7.1*10^{-6}$
Ganimede	$1.07*10^{9}$	$1.48*10^{23}$	$4.35*10^{13}$	$2.46*10^{32}$	$6.56*10^{29}$	$9.41*10^{37}$ *K	$2.6*10^{-6}$
Interaction between the Uranus and							
Miranda	$1.29*10^{8}$	$6.59*10^{19}$	$3.5*10^{11}$	$3.44*10^{29}$	$3.5*10^{26}$	$4.35*10^{34}$ *K	$7.9*10^{-6}$
Oberon	$5.83*10^{8}$	$3.01*10^{21}$	$3.6*10^{12}$	$7.7*10^{29}$	$1.7*10^{26}$	$7.86*10^{34}$ *K	$9.8*10^{-6}$

Table 3. Speculative forces for two body problems.

Despite the significant differencies of masses of celestial bodies, the calculation shows, that we are able to understand the machinery of heavens. For fine tuning the concept, principles of aerodynamics should obviously be also applied. Investigations of the Allais effect also show that the pendulum reacts a half an hour before and half of hour after the real event of solar eclipse. This may mean that field effects are present.

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<u>Comment of Victor Blasjo Dec.1, 2012</u>
„Hooke's programme of "compounding the celestiall motions of the planetts of a direct motion by the tangent & an attractive motion towards the central body" (p. 2) "occasioned my findings" (p. 17) on planetary motion, Newton admitted. "It is difficult to overstate the novelty of Hooke's Programme." (p. ix) "For Kepler as well as Galileo, for Descartes himself, as well as for Grassendi and the Cartesians Mersenne and Huygens, for that venerable departed genious Horrox as well as for Newton's own favorite Borelli, the explication of the planetary motions had always included rotation [of the Sun-E.A.] as a primary cause." (p. 2; see pp. 24-29) The inverse square relation between gravity and distance, however, "was rather common" (p. 9).
Isn't it strange then that the eventual priority dispute focussed on the inverse square law? Gal's explanation is that "Newton seems to have had much more control over events," and chose this focus to utilise "his advantage over Hooke where geometrical demonstrations were concerned" (p. 18).
Hooke used the term "inflection" to describe the planet's deviation from inertial motion. This is the same term he had earlier used to describe the bending of light rays in the atmosphere: "This inflection (if I may so call it) I imagine to be nothing else, but a multiplicate refraction, caused by the unequal density of the constituent parts of the medium, whereby the motion ... of the Ray of light is hindered from proceeding in a streight line" (p. 35). Indeed, the thinning of the air at high altitudes is "clear enough evinc'd" from experiments "tryed at the tops and feet of Mountains" (p. 36), but there is "no Experiment yet known to prove a saltus, or skipping from one degree of rarity [of the atmosphere] to another much differing from it" (p. 34).

Hooke realised that planetary motion might be explained analogously, "if the aether be somewhat of the nature of air" (p. 37), Thus "if we suppose, that part of the medium, which is farthest from the center, or sun, to be more dense outward, than that which is more near, it will follow, that the direct motion will always be deflected inwards, by the easier yielding of the inward, and the greater resistance of the outward part of the medium." (pp. 36-37)

But Hooke immediately dismisses this theory owing to "improbabilities, that attend to this supposition, which being nothing to my present purpose I shall omit" (p. 37; presumably the moon's motion is one of the "improbabilities" in question). Therefore he discards the medium aspect of the theory, but nevertheless retains the forces suggested by it: his goal thus being only to "shew, that circular motion is compounded of an endeavour by a direct motion by the tangent, and of another endeavour tending to the center"' which he "endeavour[s] to explicate" experimentally with the aid of a "pendulous body" (p. 37), i.e. a conical pendulum.

When Hooke returned to the topic in 1674, his "quavering" tone is his tentative 1666 paper "is replaced by the brazen title 'a System of the World'" (p. 83). "This new self-confidence" stems from "a replacement for the pendulum in its technical as well as theoretical duties," namely the spring (p. 84). "The prospects of constructing 'power' as a viable theoretical device were therefore much brighter" (p. 84). Or so Gal claims, and takes this as a license to lunge into a long account of Hooke's work on springs. But apparently Hooke never made any explicit connection between his work on springs and celestial mechanics, so I lost interest at this point.

Hooke's first use of the inverse square law also occurred in the context of atmospheric investigations---in 1665, "much earlier than usually noted." The context is the idea that the pressure of the air is the weight of "a Cylinder [of air] indefinitely extended upwards": "I say

Cylinder, not a piece of a cone, because, as I may elsewhere shew in the Explication of Gravity, that triplicate proportion of the shels of a Sphere, to their respective diameters, I suppose to be removed by the decrease of the power of Gravity." (p. 169) In other words, while the base area of a cone with its vertex at the surface of the earth is as the height squared, gravity is as the inverse height squared, meaning that the weight is equivalent to that of a cylinder with constant gravity"

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