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Comprehensive law of motion of objects in planetary type systems

Abstract

The existing laws that describe planetary motion fail to predict and explain the presence of rotational plane inclination and the angle of inclination of this plane. These laws also fail to explain planetary rotation in one plane and how planetary motion in the direction of planetary system movement affects orbital parameters. It has been found that planetary motion in the direction of planetary system motion under the effect of the star's attraction gravitational component occurs as cyclic oscillations (motion with cyclically changing speed). A planet's cyclic oscillations form the visible declination observed in the system of coordinates of the planetary system, the rotational plane inclination and the inclination angle. The results obtained demonstrate the new understanding of the mechanisms that form the orbits of planets, and show the decisive role in this process of the star's attraction gravitational component, which acts in the direction of planetary system motion. The results are new and are the complete law of motion of objects within planetary type systems.

Content

1. Introduction

The laws of planetary motion discovered by J. Kepler [1, 2] and developed by I. Newton [3] today (being classical ones) are the same as they were during I. Newton's time.

During this time, improvements were made only to the methods and techniques of solving equations expressing I. Newton's laws.

By describing the visible motion of planets from an observer's position in the solar system of coordinates, these laws fail to explain the following:

- why do all planets revolve in one plane,
- why is the rotation plane inclined to the celestial equator plane,
- why is the inclination angle such as it is, and not otherwise, and
- several other parameters.

These laws fail to reflect and do not account for the role of planetary motion in the direction of planetary system movement in forming the parameters of planetary orbits.

Failing to reflect the hidden physical interactions that form the motion observed, and describing only the resulting motion from an observer's position in the Solar system of coordinates, J. Kepler's and I. Newton's laws cannot be considered comprehensive.

Of course, all the above physical parameters are the result of some hidden (implicit) physical interactions whose total effect determines the observed planetary motion and the state of planetary systems.

The subject of this study is to reveal these physical interactions and determine their role in forming planetary orbit parameters.

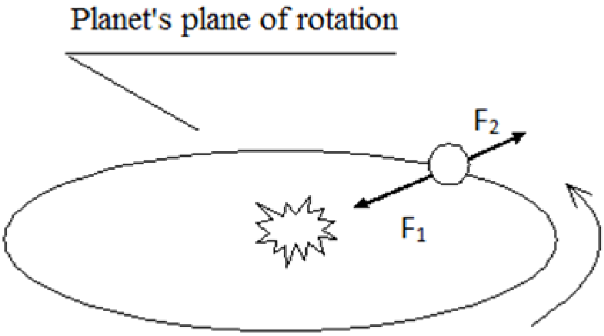


Fig. 1. Imaginary planetary system immobile in space, in which two forces act:
- force F_1 of the star's gravitation
- force F_2 – the centrifugal force balancing the action of force F_1

2. Imaginary experiment

The problem of planetary motion in the planetary system, which interacts according to I. Newton's law, with account of planetary system movement per se in the galactic gravitational field is a challenging one. Due to this, analysis of hidden mechanisms that form planetary motion has been conducted using an imaginary experiment with an idealized planetary system isolated from external gravitational action, which consists of a star and planet, Fig. 1.

If we suppose that a star has started travelling in a direction perpendicular to the plane of planet's rotation, then for the planet to follow the star in the given planetary system isolated from external gravitational action, a force is required whose action would coincide with the direction of star's motion. This force – the gravitational component F of star's gravity - will appear when the star will be displaced relative to the initial position of the planet's plane of rotation, Fig. 2.

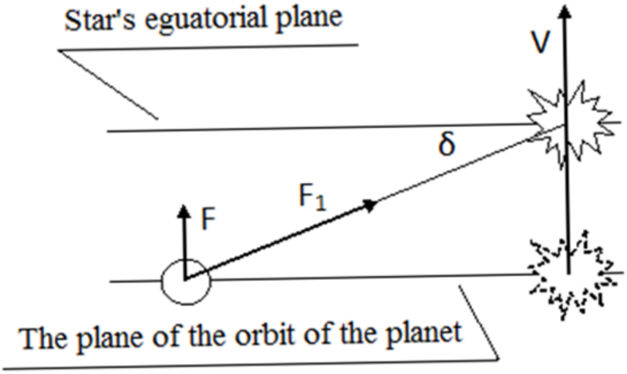


Fig. 2. A star's displacement relative to the planet's plane of rotation gives rise to the gravitational component F of the star's gravitation whose action coincides with the star's direction of motion.

The value of force F is

$$F_n = \gamma \frac{M_1 m_2}{r^2} Sin\delta_n ,$$

where

M_1 is star mass, m_2 is planet mass
F_1 is star's gravitational force

F is gravitational component of star's gravity acting in the direction of star's motion (in the direction of planetary system motion)

Under the effect of gravitational component F, the planet will acquire acceleration in the direction of action of the force (in the direction of the star's motion) and will overtake the star. After this, the action of gravitational component F will change to an opposite one and start decelerating the planet. Then this cycle will be repeated.

The planet's motion in the direction of movement of the planetary system (star) will be an oscillatory one.

The physical model of a planet's motion in the planetary system obtained with the imaginary experiment shows that the planet movement following the star (along the star orbit) occurs due to gravitational component F, acting in the direction of star movement. And this motion – following the star – can take place only as cyclic oscillations.

3. The analysis of the actual motion of the Earth in the direction of motion of the Solar system.

Fig. 3 shows the actual diagram of Earth's movement along the solar orbit. The reference scale is the solar path between two astronomical dates – the section between winter-summer solstice points and the section between the summer-winter solstice points. This diagram shows a superimposed path of the Earth during these time intervals.

The diagram shows that, in the direction of solar system movement, Earth travels over different distances during the same time intervals (moves with variable velocity). These velocity variations are cyclic and oscillatory. Earth periodically overtakes the Sun and periodically lags behind it.

On the interval from the winter to summer solstices, the average velocity of Earth's motion on Sun's orbit is 212.383 km/sec. At the summer-to-winter solstice section, the average Earth's velocity is 227.544 km/sec. (The results of all calculations in the paper are not final ones.)

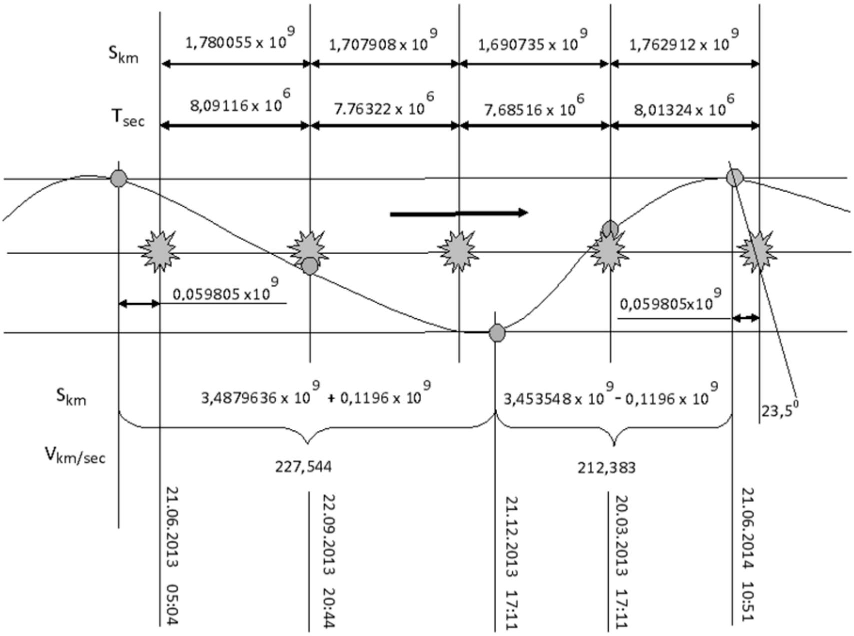


Fig. 3. Actual graph of Earth's motion in Sun's orbital direction Earth's motion against Sun's uniform motion occurs with a cyclically changing velocity. Earth periodically overtakes the Sun and lags behind it. Earth's motion is a cyclically changing oscillation in the direction of Sun's motion relative to the Sun.

4. General conclusion

Based on the results of the imaginary experiment and those obtained while considering the actual diagram of Earth's movement along the solar orbit, one can conclude that the physical model of planets' motion in the direction of motion of the planetary system obtained during the imaginary experiment has a general character and is universal.

The general motion of planets in the planetary system moving in space is oscillatory in two planes– in the plane of planet's rotation about the star (in the celestial equator plane) and in the plane of planetary system movement, Fig.4.

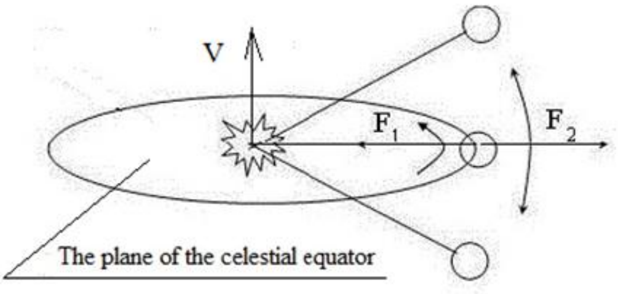


Fig. 4. A planet's motion in a planetary system moving in space is in the form of oscillations in two planes (similar to a pendulum)

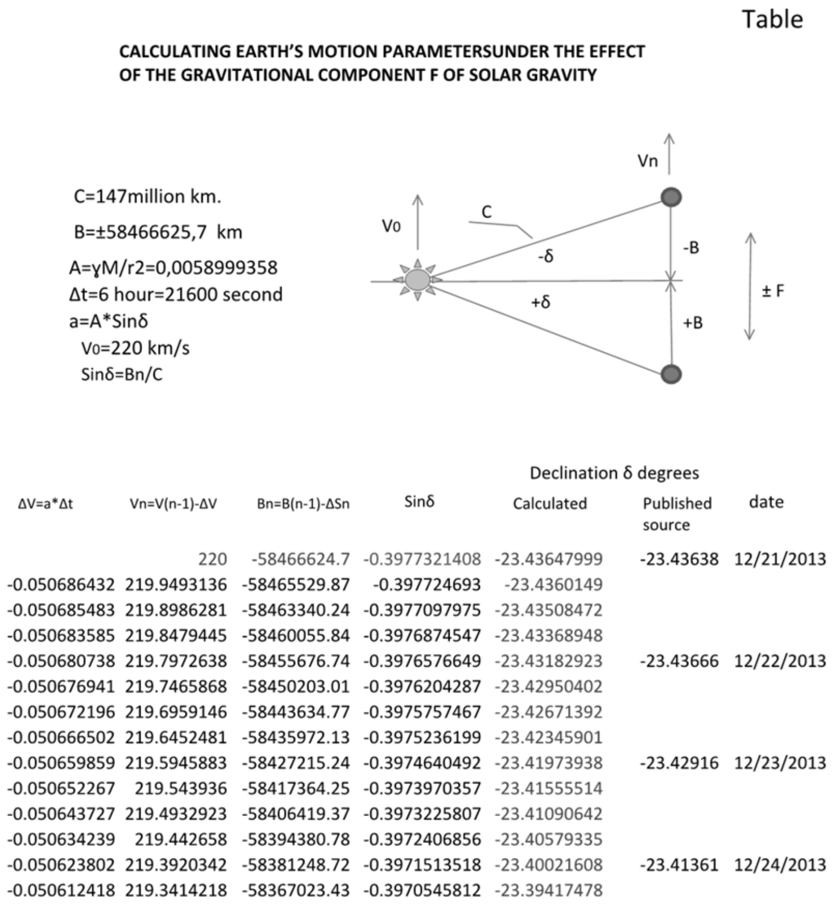
5. Hypothesis on the mechanism of formation of the declination angle (orbital inclination) and other parameters of planets' motion

The imaginary experiment allowed formulating a hypothesis, according to which the distance of a planet from a star in the aphelion and perihelion is formed by the oscillatory movement of the planet along the star's orbit, i.e. under the effect of gravitational component F acting along the line of planetary system movement. Angle δ, corresponding to each planet's position and formed by the planet's oscillatory movement in the direction of planetary system movement under the effect of gravitational component F is the observed declination angle.

The hypothesis has been validated by calculating Earth's movement in the direction of solar movement under the effect of gravitational component F only.

The influence of the planet's orbital movement and that of external interaction was not accounted for.

Fig. 5 shows a fragment of calculating Earth's cyclic motion under the effect of gravitational component F acting in the direction of planetary system motion. Calculation results give an idea on the velocity of Earth's motion in the direction of planetary system motion at each time point (V_n), its distance from celestial equator plane (B_n) and the declination angle at each time point (δ).



Table

CALCULATING EARTH'S MOTION PARAMETERSUNDER THE EFFECT OF THE GRAVITATIONAL COMPONENT F OF SOLAR GRAVITY

C=147million km.

B=±58466625,7 km

A=ɣM/r2=0,0058999358

Δt=6 hour=21600 second

a=A*Sinδ

V0=220 km/s

Sinδ=Bn/C

ΔV=a*Δt	Vn=V(n-1)-ΔV	Bn=B(n-1)-ΔSn	Sinδ	Declination δ degrees		
				Calculated	Published source	date
	220	-58466624.7	-0.3977321408	-23.43647999	-23.43638	12/21/2013
-0.050686432	219.9493136	-58465529.87	-0.397724693	-23.4360149		
-0.050685483	219.8986281	-58463340.24	-0.3977097975	-23.43508472		
-0.050683585	219.8479445	-58460055.84	-0.3976874547	-23.43368948		
-0.050680738	219.7972638	-58455676.74	-0.3976576649	-23.43182923	-23.43666	12/22/2013
-0.050676941	219.7465868	-58450203.01	-0.3976204287	-23.42950402		
-0.050672196	219.6959146	-58443634.77	-0.3975757467	-23.42671392		
-0.050666502	219.6452481	-58435972.13	-0.3975236199	-23.42345901		
-0.050659859	219.5945883	-58427215.24	-0.3974640492	-23.41973938	-23.42916	12/23/2013
-0.050652267	219.543936	-58417364.25	-0.3973970357	-23.41555514		
-0.050643727	219.4932923	-58406419.37	-0.3973225807	-23.41090642		
-0.050634239	219.442658	-58394380.78	-0.3972406856	-23.40579335		
-0.050623802	219.3920342	-58381248.72	-0.3971513518	-23.40021608	-23.41361	12/24/2013
-0.050612418	219.3414218	-58367023.43	-0.3970545812	-23.39417478		

Fig. 5. Fragment of calculating Earth's motion under the effect of gravitational component F of Sun's gravity. Earth's position is shown conventionally on one side of the Sun. The reference point is Earth's position in the winter solstice point on 21.12.2013. The right-hand column (before the dates) shows declination angle values from the literature (4) for comparison. The calculation has been performed in discrete 21600-sec steps, during which the motion parameters have been taken to be invariable.

The calculated values of the declination angle formed by Earth's oscillatory motion in the direction of Solar system motion and the dynamics of their change are practically close to a perfect match with the data in the literature (4), Fig. 6.

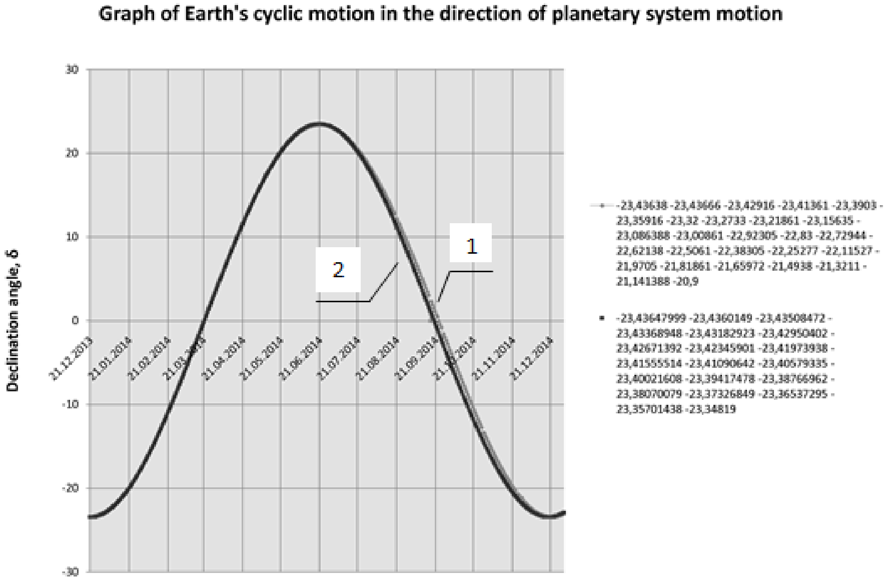


Fig. 6. The declination graph, formed by Earth's oscillatory motion under the effect of the Sun's gravitational component (line 1), and the declination graph by data from the literature (line 2).The maximum and minimal declination values correspond to the angle of inclination of Earth's plane of rotation.

Calculations have also shown that Earth's maximum velocity of motion on Sun's orbit is 231.71 km/sec in the autumnal equinox. The minimum Earth’s velocity along the solar orbit is 208.28 km/sec in the spring equinox point. In solstice points, Earth’s velocity is equal to that of the Sun – 220 km/sec., Fig.7.

The computational results confirm the hypotheses suggested, allowing accepting them as the laws of planetary (objects) motion in planetary type systems moving in space.

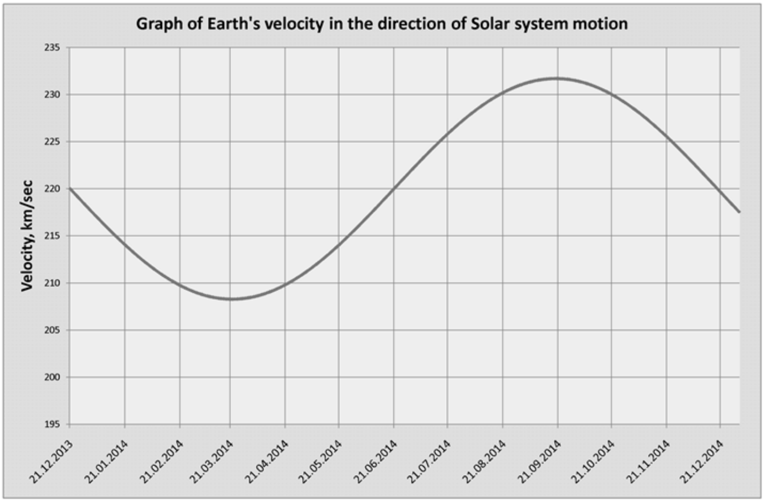


Fig. 7. Earth's minimum velocity in the direction of planetary system motion is 208.28 km/sec in the spring equinox position on 21 March. Earth's maximum velocity in the direction of planetary system motion is 231.71 km/sec in the autumnal equinox position on 21 October. In winter and summer solstice positions, Earth's velocity in the direction of planetary system motion is 220 km/sec (Sun's motion velocity).

6. Comprehensive law of motion of planets in planetary type systems moving in space

The motion of planets in planetary type systems moving in space occurs as oscillations in two planes:

- in the plane of rotation about the star (in the celestial equator plane),
- in the motion plane (in the direction of movement) of the planetary system.

Oscillations in the direction of planetary system movement take place under the effect of the gravitational component of star's gravitation occurring with relative displacement of the planet away from the celestial equator plane, and acting in the direction of planetary system movement.

Oscillatory motion of the planet in the direction of planetary system movement forms the observable declination and the character of its change.

The superposition of planet oscillations in two planes forms the following:

- observable inclination of the planet’s rotational plane with respect to the celestial equator in the planetary system coordinate system,
- observable orbit form, and
- planet velocity on each orbit section.

The angle of inclination of the planet’s rotational plane is determined by the amplitude of oscillations in the direction of planetary system movement.

References

1. J. Kepler. The New Astronomy, 1609
2. J. Kepler. The Harmony of the World, 1619
3. I. Newton. Mathematical Principles of Natural Philosophy, 1687
4. V.Krasnov, Comprehensive law of motion of objects in planetary type systems, “The Papers of Independent Authors”, ISSN 2225-6717, Lulu Inc., publ. "DNA", volume 37, 2016, ID 19203260, ISBN 978-1-365-32094-1.