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Some expected natural phenomena on the planets and satellites in exo -planetary systems

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Resume. On an example of the observably phenomena in solar system the hypothesis expresses, that the similar phenomena will be found out in the future on another celestial bodies in exoplanet systems. These phenomena have identical origins and are caused by the forced relative displacements and turns of the shells of celestial bodies.

Introduction. Since works of founders of the celestial mechanics till now in works on the celestial mechanics the direct gravitational interactions and tidal interactions of planets and satellites have been considered and studied. However, a gravitational influence of external celestial bodies on the given planet (satellite) causes not only additional tidal interaction of external celestial bodies, but also the forced interactions of shells of the given celestial body with each other (Barkin, 2002). Tidal influences are determined by tidal deformations of all layers of a celestial body. In simple interpretation they result in formation of two opposite tidal bulges definitely moving relatively to a planet after perturbing and deforming body. Masses of tidal bulges are small also additional perturbing forces also are small. However, on long intervals of time they determine evolution of orbital and rotary motion of systems of celestial bodies. The shells of celestial bodies if them (shells) to consider as individual interacting gravitating bodies test more significant mutual influences comparatively with tidal interactions. The character and intensity of interaction of shells are determined by their non-sphericity and by eccentric position of their centres of mass which for various planets and satellites can be significant. This mechanism is universal and is inherent to all celestial bodies (to planets, satellites, stars). It results in the forced interactions of shells of a body with each other. In turn these interactions result in their relative displacements and turns, lead to mutual deformations and changes of thermodynamic conditions, first of all in layers between active shells (the core, the mantle, oceanic shells and others). In other words speaking, this mechanism activates controls and directs the endogenous activity of a planet (Barkin, 2002). Really, the displacements of shells will cause variations of the tension states in all layers of planet. Variations of thermodynamic conditions and thermal modes will result to appropriate variations of all planetary natural processes and physical fields. Variations of currents in a liquid core will produce corresponding variations of a magnetic field. As the mechanism is uniform for all processes of the given planet their variations will be characterized by an uniform frequency basis and they will occur synchronously. Frequencies of variations of natural processes will be derivatives from frequencies of the perturbed orbital and rotary motions of planets and satellites (in particular multiple it). The main and primary planetary phenomena are relative oscillations and wanderings of the core relatively to the deformable and changeable mantle which first of all is reflected in identical motions of the centre of mass of a planet. Motions of the Earth centre of mass are quite accessible to the satellite observations. It gives a reliable source of the information about trend of the core and its periodic oscillations. The major property indicating action of the discussed mechanism, is planetary inversion of natural processes when in one hemisphere natural processes become more active, and in other (opposite) hemisphere their activity decreases. This property is precisely shown in seismic, volcanic, atmospheric, oceanic and climatic processes on the Earth, Mars, the Titan and other bodies of solar system. It is natural to assume, that the similar phenomena of cyclicity of processes, their inversion, a synchronism will be discovered on planets and satellites in other planetary systems. The discussed mechanism, its action and indications on the Earth, on other planets and satellites and on the Sun have already obtained numerous confirmations in studies of Solar system of last years. A wide set of the geodynamic

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phenomena (some are described below) have been actually predicted on the basis of developed geodynamical model of interaction of shells of celestial body. The purpose of the report - to show, that the given mechanism is universal and should actively is shown on planets and satellites in other s planetary systems. And the phenomena found out in solar system – dynamical consequences of the forced interactions of shells - in due course will be found out in others exoplanet systems.

1. Active polar regions on planets and satellites. Dynamic researches have shown, that relative displacements of the core and the mantle have mainly polar character. Oscillations of the core along an axis of rotation are characterized by the big amplitudes. This conclusion precisely proves to be true the satellite data on motion of the centre of mass of the Earth. Amplitudes of oscillations along a polar axis bigger in 3-4 times of amplitude of the appropriate oscillations in an equatorial plane. Polar displacements of the core, naturally, will result in stimulation of polar regions of planets (satellites). Thus, hyperactivity of natural processes in polar regions is direct consequence of action of the considered mechanism of excitation of shells by external celestial bodies. Polar hyperactivity is widely observed on bodies of solar system: Arctic and Antarctic regions on the Earth; zones of spreading in a southern hemisphere of the Earth; geysers on South Pole of Enceladus (Fig. 1); phenomenal active atmospheric zones of northern and southern poles on Venus, Jupiter, Saturn, Uranus and the Neptune.

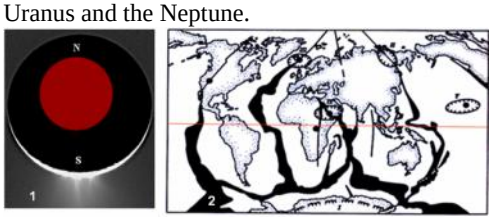

Fig. 1. (1) Asymmetrical activization of processes of decontamination on Enceladus and the Earth (2) in southern hemispheres.

These processes have a uniform nature and are caused by the directed deformation processes of the top shell (mantle, crust) at polar displacements of the bottom shell (the core) to the north. Similar structures will be observed in due course on exoplanets and their satellites. The uniform mechanism of all specified formations and processes is the mechanism of the forced relative swing of system of the core and mantle of a planet (and others shells) in the corresponding time scales (from the hour periods up to the geological periods).

2. Cyclicities of natural processes. Displacements of the core have cyclic character. It means that variations of the tension state of all layers of the mantle and, accordingly, variations of natural processes of a planet (satellite) also will be cyclic. The annual variation of natural processes is prevailing for the majority of planets, on its background variations of processes on exoplanets with the periods multiple to the period of orbital motion will be observed.

3. Pear-shaped forms of planets. On an example of the Earth, Mars and other bodies of solar system it was shown (Barkin, 2002), that pear-shaped form of planet is not initially given feature of its figure, and result of its long evolution as systems of interacting shells (crust, the core, the mantle). In present epoch a pear-shaped form of the Earth (and, apparently, Mars) varies in time that is connected to secular drift of the core in the direction of the North (Fig. 2 (1, 2)). In the future confirmations will be obtained, that many exoplanets have the strongly pronounced pear-shaped form which also changes - slowly varies in this or that side (for example as at the Earth). Told concerns both to rigid layers of planets, and to their atmospheres. Just as it is observed pear-shaped form of atmosphere of Titan (Fig. 2(3)) which can it is connected to present displacement of the bottom shell of the Titan to the north.

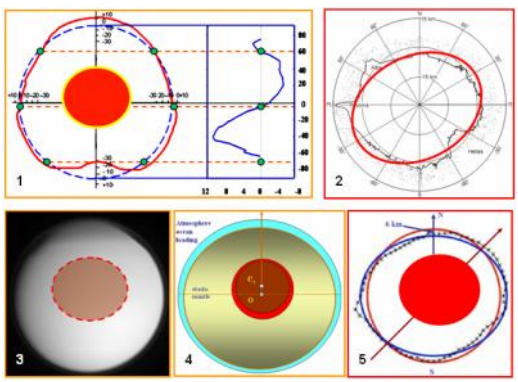

Fig. 2. (1) Pear-shaped form of geoid of the Earth and velocity of secular variations of lengths of latitudinal circles of the Earth (Barkin, Jin, 2007). (2) A global profile of Mars from MOLA crossing longitudes 52 ^{0}E

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and 247 ^{0} E. (3) Titan's atmosphere pure-shape (PIA09739). (4) Схема атмосферного инверсионного прилива при смещении ядра к северу (Barkin, 2002). (5) The Sun's oblateness magnified 10,000 times. The blue curve traces the sun's shape averaged over a three month period. The black asterisked curve traces a shorter 10-day average.

4. Displacement of the centres of mass relatively to the geometrical centres. A vivid example for the similar phenomenon is Mars. Its center of mass is displaced relatively to the centre of figure on 3.3 km in the direction of pole P (64 N, 81 E). The figure of Mars is exclusively deformed because of gravitational displacement of the core (with superfluous mass about 1/10 mass of a planet) on rather significant distance about 25 - 30 km on a direction in region of pole P. The specified displacement is so great, that probably will be shortly accessible to detection from direct seismic experiments on the Mars. Similar research arises for studying of eccentric positions of the core of the Earth and the core of the Moon. For the Earth the specified displacement of the core can make some kilometres, and for the Moon tens kilometres. A prospective secular drift of the core of Mars to the North results in secular variations of its form, rotation and various planetary processes.

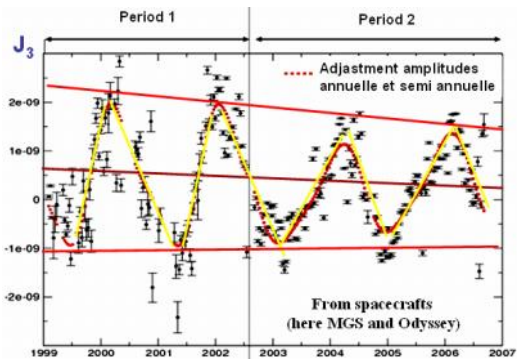

Fig. 3. Expected secular variation of the zonal coefficient J_3 of gravitational field of Mars: $\dot{J}_3 \approx -(2 \div 5) \cdot 10^{-11}$ 1/yr (Barkin, 2009).

5. The phenomena of inversion of activity of natural processes in opposite hemispheres. These phenomena are widely distributed on the Earth and on other bodies of solar system and prove in various time scales. It is natural, that they will be observed on exoplanets in other planetary systems. They are the direct consequences of action of geodynamical mechanism of forced excitation of shells. For example the mirror and step variations of mean atmospheric pressure in northern and southern hemispheres of the Earth is observed (on Burlutskii, 2007). It is observed also the step variations of masses of ice of caps of Mars. On our model step and secular changes of natural processes are connected to nonlinear character of relative displacement of the core and the mantle of the appropriate planet.
Diagrams of Fig. 2, Fig. 3 testify for the benefit of that displacement of the core of Mars take place actually both in geodynamics of Mars and in its natural processes it is necessary to expect the phenomena similar on as a matter of fact terrestrial.

6. Rotation of atmospheres of planets and satellites. Contrast rotation of atmospheres in northern and southern hemispheres. The specified phenomena should be observed on exoplanets with atmospheres. They are rather precisely observed on Venus, the Earth, Mars and other bodies of solar system. The contrast behaviour of an atmosphere in northern and southern hemisphere of planet (satellite) in the certain degree is directed and controlled by the mechanism of cyclic displacements of shells of the specified celestial bodies.

7. Step-by-step variations of natural processes on exoplanets. The data about motion of the centre of mass of the Earth specify existence of steps in its position which we connect to similar jumps in position of the centre of mass of the Earth core that is caused by non - trivial character of interaction of the core and mantle on their border. For the Earth in present period a gallop of the core can reach tens centimetres (for example, for the gallop, occurred in 1997-1998 years). All planetary geodynamical and geophysical processes have tested on itself an action of the core in the form of step and big changes of activity in mentioned years.

Conclusion. Fulfilled studies of natural processes on the Solar system bodies testify to universality of the mechanism of excitation of system of shells of a planet (satellite) by external celestial bodies. Action of this mechanism should be shown and observed on planets and satellites in others planetary systems. The work partially was financially supported by RFBR grants N 08-02-00367, N-09-02-92113-JF.