

SYMMETRIES IN CELESTIAL MECHANICS AND MODERN ASTRONAUTICS

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Nature is a pattern of beauty, perfection, harmony for Mankind. This is seen in numerous Symmetries of natural phenomena, in particular. Space is one of the evidences of this showing beauty of world, surprising men by harmony of its bodies and their motions. Men admired by perfect shapes of the Sun, Moon, by the stability and synchronism of the celestial bodies motions. They tried to understand laws which controlled these motions and the world. Every discovery at this way belongs to the greatest achievements of the Human Mind. These were for example, discoveries by N. Kopernikus - of the Solar System structure, by J. Kepler - of the planets motion laws along the ideal elliptical orbits with the Sun in a focus, by I. Newton - who not only discovered the fundamental world gravity law, but also understand and clearly formulated the material world motion main elements: absolute symmetric time and space, inertia and influence of the matter, the bodies motion main laws. Subsequent development of science gave a lot of new discoveries which deepened our understanding the world, approached us to the knowledge of the creation process for not only the Solar System but also all the world. It was found in particular that modern science can exactly enough calculate the bodies motion, as it

is seen in space navigation, for example. On the other hand, it was found out that, although the real motions are very complicated indeed, nevertheless very simple Keplerian model of the celestial bodies motion is often very good approximation for them. It is widely used in Astronautics. It was also elucidated (by P.S. Laplace, J.L. Lagrange, S.D. Poisson et al.) that the motion of many celestial bodies, planets in particular, are very stable. It was ascertained the property of the resonance, co ordination of many natural motions which helps to preserve these motions as stable. Periodic orbits in the three bodies problem, the Lagrange libration points for example, are very interesting. They are important for the modern Astronautics.

But some disturbances in initial harmony, symmetries are being found out sometimes. After thinking, these dissymmetries often turn out into other symmetries or chaos or directed motion. In connection with initial structures, they form more exact and deep picture of the world. Nevertheless, these events were often met with big trouble - and not only by the scientists. One can remember the tail comets which came from somewhere far, often suddenly, neared to the Earth and were expected by many men with a fear as God's wrath sign, carriers of ills for the Earth. This relation to the comets proved true essentially in a picture of a recent (1994) catastrophic collision of the comet P/Shoemaker Levy 9 with the Jupiter. Another page in the world knowledge that has direct connection with a subject of our paper is well known Titius Bode law (1766). This law has reflected well enough a regularity in the average radii of the most big planets orbits. Unfortunately, instead of a big planet

which had to orbit between Mars and Jupiter according to this law, a set of small planets (asteroids) was discovered there, they composed a group of the Main Belt of the asteroids. During the Solar System formation, there were not probably suitable conditions for blending bodies in a big planet. The set of small celestial bodies remained in this part of space, at the transfer from inner planets to out ones. These bodies probably preserved initial matter of the Solar System without great changes. This also concerns to the bodies from a remote beyond-Neptunian region of the Solar System (the Kuiper belt, the Hills belt, the Oort cloud, for example). It is the second special case of the Titius-Bode law, too. After some chaotic perturbations, these bodies can move toward the Sun as comets. It was found in the three bodies problem that one of the main causes of this is a close fly-by of a body near another one or their impact (now this is widely used in Astronautics as a gravity assist). That's why, the missions to the asteroids and comets are very important for modern science to get an information of the Solar System formation.

The asteroids and their orbits can also have complicated evolutions, sometimes chaotic. Now some other groups of the asteroids are discovered. In particular, a group of the asteroids crossing the Earth orbit is found recently. These asteroids can have collisions with the Earth like the comets. Traces of the space collisions are seen on the Moon and some planets and their satellites. They are found on the Earth, too. The modern science gave a scientific base for the old instinctive fear of people to these roaming bodies as the comets. It is found that

the impacts of the large asteroids and comets could really cause some catastrophes in the Earth history. These collisions are more dangerous for the modern Earth civilization. That's why, now the science and techniques, Astronautics especially, understood a new very important problem: to protect the Earth from the possible collisions with the dangerous space objects. Of course, the problem is very difficult. Nevertheless, analysis is showing that modern Mankind, its Astronautics as well as other sciences and techniques can do the space protection system for the Earth and therefore mitigate the space hazard for our civilization essentially.