Development of the analytical theory of the rotational motion of the Moon and the study of its internal dynamics

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The work is aimed at creating a new analytical theory of the physical librations of the Moon, which satisfies modern requirements for the accuracy of determining the orientation and rotation of the Moon. The proposed study is original and relies on the traditions of the Moscow school of celestial mechanics. In its richness and versatility, the theory is new. It has already made it possible to discover and explain a number of mechanical and geometric phenomena in the rotation of the Moon (the constant displacement of the pole of the axis of rotation of the Moon, a phenomenon called the splitting of the Cassini node, etc.). In the theory of the rotation of the Moon with an ellipsoidal liquid core (Mizusawa, Japan, 2012), together with Japanese colleagues, first-order perturbations were constructed for the components of the angular velocity of the Moon's rotation, and also for the duration of the lunar day. This was achieved due to the effective application of special forms of equations for the rotational motion of the Moon with a liquid nucleus in the Anduaye-Poincaré variables. However, these results were obtained in a purely trigonometric form, i.e. Without taking into account the terms of the proportional time coefficients and the square of the time. It seems natural and important to obtain perturbations of the components of the angular velocity and the duration of the moon's day of mixed type (proportional to the first and second degree of time). To obtain perturbations of a mixed type in variables describing the motion of the angular velocity vector in the body of the Moon. In the developed analytic theory, perturbations are constructed for a wider list of variables and the dynamic and kinematic characteristics of the rotation of the moon. The theory in particular assumes the construction of forced and free librations for the projections of the angular velocity vector of the Moon rotation onto its main axes of inertia, for the modulus of this velocity and for a specially introduced characteristic, the duration of the moon's day (LOD of the Moon) (Barkin, Hanada et al., 2012). All the problems and methods for solving them are new and put for the first time, and their solution should shed additional light on the inner structure of the moon. As a result of solving the problems posed in the project, the analytical theory of PLL (physical libration of the Moon) will become even more perfect, suitable and convenient for practical applications when carrying out domestic and foreign space missions to the Moon.

Keywords: Moon, libration, Anduaye variables

