Physical libration and geophysics of the Moon: achievements, problems and prospects

A. Gusev, N. Petrova

Kazan State University, Russia (Alexander.Gusev@ksu.ru / +7-843-2645604)

The realization of the modern long-time programs of comprehensive investigation of the Moon in the framework of the space "Clementine" - mission, Lunar Prospector (NASA), Lunar-A, SELENE, ILOM (Japan) are aimed at obtaining of broad information about lunar gravity field, precision position in the inertial coordinate system, geometrical and dynamical figure and lunar interior. The theory of the physical libration of the Moon plays an imported role in these investigations. The models of the two- and three-layer Moon gives several normal rotational modes: Chandler Wobble (CW), Inner Core Wobble (ICW), Free Core Nutation (FCN), Free Inner Core Nutation (FICN), which can play an important role in determination of core's parameters. Modeling was carried out with the purpose to detect a dependence of the free libration's periods on various parameters characterizing the lunar core. Case I: A Moon's model composed of a rigid mantle and a liquid core of various density: from eutectic composition Fe-FeS to pure iron core. The constraining on radius of a core at the various densities was tested on the basis of mass relation of a core to whole Moon. Case II: As in Case I, only for the completely liquid iron core with the density $7gm/cm^3$, including dissipation in the core-mantle boundary. The dissipation's coefficient R corresponds to the viscose damping at the core-mantle boundary, an effect of the electromagnetic coupling is neglected. Case III: Rigid mantle, fluid outer core (FOC) and solid inner core (SIC). Density of the FOC was taken $5.3gm/cm^3$ (eutectic composition 25 wt % S and 75 wt % Fe) and density of the SIC - $7.7gm/cm^3$ (solid iron).The modeling was performed with the purpose to detect a correlation of all four periods with the thick of the FOC. The FCN period lies in range of 144 - 186 years. The FICN has a very long period: 516 - 634 years for various core's radius. The FICN has a very long period: 516 - 634 years for various core's radius. The PICW is 101 - 108 years. In a case of free rotation of the three-layer Moon the four modes in its polar motion might be observed.