Available online at www.sciencedirect.com
ScienceDirect
Advances in Space Research 42 (2008) 289–293
ADVANCES IN SPACE RESEARCH (a COSPAR publication)
www.elsevier.com/locate/asr

Project "The Moon – 2012+": Spin-orbital evolution, geophysics and selenodesy of the Moon

Alexander Gusev, Natalia Petrova *

Kazan State University, 18, Kremljevskaja Street, Kazan 420008, Russia

Received 5 December 2006; received in revised form 8 June 2007; accepted 12 June 2007

Abstract

The Russian scientific project "The Moon – 2012+" is directed at solving fundamental problems of celestial mechanics, selenodesy and geophysics of the Moon through the pursuance of theoretical research and computer simulations of the following fields.

1. *Spin-orbital longtime evolution and physical librations of the multilayered Moon*: (a) development of the analytical theory of rotation of the two- /three-layer Moon and construction of the physical libration's tables for processing accurate observations and for constructing a lunar annual book; and (b) analysis of the spin-orbital evolution of the early Moon, an estimation of internal energy dissipation, and modeling of the long-term mechanism maintaining the free librations of the Moon.

2. *Geodynamics of a lunar core*: analysis of differentiation of a lunar core, detailed elaboration of plume-tectonics of mantle and a core of the early Moon, evolution of a boundary layer of a core–mantle boundary, reconstruction of the gravitational and viscous–mechanical interactions of a lunar core and mantle, research on resonant dissipation of internal energy, and calculation of free and forced nutations of a lunar core and of free fluctuations of a core–mantle system.

3. *Selenodesy of lunar far-side*: solution of an inverse problem in lunar gravimetry, construction of a geodynamic model of the lunar crust and of a Moho's boundary, reconstruction of initial mascons on the far-side of the Moon, and creation of accurate topographical and gravitational models of the Moon on the basis of modern observations.

Keywords: Lunar physical libration; Lunar core; Resonances in lunar dynamics

1. Introduction

The modeling of external and internal processes, acting on the rotation of a multilayer Moon, development of the theory of physical libration of the viscoelastic Moon with two or three layers used to obtain the observed effects on rotational modes of the two-phase core, and geophysical interpretation of gravitation and topography anomalies at the lunar far-side form the important aims in the study of dynamics and interiors of the Solar system's bodies and of the Moon, in particular (Konrad and Spohn, 1997; Kuskov and Kronrad, 2001; Stegman et al., 2003). These aims should be addressed in light of observations made during the forthcoming space missions.

One more objective to be considered under the project's scope is the evaluation of the role of the resonance in the dynamic history of the Earth–Moon system. The orbital resonance acts on lunar rotation and on the resonant increase of dissipation in a lunar core and mantle due to the solar–earth tidal interaction (Peale, 1999).

2. Lunar interior stratigraphy

A unique situation has now been formed: the accuracy and amount of radio-and-laser ranging longtime observations, data from Clementine (Zuber et al., 1994) and Lunar Prospector (Konopliv et al., 1998, 2001) missions has come

* Corresponding author. Tel.: +7 8432 100 572.
E-mail address: Alexander.Gusev@ksu.ru (N. Petrova).

0273-1177/$34.00 © 2008 Published by Elsevier Ltd on behalf of COSPAR.
doi:10.1016/j.asr.2007.06.023