IAA Transactions, No. 8, "Celestial Mechanics", 2002

Selenodynamical parameters from analysis of LLR observations of 1970–2001

G. A. Krasinsky

Institute of Applied Astronomy, St.Petersburg, Russia

LLR observations of 1969–2001 are processsed to estimate a set of parameters of the Earth–Moon system. The dynamical model accounts for effects of elasticity of the lunar body, tidal dissipation in the Moon, and friction coupling between the lunar mantle and its fluid core. A Poincare's type model is developed to describe effects of the fluid core assumed to be a three–axis ellipsoid. Estimated selenodynamical parameters include Love numbers h_2, l_2, k_2, dissipation factor Q, undimensional moment of inertia, coefficients of the lunar gravitational potential of the orders 2 and 3, coupling parameter κ and three parameters describing the fluid core. Except these three parameters the obtained estimates seem to be reliable. So no evidences of direct effects of the fluid core is found. For the dissipation factor Q (defined by the relation $Q = 1/2\delta$ where δ is the tidal lag) the estimates vary in the range from $Q = 13$ to $Q = 18$ depending on solution. They are of the same order as the value $Q = 11.032 \pm 0.004$ obtained for the Earth, which means that the tidal dissipation in the Moon is close to that in the Earth (notwithstanding that there are no oceans on the Moon to contribute to the dissipation). Thus a widespread opinion that the largest contribution to the dissipation of energy in the Earth is due to the ocean tides becomes doubtful. Analysis of residuals reveals a sharp change of their time behavior after March 1998. This effect could not be modeled by other ways but including corrections to coordinates of the reflectors after this date as independent solve–for parameters. Because the corrections derived for all four observed reflectors appear to be rather close it is conjectured that near this date a jump of a few centimeters in the position of the lunar barycenter with respect to the lunar crust has occurred.