

About drift, oscillations and steps of the center of mass of the Moon

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We have previously predicted and studied a step (abrupt) shift of the center of mass of the Earth in 1997 - 1998 years relatively to the mantle (Zotov, Barkin, Lubushin, 2009). In accordance with the basic provisions of the geodynamic model of excitation of planets and satellites shells (Barkin, 2002) we expected and we expect similar displacements of the centers of mass for other bodies in the solar system (for Mercury, Moon, Sun, Titan, Mars, etc.). Moreover, according to our hypothesis these abrupt geodynamic phenomena for solar system bodies are synchronous (Barkin, 2000) and, in particular, it should appear in 1997-1998. On the Earth, the similar jumps in 1997-1998 were observed in almost all planetary processes (Barkin, 2009). In the case of the Moon similar jump of center of mass obtains a confirmation in the data of laser observations and accounts for a specified period of time 1997-1998.

The jump (step) in the center of mass of the Moon in 1997 on data of laser ranging of reflectors on the lunar surface. On the basis of current laser measurements of distances to reflectors mounted on the Moon the preliminary estimates of the parameters of drift, oscillations and jump of the center of mass of the Moon were obtained. Their dynamic interpretation on the base of a geodynamic model of forced relative oscillations of the shells of planets and satellites has been done (Barkin, 2002). In the paper of G.A. Krasinskii (2003) from the analysis of lunar laser range measurements (or rather their residual differences compared with the theoretical celestial-mechanical design values of ranges) an abrupt (step) changes (in 1997 - 1998) in the coordinates of reflectors on the very substantial distances of about 15 -25 cm in selenographic coordinate system of the epoch have been discovered. Since jumps of coordinates for all four observed reflectors were quite close, it is natural to assume that the jump occurred in the position of the center of mass of the Moon by about 25-35 cm relatively to the lunar crust (in direction toward the Earth). Extremely important here is the fact that the jumps occurred in 1997-1998, as it was predicted by the theory of the unified geodynamic synchronous rhythms in variations of the activity of natural processes on the bodies of the solar system (Barkin, 2000). For the mean values of displacements of reflectors the following values were obtained (in meters): -0.15 +/- 0.04 m (offset along x coordinate - from the Earth), 0.23 +/- 0.07 m (offset on y - east), - 0.23 +/- 0.07 m (offset along z - to the north). Thus in 1997, the center of mass of the Moon abruptly shifted to a geographical point on the lunar surface with coordinates 40.0o N, 32.1o W approximately on distance in 0.36 +/- 0.11 m. According to the Krasinskii work (2003) we have identified trends in the changes of distances to reflectors and their abrupt changes before 1997 and after 1998, with rates of about 0.036 ns / year (before the jump) and at a rate of 0.128 ns / year (after the jump). If we consider only the drift relatively to the axis x, then estimates the drift velocities decrease: 0.98 cm / year - until 1997 and 1.47 cm / year - since 1998. It is expected to perform a spectral analysis of the residual differences of distances in order to identify their cyclic variations (with lunar months periods and with multiple periods).

Keywords: center of mass of the Moon, jumps and trends of center of mass of the Moon, LLR data