High-precision modern ephemeris of the Moon EPM2023 of the IAA RAS

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The main tasks of the Laboratory of Ephemeris Astronomy of the IAA RAS (Institute of Applied Astronomy of the Russian Academy of Sciences) are as follows:
construction and support of high-precision theories of the movement of the Sun, Moon, planets, and their natural satellites; ephemeris support of observation programs (satellites, spacecraft, landers); maintenance and development of the relevant software.

In the process of implementing these programs, it is necessary to refine dynamic models and construct high-precision theories of solar system objects, clarify the parameters of these theories and astronomical constants from radio ranging, laser and optical observations of planets, the Moon, natural and artificial satellites of large planets.

In particular, this paper will focus on the problems of clarifying the parameters of the Moon's ephemeris EPM2023 and using this data to study our close satellite. Since 1969 till 2017 Lunar Laser Ranging observations were used to construct and improve the lunar ephemeris (within the ERA7 system, Laboratory of Ephemeris Astronomy of IAA RAS). This paper discusses the results of processing new lunar laser observations to obtain updated parameters of the lunar ephemeris EPM2023 which was created and maintained within the modernized ERA-8 system. The EPM2023 version of the Moon ephemeris still implements a model of the orbital-rotational motion of the Moon, close to that used in DE430 (NASA JPL). The Moon is considered as an elastic body with a rotating liquid core, and the rotation of the Moon around the center of mass in the celestial coordinate system is defined by three Euler angles. Together with the new geophysical and geodynamic parameters needed today, this model replaced the model of the orbital-rotational motion of the Moon existing in ERA-7. To obtain and refine parameters of the EPM2023 lunar ephemeris , the 32689 LLR observations (normal points, including 1250 new n.p.) were used. About 100 parameters of the new lunar ephemeris have been improved and some of them have been compared with the same parameters of the INPOP21a (France) and DE440 (USA) ephemerides. Currently, all the three ephemeris are of the same level of accuracy. For various new space projects related to the study of the Moon and surrounding space , it is necessary to maintain the accuracy of the parameters of the Moon's ephemeris based on the processing of Lunar laser ranging observations.

Key words: laser ranging of the Moon (LLR), ephemeris of the Moon EPM2023, model of the orbital-rotational motion of the Moon, new parameters of the Moon in EPM2023