MODELLING OF THE SOLAR SYSTEM EARLY STAGES EVOLUTION FOR DETERMINING CONDITIONS OF THE EARTH-MOON SYSTEM FORMATION.

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Introduction. The concept of the Earth-Moon formation from the common source [1] has described evolution of the Earth-Moon system after it was originated from a planetary sized gas-dust cloud. The current research is devoted to determining the conditions for the formation of such gas-dust cloud in the process of the early Solar system evolution. Computer simulation using particles is employed to model the early stages of the Solar system formation, where the gas-dust agglomerations played the key role in the preparation of the conditions for the planet genesis.

Main. In the previous work [1] we have shown that the Earth and the Moon could were formed by fragmentation of a common massive gas-dust cloud. The obtained model satisfies well the geochemical constraints that the hypothesis of "megaimpact" origin of the Moon failed to describe. Additionally the model has proved from the dynamical point of view the possibility of fragmentation of the gas-dust cloud in the process of the rotational collapse resulted in the formation of the Earth and Moon embryos. The current work is devoted to description of the early stages of the Solar system evolution, which can result in preparation of the conditions satisfactory for the mentioned above process of the Earth-Moon system formation. The computer modelling based on the particles dynamics is used to model the evolution of the circumsolar disk. The recent observations and mathematical modelling showed that the circumstellar disks have tendency to the formation of the ring systems, where each ring contains material for the emerging planet and its satellites. The presented work deals with one of these rings, which is modelled as a gas-dust system rotated around the Sun.

The dynamic particle model is used for the computations, where the gravitational attraction, the gas-phase repulsion and the energy dissipation are taken into account. The series of thousands computer experiments varying the system parameters and random initial settings are performed using massive multiprocessor computations. The system parameters are found that provide a uniform equilibrium state of the self-gravitating circumsolar ring. It is shown that depending on the initial geometry and density of the ring, the different scenarios of its development are possible, including clustering and not. However, the parameters change due volatiles evaporation and etc. after certain time should result in the localized clouds (clusters) formation. This is also stimulated by the permanent energy supply from the Sun and the internal energy losses in the system. In the series of computations the conditions for the formation of the single localized gas-dust cloud that attracts the most of the circumsolar ring material are obtained and verified. It is shown that a stiff interaction, inherent to rigid bodies' impacts, results in multiply cluster formation; whereas a soft interaction, associated with the gas-dust clouds interaction, results in a single cloud formation. Further long-time evolution of the cloud may be associated with additional factors: the loss of mass due to volatile evaporation for the particles that are close to the Sun and the acquisition of mass by the remote particles (gas capture). Counteracting factors: solar wind and the Poynting-Robertson drag can create a convection effect in the radial direction. The cloud is also growing due to accumulation of the distributed gas-dust material around its orbit. The final loose of the volatiles in the system leads to the phase of the rotational collapse of the cloud, resulting in the formation of the Earth-Moon system.

References:

[1] Galimov E. M. and Krivtsov A.M. (2012) *Origin of the Moon. New Concept. Geochemistry and Dynamics.* De Grueter, Berlin/Boston, 168 pp.