Analysis of spacecraft trajectories for the space mission Earth — Apophis — Earth and the spacecraft orbital motion around the asteroid Apophis

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It is of great current interest to organize a space mission to explore the "dangerous" asteroid Apophis in order to research its surface using a landing device and to conduct remote investigation with the instruments of this device using a satellite near Apophis. This paper defines and examines the trajectories for the spacecraft flight (with a special mini-device) to the asteroid Apophis, staying there for some time and coming back to the Earth. We have estimated economical trajectories for this mission provided that it would last for two years - from 2019 to 2022. We have analyzed the task of the spacecraft motion around the asteroid taking into account three types of perturbations: the gravitational effects of some distant celestial bodies (Sun, Earth, Moon, Venus and Jupiter), the non-spherical structure of Apophis and the solar radiation pressure (SRP). The article considers two possible types of spacecraft: the main spacecraft, which is expected to come back to the Earth after staying around Apophis for about a week or a month, and a special mini-satellite, with a long stay around the asteroid for clarifying the asteroid orbit.

Keywords: *space mission to asteroid Apophis, optimal trajectories, satellite orbital motion around asteroid Apophis, nonsphericity of the asteroid, solar radiation pressure, duration of spacecraft motion around Apophis*

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