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MISSION TO THE TRANS-NEPTUNIAN OBJECT SEDNA: A POSSIBLE NEXT STEP OF  
HUMANITY TOWARDS STARS**Abstract**

The presented research is devoted to the analysis of the flight trajectories to the trans-Neptunian object (TNO) (90377) Sedna for launch windows from 2029. Sedna has been an object of significant interest for study since its discovery in 2003. This large object may be the key component to expand the knowledge of the earliest stages of the Solar System evolution, including the protoplanetary disc and related mechanisms of its evolution. There are also other objects whose orbital parameters are close to those of Sedna. This may be the evidence of the existence of a large perturber in our planetary system, the so-called hypothesis of the Ninth Planet. Also, there has been plenty of other facts that advocate such a mission: for example, study of Sedna, since it will not come closer than 75 AU to the Sun, may serve as the next steps of humanity towards the stars and the interstellar flight.

We focus on two possible ways of reaching the object: a direct flight and a flight including gravity assist maneuvers. The gravity assist maneuvers considered in the research can reduce the required value of total  $\Delta V$  and flight duration. Gravity assist maneuvers near Venus and Earth, as well as near Jupiter, Saturn and Neptune are considered. It is shown that for launch windows in 2029-2034, the use of the Venus-Earth-Earth-Jupiter (-Neptune) gravity assists sequence allows one to significantly reduce the total  $\Delta V$  (down to 4 km/s), under restriction on the time of flight from up to 50 years (the options with TOF less than 20 years are considered as well). The flight schemes including the Earth-Earth-Jupiter gravity assists sequence and the Earth-Jupiter part, the same as in the New Horizons mission, also were checked. Also, an expansion of the mission scenarios to TNOs have been proposed by combining scientific missions to explore the outer planets with a flight to the trans-Neptunian region. Another option could be a simultaneous flight to two or more trans-Neptunian objects. Five TNOs have been discovered under such scenario, the flight to which is possible during a simultaneous flight to Sedna using schemes involving maneuvers near Jupiter and Neptune. In addition, the scenario of extending the mission to Sedna with the passage of the main belt asteroids is considered. It is worth noting that in this scenario, a flyby of large main-belt asteroids such as (16) Psyche, (20) Massalia and (152) Hilda is possible.