

49th STUDENT CONFERENCE (E2)
Student Conference - Part 2 (2)

Author: Mr. Vladislav Zubko
Space Research Institute (IKI), Russian Academy of Sciences (RAS), Russian Federation,
v.zubko@iki.rssi.ru

Mr. Andrey Belyaev
Bauman Moscow State Technical University, Russian Federation, a.belyaev@iki.rssi.ru

FLIGHT TRAJECTORIES DETERMINATION AND ANALYSIS TO THE TRANS-NEPTUNIAN
OBJECT 2012 VP113 IN 2026**Abstract**

Current research focuses on the flight trajectories determination and analysis to the trans-Neptunian object 2012 VP₁₁₃ discovered in 2012 by Scott Sheppard and Chadwick Trujillo. The object is classified as a sednoid, due to the similarity of the orbital parameters of the object and the minor planet candidate (90377) Sedna. The aphelion and perihelion of this sednoid's orbit exceed 440 and 80 AU, respectively. The object is of interest because of its possible belonging to the scattered disk, or the inner part of the Oort Cloud, and within the framework of the Ninth Planet's hypothesis.

This paper deals with the flight to object 2012 VP₁₁₃ using gravity assist manoeuvres near Earth, Venus, Jupiter and Neptune. We have chosen 2026 as the launch date because, as our research has shown, it does not make any practical sense to consider launch dates earlier. Launch dates later than 2026 are also not suitable because the object is practically 50 years moving away from perihelion, shifting the launch dates after 2026 will increase the total delta-v budget (ΔV) required for flight to the object.

The analysis shows that Venus-Earth-Earth-Jupiter gravity manoeuvres' scheme for the launch in 2026 achieves a minimum of ΔV only when the flight time is more than 35 years. However, Neptune flyby's inclusion into this scheme gives considerable advantage as in this case the minimal value of ΔV is reached at flyby time of 27 years and is about 4 km/s. The authors also analyzed the schemes of gravity assist manoeuvres implemented earlier in the Pioneer 10, 11 and New Horizons missions, namely, the gravity manoeuvre only at Jupiter. It is shown that the inclusion of the Neptune flyby, even, in this case, leads to a significant reduction in the required ΔV .

As a result of this work, it is shown that the lowest ΔV cost, among all considered, is provided by the Earth-Venus-Earth-Earth-Jupiter-Neptune-2012 VP₁₁₃ scheme when launched in 2026 for a flight time of more than 27 years.