



EXTENSION OF THE EARTH LIBRATION POINT MISSIONS BY TARGETING A SPACECRAFT TO NEAR-EARTH ASTEROIDS

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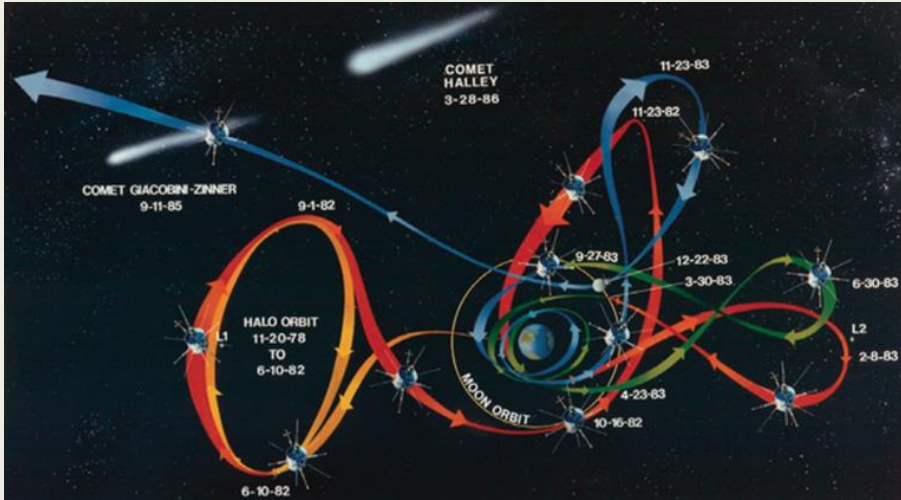
¹ Space Research Institute of Russian Academy of Sciences

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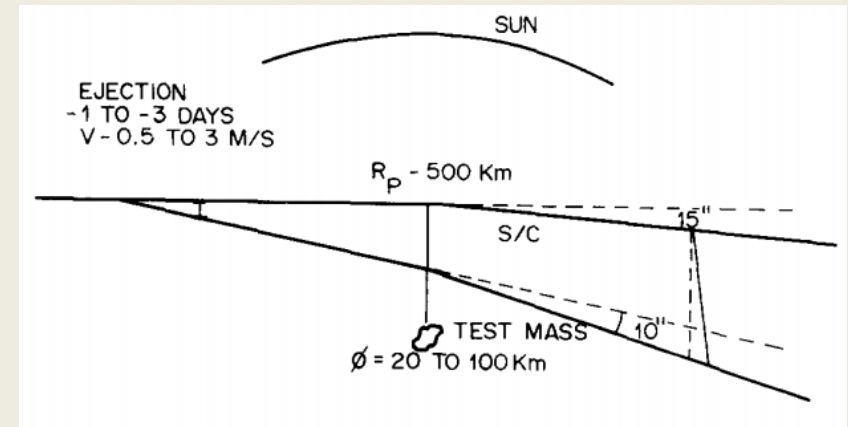
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ISEE-3/ICE Project¹



An Approach to Estimate the Mass of an Asteroid²



¹ David W. Dunham, Robert W. Farquhar et al. "The 2014 Earth return of the ISEE-3/ICE spacecraft." Acta Astronautica. Vol. 110, 2015, pp. 29-42.

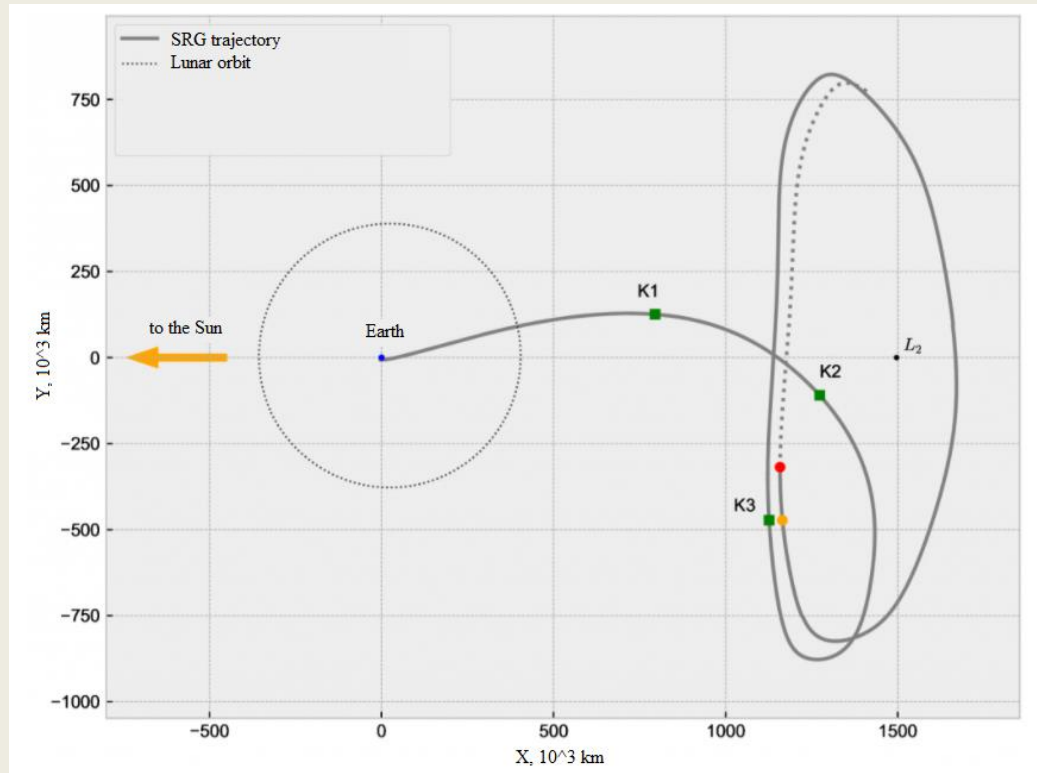
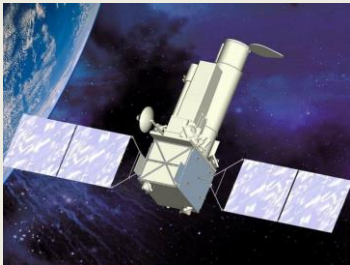
² A. Perret. "Mass Determination of a Small Body in Solar System by Using a Test-Mass During a Fly-By." Acta Astronautica. Vol. 12, No. 1, 1985, pp. 41-44.

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Spectrum-Roentgen-Gamma³

Launch: July 13, 2019
Wet mass: 2712.25 kg
Payload mass: 1210 kg
Exp. lifetime: 6.5 years

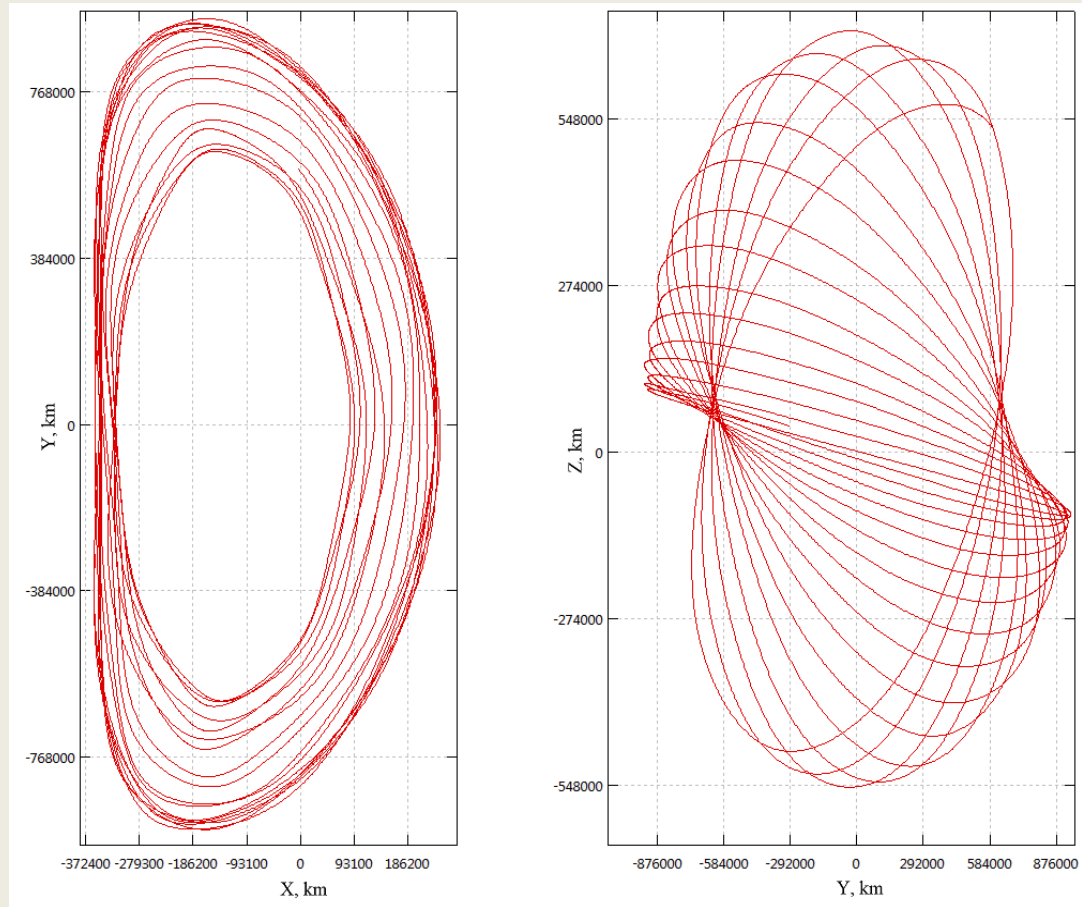


³Spectrum-Roentgen-Gamma, Astrophysical project.
URL: <http://srg.iki.rssi.ru/>

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SRG Trajectory Simulating⁴



⁴Aksenov S.A., Bober S.A. “Calculation and Study of Limited Orbits around the L2 Libration Point of the Sun–Earth System.” *Cosmic Research*, 2018, Vol. 56, Iss. 2, pp. 144–150.

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General Mission Analysis Tool⁵



General Mission Analysis Tool

GMAT
version
2018a

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- NASA GSFC
- Thinking Systems, Inc.
- Omitron, Inc.
- Emergent Space Technologies, Inc.
- a.i. solutions, Inc.
- AFRL
- The Schafer Corporation
- Computer Sciences Corporation
- Honeywell Technology Solutions
- The Boeing Company
- NASA JPL
- Korea Aerospace Research Institute
- Chonbuk National University
- Korea Advanced Institute of Science and Technology
- Yonsei University

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⁵ GMAT: General Mission Analysis Tool.
URL: <https://sourceforge.net/projects/gmat>

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Asteroids

(35396) 1997 XF11

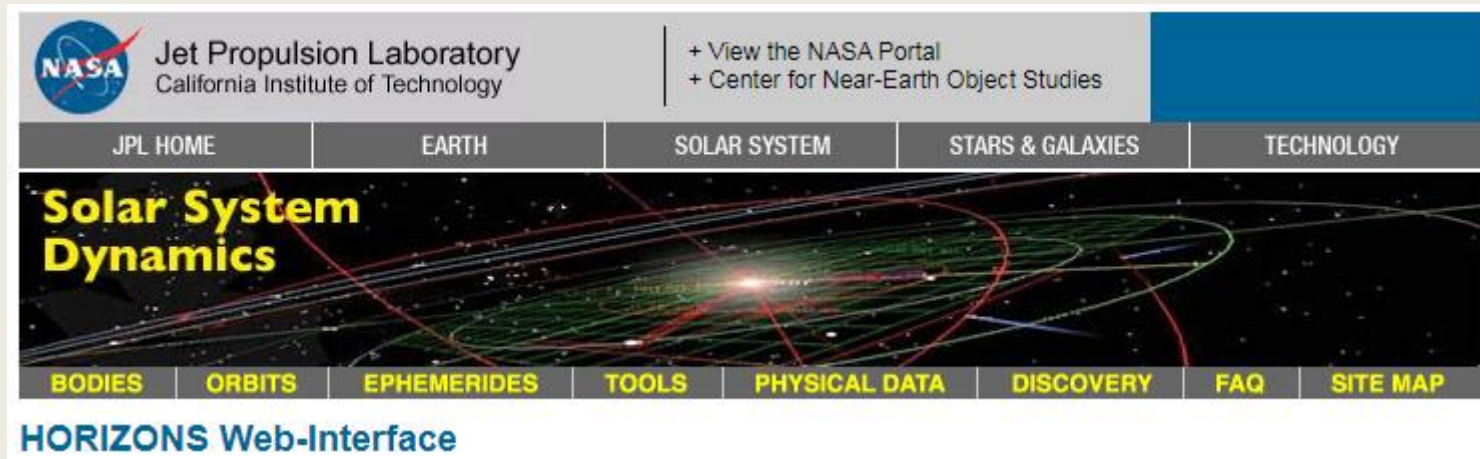
(99942) Apophis

Comets

289P/Blanpain

300P/Catalina

Ephemeris data – from NASA Horizons interface⁶

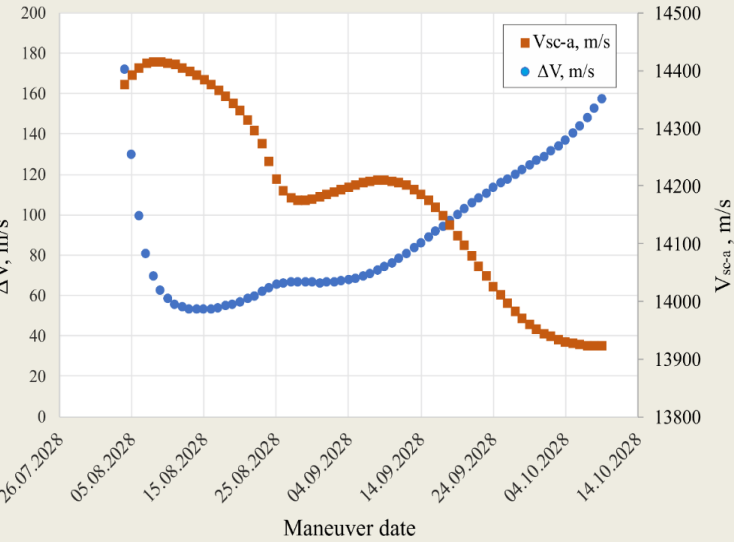


⁶ WebGeocalc: A Tool of the Navigation and Ancillary Information Facility.
URL: <https://ssd.jpl.nasa.gov/horizons.cgi>

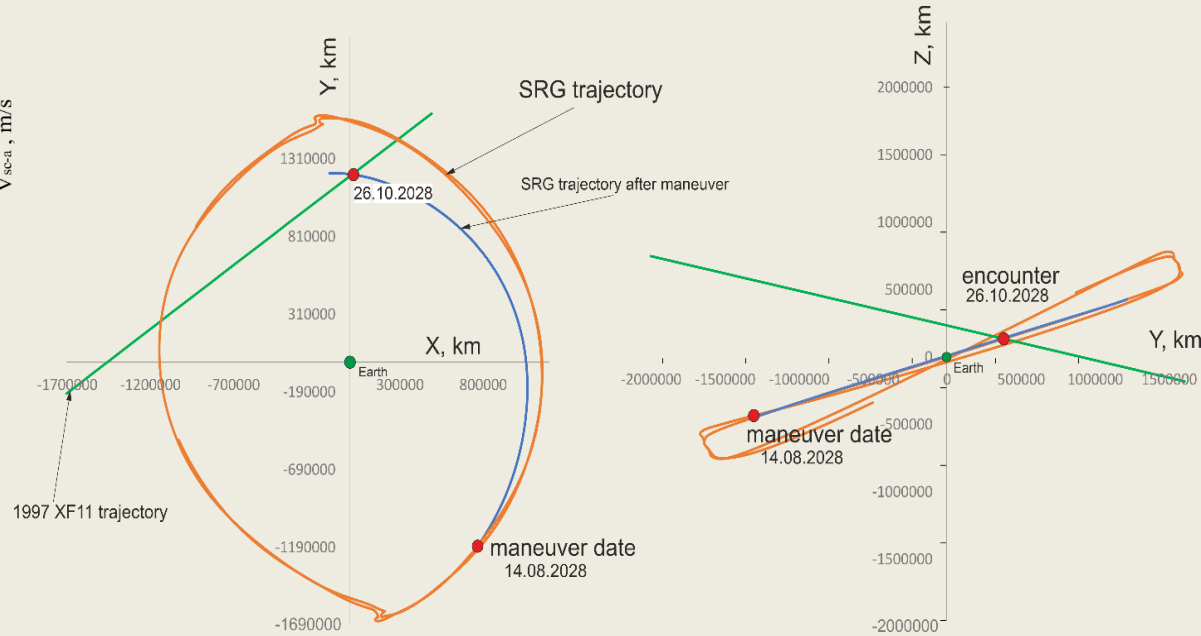
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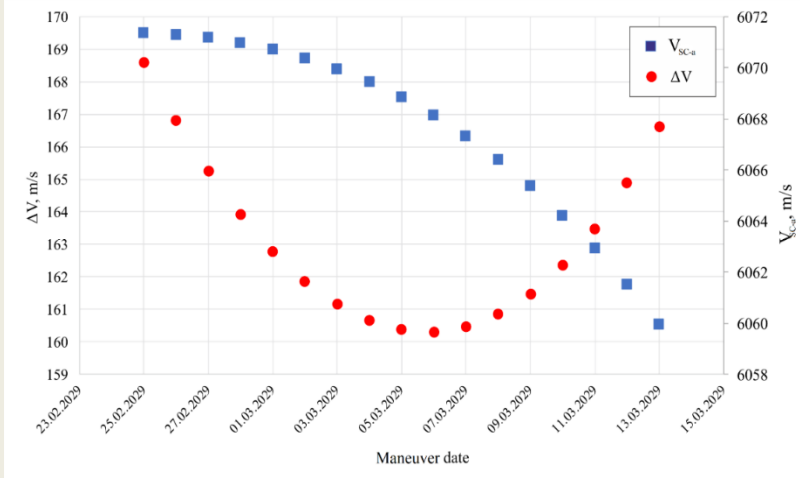
Asteroid (35396) 1997 XF11



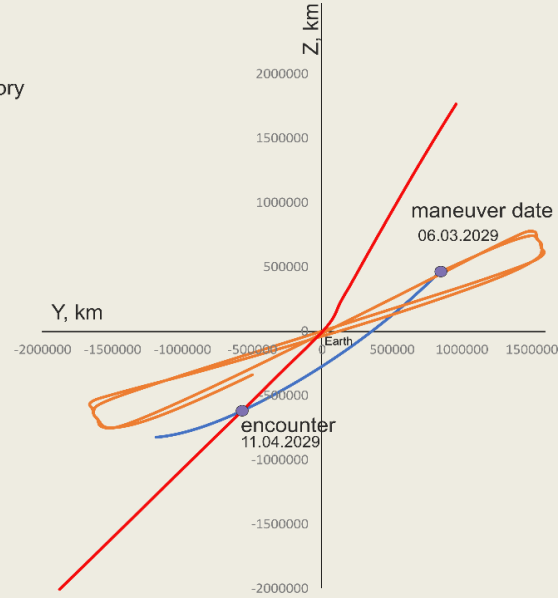
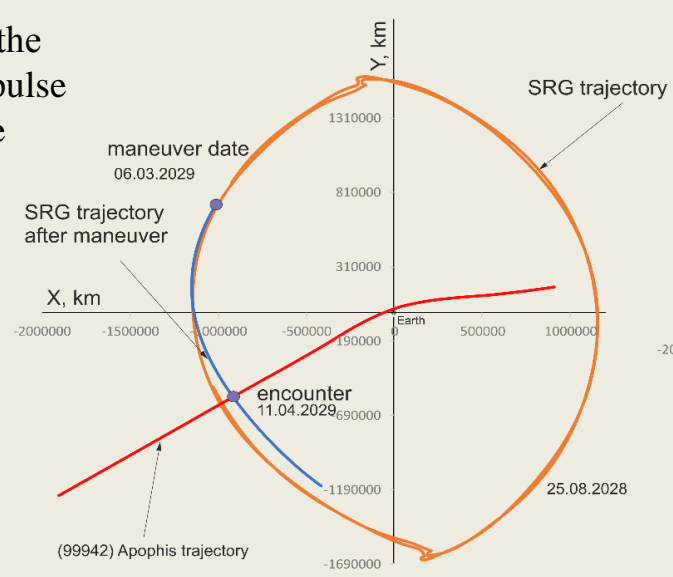
Dependence of the minimal ΔV required for the SRG transfer to the 1997 XF11 asteroid on the date of the impulse application (shown in red), and the relative velocity of the spacecraft (shown in blue)



Asteroid (99942) Apophis



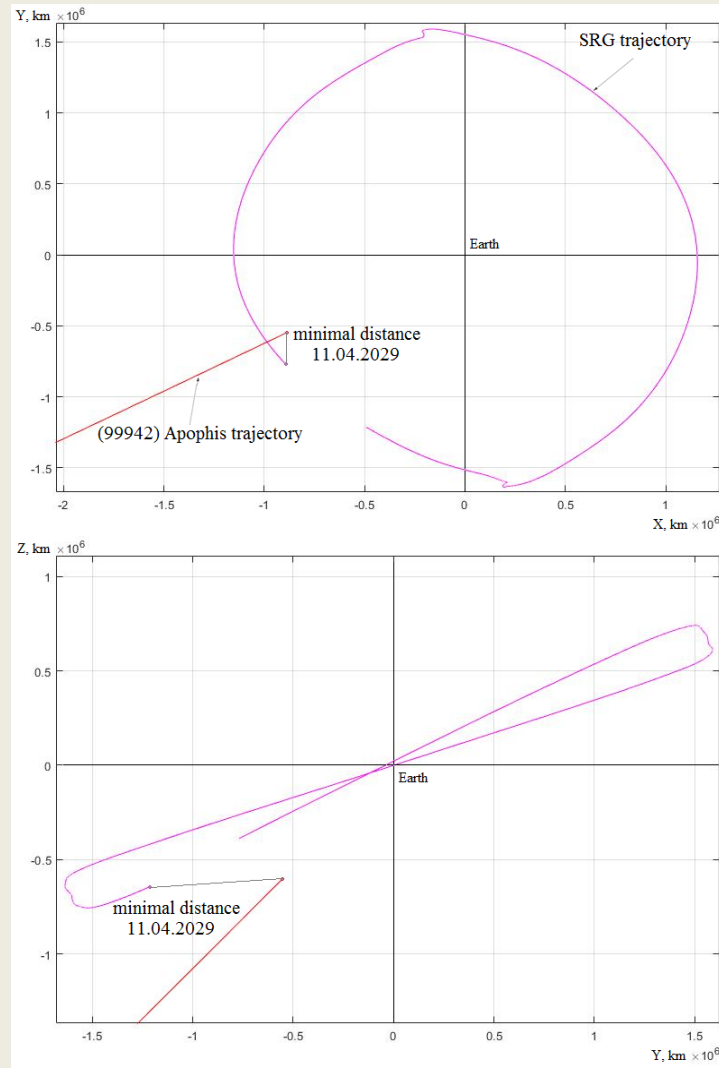
Dependence of the minimal ΔV required for the SRG transfer to Apophis on the date of the impulse application (shown in red), and the relative velocity of the spacecraft (shown in blue)



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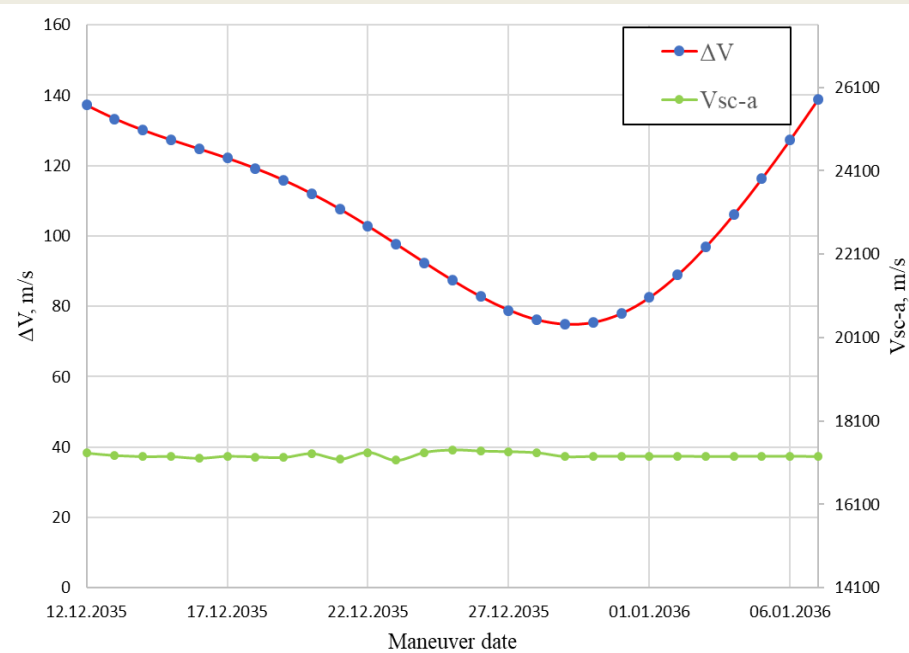
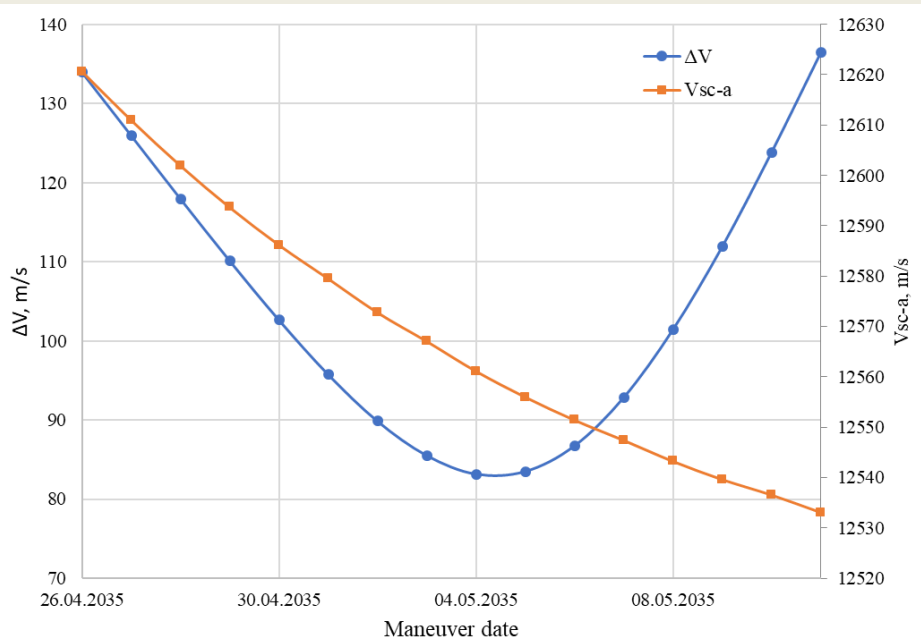
Observing Apophis from the SRG initial orbit



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Comets 289P/Blanpain and 300P/Catalina



Dependence of the minimal ΔV required for the SRG transfer to 289P/Blanpain on the date of the impulse application (shown in blue), and the relative velocity of the spacecraft (shown in orange)

Dependence of the minimal ΔV required for the SRG transfer to 300P/Catalina on the date of the impulse application (shown in red), and the relative velocity of the spacecraft (shown in green)

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Thank you for attention!

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