

## THE ASTEROID APOPHIS

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**Introduction:** Apophis asteroid, discovered on Christmas 2004 became famous back then because of the prediction of its great proximity to the Earth on 13th of April/2029 (to merely 32000 kms trough from the Earth), and because of the possible impact of this body with our planet by the year 2036 or 2068. Apophis has an effective diameter of 270 +/- 60 m [1], an axial ratio of ~2:1 [2], and NPA rotation  $P_{\varphi}=27.38\pm 0.07$  hours [3]. Although the big Arecibo radiotelescope unfortunately collapsed, and could not be used for radar observations, there were used “The Deep Space Network’s Goldstone complex” radiotelescope in California and “The Green Bank Telescope” in West Virginia. With a large amount of photometry and radar data captured in dates around the 5th of March of this year, it has been concluded that there’s not any likelihood that this asteroid collides; as Davide Farnocchia from NASA’s CNEOS states: “Our calculations don’t show any impact risk for at least the next 100 years. With the support of recent optical observations and additional radar observations, we can now remove Apophis from the risk list.” [4]

**Methodology:** I took part in the international research team “99942 Apophis 2021 Observing Campaign” [5] directed by Vishnu Reddy and in which Davide Farnocchia also took part. I captured several images and videos of the asteroid. My data was published by the Minor Planet Center (MPC) and also appears at the web page of NEODyS [6]. From our Observatory, located in Pasto-Colombia, I captured several pictures, videos and astrometry data during four days. The animation was published by SPACEWEATHER on the following date: March 07/2021 [7], and at the web of Observing Campaign [8]. The pictures of the asteroid were captured with the following equipment: CGE PRO 1400 CELESTRON (f/11 Schmidt-Cassegrain Telescope) and STL-1001 SBIG camera.

**Conclusions:** I calculated the orbital elements and physical parameters. I obtained the following orbital parameters: eccentricity = 0.191104 +/- 0.000104, orbital inclination = 3.3305 +/- 0.0017 deg, semi-major axis = 0.922604 +/- 3.4e-5 A.U, longitude of the ascending node = 204.0044 +/- 0.0043 deg, argument of perihelion = 126.6403 +/- 0.0042 deg, perihelion distance = 0.746291 +/- 0.000123 A.U, aphelion distance = 1.0989181 +/- 5.57e-5 A.U, mean motion = 1.1121947 +/- 6.15e-5 deg/d. Physical parameters: Absolute magnitude = 19.5, sidereal orbital period = 323.68 days, earth encounter velocity 5.5 km/s. The parameters were calculated based on 21 observations (March 07-April 06) with mean residual = 0.30 arcseconds.

### References:

- [1] Licandro et al. (2016) *Astronomy & Astrophysics* 585, A10.
- [2] Brozovic et al. (2018) *Icarus* 300, 115-128.
- [3] Pravec et al. (2014) *Icarus* 233, 48.
- [4] <https://www.jpl.nasa.gov/news/nasa-analysis-earth-is-safe-from-asteroid-apophis-for-100-plus-years>
- [5] <https://iawn.net/obscomp/Apophis/index.shtml>
- [6] <https://newton.spacedys.com/neodys/index.php?pc=2.1.2&o=H78&ab=10>
- [7] <https://spaceweather.com/archive.php?view=1&day=07&month=03&year=2021>
- [8] [https://iawn.net/obscomp/Apophis/apophis\\_gallery.shtml](https://iawn.net/obscomp/Apophis/apophis_gallery.shtml)