**PDC2023**
**Vienna, Austria**

**Ongoing and Upcoming Mission Highlights**

# Change in the mutual orbit of Dimorphos due to the DART impact

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***Keywords:*** *Maximum of five keywords separated by comma*

## ABSTRACT

On September 26, 2022 NASA's Double Asteroid Redirection Test (DART) mission impacted Dimorphos, the satellite of binary near-Earth asteroid 65803 Didymos, to test the kinetic-impactor approach to planetary defense (Rivkin et al, 2021). One of the primary goals of the mission was to measure the change in the mutual orbit of Dimorphos and estimate the momentum enhancement due to the momentum carried by the impact ejecta. We used ground-based photometric observations from 2003 to 2022, radar observations from 2022, and optical astrometry from the Didymos Reconnaissance and Asteroid Camera for Optical navigation (DRACO) to estimate the pre- and post-impact orbit of Dimorphos. We conducted radar observations with Goldstone and the Green Bank Telescope. DRACO images indicate that Dimorphos is an oblate spheroid with dimensions of about 177 X 174 x 116 m (Daly et al.) and that Didymos has a mean (volume-equivalent) diameter of about 761 m (Daly et al.). Prior to the impact, Dimorphos was in a nearly circular orbit with a semimajor axis of 1.2 km and a period of 11.92147 $\pm$ 0.00002 h (Naidu et al, 2022; Scheirich & Pravec, 2022). We estimate that the DART impact changed the orbital period of Dimorphos by -33 $\pm$ 1 minutes to 11.371 $\pm$ 0.003 h (Thomas et al.). The period change implies a reduction of the semimajor axis by about 40 m and a slight increase of the orbital eccentricity to about 0.03. We will incorporate additional ground-based photometric measurements made until March 2023 to refine the post-impact orbital elements of Dimorphos. The long data arc could reveal higher-order effects such as orbital precession caused by the orbital eccentricity and the non-spherical mass distribution of Didymos.

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***Comments:***

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