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The Decision to Act: Political, Legal, Social, and Economic Aspects

**Post-impact Mutual Orbit of the Didymos Binary System Derived from
Photometry**

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ABSTRACT

On September 26, 2022, NASA's Double Asteroid Redirection Test (DART) spacecraft impacted the satellite, called Dimorphos, of the binary near-Earth asteroid (65803) Didymos. The impact modified the Dimorphos' orbit, with the change of the orbit period of ~33 minutes (Thomas et al., submitted). Thorough ground-based photometric observations of the Didymos system are scheduled from the impact through March 2023. The observations have been carefully planned in order to detect the orbit period change, its eccentricity and apsidal precession rate, as well as possible libration-induced orbit period variations (Meyer et al., 2021, *Planetary Science Journal* 2, 242).

We will present results of our modeling of the data, using Keplerian mutual orbit with apsidal precession due to non-spherical shape of the primary. We will obtain an updated estimate of the post-impact orbit period and place constraints on its possible

libration-induced variations. We estimate that we will determine the post-impact orbit period with a 3-sigma uncertainty of ± 2 seconds from data obtained by March 31.

From the data obtained from the impact through November 2022, we obtained the eccentricity of the orbit of 0.028 ± 0.014 and got two solutions of the apsidal precession: 7.2 ± 1.5 and 21.5 ± 1.5 deg/day (all uncertainties are 3-sigma), with the former solution being preferred based on the quality of the fit and value of its mean anomaly at the time of the DART impact. We expect that data obtained by March 2023 will identify the true of the two solutions and further constrain the eccentricity.

For the modeling, we will use the binary asteroid lightcurve decomposition technique by Pravec et al., 2022 (Planetary Science Journal 3, 175) and the binary asteroid mutual orbit modeling method by Scheirich and Pravec, 2022 (Planetary Science Journal 3, 163).

Comments:

Oral presentation preferred, will be attending in person.

We note that two related abstracts are also being submitted:

Naidu et al.: Change in the mutual orbit of Dimorphos due to the DART impact

Moskovitz et al.: Lightcurve photometry of Didymos in support of NASA's DART mission