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Didymos in a context of the population of binary asteroids

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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. It was a successful test of the Kinetic Impactor technology for diverting dangerous asteroids from collision course with Earth. Photometric, radar and spectral observations taken from 2003 up to the day of the DART impact and the images taken with the DRACO camera onboard DART led to a description of the binary system at an unprecedented level (e.g., Pravec et al., 2022, Planetary Science Journal 3, 175; Scheirich and Pravec, 2022, Planetary Science Journal 3, 163; Naidu et al., 2022, Planetary Science Journal 3, 234; Daly et al., Nature, submitted; and references therein). In this contribution, we will present a comparison of the properties of the Didymos system (that it had before the DART impact) with a

number of other small binary asteroids studied with remote photometric and radar observations over the past 20+ years.

While Didymos appears to be a typical binary system in some of its parameters, it is close to being an “end member” of the binary asteroid population in some other properties. Among its parameters that appear typical for small binary asteroids, there are its secondary-to-primary mean diameter ratio of about 0.21, the S class taxonomy, the nearly spheroidal (oblate) shape of the primary with the equatorial axis ratio close to 1, the obliquity of its mutual orbit not far from 180 degrees, the (near-)zero eccentricity of its mutual orbit, and its total angular momentum close to critical. Among the other properties that make it a sort of “end member” of the binary asteroid population, there are its very fast primary rotation and short orbit period (both the primary spin period 2.26 h and the mutual orbit period 11.92 h are among the shortest ones observed in small binary asteroids), and the secondary’s shape close to an oblate spheroid.

We will compare the pre-impact properties of the Didymos system with the properties of about 200 near-Earth and small main-belt binary asteroids that were estimated from remote observations over the past 20+ years. We will also take into account observational biases that affected the observed distributions of some binary asteroid parameters and we will suggest how to characterize or eliminate the biases in further studies.

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