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Proximity Observations by the Didymos Reconnaissance and Asteroid Camera for OpNav (DRACO)

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ABSTRACT

The Didymos Reconnaissance and Asteroid Camera for OpNav (DRACO) is a narrow field of view imager on NASA's Double Asteroid Redirection Test (DART) spacecraft. DART is a planetary defense mission that will perform the first kinetic impactor demonstration by impacting the secondary asteroid in the binary 65803 Didymos system in October 2022. The primary and secondary are ~780 m and ~160 m in diameter, respectively, separated by ~1.2 km. The impact will produce a period change in the binary orbital period, characterization of which will be used to measure the momentum transfer enhancement parameter, or beta.

DRACO is designed to support optical navigation of the spacecraft and ensure impact with the secondary member of the Didymos system, to refine system properties (e.g., orbit, rotation rate, pole), to characterize the surface characteristics and shape of the Didymos secondary during the terminal phase, and to constrain the location of the impact site.

DRACO proximity observations begin approximately 30 days before impact, when a suite of long-range images is obtained over time to supplement Earth-based data. These data will be used to refine the orbit period of the secondary, provide constraints for modeling the shapes of both bodies, and search for additional material or a distant tertiary not observed from Earth. Beginning ~12 hours before impact, images will be acquired every second, alternating between unsaturated (for target characterization) and saturated (for autonomous navigation). The final image to contain both members of the system will be acquired ~4 minutes before impact, at a pixel scale of ~7 m. Approximately two minutes before impact, autonomous navigation will have ended, and unsaturated images will be acquired for the duration. The final image to contain any portion of the primary will occur about this time, and have a pixel scale of ~3.5 m. A pixel scale of 50 cm will be achieved for the secondary ~17 seconds before impact, while the body is still completely contained within the field of view. At this scale, surface features are sufficiently well resolved to provide key geological information about the secondary and the impact site, critical for estimating beta. Higher-resolution images will continue to be acquired and downlinked in the final seconds of the DART spacecraft operations, which end upon impact.

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