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Ongoing and Upcoming Mission Highlights

PRELIMINARY RESULTS FROM MODELING THE KINETIC IMPACT OF THE DART SPACECRAFT INTO DIMORPHOS

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ABSTRACT

The NASA Double Asteroid Redirection Test (DART) spacecraft successfully impacted Dimorphos on September 26, 2022. The mission was the first of its kind to test the kinetic impactor deflection method for planetary defense. Prior to launch, several case studies were performed across a number of hydrocodes that would be used in further mission simulations [1]. Prior to impact, the Investigation Team ran a number of simulations of plausible impact scenarios, including two inverse tests that simulated the type of data that would be available to modelers after impact [2,3].

Since the spacecraft impacted Dimorphos, the modeling efforts have shifted to include updated shape models of Dimorphos, surface features of Dimorphos determined by mission images, spacecraft mass and velocity, and the momentum enhancement and resulting period change. Here, we share preliminary 2D and 3D hydrocode models of the DART impact using a number of material compositions and configurations of Dimorphos using the hydrocode FLAG, which has been used to successfully model high-velocity impacts, including pre-impact simulations of the DART mission [2,3,4,5].

[1] Stickle *et al*. “Benchmarking impact hydrocodes in the strength regime: Implications for modeling deflection by kinetic impactor.” *Icarus* 338:113446 (2020).

[2] Stickle *et al*. “Effects of impact and target parameters on the results of a kinetic impactor: predictions for the Double Asteroid Redirection Test (DART) mission.” *The Planetary Science Journal* 3(11):248 (2022).

[3] Kumamoto *et al*. “Predicting asteroid material properties from a DART-like kinetic impact.” *The Planetary Science Journal* 3(10):237 (2022).

[4] Caldwell *et al*. “Verification and validation of the FLAG hydrocode for impact cratering simulations.” *Journal of Verification, Validation and Uncertainty Quantification* 3(3):031004 (2018).

[5] Caldwell *et al*. “Understanding Asteroid 16 Psyche’s composition through 3D impact crater modeling.” *Icarus* 351:113962 (2020).

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Comments:

(Prefer oral presentation)