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Session Choice:

Deflection / Disruption Modeling & Testing

Spacecraft Geometry Effects for the DART Mission

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ABSTRACT

On September 26, 2022, the first full scale test of the kinetic impactor planetary defense mitigation method was successfully tested. NASA's DART Mission demonstrated that the kinetic impactor technique for planetary defense is not only possible technologically, but also that there is an increased deflection efficiency due to the momentum enhancement from the ejecta resulting from the impact. This additional momentum from the ejecta transferred into the body is characterized by the value " β ". For the DART mission, the value of β was dynamically determined to be 2.2 – 4.9 using the observed change in orbital period of Dimorphos, the secondary in the (65803) Didymos system; variation in this value arises due to the choice of mass for Dimorphos, which will remain unknown until the ESA/HERA mission measures it in the late 2020's.

High-fidelity numerical impact models can also be used in combination with β to infer the material properties of the Dimorphos. Prior to the DART impact, many studies (see Stickle et al. 2022 for an overview) were conducted to predict what outcomes were plausible from the DART spacecraft's impact into Dimorphos, including a study on how the complex shape of the DART spacecraft would affect the impact (Owen et al. 2022). In those studies, we found that the simple sphere often used in impact simulations is not sufficient to capture the full 3D extent of the spacecraft but rather a series of 3 spheres better matches the results obtained using the full spacecraft geometry. However, the dependence on impactor shape demonstrates that to have a complete understanding of what occurred during the impact, simulations of the full spacecraft geometry are necessary. Here, we will present 3D simulations of the DART spacecraft impacting into a range of materials representative of Dimorphos. We will examine the differences in cratering observed for each of these impacts and

show how the role of the surface boulders observed by DRACO influence both the cratering and momentum enhancement.

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References

Stickle, Angela M., et al. "Effects of impact and target parameters on the results of a kinetic impactor: predictions for the Double Asteroid Redirection Test (DART) mission." 2022, *PsJ*, 3, 248.

Owen, J. M.; DeCoster, M.; Graninger, D.; Raducan, S. "Spacecraft Geometry Effects on Kinetic Impactor Missions", 2022, *PsJ*, 3, 218

Comments:

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