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POST DEFLECTION IMPACT RISK ANALYSIS OF THE DOUBLE ASTEROID REDIRECTION TEST (DART)

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ABSTRACT

Kinetic impact based asteroid orbit deflection constitutes one of the most mature impact hazard mitigation concepts. The Double Asteroid Redirection Test (DART) [1] could demonstrate the feasibility of this approach in practice by altering the mutual orbit of the moonlet of the binary asteroid (65803) Didymos through a kinetic impact. The momentum imparted during the collision between the DART spacecraft and Didymoon would also slightly affect the heliocentric orbit of the binary system. Since the Didymos system has several close approaches with the Earth over the next one hundred years, possible future encounter distances between Didymos and the Earth must be analyzed.

In this contribution we present an end-to-end post deflection impact risk assessment for DART. Based on the current mission design we simulate the DART impact on Didymoon and calculate the likely momentum enhancement due to ejecta (β-factor) using a state-of-the-art hypervelocity SPH impact code. Mapping uncertainties in the deflection momentum to corresponding changes in the heliocentric state we propagate the Didymos system to future encounters with the Earth [2]. An analysis of Didymos' closest encounters with our planet confirms that no planetary safety issues would arise in the foreseeable future if DART were flown.

References

[1] Cheng A. et al., 2016, Planetary and Space Science, 121, 27
[2] Chesley, S.R. & Eggl, S., 2018, Technical Report IOM392-18-003. JPL.
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