**PDC2017**
**Tokyo, Japan**

**IAA-PDC-17-04-06**

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# IMPACT SIMULATIONS IN SUPPORT OF THE DOUBLE ASTEROID REDIRECTION TEST (DART) AND THE ASTEROID IMPACT AND DEFLECTION ASSESSMENT (AIDA)

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***Keywords:*** *AIDA, DART, Kinetic Impact Deflection, Impact Modeling*

## ABSTRACT

The Double Asteroid Redirection Test (DART) is a NASA kinetic-impactor deflection mission concept currently in Phase-A study. The DART spacecraft will impact the moon of the binary system 65803 Didymos in October 2022 and induce a period change in the orbit of the moon (Didymos B, colloquially “Didymoon”) around the parent body Didymos A. When combined with the ESA-developed spacecraft, the Asteroid Impact Monitor (AIM, intended to provide system characterization with added *in situ* monitoring of the DART impact), DART + AIM make up the Asteroid Impact and Deflection Assessment (AIDA) mission.

There have been two planetary-scale impact experiments performed in the past: Deep Impact and LCROSS. Though providing important information about the impact process at a large scale, and verification opportunities for impact models, neither of these missions included a planetary defense demonstration. DART will be the first large-scale kinetic impact demonstration for planetary defense, and thus the

first opportunity to truly benchmark and validate simulations of kinetic impactors and their effects, which is a goal of the DART mission. Within the greater AIDA working group structure, our working group is tasked with modeling the DART impact and predicting the expected outcomes. The Impact Simulation working group includes impact experts from around the world and has 4 main goals:

1. Benchmark impact hydrocodes and determine the sensitivity to impact models and to impact conditions;
2. From the magnitude of the deflection, determine the momentum transfer efficiency and beta and its relation to the target properties;
3. From the impact event, investigate the ejecta mass and the predicted size of the resulting crater;
4. Support mission design studies.

Goals 1 and 4 include work ongoing prior to the mission, while goals 2 and 3 will be informed by pre-mission modeling but occur following the deflection experiment. We will discuss the results of our impact code benchmarking campaign, including how models compare with one another for specific cases where material strength is important, and examinations of methods to determine momentum transfer. We will also discuss specific results of modeling studies focused on determining the expected range of $\beta$ values (i.e., momentum transferred to the system's secondary by the DART spacecraft) for specific impact scenarios (e.g., target property variations such as porosity, strength, rubble pile v. solid targets) that are being studied by the working group. Initial modeling studies for solid targets indicate that we can expect values for $\beta$ between 1-5, though this is highly case dependent. Ongoing studies aim to identify specific impact scenarios that affect $\beta$ and quantify the magnitude.

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***Comments:***

*We would prefer an oral presentation slot, but will accept a poster if that is offered.*