MODELING KINETIC IMPACTORS FOR PLANETARY DEFENSE APPLICATIONS. W. K. Caldwell1 and C. S. Plesko2, 1Computational Physics Division, Los Alamos National Laboratory, Los Alamos, N.M., wkcaldwell@lanl.gov, 2Theoretical Design Division, Los Alamos National Laboratory, Los Alamos, N.M., plesko@lanl.gov.

Introduction: Planetary defense has been prevalent in popular culture, the subject of many memes, movies, and even stand-up comedy specials, but it is also a key component in planetary science. Once a science fiction fantasy, asteroid deflection is now a reality, given the success of the Double Asteroid Redirection Test (DART) mission, which impacted Dimorphos on Sept. 26, 2022, resulting in an orbital period change of 33 minutes [1].

Results: We began with scoping simulations in 2D axisymmetric and 2D Cartesian geometries. The 2D axisymmetric simulations provide good approximations to spherical impactors and round targets, while the 2D Cartesian simulations provide the best 2D approximations of rubble piles, as the axisymmetric geometry introduces artificial hoop stresses. In previous studies using FLAG, 2D Cartesian rubble piles matched their 3D counterparts well, indicating that this modeling approach can provide valuable insight at lower computational cost.

3D simulations included modeling the top half to Dimorphos in order to comply with memory constraints. Our simulations showed good agreement with the measured momentum enhancement and velocity change when extrapolating early-time simulation data to later times. Simulations in 3D took considerably longer to run than their 2D counterparts.

In this work, we show results from simulations modeling the DART kinetic impact into Dimorphos. We explore porous geologic materials in a rubble-pile configuration of boulders and matrix material with varying orders of magnitude of strength.


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