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BENCHMARKING ASTEROID-DEFLECTION EXPERIMENTS

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ABSTRACT

In preparation to deflect or disrupt an asteroid before it reaches Earth, it is imperative to have modeling capabilities that adequately simulate the deflection actions. We rely on codes to simulate how to deflect or disrupt an asteroid. Code validation is key to ensuring full confidence in simulation results used in an asteroid-mitigation plan and is important in advancing our understanding of impact processes on asteroids. Laboratory benchmarking experiments using well-characterized materials undergoing high-velocity impacts are powerful checks on such codes, often pointing the way to enhancements or refinements.

In a collaboration between Lawrence Livermore National Laboratory, Kobe University, and the University of Washington, this work explores the ability of Spheral, an adaptive smooth particle hydrodynamics code, to replicate results from well-known hypervelocity impact experiments. Using data from two separate gas-gun

experiments — impacting spherical and cylindrical basalt targets, respectively — we evaluate our simulation results. In particular, we investigate the strength, fracture and damage in basalt targets caused by high-velocity impacts. We compare the velocity distribution of fragments calculated with Spheral to the experimental results, probe the scale effects in strength-dominated collisions, and discuss what we have learned from our work.

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