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NEO Discovery
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LOS ALAMOS RAGE SIMULATIONS OF THE HAIV/NIAC NASA MISSION

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ABSTRACT

The mitigation of potentially hazardous objects (PHOs) can be accomplished by a variety of methods including kinetic impactors, gravity tractors and several nuclear explosion options. Depending on the available lead time prior to Earth impact, non-nuclear options can be very effective at altering a PHO's orbit. However if the warning time is short nuclear options are generally deemed most effective at mitigating the hazard. The NIAC mission concept for a nuclear mission has been presented at several meetings, including the last PDC (2013).

We use the adaptive mesh hydrocode RAGE [Gittings et al., Computational Science and Discovery, 1, 015005] to perform detailed simulations of this Hypervelocity Asteroid Intercept Vehicle (HAIV) mission concept. We use the RAGE code to simulate the crater formation by the kinetic impactor as well as the explosion and energy coupling from the follower nuclear explosive device (NED) timed to detonate below the orginal surface to enhance the energy coupling.

The RAGE code has been well validated for a wide variety of applications. A parametric study will be shown of the energy and momentum transfer to the target ~100 m diameter object: 1) the HAIV mission as planned; 2) a surface explosion and 3) a subsurface (contained) explosion; both 2) and 3) use the same source energy as 1).

Preliminary RAGE simulations show that the kinetic impactor will carve out a surface crater on the object and the subsequent NED explosion at the bottom of the crater transfers energy and momentum to the target effectively moving it off its Earth crossing orbit. Figure 1 shows the initial (simplified) RAGE 2D setup geometry for this study. Figure 2 shows the crater created by the kinetic impactor and Figure 3 shows the time sequence of the energy transfer to the target by the NED.

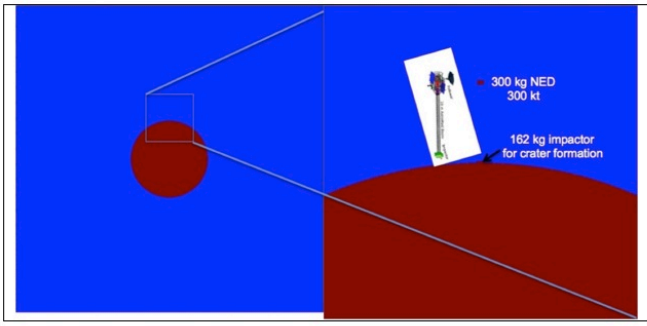

Figure 1. The initial geometry for the 2D RAGE simulations of the HAIV mission concept.

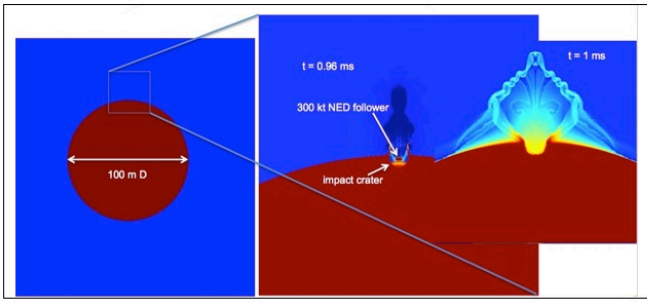

Figure 2. The surface crater created by the kinetic impactor with the NED following.

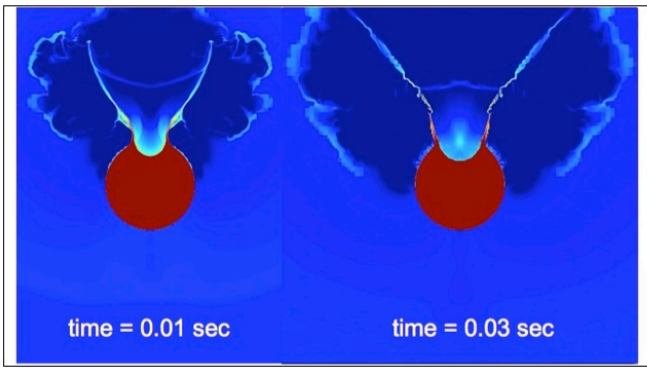

Figure 3. Preliminary simulations of the NED explosion and momentum transfer to the target object.

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