An Exploration of the Technical Challenges of Deploying a Nuclear Explosive Device Against a Potentially Hazardous Object

C. S. Plesko[1], T. Heberling[2], G. R. Gisler[3], R. P. Weaver[3], [1]Los Alamos National Laboratory, XTD-NTA (plesko@lanl.gov), [2]Los Alamos National Laboratory, XTD-SS, [3]Los Alamos National Laboratory, XTD-IDA

Most previous studies of the nuclear deflection of potentially hazardous objects (PHOs) begin with the device at the target. Here we describe initial work done in collaboration with NASA Goddard, Lawrence Livermore, and Sandia National Laboratories to explore the technical challenges involved in the preparation, launch, and transportation of a nuclear explosive device (NED) to a PHO. We find that some aspects of this process are at a higher technical readiness level (TRL) than conventional wisdom expects, while some are at a lower TRL than is commonly assumed.

Our study began with the Hypervelocity Asteroid Mitigation Mission for Emergency Response (HAMMER) theoretical design study at the Goddard Space Flight Center's Mission Design Lab in fall 2015. The HAMMER design study explored the possibility of delivering a kinetic impactor, a stand-off nuclear burst, or a sub-surface nuclear burst to a PHO of similar size and composition to asteroid 101955 Bennu. We also began an exploration of the logistics involved in a multi-spacecraft, multi-push mitigation attempt, similar to that proposed by Teller et al. (1995). As part of the study, we did a preliminary exploration of questions of safety, security, and engineering issues that would need to be addressed for such a mission to be successful.

For example, in the HAMMER study we attempted to make the spacecraft relatively NED-agnostic, such that a variety of possible devices could be used, depending on the requirements of policymakers and future improvements in our understanding of PHO properties and mitigation processes. This flexibility would allow the spacecraft to be built and stored separately from the NED, simplifying and decreasing the cost of spacecraft storage. Allowing such flexibility would, however, require careful thought and documentation of assumptions about allocated mass, volume, inertial properties, thermal and vibrational environments, and pass-through communications, among other concerns.

A question at the intersection of rocket science and nuclear physics will not be a simple one to solve, but we do believe it is a tractable problem, especially if the international community continues to explore it well in advance of the discovery of an impending threat.