Studies of Short Time Response Options for Potentially Hazardous Objects: Current and Forthcoming Results

Brent W. Barbee  
NASA/GSFC  
brent.w.barbee@nasa.gov

Kevin C. Greenaugh  
NNSA - DOE  
kevin.greenaugh@nnsa.doe.gov

Bernard D. Seery  
NASA/GSFC  
bernard.d.seery@nasa.gov

Myra Bambacus  
NASA/GSFC  
myra.j.bambacus@nasa.gov

Ronald Y. Leung  
NASA/GSFC  
ronald.y.leung@nasa.gov

Lee Finewood  
NNSA - DOE  
lee.finewood@nnsa.doe.gov

David S. P. Dearborn  
LLNL  
dearborn2@llnl.gov

Paul L. Miller  
LLNL  
miller3@llnl.gov

Robert P. Weaver  
LANL  
rpwe@lanl.gov

Catherine Plesko  
LANL  
plesko@lanl.gov

Megan Bruck-Syal  
LLNL  
syal1@llnl.gov

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The research program is organized around three case studies:

1. Deflection of the Potentially Hazardous Asteroid (PHA) 101955 Bennu (1999 RQ36) [OSIRIS-REx mission target]
2. Deflection of the secondary member of the PHA 65803 Didymos (1996 GT) [DART mission target]
3. Deflection of a scaled-down version of the comet 67P/Churyumov-Gerasimenko [Rosetta mission target]

NASA/GSFC is providing astrodynamics and spacecraft/mission design expertise, while NNSA/DOE/LLNL/LANL/SNL are providing expertise in modeling the effects of kinetic impactor spacecraft and nuclear explosive devices on the target objects.

Our research is oriented toward defining solution spaces for the problem of responding to incoming asteroid/comet scenarios with relatively short time available to respond (e.g., <10 years)

Current preliminary findings:

* Existing nuclear devices appear to be effective for Planetary Defense purposes.
* Good agreement is seen between different modeling codes at the different laboratories.
* A single ~8 metric ton HAMMER-like kinetic impactor is not sufficient to deflect a Bennu-class (>500 m) asteroid.
* A single ~8 metric ton HAMMER-like kinetic impactor may be capable of deflecting asteroids ~100--300 m in size or smaller, depending on factors including asteroid density and orbit.
* However, asteroids smaller than ~100--200 m in size may not be able to physically tolerate the imparted velocity change required to deflect them. Attempting to deflect them may be likely to accidentally weakly disrupt them, in which case deliberate robust disruption may be preferred.
* Short time response is particularly relevant to cometary nuclei (most energetic, lowest lead time Earth impact threats). In any case, short time response will require prior testing and validation of Planetary Defense spacecraft systems, as well, as taking steps to dramatically reduce the time needed to prepare the spacecraft for launch.