PDC2015
Frascati, Roma, Italy

IAA-PDC-15-03-09

Planetary Defense – Recent Progress & Plans
NEO Discovery
NEO Characterization
Mitigation Techniques & Missions
Impact Effects that Inform Warning, Mitigation & Costs
☐ **Consequence Management & Education**
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☒ **SUBORBITAL ASTEROID INTERCEPT AND FRAGMENTATION FOR VERY**
☐ **SHORT WARNING TIME SCENARIOS**
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Keywords: *asteroid, suborbital intercept, planetary defense, asteroid mitigation*

ABSTRACT

Small near-Earth objects (NEOs) ~50—150 m in size are far more numerous (hundreds of thousands to millions yet to be discovered) than larger NEOs. Small NEOs, which are mostly asteroids rather than comets, are very faint in the night sky due to their small sizes, and are, therefore, difficult to discover far in advance of Earth impact. However, even small NEOs are capable of creating explosions with energies on the order of tens or hundreds of megatons (Mt).

We are, therefore, motivated to prepare to respond effectively to short warning time, small NEO impact scenarios. In this paper we explore the lower bound on actionable warning time by investigating the performance of notional upgraded Intercontinental Ballistic Missiles (ICBMs) to carry Nuclear Explosive Device (NED) payloads to intercept and disrupt a fictitious incoming NEO at high altitudes (generally, at least 2500 km above Earth). We conduct this investigation by developing optimal NEO intercept trajectories for a range of cases and comparing their performances.

Our results show that suborbital NEO intercepts using Minuteman III or SM-3 IIA launch vehicles could achieve NEO intercept a few minutes prior to when the NEO

would strike Earth. We also find that more powerful versions of the launch vehicles (e.g., total ΔV ~9.5–11 km/s) could intercept incoming NEOs over a day prior to when the NEO would strike Earth, if launched at least several days prior to the time of NEO intercept. Finally, we discuss a number of limiting factors and practicalities that affect whether the notional systems we describe could become feasible.

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