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PLANETARY DEFENSE IN THE AGE OF SPACE INDUSTRIALIZATION

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ABSTRACT

The threat hazard from the NEA population is by now relatively well-defined and most new NEA PHA discoveries will, if they breach the Torino scale, still provide some years or decades of advance warning. Almost all NEAs >1km nominal diameter have now been discovered, therefore that component of the Impact Risk can be considered to be essentially 'retired'. The US searches are now focussed on 'retiring' the risk associated with the >140m, <1km diam objects.

A much more disturbing and poorly quantified threat arises within the set of *cometary trajectory* impactors. These, if found to be on an impact trajectory, on 'discovery apparition', as they 'light up' inbound, passing Jupiter-orbit, would only provide a year or less of forewarning and thus make for extremely difficult response. Even worse would be 'dark objects' on cometary trajectories, which fail to light up at all, thus failing to be detected until very late, if at all.

Several workers have estimated that 20 to 40% of large impacts on Earth have been from cometary bodies, rather than from Earth-crossing asteroids (see Gehrels, *Hazards Due to Comets and Asteroids*, 1994). There is also a fear that 'dark objects' might comprise a significant proportion of cometary-orbit bodies.

The development of operations to access in-space resources, particularly of capabilities associated with return of massive payloads of commodities to Earth-cislunar space from deep-space mining operations, will *inter-alia* bring with it some ability to interdict Impact-Threat objects, by collisional deflection or disruption.

As space mining operations grow in number, both throughout the Near Earth Asteroid belt, and later through the Main Belt, one can foresee the development of a network of *at-call interdiction-package launch capabilities* based at mining operations spread around the ecliptic plane, generally at or beyond Mars-distance, which will over time grow to provide an increasing coverage of the sky, albeit mainly in the ecliptic plane but with some +z and -z coverage as well. These sites would usefully also host (at quite low incremental cost) highly-capable IR telescopes tasked to gaze outwards to look for incoming comets and 'dark objects'.

Thus, deep-space mining ventures can be seen as, and should be developed at least in part considering, their growing dual-use capability to identify and interdict Earth-Impact Threats particularly those of a short-timeline-to impact nature.

This presentation will provide examples of possible interdiction scenarios that can be achieved through in space resources.