Please send your abstract to iaapdc (at) iaamail.org
You may visit www.pdc.iaaweb.org

(please choose one box to be checked)
(you may also add a general comment - see end of the page)

☐ Key International and Political Developments
☐ Advancements and Progress in NEO Discovery
☐ NEO Characterization Results
☐ Deflection and Disruption Models & Testing
☐x Mission & Campaign Designs
☐ Impact Consequences
☐ Disaster Response
☐ Decision to Act
☐ Public Education & Communication

The Distribution of Required Deflection Impulses as a Function of Time Before Impact for Earth Impacting Asteroids

Edward Lu\textsuperscript{(1)}, Mike Loucks\textsuperscript{(2)}, and John Carrico\textsuperscript{(3)}

\textsuperscript{(1)}B612 Foundation, 20 Sunnyside Ave. Suite 427, Mill Valley CA 94941, 650-644-4539, ed@b612foundation.org

\textsuperscript{(2)}Space Exploration Engineering, 687 Chinook Way, Friday Harbor WA 98250, 360-378-7168, loucks@see.com

\textsuperscript{(3)}Google Inc., 1600 Amphitheatre Parkway, Mountain View CA 94043, 650-253-5676, astrogator@google.com

\textbf{Keywords:} Impactors, Deflection, Computation

\textbf{ABSTRACT}

We have built a precision cloud based asteroid orbit propagation and targeting capability that enables investigations of planetary defense questions requiring large computational resources. We use this to investigate the distribution of deflection $\Delta V$ required to deflect asteroids from hitting Earth as a function of time before impact. Starting from a population of 10000 virtual impacting asteroids (from Veres et al), we calculate at various times before impact the impulsive $\Delta V$ required to cause them to miss the Earth by a distance of 10 Earth radii. We find a significant fraction of impacting asteroids are significantly easier to deflect than the mean, with more than an order of magnitude less velocity impulse required. An example distribution of required deflections at 30 years prior to impact is shown below.
At larger times before impact, the fraction of these easily deflected asteroids increases. These easily deflected asteroids are found to have intervening close approaches with a planet (usually the Earth itself) prior to Earth impact which substantially reduces the impulsive deflection requirement (the real asteroid Apophis is a good example of such a case). At 30 years prior to impact, 5% of the impactors had a close approach (within a Hill radius) of a planet prior to impact. While these represent a small fraction of asteroid impact cases, we expect them to be overrepresented among the difficult deflection decision cases because they are also the asteroids which are observationally most difficult to rule out as impact threats. Our real world asteroid impact deflection scenario decisions are likely to be dominated by such cases.