

**Dear ASE Colleagues:**

**April 11, 2023**

**Last week I attended the 8<sup>th</sup> IAF Planetary Defense Conference, sponsored by ASE among others, and hosted by the UN Office of Outer Space Affairs (UNOOSA) in Vienna, Austria from Monday-Friday, April 3-7. I'd like to share with you a few impressions of the conference content.**

**In my accompanying notes, you'll find links to the recorded conference video, a program listing the talks presented, and a link to the abstracts and presentation slides for many of the talks.**

**Much of the first day focused on the results of the successful DART kinetic impactor demonstration last September, in which the 550-kg spacecraft struck Dimorphos at 6.1 km/s. The deflection changed the orbital period around the larger Didymos--roughly 12 hours--by 33 minutes. The impact ejected about 10 million kg of debris, enhancing the momentum transfer, and decreasing the orbital period by much more than the planned 7 minutes.**

**ESA updated us on the plans for HERA, launching next year to the Didymos system to measure the orbit, mass, and crater left on Dimorphos by DART. The mission will also land two CubeSats on Dimorphos, and finish by landing on Didymos.**

**The PDC exercise began on Monday with the conjecture that the mythical NEO, 2023 PDC, was headed for a 2036 impact with Earth. About 800 m across, 2023 PDC had a risk corridor crossing both Africa and North America and was so large that its impact would be devastating to much of either continent. By late Monday we'd learned that the impact would indeed strike Nigeria, unless deflected. This pending impact was then discussed for the balance of the week by disaster managers, mission designers, impact physicists, and government officials present at the conference.**

**Tuesday's sessions updated the status of PD programs among the various space agencies and presented the state of NEO observing programs around the globe. NASA's NEO Surveyor mission has been approved and now has a launch date of 2028, and its aim is to complete the survey of NEOs > 140 m to the 90% level some ten years later. Simultaneously, the NSF Vera Rubin Telescope in Chile will debut sometime next year, and in five years discover about 100,000 NEOs. However, Rubin cannot look too close to the sun, and is limited to night, fair weather operations. It will take about a decade for its sky surveys to approach the 140 m/90% goal of the George Brown NEO Survey Act of 2005.**

Wednesday's conference sessions surveyed the analysis of the DART-induced ejecta from Dimorphos—its composition, amount, and spatial distribution. Presenters also described new methods of characterizing NEOs after ground discovery or visits by spacecraft. A fast recon flyby to a small NEO is the top mission priority recommended to NASA by last year's Decadal Survey of Planetary Science and Astrobiology.

The day's content shifted to deflection testing and modeling, with efforts to model the observed ejecta plume from DART and use those models to plan for deflection or disruption of future hazardous NEOs. The DART impact threw off a wave of surface boulders, followed by a lesser amount of subsurface material. The ejecta contributed to a Beta (momentum enhancement factor) of about 3.6, probably because Dimorphos seems to be a rubble pile, and the impact easily liberated the boulders and unconsolidated material.

The day ended with discussion of how nuclear explosive devices could be used to divert the 2023 PDC exercise NEO, with many presentations by nuclear specialists on the effects of a near-surface burst. For larger NEOs like the exercise object, an NED is the only way to achieve a deflection, compared to the hundreds of kinetic impactors required.

Thursday considered the physical effects on Earth of a future impact, using the latest physics models to consider blast, radiant thermal pulses, crater excavation and tsunamis. The blast and tsunami created by last year's Tonga volcanic eruption (120 megatons) serves as a way to calibrate impact models into oceanic targets. A new "last-ditch" deflection technique called PI (pulverize it!) was presented, involving a swarm of hypervelocity penetrators designed to disrupt an object completely. The Earth's atmosphere would screen out the remaining small fragments.

Late in the day, and into Friday, the conferees considered the issues of disaster management, Earth impact response, and the decision to act (with its political, legal, social, and economic aspects). Public communications on warning of an impact were discussed on Friday morning to close out the conference.

The next PDC will be held in two years, but no 2025 site has been decided upon. ASE should continue its sponsorship and active participation, with your help.

Tom Jones

Chairman, ASE Committee on Near-Earth Objects