WHAT IS PLANETARY DEFENSE? *From Research to Implementation*

Joel Marks

Professor Emeritus of Philosophy, University of New Haven, West Haven CT 06516 jmarks@newhaven.edu

As planetary defense has matured, planetary science has pre-empted *defense*, in that planetary defense has become a research program rather than an implementation program. Research is of course essential to planetary defense: We need to know the general distribution of potential impactors and their compositional and dynamical characteristics relative to technologies for detecting and deflecting or disrupting them. But research cannot take the place of an actual preparedness to defend. The simple and sad fact is that right now we are defenseless against a short-warning impactor of any size. This poster analyzes key concepts of planetary defense and then, on that basis, makes several recommendations that both support and go beyond current plans and proposals such as NSTC (2018), NA (2019), Barbee (2020), and Mainzer (2020).

The two components of planetary defense

Surveillance

"Surveillance" is the appropriate term for what a comprehensive planetary defense requires of a detection regime. It implies that more than a *survey* of potential impactors is being carried out, since there is no limit in space or time to where and when a potential impactor may appear. For example, a long-period comet or an interstellar object heading toward Earth collision could arrive from any direction in or outside the ecliptic, and its apparition could be a million years from now or today. To date there have been and are planned several significant surveys of potential impactors, but, after the initial and remarkable Spaceguard Survey, the pace has been slow relative to the estimated number of relevant objects that remain to be detected and tracked (Mainzer 2020); and all of these surveys are limited in spatial and temporal scope. ***What is now needed, therefore, is an explicit commitment to implement real-time surveillance of the entire celestial sphere, with redundancy[1], to ever greater distances, and in perpetuity.***

Mitigation

"Mitigation" is not the most apt term for the other integral component of planetary defense, since in non-technical usage it suggests only lessening the severity of harm, whereas planetary defense is primarily oriented toward eliminating a threat entirely. However, planetary defense also includes true mitigations in the sense of reducing threats and harms by evacuating an area before an unpreventable impact and helping in recovery afterward. In any case, the term in actual usage in planetary defense covers complete elimination of an impact threat by either deflection or disruption of the potential impactor. To date the approach to this sort of mitigation has been assembling knowledge and developing technologies that could be deployed in the case of a potential impactor being discovered (Barbee 2020). But it is universally recognized by the planetary defense community that potential impactors of any size can be discovered when there would be insufficient time to prepare an assured mitigation mission from scratch. ***What is now needed, therefore, is an explicit commitment to test, build, and maintain (including upgrades as appropriate) a launch-ready characterization and deflection/disruption infrastructure, with redundancy[2], on land or in space, and in perpetuity.***

Next steps

Funding

In order for surveillance and mitigation to come into their own as not only research programs but also actual preparedness to defend, funding needs to be increased significantly and assured consistently for the long-term **(cf. Mainzer 2020). Currently the needs of planetary defense must often compete against funding for science and exploration. Thus we see that even a no-brainer like an infrared space telescope, which would meet Congress's own mandate[3] to discover, characterize, and track 90% of NEOs that are big enough to cause regional damage, has not been fast-tracked. The notion of *defense* is relevant because defense spending is a constant in the national budget. Therefore if planetary defense were to become folded into public and political consciousness as a component of the overarching conception of *defense*, a larger and more reliable source of funding would likely result, consistently with an appropriate cost/benefit analysis (Matheny 2007).**

International Understandings regarding Nuclear Explosive Devices in Planetary Defense

It is readily understood that planetary defense is an international concern and undertaking. But over and above assuring the necessary funding, legal and political matters need to be addressed. Of central significance is the role of nuclear explosive devices (NEDs) in planetary defense. It is widely recognized that NEDS are an essential instrument for the mitigation of threats by large and/or short-warning potential impactors (NRC 2010, p. 84). Yet it is currently illegal to test or deploy or otherwise use them in space. Indeed, three months prior to this conference a new UN treaty[4] has come into force that commits the signatories to the elimination of NEDs. Furthermore, even if it were legal, the well-known dilemmas of deterrence (Marks 2019) have convinced many that NEDS are better eliminated than stockpiled or deployed for use in planetary defense (cf. Sagan and Ostro 1994). ***What is urgently needed therefore is further negotiation among all nations to clarify the role of NEDs in planetary defense. Laws should then be devised with specific protocols for control and use that anticipate and resolve the relevant dilemmas.*** **In this way planetary defense could be a vehicle for bringing all nations together in the common defense rather than pitting them against one another in purely national defense.**

PUTTING THE *DEFENSE* IN PLANETARY DEFENSE

In national defense against a foreign adversary, we do not let our guard down for one second. Radar and other devices scan the horizon continuously for incoming missiles, and with backups in case of failures. Furthermore, we are prepared to *respond massively* to any detection *at once*.

Now consider planetary defense: We have only incomplete and scattershot surveillance and mostly without backups. Furthermore, should an incoming impactor be discovered with relatively short warning, we have at present zero response capability.

This is a situation that makes no sense and cannot be allowed to stand. It is time to move beyond only research and begin full-scale implementation of a comprehensive planetary defense on the model of national defense.

Notes

[1] With regard to the need for redundancy in surveillance, witness what happened to Arecibo last year. See also Adamo (2020).

[2] Compare America's nuclear triad, which is redundant many times over in defense against a human threat.

[3] NEOCam/NEOSM/NEO Surveyor has been designed to complete the George E. Brown, Jr., Survey goals.

[4] The Treaty on the Prohibition of Nuclear Weapons went into effect on January 22, 2021.

References

Adamo, D. R. 2020. "Toward Greater Preparedness and Resilience in Planetary Defense." White paper. http://www.aiaahouston.org/adamo_astrodynamics/, ATIG_116

Barbee, B. W. 2020. "Future Spacecraft Missions for Planetary Defense Preparation." White paper for the 2023-2032 Planetary Science and Astrobiology Decadal Survey. http://surveygizmoresponseuploads.s3.amazonaws.com/fileuploads/623127/5489366/172-a3aaea99940d982fc44e391409e0046b_BarbeeBrentW3.pdf

Mainzer, A. 2020. "The Future of Planetary Defense in the Era of Advanced Surveys." White paper for the 2023-2032 Planetary Science and Astrobiology Decadal Survey. Small Bodies Assessment Group. https://neos.arizona.edu/sites/neos.arizona.edu/files/data/TheFutureofPlanetaryDefense.pdf

Marks, J. 2019. Review of *Planetary Defense: Global Collaboration for Defending Earth from Asteroids and Comets*, Nikola Schmidt, ed. (Springer, 2019). *Space Policy*, vol. 49, article no. 101327, August.

Matheny, J. G. 2007. "Reducing the Risk of Human Extinction." *Risk Analysis* 27:5 (1335-44).

National Academies of Sciences, Engineering, and Medicine (NA). 2019. *Finding Hazardous Asteroids Using Infrared and Visible Wavelength Telescopes*. Washington, DC: The National Academies Press. https://doi.org/10.17226/25476

National Research Council (NRC). 2010. *Defending Planet Earth: Near-Earth-Object Surveys and Hazard Mitigation Strategies*. Washington, DC: The National Academies Press. https://doi.org/10.17226/12842

National Science and Technology Council (NSTC). 2018. *National Near-Earth Object Preparedness Strategy and Action Plan*.

Sagan, C., & S. J. Ostro. 1994. "Long-range Consequences of Interplanetary Collisions." *Issues in Sci. and Tech* 10 (Summer): 67–72.