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Asteroid Kinetic Impactor Mission Concepts

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Asteroid impact missions can be carried out as a relatively low-cost add-on to most asteroid rendezvous missions and such impact experiments have tremendous potential, both scientifically and in the arena of planetary defense.

The science returns from an impactor demonstration begin with the documentation of the global effects of the impact, such as changes in orbit and rotation state, the creation and dissipation of an ejecta plume and debris disk, and morphological changes across the body due to the transmission of seismic waves, which might induce landslides and toppling of boulders, etc. At a local level, an inspection of the impact crater and ejecta blanket reveals critical material strength information, as well as spectral differences between the surface and subsurface material.

From the planetary defense perspective, an impact demonstration will prove humankind's capacity to alter the orbit of a potentially threatening asteroid. This technological leap comes in two parts. First, the demonstration of terminal guidance systems that can deliver an impactor with small errors relative to the ~100-200 meter size of a likely impactor has yet to be demonstrated in a deep space environment. Second, the response of an asteroid to such an impact is only understood theoretically due to the potentially significant dependence on the momentum carried by escaping ejecta, which would tend to enhance the deflection by tens of percent, and even by a factor of a few. A lack of validated understanding of momentum enhancement is a significant obstacle in properly sizing a real-world impactor deflection mission.

In this talk we will describe the drivers for asteroid impact demonstrations and cover the range of such concepts, starting with ESA's pioneering Don Quijote mission concept and leading to a brief description of concepts under study at the present time, including the OSIRIS-REx/ISIS, BASiX/KIX and AIM/DART (AIDA) concepts.