SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (4)

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ASTEROID IMPACT DEFLECTION ASSESSMENT: DOUBLE ASTEROID REDIRECTION TEST

Abstract

The Asteroid Impact Deflection Assessment (AIDA) mission will be the first space experiment to demonstrate asteroid impact hazard mitigation by using a kinetic impactor. AIDA is a joint ESA-NASA cooperative project, consisting of the ESA Asteroid Impact Mission (AIM) rendezvous mission and the NASA Double Asteroid Redirection Test (DART) mission which is the kinetic impactor. The AIDA target is the near-Earth binary asteroid 65803 Didymos, which will make an unusually close approach to Earth in October, 2022. The DART spacecraft is designed to impact the Didymos secondary at 7 km/s and demonstrate the ability to modify its trajectory through momentum transfer. DART and AIM are currently Phase A studies supported by NASA and ESA respectively.

The primary goals of AIDA are (1) perform a full-scale demonstration of the spacecraft kinetic impact technique for deflection of an asteroid; (2) measure the resulting asteroid deflection; and (3) study hypervelocity collision effects on an asteroid, validating models for momentum transfer in asteroid impacts based on measured physical properties of the asteroid surface and sub-surface, and including long-term dynamics of impact ejecta. The DART impact on the moon of the Didymos binary system will change the orbital period of the binary. This change can be measured by supporting Earth-based optical and radar observations.

The baseline DART mission launches in December, 2020 to impact the Didymos secondary in September, 2022. The AIM spacecraft will be launched in October, 2020 and arrive at Didymos in spring, 2022, several months before the DART impact. AIM will characterize the Didymos binary system by means of remote sensing and in-situ instruments both before and after the DART impact. The asteroid deflection will be measured to higher accuracy, and additional results of the DART impact, like the impact crater, will be studied in detail by the AIM mission. The combined DART and AIM missions will provide the first measurements of momentum transfer efficiency from a kinetic impact at full scale on an asteroid, where the impact conditions of the projectile are known, and physical properties and internal structures of the target asteroid are also characterized. The DART kinetic impact is predicted to make a crater of 6 to 17 meters diameter, depending on target physical properties, but will also release a large volume of particulate ejecta that may be directly observable from Earth or even resolvable as a coma or an ejecta tail by ground-based telescopes.