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Asteroid Impact Mission: a unique small mission of opportunity

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In October 2022 the binary asteroid system 65803 Didymos will have an exceptionally close approach with the Earth flying by within only 0.11 AU. ESA is planning to leverage on this close encounter to launch a small mission of opportunity called Asteroid Impact Mission (AIM) to explore and demonstrate new technologies for future science and exploration missions while addressing planetary defense and performing asteroid scientific investigations. AIM is part of an international cooperation between ESA and NASA currently in Phase A/B1 called Asteroid Impact & Deflection Assessment (AIDA), consisting of two mission elements: the NASA Double Asteroid Redirection Test (DART) mission and the AIM rendezvous spacecraft. The primary goals of AIDA are to test our ability to perform a spacecraft impact on a near-Earth asteroid and to measure and characterize the deflection caused by the impact. The two mission components of AIDA, DART and AIM, are each independently valuable but when combined they provide a greatly increased scientific return. The DART hypervelocity impact on the secondary asteroid will alter the binary orbit period, which can be measured to within 10% by means of lightcurves observations from Earth-based telescopes. AIM main objectives are to determine Didymos secondary asteroid orbital and rotation state, size, mass and shape and analyze geology and surface properties. AIM will be the first mission to rendezvous with a binary system and understand the formation process of such bodies. In addition, AIM will demonstrate deep-space optical communication and inter-satellite network in deep-space with a number of CubeSats deployed in the vicinity of the Didymos system and a lander on the surface of the secondary based on DLR's MASCOT heritage. By combining AIM's technology and scientific payload to support both close-proximity navigation and scientific investigations together with a fast development schedule and short mission operation, AIM will demonstrate the capability to achieve a small spacecraft design with a very large technological and scientific mission return.