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The Asteroid Impact Mission

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The Asteroid Impact Mission (AIM) is a small and innovative mission of opportunity, currently under study at ESA, intending to demonstrate new technologies for future deep-space missions while addressing planetary defense objectives and performing for the first time detailed investigations of a binary asteroid system. It leverages on a unique opportunity provided by asteroid 65803 Didymos, set for an Earth close-encounter in October 2022, to achieve a fast mission return in only two years after launch in October/November 2020. AIM is also ESA's contribution to an international cooperation between ESA and NASA 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 will also be measured by means of lightcurves observations from Earth-based telescopes. AIM instead will perform before and after detailed characterization shedding light on the dependence of the momentum transfer on the asteroid's bulk density, porosity, surface and internal properties. AIM will gather data describing the fragmentation and restructuring processes as well as the ejection of material, and relate them to parameters that can only be available from ground-based observations. Collisional events are of great importance in the formation and evolution of planetary systems, own Solar System and planetary rings. The AIDA scenario will provide a unique opportunity to observe a collision event directly in space, and simultaneously from ground-based optical and radar facilities. For the first time, an impact experiment at asteroid scale will be performed with accurate knowledge of the precise impact conditions and also the impact outcome, together with information on the physical properties of the target, ultimately validating at appropriate scales our knowledge of the process and impact simulations. AIM's important technology demonstration component includes a deep-space optical communication terminal and inter-satellite network with two CubeSats deployed in the vicinity of the Didymos system and a lander on the surface of the secondary. To achieve a low-cost objective AIM's technology and scientific payload are being combined to support both close-proximity navigation and scientific investigations. AIM will demonstrate the capability to achieve a small spacecraft design with a very large technological and scientific mission return.