If an asteroid was ever headed our way, what could be done about it? ESA and NASA plan to test if a technique called kinetic impact would work to deflect it. The Asteroid Impact and Deflection Assessment mission is made up of two spacecraft: the US-led Double Asteroid Redirection Test and the European-led Asteroid Impact Mission.

Headed to the double-asteroid Didymos system, ESA's AIM has three objectives: to see if asteroid deflection is feasible; to test deep-space laser communication systems; and to perform scientific investigations on the asteroid system.

AIM will be launched in October 2020 in order to rendez-vous with Didymos in May 2022. AIM will be humanity's first probe to reach a binary system: the larger asteroid is orbited by a smaller one, known as Didymoon.

Upon arriving, the spacecraft will take its first high-resolution pictures of the binary system.

AIM will scan the smaller Didymoon closely with its visual imaging system, gathering information on its orbital dynamics as well as its physical characteristics. High-resolution surface mapping will chart the surface landscape and provide invaluable data for the targeting system of DART

The results will be beamed back to Earth by a high-bandwidth laser communication link. Engineers will try to push the limits of such instrument to work also as a laser altimeter and an infrared camera while operating in close proximity of Didymos.

AIM's high-frequency radar will probe the first layers beneath Didymoon's surface. This will help engineers to fully understand the structure and model DART's impact.

Thermal imaging will reveal more surface properties, including the soil structure and cohesion.

Next comes putting down a lander, developed by the German Aerospace Center, which will return data back to AIM.

In particular, the lander will emit low-frequency radar waves that will pierce right through the asteroid to the other side, allowing AIM to chart Didymoon's deep-interior structure.

Several tiny CubeSats will also be released from AIM, to perform further scientific monitoring while also testing inter-satellite links in deep space.

Once this pocket-sized rock is explored, AIM will move away to a safe distance – as the US DART mission is on its way. DART will target Didymoon, and then crash into it, deep centre. The impact will be monitored both by AIM and its CubeSats.

Thermal images of the moment of impact should give an idea of how much and what type of debris is ejected from Didymoon, and how far the resulting plume will reach.

The next question is: how will the impact alter the orbit of Didymoon around the larger asteroid? In the aftermath, AIM will move closer to Didymoon to find out, in conjunction with ground observatories.

AIM’s high-resolution view will assess the size and depth of the crater left by the impact.

The lander will repeat its low-frequency radar transmissions through the asteroid to reveal any major changes to the asteroid’s internal structure.

Meanwhile AIM will also perform a second set of detailed radar and thermal probing for detailed comparison of the situation before and after impact.

AIM is being developed by the European Space agency while DART is concurrently being developed by NASA jointly with the Johns Hopkins University Applied Physics Laboratory. Together with the German aerospace centre and the Observatoire de la Cote d'Azur they form the AIDA team which supports the Asteroid Impact and Deflection Assessment mission.