

Radar tomography of small asteroids with cubesat platform

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The knowledge of the asteroid's internal structure is crucial to better understand its accretion and dynamical evolution, to study its stability conditions and to model its response to the gravitational constraints induced by Earth close approach. This is also crucial to plan any interaction with an asteroid especially for Planetary Defense purposes. While our present knowledge entirely relies on inferences from optical remote sensing observations and theoretical modeling, the Radar is one of the most mature technique to providing a direct measurement of the internal structure. Thus small low frequency radars are developed to instrument the HERA mission and DROID proposed mission.

The Hera/ESA mission will be launched in 2024 to rendezvous in 2027 the Near Earth Asteroid 65803 Didymos binary system. Dimorphos, the Didymos moonlet, was the target of the DART impactor NASA Mission last September. HERA will deeply investigate the binary system and especially the DART crater on Dimorphos, increasing the science return of the DART mission. After rendezvous, HERA will deliver two CubeSats, Milani and Juventas, for close observation during two months of both Dimorphos and Didymos down to less than 1 kilometer distance. Juventas is a 6U CubeSat carrying JuRa, a low frequency radar operating in monostatic mode. JuRa will provide the first direct measurement of an asteroid's internal structure probing two small bodies. It is associated with a gravimeter and an Inter Satellite Link to access the gravity field.

The DROID (Distributed Radar Observations of Interior Distributions) mission is proposed to rendezvous Asteroid 99942 Apophis in 2029, a potentially dangerous asteroid which will then approach Earth as close as 32000 kilometers. The mission concept has been developed in a collaboration between NASA/JPL and CNES: the DROID mothership will arrive months prior to Earth closest approach proving crucial optical observations to monitor any induced tidal response. After Earth-closed approach, it will release two CubeSats which will orbit Apophis for several weeks. These two 6-8U CubeSats will offer a unique opportunity to directly observe the Apophis internal structure with a Bistatic Low Frequency Radar associated to the gravity field measurements from the Inter Satellite Link.

CubeSat platforms are especially relevant for both bistatic and monostatic radar offering measurement at low altitude associated with a large diversity of geometry of observation. In this talk will present the concept and status of the two missions in association with the question of the radar tomography.