Geophysical Research Abstracts
Vol. 18, EGU2016-12140, 2016
EGU General Assembly 2016

Investigating the surface and subsurface properties of the Didymos binary asteroid with a landed CubeSat

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Despite the successes of recent space missions (e.g., Cheng et al., 1997; Fujiwara et al., 2006), there is still no clear understanding of the asteroid internal structure(s). Depending on their size, evolution and physical properties, many different asteroid internal structure models have been suggested from completely cohesive bodies, through to rubble pile objects.

The Asteroid Geophysical Explorer (AGEX), a COPINS payload selected by ESA*, will land geophysical instrument packages on the surface of Didymoon; the secondary object in the (65803) Didymos (1996 GT) binary system (Karatekin et al 2016). The instruments will characterize the asteroid surface mechanical properties and probe, for the first time, the sub-surface structure of an asteroid.

AGEX will be deployed from AIM on a ballistic transfer to the asteroid surface, several days before the MASCOT-2 package. We expect that AGEX will bounce multiple times before coming to rest on the surface of the asteroid thus providing a unique opportunity to study the asteroid surface properties, perhaps at several locations, using accelerometers. Once stationary, the seismological surface-monitoring phase, using a three-axis set of geophones, can begin.

The high speed DART impact will be a major seismic source on Didymoon. However, the seismic payload may also be able to perform seismological investigations using natural seismic sources such as micrometeoroid impacts (e.g., Garcia et al., 2015), thermal cracks (e.g., Delbo et al., 2014), internal quakes due to tidal forces (e.g., Richardson et al. 1998) and other geophysical processes (see Murdoch et al., 2015).

We will present the expected signal characteristics of the landing and also of the natural seismic sources that may occur on Didymoon. An understanding of the amplitude and frequency content of such signals is necessary in order to design the optimal geophysical payload for small body exploration using a CubeSat platform.

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*http://www.esa.int/Our_Activities/Space_Engineering_Technology/Asteroid_Impact_Mission/CubeSat_companions_for_ESA_s_asteroid_mission