

ASPECT CUBESAT MISSION TO A BINARY ASTEROID DIDYMOS. T. Kohout^{1,2}, A. Näsilä³, T. Tikka⁴, A. Penttilä¹, K. Muinonen^{1,5}, A. Kestilä⁴, M. Granvik¹, E. Kallio³, ¹Department of Physics, University of Helsinki, Finland (tomas.kohout@helsinki.fi), ²Institute of Geology, The Czech Academy of Sciences, Prague, Czech Republic, ³VTT Technical Research Centre of Finland, Espoo, Finland, ⁴Aalto University, Espoo, Finland, ⁵Finnish Geospatial Research Institute, Masala, Finland.

Introduction: ASPECT (Asteroid Spectral Imaging Mission) is a part of AIDA/AIM project and aims to study the composition of the Didymos binary asteroid and the effects of space weathering and shock metamorphism in order to gain understanding of the formation and evolution of the Solar System.

AIDA mission: The joint ESA/NASA AIDA (Asteroid Impact & Deflection Assessment) mission to binary asteroid Didymos consists of AIM (Asteroid Impact Mission, ESA) and DART (Double Asteroid Redirection Test, NASA). DART is targeted to impact Didymos secondary component (Didymoon) and serve as a kinetic impactor to demonstrate deflection of potentially hazardous asteroids. AIM will serve as an observational spacecraft to evaluate the effects of the impact and resulting changes in the Didymos dynamic parameters.

ASPECT mission: The AIM mission will also carry two CubeSat miniaturized satellites, released in Didymoon proximity. This arrangement opens up a possibility for secondary scientific experiments. ASPECT is one of the proposed CubeSat payloads.

ASPECT objectives: Whereas Didymos is a space-weathered binary asteroid, the DART impactor is expected to produce a crater and excavate fresh material from the secondary component (Didymoon). Spectral comparison of the mature surface to the freshly exposed material will allow to directly determine space weathering effects. It will be also possible to study spectral shock effects within the impact crater.

ASPECT will also demonstrate for the first time the joint spacecraft – CubeSat operations in asteroid proximity and miniature spectral imager operation in deep-space environment.

Science objectives:

- Study of the surface composition of the Didymos system.
- Photometric observations (and modeling) under varying phase angle and distance.
- Study of space weathering effects on asteroids (comparison of mature / freshly exposed material).
- Study of shock effects (spectral properties of crater interior).
- Observations during the DART impact.

Engineering objectives:

- Demonstration of CubeSat semi-autonomous operations in deep space environment.
- Navigation in the vicinity of a binary asteroid.
- Demonstration of a satellite survival during impact.
- Demonstration of joint spacecraft – CubeSat operations.

ASPECT configuration: ASPECT is a 3U CubeSat (size of 3 units, Fig. 1) equipped with a spectral imager from 500 nm to 1600 nm (spatial resolution < 2 m, spectral resolution 10 – 30 nm; VIS channel 512 x 512 pixels, NIR channel 256 x 256 pixels), and a non-imaging spectrometer from 1600 – 2500 nm. The design is based on the Aalto-1 CubeSat Spectral Imager heritage. ASPECT will also demonstrate the capabilities of a CubeSat and a miniature spectral imager for the first time in deep-space environment.

Acknowledgements: This work is done under SysNova: R&D Studies Competition for Innovation contract with ESA.

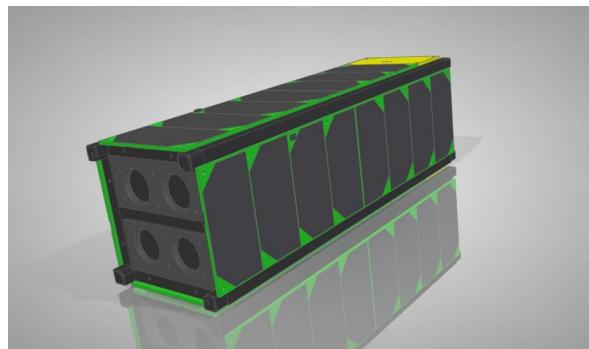


Fig. 1. Proposed ASPECT CubeSat.