LICIACube at (65803) Didymos: the Italian cubesat in support to the NASA DART mission. E. Dotto[1], V. Della Corte[2], M. Amoroso[3], I. Bertini[4,2], J.R. Brucato[5], A. Capannolo[6], B. Cotugno[7], G. Cremonese[8], V. Di Tana[7], I. Gai[9], S. Ieva[1], G. Impresario[3], S.L. Ivanovski[10], M. Lavagna[6], A. Lucchetti[8], E. Mazzotta Epifani[1], A. Meneghin[5], F. Miglioretti[7], D. Modenini[9], M. Pajola[8], P. Palumbo[4,2], D. Perna[1], S. Pirrotta[3], G. Poggiali[5,11], A. Rossi[12], E. Simioni[8], S. Simonetti[7], P. Tortora[9], M. Zannoni[9], G. Zanotti[6], A. Zinzi[13,3], A. F. Cheng[14], A. S. Rivkin[14], E. Y. Adams[14], E. L. Reynolds[14], K. Fretz[14]

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Introduction: DART, the NASA Double Asteroid Redirection Test will be the first mission demonstrating the applicability of the kinetic impactor to change the motion of an asteroid in space and prevent the impact of Earth with a hazardous object [1].

After being launched in 2021, in autumn 2022 the DART spacecraft will impact Dimorphos, the secondary member of the (65803) Didymos binary asteroid. With a mass of 650 kg and an impact velocity of about 6.6 km/s, DART is expected to change the binary orbital period of the 160-m Dimorphos by about 10 minutes, an effect that can be easily measured by ground-based telescopes.

Mission scenario: "LICIACube – the Light Italian Cubesat for Imaging of Asteroids"[2] is an Italian CubeSat, managed by the Italian Space Agency (ASI), that will be part of the DART mission (in Fig. 1 the LICIACube logo).

Figure 1 – Logo of LICIACube.

LICIACube will be launched as a piggyback with the DART spacecraft (see Fig. 2) and, after 15 months and 10 days before the impact, it will be release and autonomously guided to the target, reaching a minimum distance of about 55 km ([2], [3]).

Several images of the target impact and non-impact sides, as well as of the plume produced by the DART impact, will be acquired aiming to: i) document the DART impact's effects on the secondary member of Didymos, ii) characterize the shape of the target, and iii) perform dedicated scientific investigations on it (see Fig. 3).

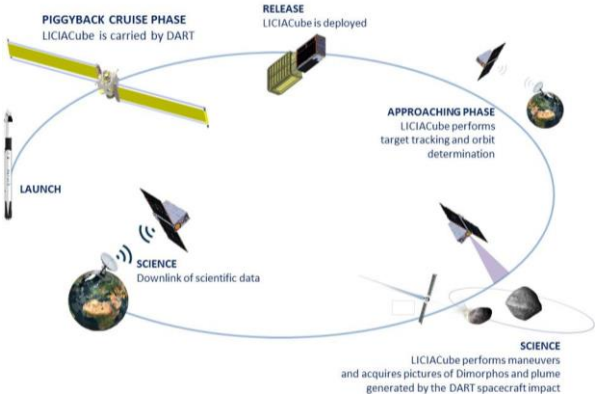

Figure 2 – The LICIACube nominal mission.

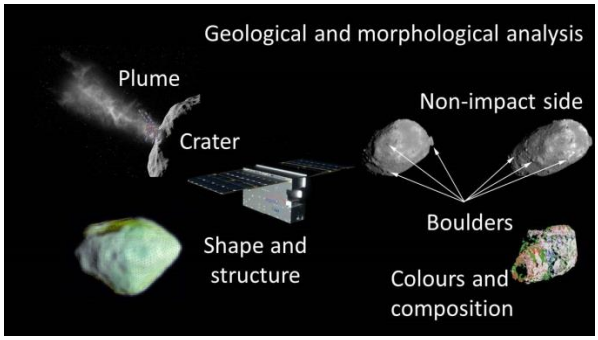

Figure 3 – Scientific Objectives of LICIACube

Spacecraft overview: The LICIACube spacecraft design is based on a 6U CubeSat platform, developed by the aerospace company Argotec ([4], [5], [6]) for the Italian Space Agency (ASI).

LICIACube is equipped with two optical cameras (narrow and wide FoV) that allow acquiring significant images and evidence of the DART mission fulfillment. The primary instrument, named LEIA (Liciacube Explorer Imaging for Asteroid), is a catadioptric

camera composed of two reflective elements and three refractive elements with a FoV of ± 2.06° on the sensor diagonal. The optic is designed to work in focus between 25 km and infinity and the detector is a monochromatic CMOS sensor with 2048x2048 pixel. The latter is equipped with a Panchromatic filters centered at 650nm±250nm. The primary camera will acquire pictures from a high distance providing high level of details of the frame field.

The secondary instrument, named LUKE (Liciacube Unit Key Explorer), is the Gecko imager from SCS space, a camera with an RGB Bayer pattern filter, designed to work in focus between 400 m to infinity. The sensor unit is designed to contain the image sensor interfacing with a NanoCU, while the optics consists of a ruggedized, mission configurable aperture, lens and required spectral filters. Moreover, the hardware is capable of directly integrating the image data to the integrated mass storage.

The CubeSat will downlink images directly to Earth after the Dimorphos fly-by. The architecture of the LICIACube Ground Segment is based on the Argotec Mission Control Centre, antennas of the NASA Deep Space Network and data archiving and processing, managed at the ASI Space Science Data Center where images are planned to be integrated in the MATISSE tool ([7], [8]] for visualization and analysis.

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