# Expected geological assessment at Didymos and Dimorphos from DART and LICIACube

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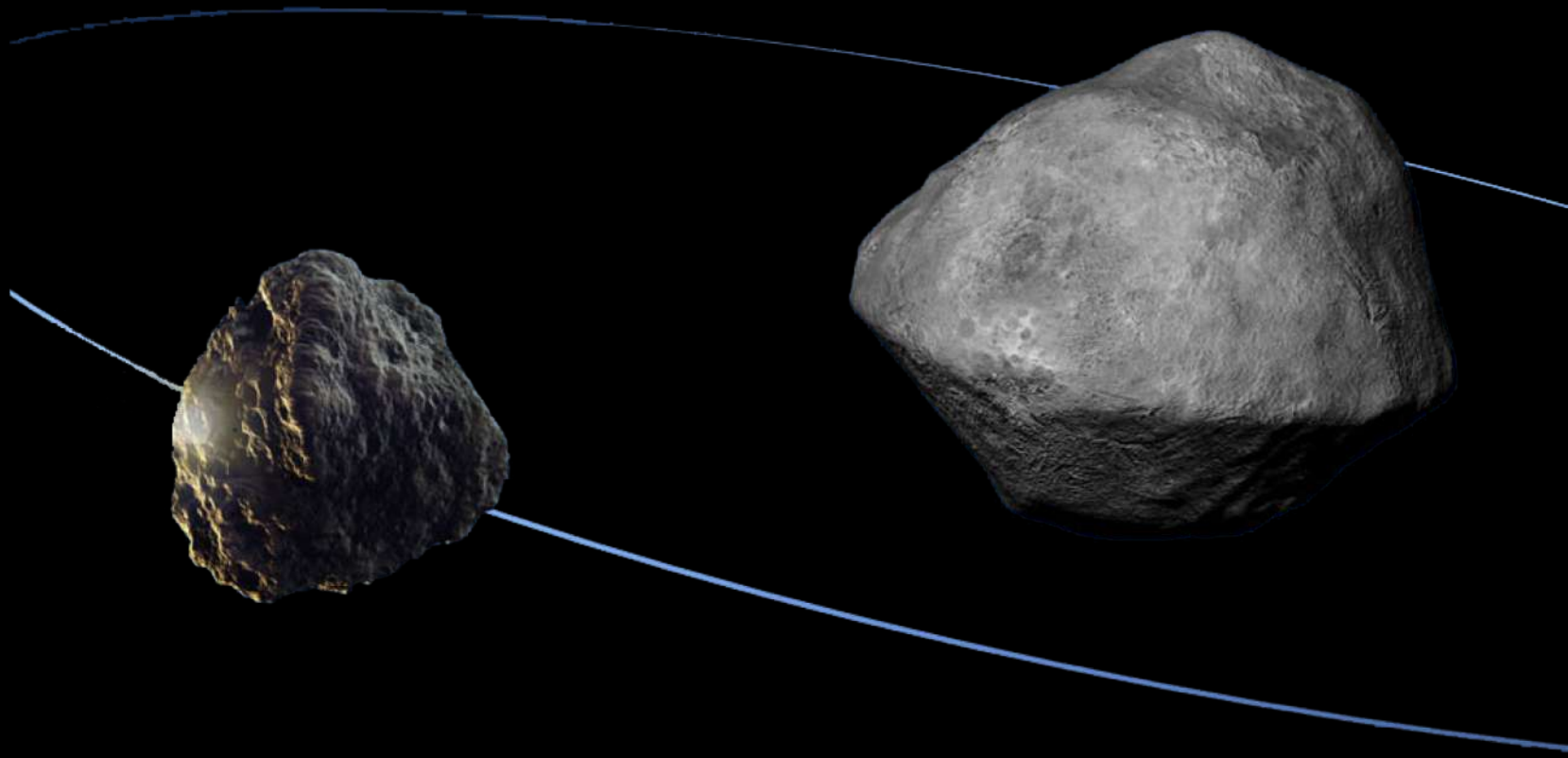
PDC 2021 E-lightning Talk

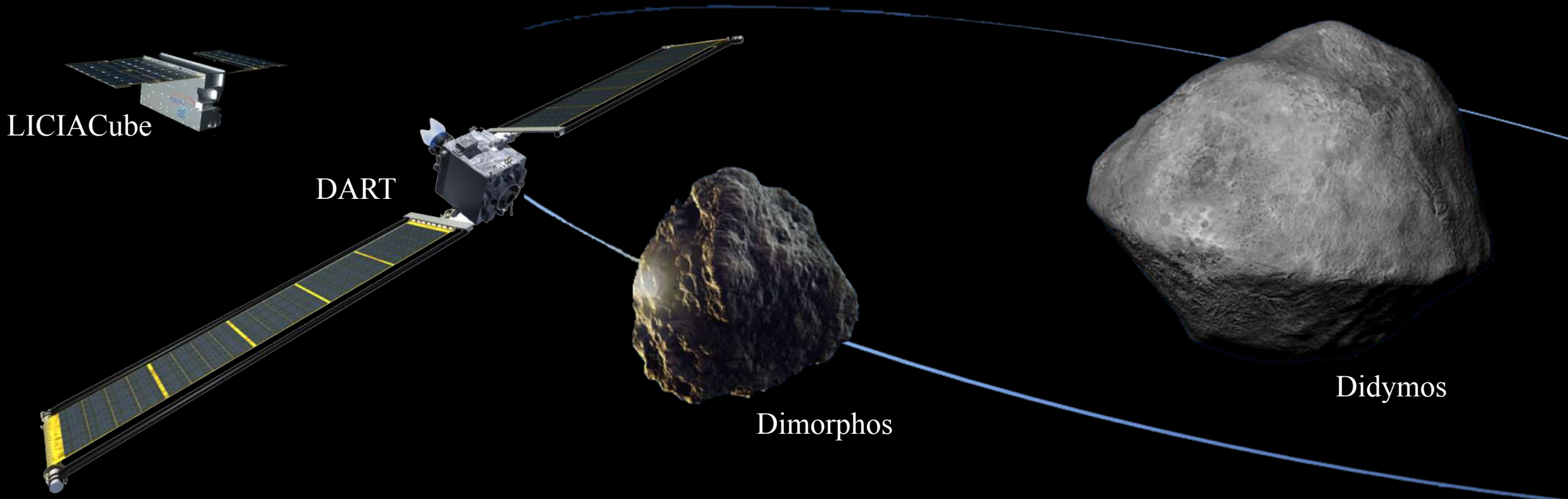
# The binary asteroid (65803) Didymos

Asteroid (65803) Didymos is a Near Earth S-type asteroid of the Apollo group. It is a binary system characterized by a 780±30 m size primary, called Didymos, and a 164±18 m size secondary, called Dimorphos, orbiting at a distance of ~1.19 km. The primary rotation period is 2.26 h, close to the 2.2 h disruption spin barrier (if the bulk density is less that 2.1 g/cm$^3$), while the period of revolution of Dimorphos around the primary is 11.92 h.



# The binary asteroid (65803) Didymos

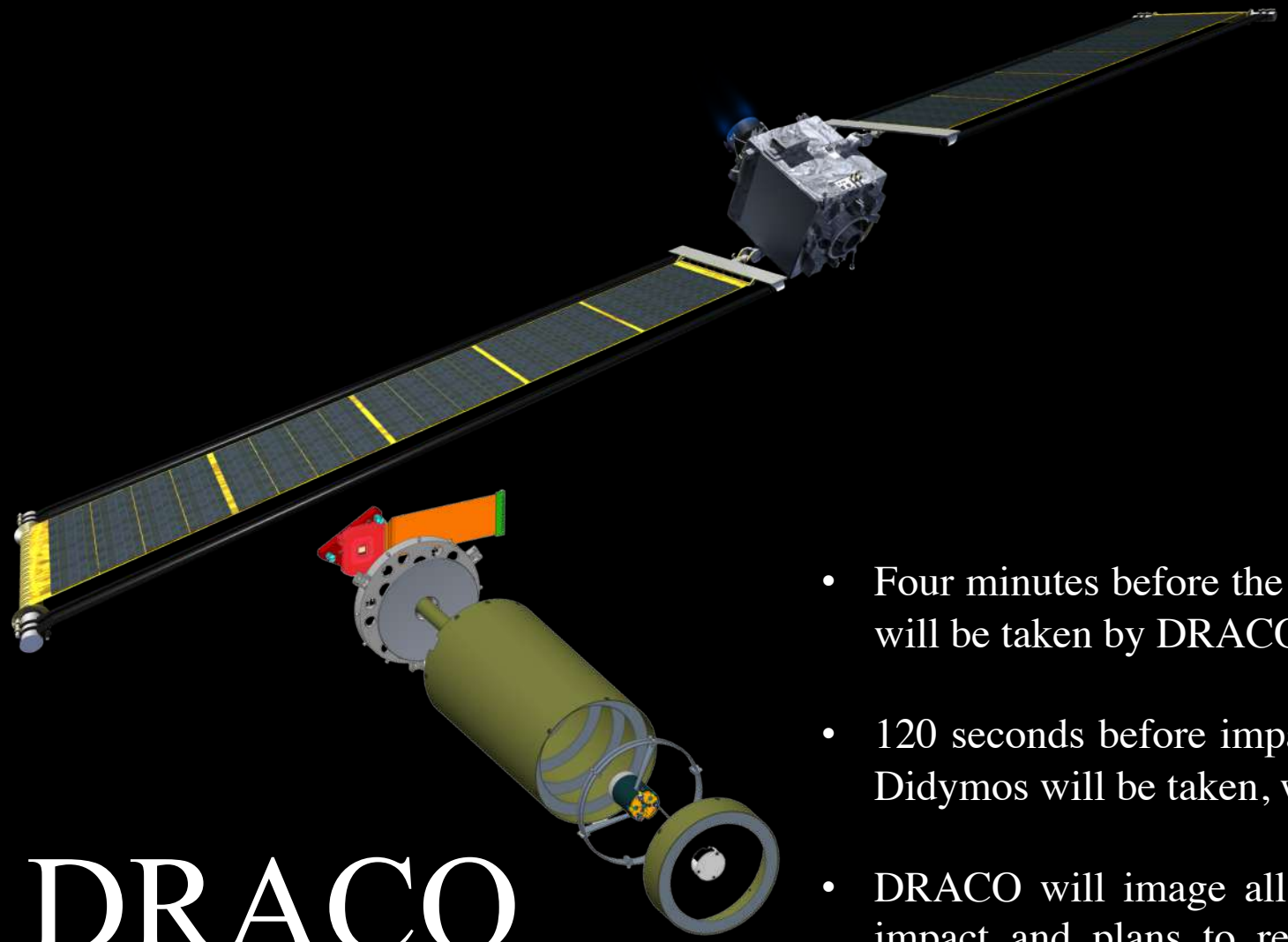
This asteroid is the target of the NASA Double Asteroid Redirection Test mission (DART), whose main goal is to impact Dimorphos at a speed of 6.6 km/s during the September-October 2022 timeframe. A complementary cubesat, called the Light Italian Cubesat for Imaging of Asteroids (LICIACube) will be released from DART ten days before the impact, and it will be autonomously guided through a flyby with closest approach (CA) distance of ~55 km from the target.

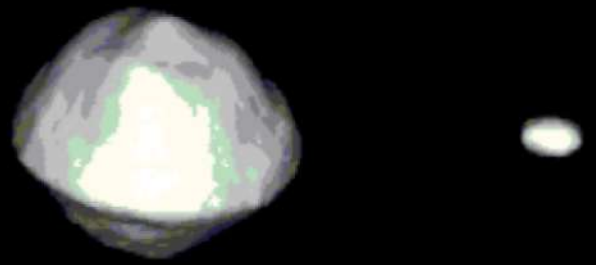


# DART

Goddard Space Flight Center
Johnson Space Center
Langley Research Center
Glenn Research Center
Marshall Space Flight Center
Planetary Defense Coordination Office

Johns Hopkins Applied Physics Laboratory
Jet Propulsion Laboratory, California Institute of Technology
Aerojet Rocketdyne
Lawrence Livermore National Laboratory
Auburn University
University of Colorado Boulder
University of Maryland
Northern Arizona University
Planetary Science Institute

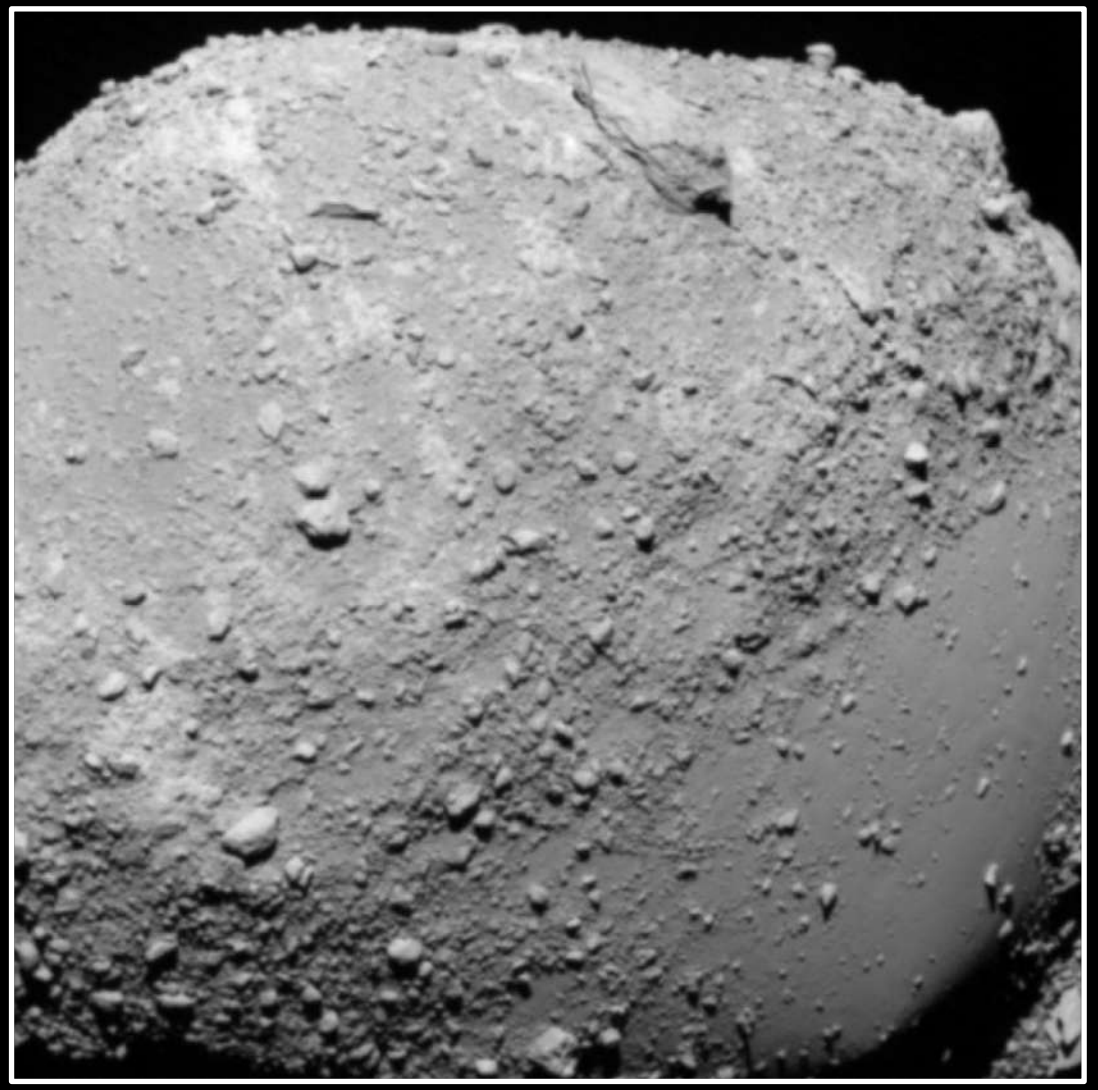




# DRACO

- Four minutes before the impact the last image that contains all of Didymos will be taken by DRACO, with an expected spatial scale of 7 m/pixel;
- 120 seconds before impact, the last DRACO image containing any part of Didymos will be taken, with a maximum resolution of 3.5 m;
- DRACO will image all of Dimorphos ~50 cm/pixel ~17 seconds before impact and plans to return at least one higher-resolution image before impact. These final image(s) will have pixel scales <15 cm/pixel.

Simulated view of the DRACO camera 129 seconds before impact. The shape used for Dimorphos is asteroid Itokawa, reduced in size to match the real dimensions.

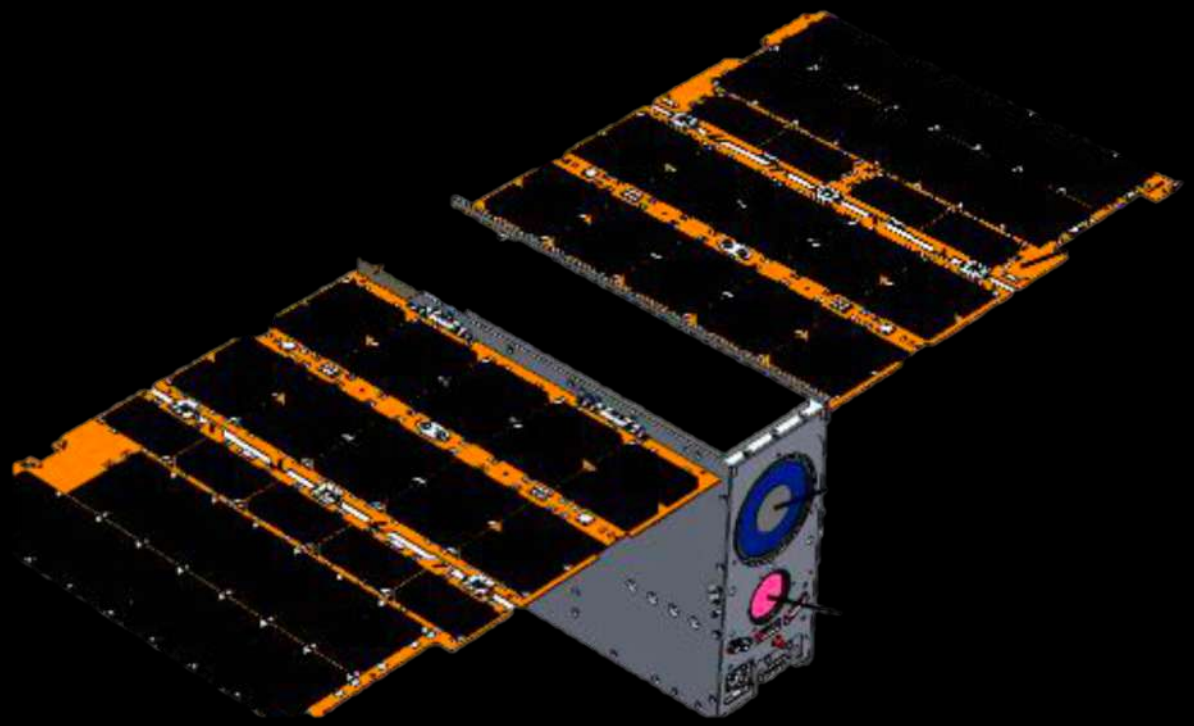


Hayabusa image of Itokawa at 50-cm pixel scale. Planned DRACO imaging will achieve the required 50-cm pixel scale ~17 s prior to impact.

# LICIACube

## LEIA <=> LUKE

"NAC" (3.12X) <=> "WAC"



Closest Approach

| | Focal length (mm) | FoV (°) | IFoV (μrad) | Spatial scale at 55.3km (m/px) |
|---|---|---|---|---|
| LEIA | 220 | ± 2.06 | 25 | 1.38 |
| LUKE | 70.55 | ±5 | 78 | 4.31 |

LEIA will image the non-impacted side of Dimorphos (not observed by DRACO) with resolutions ranging from 1.5 to 5 m.

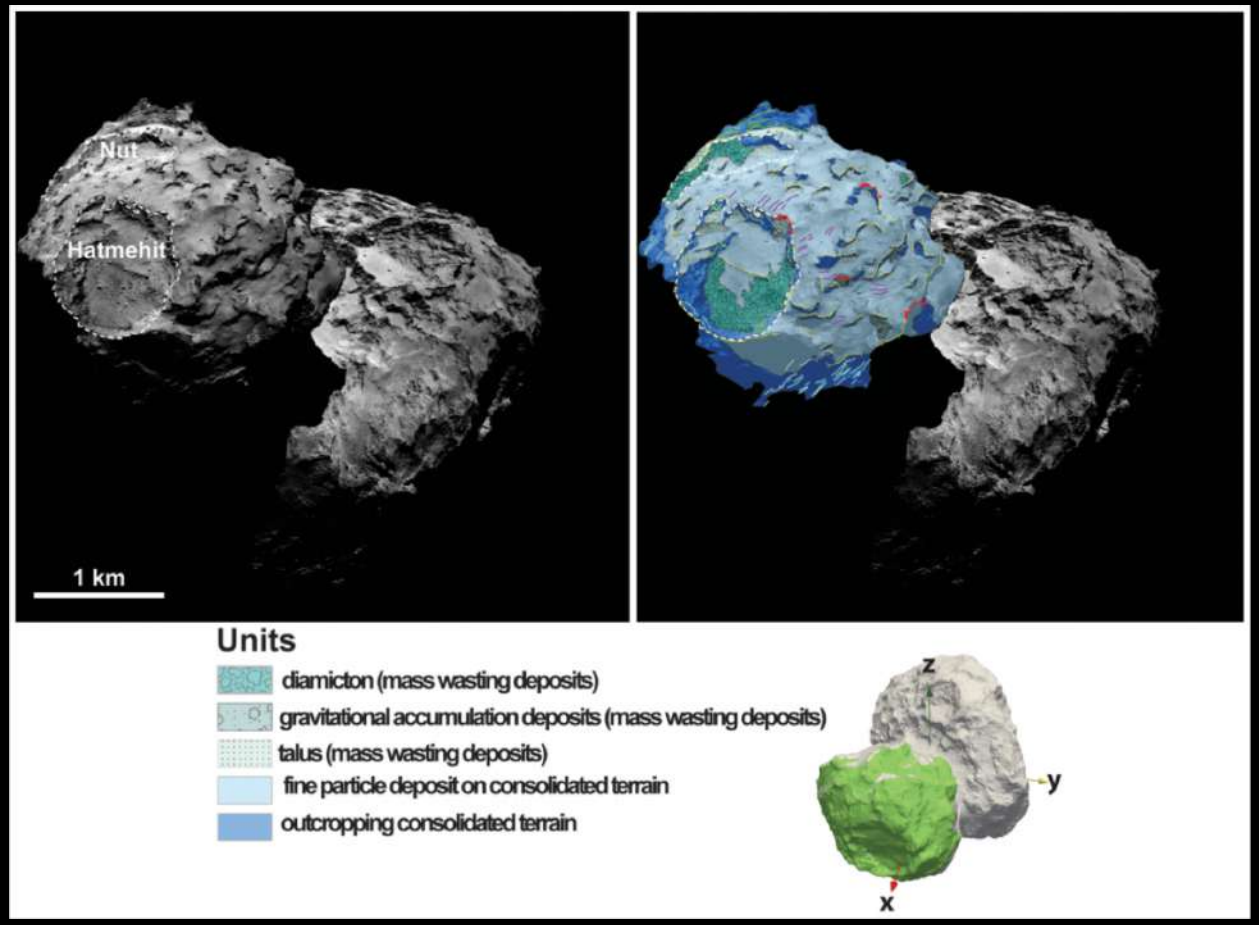
The S-type asteroid (25143) Itokawa observed with the Hayabusa/AMICA camera [16]. The spatial scale is 1.4 m/pixel, similar to the one that LEIA will take of Dimorphos at CA.

# Expected geological assessment for Didymos & Dimorphos

The multi-scale DRACO-LEIA dataset will be characterised by different geometry and viewing angles. Such images will allow assessment of surface geology, not only of the DART impact site, but also of the observed surfaces as a whole.

**1) Geomorphological units identification and definition** ==>> multi-scale <<==

The morphological units of the surface are characterised by different texture, roughness and albedo.



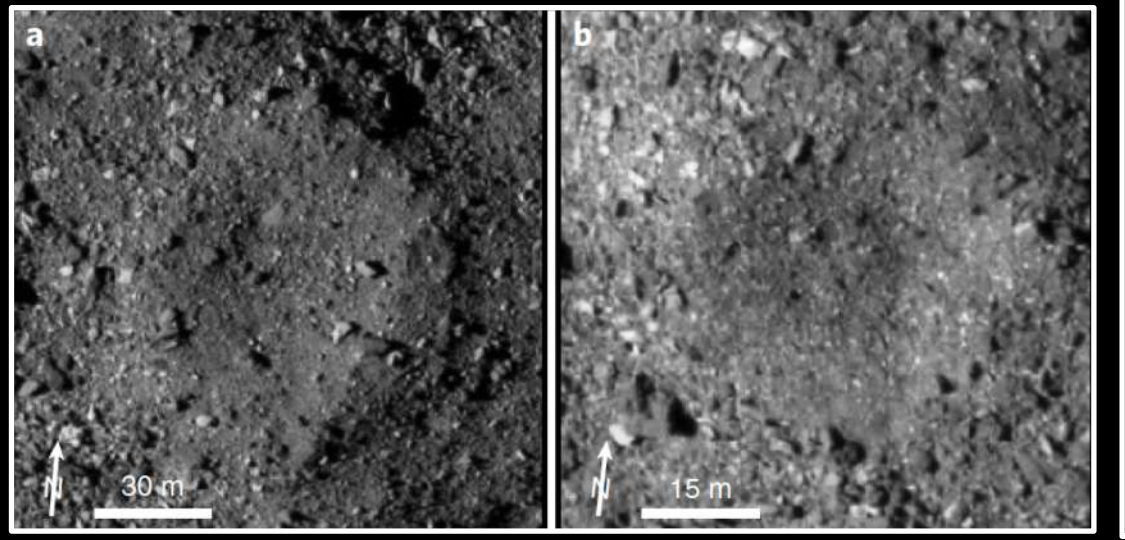
# Expected geological assessment for Didymos & Dimorphos

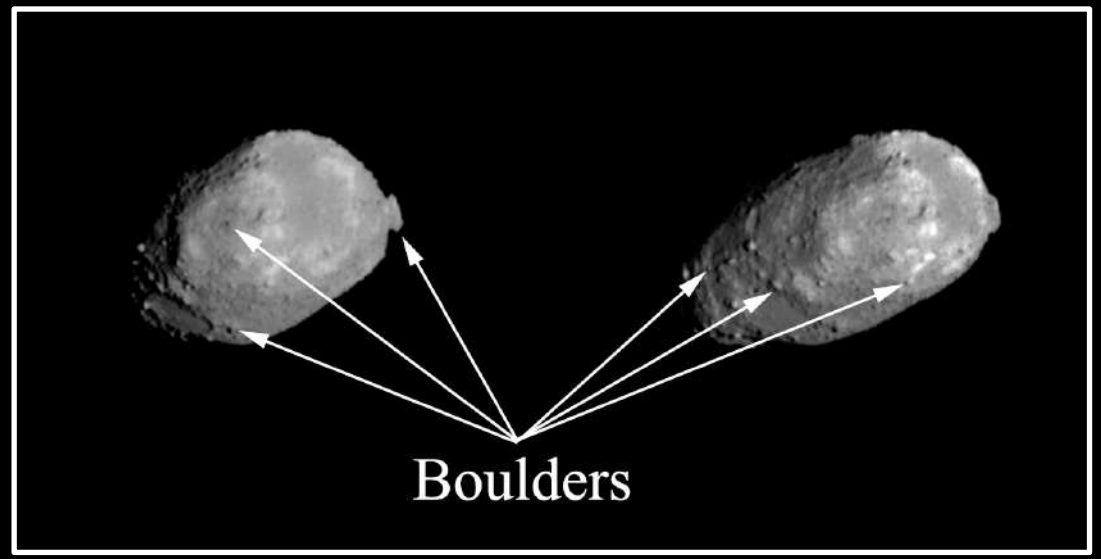
**2) Geological Processes that occurred or are still occurring on the asteroids' surfaces** ==>> multi-scale

- **Craters morphology** (are there degradation states? how many craters are there?) and **cratering age determination** (DART/DRACO)

- **Mass wasting** (if any). Possible latitudinal differences in texture => Didymos asteroid is spinning close to the ~2.2 h disruption point. What are the implications of such spin on its surface? Possible longitudinal variations like those on Ryugu? (DART/DRACO – LICIACube/LEIA).

- **Boulders SFD:** we are referring to both the ones formed in situ due to cratering, as well as the "primordial-parent body shards" that pop out on the surface (DART/DRACO – LICIACube/LEIA).



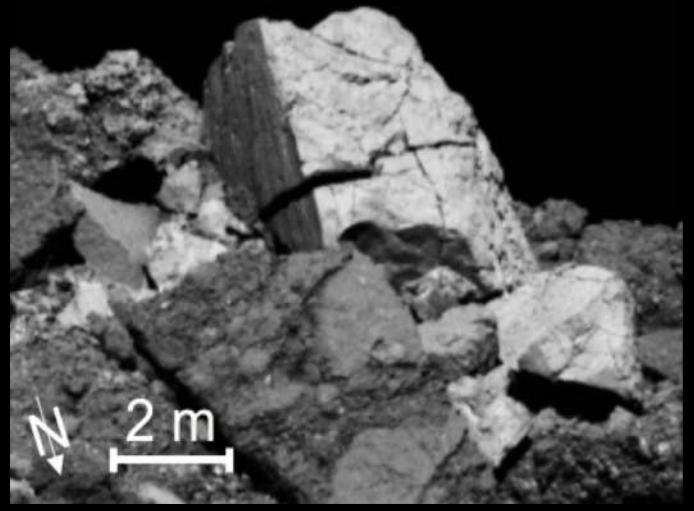
# Expected geological assessment for Didymos & Dimorphos

**2) Geological Processes that occurred or are still occurring on the asteroids' surfaces** ==>> multi-scale

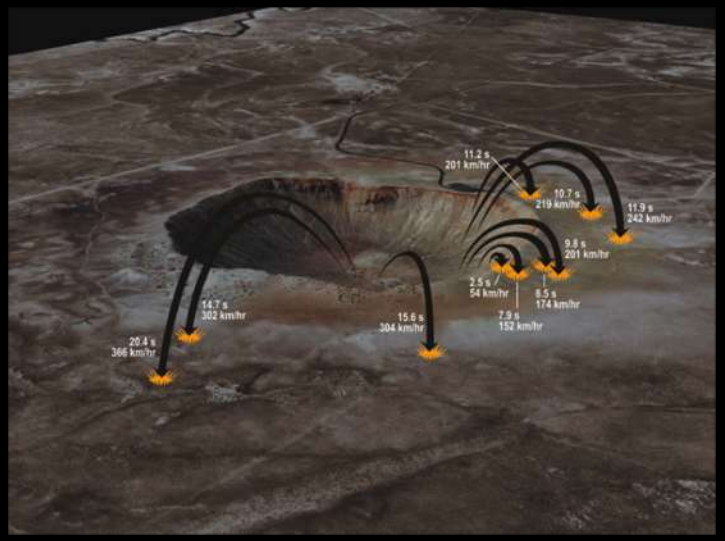
- **Fractures/lineaments** both located on the surface of the asteroid, as well as on boulders (DART/DRACO). Thermal implications? Impacts-related?

- **Color differences/variegation on the surface** (LICIACube/LUKE). Are we expecting any surface variegation? Reddening effects?

- **The newly crater formed**: what are the implications for the geological assessment? Subsurface exposition (LICIACube/LEIA observations), no weathering, colors (LICIACube/LUKE), boulders ejected.







# Thanks!

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