



Advancing near-Earth asteroid science through CubeSat missions and ground-based observations

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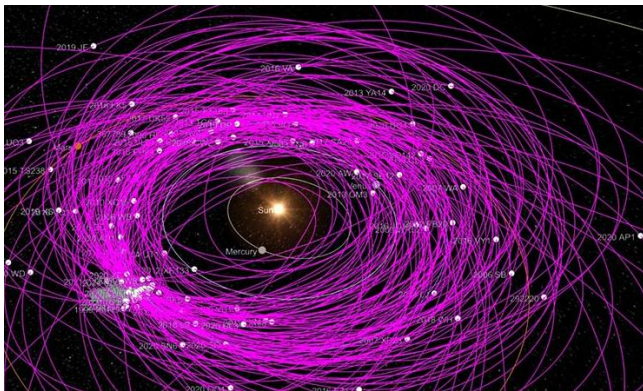
Piazzini 200: new frontiers in astrometry, small bodies and technologies
Palermo, 30 Sep – 2 Oct 2026

Why near-Earth asteroids do matter



- The closest building blocks of the solar system
- Source of prebiotic material on the early Earth
- Study of small-sized asteroids
- Accessible targets for space missions
- Planetary defense

From ground (population studies)



From space (detailed characterization)



NEA characterization: European projects



NEOShield

2012-2015

No Italian participation



NEOShield-2

2015-2017

INAF-OAR participation



NEOROCKS

2020-2023

Led by INAF-OAR



NEOPOPS

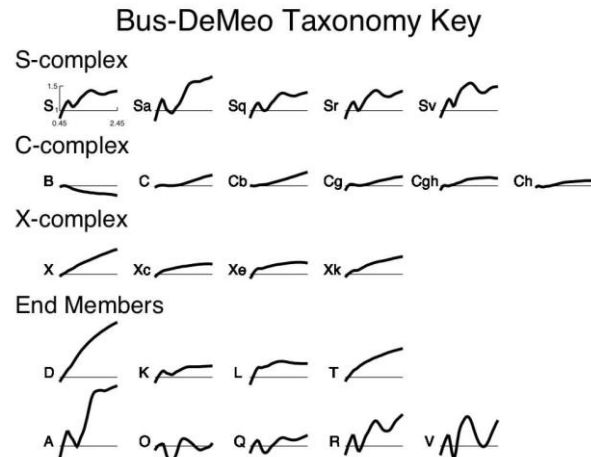
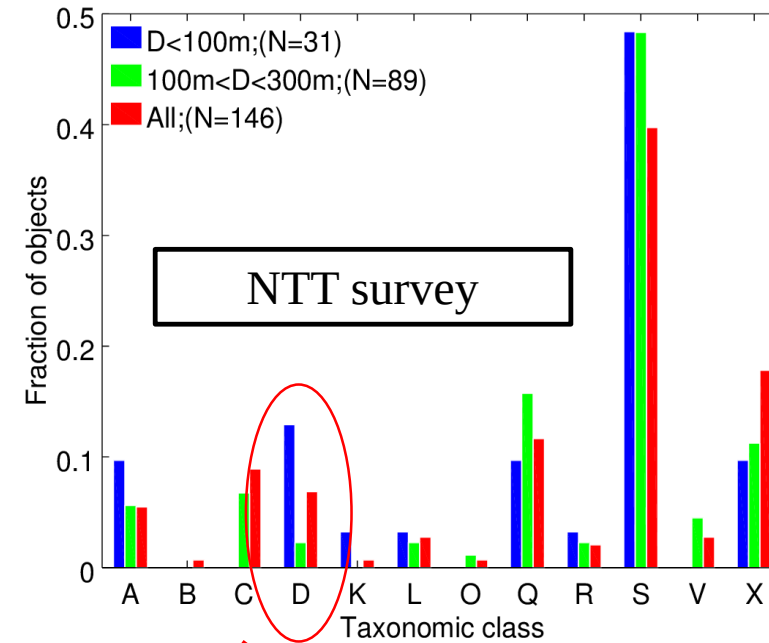
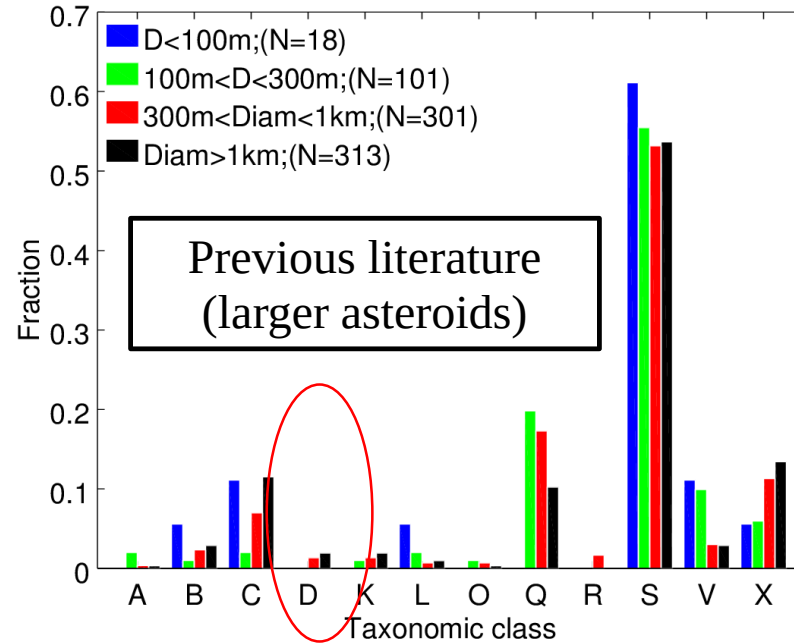
2025-2028

Led by INAF-OAR

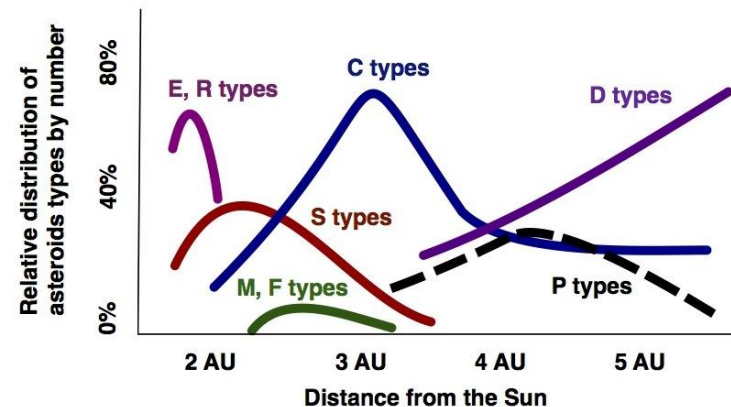


Small NEAs: the ESO-NTT survey

(Perna et al. 2018, P&SS)



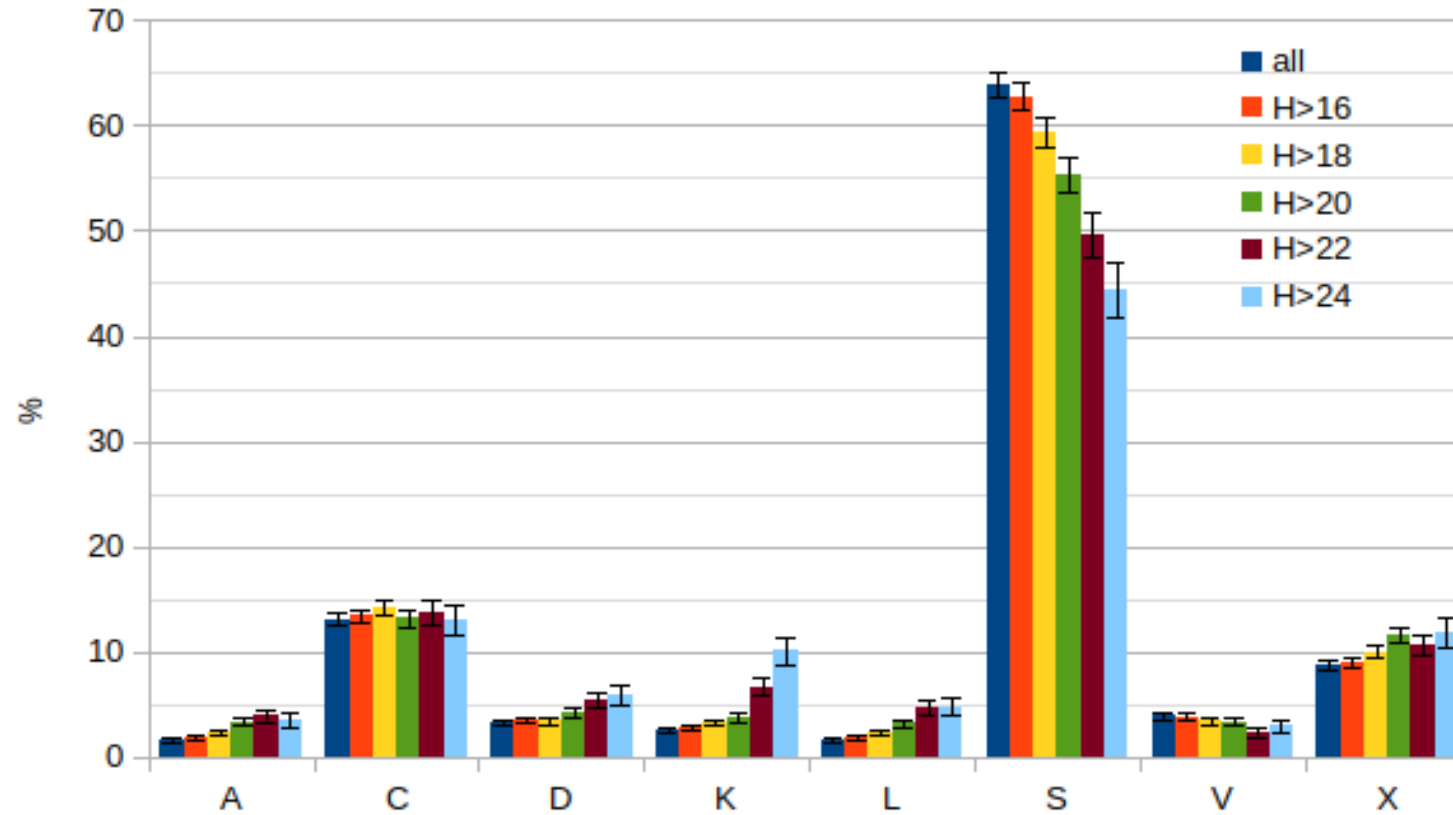
<http://smass.mit.edu/busdemeoclass.html>
F. E. DeMeo, R. P. Binzel, S. M. Slivan, and S. J. Bus. Icarus 202 (2009) 160-180



Asteroidal contribution to the terrestrial prebiotic material could be even more important than previously foreseen

Small NEAs: extended survey

(Ieva et al. 2020, A&A)



- Our data (ESO-NTT + TNG) + MITHNEOS/MANOS surveys: 1081 NEAs
- Primitive (dark) asteroids: more abundant at small sizes (larger H), despite observational bias
- Still limited statistics (few tens of NEAs) for most classes: more data needed!

The Rapid Response Experiment

(Bourdelle de Micas et al. 2026, P&SS)



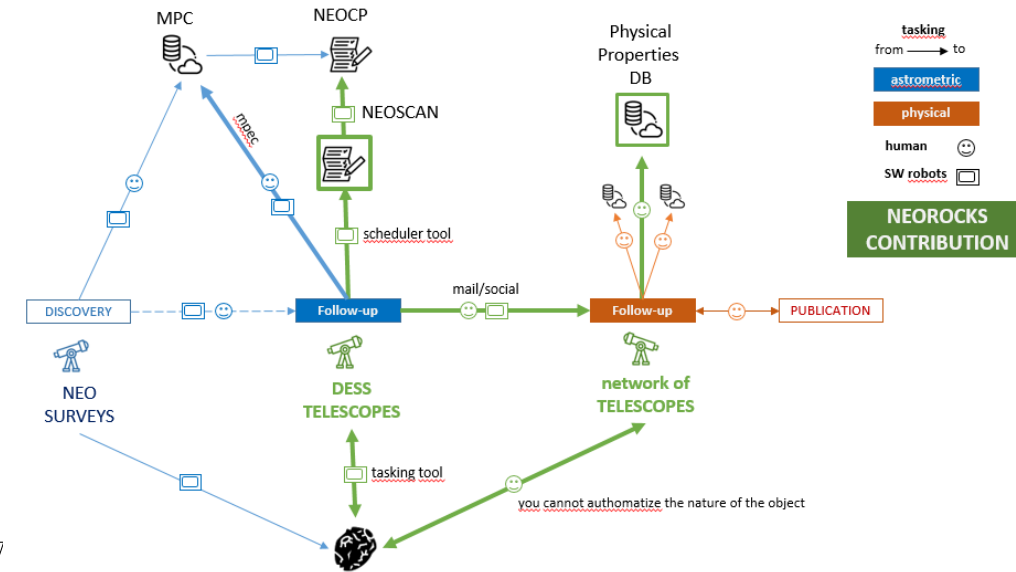
WP3 – carry out physical characterization upon short notice through the project observational network



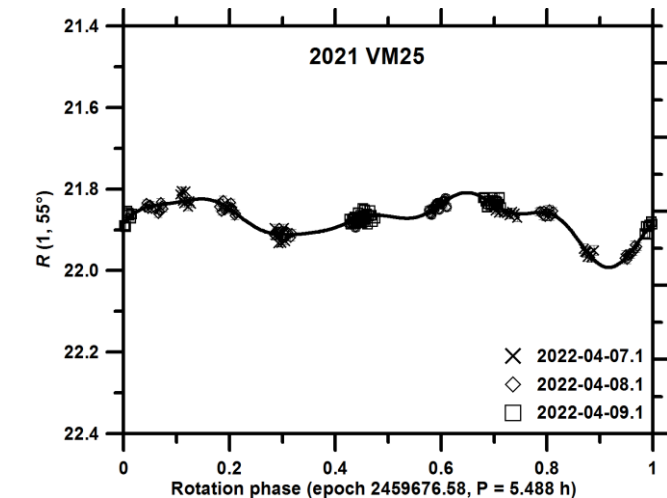
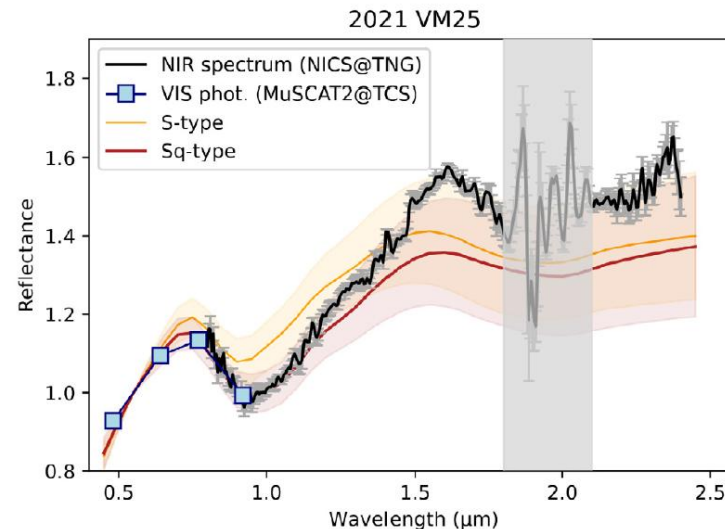
WP4 – implement a basic rapid response system scenario based on existing robotic telescopes through developing the related procedures and tasking SW



WP6 – analyze outcome and issue recommendations:
Final Report on international cooperation for NEO physical characterization and rapid response systems

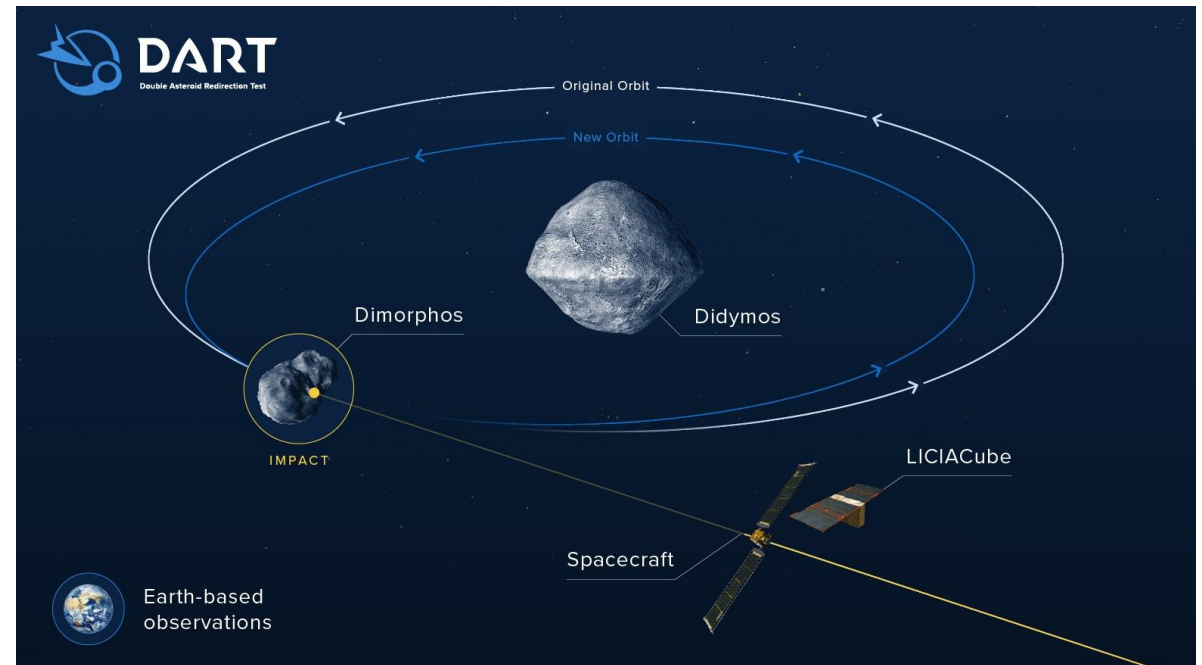
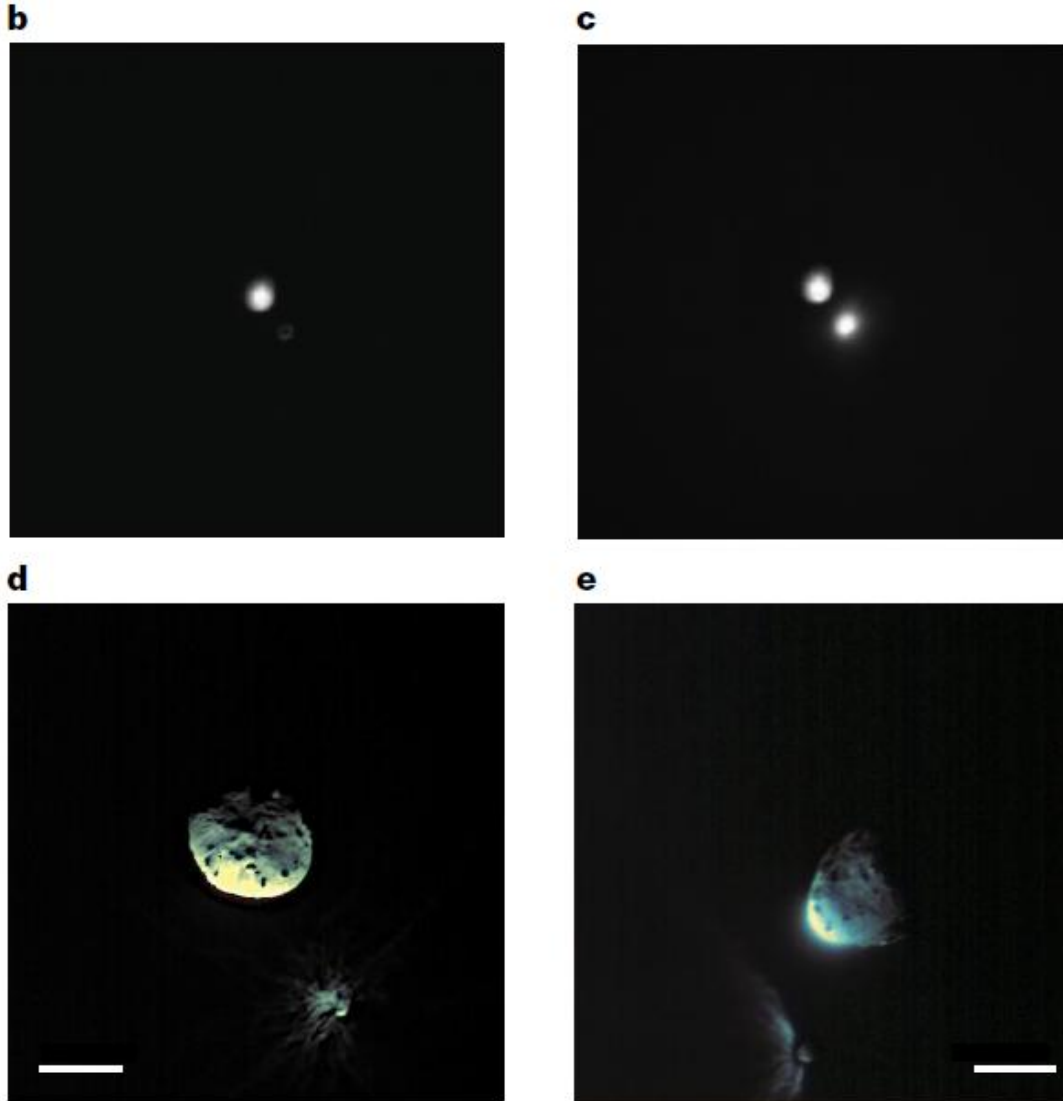


Example results for 2021 VM25:



LICIACube: close-up observer of the DART impact

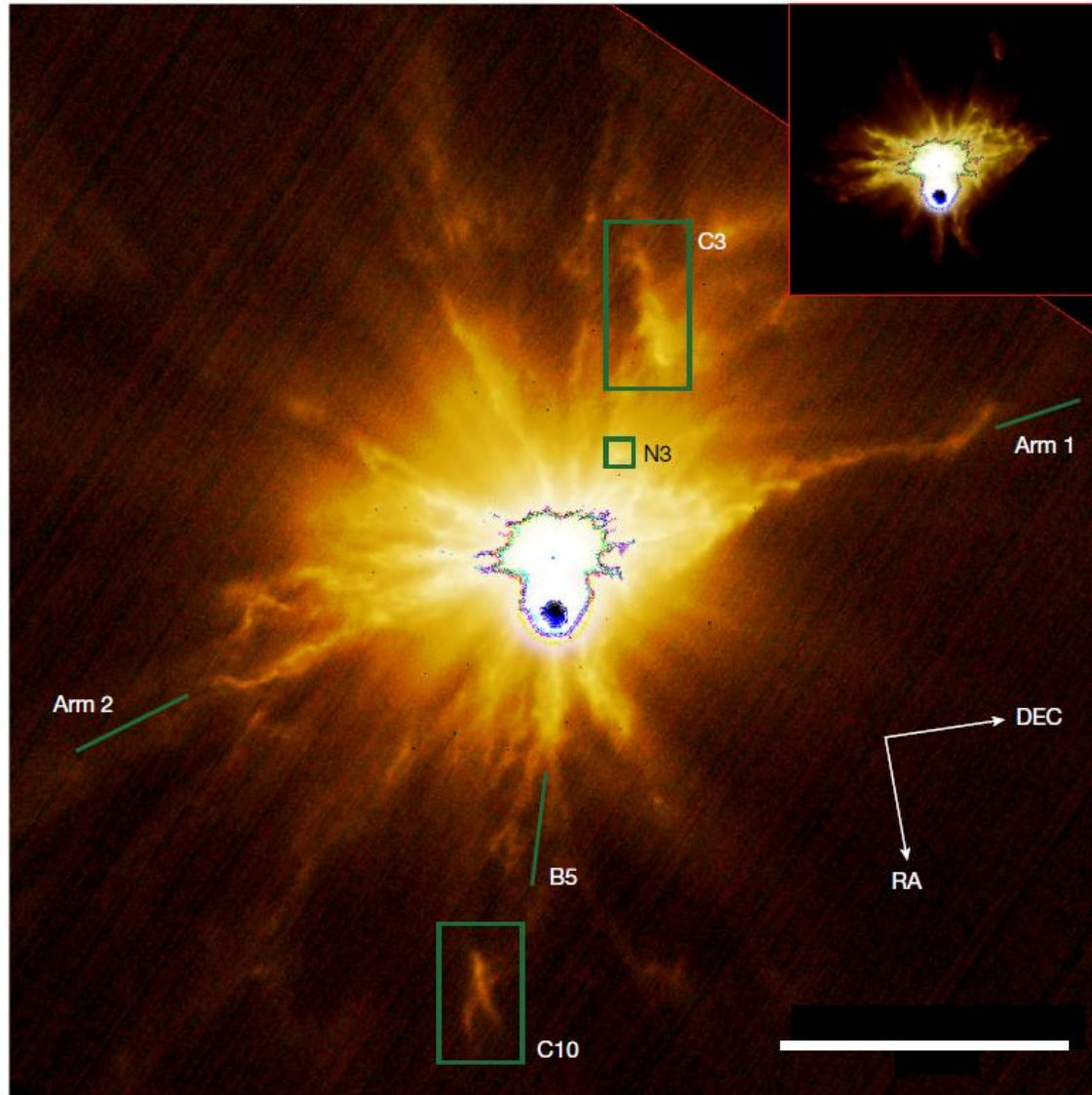
(Dotto et al. 2024, Nature)



- 6U ASI CubeSat
- 58 km closest approach
- LEIA (pan) and LUKE (RGB) cameras
- 426 scientific images

LICIACube: close-up observer of the DART impact

(Dotto et al. 2024, Nature)



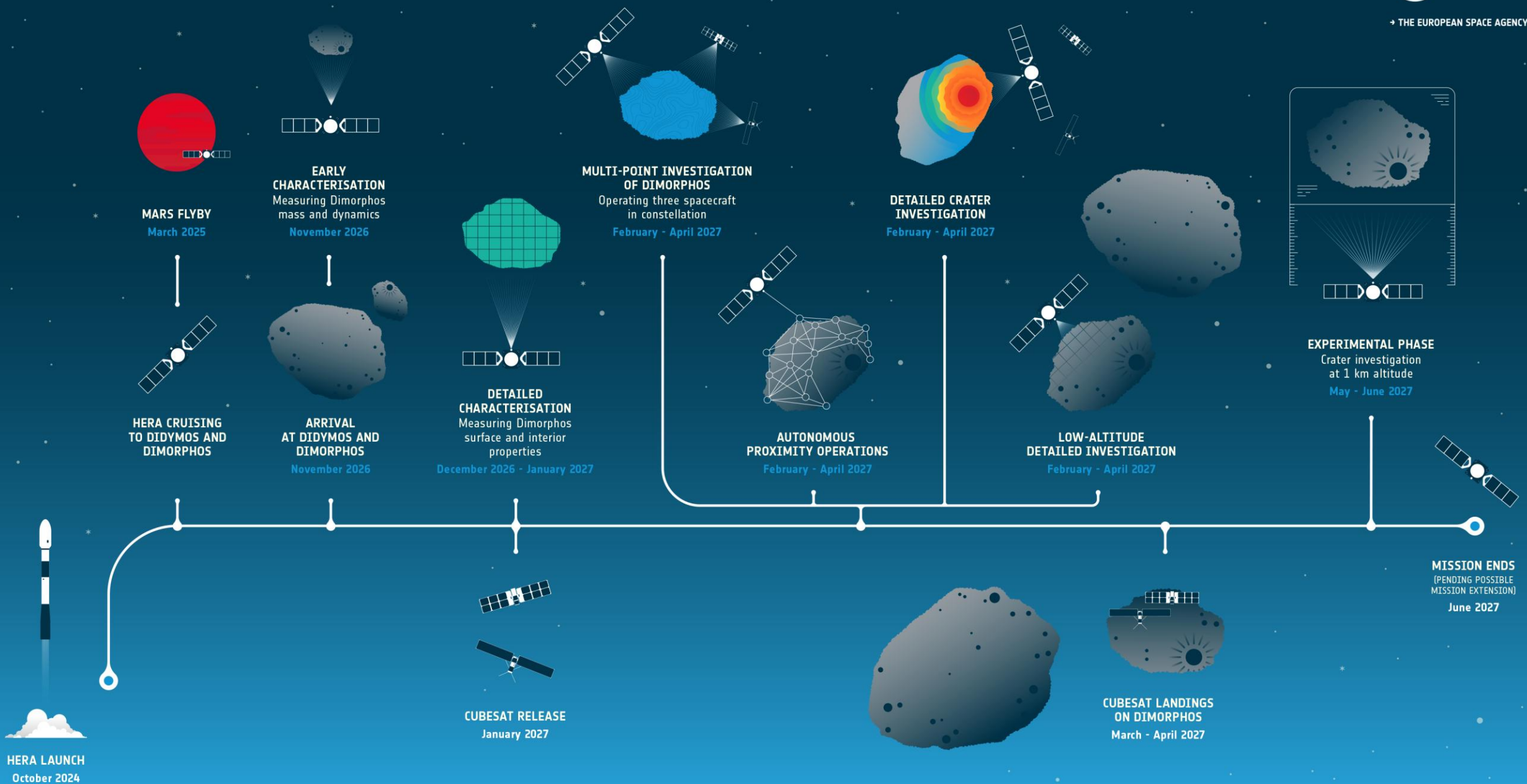
Highly structured and heterogeneous ejecta plume

- Cone aperture: $140 \pm 4^\circ$
- 18 main filaments resolved close to Dimorphos
- Ejecta velocities: tens to ≈ 500 m/s

HERA MISSION TIMELINE



→ THE EUROPEAN SPACE AGENCY



Selected within ASI ALCOR small satellites program

- 8-month Phase A completed
(see results in *Perna et al. 2026, Acta Astronautica*)
- Target launch date: 2030-2033

Interplanetary 12-U CubeSat

- Encounters with multiple near-Earth asteroids (NEAs)
 - 2 flybys (interplanetary cruise: ~20 months)
 - 2-month rendezvous with a “small” (< 100 m) NEA
- Payload: 2 COTS cameras (+ transponder)

Robust, flexible, low-cost, high-return concept

- To explore the huge NEA diversity

