

# Hera Measurement Goals and Payload

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Presented for  
The Hera Team

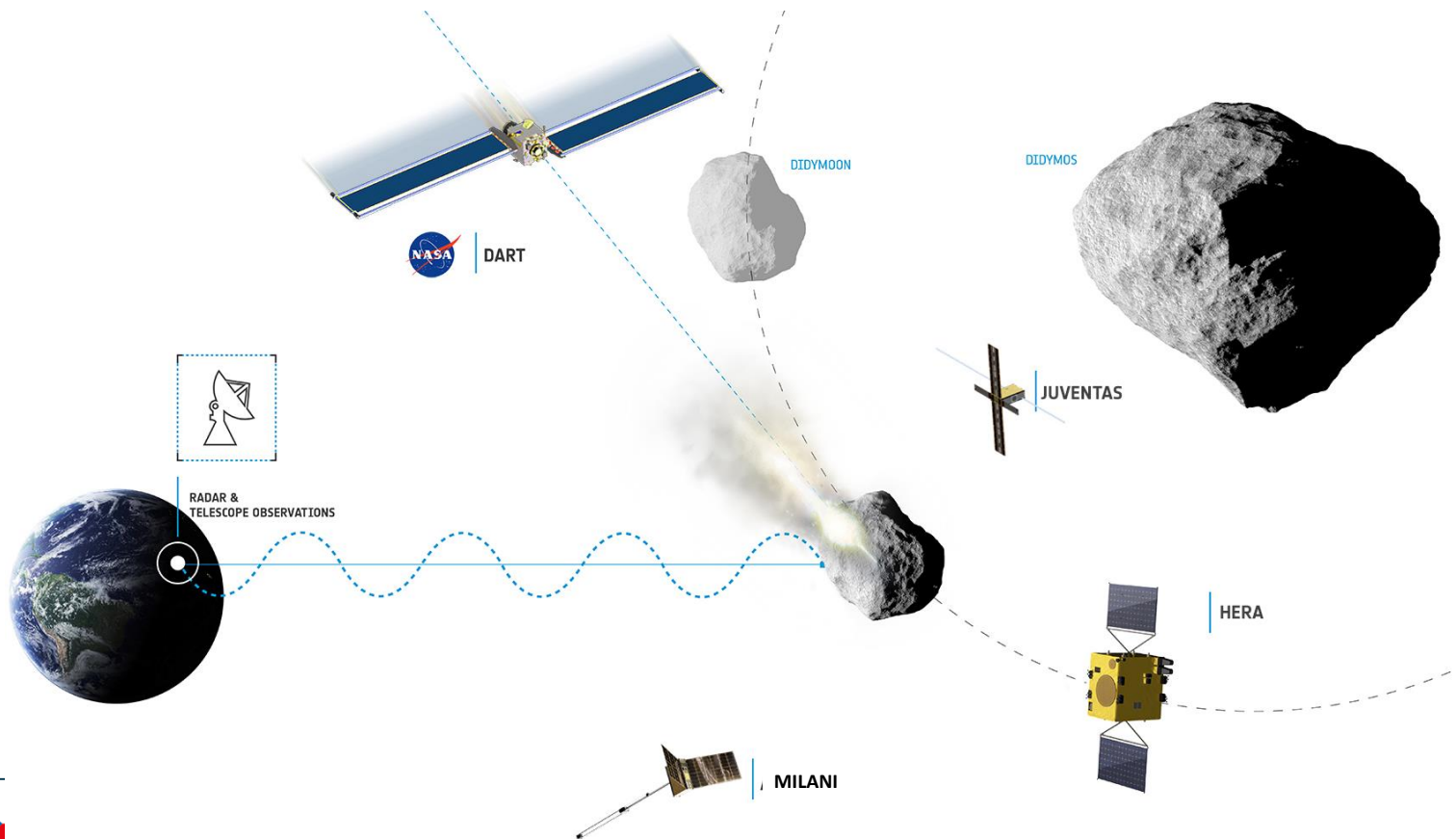
Michael Küppers

ESA/ESAC

26 April 2021

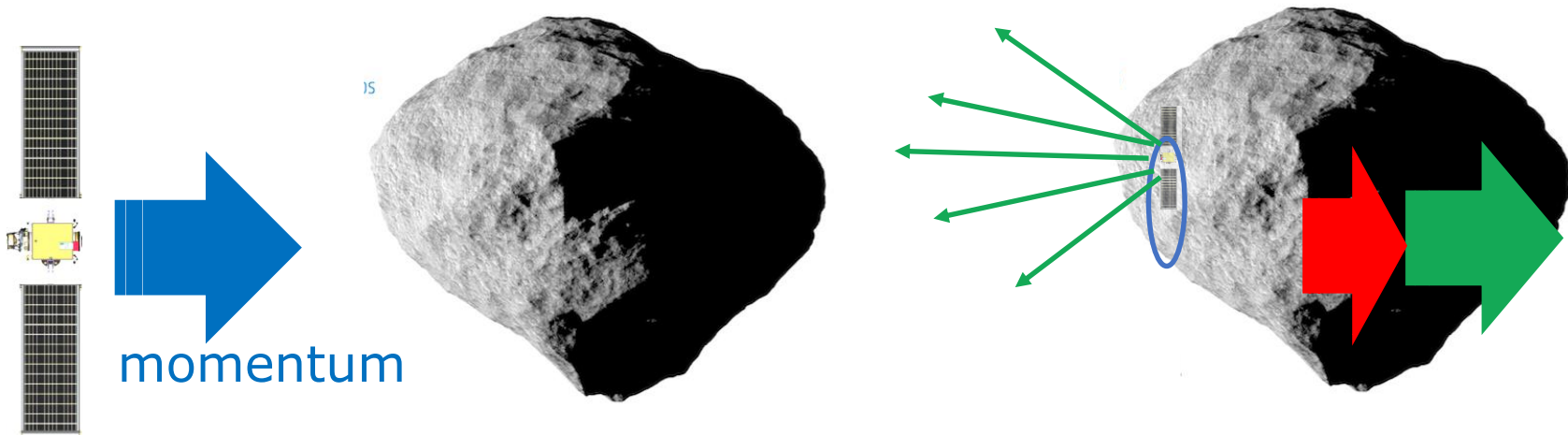


1. Demonstrate the deflection of the target -> DART, Groundbased
2. Measure the efficiency of the momentum transfer from projectile (DART) to target (Dimorphos) -> Hera, Groundbased
3. Characterize the target -> Hera



$$\text{Dimorphos mass} \times \Delta V = \text{momentum} + \text{momentum (ejecta)}$$

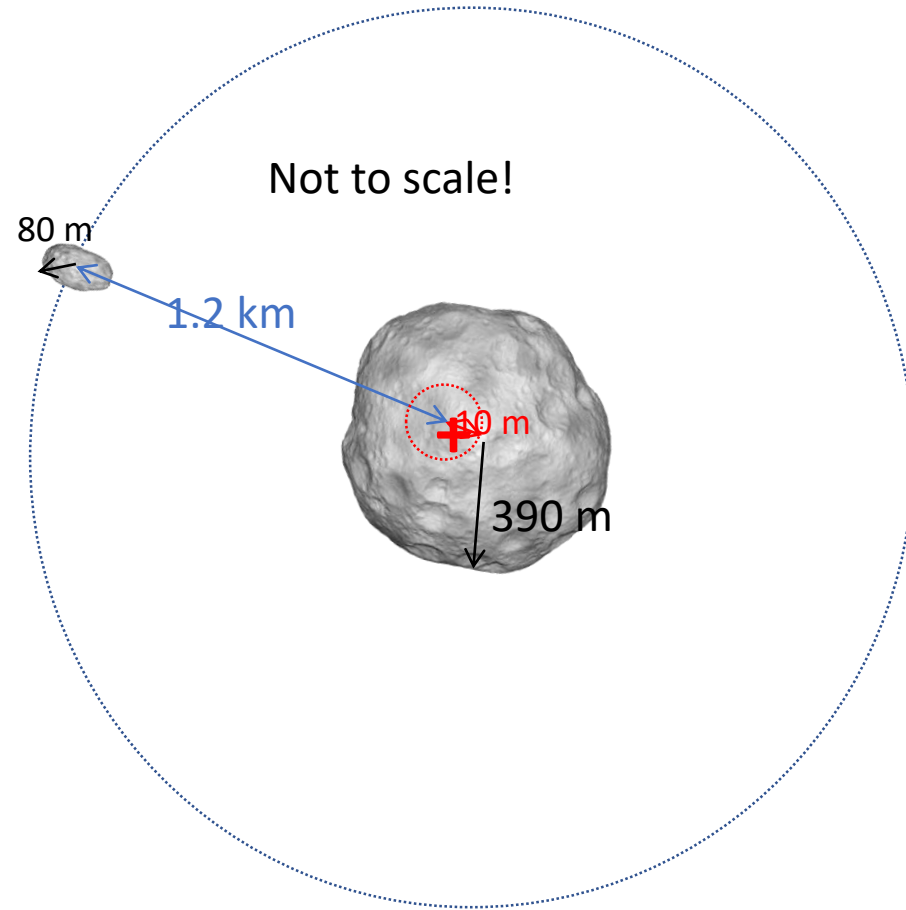
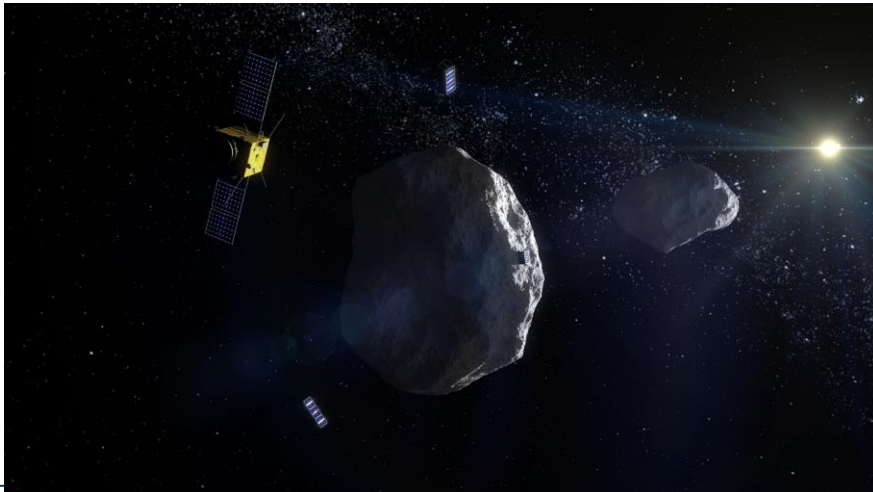
$$= \text{momentum} \times \beta$$

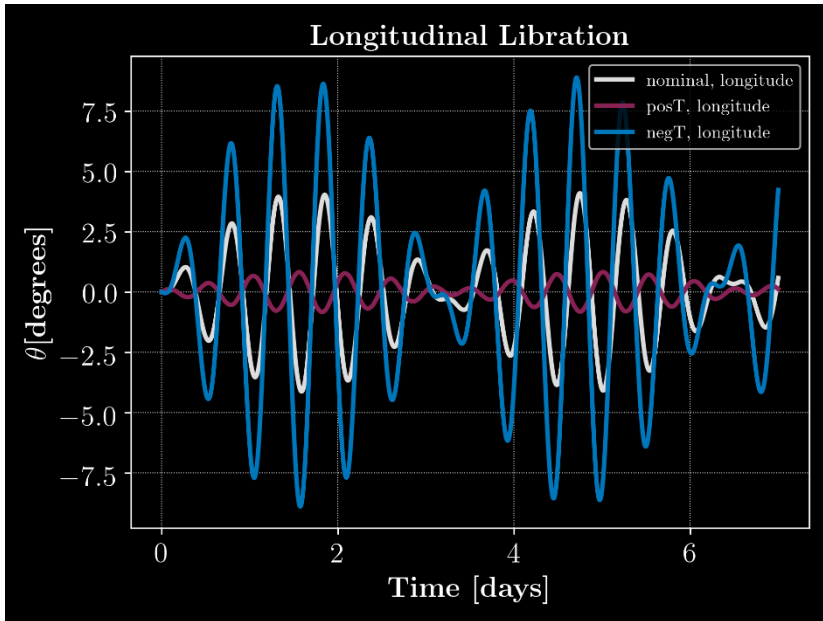


$$\text{Efficiency } \beta = \frac{\text{Dimorphos mass} \times \Delta V}{\text{momentum}}$$

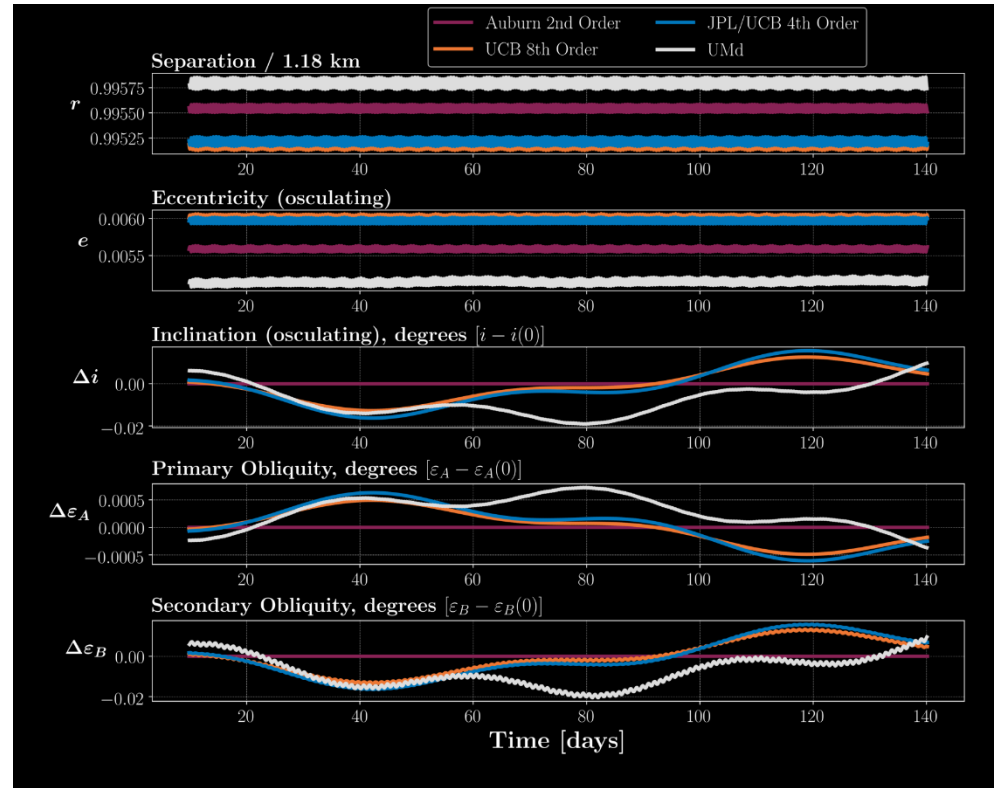
2 unknowns in the momentum equation: **Dimorphos mass** and  **$\beta$**

- Measurement of the “Wobble” motion of Didymos due to the gravity of Dimorphos
- Supporting observations by Radio Science (spacecraft deflection due to Dimorphos gravity)





Source: Agrusa et al., Icarus 349, Art. 113849, 2020

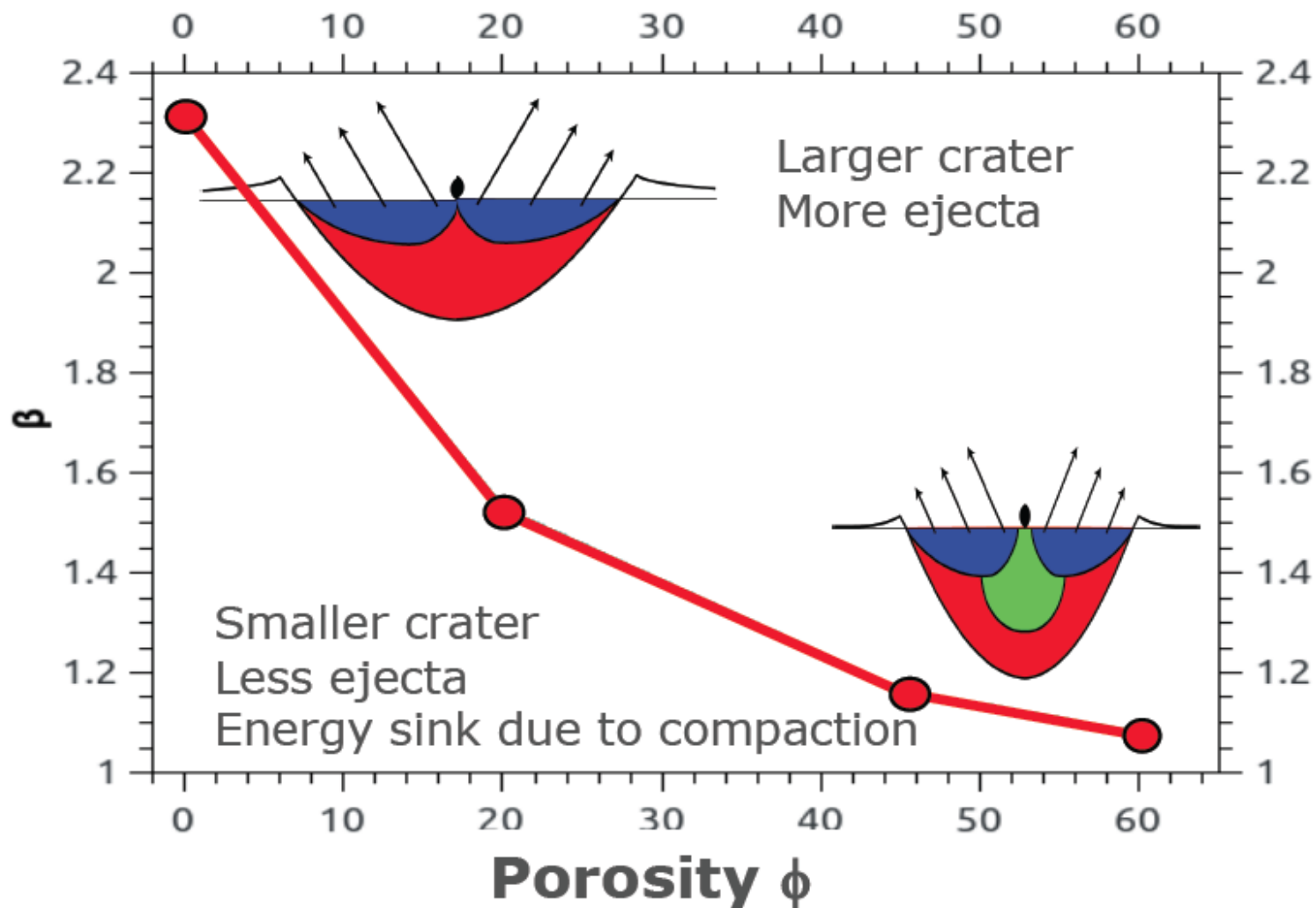


Additional contribution to  $\beta$ : Momentum transfer into rotational motion =>

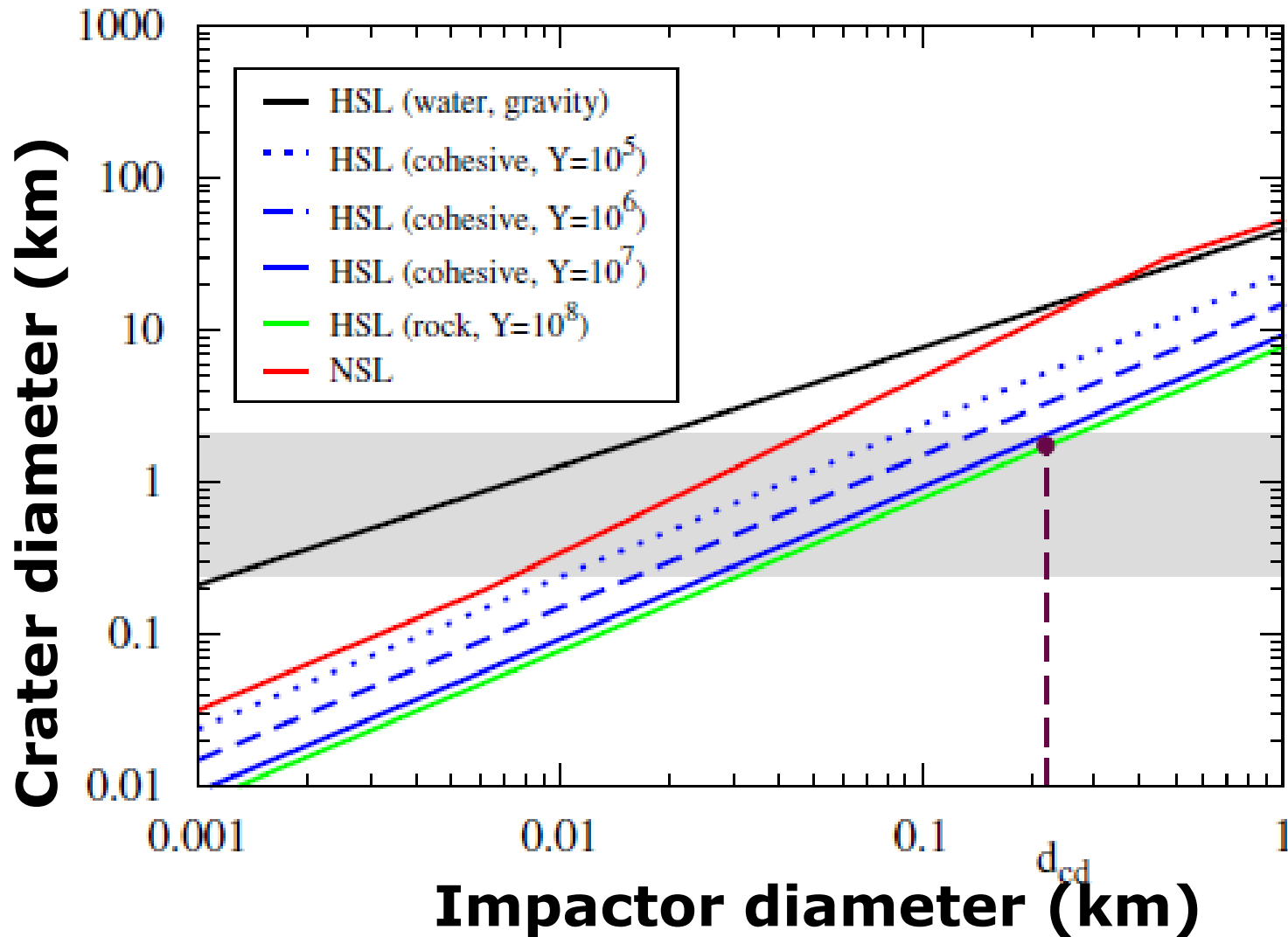
Need for determination of orbital and spin parameters, including possible libration of Dimorphos induced by DART impact

# Hera Measurement Goal 3: Properties of Dimorphos (for scaling of the impact outcome to other objects)

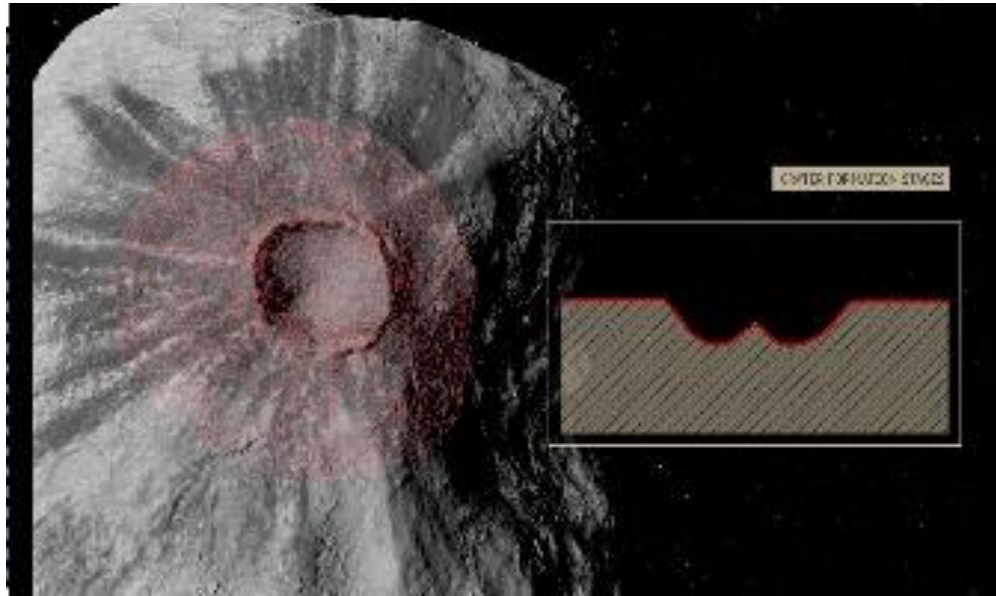
Momentum transfer enhancement factor



# Hera Measurement Goal 3: Properties (Example material strength)



# Hera Measurement Goal 4: Shape and Volume of the Impact Crater, spectral comparison to bulk asteroid



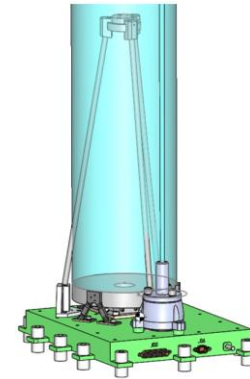
Unique opportunity to verify impact models and experiments as impactor and crater are both known!





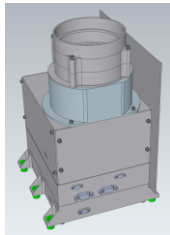
## Asteroid Framing Cameras (AFC)

- Broadband, pan-chromatic visual imager
- 5.5 deg. FoV
- 1m/pixel from 10 km



## Planetary Altimeter (PALT)

- Laser Range Finder
- Wavelength 1.5  $\mu\text{m}$
- footprint 1 mrad (1m from 1 km)
- operating frequency up to 10 Hz



## Thermal InfraRed Imager (TIRI)

- Contributed by JAXA,
- Wavelength range 7 -14  $\mu\text{m}$ , 6 filters
- Field of view 13.3 X 10.6 deg.
- 2.3 m/pixel from 10 km



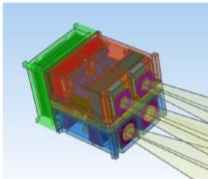
## Hyperspectral Imager (Hyperscout-H)

- Visible spectral imager
- 15.5 X 8.3 deg. field of view (TBC)
- 1.3 m/pixel from 10 km
- Spectral range and resolution TBD



Milani Cubesat with

**1. ASPECT: Visual and near-IR Fabry-Perot imaging spectrometer**

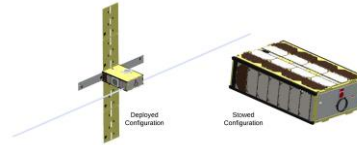


- Spectral range 0.5 – 2.5  $\mu\text{m}$
- Spectral resolution <40 nm (visible < 20nm)
- 2 m/pixel from 10 km

**2. VISTA: Thermogravimeter**

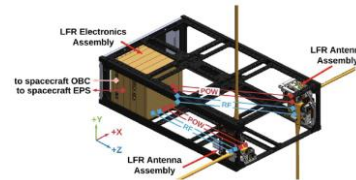


- Dust detector
- Composition analysis (water, organics)



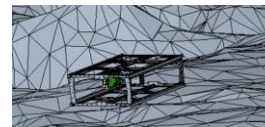
Juventas Cubesat with

**1. Low-Frequency Radar (LFR)**



- Frequency 50-70 MHz
- Resolution 10-15 m

**2. Gravimeter (GRASS)**



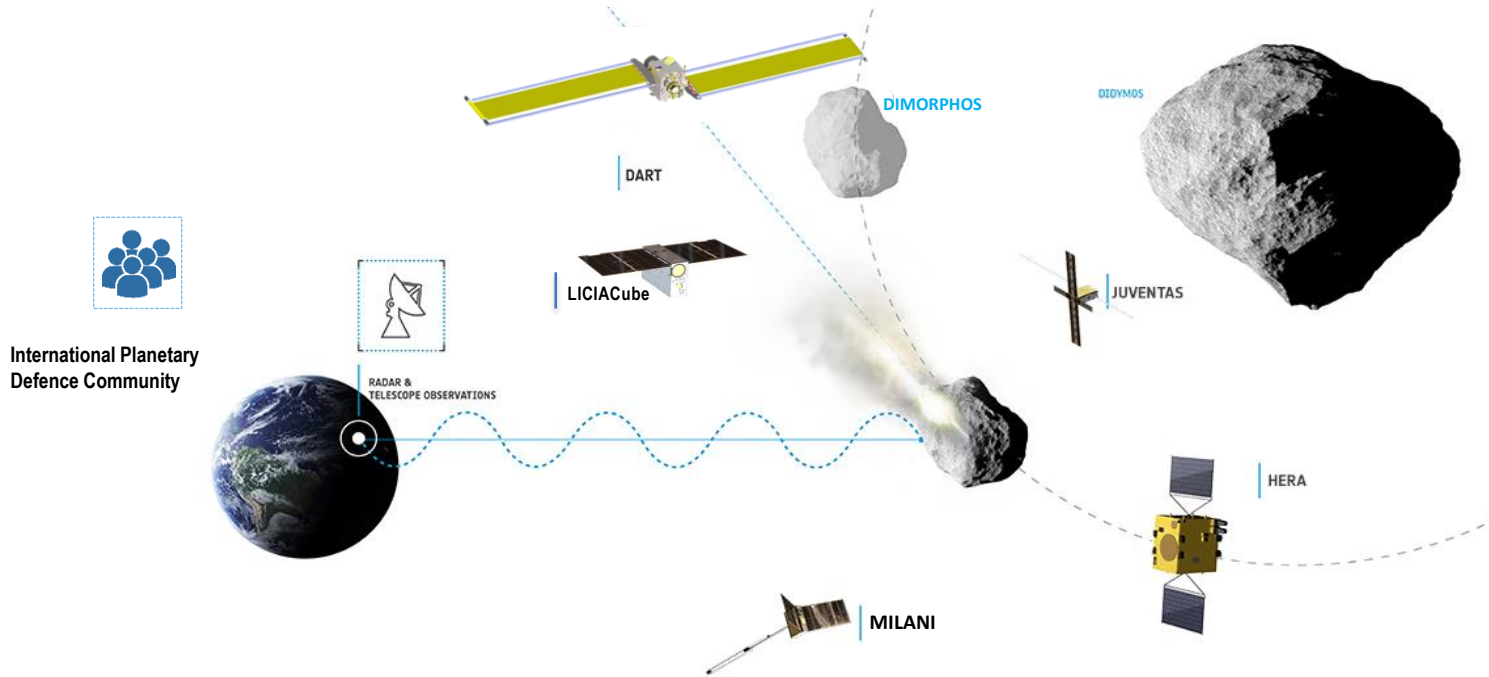
- Dynamic range  $5 * 10^{-4} \text{ m/s}$
- Sensitivity  $5 * 10^{-7} \text{ m/s}$



**Radio Science Experiment**

- Utilizes Hera->earth link and Intersatellite link Hera <-> cubesats

# Summary: Asteroid Impact Deflection Assessment (AIDA)



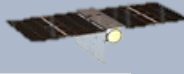
## AIDA

Synergy from

**DART** 

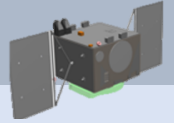
First demonstration of asteroid deflection by kinetic impact on Dimorphos, to change its orbit

with

**LICIACube** 

First prompt imaging of the impacted surface, ejecta plume evolution and of the non-impacted hemisphere of Dimorphos

+

**Hera** 

Mass of Dimorphos  
Detailed dynamical characterization  
Detailed investigation of final crater  
Overall characterization of the asteroids

Thank You!

