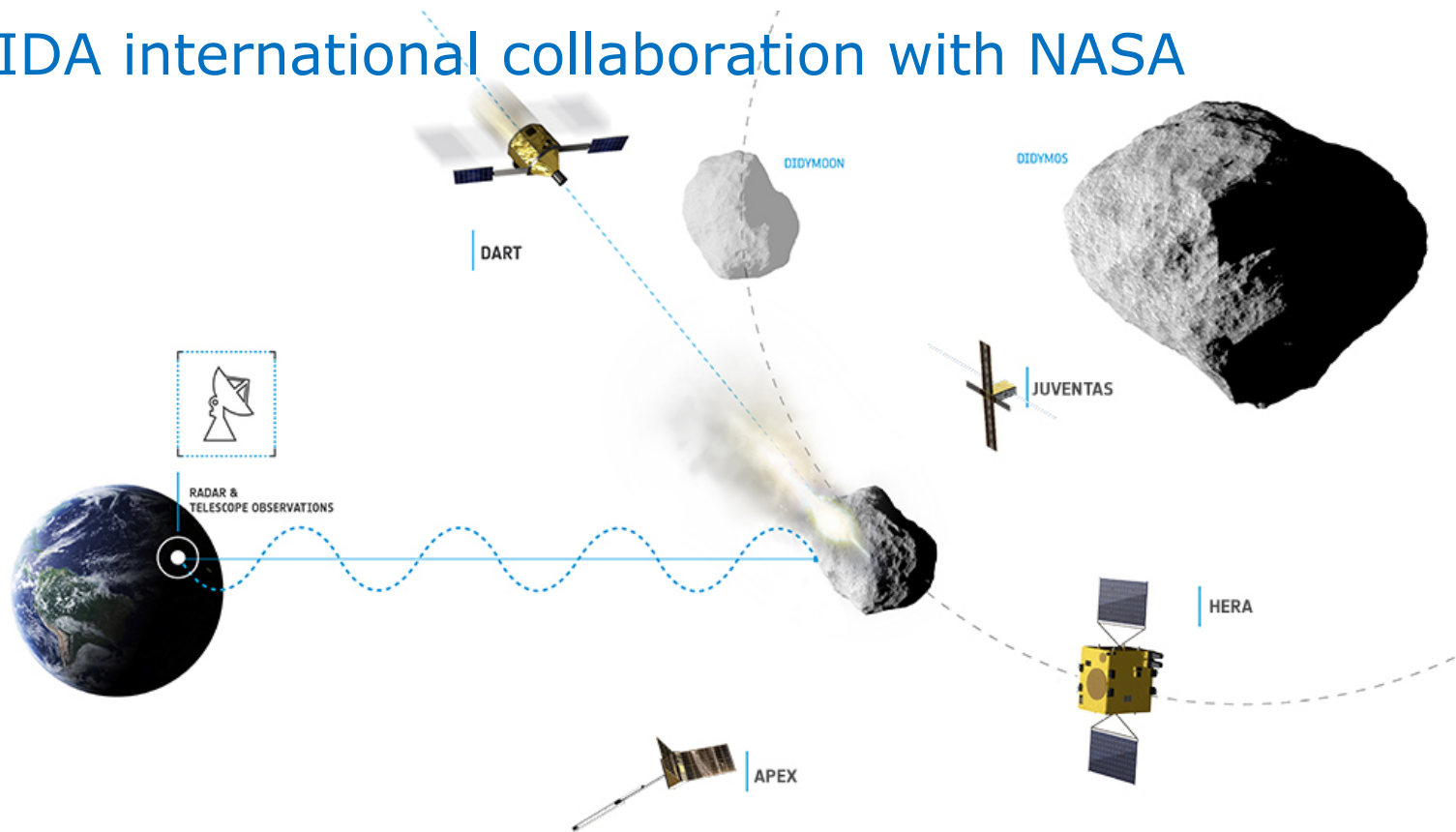


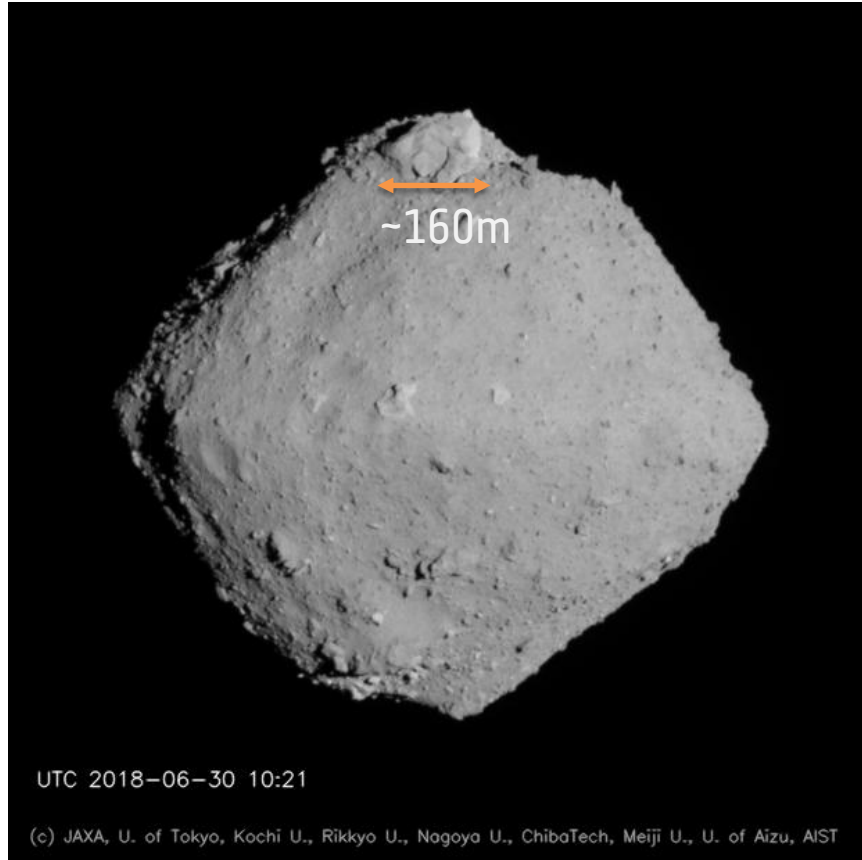
# HERA MISSION

# AIDA international collaboration with NASA



“kinetic impactor” validation = impactor (NASA/DART) + observer spacecraft (ESA/Hera)  
retrieve physical and dynamical parameters of Didymos to validate numerical impact codes

# Didymos vs Ryugu



## Hera mission firsts

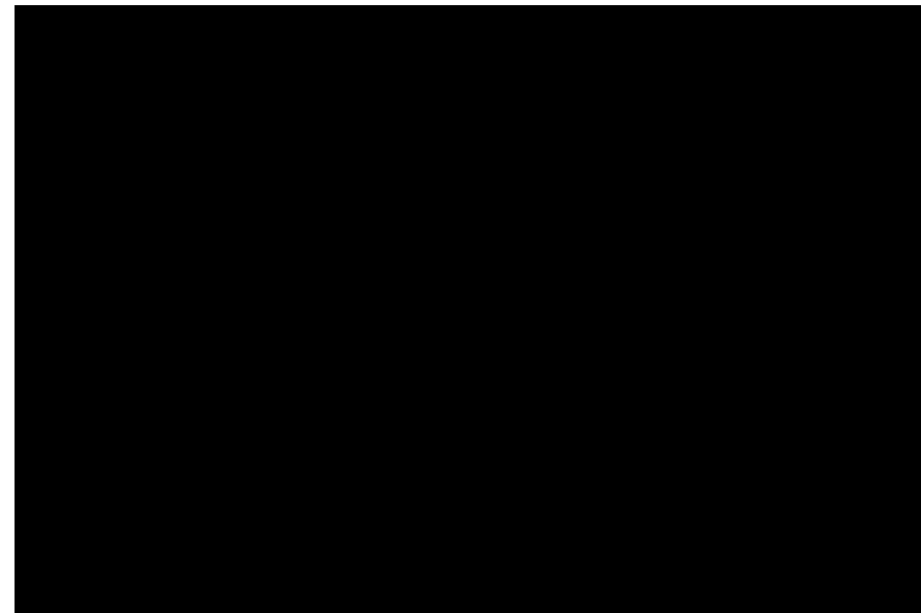
- First mission to **binary asteroid**
- **Smallest asteroid** ever studied
- First full scale **cratering physics assessment**
- First **radar tomography of an asteroid**

# DART status (for info)

- CDR successfully achieved in June 2019
- Spacecraft integration ongoing
- Electric propulsion system test campaign completed
- Launcher selected by NASA: Falcon 9
- Launch window: Jan-June 2021
- Impact date: Oct 2022



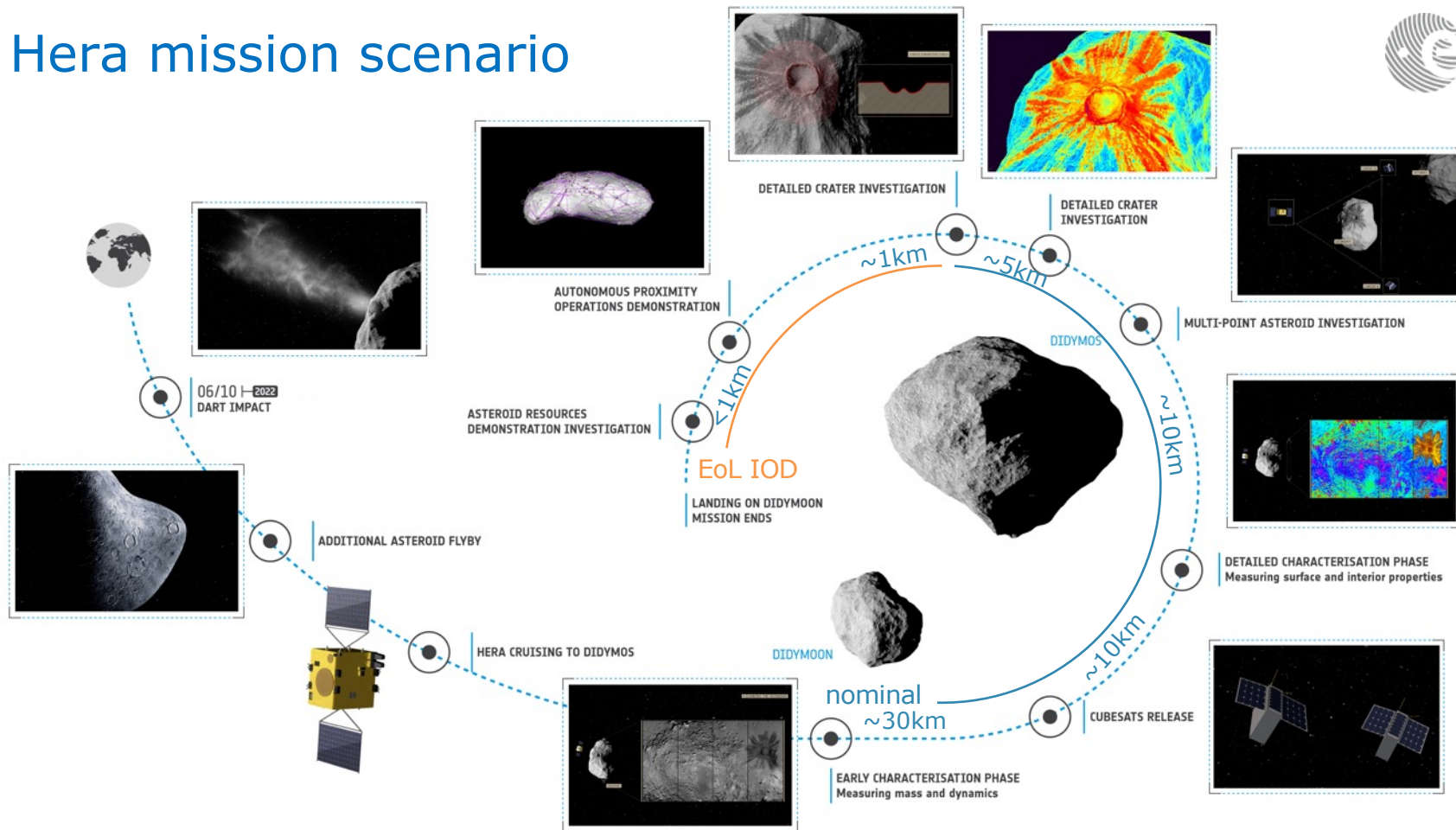
SEP test



DART structure “unboxing”



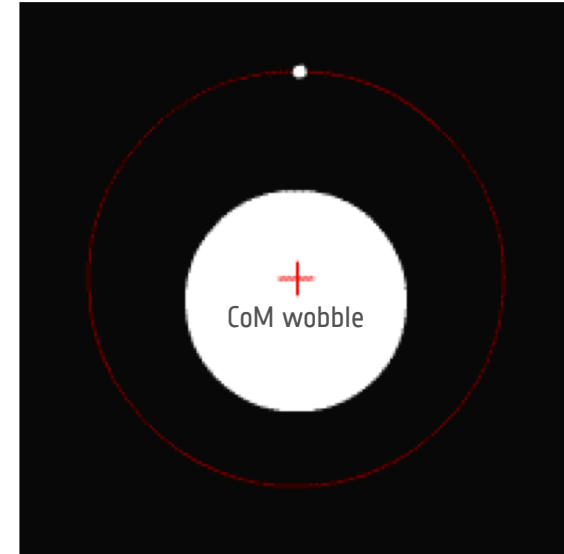
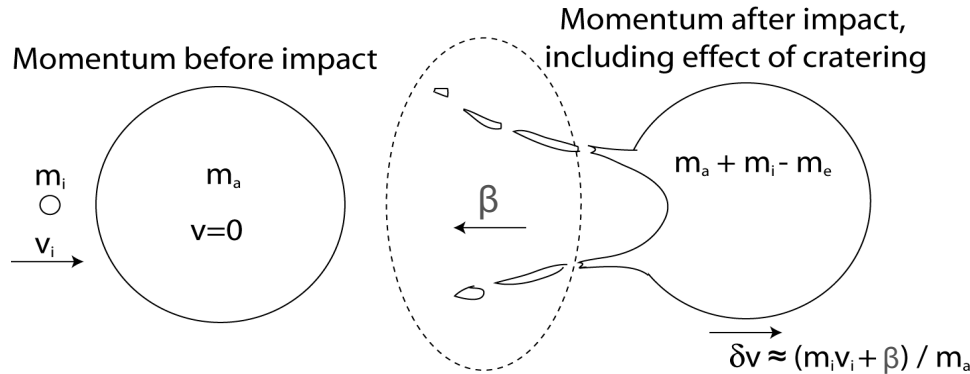
# Hera mission scenario



# Hera asteroid deflection objectives

## 1. Measure the momentum transfer (incl. ejecta enhancement $\beta$ ) from a kinetic impactor on the binary asteroid

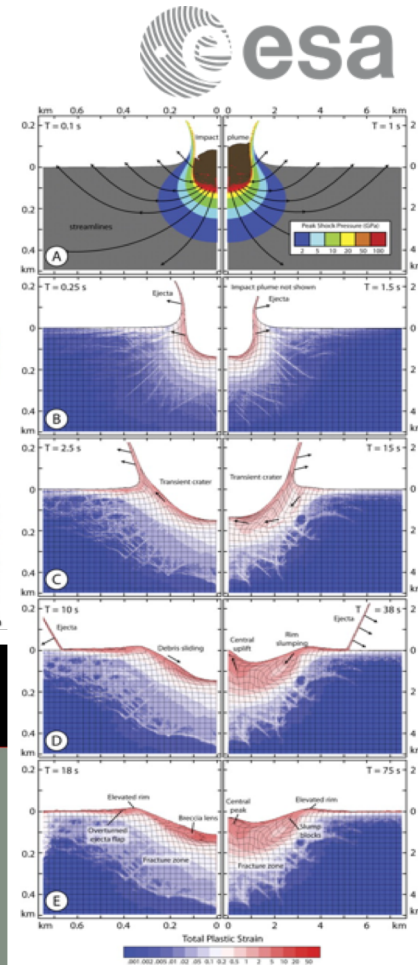
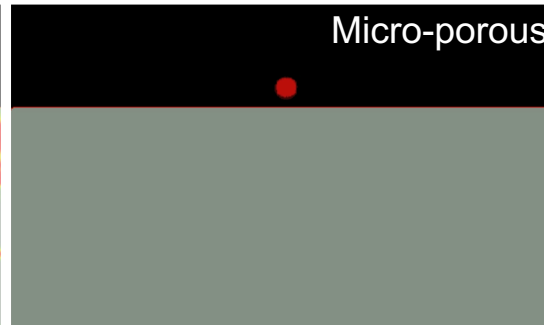
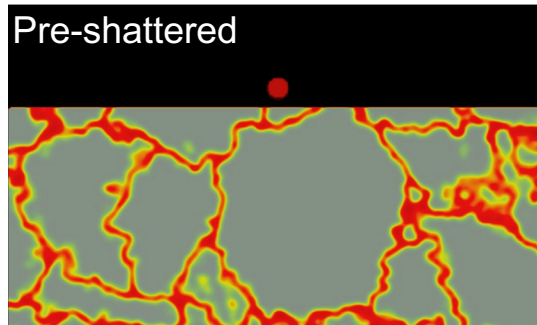
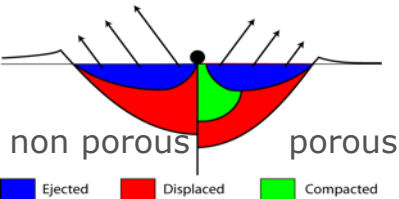
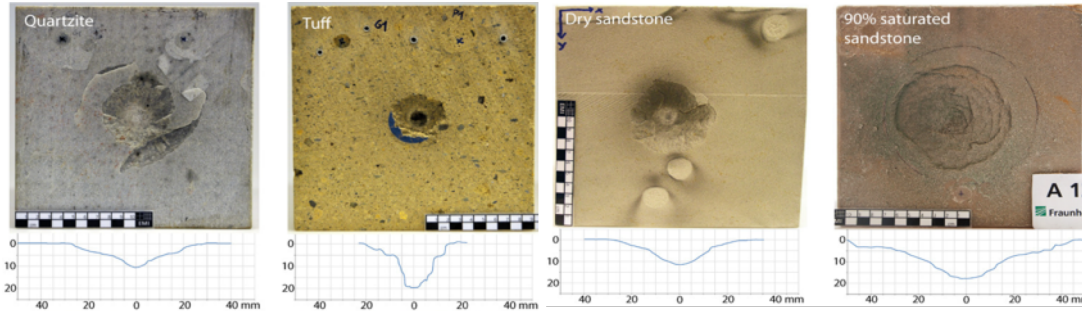
- Asteroid (Didymoon) mass by measuring wobble and through radioscience
- Asteroid dynamical properties via navcam



# Hera asteroid deflection objectives

## 2. Impact models validation and extrapolation to other asteroids

- Crater size/morphology, density, *change in the surface material*

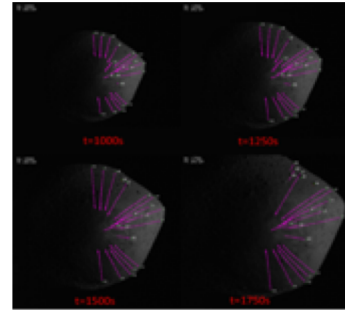


# Hera technology experiments



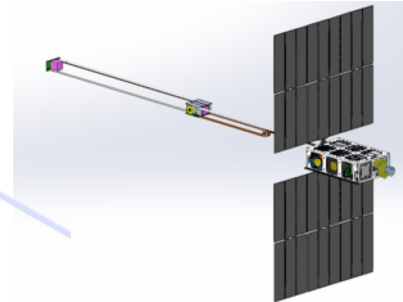
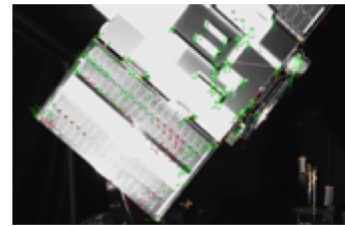
## 1. Validate spacecraft far-range navigation, early characterization (centroid), close-range inspection (based on feature-tracking navigation increasing on-board autonomy)

- *Synergies with technologies under development for in-orbit servicing (including novel FDIR based on sensor data fusion) without collision liabilities.*



## 2. Demonstrate deep-space (6U) CubeSats relayed via an inter-satellite link with ranging capability (supporting planetary defence objectives):

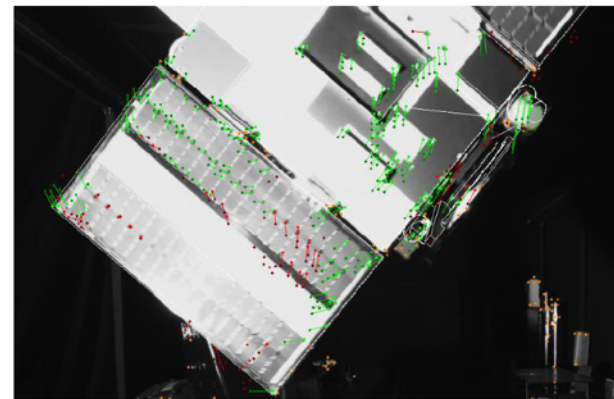
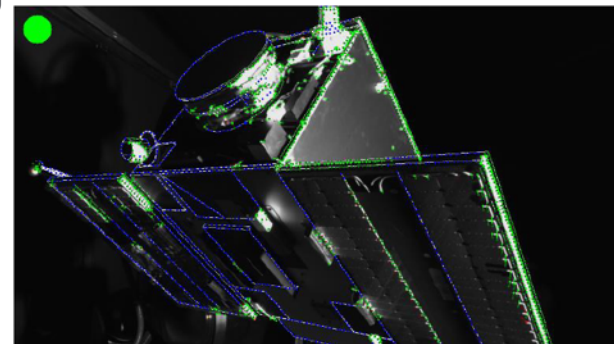
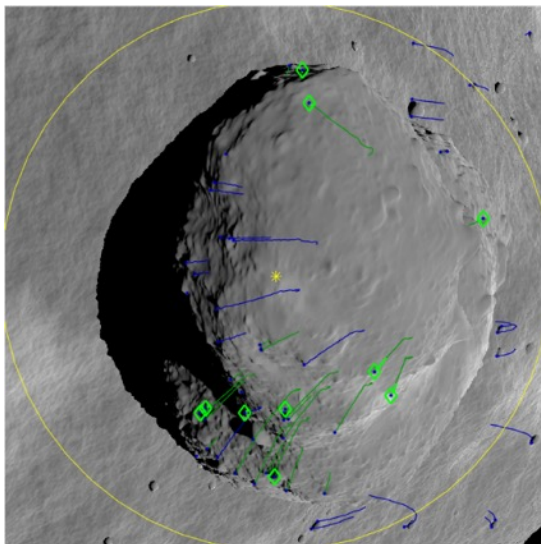
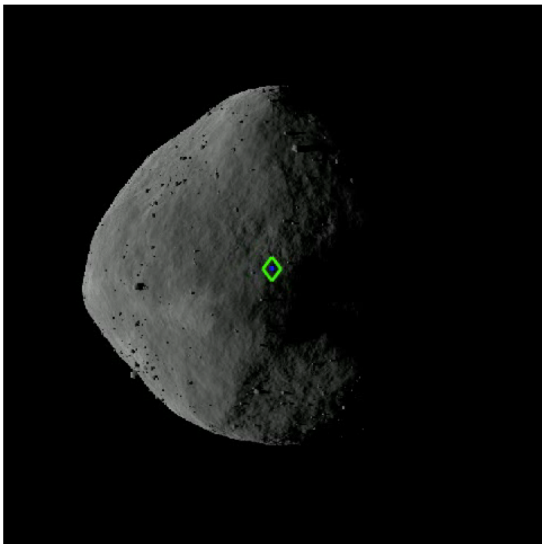
- Very high-resolution close up asteroid imaging incl. crater and subsurface material
- Provide complementary measurements to Hera



# Close target inspection (detailed characterization)

## Autonomous Guidance, Navigation, and Control for close-proximity operations

- “All-weather” navigation based on unknown features tracking and shape fitting using thermal imaging
- Pointing to region-of-interest @ very short distance
- Autonomous collision avoidance maneuvers

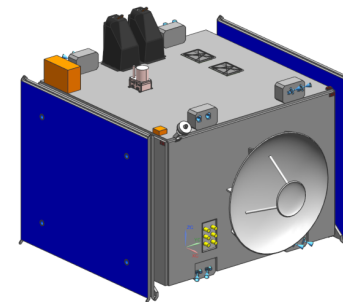
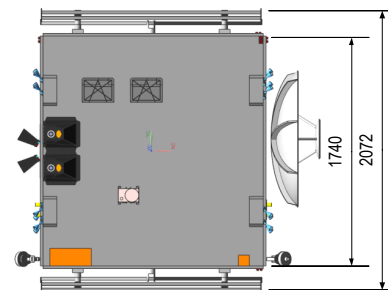
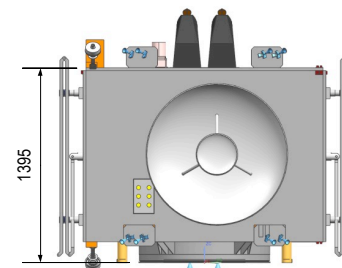
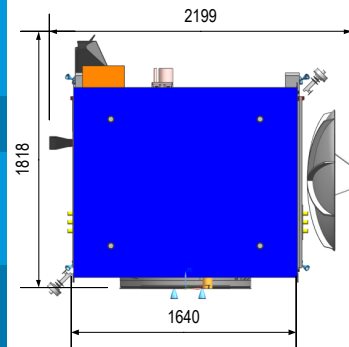




# Spacecraft design



Dimensions	~1.4 x 1.6 x 1.7 (main body)
Mass	Dry Mass 505 kg Wet Mass 830 kg
Power	~400W @ 2.33 AU, ~500W @ 1.9 AU
Thrusters	16 x 10N thruster (ACS N+R) 4 x 22N thruster (OCS N+R)
AOCS	Sensors: 2 x STR, 12 x CSS, 2 x IMU, 2x AFC Actuators: RW, ACS Thrusters RPE o(0.1) deg
TT&C	1 x X-band HGA 2 x ISL (S-Band), 2 x LGA 2 x X-DST (N+R), 35W + 70W TWTAs
OBDH	QinetiQ PROBA-Next Avionics 2 x RTU + 1 IP-ICU
Power	2 wings, 2 panels each, 8.7 m <sup>2</sup> total 28 V unregulated



# Hera mission current status







**SRR completed on 17 July with recommendation to proceed to phase B2** (*KO 19<sup>th</sup> Sep*)  
**Project running according to nominal schedule.**

Main actions recommended by the board:

1. Split the mission requirements into “Core requirements” (AFC camera only) and “Opportunity requirements” (with additional payload and technology experiments)  
→ already implemented into new MRD
2. Baseline Ariane 6.2 with Kick Stage or Ariane 6.4 instead of Soyuz  
→ minor design updates
3. Focus on Oct 2024 launch which allows ~2 years transfer: given the maturity of the main payload, recommendation to disembark technology demonstrations and opportunity payloads if not ready on time

# Hera main technology developments status

Item		Company	Current status
OBC		QS (BE) + subcos (BE)	Proba-Next avionics tested under Hera Ph. B1 EEM (GSTP) → Env Qualification Q1 2020 MMU EQM (GSTP) -> Env Qualification Q2 2020
IPU		GMV (RO)	EBB under development, Feb 2020 E(Q)M planned by Q2 2021
Cubesat Deployer		ISISpace (NL)	heritage from 6U XL Standard ISIS deployer and 3U CRS (Validated In-Orbit) EQM ongoing under GSTP environmental testing: mid 2020
ISL		Tekever (PT)	Based on Proba-3 ISL, EM+PFM foreseen Antenna modification ongoing EBB under development delivery by Q4 2019 Upgrade to EM in Q2 2020

# Hera core payload: AFC status



FM2 & FS1 on DAWN S/C  
operated 2007-18



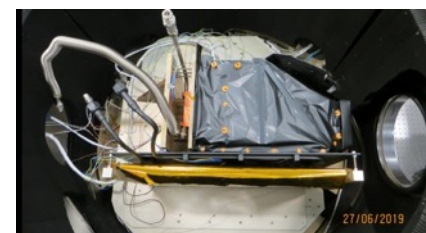
FM1 (AFC1) in storage,  
under purging



EM (back from JPL)  
in MPS laboratory



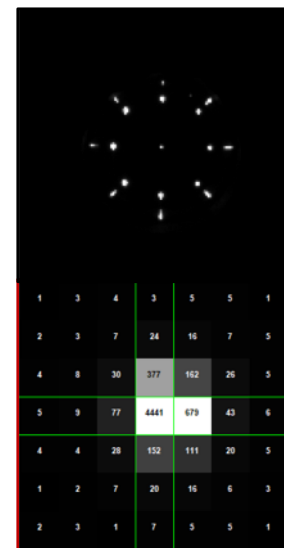
EQM  
at GMV, Madrid



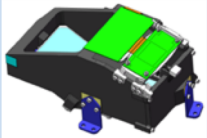
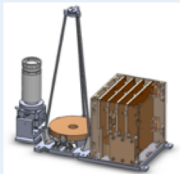
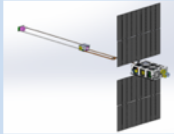
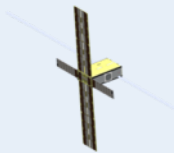
FS2 (AFC2) in test facility

- **Full inspection** of the AFC1 and AFC2 storage conditions, components quality and ageing, availability: no major points of concern raised.
- **Successful full performance test** performed on both cameras
- **Significant number of spares** identified at component and board level

→ low risk

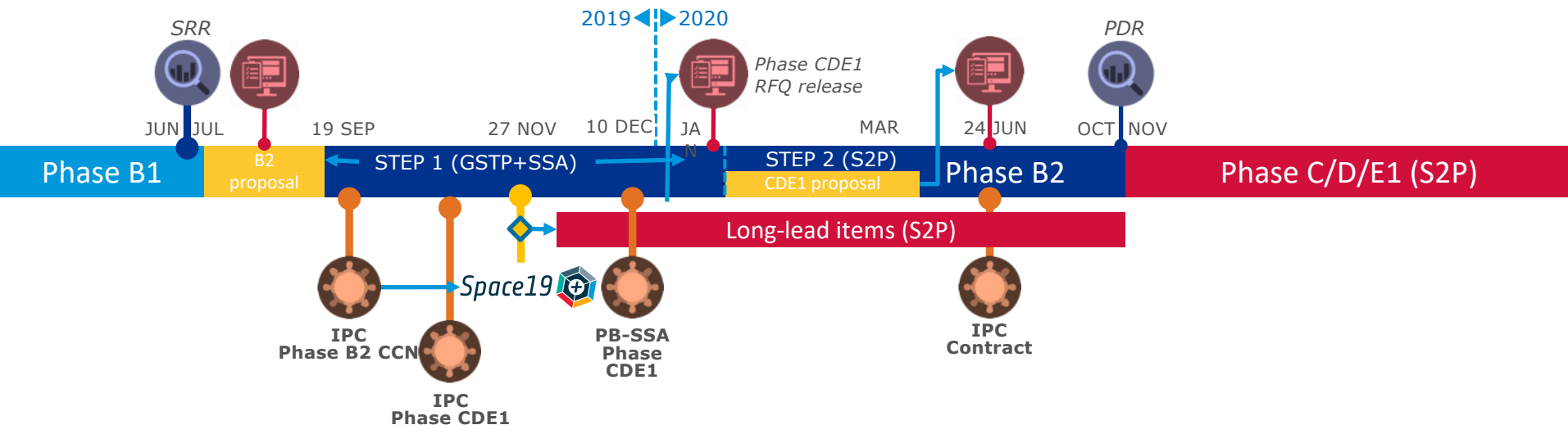


# Hera opportunity payload status

Payload		Company	Current status
TIRA		VITO (BE) + subcos (BE)	BB Under development, by end 2019 Backup options under assessment: SODERN, JAXA Hayabusa2 TIR
PALT		EFACEC (PT) + subcos (PT,RO)	Currently at CDR EM delivery Nov 2019
APEX Cubesat		IRF (SE) + subcos (SE, FI, CZ)	PDR in Nov 2019
Juventas Cubesat		GomSpace (DK) + subcos (LU, RO)	PDR in Nov 2019 LFR payload breadboarding ongoing



# Hera procurement approach



1. LLIs procurements anticipated to Dec19/Jan20 to increase margins,  
*procurement proposal for approval in October*
2. CDE1 procurement proposal, direct negotiation with OHB System (DE)  
*for consultation in October and approval in November*

# Phase B2 consortium



Proposal  
received on 9  
September

TEB on 17  
September

Nego/KO on 24  
September

