Hera status

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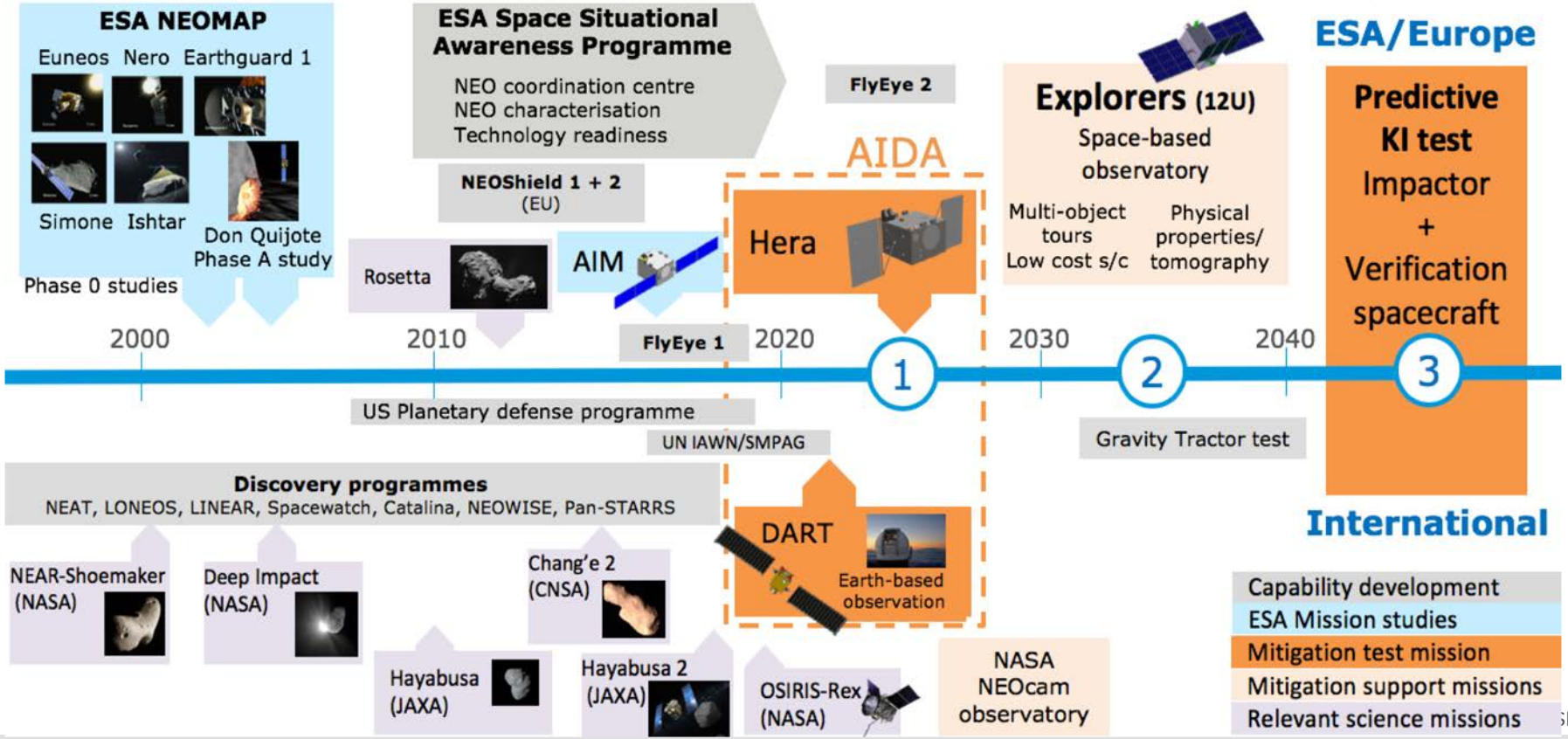
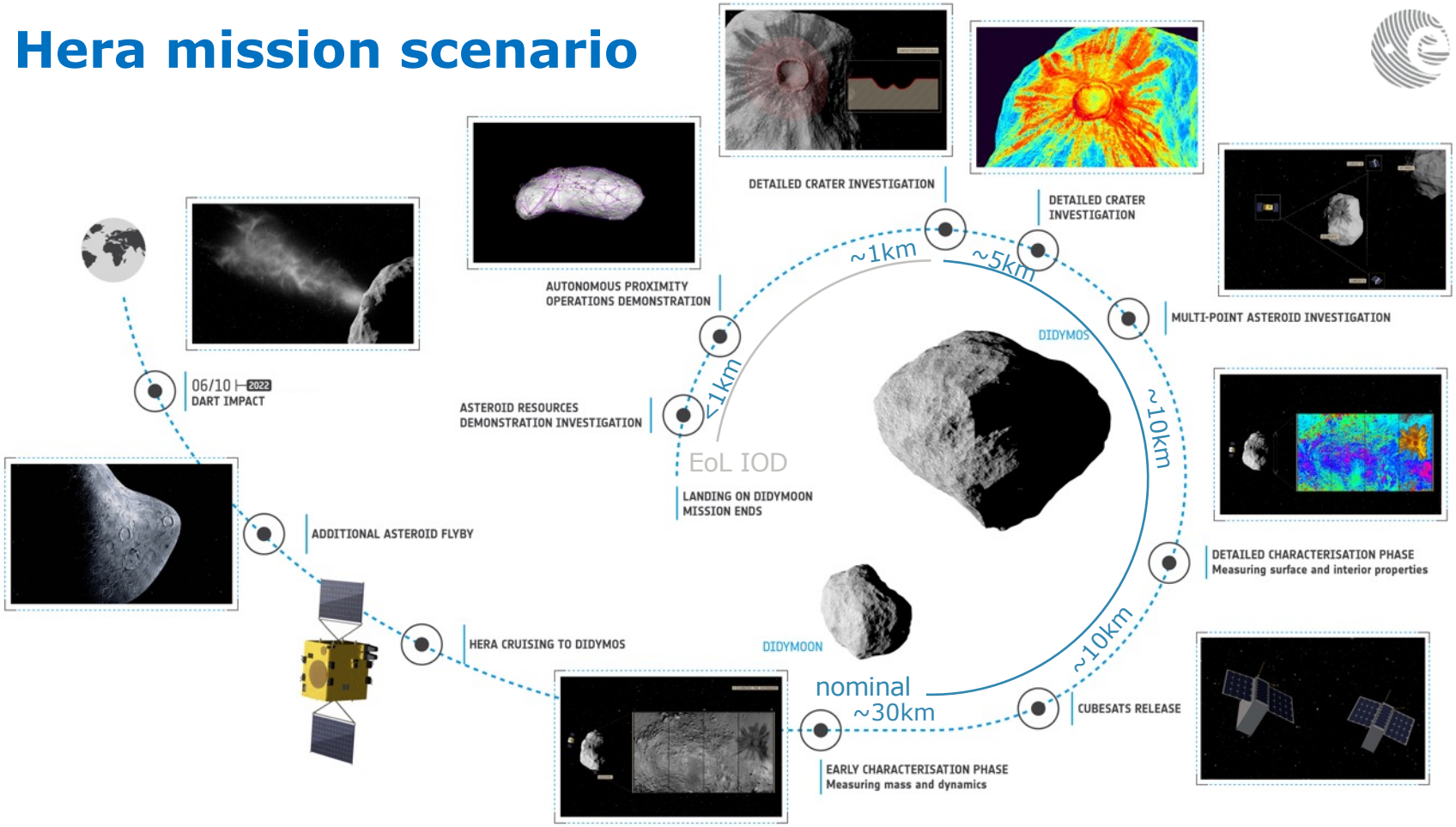
Context and overview of the 'cornerstone'



Planetary defence readiness: As easy as 1, 2, 3

1) **Kinetic impactor test on Didymos with DART and Hera**
2) **Exploration of other asteroids with small explorer spacecraft to determine quantities relevant to impact deflection (strength, density, porosity,…)**
3) **Predictive kinetic impactor and verification spacecraft**

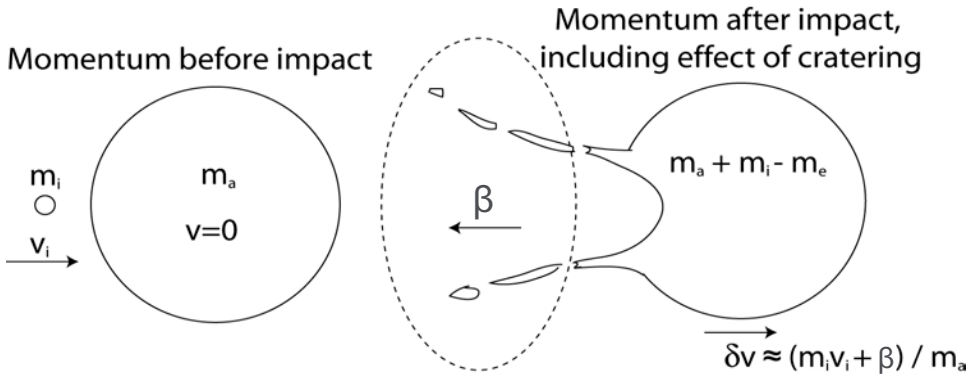
Hera mission scenario

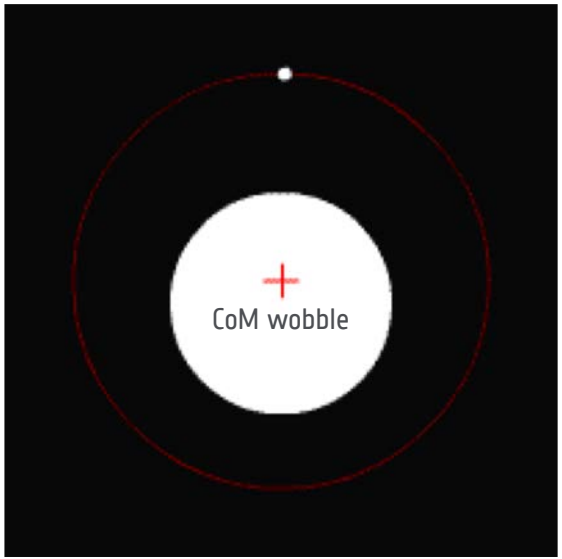


Hera asteroid deflection objectives

1. Measure the momentum transfer (incl. ejecta enhancement β) from a kinetic impactor on the binary asteroid

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

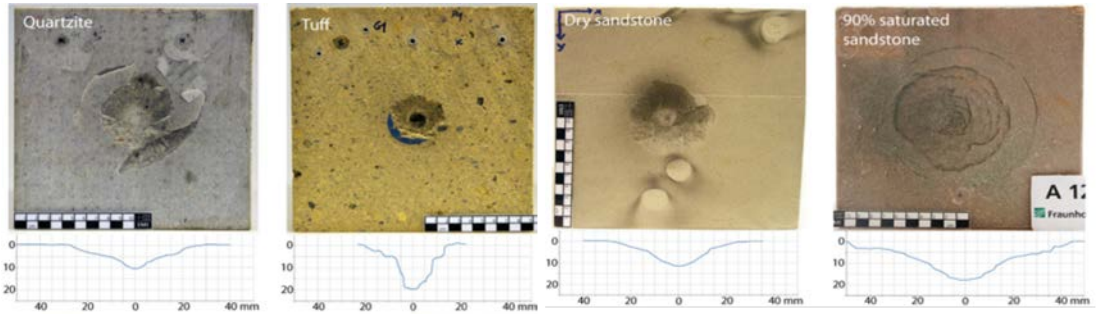


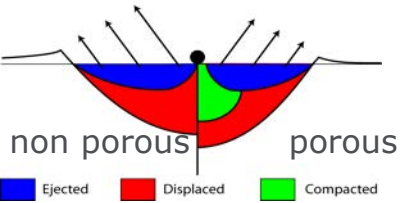


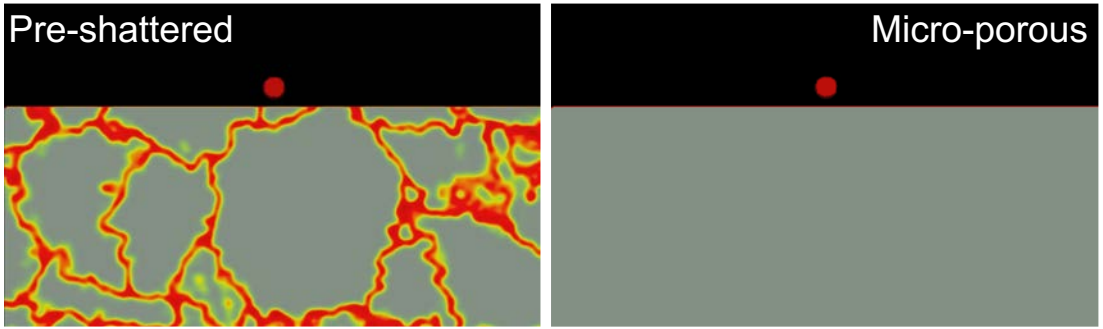
HERA asteroid deflection objectives

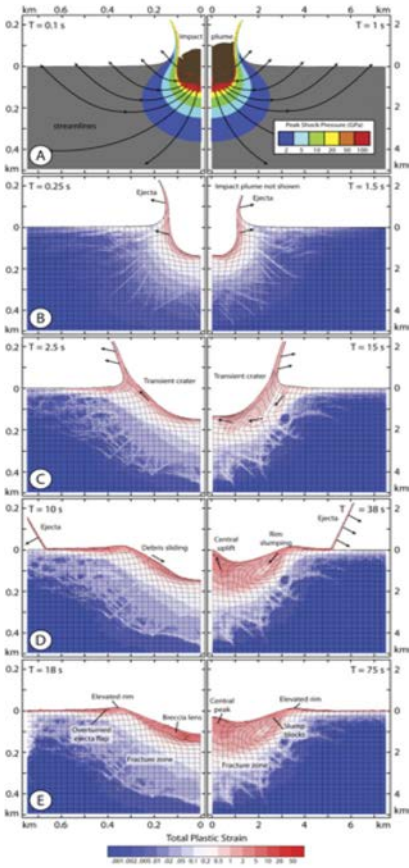
2. Impact models validation and extrapolation to other asteroids

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







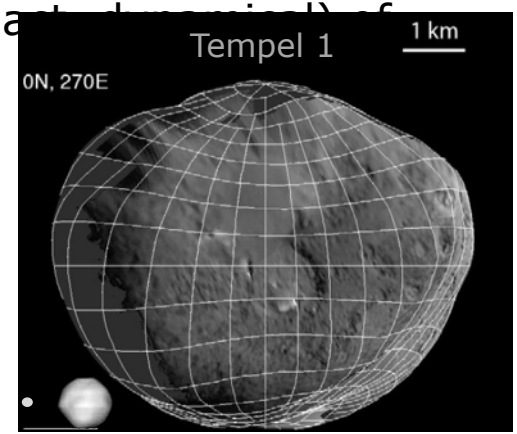


Measuring crater properties

- Asteroid physical properties related to deflection test do not change over few years
- No erosion, no atmosphere (wind), no outside process (impact, chemical) of magnitude allowing any change over few years

Demonstration:

- **NASA Deep Impact** mission: impact cratering on the 6 km-size comet Tempel 1 on July 4th, 2005 (but no possibility to measure the crater's properties)
- **NASA Stardust NEXT**: returned to Tempel 1 in 2011 and could measure the crater's properties, although the comet passed its perihelion between the two moments!



Didymos

Image taken by Deep Impact before its impact on comet Tempel 1 (2005)

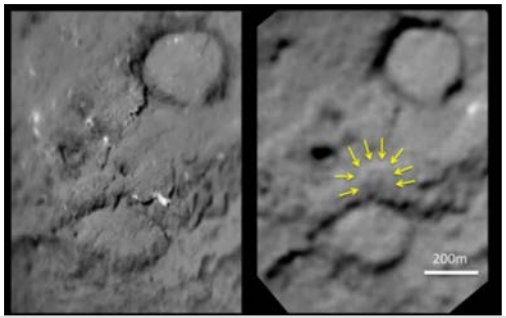


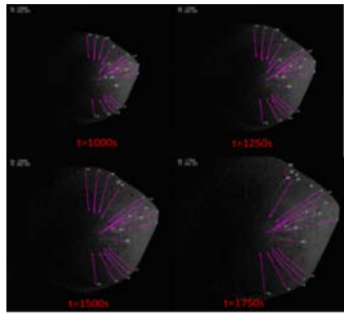
Image taken by Stardust NEXT (crater identification) after Tempel 1 perihelion passage in 2011 (5 years after the impact)

Credit: NASA/JPL-Caltech/University of Maryland/Cornell

HERA technology experiments

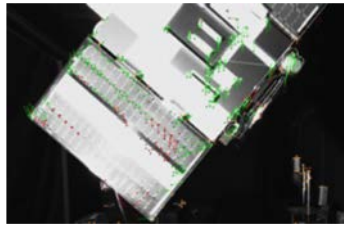
1. Validate spacecraft far-range navigation and close-range feature-tracking navigation increasing on-board autonomy

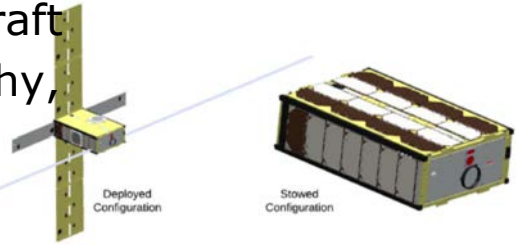
- *Synergies with technologies under development for in-orbit servicing, including novel FDIR based on sensor data fusion.*



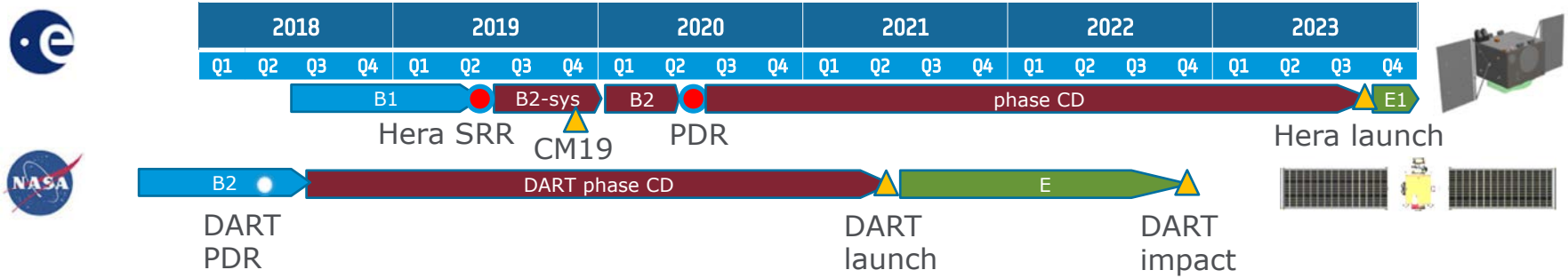
2. Demonstrate deep-space (6U) CubeSats relayed via an inter-satellite link with ranging capability (supporting planetary defence objectives):

- Very high-resolution close up asteroid imaging incl. crater and subsurface material
- Provide complementary measurements to main spacecraft (e.g. spacecraft-CubeSat radioscience, radar tomography, volatiles…)

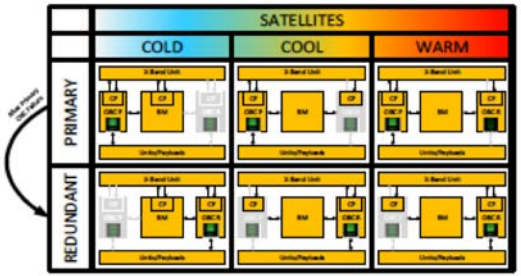




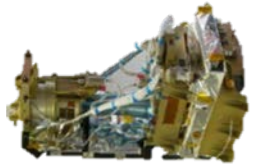
Hera phase B1



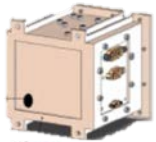
- **KO on 25 July** (DE, BE, RO, LU, SE, PT, ES, CZ, AU, FI, PL, CH) including breadboarding activities:
  - Onboard computer EQM for HW/SW integration
  - GNC and FDIR HIL and SIL in robotic lab incl:
    - Prototype a Collision Avoidance Manoeuvre
    - Mission Performance Simulator
    - High fidelity validation of Hyperspectral camera for close proximity operations
    - Enhanced Relative Navigation algorithm
  - Onboard Software prototype implementation and validation with OBC EQM



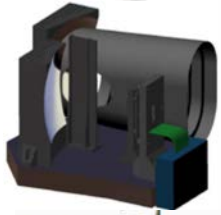
Payload status



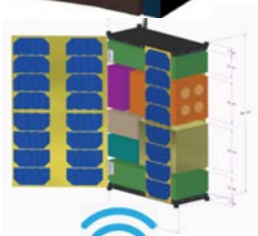
AFC (Asteroid Framing Camera) QM is provided to GMV-Spain for GNC hardware and software in the loop testing (2 flight units already in storage)



PALT (planetary altimeter) EQM under development with EFACEC and subcos (PT, RO)



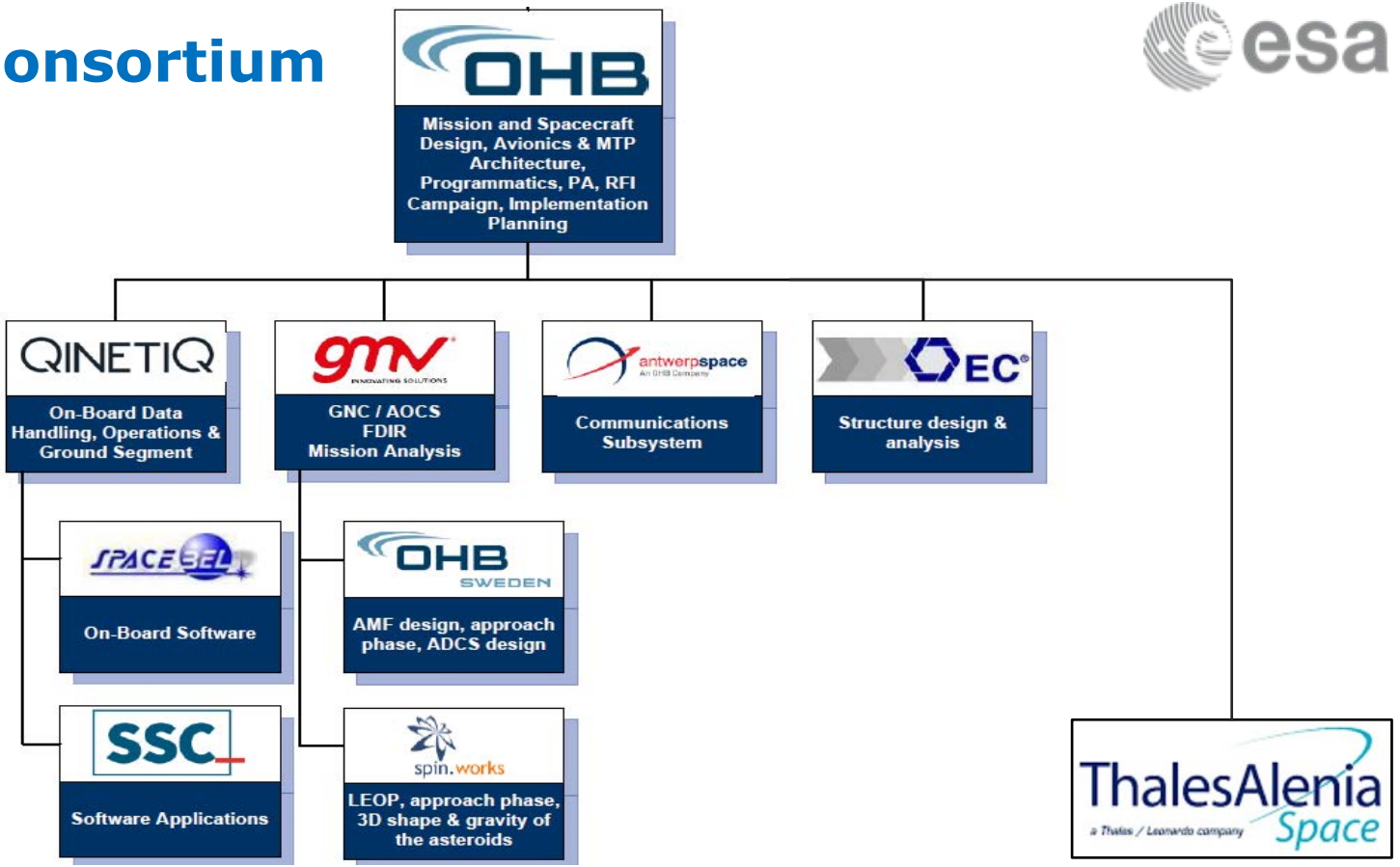
CHIEM (hyperspectral camera) expected EM development to kick-off in November



Cubesats ”APEX” (FI, SE, CZ, DE) kicked-off, second cubesat team to be selected in November

Inter-Satellite Link (ISL) RFQ to be issued in July (PT), expected KO to be in parallel to spacecraft phase B1

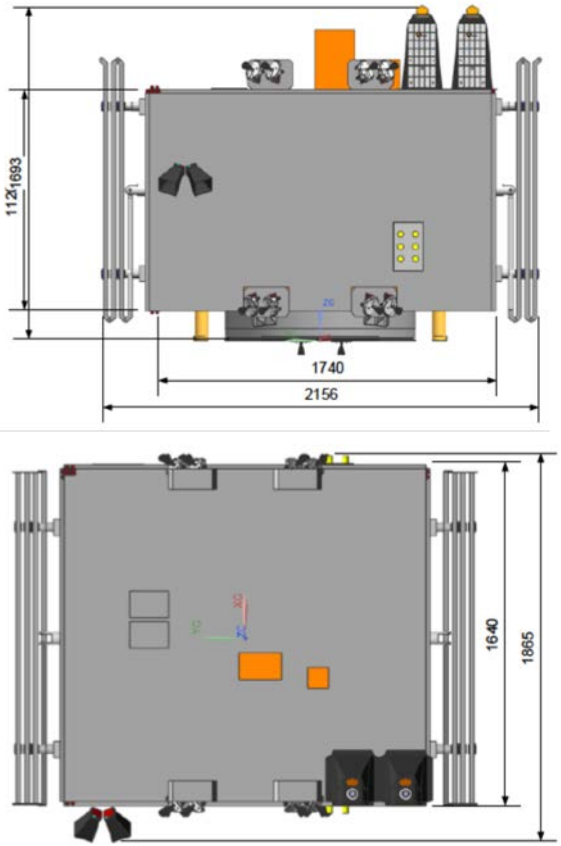
Industrial Consortium



(DE, BE, ES, RO, PL, PT, CZ, SE, LU + IT in kind)

Spacecraft design at PM1

Dimensions	1865 x 2156 x 1693 mm^3 (stowed) 1865 x 11057 x 1693 mm^3 (deployed)
Mass	478.5 kg dry 255 kg propellant
Power	573 W max
Thrusters	16 x 10 N thruster (ACS N+R) 4 x 22 N thruster (OCS N+R)
TT&C	1 x X-band metasurface HGA 2 x ISL (S-Band), MGA, LGA(omnidirectional) 2 x X-DST (N+R)
OBDH	QinetiQ PROBA-Next Avionics 2 x Crisa PROBA-3-derived RTU
Power	2 wing, 3 panels, ~12 m^2 total 28 V unregulated



Spacecraft design at PM1