hera

→ MEDIA BRIEFING NOTES

APRIL 2024

#heramission #dartmission

www.esa.int/hera

➔ HERA IN A NUTSHELL

Hera is an ESA-led mission for planetary defence, developed as part of a larger international endeavour, the Asteroid Impact and Deflection Assessment (AIDA) collaboration. In the first part of AIDA, **NASA's DART mission** impacted **Dimorphos, a small asteroid moonlet,** to **change its orbit** around the larger Didymos primary body. Now Hera will visit this asteroid pair to gather additional data on Dimorphos to **help turn this 'kinetic impact' planetary defence method into a well-understood and potentially repeatable technique**.

Hera will launch on a SpaceX Falcon-9 rocket at the end of 2024.

Its destination is Didymos, the binary asteroid, which it will reach on 28 December 2026, to begin six months of investigation.

Hera will perform **a detailed post-impact survey** of the target asteroid, Dimorphos – the orbiting moonlet of a binary asteroid system known as Didymos.

Hera will carry a total of 12 instruments, including **two CubeSats**, plus a radio science experiment.

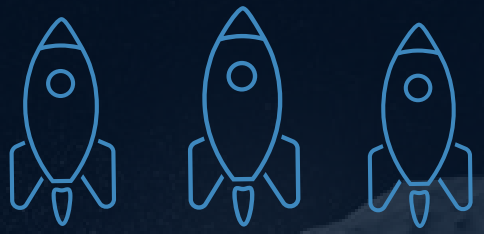
As well as serving planetary defence, Hera will also demonstrate **new European technologies** in deep space – including **autonomous vision-based navigation and inter-satellite links** connecting the three spacecraft.

Hera is the European contribution to an international double-spacecraft endeavour with NASA.

QUICK FACTS

780m
Diameter of Didymos, the primary body

150m
Diameter of Dimorphos, the target moonlet



OCTOBER 2024
READY FOR LAUNCH

2.26 hours
Rotation period of Didymos, the primary body

12 hours
Rotation period of Dimorphos around Didymos

770 days
Length of binary asteroid system's orbit around the Sun

Named after the Greek goddess of marriage

1081.8kg
When fully fuelled launch mass

11.5m wide
with solar arrays fully deployed

181 million km
Distance from Earth at arrival in Dec 2026

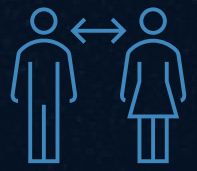
15%
of all asteroid systems are binary

2
Hera CubeSats

12
Hera payloads

1602
Number of Near Earth Asteroids (NEA's) currently on risk list

18
Participating States and 28 industrial partners



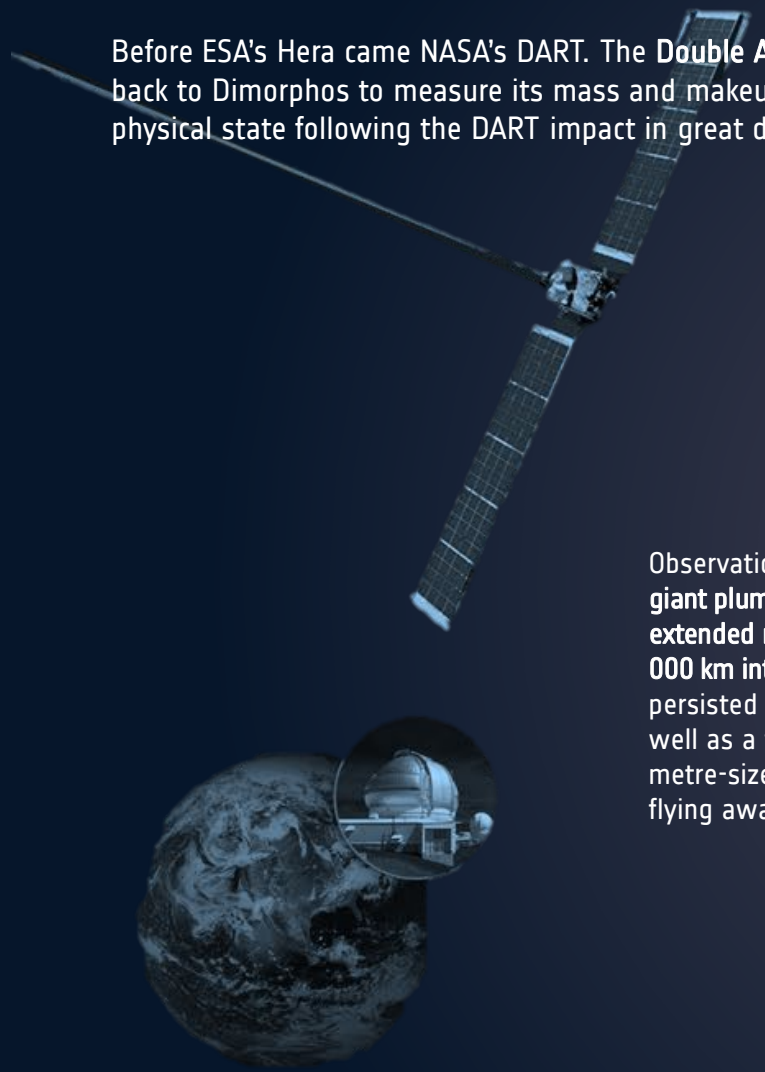
1.2km
Distance between the two bodies of the Didymos binary system

➔ MISSION FIRSTS

1. First planetary defence mission for ESA
2. First mission to enter orbit around a binary asteroid system
3. First mission to deploy ESA deep-space CubeSats, which will go on to touch down
4. First mission to visit the smallest asteroid yet explored
5. First mission to visit the fastest-spinning asteroid yet explored
6. First mission to perform a radar probe of an asteroid's interior

NASA'S DART

Before ESA's Hera came NASA's DART. The **Double Asteroid Redirect Test** spacecraft, launched in November 2021 and crossed space to reach Dimorphos. Hera will go back to Dimorphos to measure its mass and makeup as well as its shifted orbit from up close and perform its own 'crash scene investigation' of the asteroid moon's physical state following the DART impact in great detail. Hera 's data will render this deflection technique ready for operational use if ever needed for real.



Observations show **a giant plume of debris that extended more than 10 000 km into space** and persisted for months, as well as a total of 37 metre-sized boulders flying away.

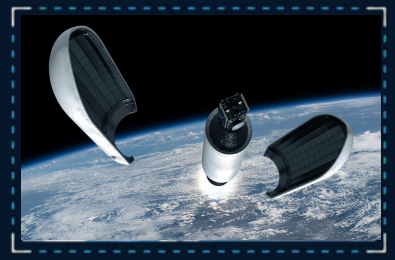
On **26 September 2023** the vending-machine-sized, approximately half-tonne DART struck the 150-m diameter moonlet at **6.1 km/s**.

The 11 hour 55 minute orbit of Dimorphos around its parent asteroid Didymos was shortened by around 33 minutes

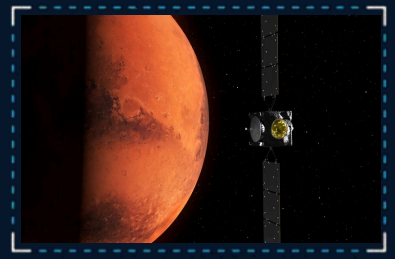
WHAT WE STILL DON'T KNOW

Measurements of Dimorphos's altered orbit are **stuck with a 10% residual uncertainty** and models of the impact are still missing some vital pieces of information: the mass and structure of Dimorphos and traces left by the DART impact in the form of a crater or a global reshaping of the object, as well as the overall efficiency of momentum transfer.

LIFT OFF TO LANDING

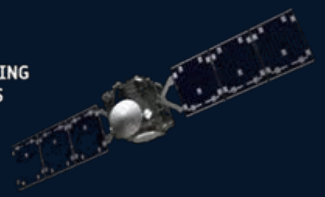


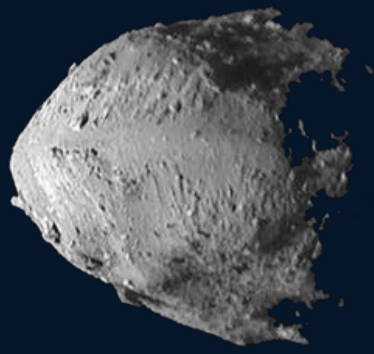
HERA LAUNCH IN OCTOBER 2024



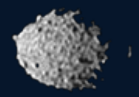
MARS FLYBY

HERA CRUISING TO DIDYMOS



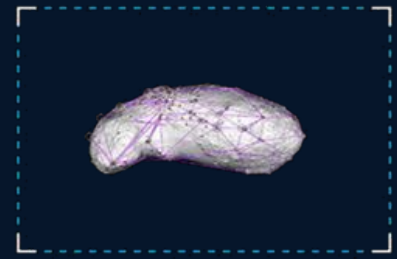


DIDYMOS

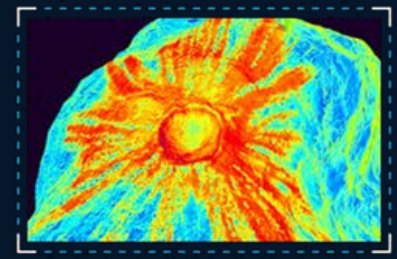


DIMORPHOS

LANDING ON DIDYMOS
MISSION ENDS

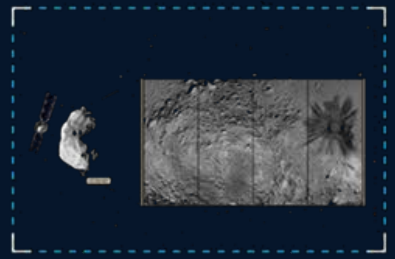


AUTONOMOUS PROXIMITY OPERATIONS DEMONSTRATION



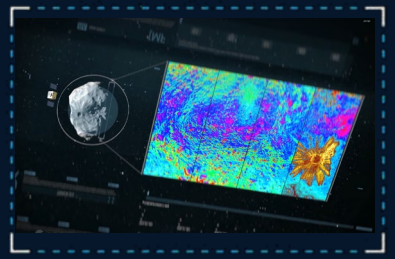
DETAILED CRATER INVESTIGATION

EARLY CHARACTERISATION PHASE
'Measuring dymorphos' mass and dynamics



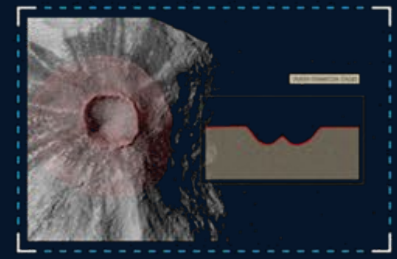
CUBESATS RELEASE

DETAILED CHARACTERISATION PHASE
Measuring Dimorphos surface and interior properties



MULTI-POINT INVESTIGATION OF DIMORPHOS

VERY LOW-ALTITUDE DETAILED INVESTIGATION



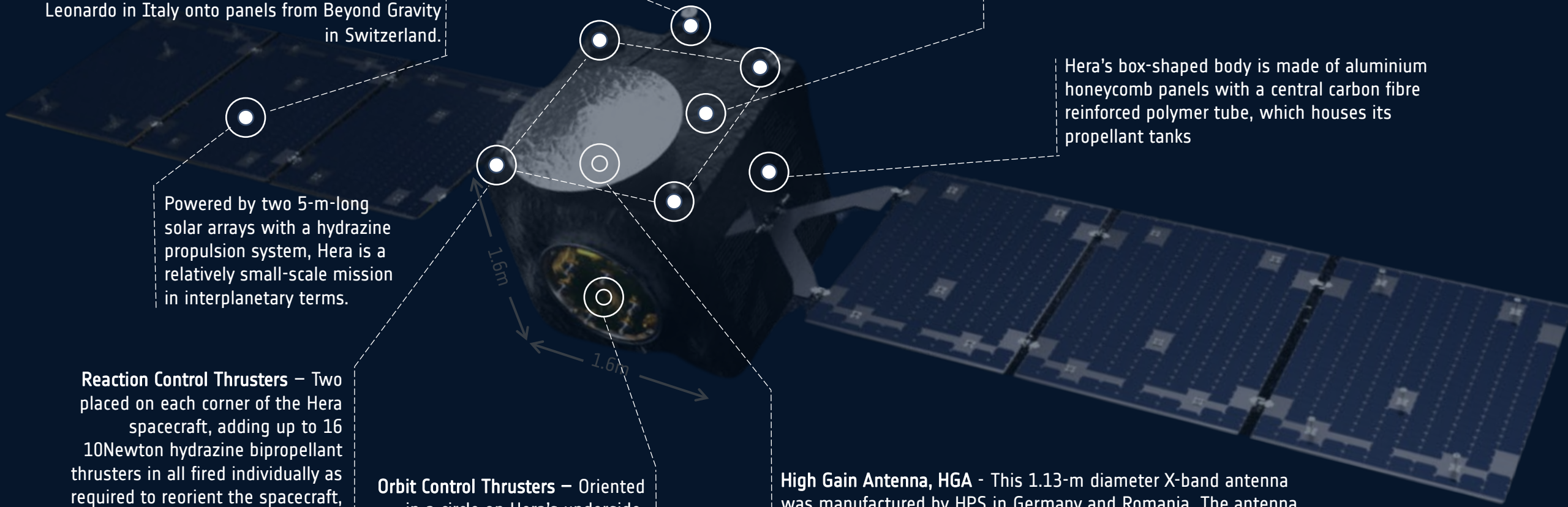
THE SPACECRAFT

Low Gain Antenna, LGA – Omidirectional Low Gain Antenna for back-up, low data rate communications, sourced from Sener in Spain. A second LGA is positioned on the aft side of the spacecraft

Each wing is made up of 3 hinged panels each adding up to 14 square meters, with more than 1,600 solar cells. Azur Space in Germany manufactured the solar cells, interconnected by Leonardo in Italy onto panels from Beyond Gravity in Switzerland.

Asteroid Deck – Hosting all onboard instruments, see dedicated graphic for details

Hera's box-shaped body is made of aluminium honeycomb panels with a central carbon fibre reinforced polymer tube, which houses its propellant tanks



Powered by two 5-m-long solar arrays with a hydrazine propulsion system, Hera is a relatively small-scale mission in interplanetary terms.

Reaction Control Thrusters – Two placed on each corner of the Hera spacecraft, adding up to 16 10Newton hydrazine bipropellant thrusters in all fired individually as required to reorient the spacecraft, for instance to line up its High Gain Antenna with Earth.

Orbit Control Thrusters – Oriented in a circle on Hera's underside, these six 10 Newton hydrazine bipropellant thrusters are fired together for spacecraft manoeuvres and orbital changes.

High Gain Antenna, HGA - This 1.13-m diameter X-band antenna was manufactured by HPS in Germany and Romania. The antenna boosts Hera signals more than 4000-fold to reach Earth, focused down to only half a degree, so that the entire spacecraft will move in order to line up with its homeworld.

THE ASTEROID DECK

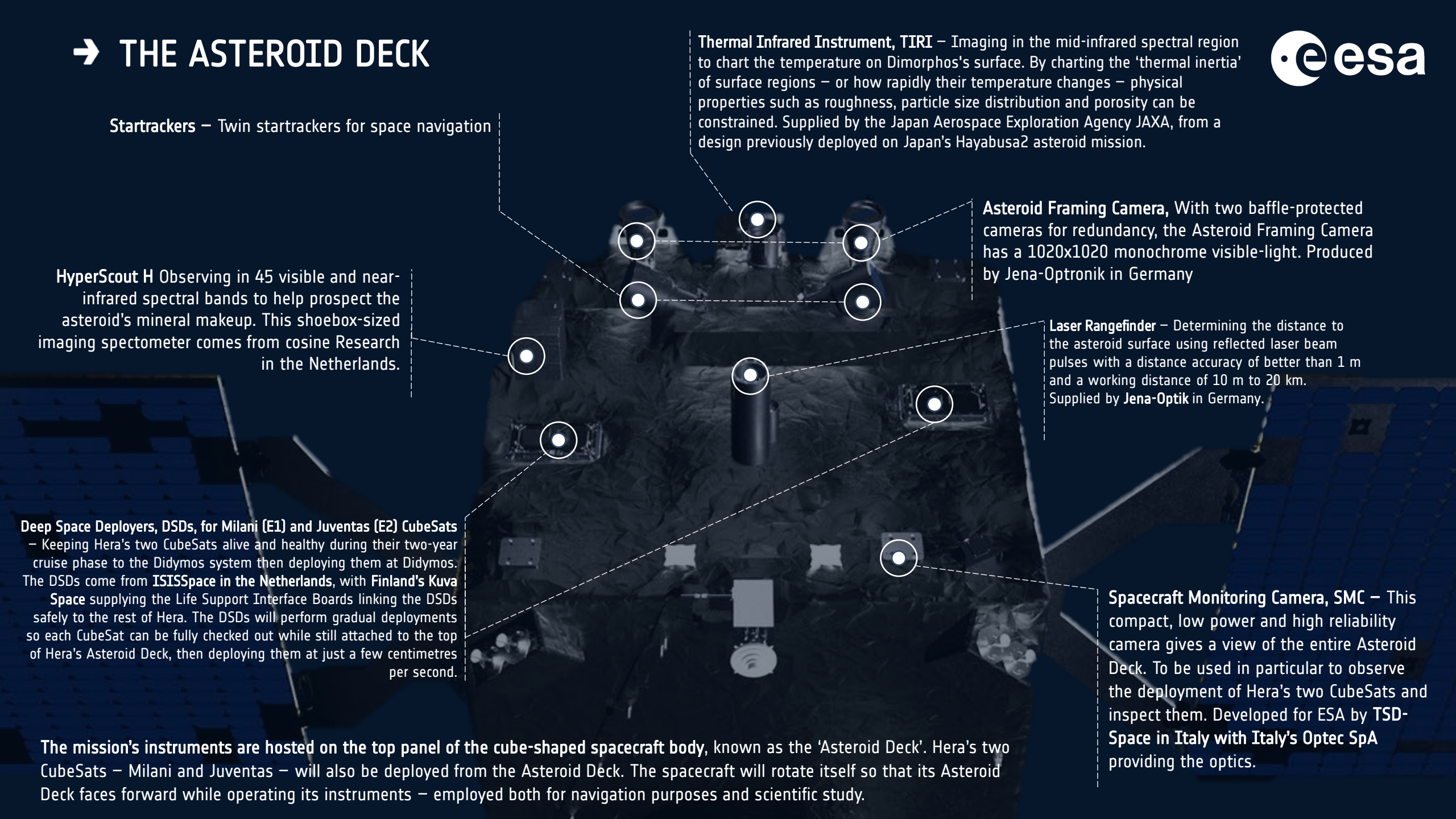
Startrackers – Twin startrackers for space navigation

Thermal Infrared Instrument, TIRI – Imaging in the mid-infrared spectral region to chart the temperature on Dimorphos's surface. By charting the 'thermal inertia' of surface regions – or how rapidly their temperature changes – physical properties such as roughness, particle size distribution and porosity can be constrained. Supplied by the Japan Aerospace Exploration Agency JAXA, from a design previously deployed on Japan's Hayabusa2 asteroid mission.

Asteroid Framing Camera, With two baffle-protected cameras for redundancy, the Asteroid Framing Camera has a 1020x1020 monochrome visible-light. Produced by Jena-Optronik in Germany

HyperScout H Observing in 45 visible and near-infrared spectral bands to help prospect the asteroid's mineral makeup. This shoebox-sized imaging spectometer comes from cosine Research in the Netherlands.

Laser Rangefinder – Determining the distance to the asteroid surface using reflected laser beam pulses with a distance accuracy of better than 1 m and a working distance of 10 m to 20 km. Supplied by **Jena-Optik** in Germany.



Deep Space Deployers, DSDs, for Milani (E1) and Juventas (E2) CubeSats – Keeping Hera's two CubeSats alive and healthy during their two-year cruise phase to the Didymos system then deploying them at Didymos. The DSDs come from **ISISSpace in the Netherlands**, with **Finland's Kuva Space** supplying the Life Support Interface Boards linking the DSDs safely to the rest of Hera. The DSDs will perform gradual deployments so each CubeSat can be fully checked out while still attached to the top of Hera's Asteroid Deck, then deploying them at just a few centimetres per second.

Spacecraft Monitoring Camera, SMC – This compact, low power and high reliability camera gives a view of the entire Asteroid Deck. To be used in particular to observe the deployment of Hera's two CubeSats and inspect them. Developed for ESA by **TSD-Space in Italy with Italy's Optec SpA** providing the optics.

The mission's instruments are hosted on the top panel of the cube-shaped spacecraft body, known as the 'Asteroid Deck'. Hera's two CubeSats – Milani and Juventas – will also be deployed from the Asteroid Deck. The spacecraft will rotate itself so that its Asteroid Deck faces forward while operating its instruments – employed both for navigation purposes and scientific study.

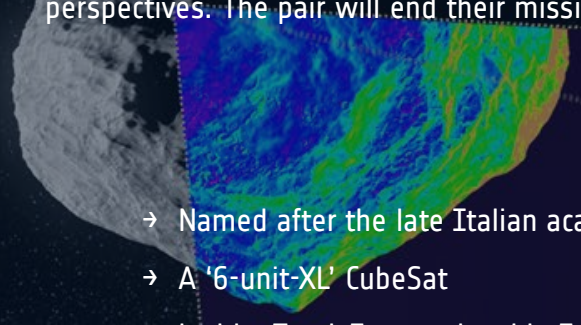
THE CUBESATS - JUVENTAS

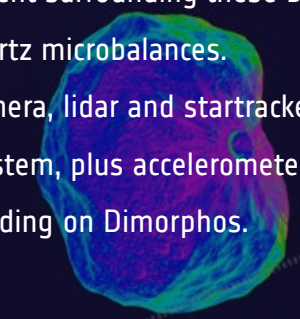
Hera will not travel to the Didymos system alone but will carry two shoebox-sized CubeSats with it. Think of Hera like an aircraft then the CubeSats are more like drones, packed with miniaturised technology, able to fly lower and closer, to take more risks and gather additional perspectives. The pair will end their missions by landing on Dimorphos.

- Named for the Roman name of the daughter of Hera
- '6-unit-XL' CubeSat
- Led by GomSpace in Luxembourg
- Carries the smallest radar instrument ever flown in space, which will perform the first radar sounding within an asteroid, by unfurling 1.5 m antennas longer than the CubeSat itself.
- Its other instrument is a gravity-measuring 'gravimeter' which will come into operation once Juventas lands on Dimorphos.
- Juventas is equipped with a visible light camera, lidar and startrackers for navigation as it orbits around the Didymos asteroid, plus its inter-satellite link and a cold gas propulsion system for manoeuvres.
- Also aboard are accelerometers and gyros which will gather data during the CubeSat's eventual landing on Dimorphos, planned to conclude the mission.

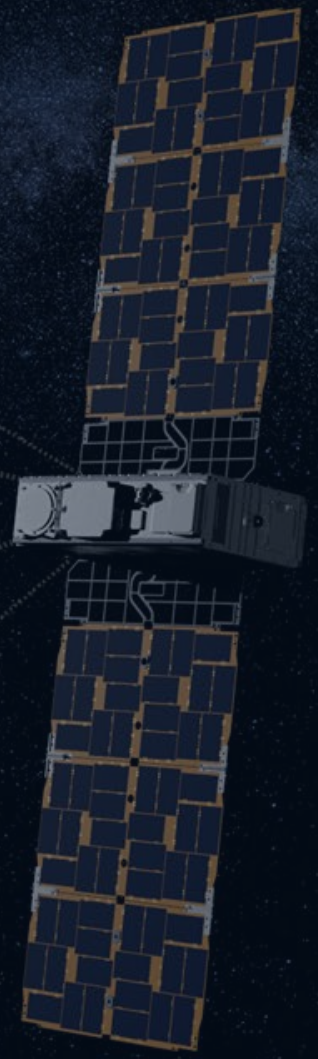
THE CUBESATS - MILANI

Hera will not travel to the Didymos system alone but will carry two shoebox-sized CubeSats with it. Think of Hera like an aircraft then the CubeSats are more like drones, packed with miniaturised technology, able to fly lower and closer, to take more risks and gather additional perspectives. The pair will end their missions by landing on Dimorphos.





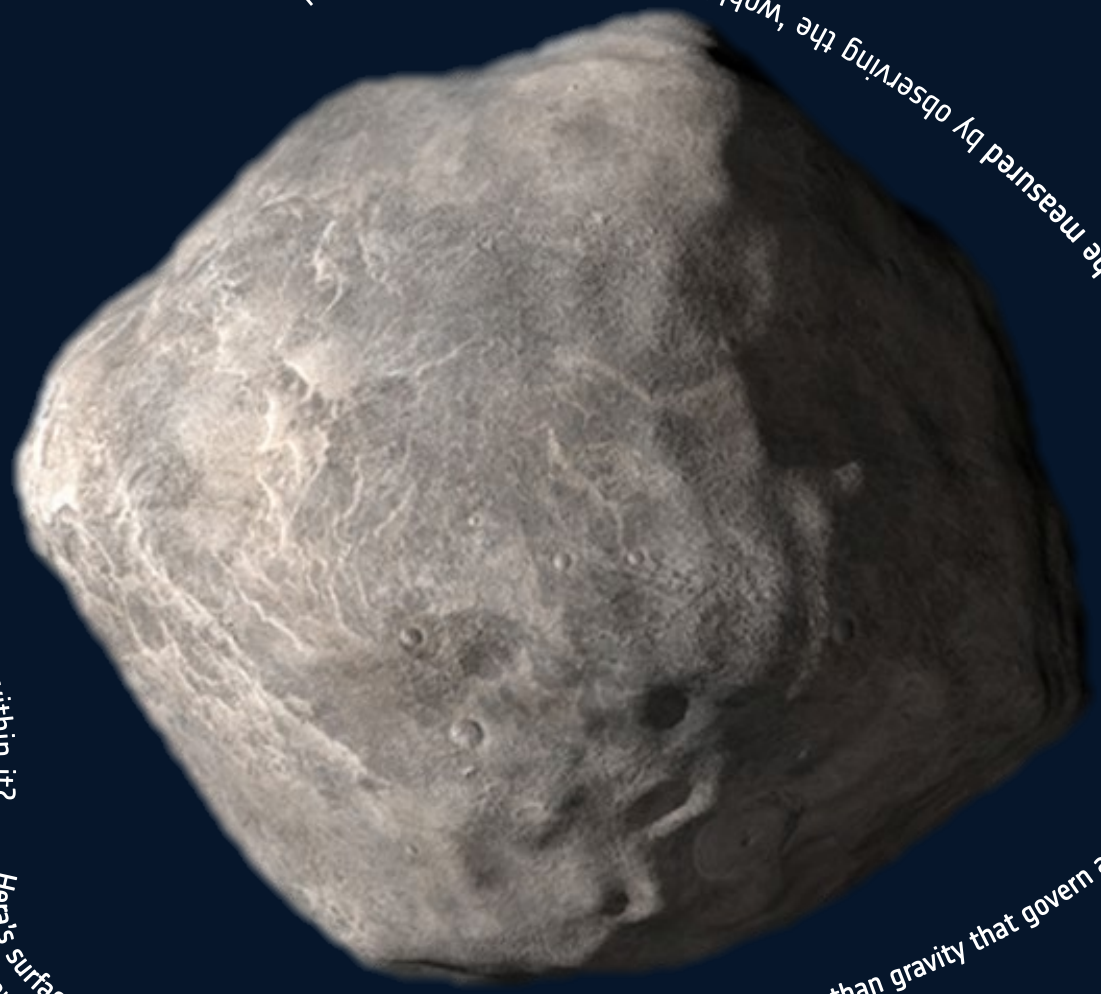
- Named after the late Italian academic who devised the DART/Hera missions
- A '6-unit-XL' CubeSat
- Led by Tyvak International in Italy
- Will image the asteroids in a wider range of colours than the human eye can see, using its ASPECT multispectral instrument.
- It will also survey the dust environment surrounding these bodies with the VISTA instrument based on piezoelectric quartz microbalances.
- In addition Milani carries a visible camera, lidar and startrackers for navigation, an inter-satellite link, a cold gas propulsion system, plus accelerometers and gyros employed when Milani performs its end-of-mission landing on Dimorphos.



ASTEROID MYSTERIES

Hera will **validate the kinetic impactor method of planetary defence** – while also delivering unique science.

Hera will perform a close-up survey of all Dimorphos's properties. Is it a rubble pile, held together mainly by gravity, with large voids within it? Or a solid core surrounded by boulders and gravels?.



The mass of Dimorphos will be measured by observing the 'wobble' of its parent Didymos asteroid.

Hera's surface observations will reveal the range of physical phenomena other than gravity that govern asteroid surfaces. Results would hold relevance for asteroid mining as well as planetary defence.