

## CASE STUDY

### JUVENTAS TO PERFORM FIRST-EVER ASTEROID RADAR PROBE



#### Juventas nanosatellite mission overview

A compact spacecraft with big ambitions—Juventas will help us see inside an asteroid for the first time.

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#### Executive summary

Juventas is a 6U nanosatellite deployed from ESA's Hera spacecraft to the Didymos binary asteroid system. Its primary objective is to perform the first radar measurements of an asteroid's interior, enabling unprecedented insight into its structure, formation, and surface properties. Following close-orbit operations, Juventas will conclude with a controlled landing on Didymoon, collecting high-rate sensor data during impact and surface activities.

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#### Mission overview and objectives

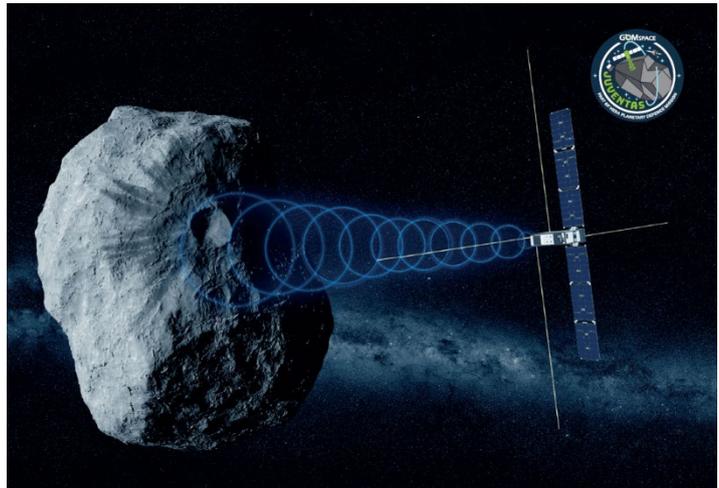


- **Mission context:** Juventas travels as a passenger on ESA's Hera spacecraft to the Didymos system, relying on Hera for command relay, data transport, and navigation via an inter-satellite radio link.
- **Primary science goal:** Perform low-frequency radar measurements capable of penetrating the asteroid body to reveal its internal structure—akin to an “X-ray scan” of Didymoon.
- **Secondary science goals:** Characterize binary asteroid formation processes, surface properties, and dynamical behavior through radio science, gravimetry, imaging, and landing data collection.

- **Mission timeline:** Operates from a stable terminator orbit for approximately 1–3 months, then descends to land on Didymoon and conducts several days of surface operations.
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## Spacecraft and operations

- **Configuration:** Juventas is a 6U nanosatellite built for close-proximity operations around Didymoon, aligning with Hera to conduct coordinated radio-science experiments.
- **Communications and navigation:** Uses Hera's inter-satellite link to receive navigation information and relay data and commands to ground operations centers.
- **Orbit operations:** Maintains a stable terminator orbit for radar and radio-science observations before descent and surface activities.
- **End-of-mission landing:** The landing sequence leverages natural bouncing dynamics; high-rate sensors monitor impact and settle behavior to infer surface mechanical properties.



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## Payloads and instruments

- **Low-frequency radar (monostatic):** Performs interior probing to derive structural insights beneath the asteroid's surface.
- **Gravimeter:** Measures local gravity at the surface to support internal and mass distribution models.

- **Radio science via ISL link:**  
Enables satellite-to-satellite experiments with Hera for dynamical characterization and precise measurements.
  - **Visible camera:**  
Provides context imagery for the radar and radio-science observations, aiding interpretation and mission navigation.
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## Key specifications and mission phases

Attribute	Details
Form factor	6U nanosatellite
Deployment	Passenger on ESA's Hera spacecraft
Target	Didymos binary asteroid system (focus: Didymoon)
Comms/Navigation	Inter-satellite link with Hera
Mission duration	~1–3 months in orbit; several days on surface
End state	Controlled descent and surface operations

## Mission phases

1. **Cruise and delivery**
  - **Transport:** Hitchhikes on Hera to the Didymos system.
2. **Deployment and commissioning**
  - **Release:** Juventas separates and establishes a stable terminator orbit around Didymoon.

### 3. Science orbit operations

- **Radar interior survey:** Conducts low-frequency radar passes to probe internal structure.
- **Radio-science alignment:** Lines up with Hera for satellite-to-satellite experiments.

### 4. Descent and landing

- **Impact characterization:** High-rate sensors capture bouncing dynamics and contact events to assess regolith and surface properties.

### 5. Surface operations

- **Short-duration activities:** Continues science for several days using onboard instruments.

## Why Juventas matters

- **First-of-its-kind interior mapping:** Penetrating radar on a nanosatellite offers unique insight into asteroid structure, composition, and formation history.
- **Risk-informed planetary defense:** Understanding internal properties supports models of impact mitigation and system response to external forces.
- **Agile deep-space engineering:** Demonstrates how small spacecraft, tightly integrated with a mothership, can deliver sophisticated science at low mass and complexity.

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## Credits

- Mission and spacecraft information: GomSpace, ESA Hera mission context, Juventas payloads and operations.
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## References

GOMspace | Juventas. <https://gomspace.com/juventas.aspx>

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