



Psyche

Exploring a metal-rich world

The asteroid Psyche has remained largely a mysterious point of light in the distance. Scientists know its location (orbiting the Sun in the main asteroid belt, between Mars and Jupiter), size (about 140 miles, or 226 kilometers, across), shape (somewhat like a potato), and something of its composition (likely rich in metal). But there's much that they don't know about the asteroid's origins. NASA's Psyche mission aims to find out.

It will be the first to visit this unexplored world and provide more insight into what this asteroid is exactly. One hypothesis is that Psyche is part of the core of a planetesimal, the building block of an early planet. If so, it could provide a unique opportunity to study how planets like our own Earth formed. But the mission's scientists are also prepared to be surprised. They may find out that Psyche is made of material from a primordial solar system object that has never before been studied. The asteroid is formally named 16 Psyche, as it was the 16th asteroid to be discovered – in 1852 by Italian astronomer Annibale de Gasparis.

Expected Mission Timeline

- **October 2023:** The Psyche spacecraft is scheduled to launch no earlier than Oct. 5 from NASA's Kennedy Space Center in Florida on a SpaceX Falcon Heavy rocket.
- **March-May 2026:** Psyche spacecraft flies by Mars for a gravity assist, to gain speed and slingshot it out to the asteroid belt
- **August 2029:** Spacecraft expected to enter orbit around asteroid after a journey of about 2.2 billion miles (3.6 billion kilometers)
- **26 months:** The minimum time the spacecraft will spend mapping the asteroid and studying its properties. It will use its electric propulsion system to



NASA's Psyche spacecraft is shown in a clean room on June 26, 2023, at the Astrotech Space Operations facility near the agency's Kennedy Space Center in Florida.

orbit the asteroid at different altitudes, starting at 440 miles (709 kilometers) above the surface, down to its lowest altitude of 47 miles (75 kilometers) and then back up again to a final altitude of 188 miles (303 Kilometers).

Key Goals

- Explore a new type of world, examining, for the first time, an asteroid rich in metal.
- Determine whether the asteroid Psyche is part of a core of an early planetary building block or if it is some other primordial material that has never been seen before.
- Determine the relative ages of regions of Psyche's surface.
- Characterize Psyche's topography and surface.

Key Hardware

- **Magnetometer:** The instrument will look for evidence of an ancient magnetic field, which could be frozen into Psyche's layers. Evidence that Psyche once held a magnetic field would be strong evidence that the asteroid is the core of an early planet.

NASAfacts



Team members prepare to integrate one of two solar arrays on NASA's Psyche spacecraft inside the Astrotech Space Operations facility near the agency's Kennedy Space Center in Florida on July 24, 2023.

- **Gamma-Ray and Neutron Spectrometer:** As cosmic rays and high energy particles bombard Psyche's surface, the elements there absorb the energy. In response, they emit neutrons and gamma rays of varying energy levels. The spectrometer will measure those to help scientists determine the chemical elements that make up the asteroid.
- **Multispectral imagers:** A pair of cameras equipped with filters and telescopic lenses will capture images of the surface of Psyche at different wavelengths of light. Data from the imagers will provide information about the mineralogical composition of Psyche. The imagers also will provide a topographic map of the surface, allowing scientists to study features that provide clues to the asteroid Psyche's history.
- **Telecommunications system:** Intended primarily to send data and receive commands, the telecommunications system will also be used to conduct gravity science. By analyzing the X-band radio waves the spacecraft relies on to communicate, scientists can measure how the asteroid Psyche affects the orbit of the spacecraft. From that, scientists can determine the asteroid's rotation, wobble, mass, and gravity field.

Psyche Spacecraft

The main body of the Psyche spacecraft is shaped like a box and is slightly larger than a small van. One of its most visible features is its dish-shaped high-gain antenna, which measures 6.5 feet (2 meters) across.

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Psyche will use solar electric propulsion to reach its target. The spacecraft's enormous solar arrays will convert sunlight into electricity to power its four thrusters. Those thrusters, operating one at a time, use electromagnetic fields to expel charged atoms, or ions, of xenon, the same neutral gas found in car headlights and plasma TVs. As the thrusters expel ions, they will push the spacecraft through space, trailing a blue glow of xenon.

Technology Demonstration

- **Deep Space Optical Communications (DSOC):** Psyche will carry an experiment that will demonstrate NASA's farthest-ever test of high-bandwidth optical communications. DSOC will send and receive test data to and from Earth using an invisible near-infrared laser, which can transmit data at 10 to 100 times the bandwidth of conventional radio wave systems used on spacecraft today. As the first demonstration of deep space laser communications, DSOC could pave the way for broadband communications that will help support humanity's next giant leap: When NASA sends astronauts to Mars.

Mission Partners

Leading the Psyche mission is Arizona State University, the home institution of Principal Investigator Lindy Elkins-Tanton. NASA's Jet Propulsion Laboratory, a division of Caltech in Pasadena, California, is responsible for the mission's overall management, system engineering, integration and testing, and operations. Maxar Technologies delivered the solar electric propulsion chassis, the main body of the spacecraft and most of its engineering hardware systems. NASA's Launch Services Program at Kennedy Space Center manages launch operations. Psyche is the 14th mission selected as part of NASA's Discovery Program, managed by the agency's Marshall Space Flight Center in Huntsville, Alabama.

Mission Websites

For more information about the Psyche mission, visit:

<http://www.nasa.gov/psyche>

<https://psyche.asu.edu/>