NASAfacts

Psyche
Journey to a Metal World

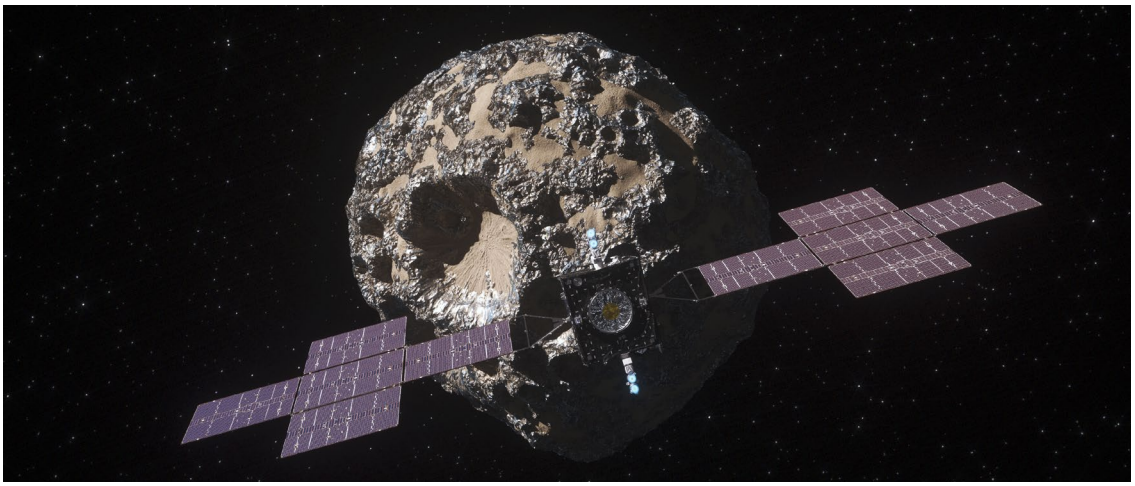
Since the asteroid Psyche was discovered in 1852, it has intrigued scientists but remained largely a mysterious point of light in the distance. Scientists now know its location (orbiting the Sun in the main asteroid belt, between Mars and Jupiter), size (about 140 miles, or 226 kilometers across), shape (somewhat like a potato), and something of its composition (likely rich in metal mixed with rock). NASA's Psyche mission will be the first to visit this unexplored world and provide more insight into what this asteroid may be. Scientists think Psyche may consist largely of metal from the core of a planetesimal, one of the building blocks of the terrestrial (rocky) planets in our solar system: Mercury, Venus, Earth, and Mars. If so, it could provide a unique opportunity to study how planets like our own Earth formed. But scientists are also prepared to be surprised and may find that Psyche is some other type of primordial solar system object never before studied.

Key Goals

- Explore a new type of world. For the first time, examine an asteroid rich in metal
- Determine what the asteroid is made of and whether it's part of the core of a planetesimal, the building block of an early planet
- Determine the relative ages of different regions of Psyche's surface
- Characterize Psyche's topography and surface

Mission Timeline

- Aug. 2022: Psyche spacecraft is scheduled to launch from NASA's Kennedy Space Center on a SpaceX Falcon Heavy rocket.
- May 2023: Spacecraft flies by Mars for a gravity assist so the spacecraft can gain speed.
- Jan. 2026: Spacecraft is expected to enter orbit around asteroid Psyche after a journey of about 1.5 billion miles (2.4 billion kilometers).
- Spacecraft then spends at least 21 months mapping the asteroid and studying its properties. It will use its electric propulsion system to dip into lower and lower orbits throughout the mission, establishing a final orbit about 53 miles (85 kilometers) above the surface.



This illustration depicts NASA's Psyche spacecraft approaching the 140-mile-wide (226-kilometer-wide) metal-rich asteroid of the same name. Credit: NASA/JPL-Caltech/ASU

The Spacecraft

The main body of the Psyche spacecraft is shaped like a box and is roughly the size of a van. Notable features include its 6.5-foot-wide (2-meter-wide) dish-shaped high-gain antenna and the two 6.5-foot-long (2-meter-long) booms covered in thermal blankets which support the Gamma Ray and Neutron Spectrometer and Magnetometer instrument sensor heads. At the bottom of the spacecraft, two robotic arms support and position the spacecraft's four main thrusters.

Psyche will use solar electric propulsion to reach its target. This starts with Psyche's enormous solar arrays, which convert sunlight into electricity, providing power for the spacecraft's four Hall thrusters.

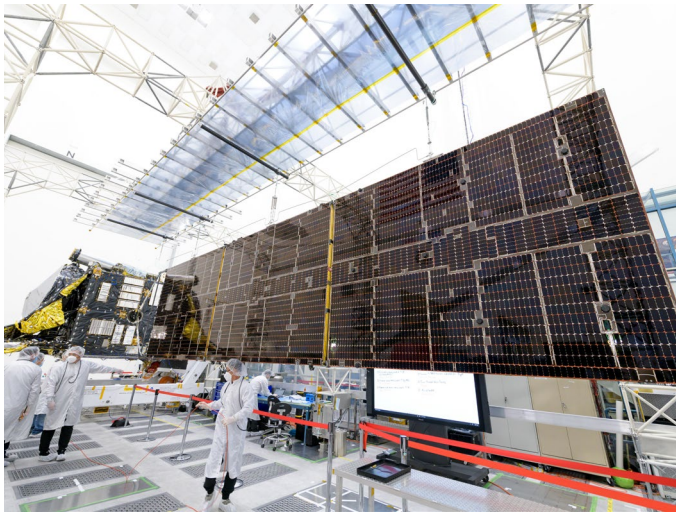
The thrusters themselves use electromagnetic fields to expel charged atoms, or ions, of xenon – the same neutral gas used in car headlights and plasma TVs. As the ions are expelled, they push Psyche through space, trailing a blue glow of xenon.

Key Hardware

- Magnetometer: will look for evidence of an ancient magnetic field that could be found frozen into Psyche's layers. Evidence that Psyche once experienced a magnetic field would help determine whether the asteroid is remnant core material of an early planetesimal.
- Gamma Ray and Neutron Spectrometer: will measure Psyche's elemental composition using gamma rays and neutrons emitted from the asteroid that are generated by energetic protons (cosmic rays) hitting its surface.
- Multispectral imager: a pair of cameras equipped with filters and telescopic lenses that will capture images of asteroid Psyche's surface at different wavelengths of light. Data from the imagers will provide information about the mineralogical composition of Psyche. They also will provide a topographic map of the surface, allowing scientists to study features that provide clues to Psyche's history.
- Telecommunications system: will be primarily used to send commands to and receive data from the spacecraft but will also conduct gravity science. By analyzing subtle changes in the characteristics of the X-band radio waves the spacecraft uses to communicate, scientists can measure how asteroid Psyche affects the orbit of the spacecraft. From that, scientists can determine the asteroid's rotation, wobble, mass, and gravity field.

Technology Demonstration

Deep Space Optical Communication (DSOC): The Psyche mission will also carry a sophisticated new experiment that will test high-data-rate laser communications with Earth during the spacecraft's journey to the asteroid belt – technology that could be used by future NASA missions. The DSOC instrument, with its large sunshade, protrudes out of the side of the spacecraft and is yet another distinguishing visual feature of the overall spacecraft. DSOC is managed by JPL for the Technology Demonstration Missions program within NASA's Space Technology Mission Directorate, and the Space Communications and Navigation (SCaN) program within the agency's Space Operations Mission Directorate.



Engineers at NASA's Jet Propulsion Laboratory successfully deployed one of two solar arrays installed on the agency's Psyche spacecraft in February 2022. Credit: NASA/JPL-Caltech

Program Management

Arizona State University leads the Psyche mission as the home of the mission's principal investigator, Lindy Elkins-Tanton. NASA's Jet Propulsion Laboratory, a division of Caltech, is responsible for the mission's overall management, system engineering, integration and testing, and mission 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.

For more information about NASA's Psyche mission go to:

http://www.nasa.gov/psyche

and

https://psyche.asu.edu/

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