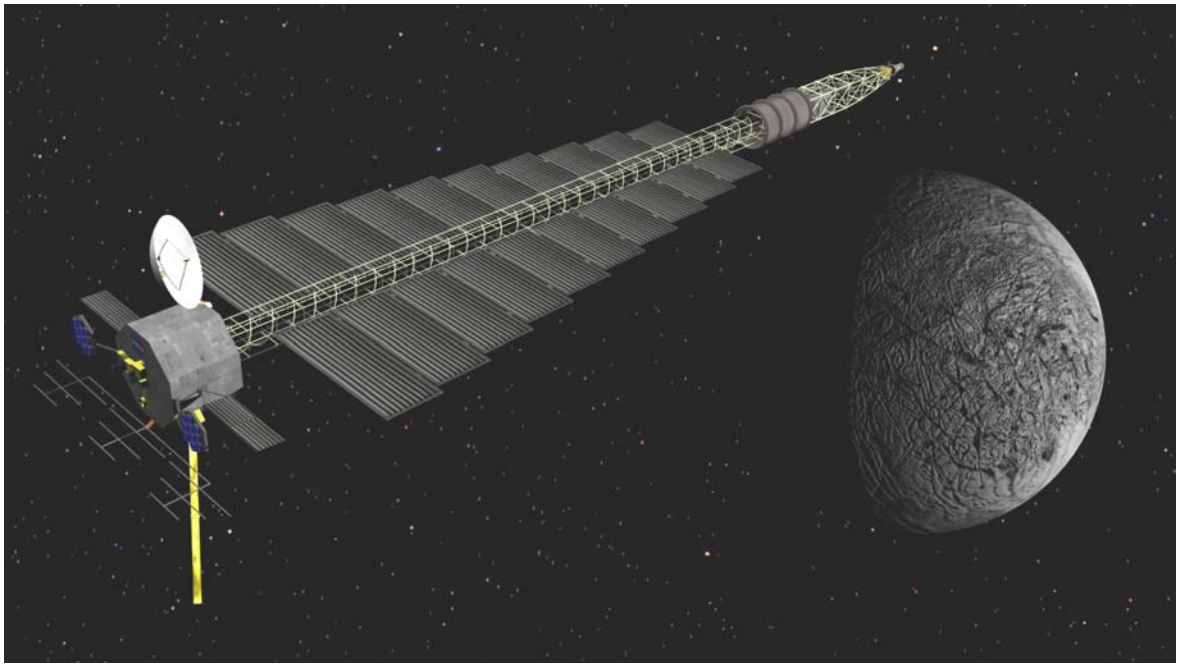
Project Prometheus

Jupiter Icy Moons Orbiter
Fact Sheet

What Is the Jupiter Icy Moons Orbiter?

NASA is developing plans for an ambitious mission to orbit three planet-sized moons of Jupiter -- Callisto, Ganymede and Europa -- which may harbor vast oceans beneath their icy surfaces. The mission, called the Jupiter Icy Moons Orbiter, would orbit each of these moons for extensive investigations of their makeup, their history and their potential for sustaining life. NASA's Galileo spacecraft found evidence for these subsurface oceans, a finding that ranks among the major scientific discoveries of the Space Age.



A technology-pioneering spacecraft called Jupiter Icy Moons Orbiter approaches the moon Europa in this artist's version of a proposed NASA mission. The spacecraft would orbit three different moons of Jupiter where earlier spacecraft discovered evidence for vast saltwater oceans hidden beneath icy surface layers: Europa, Ganymede and Callisto. The proposed mission would also raise NASA's capability for space exploration to a revolutionary new level by demonstrating safe and reliable use of electric propulsion powered by a nuclear fission reactor.

The JIMO mission also will raise NASA’s capability for space exploration to a revolutionary new level by pioneering the use of electric propulsion powered by a nuclear fission reactor. This technology not only makes it possible to consider a realistic mission for orbiting three of the moons of Jupiter, one after the other, it also would open the rest of the outer Solar System to detailed exploration in later missions.

Why are Jupiter's icy moons a priority for a major NASA program?

To explore the universe and search for life is central to the agency's mission. Jupiter's large icy moons appear to have three ingredients considered essential for life: water, energy, and the necessary chemical elements. The evidence from Galileo suggests melted water on Europa has been in contact with the surface in geologically recent times and may still lie relatively close to the surface. The National Research Council completed a report last year drawing on input from scores of planetary scientists to prioritize potential projects for exploring the solar system. It ranked a Europa orbiter proposal as top priority for a "flagship" mission, because of the recent discovery of Europa's ocean and the potential that it might harbor life. The Jupiter Icy Moons Orbiter would fulfill NASA's science goals for the exploration of Europa and also examine Callisto and Ganymede, providing comparisons key to understanding the evolution of all three.

What are the science goals?

The mission has three top-level science goals:

1. Scout the potential for sustaining life on these moons. This would include determining whether the moons do indeed have subsurface oceans; mapping where organic compounds and other chemicals of biological interest lie on the surface; and determining the thicknesses of ice layers, with emphasis on locating potential future landing sites.
2. Investigate the origin and evolution of these moons. This would include determining their interior structures, surface features and surface compositions in order to interpret their evolutionary histories (geology, geochemistry, geophysics) and how this illuminated the understanding of the origin and evolution of the Earth.
3. Determine the radiation environments around these moons and the rates at which the moons are weathered by material hitting their surfaces. Callisto, Ganymede and Europa all orbit within the powerful magnetic environment that surrounds Jupiter. They display varying effects from the natural radiation, charged particles and dust within this environment. Understanding this environment has implications for understanding whether life could have arisen on these distant moons.

What instruments would it carry?

NASA would choose the final suite of instruments through a competitive process open to proposals from scientists worldwide. Two highly probable ones are a radar instrument for mapping the thickness of surface ice and a laser instrument for mapping surface elevations. Others would likely include a camera, an infrared imager, a magnetometer, and instruments to study charged particles, atoms and dust that the spacecraft encounters near each moon. A generous electrical power supply available from the onboard nuclear system could run higher-powered instruments than have flown on other spacecraft and would boost the data-transmission rate back to Earth. The expanded scientific capacities would allow mapping the entire surfaces of Callisto and Ganymede, and more than half of Europa, in enough detail to see features as small as a house.

How would it get there?

The proposed baseline for the spacecraft incorporated a form of electric propulsion, called ion propulsion. NASA's Deep Space 1 mission, that successfully demonstrated ion propulsion for interplanetary travel, drew electricity for its thrusters from solar panels. The Jupiter Icy Moons Orbiter, a more heavily instrumented craft traveling farther from the Sun, would power its ion thrusters with a nuclear fission reactor and a system for converting the reactor's heat to electricity. This could give the craft more than 100 times as much power as a non-fission system of comparable weight.

What is the mission timeline?

To allow sufficient development and ground-testing time, the mission is not proposed for launch before the year 2011. A heavy lift expendable launch vehicle would lift the spacecraft into high Earth orbit. The ion-propulsion thrusters would spiral the spacecraft away from Earth and then on its trip to Jupiter. After entering orbit around Jupiter, the spacecraft would then orbit Callisto, then Ganymede, and finally Europa. The intensity of the radiation belts at Europa limits how long a spacecraft's electronics are able to operate in orbit around Europa, even with advances in radiation-resistant electronics that would be used on this mission. The instruments onboard the spacecraft will take uniform measurements, using the same complement of instruments, of all three moons. Special attention will be paid to identifying high-potential future landing sites.

Several NASA centers around the country, the Department of Energy, national laboratories, industrial contractors, and university researchers, could collaborate on this mission.

What is NASA's Project Prometheus?

NASA's Project Prometheus was established this year to develop technology and conduct advanced studies in the areas of radioisotope power system and nuclear power and propulsion for the peaceful exploration of the Solar System. Project Prometheus, organized within the NASA Office of Space Science, has the goal of developing the first reactor powered spacecraft capability and demonstrating that it can be operated safely and reliably in deep space on long duration missions. The proposed Jupiter Icy Moons Orbiter has been identified as the first space science mission to potentially incorporate this new revolutionary capability.

# # #

February 2003