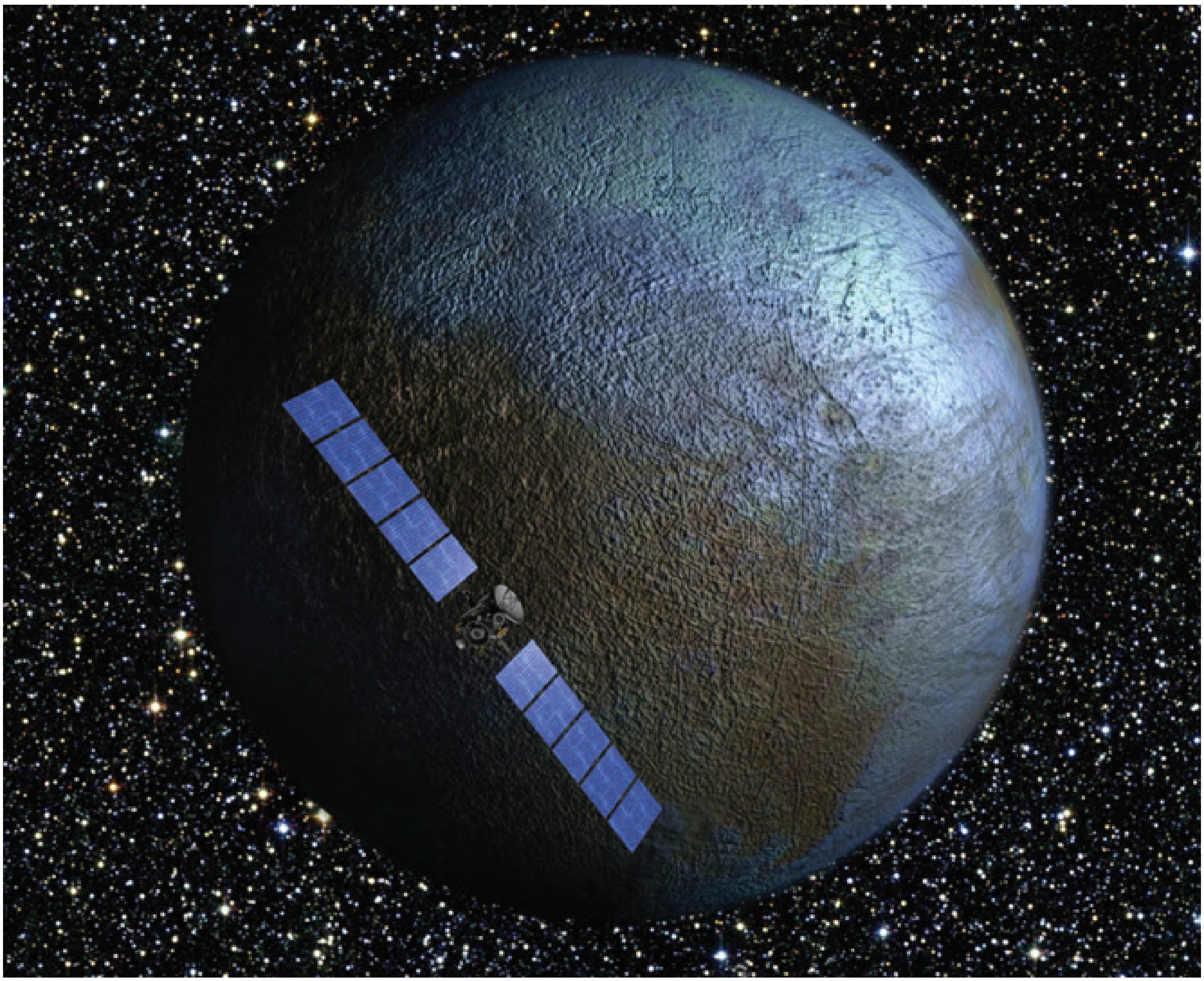
National Aeronautics and Space Administration

PRESS KIT/MARCH 2015

Dawn at Ceres



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Media Services Information

NASA Television Transmission

NASA Television Channels are MPEG-2 digital C-band signals, carried by QPSK/DVB-S modulation on satellite AMC-18C, transponder 3C, at 105 degrees west longitude, with a downlink frequency of 3760 MHz, vertical polarization, data rate of 38.80 MHz, symbol rate of 28.0681 Mbps, and 3/4 FEC. A Digital Video Broadcast (DVB) compliant Integrated Receiver Decoder (IRD) is needed for reception.

For digital downlink information for NASA TV's Media Channel, access to NASA TV's Public Channel on the Web and a schedule of programming for Dawn launch activities, visit **http://www.nasa.gov/nasatv.**

News conference

A preview news conference to discuss Dawn's approach to Ceres and planned operations at the dwarf planet will be held at NASA's Jet Propulsion Laboratory at noon EST (9 a.m. PST) on March 2, 2015. The briefing will be carried live on NASA Television and on voice circuits.

Internet Resources

News and information about the Dawn mission, including an electronic copy of this press kit, news releases, fact sheets, status reports and images, are available from the NASA Web site at **http://www.nasa.gov/dawn.**

Detailed background information on the mission is available from the Dawn project home page at **http://dawn.jpl.nasa.gov.**

Quick Facts

Spacecraft

Dimensions: The spacecraft bus is 5.4 feet (1.64 meters) long, 4.2 feet (1.27 meters) wide and 5.8 feet (1.77 meters) high. High-gain antenna is 5 feet (1.52 meters) in diameter. When the solar arrays are deployed, Dawn's wingspan is 64 feet, 9 inches (19.7 meters).

Weight: 2,684.6 pounds (1,217.7 kilograms) at launch, consisting of 1,647.1-pound (747.1-kilogram) spacecraft, 937 pounds (425 kilograms) xenon propellant and 100.5 pounds (45.6 kilograms) hydrazine propellant.

Power: Two 27-foot-by-7-foot (8.3-meter-by-2.3-meter) solar panels, together providing more than 10 kilowatts, depending on distance from the sun.

Each wing weighs almost 139 pounds (63 kilograms).

Power storage via 35-amp-hour rechargeable nickel hydrogen battery

Number of science instruments: 3

Ion Propulsion System

Number of thrusters: 3

Thruster dimensions (each): 13 inches (33 centimeters) long, 12 inches (30 centimeters) in diameter

Weight: 20 pounds (8.9 kilograms) each

Fuel: 937 pounds (425 kilograms) of xenon propellant at launch

Fuel remaining at Ceres orbit entry: 88 pounds (40 kilograms)

Spacecraft acceleration via ion propulsion: 0 to 60 mph in four days

Thrust: 0.07 to 0.33 ounce (19 to 91 millinewtons)

Estimated days of thrusting for entire mission: 2,000

Days of thrusting up to orbit at Ceres: 1,885

Mission

Launch: Sept. 27, 2007

Launch site: Cape Canaveral Air Force Station, Fla., Pad 17B

Launch vehicle: Delta II Heavy 2925H-9.5 including Star 48 upper stage

Mars gravity assist: Feb. 17, 2009

Vesta arrival: July 16, 2011

Ceres' distance to Earth at time of Dawn arrival: 310 million miles (500 million kilometers)

Distance traveled by spacecraft launch-to-Vesta: 1.7 billion miles (2.8 billion kilometers)

Vesta departure: Sept. 5, 2012

Ceres arrival: March 6, 2015

Distance spacecraft travels between Vesta and Ceres: 920 million miles (1.5 billion kilometers)

Total distance spacecraft travels from Earth to Vesta to Ceres: 3.1 billion miles (4.9 billion kilometers)

End of primary mission: June 2016

Program Cost: $472 million total, including $373 million to build and launch the spacecraft and $99 million for 10 years of operations and data analysis.

Ceres is the largest, most massive object in the main asteroid belt, with an average diameter of about 590 miles (950 kilometers).

Vesta is 326 miles (525 kilometers) in diameter and the second most massive object in the asteroid belt.

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*Additional facts about Ceres:
http://solarsystem.nasa.gov/planets/profile.cfm?Object=Dwa_Ceres&Display=Facts

Dawn Firsts

Dawn's mission to Ceres and Vesta is unique for the following reasons:

- Dawn is the first mission to visit Ceres and the first mission to visit Vesta.
- Dawn is the first spacecraft to orbit two extraterrestrial targets
- When Dawn arrives at Ceres in March 2015, it will be the first spacecraft to visit a dwarf planet. (New Horizons flies by Pluto, another dwarf planet, in July 2015.) A dwarf planet is round and orbits the sun, but is unable to clear its orbital path such that there are no similar objects at roughly the same distance from the sun.
- When Dawn visited Vesta, it also became the first spacecraft to orbit a main-belt asteroid.

About the Dawn mission

Why Dawn?

NASA's Dawn spacecraft is on a mission to study the two most massive objects in the main asteroid belt between Mars and Jupiter, Vesta and Ceres. Studying these worlds allows scientists to do historical research in space, opening a window into the earliest chapter in the history of our solar system. At each target, Dawn acquires color photographs, maps the elemental and mineralogical composition, measures the gravity field and searches for moons.

The data gathered by Dawn will enable scientists to understand the conditions under which these objects formed, determine the nature of the building blocks from which the terrestrial planets (like Earth) formed, and contrast the formation and evolution of Vesta and Ceres.

Dawn's quest to understand the conditions that existed when our solar system formed provides context for the observation of planetary systems around other stars. Vesta and Ceres are the two largest surviving intact asteroids. Their special qualities are explained by the processes at work during the earliest chapters of our solar system's history, when the materials in the solar nebula (a disk around the sun that formed from dust and hydrogen gas) varied with their distance from the sun. As this distance increased, the temperature dropped, with terrestrial bodies forming closer to the sun, and icy bodies forming farther away.

Vesta and Ceres straddle a boundary in the asteroid belt between primarily rocky bodies and ice-bearing bodies. They present contrasting stories of fire and ice. Vesta is a dry, differentiated object, shaped by volcanism, with a crust that shows signs of resurfacing. Ceres, by contrast, has a surface containing lower-temperature water-bearing minerals, and may possess a very tenuous atmosphere.

By studying both of these two distinct bodies with the same complement of instruments on the same spacecraft, the Dawn mission hopes to compare the different evolutionary path each took, and create a picture of the early solar system history in the region of the main asteroid belt. Data returned from the Dawn spacecraft could contribute to significant breakthroughs in our understanding of how the solar system formed.

To carry out its scientific mission, the Dawn spacecraft will conduct four science experiments producing data that will be used in combination to characterize these bodies. Dawn carries a pair of visible-light cameras (one prime and one backup), a visible and infrared mapping spectrometer, and a gamma ray and neutron spectrometer. Radio and optical navigation data will provide information about the gravity field, and thus bulk properties and internal structure, of the two bodies.

Dawn's mission to Vesta and Ceres is managed by the Jet Propulsion Laboratory for NASA's Science Mission Directorate in Washington. Dawn is a project of the directorate's Discovery Program, managed by NASA's Marshall Space Flight Center in Huntsville, Alabama. UCLA is responsible for overall Dawn mission science. Orbital ATK, Inc., of Dulles, Virginia, designed and built the spacecraft. JPL is managed for NASA by the California Institute of Technology in Pasadena.

The Framing Cameras were provided by the Max Planck Institute for Solar System Research, Göttingen, Germany, with significant contributions by the German Aerospace Center (DLR) Institute of Planetary Research, Berlin, and in coordination with the Institute of Computer and Communication Network Engineering, Braunschweig. The visible and infrared mapping spectrometer was funded and coordinated by the Italian Space Agency and built by SELEX ES, with the scientific leadership of the Institute for Space Astrophysics and Planetology, Italian National Institute for Astrophysics, Italy, and is operated by the Institute for Space Astrophysics and Planetology, Rome, Italy. The gamma ray and neutron detector was built by Los Alamos National Laboratory, New Mexico, and is operated by the Planetary Science Institute, Tucson, Arizona.

Top Findings at Vesta

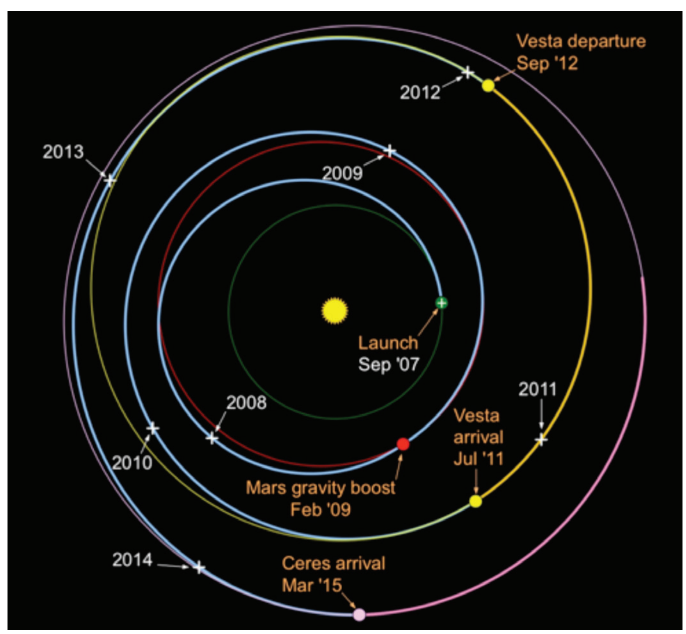
Data from Dawn revealed the presence of anomalous dark spots and streaks on Vesta's surface, which correspond to dark inclusions found in meteorites from Vesta, which were likely deposited by ancient asteroid impacts. Based on measurements of its mass, shape, volume and spin state with radiometry and imagery, Dawn confirmed the presence of a core inside Vesta and placed constraints on its size.

Researchers continue to examine data collected by Dawn for additional insights into the formation and history of Vesta. Dawn data can be accessed by the public at **http://dawndata.igpp.ucla.edu** and through NASA's Planetary Data System.

Mission Science Objectives

In particular, the mission's scientific objectives are to:

- Investigate the internal structure, density and homogeneity of two complementary protoplanets — one wet (Ceres) and one dry (Vesta).
- Determine surface shape and cratering via near-global surface imagery in three colors at Vesta and at Ceres.
- Perform radio tracking to determine mass, gravity field, principal axes, rotational axis and moments of inertia of both Vesta and Ceres.
- Determine shape, size, composition and mass of Vesta and Ceres.
- Determine thermal history and size of each body's core.
- Determine the spin axis of Vesta and Ceres.
- Understand the role of water in controlling asteroid evolution.
- Test the scientific theory that Vesta is the parent body for a class of stony meteorites known as howardite, eucrite and diogenite meteorites; determine which, if any, meteorites come from Ceres.
- Provide a geologic context for howardite, eucrite and diogenite meteorites (at Vesta).
- Obtain surface coverage with the mapping spectrometer from 0.4- to 5.0-micron wavelengths.
- Obtain neutron and gamma ray spectra to produce maps of the surface elemental composition of each object, including the abundance of major rock-forming elements (oxygen, magnesium, aluminum, silicon, calcium, titanium and iron), trace elements (gadolinium and samarium), and long-lived radioactive elements (potassium, thorium and uranium).



This graphic shows Dawn's path to Vesta and Ceres with the spacecraft's location on September 27 of various years.

Dawn at Ceres

Spectral characteristics of Ceres from ground-based telescopic data suggest it has a surface composition similar to that of meteorites known as carbonaceous chondrites. In January 2014, emissions of water vapor were detected from several regions of Ceres. Dawn will explore the dwarf planet Ceres with the same complement of instruments used in its visit to Vesta. In-depth analysis and comparison of these two celestial bodies will provide insight into their origin and evolution — and thus give us a better understanding of the conditions and processes that have acted upon them since their formation 4.56 billion years ago.

During its orbital studies, Dawn will investigate the internal structure, density and homogeneity of Ceres by measuring its mass, shape, volume and spin state with radiometric tracking and imagery. It will determine the dwarf planet's elemental and mineral composition. From this information, scientists can explore the possible relationship between meteorites and Ceres, and the thermal histories of the dwarf planet. From images of the surface, knowledge of Ceres' bombardment, and its tectonic, and possibly volcanic, history will be revealed.

About Ceres

Scientists describe Ceres as an "embryonic planet." Gravitational perturbations from Jupiter billions of years ago prevented the formation of a terrestrial-sized planet between itself and Mars. Ceres ended up among the leftover debris of planetary formation in the region now known as the main asteroid belt.

NASA's Hubble Space Telescope observed Ceres' rotation, demonstrating that it is nearly round. Like Earth, Ceres' diameter at its equator is wider than at its poles. On average, Ceres is approximately 590 miles (950 kilometers) across. Ceres comprises 25 percent or more of the asteroid belt's total mass.

But Ceres has more in common with Earth and Mars than its rocky neighbors. There are signs that Ceres contains large amounts of water ice beneath its surface. In 2014, scientists using the Herschel Space Observatory found evidence for water vapor being emitted by Ceres. The vapor may be produced by cryovolcanoes or by ice near the surface sublimating (transforming from solid to gas).

Astronomers estimate that if Ceres were composed of 25 percent water, it might have more water than all the fresh water on Earth. Ceres' water, unlike that found on Earth, cannot remain liquid on the surface. The water is located in the mantle beneath the surface in the form of liquid water, ice and hydrated rock.

Observations by NASA's Hubble Space Telescope show that Ceres shares characteristics of the rocky, terrestrial planets of our inner solar system. Computer models show that nearly round objects such as Ceres have a differentiated interior, with denser material at the core and lighter minerals near the surface. All the terrestrial planets — including Earth — have differentiated interiors. This sets Ceres and Vesta apart from most of their asteroid neighbors.

Discovery

Ceres was the first object discovered in the asteroid belt. Sicilian astronomer Father Giuseppe Piazzi spotted the object in 1801. As more such objects were found in the same region, they became known as asteroids or minor planets. Ceres was initially classified as a planet and later classified as an asteroid. In recognition of its planet-like qualities, Ceres was designated a dwarf planet in 2006 along with Pluto and Eris.

How Ceres Got its Name

Ceres is named for the Roman goddess of agriculture and harvests. Craters on Ceres will be named for gods and goddesses of agriculture and vegetation from world mythology. Other features will be named for agricultural festivals.

Dawn's Ceres Activity Plan

Ceres Approach and Arrival

As it did at Vesta, Dawn will use its ion propulsion to make a slow approach to drop into orbit around Ceres. The approach phase began in December 2014, and will conclude when Dawn achieves its first planned science observation orbit around Ceres in April 2015. On March 6, 2015, at a distance of 41,000 miles (61,000 kilometers), Ceres' gravity will gently capture Dawn into orbit.

Ceres Orbit

The 14-month prime science phase will run from April 2015 through June 2016. As at Vesta, Dawn will navigate a series of near-circular, near-polar orbits of different altitudes and orientations that will provide vantage points for studying nearly the entire surface of Ceres.

Dawn will make its first full scientific characterization of Ceres in April and May 2015, at an altitude of about 8,400 miles (13,500 kilometers); this phase is called the Rotation Characterization #3 (RC3) orbit. Then, it will spiral down to an altitude of about 2,750 miles (4,430 kilometers), and obtain more science data in its survey science orbit. This phase will last for 22 days and is designed to obtain an improved global view of Ceres with the camera and the visible and infrared mapping spectrometer (VIR).

Dawn will then continue to spiral down to an altitude of about 920 miles (1,480 kilometers), and in August 2015, will begin a two-month phase known as the high-altitude mapping orbit, or HAMO. During this phase, the spacecraft will continue to acquire near-global maps with VIR and the camera at higher resolution than in the survey phase. The spacecraft also will image in "stereo" to resolve the surface in 3-D.

Then, after spiraling closer to Ceres for two more months, Dawn will begin its nearest orbit around Ceres in late November, at a distance of about 230 miles (375 kilometers). This low-altitude mapping orbit, or LAMO, is specifically designed to acquire data with Dawn's gamma ray and neutron detector (GRaND) and to perform a gravity investigation. GRaND will reveal the signatures of the elements on and near the surface. The gravity experiment will measure the tug of the dwarf planet, as monitored by changes in the high-precision radio link to NASA's Deep Space Network of antennas on Earth.

End of Mission

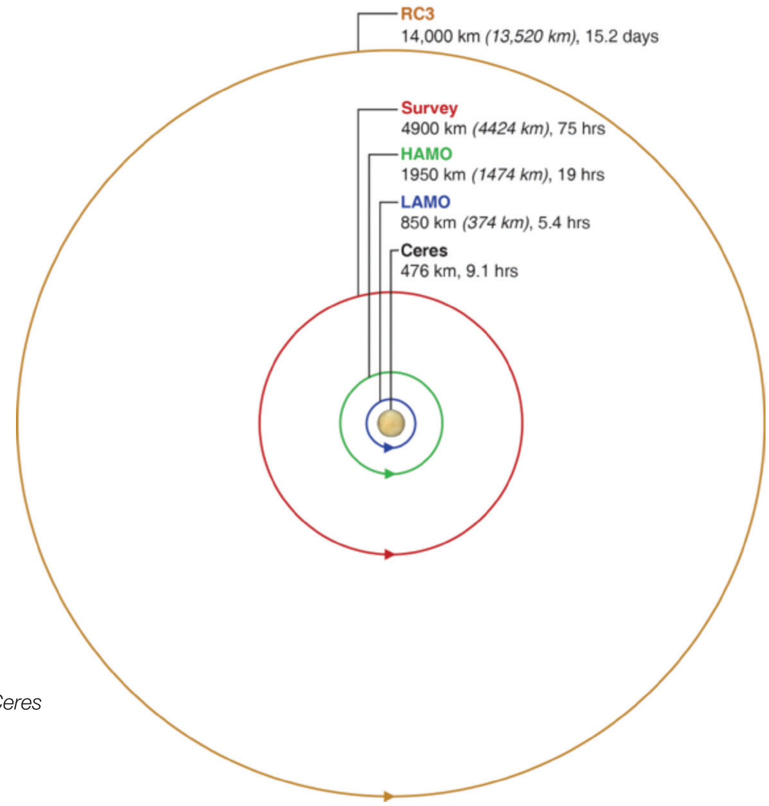
The resource that will ultimately limit Dawn's lifetime is its hydrazine fuel. Once the fuel is exhausted, the spacecraft will no longer be able to point its instruments at the surface. It also will be unable to point any of its ion engines for maneuvering purposes, nor point its antenna at Earth or its solar arrays at the sun. The battery will be depleted in a matter of hours. The spacecraft will remain in orbit around Ceres, but it will cease operating.

Planetary Protection

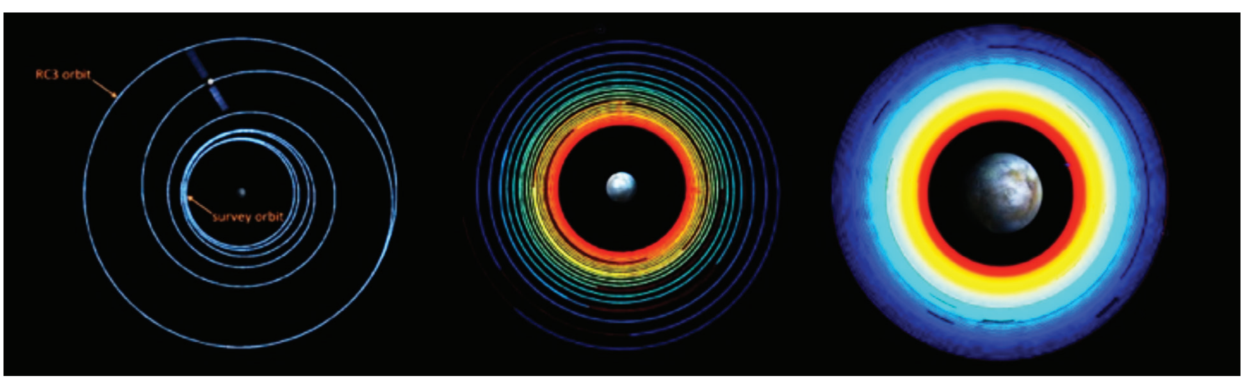
Asteroids and dwarf planets are bodies that are of intense interest to the study of organic chemistry and the origin of life, but are not typically believed to be vulnerable to contamination by Earth-origin microorganisms. However, the potential for the presence of water ice on Ceres prompted the NASA Planetary Protection Office to impose a requirement that the spacecraft not impact Ceres for at least 20 years after completion of the nominal mission. To be conservative, the Dawn project team chose an orbit that will not impact Ceres for at least 50 years.

Ceres Timeline

Science Phase	Start Date	End Date	Altitude (Preliminary Estimates)	Duration (days)
Approach	Dec. 26, 2014	April 23, 2015		100
Capture	March 6, 2015		41,000 miles (61,000 km)	
RC3	April 23, 2015	May 9, 2015	8,400 miles (13,500 km)	20
Survey	June 6, 2015	June 30, 2015	2,730 miles (4,400 km)	22
HAMO	Aug. 4, 2015	Oct. 15, 2015	910 miles (1,470 km)	56
LAMO	Dec. 15, 2015	June 30, 2016	230 miles (375 km)	92



Dawn science orbits at Ceres



These diagrams show Dawn's spiraling transitions to increasingly lower orbits. Left to right: RC3 orbit to survey orbit, survey orbit to HAMO and HAMO to LAMO. In the latter two figures, dark blue represents time spent in higher orbits and red represents time in lower orbits.

Spacecraft

The Dawn spacecraft combines innovative state-of-the-art technologies pioneered by other recent missions with off-the-shelf components and, in some cases, spare parts and instrumentation left over from previous missions.

Most systems on the spacecraft have a backup available if the main system encounters a problem. Automated onboard fault protection software will sense any unusual conditions and attempt to switch to backups.

With its wide solar arrays extended, Dawn is about as long as a tractor-trailer at 65 feet (19.7 meters).

Structure

The core of the Dawn spacecraft's structure is a graphite composite cylinder. Tanks for the ion engines' xenon gas and the conventional thrusters' hydrazine are mounted inside the cylinder. The cylinder is surrounded by panels made of aluminum core with aluminum facesheets; most of the other hardware is mounted on these panels. Access panels and other spacecraft panels have composite or aluminum facesheets and aluminum cores. Blankets, surface radiators, finishes and heaters control the spacecraft's temperature.

Telecommunication

The telecommunication subsystem provides communication with Earth through any of three low-gain antennas and one 5-foot (1.52-meter) diameter parabolic high-gain antenna. The high-gain antenna is the primary one used for most communication. The low-gain antennas are used when the spacecraft is not pointing the high-gain antenna toward Earth. Only one antenna can be used at a time.

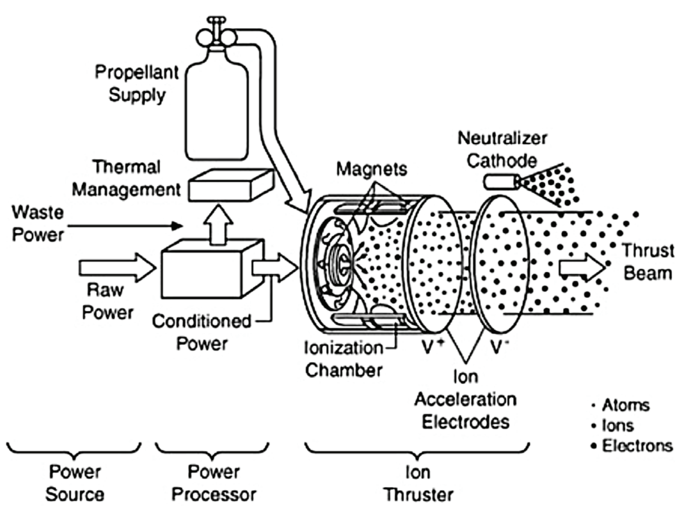
Ion Propulsion

Dawn's futuristic, hyper-efficient ion propulsion system allows Dawn to go into orbit around two different extraterrestrial targets, a first for any spacecraft. Meeting the ambitious mission objectives would be impossible without the ion engines.

Each of Dawn's three 12-inch (30-centimeter) diameter ion thrust units is movable in two axes to allow for migration of the spacecraft's center of mass during the mission. This also allows the attitude control system to use the ion thrusters to help control spacecraft attitude.

Three ion propulsion engines are required to provide enough thruster lifetime to complete the mission and still have adequate reserve. However, only one thruster operates at any given time. Dawn has used ion propulsion for years at a time, with interruptions of only a few hours each week to turn to point the spacecraft's antenna to Earth.

The thrusters work by using an electrical charge to accelerate ions from xenon fuel to a speed seven to 10 times that of chemical engines. The electrical power level and xenon fuel feed can be adjusted to throttle each engine up or down in thrust. The engines are thrifty with fuel, using only about 3.25 milligrams of xenon per second (about 10 ounces over 24 hours) at maximum thrust. The Dawn spacecraft carried 937 pounds (425 kilograms) of xenon propellant at launch.



Ion Propulsion System

Xenon was chosen because it is chemically inert, easily stored in a compact form, and the atoms are relatively heavy so they provide a relatively large thrust compared to other candidate propellants. At launch, the gaseous xenon stored in the fuel tank was 1.5 times the density of water.

At maximum thrust, each engine produces a total of 91 millinewtons -- about the amount of force involved in holding a single piece of notebook paper in your hand.

Solar Power

The electrical power system provides power for all onboard systems, including the ion propulsion system when thrusting. Each of the two solar arrays is 27 feet (8.3 meters) long -- the width of a singles tennis court -- by 7.4 feet (2.3 meters) wide. From tip to tip, the spacecraft with fully deployed solar arrays would extend from the pitcher's mound to home plate on a professional baseball field. On the front side, 18 square meters (21.5 square yards) of each array is covered with 5,740 individual photovoltaic cells.

The cells can convert about 28 percent of the solar energy that hits them into electricity. On Earth, the two wings combined could generate more than 10,000 watts. The arrays are mounted on opposite sides of the spacecraft, with a gimbaled connection that allows them to be turned at any angle to face the sun.

A nickel-hydrogen battery and associated charging electronics provided power during launch and continues to provide power at any time the solar arrays are directed away from the sun.

Science Instruments

To acquire science data at Vesta and Ceres, Dawn carries three instrument systems. In addition, an experiment to measure gravity will be accomplished with existing spacecraft and ground systems.

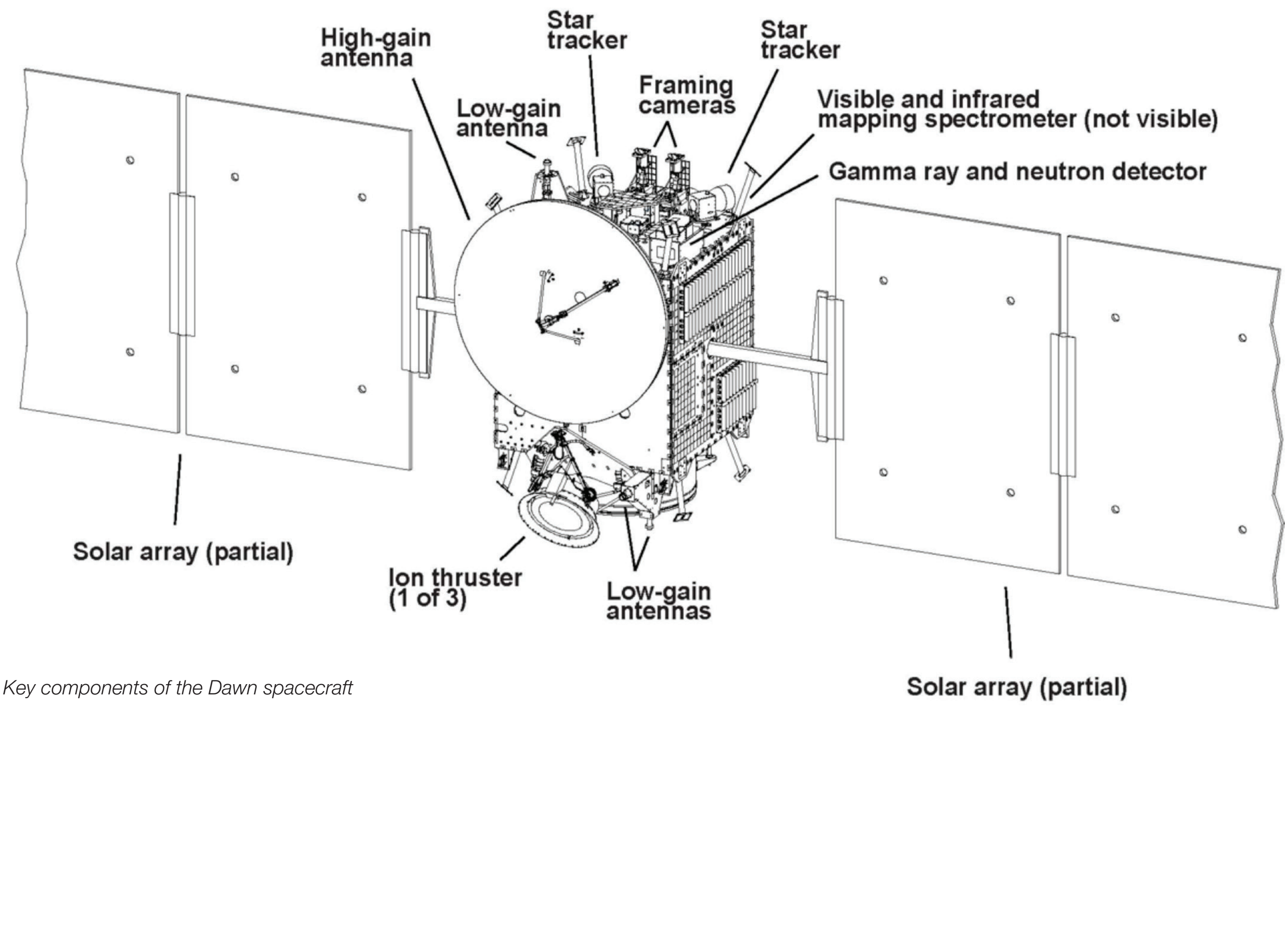
- The **framing camera** is designed to acquire detailed optical images for scientific purposes as well as for navigation in the vicinities of Vesta and Ceres. Dawn carries two identical and physically separate cameras for redundancy, each with its own optics, electronics and structure. Only one camera is in use during normal operations, with the other held as a backup. Each camera is equipped with an f/7.9 refractive optical system with a focal length of 150 millimeters and can use a clear filter or seven color filters, provided mainly to help study minerals on the surface of Vesta or Ceres. In addition to detecting the visible light humans see, the cameras register near-infrared energy. The framing cameras were provided by the Max Planck Institute for Solar System Research, Gottingen, Germany, with significant contributions by the German Aerospace Center (DLR) Institute of Planetary Research, Berlin, and in coordination with the Institute of Computer and Communication Network Engineering, Braunschweig. The team lead for the framing camera, Andreas Nathues, is based at the Max Planck Institute, Gottingen, Germany.

- The elemental composition of both Vesta and Ceres is measured with the **gamma ray and neutron detector**, or GRaND. This instrument uses a total of 21 sensors with a very wide field of view to measure the energy from gamma rays and neutrons that either bounce off or are emitted by a celestial body. Gamma rays are a form of light, while neutrons are particles that normally reside in the nuclei of atoms. Together, gamma rays and neutrons reveal many of the important atomic constituents of the celestial body's surface down to a depth of 3 feet (1 meter). Gamma rays and neutrons emanating from the surface of Vesta and Ceres can tell us much about the elemental composition of each. Many scientists believe that Ceres may be rich in water; if that is the case, the signature of the water may be contained in this instrument's data. Unlike the other instruments aboard Dawn, the detector has no internal data storage. The instrument was built by Los Alamos National Laboratory, Los Alamos, New Mexico. The team lead for the gamma ray and neutron detector, Thomas Prettyman, is based at the Planetary Science Institute, Tucson, Arizona.

- The surface mineralogy of both Vesta and Ceres is measured by the **visible and infrared mapping spectrometer**, or VIR. The instrument is a modification of a similar spectrometer on both the

European Space Agency's Rosetta and Venus Express missions. It also draws significant heritage from the visible and infrared mapping spectrometer on NASA's Cassini spacecraft. Each picture the instrument takes records the light intensity at more than 400 wavelength ranges in every pixel. When scientists compare its observations with laboratory measurements of minerals, they can determine what minerals are on the surfaces of Vesta and Ceres. The visible and infrared mapping spectrometer was funded and coordinated by the Italian Space Agency and built by SELEX ES, with the scientific leadership of the Institute for Space Astrophysics and Planetology, Italian National Institute for Astrophysics, Italy. It is operated by the Institute for Space Astrophysics and Planetology, Rome, Italy, led by Maria Cristina De Sanctis.

- As it did at Vesta, Dawn will make a set of scientific measurements at Ceres using the spacecraft's radio transmitter and sensitive antennas on Earth. Monitoring signals from Dawn, scientists can detect subtle variations in the gravity fields of the dwarf planet. These variations will point to how mass is distributed within the body, in turn providing clues about the interior structure of Ceres. The team lead for the **gravity science** experiment is Alex Konopliv, NASA's Jet Propulsion Laboratory, Pasadena, California.



Key components of the Dawn spacecraft

Program & Project Management

The Dawn project is managed by the Jet Propulsion Laboratory, Pasadena, California, for NASA's Science Mission Directorate, Washington. Principal investigator Christopher T. Russell of UCLA leads the overall mission. Carol Raymond of JPL is the deputy principal investigator. At NASA Headquarters, John Grunsfeld is associate administrator for the Science Mission Directorate. Dr. James Green is director of NASA's Planetary Division. Anthony Carro is Dawn program executive, and Michael Kelley is Dawn program scientist. Allen Backsay of NASA's Marshall Space Flight Center is the Discovery Program manager.

At JPL, Robert Mase is Dawn project manager. Marc Rayman is mission manager and chief engineer. JPL is a division of the California Institute of Technology in Pasadena. Orbital ATK, Inc., Dulles, Va., built the Dawn spacecraft. Orbital provides technical support and consulting services to the flight operations team at JPL. Joseph Makowski is the Dawn manager at Orbital.

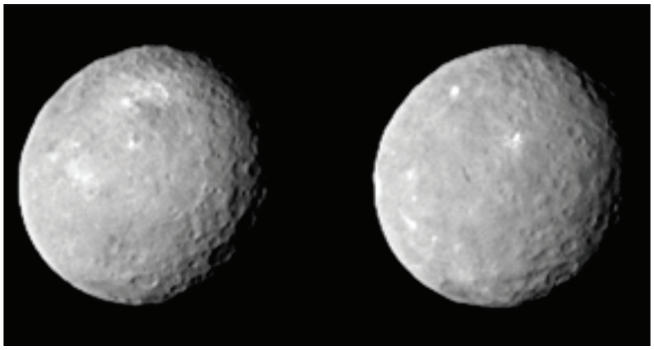
NASA's Discovery Program

The Dawn mission was competitively chosen and funded as part of NASA's Discovery program.

As a complement to NASA's larger "flagship" planetary science explorations, the Discovery Program's goal is to achieve outstanding results by launching many smaller missions using fewer resources and shorter development times. The main objective is to enhance our understanding of the solar system by exploring the planets, their moons, and small bodies such as comets and asteroids. The program also seeks to improve performance through the use of new technology and broaden university and industry participation in NASA missions.

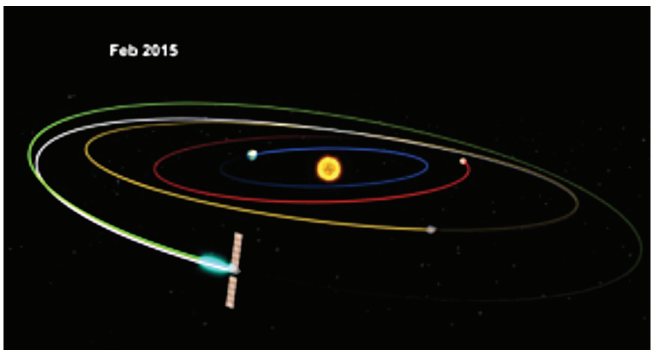
Further information on NASA's Discovery Program can be found at: **http://discovery.nasa.gov.**

Appendix: Selected Images and Videos

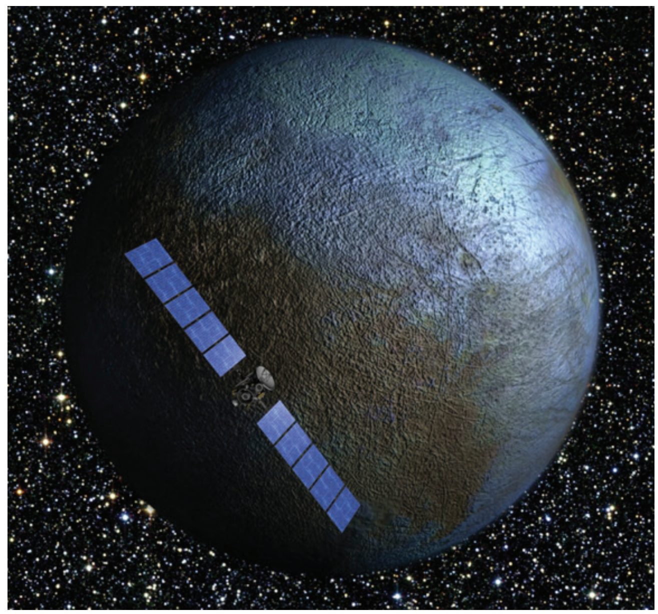


Dawn images of Ceres
http://go.nasa.gov/1vdPLe1

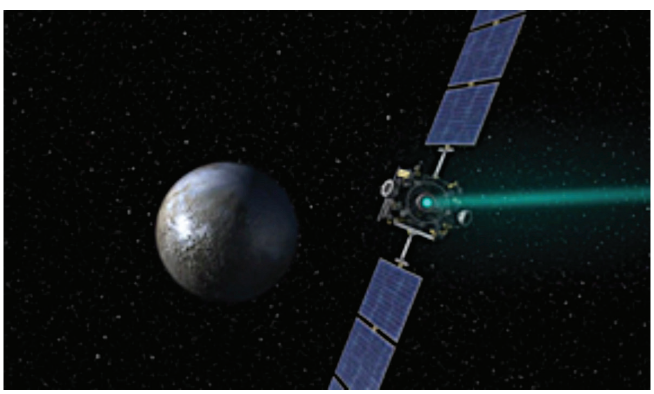
JPL videos featuring Dawn
http://go.nasa.gov/1vdOK5Z



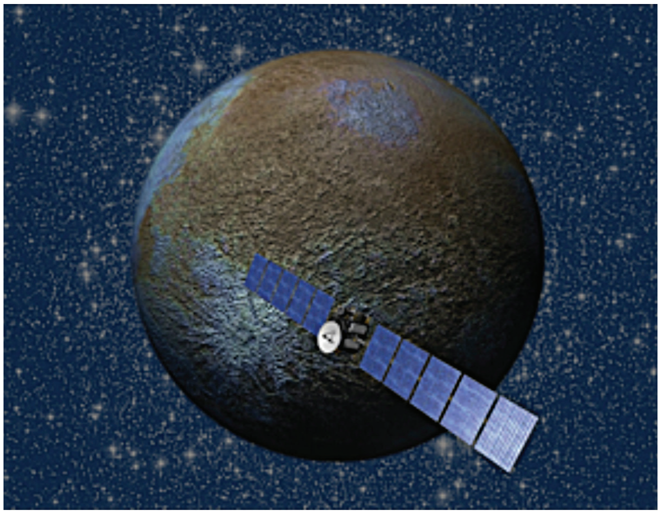
Dawn media reel (mission animations)
https://vimeo.com/118523333



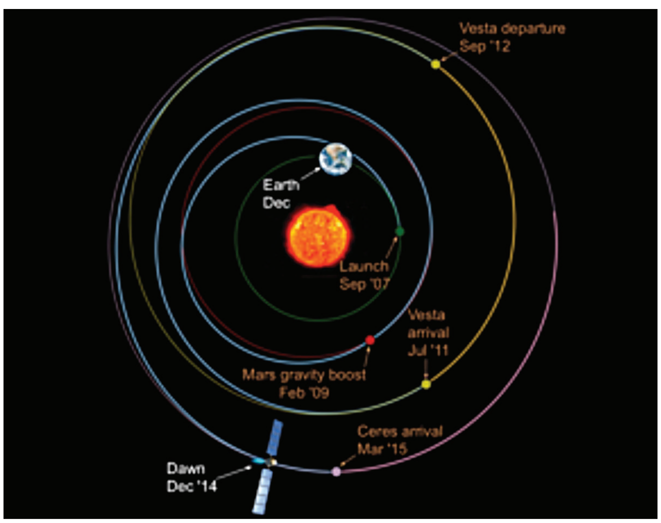
Dawn in orbit at Ceres (artist's concept)
http://go.nasa.gov/1EUHnAh



NASA video file — Dawn arrives at Ceres (available March 2, 2015)
https://vimeo.com/jplraw/videos



Dawn in orbit at Ceres (artist's concept)
http://go.nasa.gov/1EUHo7u



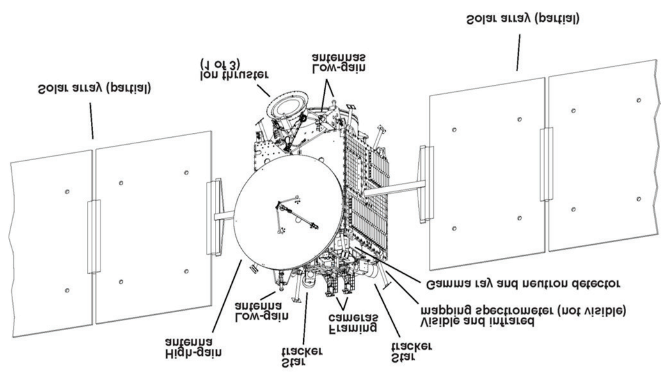
Dawn's flight path
http://go.nasa.gov/1EUHplx

More information about NASA's Dawn mission:

http://www.nasa.gov/dawn

http://dawn.jpl.nasa.gov

Images of the Dawn spacecraft:



Dawn spacecraft structure
http://dawn.jpl.nasa.gov/technology/spacecraft.asp

Assembly and launch images
http://mediaarchive.ksc.nasa.gov/search.cfm?cat=173