Project Galileo Frequently Asked Questions

General Spacecraft Anatomy
- How much does the spacecraft weigh?
- Where is the spacecraft's camera located?
- Why is the spacecraft wrapped in black and gold stuff?
- What is the long boom for?
- How did the spacecraft fit inside the shuttle bay?
- Why does Galileo spin?

The Probe
- Where does the Probe fit?
- How fast is the Probe going when it enters Jupiter's atmosphere?
- What science will the Probe instruments return?
- Once the Probe separates, what wakes it up many months later just before entry?
- Will the Probe see Jupiter's surface?
- Why aren't we taking an image of the Probe?

Galileo Status Report
- How fast is Galileo travelling?
- How far is it from Earth? From Jupiter?

Galileo's Antennas
- What's the high-gain antenna?
- Why didn't the antenna open all the way up? Is JPL still trying to open it?
- Why not send a satellite to Jupiter to relay a signal from Galileo back to Earth?
- Is that big black thing at the top of the spacecraft a mirror for the antenna?
- What is the low-gain antenna, and where is it located?
- When Jupiter is on the other side of the Sun, how does that affect data transmission?

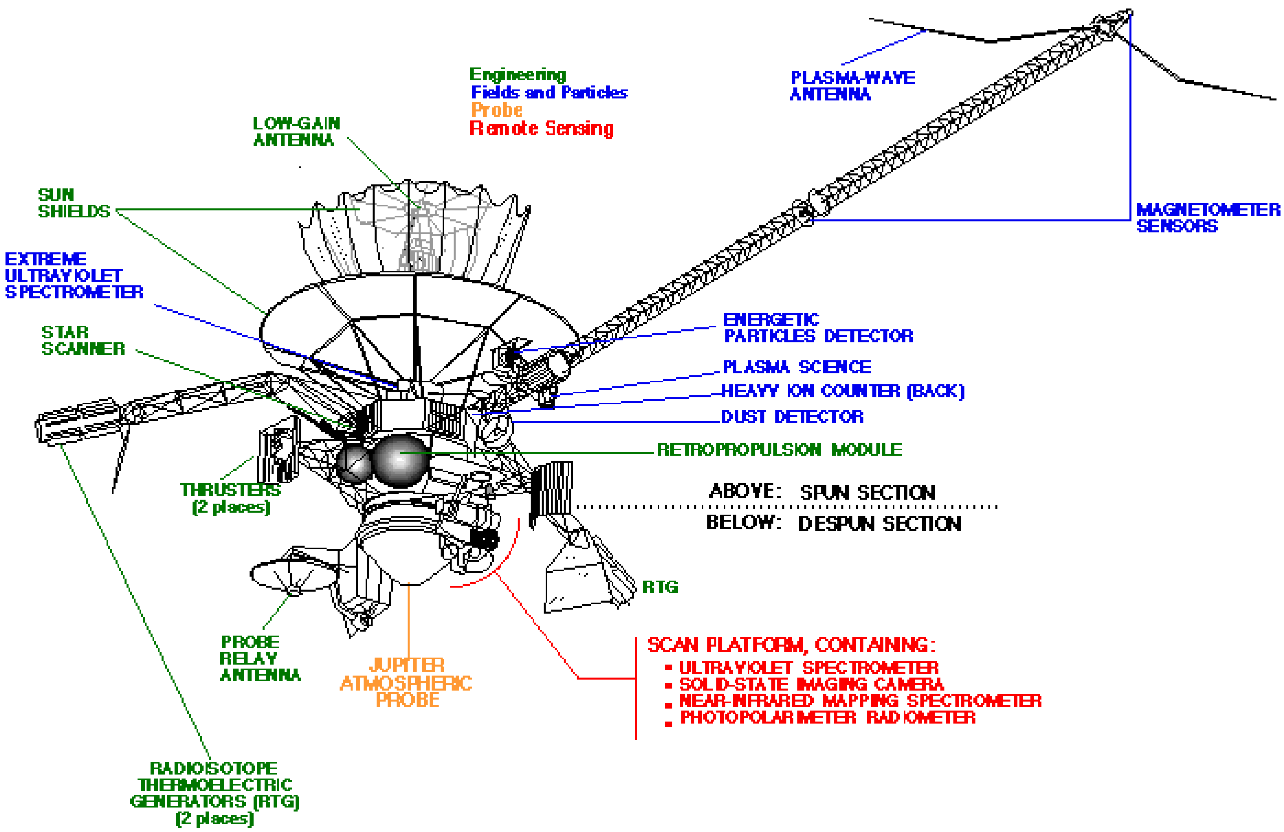
Miscellaneous Questions
- How does the spacecraft orient itself?
- How does the Galileo spacecraft's software work? What language was the software written in?
- Where can I find Galileo's code listings?

Power
- How is the spacecraft powered?
- What type of fuel do Galileo's engines use?
- Why do we have to use plutonium? Why not use solar panels?

What spinoff technology has Galileo produced?

Imaging Science
- Of what scientific value are the pictures that are sent back from Galileo?

Sources for Pretty Pictures
- Where can I get pictures from the Spacecraft? Can I get images on CD?
- I'm a teacher who needs pictures for my classroom.
- How can I watch Galileo press conferences?
- Where can I get pictures of Comet Shoemaker-Levy-9 impacting Jupiter?



Engineering
Fields and Particles
Probe
Remote Sensing
LOW-GAIN ANTENNA
PLASMA-WAVE ANTENNA
SUN SHIELDS
MAGNETOMETER SENSORS
EXTREME ULTRAVIOLET SPECTROMETER
STAR SCANNER
ENERGETIC PARTICLES DETECTOR
PLASMA SCIENCE
HEAVY ION COUNTER (BACK)
DUST DETECTOR
RETROPROPULSION MODULE
THRUSTERS (2 places)
ABOVE: SPUN SECTION
BELOW: DESPUN SECTION
RTG
PROBE RELAY ANTENNA
JUPITER ATMOSPHERIC PROBE
SCAN PLATFORM, CONTAINING:
- ULTRAVIOLET SPECTROMETER
- SOLID-STATE IMAGING CAMERA
- NEAR-INFRARED MAPPING SPECTROMETER
- PHOTOPOLARIMETER RADIOMETER
RADIOISOTOPE THERMOELECTRIC GENERATORS (RTG) (2 places)

General Spacecraft Anatomy

Use the line drawing of the spacecraft as a visual aid (on the previous page).

How much does the spacecraft weigh?

At launch, the orbiter had a mass of 2,223 kg (4891 lbs), which includes a 118 kg (260 lbs) science payload and 925 kg (2,035 lbs) of usable propellent. Over 40% of the orbiter's mass at launch is for propellent! The probe's total mass is 339 kg (746 lbs); the probe descent module is 121 kg (266 lbs), including a 30 kg (66 lbs) science payload.

Where is the spacecraft's camera located?

Most people think that the Solid-State Imaging instrument (SSI), which takes photos in visible light, is Galileo's only camera, but there are actually three other cameras on board. A photopolarimeter-radiometer will measure the polarization of light scattered from Jupiter's clouds and the satellites' surfaces, by a process like using polarized sunglasses to cut down on glare. In addition, its infrared channels will sound the atmosphere and measure satellite temperatures. The near-infrared mapping spectrometer will map the satellites, looking for different minerals across their surfaces. It will also study cloud structure and gas composition in the jovian atmosphere. An ultraviolet spectrometer and extreme ultraviolet spectrometer will investigate volatile excape and surface composition of the Galilean satellites, the Io plasma torus, small and large scale properties of the Jupiter clouds, and the composition, structure, and evolution of Jupiter's upper atmosphere.

All four cameras are mounted on a scan platform, located near the bottom of the orbiter. This section of the spacecraft can be "despun," or kept from spinning with the rest of the orbiter--otherwise, all the images would be blurry.

Why is the spacecraft wrapped in black and gold stuff?

Galileo's electronics and science instruments are designed to work in interplanetary space, but, without some sort of insulation, it's too cold for them to operate (just like your camera shutter might freeze if you take it to the North Pole). The black and gold blankets are carefully designed to keep Galileo's innards at a "comfortable" temperature. They also keep micrometeorites from smashing into the spacecraft electronics.

The black blankets, which are made up of 20 different layers, are very efficient insulation. Although only 1/5th of an inch thick, it's three times as good an insulator as the four-inch-thick fiberglass insulation in your attic. The black color is due to carbon in the outer layer, which keeps electrostatic charge from building up in one spot and then shorting out the spacecraft electronics.

Black material in the sun picks up lots of heat, and emits a great deal of infrared light. The "gold" blankets, however, don't absorb a great deal of solar heat, though they do radiate well in the infrared. This material (called "second-surface aluminized kapton") therefore does an even better job of insulation. It's not used on the entire spacecraft because it was developed after Galileo was designed and built. When Galileo's flight path was changed to take advantage of a Venus gravitational assist, there was enough time to use kapton on critical areas of the spacecraft.

What is the long boom for?

That's the science boom. It's 10.9 meters long, and is designed to minimize the effects of orbiter-generated interference on the magnetometer and plasma wave instruments. The fields and particles instruments are mounted at the end of the boom, and also about 3 meters from the spacecraft.

How did the spacecraft fit inside the shuttle bay?

The spacecraft was folded up, like an elaborate piece of origami. The high-gain antenna and booms were furled up.

Why does Galileo spin?

Unlike previous planetary spacecraft, Galileo features an innovative "dual spin" design: part of the orbiter rotates constantly at three revolutions per minute, and part of the spacecraft remains fixed in inertial space. This means that the orbiter can easily accomodate magnetospheric experiments (which need to take measurements while rapidly sweeping about) while also providing stability and a fixed orientation for cameras and other sensors. The spin rate can be increased to 10 revolutions per minute for additional stability during major propulsive maneuvers.

index

The Probe

Where does the Probe fit?

The Probe is nestled on the "bottom" of the spacecraft, below the area where the camera scan platform is mounted.

How fast is the Probe going when it enters Jupiter's atmosphere?

170,700 kilometers per hour (106,000 miles per hour), or 47 kilometers per second (29 miles per second) That's the highest impact speed of any man-made object ever; it's about 100 times the muzzle velocity of a bullet fired from a .45 caliber gun.

What science will the Probe instruments return?

Galileo's Probe incorporates experiments to measure temperature and pressure along the descent path, locate major cloud decks, and analyze the chemistry of atmospheric gases. In addition, the Probe will attempt to detect and study jovian lightning both by looking for optical flashes and by listening for the radio "static" they generate. The latter detector will also measure high-energy electrons close to Jupiter just prior to atmospheric entry.

Once the Probe separates, what wakes it up many months later just before entry? Does it just have a built-in programmable timer, or does the Orbiter beam the Probe a command to wake up? Or does it remain fully "awake," doing the same thing (that is, taking data) from the time it separates until the end of its mission?

Yes, the Probe does have a built-in, programmable timer, which is set by ground command shortly before the Probe separates from the orbiter. The Probe designers wanted to have some flexibility in starting the timer to accomodate any late changes in the Probe release schedule. If Probe release is delayed for any reason, the timer is reset appropriately. The timer is the only thing running on the Probe during its five month long cruise to Jupiter.

Like an alarm clock, the timer is set to wake up the Probe 6 hours before entry into Jupiter's atmosphere so that the Probe can 1) take measurements of the inner magnetospheric energetic particle environment, and 2) listen for radio emissions characteristic of lightning (these actually sound like long, descending whistles).

This "pre-entry" phase ends when the Probe's accelerometers detect signs that the Probe is being decelerated by Jupiter's atmosphere. At this point, the Probe starts its entry/descent phase.

When the Galileo Probe enters Jupiter's atmosphere in December, will we be able to see pictures of the surface of Jupiter for the first time?

Although Jupiter is a planet, it is very different from Earth. In fact, scientists refer to hard and rocky planets like Earth, Mercury, Venus, and Mars as "terrestrial," while planets like Jupiter, Saturn, Neptune, and Uranus are called "gas giants," since they seem to be, essentially, huge balls of gas and liquid with a small rocky core. So, Jupiter doesn't really have a "surface" in the sense of its being something that humans could walk around on, or that a spacecraft could land on.

Galileo's atmospheric Probe will travel between 130 and 160 kilometers below Jupiter's cloud tops, deep enough to help answer questions such as what's in Jupiter's yellow clouds, or how strong are the winds below the cloudtops. However, the Probe won't come anywhere near seeing the "surface" of Jupiter's rocky core, buried roughly 60,000 kilometers underneath the cloud tops.

Why aren't we taking an image of the Probe as it drifts away from the Orbiter after separation?

Imaging the Probe as it drifts away from the Orbiter was contemplated both for engineering assessment (that is, looking for any problems with the Probe hardware) and optical navigation. In order to assess the external condition of the Probe, detailed pictures would be desireable, but, because the SSI is focused on infinity, objects up close would be out of focus. In fact, by the time the Probe is in focus (at about 18 km away from the Orbiter), it would only be about 2-3 resolution elements (about 4-6 pixels) across--not very detailed!

Optical Navigation

Spacecraft which are equipped with imaging instruments can use them to observe the spacecraft's destination planet against a known background starfield. These images are called OPNAV images. Interpretation of them provides a very precise data set useful for refining knowledge of a spacecraft's trajectory.

Taking a picture of the Probe for Optical Navigation purposes appears to be feasible , but, because the Probe delivery knowledge requirements are being met, and because of the operational costs of trying to return large data sets (such as images), it was decided not to pursue optical navigation.

index

Galileo Status Report

As of Oct 9 1995 at 12:00:00 EDT, Galileo is

> 860,148,200 kilometers (534,471,300 miles) from Earth,
> 792,039,800 kilometers (492,150,700 miles) from the Sun, and
> 36,574,600 kilometers (22,726,400 miles) from Jupiter, travelling at
> 24,100 kilometers per hour (15,000 miles per hour), relative to the Sun.

For the astronomically minded, Galileo is

> 5.73 AU (47.79 light minutes) from Earth,
> 5.28 AU (44.00 light minutes) from the Sun, and
> 511.59 Jovian radii (121.92 light seconds) from Jupiter.

Galileo has travelled a total distance of

> 3,758,932,200 kilometers (2,335,692,200 miles) to date.

Galileo arrives at Jupiter and flies by Io in **59** days.

index

Galileo's Antennas

What's the high-gain antenna?

The umbrella-like high gain antenna is located at the top of the spacecraft, and is 4.8 meters (16 feet) in diameter. It was designed to transmit data back to earth at rates of up to 134,000 bits of information per second (the equivalent of about one television picture each minute). Compare this to a fast home modem, which only manages to send 14,400 bps!

The antenna, which is made of gold-plated metal mesh, was stowed behind a sun shield at launch, in order to avoid heat damage from the sun while the spacecraft flew "inside" the earth's orbit.

Why didn't the antenna open all the way up? Is JPL still trying to open it?

On April 11, 1991, the Galileo spacecraft began to deploy its high-gain antenna under computer-sequence control.

The antenna -- a 16-foot mesh paraboloid stretched over 18 umbrella-like ribs -- had been furled and hiding behind a small sunshade for the almost 18 months since launch, in which the spacecraft came closer to the sun than Earth and briefly closer even than Venus. Communications, including Venus and Earth-moon science data return, had been using the low-gain antennas.

Within minutes, Galileo's flight team, watching spacecraft telemetry 37 million miles away on Earth, could see that something was wrong: The motors had stalled, something had stuck, the antenna had opened only part way.

Within weeks, a tiger team had thoroughly analyzed the telemetry, begun ground testing and analysis, and presented its first report.

They attributed the problem to the sticking of a few antenna ribs due to friction between their standoff pins and their sockets. The first remedial action was taken -- turning the spacecraft to warm and expand the central tower, in hopes of freeing the stuck pins.

In addition to thermal cycling, the tiger team developed other ideas for loosening the stuck ribs: retracting the second low-gain antenna (on a pivoting boom), pulsing the antenna motors, and increasing the spacecraft spin rate to maximum 10 rpm (normally about 3 rpm).

After a nearly two-year campaign to try to free the stuck ribs there is no longer any significant prospect of deploying the HGA, though one last attempt will be made in March of 1996. The Project is proceeding to perform the Galileo Mission with the Low-Gain Antenna.

For additional information, see "Galileo's antenna: the anomaly at 37 million miles," an article by Jim Wilson that appeared in JPL's newspaper on July 3, 1992, or Unfurling the HGA's Enigma in the August, 1991 Galileo Messenger.

What's that big black thing at the top of the spacecraft? Is it a mirror for the antenna?

That's one of the sunshades for the spacecraft, designed to protect the instruments from the sun's heat while the spacecraft was travelling inside of Earth's orbit.

Why not send up a "re-transmitter," or some sort of satellite to relay a strong signal from Galileo back to the ground?

The project briefly studied this option, but quickly determined that, given the short amount of time in which the relay satellite would need to be designed and launched, a relay would be prohibitively expensive.

There were also significant unresolved technical problems related to both orbital mechanics and telemetry. Engineers first proposed having a relay satellite that would follow Galileo closely, like a well-trained dog. But, the amount of propellant needed made the mission too expensive. Even keeping the relay satellite within a few million kilometers of the spacecraft throughout the entire two-year orbital tour would be a difficult (if not impossible) engineering problem, given the limited amount of fuel on board a relay satellite. Finally, the relay antenna itself would need to be comparable in size to Galileo's original high gain antenna, which would add to the expense and complexity of a relay mission.

What is the low-gain antenna, and where is it located?

The low-gain antenna is located on the tip of the cone (the "feed") sticking up over the High Gain Antenna. It can transmit data at rates up to 1,200 bits per second, comparable to a slow home modem. However, top transmission rate during orbital operations will be 160 bits per second (remember, Galileo will be much further away from the Earth, so the data rate drops)

There is a second low-gain antenna on the spacecraft--the long, thin antenna that hangs off of the short boom that holds the radioisotope thermoelectric generators--but it is stowed away permanently.

Since the Galileo mission will last 2+ years in orbit around Jupiter, Jupiter will be opposite the Sun twice during that period. How will that affect the science gathering and transmission of data to Earth?

You've identified one of the significant problems in returning as much data as possible from the spacecraft to Earth!

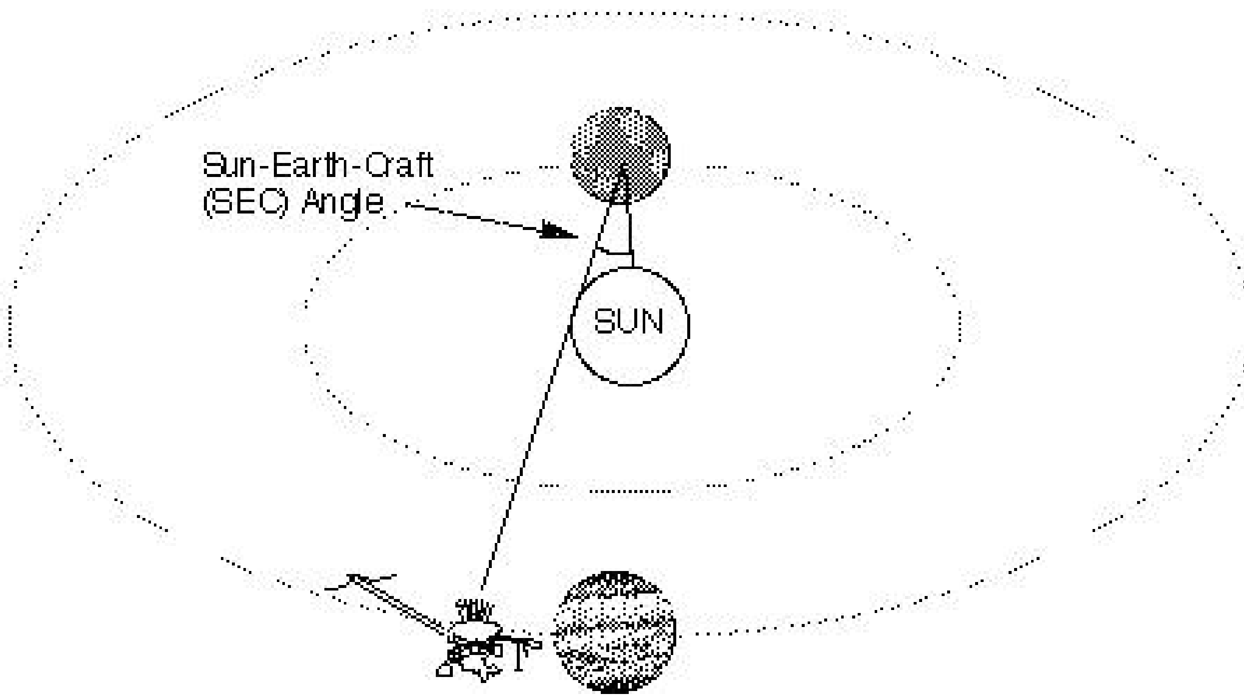
The geometrical situation that we have to deal with occurs when the Sun lies directly between Jupiter and Earth (scientists refer to this as "conjunction"). The Sun is a strong source of electromagnetic activity, and it wreaks havoc with the spacecraft's radio signal, essentially reducing the spacecraft's data rate to Earth to 0 for the two and a half weeks centered around conjunction. Mission planners and telemetry engineers define this problem area as occurring when the Sun-Earth-Craft angle is less than 7 degrees (see figure below); a relatively "quiet" Sun can mean that data can be successfully returned at SEC angles as small as 3-5 degrees.

See illustration of conjunctiongeometry on next page.

Galileo's two conjunction periods will run from December 11-28, 1995, and January 11-28, 1997. Conjunction lowers the amount of data that can be returned to Earth. However, Galileo still has roughly two years in which to investigate the Jovian system, so not being able to return data for 18 days out of those two years is not a serious difficulty.

index

NOT TO SCALE



Miscellaneous Spacecraft Questions

How does the spacecraft know how to orient itself?

When spacecraft engineers refer to attitude, they're discussing how the spacecraft is oriented, or pointed, with respect to some unmoving reference, like the stars. This is one of the jobs of the Attitude and Articulation Control Subsystem, or AACS, which performs a number of functions for the Spacecraft, including:

1. Attitude Determination (i.e.- determining the orientation of the spacecraft in inertial space). The AACS uses data from several different sensors: the Star Scanner, the Sun Sensor, the Accelerometer, and the Spin Detector;
2. Attitude Propagation (i.e.- keeping track of what the spacecraft orientation is in inertial space when the spacecraft hasn't just performed an Attitude Determination) using gyroscopes, the spin detector, and accelerometers; and
3. Attitude Control (i.e.- changing the orientation, spin rate, or wobble of the spacecraft) using the various parts of the spacecraft that can change the spacecraft's attitude. These controls include the thrusters, nutation damper, and the 400 Newton main engine. We can also move the booms that the Radioisotope Thermoelectric Generators (RTGs) are attached to, changing the RTG's position relative to the spacecraft spin axis. Watch how an ice skater uses his/her arms during a spin to get some idea how this might affect the spacecraft (though the skater turns much faster than the spacecraft!).

If you're interested in more information, look at the article on attitude and articulation found in JPL's Basics of Space Flight Workbook. There is also an older Galileo Messenger article on the AACS.

How does the Galileo spacecraft's software work? What language was the software written in?

Before we start to discuss software, we need to know a little about the hardware, since there can be up to 18 microcomputers running on Galileo at any given time.

First off, although all eleven science instruments use microprocessors, only eight of the instruments are actually reprogrammable in flight (some technical details are available; additional information on the science instruments can be found in back issues of the Galileo Messenger).

Only two of the major engineering subsystems--the Attitude and Articulation Control Subsystem (AACS) and Command and Data Subsystem (CDS)--are programmable in flight. These two use very different computer architectures.

Each of the AACS's attitude functions requires a tremendous amount of mathematical computation, all of which is the job of the AACS software.

Just like the word processor or spreadsheet on a home computer system gets revised into newer, sometimes better versions, the AACS software has evolved from what was originally launched with the spacecraft in 1989--except that the AACS improvements really are better! The software will continue to evolve for the remainder of the mission.

An additional technical description of the AACS software discusses the AACS hardware, programming language, and operating system. There is also a Galileo Messenger article on the AACS available.

The Command and Data Subsystem (CDS) and its software perform a number of functions for the spacecraft. For example:

1. CDS receives and processes commands sent from Earth. These commands can be in the form of real-time (i.e. do this NOW!) commands, or they can be stored sequences which are long series of instructions to tell the spacecraft what to do for an extended period of time (as long as several weeks).
2. The CDS also collects information from all of the science instruments and engineering subsystems and packages it into the data that is actually sent to the Earth. The collection process and CDS operations methods will change after Galileo arrives at Jupiter.
3. The CDS performs a number of other functions for the spacecraft such as storing data on a tape recorder for later playback to Earth, and broadcast of the timing coordination signal to all spacecraft subsystems (basically, a way for all the subsystems to synchronize their "watches").
4. CDS also performs the major "fault protection" functions for the spacecraft. If a piece of hardware on the spacecraft fails, the CDS is programmed to a) figure out what is wrong (fault detection), and then b) isolate the problem so an operational spacecraft can be recovered (i.e. the rest of the spacecraft can continue to operate). Fault protection is needed because at Jupiter radio signals take about an hour just to reach Earth, so ground controllers cannot respond in real time to fix urgent problems on the spacecraft; the spacecraft must take care of itself.

I'm a student/systems engineer/computer buff who is interested in looking at listings of Galileo's software code. Where can I find code listings?

Spacecraft software listings are not available electronically. In paper form, there are a lot of them and they take up a lot of shelf space (volumes and volumes). Without a lot of supporting documentation, they would be of little use since one needs to know a great deal about the hardware in which software operates in order to understand what the software is doing. Nor would such listings be of much value to anyone other than someone working directly on the Galileo spacecraft team itself.

index

Power

How is the spacecraft powered?

Galileo uses two Radioisotope Thermoelectric Generators (or RTGs for short) to generate electrical power. The RTGs power the spacecraft through the radioactive decay of plutonium-238. The decay emits heat, which is converted into electricity for the spacecraft to "see, sense, hear, and speak." Each RTG is mounted on a 5 meter long boom.

The spacecraft was able to generate 570 watts of electric power at launch; we expect that it will be able to get to 480 watts when the spacecraft actually arrives at Jupiter in December of 1995.

What type of fuel do Galileo's engines use?

Galileo uses monomethylhydrazine for fuel. The fuel has to be oxidized in order to ignite, so nitrogen tetroxide is mixed into the fuel right before a burn. There are two separate tanks of helium pressurant. In all, Galileo carried 932 kg (2,050 lbs) of propellant at launch.

Why do we have to use plutonium? Why not use solar panels?

Spacecraft that travel at or within Earth's orbit can use solar energy to power their instruments. However, at the great distance of Jupiter, the only feasible power source means using Galileo's Radioisotope Thermal Generators (or RTGs for short). Galileo would need a minimum of 700 to 1,600 square feet of solar panels--a solar panel about the size of a house!

Unlike other power sources, the RTGs are insensitive to the freezing cold of space, and are virtually invulnerable to high radiation fields, such as Earth's Van Allen belts and Jupiter's magnetosphere.

For additional details, and a discussion of the safety review conducted on the RTGs, see What's in an RTG?

index

What spinoff technology has Galileo produced?

A few of the inventions we now enjoy were originally developed for Galileo. Charge-coupled devices like those in Galileo's television systems are used in some of our home video cameras, yielding sharper images than ever conceived of in the days before the project began. In addition, radiation-resistant components developed for Galileo are now used in research, businesses, and military applications where radiation environment is a concern. Another advance, integrated circuits resistant to cosmic rays, has helped to handle disturbances to computer memory that are caused by high-energy particles; these disturbances plague extremely high-speed computers on Earth and all spacecraft.

index

Imaging Science

Of what scientific value are the pictures that are sent back from Galileo? Or are they only used for public relations? After all, it takes so much time to send back one picture!

Imaging data will make up less than 25% of all of the "bits" of scientific data returned ("downlinked") to Earth during the orbital tour. The remainder of the downlink budget will be used to return data from other scientific instrumentation, such as infrared, ultraviolet, and fields and particles observations.

It can be argued that more has been learned about the solar system from images than from any other type of instrumentation. Most astronomical discoveries through the ages have been made through either visual observations or using cameras attached to powerful telescopes. The same is true for solar system exploration using robotic spacecraft. That is why virtually every planetary exploration mission has included a camera in its payload. The value of images for public information is a wonderful bonus, but if it were not for the scientific utility of these cameras, few would be flown.

A simple review of some of the major discoveries and scientific studies that have been made possible through spacecraft images illustrates the valuable contributions pictures have made to our understanding of the solar system.

1. The geological history of virtually all atmosphereless planets and their major satellites with the exception of Pluto.
2. The cratering history of the solar system with implications for its age and evolution.
3. Ancient flooding on Mars.
4. New satellites of Jupiter, Saturn, Uranus, Neptune, and asteroid Ida.
5. Active volcanism on Jupiter's satellite Io.
6. Transport of volatile materials on Mars and Triton.
7. The origins of Martian global dust storms.
8. The atmospheric circulation patterns on Venus, Jupiter, Saturn, Uranus,and Neptune.
9. Spatially-resolved initial impact signatures of fragments of comet Shoemaker/Levy-9 colliding with Jupiter.
10. Discovery of a ring around Jupiter.
11. The dynamics of ring particles around Saturn, Neptune, and Uranus.

So why aren't we sending back even more pictures, since they add so much to scientist's understanding of the solar system? As the question noted, it's expensive to send back pictures, compared to fields and particles data. However, it is the mix of both types of data that will yield the most complete and scientifically interesting picture of the jovian system.

Consider some of the goals of the imaging team: long-term studies of Io's active volcanoes and specific features in Jupiter's atmosphere, for starters. Both of these phenomena show changes from day to day, but the quick Voyager flybys didn't allow scientists to see how these changes evolved. We need pictures in order to, for example, map out the surface of the Galilean satellites (Jupiter's four largest moons), or to detect ring particles.

Pictures are also used to support other types of scientific observations. For example, the atmospheric Probe will send back data on the temperature, pressure, and composition of the atmosphere, but it will be images from the Orbiter that will help scientists to put the Probe observations into context. In another example, the fields and particles instruments on board the orbiter will map and characterize the distribution of magnetic fields, plasma, and particles, but pictures of Jupiter's auroral phenomena, which are intimitely connected with fields and particles, will add additional insight into the magnetic field's interaction with Jupiter's atmosphere.

Sources for Pretty Pictures

Where can I get pictures from the Spacecraft? Can I get images on CD?

Galileo images will show up on the Galileo Home Page throughout the mission. If you're interested in hard copies, the following vendors make JPL/NASA photographic and video press-release products available to the general public.

For press-release photographs:

Newell Color Lab
221 N. Westmoreland Ave.
Los Angeles, CA 90064
(213)380-2980
fax (213) 739-6984

For slide sets featuring images from JPL planetary missions:

Finley Holiday Film Corporation
12607 E. Philadelphia St.
P.O. Box 619
Whittier, CA 90601
(310) 945-3325

CD-ROM images from Galileo are available from the National Space Science Data Center

Press-released videotapes (for example, a time lapse movie of the earth rotating) are also available; please contact the JPL Public Information Office for further information.

I'm a teacher who needs pictures for my classroom.

The Teaching Resource Center can be of help.

How can I watch Galileo press conferences?

If you have a satellite dish, you can find NASA TV on Spacenet 2, transponder 5, channel 9, 69 degrees West,. Transponder frequency is 3880 MHz, audio subcarrier is 6.8 MHz, polarization is horizontal.

Where can I get pictures of Comet Shoemaker-Levy-9 impacting Jupiter?

Galileo's pictures of the impact are available online. Also, JPL has a SL-9 homepage . There are literally hundreds of downloadable images available from this site.

index