

# STEREO QUICK FACTS



## About the Mission

### What is STEREO and its purpose?

STEREO is an acronym for Solar TERrestrial RELations Observatory. This mission employs two nearly identical observatories providing the first-ever, 3-D stereoscopic images to study the nature of coronal mass ejections (CMEs). These powerful solar eruptions are a major source of the magnetic disruptions on Earth and a key component of space weather, which can greatly affect satellite operations, communications, power systems, the lives of humans in space, and even global climate over the long term.

The science objectives of the STEREO mission are to understand the causes and mechanisms of the origins of CMEs and characterize their propagation through the heliosphere; discover the mechanisms and sites of energetic particle acceleration in the low corona and the interplanetary medium; and develop a 3-D time-dependent model of the magnetic topology, temperature, density and velocity structure of the ambient solar wind.

### How does STEREO fit into NASA's science program?

The Heliophysics Division, within NASA's Science Mission Directorate, manages science flight programs that carry out the exploration of the sun, its effects on the planets within the solar system, and space environmental conditions and their evolution. Specifically, it seeks to understand the transfer of energy from the sun to the Earth, and the interaction of solar plasma and radiation with Earth, the other planets and the galaxy.

The Solar Terrestrial Probes (STP) Program in the Heliophysics Division focuses on specific scientific areas required to advance our fundamental understanding of the sun-solar system connection. STP missions will focus on studying the sun and Earth as an integrated system using a blend of in situ and remote-sensing observations, often from multiple platforms. The major goals of the STP program are aligned with the Heliophysics Division's science goals and objectives which include: (1) understanding the changing flow of energy and matter throughout the sun, heliosphere and planetary environments, and (2) exploring the fundamental physical processes of plasma systems in the solar system.

STEREO is the third mission within the Solar Terrestrial Probes Program. APL also designed, built and operates the first STP spacecraft, TIMED, which was launched on Dec. 7, 2001 ([www.timed.jhuapl.edu](http://www.timed.jhuapl.edu)).

### When and from where were the observatories launched?

The twin STEREO observatories were launched aboard a Boeing Delta II 7925 rocket from Launch Complex 17B at Cape Canaveral Air Force Station, Fla., on Oct. 25, 2006.

### How long will the mission last?

STEREO is expected to operate for a minimum of two years. An additional one year of data analysis will be supported by STEREO's science team and by the mission's science center, located at NASA Goddard Space Flight Center, Greenbelt, Md.

Payload operations are conducted remotely from each of the instruments' facilities:

- **Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI)** – Naval Research Laboratory
- **STEREO/WAVES (S/WAVES)** – Paris Observatory, Meudon/University of Minnesota
- **In situ Measurements of Particles and CME Transients (IMPACT)** – University of California, Berkeley
- **PLASMA and SupraThermal Ion Composition (PLASTIC)** – University of New Hampshire

### **What are the mission costs?**

The total cost for STEREO is approximately \$550 million for the spacecraft, all instruments, the launch vehicle, as well as ground operations, mission operations and data analysis.

### **Who is sponsoring and managing the mission? Who is building and operating the spacecraft?**

STEREO is sponsored by NASA Headquarters' Science Mission Directorate, Washington, D.C. NASA Goddard Space Flight Center's Solar Terrestrial Probes Program Office, in Greenbelt, Md., manages the mission, instruments and science center. The Johns Hopkins University Applied Physics Laboratory (APL) in Laurel, Md., designed and built the spacecraft and will operate the twin observatories for NASA during the 2-year mission.



## **About the Science**

### **What are coronal mass ejections and why is it important to study them?**

Coronal mass ejections (CMEs) are powerful eruptions that can blow up to 10 billion tons of the sun's atmosphere into interplanetary space. Typically, CMEs eject about one billion tons of solar particles into space and travel at about one million mph. They can create major disturbances in the interplanetary medium (the space between planets containing electromagnetic radiation, dust, gas and plasma) and trigger severe magnetic storms if they reach Earth.

CME-driven shocks may also play a significant role in the acceleration of solar energetic particles, which can damage spacecraft and harm astronauts. CMEs are often associated with solar flares and prominence eruptions, but they can occur when neither is present.

Despite their importance, scientists don't fully understand the origin and evolution of CMEs, nor their structure or extent in interplanetary space. STEREO's unique 3-D images and movies of the structure of CMEs will enable scientists to determine their fundamental nature and origin.



## About the Mission Design

### How were the twin STEREO observatories placed into their respective orbits?

The twin STEREO observatories were launched together aboard a Boeing Delta II rocket. To place them into orbit in the most efficient and cost-effective manner possible, STEREO mission designers used lunar gravity to redirect the observatories to their appropriate orbits — something the launch vehicle alone couldn't do.

After launch, the observatories flew in an orbit from a point close to Earth to one that extends just beyond the moon. On Dec. 15, 2006, approximately two months after launch, mission operations personnel at APL synchronized spacecraft orbits, directing one observatory to its position ahead of Earth in its orbit. On Jan. 21, 2007, approximately three months after launch, the second observatory was redirected to its position trailing Earth.

### Is this the first time lunar swingbys have been used to manipulate spacecraft orbits?

The STEREO mission is the first to use lunar swingbys to manipulate orbits of more than one spacecraft. This technique enables multiple payloads to be launched aboard a single vehicle, saving a great deal of money.

Lunar swingbys have been used, however, to manipulate orbits of single spacecraft. In fact, APL was part of the first mission team to use lunar swingbys as they maneuvered the ISEE-3 (International Sun-Earth Explorer-3) spacecraft for its exploration of Earth's magnetotail in 1983.



## About the Observatories

### How are the STEREO observatories providing the first-ever “stereo” or 3-D views of the sun?

The STEREO mission provides a totally new perspective on solar eruptions by imaging coronal mass ejections and background events from two nearly identical observatories simultaneously. To obtain unique views of the sun, the twin observatories had to be placed into a rather challenging orbit where they were offset from one another. One observatory was placed ahead of Earth in its orbit around the sun and the other behind. Just as the slight offset between your eyes provides you with depth perception, this placement allows the STEREO observatories to obtain 3-D images of the sun.

### Why do you use “nearly identical” to describe the twin observatories?

The twin STEREO observatories fly as mirror images of each other in order to obtain “stereo” views of the sun's activities. This requires the identical instruments on each spacecraft to be placed in slightly different locations. This ensures the high-gain dish antennas on each observatory remain pointed at Earth for

command and telemetry, and the instruments remain pointed at the sun. Neither observatory has to be rotated to accommodate the instruments' viewing angles.

The main structure of the observatory that was placed behind Earth in its orbit around the sun (the "B" observatory) is a little thicker so that it could support the weight of the other spacecraft during launch. The "B" observatory retains a portion of the separation fitting or ring used to connect the two during their ride into space.

### **How many and what types of instruments are onboard the observatories?**

Each twin STEREO observatory carries two instruments and two instrument suites. This combination provides a total of 16 instruments per observatory. APL designed and built the spacecraft platform that houses the instruments.

STEREO's instruments include **PL**asma and **S**upra**T**hermal **I**on and **C**omposition (**PLASTIC**) and **STEREO/WAVES (S/WAVES)**.

The instrument suites onboard each observatory include the **S**un **E**arth **C**onnection **C**oronal and **H**eliospheric **I**nvestigation (**SECCHI**) and the **I**n situ **M**easurements of **P**articles and **C**ME **T**ransients (**IMPACT**).

### **What are the key characteristics of each STEREO observatory?**

Each observatory has a launch mass, including propellant, of approximately 1,412 pounds (642 kilograms).

When stacked together on the rocket, the observatories measure approximately:

- 8.9 feet (2.7 meters) long
- 8.5 feet (2.6 meters) wide
- 10.5 feet (3.2 meters) high

In space, once solar arrays, booms and antennas are extended, each observatory measures (from tip to tip) approximately:

- 24.5 feet (7.4 meters) long
- 28.6 feet (8.6 meters) wide
- 19.2 feet (5.8 meters) tall