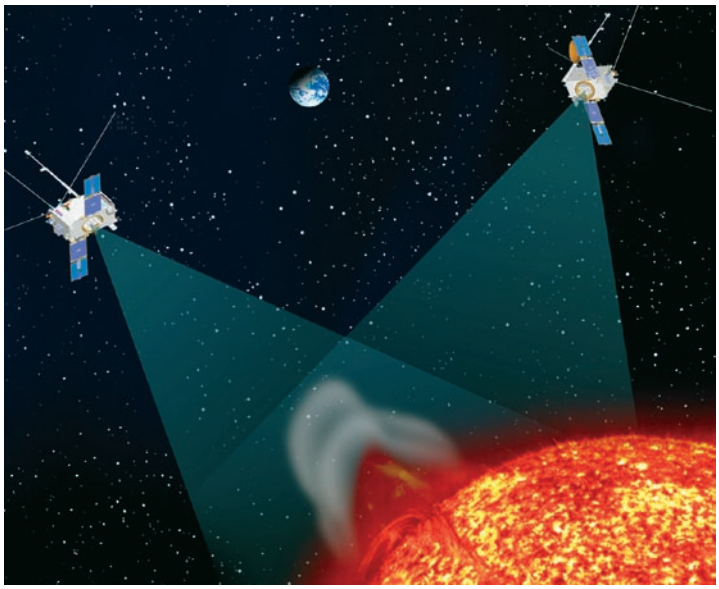
# STEREO

## The Solar Terrestrial Relations Observatory

The STEREO mission is managed by the NASA Goddard Space Flight Center.
The Johns Hopkins University Applied Physics Laboratory is responsible for mission definition, implementation and operations.

One of the most important scientific advances of the space age was the discovery of Coronal Mass Ejections (CMEs)—powerful eruptions that can blow up to 10 billion tons of the Sun's atmosphere into interplanetary space. Typically, CMEs are about 1 billion tons and move at about 1 million miles per hour. They can create major disturbances in the interplanetary medium and trigger severe magnetic storms at Earth. CME-driven shocks also may play a significant role in the acceleration of solar energetic particles, which can damage spacecraft and harm astronauts. But while CMEs are seen routinely with existing instruments, those directed toward Earth are the least likely to be detected. Despite their importance, the origin and evolution of CMEs are still not well understood, and no one has a clear idea of their structure or extent in interplanetary space. Only one thing is clear: until the 3-D structure of CMEs is revealed, scientists cannot be sure of their fundamental nature or origin.



### Mission Concept

The STEREO mission will offer a totally new perspective on solar eruptions by imaging CMEs and background events from two nearly identical observatories simultaneously. One observatory will lead Earth in its orbit and one will lag behind, each carrying a cluster of instruments. When combined with data from observatories on the ground or in low Earth orbit, these data will allow us to track the buildup and lift-off of magnetic energy on the Sun and the trajectory of Earth-bound CMEs in 3-D. STEREO is a NASA Goddard Space Flight Center (GFSC) Solar-Terrestrial Probe (STP) mission. It is scheduled for launch in February of 2006 on a Delta II expendable launch vehicle.

### Science Objectives

- Understand the causes and mechanisms of CME initiation
- Characterize the propagation of CMEs through the heliosphere
- Discover the mechanisms and sites of energetic particle acceleration in the low corona and the interplanetary medium
- Develop a 3-D time-dependent model of the magnetic topology, temperature, density, and velocity structure of the ambient solar wind

### Instrument Payload

The twin STEREO observatories will carry two instruments and two instrument suites aboard each craft. This combination provides a total of 16 instruments per observatory, most of which are housed in the SECCHI and IMPACT suites.

- SECCHI (Sun-Earth Connection Coronal and Heliospheric Investigation) is a suite of remote-sensing instruments consisting of an extreme ultraviolet imager, two white-light coronagraphs, and a heliospheric imager. These instruments will study the 3-D evolution of CMEs—the most energetic eruptions on the Sun and primary cause of major geomagnetic storms—from their origin at the Sun's surface through the corona and interplanetary medium to their eventual impact at Earth.
- IMPACT (In situ Measurements of PArticles and CME Transients) provides measurements of the solar wind electrons, interplanetary magnetic fields, and solar energetic particles. It consists of seven instruments, including a solar wind electron analyzer, a magnetometer, and an array of particle detectors measuring the energetic ions and electrons accelerated in CME shocks and in solar flares.
- The PLASTIC (PLAsma and SupraThermal Ion Composition) instrument is slated to study coronal–solar wind and solar wind–heliospheric processes. PLASTIC will provide in situ plasma characteristics of protons, alpha particles, and heavy ions. It will supply key diagnostic measurements of mass and charge state composition of heavy ions and will characterize the CME plasma from ambient solar wind plasma.
- STEREO/WAVES (S/WAVES) is an interplanetary radio burst tracker that will trace the generation and evolution of traveling radio disturbances from the Sun to Earth's orbit. A radio and plasma wave receiver, S/WAVES is both a remote sensing and an in situ instrument.

# The Solar Terrestrial Relations Observatory

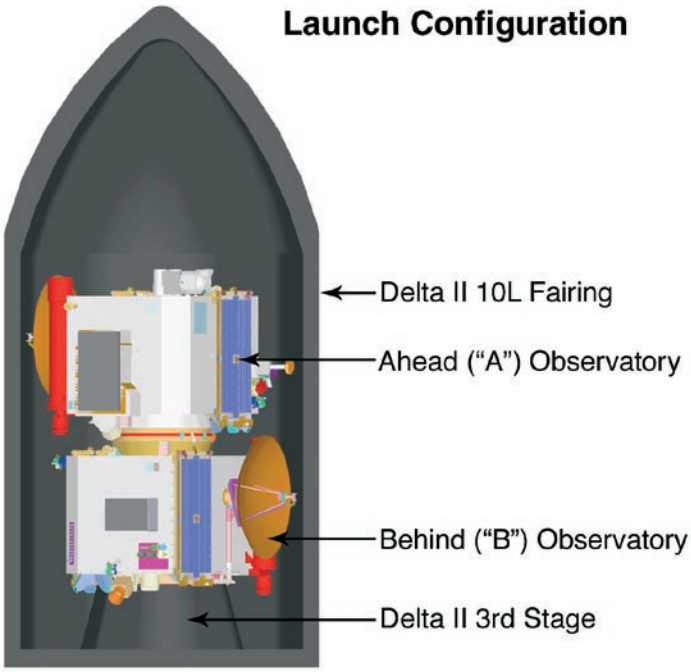
## Science Team Management

### Mission Science

- Madhulika Guhathakurta, NASA Headquarters Program Scientist
- Mike Kaiser, NASA/GSFC Project Scientist

### Instrument Principal Investigators

- **SECCHI:** Russell Howard (Naval Research Laboratory)
- **S/WAVES:** Jean-Louis Bougeret (Centre National de la Recherche Scientifique Observatory of Paris) and Michael Kaiser (NASA/GSFC)
- **IMPACT:** Janet Luhmann (University of California, Berkeley)
- **PLASTIC:** Antoinette Galvin (University of New Hampshire)




## The STEREO Observatories

The Johns Hopkins University Applied Physics Laboratory (APL) is designing and building the spacecraft platform that houses the instruments onboard the twin STEREO observatories. During the 2-year mission, the Laboratory will also operate the twin observatories, for NASA, from the APL-based Mission Operations Center.

### Observatory Characteristics

- Mass: 620 kilograms (1,364 pounds)
- Orbit average power: 475 watts (596-watt solar panel output at end of life); 23 ampere-hour Ni-H battery
- Science data downlink rate: 720 kilobits per second (X-band, CCSDS compliant)
- Control: 7 arcseconds, 3-σ (3 axis stabilized)
- Knowledge: 0.1 arcsecond, 3-σ
- Total memory: 1.0 gigabyte (solid state recorder)
- Spacecraft processor: Rad 6000 (2)
- Optimized data compression techniques
- Lightweight, ultra-low-scatter optics

### Advanced Technology

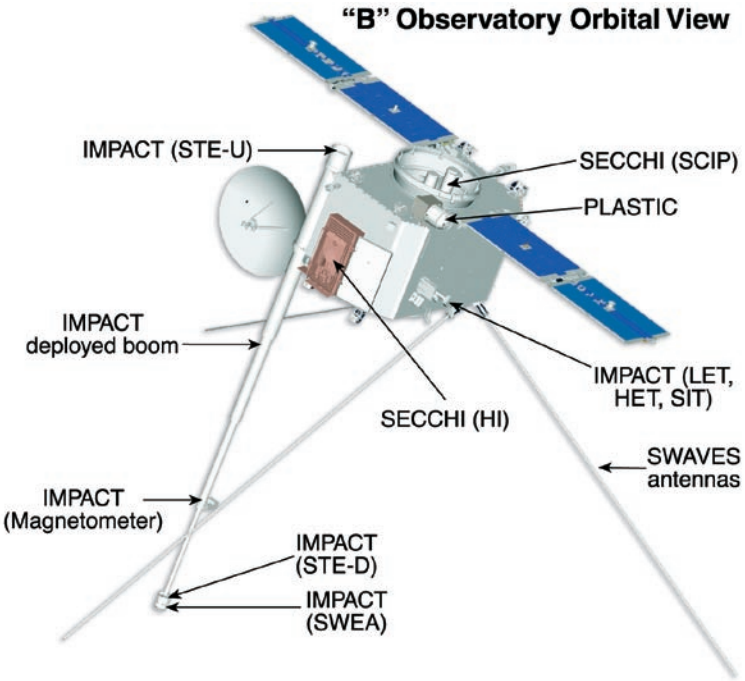
- Stereoscopic image processing
- Light-weight coronagraphs
- High-sensitivity, low-scatter, wide-angle photometry
- CME radio tracker
- Autonomous broadcast space weather mode

## STEREO Mission Management

- Nick Chrissotimos, NASA/GSFC STEREO Project Manager
- James T. Mueller, APL Project Manager

STEREO is expected to operate for a minimum of 2 years. The Mission Operations Center will be located at APL. Payload operations will be conducted remotely from each of the instruments' facilities. The STEREO Science Center will be located at NASA/GSFC.

Further information on STEREO can be found at **http://stp.gsfc.nasa.gov** and **http://stereo.jhuapl.edu**.

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