

# Stereo

Add-on for Orbiter 2010 - P1  
(build 100830)

## Mission Overview

STEREO (Solar TERrestrial RELations Observatory) is the third mission in NASA's Solar Terrestrial Probes program (STP). This two-year mission employs two nearly identical space-based observatories - "Stereo-A" ahead of Earth in its orbit, "Stereo-B" trailing behind - to provide the first-ever stereoscopic measurements to study the Sun and the nature of its coronal mass ejections, or CMEs.

The twin Stereo-A and Stereo-B spacecraft were launched on 26<sup>th</sup> October 2006 at 00:52 UTC on a Delta II 7925-10L rocket from KSC LC-17 Pad-B. The spacecraft were injected into a highly eccentric Earth orbit, with the apogee at approximately the distance of the Moon's orbit.

More info:

<http://stereo.gsfc.nasa.gov/>

<http://en.wikipedia.org/wiki/STEREO>

<http://stereo-ssc.nascom.nasa.gov/ancillary.shtml>

## Add-on Spacecraft Specifications and Controls

### Stereo-A

Spacecraft Mass 562 kg

Fuel Mass 62 kg  
Fuel ISP 2500 Ns/kg  
RCS Engines 18N each

Controls:

[G] = Antennae & Lens Caps

[K] = Solar Panels & HGA

### Stereo-B

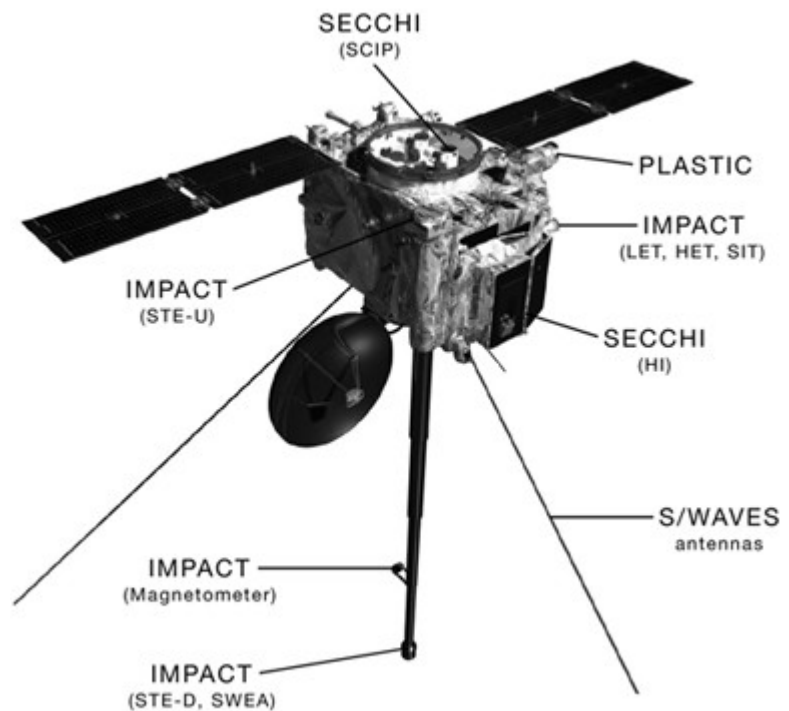
Spacecraft Mass 599 kg  
Fuel Mass 62 kg  
Fuel ISP 2500 Ns/kg  
RCS Engines 18N each

Controls:

[G] = Antennae & Lens Caps

[K] = Solar Panels & HGA

[J] = Jettison Stereo-A



Available commands and remaining dV capability are displayed on the HUD.

## Launch

Launched 26<sup>th</sup> October 2006 at 00:52:00 UTC from LC-17B to a 28.5° inclination, short duration (~ 5 mins) 165km x 175km parking orbit.

This add-on has a launch autopilot available. Press [P] at T-10s to activate the autopilot. The autopilot will jettison fairings and stages automatically and make all the necessary burns to put the spacecraft on a usable trajectory.

For increased accuracy, you may like to disengage the autopilot during parking orbit and plan your own escape burn. Press [P] to disengage the autopilot (cannot be restarted).

Final separation of the spacecraft from the launcher 3<sup>rd</sup> stage must be made manually.

Delta II Launcher Controls:

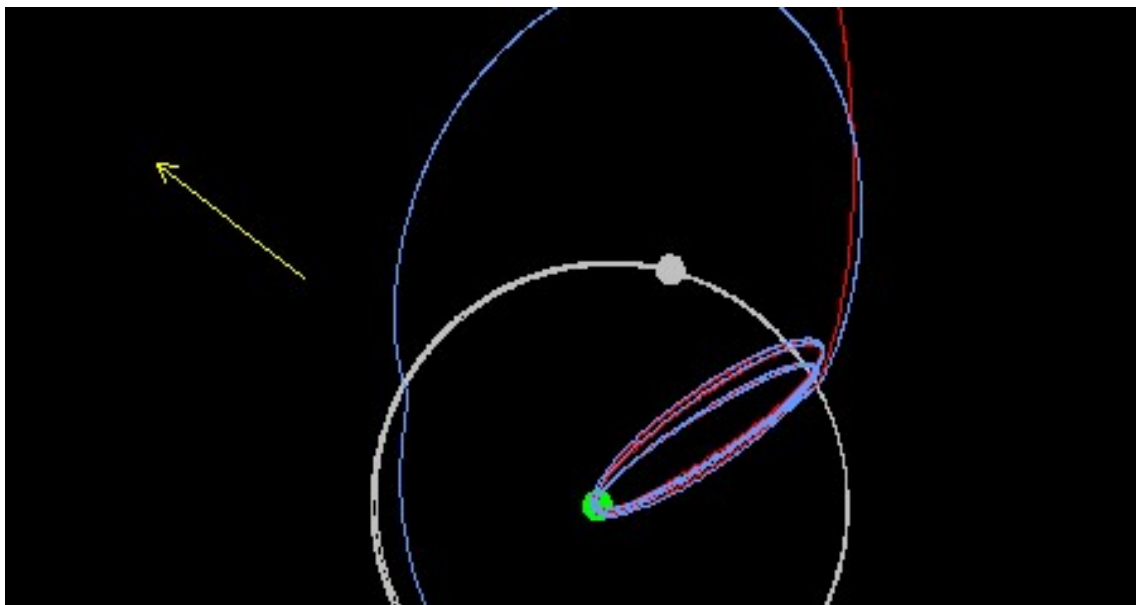
[P] = Start/Stop Autopilot

[F] = Jettison Fairing

[J] = Jettison Stage or Spacecraft

## Trajectory

After injection to a highly eccentric Earth orbit, both spacecraft completed four orbits before flying by the Moon on the 5<sup>th</sup> apogee for a gravity assist which put Stereo-A (ahead) into a heliocentric orbit, while Stereo-B (behind) was put into a high Earth orbit which allowed it to return for a second gravity assist flyby of the Moon that put it into a heliocentric orbit.



Red = Stereo-A

Blue = Stereo-B

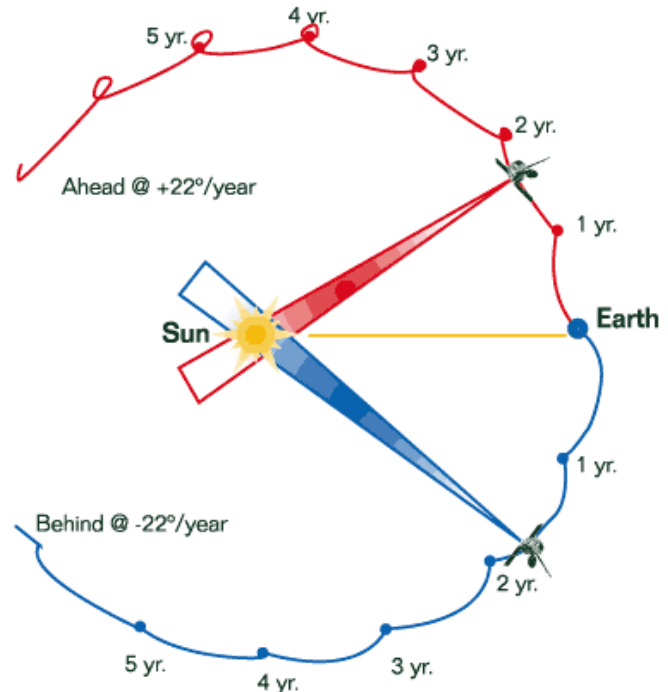
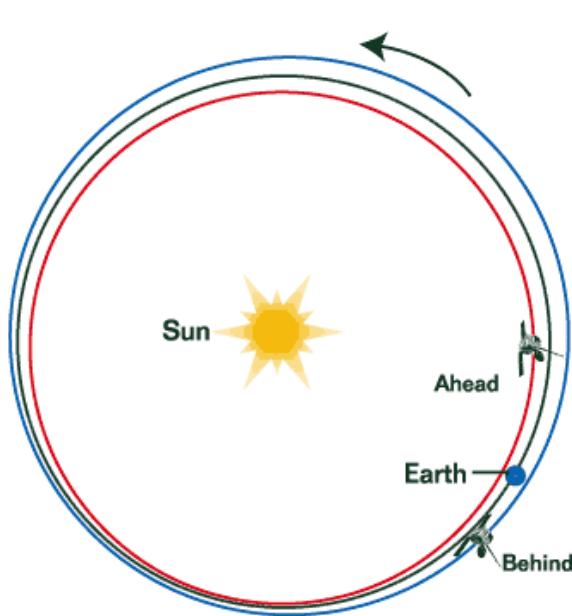
## Final Orbits

### Stereo-A

Apohelion 0.9706 AU  
Perihelion 0.9585 AU  
Period 346 days

### Stereo-B

Apohelion 1.0842 AU  
Perihelion 0.9909 AU  
Period 386 days



Note: the diagram above-right shows the orbits in a *rotating frame* (Sun-Earth line is fixed)

## Scenarios

Two scenarios are provided in the Scenarios/Stereo/ folder.

1. Stereo Launch
2. Stereo post launch

## Add-on Notes

The Delta II launcher is controlled by Vinka's "multistage2.dll", the Stereo spacecraft have their own custom .dll's. Both scenarios use the default Orbiter solar system "Sol.cfg".

During the Earth orbits, the trajectories of the spacecraft are quite stringly perturbed by the Moon. I recommend using IMFD "Map (Plan View)" + IMFD "Course (Delta Velocity)" to plan your manuevres for achieving the required lunar gravity assists.

## Quick Reference

### Final Orbit Parameters

	Stereo-A	Stereo-B
Aphelion	0.9706 AU	1.0842 AU
Perihelion	0.9585 AU	0.9909 AU
Period	346 days	386 days
Inclination	0.123	0.315
Eccentricity	0.006	0.045

### Stereo-A Timeline

Launch	26 Oct 2006 00:52:00 UTC	MJD 54034.0361
Apogee 1	31 Oct 2006 17:17 UTC	MJD 54039.7201
Perigee 1	06 Nov 2006 10:36 UTC	MJD 54045.4417
Apogee 2	12 Nov 2006 01:38 UTC	MJD 54051.0681
Perigee 2	17 Nov 2006 16:34 UTC	MJD 54056.6903
Apogee 3	23 Nov 2006 16:39 UTC	MJD 54062.6938
Perigee 3	29 Nov 2006 17:38 UTC	MJD 54068.7347
Apogee 4	05 Dec 2006 20:50 UTC	MJD 54074.8681
Perigee 4	12 Dec 2006 00:20 UTC	MJD 54081.0139
Moon Flyby 6832 km alt.	15 Dec 2006 13:53 UTC	MJD 54084.5785

### Stereo-B Timeline

Launch	26 Oct 2006 00:52:00 UTC	MJD 54034.0361
Apogee 1	31 Oct 2006 16:16 UTC	MJD 54039.6778
Perigee 1	06 Nov 2006 08:33 UTC	MJD 54045.3563
Apogee 2	11 Nov 2006 22:43 UTC	MJD 54050.9465
Perigee 2	17 Nov 2006 12:45 UTC	MJD 54056.5313
Apogee 3	23 Nov 2006 14:13 UTC	MJD 54062.5924
Perigee 3	29 Nov 2006 16:37 UTC	MJD 54068.6924
Apogee 4	05 Dec 2006 21:19 UTC	MJD 54074.8882
Perigee 4	12 Dec 2006 02:21 UTC	MJD 54081.0979
Moon Flyby 1 12366 km alt.	15 Dec 2006 13:47 UTC	MJD 54084.5743
Apogee 5	02 Jan 2007 03:09 UTC	MJD 54102.1313
Moon Flyby 2 18446 km alt. (retrograde)	21 Jan 2007 15:52 UTC	MJD 54121.6611