Imaging the Heliosphere at Solar Minimum: SECCHI Observations During the Whole Heliosphere Interval

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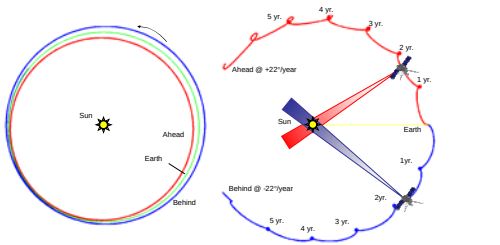
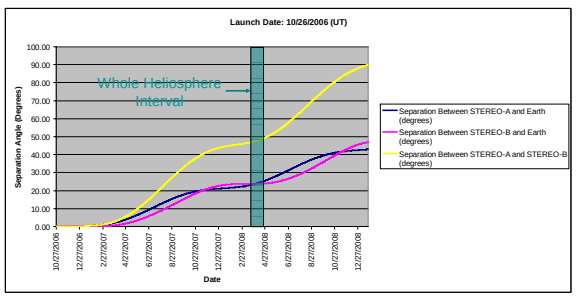
STEREO Mission Characteristics

- STEREO consists of two spacecraft ('Ahead' and 'Behind') in heliocentric orbit in the ecliptic plane at approximately 1 AU. The STEREO spacecraft separate from Earth at a rate of about 22.5° per year, with Ahead leading the Earth and Behind trailing the Earth in orbit about the Sun.



Ecliptic plane projections of the STEREO orbits in heliocentric inertial (left) and geocentric solar ecliptic (right) coordinates.



STEREO spacecraft separation angle as a function of time, with the WHI shaded.

SECCHI Instrument Characteristics

- SECCHI consists of two identical suites of 5 telescopes on each of the twin STEREO spacecraft. SECCHI provides remotely sensed images of the corona and the inner heliosphere from the surface of the Sun to beyond the orbit of the Earth.

Telescope	Observable	Wavelength	Pixel Size	Field of View
EUVI	He II Intensity	30.4 nm	1.6 arc sec	<1.7 $R_\odot$
	Fe X, Fe XII, Fe XV Intensities	17.1, 19.5, 28.4 nm		
COR1	Intensity – B, pB	650 – 660 nm	3.75 arc sec	1.4 – 4 $R_\odot$
COR2	Intensity - B, pB	650 – 750 nm	14.7 arc sec	2.5 – 15 $R_\odot$
HI1	Intensity – B	630 – 730 nm	35 arc sec	20° (15 – 90 $R_\odot$)
HI2	Intensity – B	400 – 1000 nm	120 arc sec	70° (70 – 332 $R_\odot$)

Note: COR1, HI1 and HI2 images are usually 2×2 binned, so the typical image pixel size is twice the value quoted above.

SECCHI Observations During the Whole Heliosphere Interval

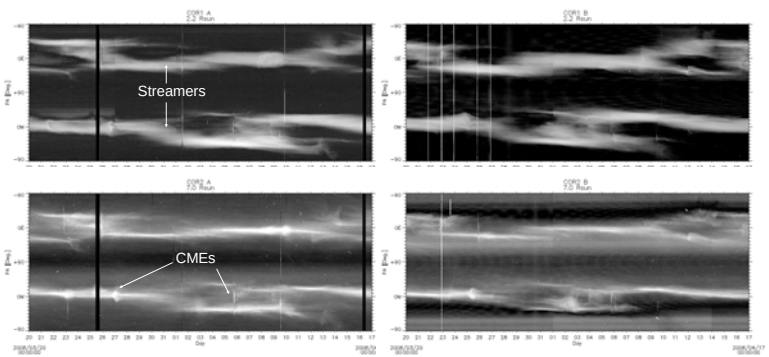
- SECCHI followed a standard program of synoptic observations throughout the WHI, with the exception of short interruptions for scheduled instrument and spacecraft calibrations.

Telescope	# Images and Size (pixels)	Exposure (seconds)	Cadence (minutes)	Total Images/Day	Compression Scheme	Total Mbits/Day
EUVI	1 2k × 2k (171)	4	2.5	575	ICER6	994.2
	1 2k × 2k (171)	16	120	11	ICER4	37.9
	1 2k × 2k (195)	16	10	133	ICER5	345.1
	1 2k × 2k (195)	16	120	11	ICER4	37.9
	1 2k × 2k (284)	32	10	143	ICER6	247.3
	1 2k × 2k (284)	4	10	133	ICER5	345.1
	1 2k × 2k (304)	4	120	11	ICER4	37.9
	4 2k × 2k (All)	16/16/32/4	1440	4	ICER0	59.1
COR1	3 1k × 1k (pB)	1.7	10	432	ICER5	1103.3
COR2	3 2k × 2k (pB)	6	30	142	ICER3	729.0
	1 2k × 2k (B)	6	30	48	ICER3	244.7
	1 2k × 2k (B)	72	1440	1	HC4	16.2
HI1	1 1k × 1k (B)	1200	40	36	Rice	477.4
HI2	1 1k × 1k (B)	4950	120	12	Rice	214.4
Total				1693		4889.7

SECCHI daily synoptic program summary during the WHI.

Global Coronal and Heliospheric Morphology

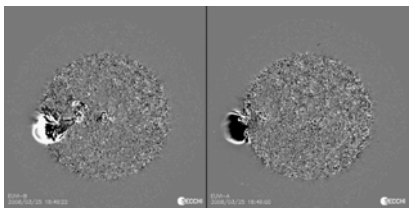
- Synoptic maps, presented for each of the SECCHI coronagraphs below, are an excellent way to visualize the global morphology of the corona and inner heliosphere during the Whole Heliosphere Interval.
  - Synoptic maps can be used to quickly identify major events or features (CMEs, active regions), to locate the streamer belt, and to show the evolution of the corona on time scales from less than one day to several weeks.
- Synoptic maps are generated as follows:
  - A slice through each image is taken over all position angles at a constant altitude or elongation angle.
  - Slices are stacked vertically to form columns in the synoptic map showing coronal brightness as a function of time along the horizontal axis and heliographic or apparent heliocentric latitude along the vertical axis.
  - If one or more columns in the map are skipped, values are interpolated from adjacent columns. If the gap is more than 1.5 days, the map is left blank.
  - Each map is scaled to best display the visible features.
  - Coronagraph images are processed by subtracting an average "model" from each image to cancel the F-corona and instrumental stray light. This model is created by taking the minimum value of each pixel from a series of daily median images over a period of 28 days.

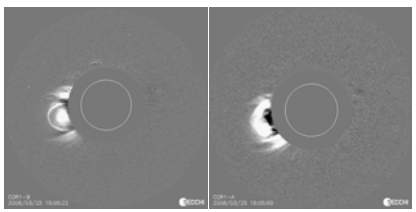


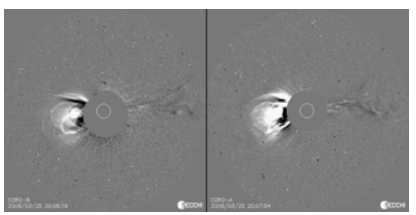
Synoptic maps of polarized brightness (pB) for the COR1 and COR2 coronagraphs during the WHI. COR1 maps are shown at an altitude of 2.2 $R_\odot$, and COR2 maps are shown at an altitude of 7.0 $R_\odot$. Streamers are visible at low and middle heliographic latitudes, as expected near solar minimum. Occasional CMEs are visible as short-duration vertical features superimposed on the streamer structure.

CME on March 25, 2008

- A CME with accompanying flare and Type II radio burst was observed by both STEREO spacecraft on March 25, 2008.
- The CME source region (active region flare site) was close to the East limb from the perspective of STEREO Behind, and was behind the East limb from the perspective of STEREO Ahead.
- The CME, flare, and EUV wave were all observed in near real-time in the SECCHI space weather beacon data.
- Representative images from the SECCHI instruments, and an elongation-time plot for the CME leading edge as seen in STEREO Ahead, are presented below. Further analysis of this event is ongoing.







NO CME IN HI-B