

# SOHO: THE FIRST YEAR

A GUIDE TO THE VIDEO



SOHO, in the year after its launch, and within nine months of science operations, has taken center stage in the discipline of Solar Physics. Evry Schatzman of the Observatoire de Meudon called SOHO

“... the most remarkable and successful spacecraft ever devoted to examining the star on which our lives depend...”

The accompanying video highlights the results obtained by the imaging experiments during SOHO's first year, but before turning our attention to those, we want to emphasize that SOHO returns more than attractive images — SOHO's helioseismology and the particle detection experiments have already revolutionized our knowledge of the Solar interior and the Solar wind. GOLF, VIRGO, and MDI have obtained p-mode spectra that are cleaner, by at least an order of magnitude, than what is observed from the ground, and MDI's local helioseismology has for the first time ever, provided a glimpse of convective flows below a stellar surface.

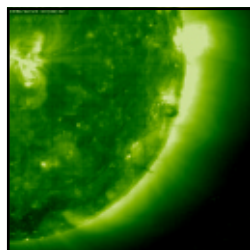
The *in-situ* particle detectors, ERNE and COSTEP, continuously monitor high energy protons, electrons, and alpha particles, finding huge increases in the aftermath of filament eruptions and CME's. And finally, CELIAS, SOHO's solar wind analyzer, has doubled the number of elements recorded in the solar wind.

## THE VIDEO



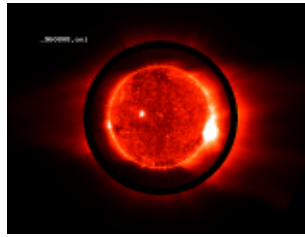
*EIT Image of a Prominence Eruption*

The second segment features full-disk EIT images in the Fe XII line at 195 Å (~1,500,000 K), taken with a cadence of one image every 12 minutes. On the 23rd of December a rare event on the South-West limb caught the observers' attention --the sudden eruption of a bubble-like structure, probably magnetic in origin.



*EIT Observation of an Eruption on December 23, 1996*

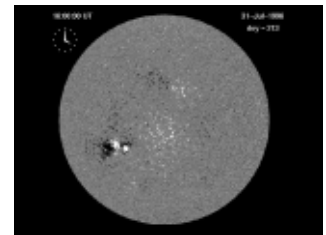
The first sequence, of EIT images in the Helium II and Si XI lines at 304 Å taken at a cadence of 17 minutes, shows both an eruption off the South pole and a filament eruption, moving like the crack of a whip, followed by the formation of post-flare loops.



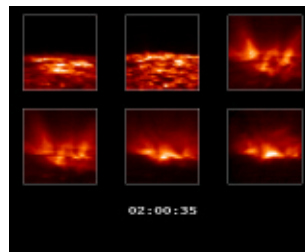
*Combined UVCS and EIT Image, Showing Magnetic Topology from the Solar Surface to the Deep Corona*

The next video sequence dramatically underlines SOHO's capability to trace the topology of magnetic field from the Sun's surface out into the deep corona. The sequence in the outer region consists of 120 daily maps obtained by UVCS in Oxygen VI (1032 Å), while the inner region consists of daily full-disk images of EIT in the Fe XV line at 284 Å. The dominant feature is an active region in the Southern hemisphere that illuminates the corona like a lighthouse.

The fourth clip features a sequence of full disk magnetograms obtained by MDI in a 96 minute cadence, followed by a zoom-in on a rapidly developing active region in the Southern hemisphere. Differential rotation, meridional flow, and flux emergence and cancellation are all easily recognized. While the resolution of these images (1 pixel = 2.5") is less than what is achieved from the ground, the continuity, and absence of atmospheric interference leads to sequences that are extremely well suited to observe the evolution of the surface magnetic field over the course of the Solar cycle.



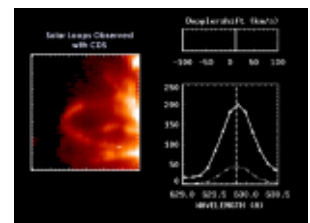
*MDI Full Disk Magnetogram*



*CDS Images of Limb Active Region in Si XII, He I, Fe XVI, O V, Mg X, and Mg IX*

Turning our attention now to SOHO's twin EUV spectrometers, SUMER and CDS, the first clip demonstrates CDS's unique combination of high angular spectral and temporal resolution by showing an Active Region near the West limb observed in six temperature lines simultaneously.

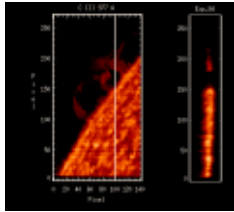
In the second CDS clip successive spectra are shown taken at different points along the axis of a coronal loop on the limb in the Oxygen V line at 629 Å. The sequence highlights the ceaseless plasma



*CDS Spectroscopy of a Solar Coronal Loop*

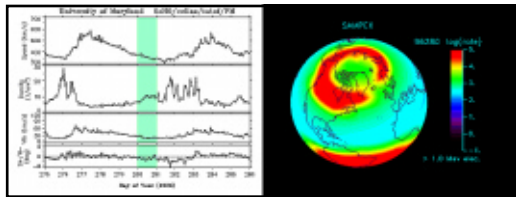
motions within the loop, through the Dopplershifts, as well as the variation in temperature through the line-width.

The following segment shows a SUMER raster image of a prominence on the limb on the left side, with a vertical slide representing the SUMER raster slit moving in the East-West direction. On the right hand side the observed spectra along the slit are shown in color intensity. The spectral resolution is about  $0.04 \text{ \AA}/\text{pixel}$ , with 50 pixels shown in the horizontal direction, centered around  $977 \text{ \AA}$ .



*SUMER Spectroscopy of a Limb Prominence in C III*

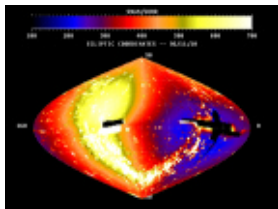
Far away from the Solar surface, the SOHO *in-situ* particle detectors provide about an hour's advance warning for dense plasma clouds about to impinge on the Earth's magnetosphere. The combined video clip of



*Simultaneous Solar Wind Observations by CELIAS and Auroral Electrons Detected by SAMPEX (NASA)*

solar wind density, velocity, and temperature, observed by SOHO's solar wind analyzer CELIAS, and high energy electrons causing the Aurora Borealis detected by the NASA spacecraft SAMPEX, underlines the direct connection between these phenomena.

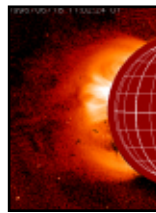
We now completely turn away from the Sun. The SWAN instrument measures the sky intensity in the spectral range  $1100\text{-}1800 \text{ \AA}$ . The color scale in the video clip shows the level of Lyman- $\alpha$  intensity scattered by hydrogen atoms in the interplanetary medium. Over a one year period, the sky pattern changes according to the position of SOHO on its orbit around the sun. The swan shaped feature near the equator is the blocked out part of the sky near the Sun, while the small region displaced by 180 degrees in



*SWAN Full Sky Lyman- $\alpha$  Intensity Map*

longitude represents a blocked out Solar reflection from the spacecraft.

Our final three video sequences are perhaps the most spectacular. LASCO has three visible light coronagraphs, that together image the corona between 1.1 and 30 Solar radii. The first LASCO movie shows a sequence of ejections on the East limb observed by the innermost C1 coronagraph between 1.1 and 3 solar

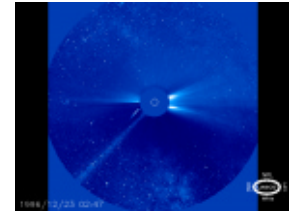


*LASCO C1 Image of an Ejection from the Low Corona on June 17-20, 1996*

radii, in the  $5303 \text{ \AA}$  green coronal emission line, with the nearby continuum subtracted. The data were taken between June 17 and 20, 1996, at a rate of about one per hour.

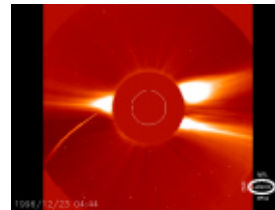
The second clip, from the outermost white light C3 coronagraph, between 3.7 and 30 Solar radii, was taken around Christmas 1996, in a cadence of one per 50 minutes. One sees very clearly the relative motion of

the Sun with respect to the background stars, and a trained observer might detect the Milky Way just below the blocked out Solar Disk. The white ring in the blocked out area represents the Solar limb. Early in the sequence a comet appears on the left side of the Sun, and doesn't return, indicating that it actually impacted on the Solar surface. At about the same time a giant Coronal Mass Ejection (CME) takes off on the right hand side of the disk.



*LASCO White Light Coronagraph Image on 12/23/96, Showing a Comet Impact, the Onset of a CME, and the Milky Way in the Background*

In the third clip the same events are rendered by the C2 white light LASCO coronagraph that images between 1.5 and 6 Solar radii. One sees in much more detail the impact of the comet and the CME onset and evolution.



*Same View Shown in the LASCO C2 Coronagraph*

More information on the SOHO mission, including a detailed description of the experiments, a Gallery of SOHO results, and the latest Solar images, is available on our Web site at

<http://sohowww.nascom.nasa.gov/>



**SOHO, the Solar and Heliospheric Observatory, is a mission of international collaboration between ESA and NASA. The Project Scientist is Dr. Vicente Domingo and the Project Scientist for NASA is Dr. Arthur Poland.**