Science JOPs: JOP 031

Title: SOLAR WIND ABOVE STREAMERS

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SOHO Instruments involved: UVCS, SUMER, CDS, LASCO, EIT, MDI

Collaborating GBO: Possible collaborations: white light coronagraphs (polarization), radio observatories

Collaborating S/C:

Campaign: yes

Last update: May 1996

First proposed: SPWG January 1995

Object: STREAMERS

## SOLAR WIND ABOVE STREAMERS (JOP 031)

**Objective**
To identify and characterize the coronal sources of the solar wind: Streamers contribution

**Scientific Case**
The primary scientific goals of the observing program are the following:

- to identify and characterize the coronal sources of the solar wind,
- to identify and understand the dominant physical processes that accelerate the solar wind.

(See JOP 006)

This observing program is dedicated to streamers. The characterization of the base of the streamer requires disk observations during a few days before the streamer appears at the limb.

This program is limited to:

- determine the mass input and energy and momentum deposition in the solar wind from the areas adjacent to the streamer and the streamer itself;
- distinguish between thermal models and models requiring momentum deposition in the extended corona.

**Observables**

- extended corona (UVCS, LASCO)
  ——————-
  determine kinetic temperature for protons and heavier ions, electron density, outflow velocity of the corona from the limb up to 3.0 $R_\odot$, in the solar wind region.

- inner corona (CDS, EIT, SUMER, MDI)
  ——————
  determine:
  - electron density and temperature
  - differential emission measure on disk near the limb and possibly up to 1.5 $R_\odot$
  - non-thermal velocity maps in
    - transition region
    - coronal lines
  - fine (2") magnetic structures in the potential solar wind sources (at least at the beginning of the tracing of the target).

**Pointing and Target Selection**

It is desirable to begin to observe the target region (streamer) in the inner corona, during a period of 2/3 days before arrival at the limb, in order to fully characterize the solar wind source. The coronagraphs shall start the joint observation when the target is approaching the west limb, continuing for the period of visibility at the west limb.

**Observations**

**UVCS**

The UVCS observations consists of a mirror scan.

**MIRROR SCAN**

Channel I: Ly $\alpha$, Fe XII 1242, N V 1239, S X 1196 (S X 1213) profiles
Channel II: O VI 1032, O VI 1037, Mg X 610, Ly $\beta$ 1026, Si XII 499, Si XII 521, Ly $\alpha$ profiles
Channel III: VL polarized 4500–6000 Å.
To determine electron density, proton/ion kinetic temperature, outflow velocity.

| | Ch I – H Ly $\alpha$ | Ch II – O VI |
|---|---|---|
| Initial IFOV position | 1.6 $R_\odot$ at the target latitude | $\|\|$ to the limb |
| Instantaneous FOV (IFOV) | 30' x 14" | 30' x 28" |
| Slit width | 0.05 mm | 0.1 mm |
| Spectral resolution | 0.28 Å | 0.36 Å |
| Area element (n. pxls) | 28" x 14" (2 x 2) | 28" x 28" (8 x 8) |
| F.O.V. | 1.6– 3.0 $R_\odot$ | |
| Average dwell time | variable with height | |
| Total time | 10. h | |

**Observing Sequence JOP-31**

| | | |
|---|---|---|
| Exposure time | 600 sec | |
| Dwell time | variable with height | |
| Total bins | 40000 | |
| Polarizer motion | each | 600 sec |
| | Channel 1 (Ly alpha) | Channel 2 (OVI) |
| Slit Width | 0.05 mm (0.28 Å, 14”) | 0.1 mm (0.36 Å, 28”) |
| Grating Position | 95000 | 185000 |
| Mask: | GPS2-LYA | GPS2-OVI |
| Binning along the slit | 4 pxls=28” | 4 pxls=28” |
| Binning in $\lambda$ | 2 pxls=0.28 Å | 2 pxls=0.18 Å |
| Full spatial range | 90 bins | 90 bins |
| Selected spatial range | 64 | 64 (72-328) |
| Spectral bins | 625 | available for transmission |
| Spectral Range | column interval<br>500–879 (190 b)<br>–Fe XII 1242–NV 1239–<br>Ly$\alpha$ 1216–SX 1213,1196 | column interval<br>280–469 Si XII 521–OVI 1037 (95b)<br>OVI 1032–Ly $\beta$ 1026<br>Si XII 499 Mg X 610, Ly$\alpha$+wings<br>700-1019 (160b) |
| Total spectral bins | 190 bins | 255 bins |
| Bins per channel | 190x64= 12160 | 255x64 = 16320 |
| Total bins | 28480 | |
| Field of View | 30’x 14” | 30’ x 28” |
| Scan step | variable | |
| Scan time | (for photon integration) | 34200 s (9.5 h) |
| Scan time | (including polarizer motion) | 35340 s (**9.8 h**) |
| Number of scans | 1 | |
| Total time | **10 h** | |

**Streamer**
**N–Predicted Counts )**

| $R_\odot$ | $\Delta$t | Ch1 | $N_{Ly\,\alpha}$ | Ch2 | $N_{OVI1032}$ |
|---|---|---|---|---|---|
| | (sec) | $pxl^2$ | | $pxl^2$ | |
| 1.60 | 1800 | 4x 2 | 2.9e+04 | 4x 4 | 1.4e+04 |
| 1.80 | 1800 | 4x 2 | 1.7e+04 | 4x 4 | 6.0e+03 |
| 2.00 | 3600 | 4x 2 | 2.2e+04 | 4x 4 | 5.5e+03 |
| 2.50 | 10800 | 4x 2 | 2.8e+04 | 4x 4 | 3.7e+03 |
| 3.00 | 16200 | 4x 2 | 2.3e+04 | 4x 4 | 3.1e+03 |

## CDS

CDS can provide information about the temperature and density of a streamer, its stability, and detect its long term evolution. A comprehensive line list is possible thanks to a long exposure time.

Study Details

Spectrometer: Normal Incidence Slit: 4 x 240 arcsec Raster Area: 4 x 4 arcminute Step (DX, DY) 4 arcsec, 0 arcsec Raster Locations: 60 x 1 = 120

Exposure Time: 250 s

Duration of raster: 255 minutes Number of rasters: 1 Total duration: 4 hours 15 minutes (incl. overheads)

Line selection: 14 lines as for the Coronal Hole: Fe VIII (370.43), Fe X (365.57), Fe XI (356.54), Fe XII (364.47), Fe XII (338.17), Fe XIII (348.18), Fe XIV (334.17), Fe XVI (335.40), Si IX (349.87), Si IX (341.95), Mg IX (368.06), Mg X (624.94)

plus O III (599.59), O IV (554.52), O V (629.73), Ne VI (562.83), Mg VIII (315.02)

Bins Across Line: 21

Telemetry/Compression: truncate to 12 bits 58 s/exposure = 18 lines x21 bins x120 pixels x12 bits /10 kbits/s

Pointing: to a streamer - field of view including cusp

Flags: Will not be run in response to inter-instrument flag and will not be run with CDS as flag Master

Solar Feature Tracking: Not required

**SUMER**

Two different scans will be done: one for disc observation, and another for off-limb observations:

on disc identical to JOP 014,

off-limb identical to JOP 014 excepted that the raster may be extended to 8' x 5' and then offset (in solar Y axis) by 5' for a new scan (if needed by the size of the streamer).

**MDI**

As in JOP 006.

**LASCO**

The LASCO primary observables for coronal hole structures will be to determine electron densities, kinetic temperatures, velocities associated with the hole, structures within the hole and structures at the boundaries of the hole. The observations are from the C1 telescope. The C2 observations to obtain electron densities will be taken as part of the normal LASCO synoptic program.

Telescope: C1 Passbands: Fe X and Fe XIV FOV: 512 x 256 pixels ( 48 x 24 arc min) Wavelengths: 6 + 1 off band Resolution: Full spatial resolution Compression: Rice (lossless) TM Downlink: 21 minutes Cycle Repeat: Once at beginning, middle and end of period

A cycle will require several repeated exposures at each wavelength step with on-board summing to be able to obtain a total exposure time at each wavelength step of about 5 minutes.

**EIT**

Synoptic observations.