Science JOPs: JOP 031

Title: SOLAR WIND ABOVE STREAMERS

Lead Person: Ester Antonucci

Authors: E. Antonucci and J. Kohl (UVCS), A. Fludra (CDS), T. Hoeksema (MDI), P. Lemaire (SUMER), R. Howard (LASCO)

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 α, 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 β 1026, Si XII 499, Si XII 521, Ly α profiles
Channel III: VL polarized 4500–6000 Å.
To determine electron density, proton/ion kinetic temperature, outflow velocity.

	Ch I – H Ly α	Ch II – O VI
Initial IFOV position	1.6 $R_\odot$ at the target latitude	$\parallel$ 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 λ	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	column interval
	500–879 (190 b)	280–469 Si XII 521–OVI 1037 (95b)
	–Fe XII 1242–NV 1239–	OVI 1032–Ly β 1026
	Lyα 1216–SX 1213,1196	Si XII 499 Mg X 610, Lyα+wings
		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)

$R_\odot$	Δt	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.