Science JOPs: JOP 010

Title: ALFVEN WAVES STUDY: INVESTIGATION OF THE NON-THERMAL BROADENING OF LINES IN THE INNER ATMOSPHERE AND SOLAR WIND

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

Collaborating GBO: White light coronagraphs (polarization), radio observatories

Collaborating S/C:

Campaign: yes

Last update:

First proposed: SPWG January 1996

Object: Coronal Holes

ALFVEN WAVES STUDY: INVESTIGATION OF THE NON-THERMAL BROADENING OF LINES IN THE INNER ATMOSPHERE AND SOLAR WIND (JOP 0XX)

Objective

- To measure non-thermal broadenings in transition region and coronal lines, as a function of temperature and as a function of height in the solar atmosphere up to a few solar radii,

- to determine the contribution of Alfvén waves to the non-thermal broadening, and then

- to study the contribution of Alfvén waves to the acceleration of the solar wind.

Scientific Case

The primary scientific goals of the observing program are the following:

- to identify the physical mechanisms responsible for non-thermal broadening of lines emitted in the inner and extended corona,
- to investigate whether the causes of non-thermal broadening are related to the acceleration of the solar wind and to what extent they contribute to the acceleration.

The study is performed by selecting a coronal hole region and the high-speed solar wind stream above the coronal hole.

Observations performed in the past have shown that non-thermal broadenings of spectral lines are not confined in the lower solar atmosphere, that is in the transition region which is not, as commonly believed, the most dynamic site of the solar atmosphere. On the contrary, the velocities derived from non-thermal motios do increase as a function of temperature, and the largest non-thermal velocities are found in the corona. Data available until now lead to derive the following law linking non-thermal velocities v_{nt} and temperature T in the solar atmosphere: $v_{nt} = 0.41\ T^{0.32}\ km/sec$, valid in

the temperature range 10^4–10^7 K (Antonucci and Dodero, Ap.J. 1995). If non-thermal broadenings are caused by the passage of Alfvén waves through the atmosphere their energy flux remains almost undiminished propagating through the inner corona.

Joint observations of the SOHO inner atmosphere instruments and coronagraphs could both confirm the previous observations and extend the range of observations to the unexplored region of the corona up to several solar radii. The major result would consist in beeing able to identify the contribution to non-thermal broadenings of Alfvén waves and determine their energy flux simultaneously to the velocity of the solar wind as a function of heliodistance, and to test the models predicting that the acceleration of the solar wind is mainly caused by the deposition of the energy carried by the waves.

Observables

- extended corona (UVCS, LASCO)

  determine kinetic temperature (non-thermal + thermal broadening of line profiles) for protons and heavier ions, electron density, outflow velocity of the corona from the limb up to 6 $R_{\odot}$, in the solar wind region.

- inner corona (CDS, EIT, SUMER, (MDI))

  determine:

  - electron density and temperature
  - non-thermal velocity maps in
    - transition region
    - coronal lines

    at the limb up to 1.3 $R_{\odot}$.

Pointing and Target Selection

Coronal hole at the limb.

Observations

UVCS

The UVCS observations consists of one mirror scan. **MIRROR SCAN**

Channel I: Ly α profile at maximum spectral resolution
Channel II: O VI, Si XII intensity
Channel III: VL polarized 4500–6000 Å.
To determine electron density, proton kinetic temperature, outflow velocity.

	Ch I – H Ly α	Ch II – O VI
Initial IFOV position	1.4 $R_\odot$ target lat.	$\|\|$ to limb
Istant. FOV (IFOV)	40' x 7"	40' x 82"
Slit Width	0.025 mm	0.3 mm
Spectral res.	0.14Å	1.11 Å
Area (n. pxls)		
1.4 $R_\odot$	107" x 7" (16 x 1)	82" x 82" (12 x 12)
1.5 $R_\odot$	107" x 7" (16 x 1)	82" x 82" (12 x 12)
2–2.5 $R_\odot$	107" x 7" (16 x 1)	120" x 82" (18 x 12)
3 $R_\odot$	214" x 7" (32 x 1)	120" x 82" (18 x 12)
> 3 $R_\odot$	402" x 7" (60 x 1)	120" x 82" (18 x 12)
F.O.V. stepped by	0.5 $R_\odot$ up to 6 $R_\odot$	
Average dwell time	(variable with height)	
Total time	10 h	