SOHO/CDS,EIT,MDI + (TRACE)
JOP PROPOSAL

SOLAR NETWORK: VARIABILITY AND DYNAMICS OF THE OUTER SOLAR ATMOSPHERE

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SCIENTIFIC OBJECTIVE:

Study of variability and dynamics of the outer solar atmospheric layers in solar network using line intensities and Doppler shifts of the chromospheric, transition region and coronal emission lines is proposed. Network located in the quiet atmosphere, in a coronal hole as well as network connected with loops outside active regions will be investigated searching for correlations between the line intensities and the Doppler shifts of different spectral lines. In particular effects of network transient events on mutual relations of the atmospheric layers in/above network will be determined. Limitations on the possible physical mechanisms which control energy transfer and mass motion in the network of the solar outer atmosphere will be derived. Relation of the emergence and motions of the photospheric magnetic flux to these mechanisms will be analyzed.

SCIENTIFIC JUSTIFICATION:

Previous observations performed with different instruments (HRTS, SOHO/CDS, SOHO/SUMER) have revealed that the upper chromosphere, transition region and corona are not static, but display significant changes and variability even in the case of the quiet solar atmosphere. Several apparently different transient events take place in the outer layers of the solar atmosphere (e.g., explosive events, blinkers, spicules, bright points). Overall mutual relations of plasma in ranges of chromospheric, transition region and coronal temperatures should depend on presence and properties of these transient events. Especially solar network is of the particular interest as energy could be channeled through the outer atmospheric layers in this target from the photosphere to corona. Moreover different global magnetic configuration (quiet sun, coronal hole) can influence energy transport and dynamics of plasma in/above the solar network as well. Because of this we propose the simultaneous spectral line measurements with the SOHO/CDS spectrometer in all layers of the outer solar atmosphere. Our interest is focused on long time series of observations in the solar network. Results of our previous measurements (JOP 078, Gömöry et al., 2003, Hvar Observatory Bulletin 27, 67-74[1]) have shown that effects of the transient events can be traced but longer series of data than that one taken during the JOP 078 are needed. The main parameters used in this study (tested on the previous CDS data) will be the intensities and the Doppler shifts of the selected spectral lines. Autocorrelations and cross-correlations of these quantities allow us to derive some information about energy transfer and mass motion in solar outer atmosphere above/in the solar network (Gömöry et al., 2003, contribution to the SOHO13 workshop[2]).

PARTICIPATING INSTRUMENTS:

The core of the program – the spectral measurements performed by the SOHO/CDS spectrometer – have already been tested on July 23, 2003 as the VARDYN1-4 programs. The data have been inspected and it was clarified that all 4 programs for the CDS spectrometers are prepared well providing the data intended to be acquired. Extension of these tested programs to the proposed operation of CDS is described below. Additional observational data are proposed to be acquired simultaneously with the proposed CDS spectral measurements, namely: EIT patrol observations in all channels and measurements in 195 Å spectral channel during the whole CDS run, MDI measurements of B_{long}, and finally TRACE filtergrams in the selected bandpasses. The TRACE observations are optional.

OPERATIONAL CONSIDERATIONS:

It is very important for our aim to run the main part of our CDS measurements (VARDYN4) within the interval created by two successive EIT patrol observations (FULL SUN 171/284/195/304), e.g., between 01:25 – 07.00 or within other such intervals. The total duration of the proposed observational run for CDS is ~ 8.3 hours. The run should be repeated in several days at different positions near the disk center and in coronal hole. Direct selection of the target can be performed several hours or one day before the start of the particular run. No near real time commanding of SOHO instruments and TRACE is required. The program is intended to be performed within the MEDOC 12 campaign in the period November, 17-30, 2003.

[1] available also at `www.astro.sk/~choc/publications/grkcw_hob_2003/grkcw_hob_2003.html`
[2] available also at `www.astro.sk/~choc/publications/grkcw_soho13_2003/grkcw_soho13_2003.html`

DETAILED OBSERVING SEQUENCES – CDS:

All data are proposed to be obtained with the Normal Incidence Spectrometer (NIS). Various modes of CDS observations (1D position - full detector, 2D raster - selected lines, 1D sequences - selected lines) are proposed in a specific procedure. All modes (observing sequences) of CDS have already been tested (July, 23, 2003). The brightest CDS spectral lines were selected for our aim with an attempt to cover wide range of temperatures (10^4 K - 10^6 K). No rotation compensation is proposed for CDS so the slit should cover several different structures during each run. Alternation of the 4" and 2" slits are planned for the CDS sequence part 4.

CDS sequence part 1: full detector (VARDYN1)
Slit: 2" $\times$ 240"
Number of exposures: 2
Exposure time: 10 s (+ app. 890 s overhead) $\rightarrow$ 900 s
Duration: $2 \times 900\text{s} = 1800\,\text{s} = 30\,\text{min}$
Telemetry/Compression: truncate to 12bits

CDS sequence part 2: full detector (VARDYN2)
Slit: 2" $\times$ 240"
Number of exposures: 2
Exposure time: 100 s (+ app. 800 s overhead) $\rightarrow$ 900 s
Duration: $2 \times 900\text{s} = 1800\,\text{s} = 30\,\text{min}$
Telemetry/Compression: truncate to 12bits

CDS sequence part 3: 2D sequential raster near the disk center centred at the position of the slit where the next CDS sequence part will be taken (VARDYN3)
Lines: He I 584.33 Å (2×10^4 K), O III 599.59 Å (8×10^4 K), O V 629.74 Å (2.5×10^5 K), Ne VI 562.80 Å (4×10^5 K), Mg IX 386.04 Å (1×10^6 K), Si XII 520.67 Å (2×10^6 K)
Slit: 4" $\times$ 240"
Detector area (V): 70 pixels = 142", (H): 21 pixels
Steps (x,y): 2", 0"
Number of positions per raster: 20
Number of rasters: 4
Number of exposures: 20 (per raster) $\times$ 4 (rasters) = 80
Exposure time: 10 s (+ app. 6 s overhead) $\rightarrow$ 16 s
Duration: $20 \times 4 \times 16\,\text{s} = 1280\,\text{s} = 22$ min
Telemetry/Compression: truncate to 12bits

CDS sequence part 4: 1D position in center of previous 2D raster (VARDYN4)
Rotation compensation: OFF
Lines: He I 584.33 Å (2×10^4 K), O III 599.59 Å (8×10^4 K), O V 629.74 Å (2.5×10^5 K), Ne VI 562.80 Å ($?\times10^5$ K), Mg IX 386.04 Å (1×10^6 K), Si XII 520.67 Å (2×10^6 K)
Slit (x,y): 4" × 240"
Detector area (V): 70 pixels = 142"
(H): 21 pixels
Steps: 0", 0"
Number of exposures: 145
Exposure time: 10 s (+ app. 5.3 s overhead) → 15.3 s
Duration: 145×15.3 s ~ 2220 s $= 37$ min
Telemetry/Compression: truncate to 12bits
Repetition: 9 times
Total duration: 9×2220 s = 19980 s = 333 min = 5 h 33 min

CDS sequence part 5: 2D sequential raster near the disk center centred at the position of the slit in the previous sequence part VARDYN4 (VARDYN3)

CDS sequence part 6: full detector (VARDYN2)

CDS sequence part 7: full detector (VARDYN1)

DETAILED OBSERVING SEQUENCES – EIT:

It is necessary for our aim to obtain the patrol measurements of EIT (FULL SUN 171/284/195/304) within the time interval in which the main part (CDS sequence parts 3 – 5) of our CDS measurements will take place. The usual patrol measurements taken at 01:00 UT, 07:00 UT, 13:00 UT and 19:00 UT are sufficient. We need EIT observations in 195 Å spectral channel (usual CME watch) during the whole CDS run.

DETAILED OBSERVING SEQUENCES – MDI:

Campaign type: 3 frames (the Doppler velocities, continuum intensities, the longitudinal magnetic field) taken and transfered in each minute, operation mode: high resolution (if possible) or low resolution – full disk

DETAILED OBSERVING SEQUENCES – TRACE:

The TRACE part is scheduled as a repetition of image acquisition in 5 wavelengths in a cycle for a long time interval covering the SOHO/CDS observing run. Pointing of TRACE should follow the CDS pointing. Fine co-alignment of TRACE images with other (CDS, EIT) data will be possible as the TRACE images should be taken in the same time as the EIT patrol measurements and the CDS rasters.

Channels: Lyα, UV continuum, C IV 1500 Å, white light, Fe IX 171 Å

In case of some constraints of instrument the full set of images in all channels can be taken only during the EIT patrol measurements and the CDS rasters and a limited set of TRACE channels (Lyα, UV continuum, Fe IX 171 Å) or just one channel (Fe IX 171 Å) can be defined for the main part of the CDS run (VARDYN4).

The TRACE observations with the partial requirements are not strictly necessary for our aim, but they could help us significantly to fulfil our scientific plans.