ON MUTUAL RELATIONS BETWEEN THE OUTER ATMOSPHERIC LAYERS IN NETWORK: SOHO/CDS AND TRACE STUDY

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AIM

Line emission and dynamics in different temperature regimes in/above supergranular network will be studied using autocorrelation and crosscorrelation functions of the intensities and the Doppler shifts of the chromospheric line He I 584.3 Å and the transition region line O V 629.7 Å.

DATA

– instrument: CDS/SOHO NIS spectrometer
(Harrison, R. A. & CDS team, 1995, Solar Phys. 162, 233)

- observation mode: 'sit-and-stare' $\Rightarrow$ 1D sequence
- spectral lines: **He I 584.33 Å** (2.0×10^4 K)
  O V 629.73 Å (2.5×10^5 K)
- slit: 2" $\times$ 240" oriented in the NS direction
- exposure time: 5 s; cadence: 9.1 s
- number of exposures: 190; run duration: 1729 s
- 'scanned' 2D area: 168" (NS) $\times$ 4.4" (EW)
- target: quiet solar atmosphere near the disk center
- date / time: May 14, 1998; 23:25 UT - 23:53 UT

– instrument: TRACE
(Handy, B. N. & TRACE team, 1999, Solar Phys. 187, 229)

- spectral channel: **Fe IX 171 Å** ($\sim 10^6$ K)
- exposure time: 39 s
- field of view: 8.5 $\times$ 8.5 arcmin; scale: 0.5"/pixel
- date / time: May 14, 1998; 23:36 UT & 23:53 UT

DATA REDUCTION

– CDS/NIS spectral data[1]:

- basic photometry correction (spectrum rotation and tilt, wavelength change with scan mirror position, CCD flat-field, micro-chanel plate burn-in, cosmic rays, NIS bias, NIS continuum, NIS data noise statistics, spatial offset between NIS1 and NIS2)
- data conversion to the physical units:
  intensity: counts $\rightarrow$ erg cm^{-2}s^{-1}sr^{-1}Å^{-1}
  velocity: pixels $\rightarrow$ km s^{-1}
- spectral profile fitting by a Gaussian profile and a linear background using relative weights of the data (Poisson statistics)
- calculation of the zero level of the Doppler shifts using laboratory wavelengths and the overall transition region redshift
- averaging of I and v_D: $n_y = 4$ pixels $\longrightarrow 6.7$"
  calculation of the mean value and standard deviation

– TRACE data[2]:

- basic photometry correction (dark current, CCD flatfield, cosmic rays)
- correction of the solar rotation
- normalization of the data
- correction of the residual displacement between the spectral channels

– CDS/TRACE coalignment: see Fig. 1

[1] http://solg2.bnsc.rl.ac.uk/software/uguide/uguide.shtml
[2] http://www.lmsal.com/~bentley/guides/tag/tag_top.html

CDS SLIT & TRACE Fe IX 171 Å

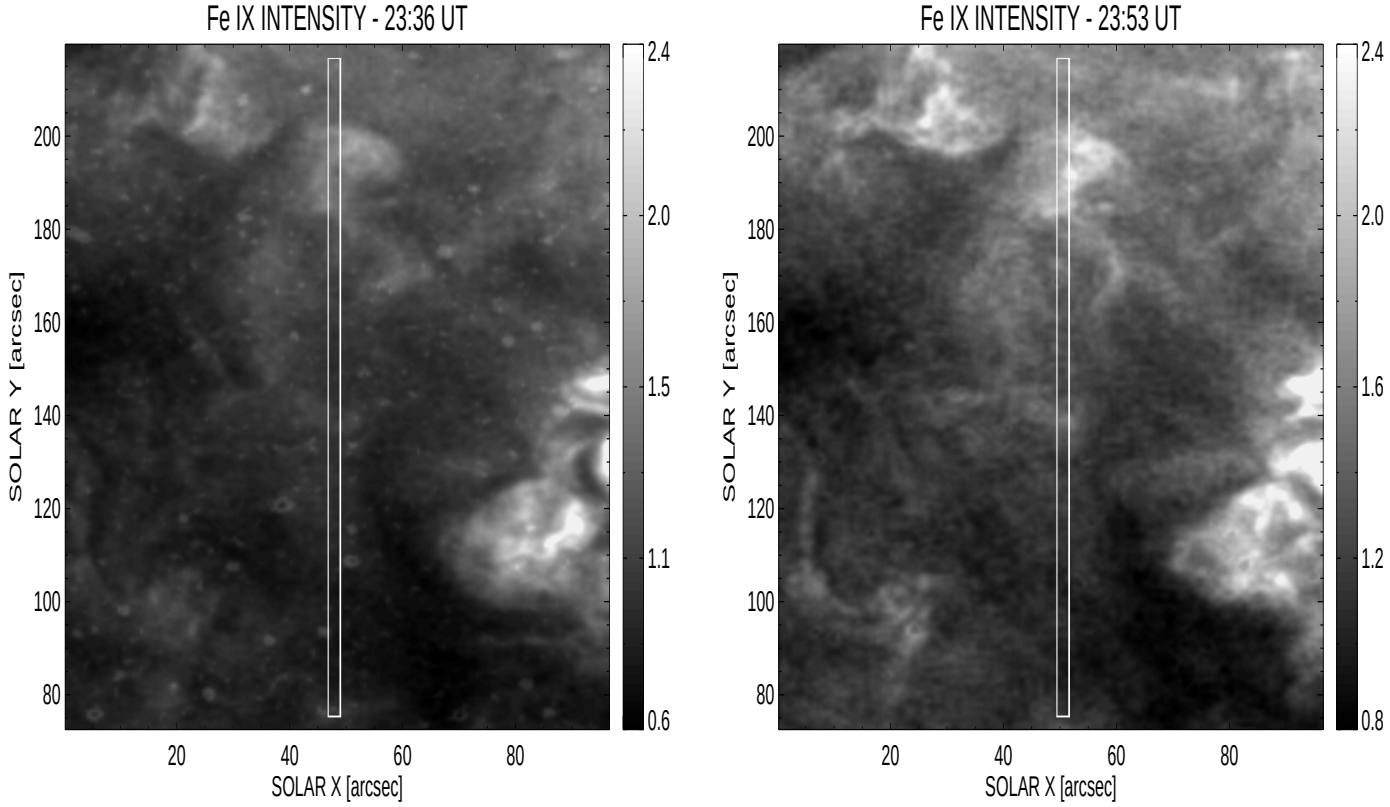

Figure 1: The TRACE Fe IX 171 Å filtergrams taken at moments which correspond to the middle (left image) and to the end (right image) of the CDS measurements. Locations of the CDS slit are indicated. The intensity values given in counts s^{-1} are displayed in the logarithmic scale. The coordinate system is given relative to the disk center.

TARGET SELECTION

- **typical network:** the brightest area of the supergranular network visible in the He I line intensity which is characterized only by a slow increase of the He I and O V line intensities (between 111" – 116"; see Fig. 2)
- **nontypical network:** an area at the edge of the supergranular network which is characterized by repeated strong increases of the He I and O V line intensities (between 97" – 102"; see Fig. 2) where the explosive event (see Figs. 7, 9) was detected *(Gömöry, P. et al., 2003, Hvar Obs. Bulletin, 27, 67)*

2D MAPS

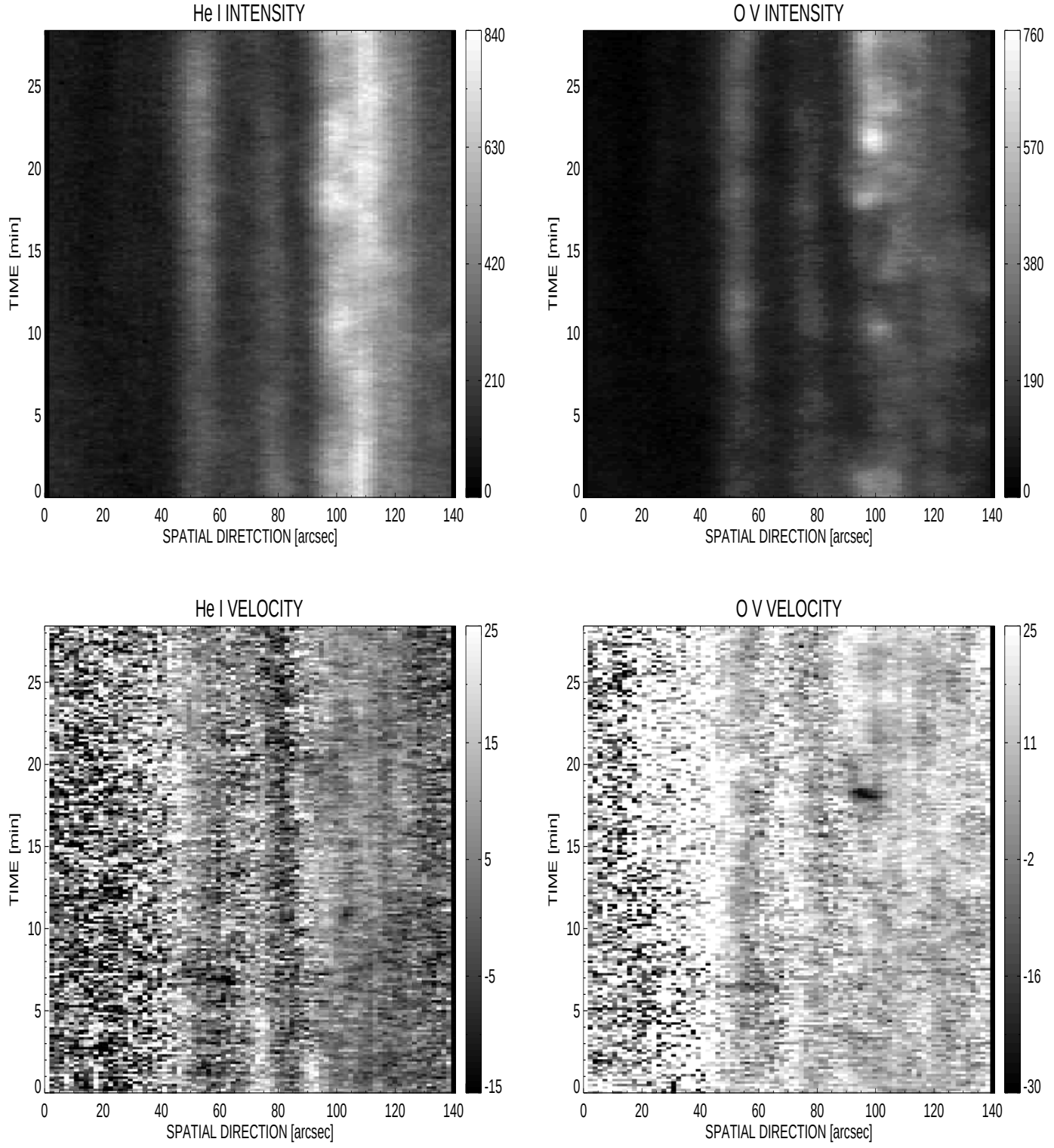

Figure 2: The 2D maps of He I and O V line intensities and the Doppler shifts. Typical network is shown in the area between 111" and 116". Nontypical network is visible in the area between 97" and 102". The intensity values are given in erg cm^{-2}s^{-1}sr^{-1}Å^{-1} and the Doppler shifts in km s^{-1}. The horizontal axis describes spatial direction and the vertical axis describes time. The solar rotation was not compensated, so the vertical axis presents also the spatial extent of the observed solar features. Positive values of the Doppler shifts = redshift (toward the solar surface); negative values of the Doppler shifts = blueshift (toward the observer).

RESULTS

– typical network: autocorrelations of the line intensities

- He I: no local maximum
  O V: local maximum: CC = 0.6, time lag $\sim$ 200 s (?)

– typical network: autocorrelations of the Doppler shifts

- He I: no local maximum
  O V: local maximum: CC = 0.46, time lag $\sim$ 60 s

– typical network: crosscorrelation of the line intensities

- global maximum: CC_{max} = 0.86, time lag = 0 s
  local maximum: CC = 0.77, time lag $\sim$ -190 s

– typical network: crosscorrelation of the Doppler shifts

- global maximum: CC_{max} = 0.54, time lag = 0 s

– nontypical network: autocorrelations of the line intensities

- He I: no local maximum
  O V: local maximum: CC = 0.55, time lag $\sim$ 195 s

– nontypical network: autocorrelations of the Doppler shifts

- He I: local maximum: CC = 0.4, time lag $\sim$ 70 s (?)
  O V: no local maximum

– nontypical network: crosscorrelation of the line intensities

- global maximum: CC_{max} = 0.56, time lag = 0 s
  local maximum: CC = 0.48, time lag $\sim$ -225 s

– nontypical network: crosscorrelation of the Doppler shifts

- global maximum: CC_{max} = 0.58, time lag = 0 s

CONCLUSIONS

– autocorrelation functions of the He I and O V line intensities and the Doppler shifts show different shape in the typical and nontypical network

– crosscorelation functions of the He I and O V line intensities as well as of the Doppler shifts of the same lines show dissimilar shape and reach different values of maxima in the typical and nontypical network

- explanation: probably the explosive event which was detected in nontypical network

– crosscorelation functions of the Doppler shifts reach lower values of CC_{max} than the crosscorelation functions of the line intensities

- explanations: 1) an evidence that the mass motion in the chromosphere and in the transition region are caused by an identical physical mechanisms only in some temporal subintervals; the rest of time series demonstrates an independent physical mechanisms in different parts of a magnetic loop; 2) data noise could be the second explanation of these effects

– more different data in the network are needed for the confirmation of the results

- longer CDS observational runs
- more spectral lines (e.g. the coronal line Mg IX 368.07 Å)

– crosscorrelations of the line intensities and the Doppler shifts of the same line will be investigated

– an analysis of the underlying photospheric magnetic field using MDI data will be added