

The observed MnI 539.47 nm spectral line profile in the preceding sunspots of the NOAA 0431 active region

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Abstract. The spectra of the MnI 539.47 nm spectral line were observed in three different sunspots of the NOAA 0431 active region. Perpendicularly to the dispersion axis, the spectra were divided into several strips that covers the quiet photosphere, penumbra and the umbra of the appropriate sunspot. The manganese spectral line parameters variation along the spectrograph slit were determined and analyzed.

1. Introduction

The long-period spectroscopic observations of the Sun as a star, carried out at the Kitt Peak Observatory, shows, that the MnI 539.47 nm photospheric spectral line parameters (equivalent width, EW and central depth, CD) vary about 2% during the 11 years solar activity cycle (Livingston, 1992). Different ideas were introduced about what might be the reason for this observational fact such as: temperature variation of the layer of formation of the manganese atoms (Vince and Vince, 2002), plage coverage variation of the solar disc (Vince and Vince, 2002), optical pumping by Mg II chromospheric emission spectral line (Doyle et al., 2001) etc. In order to give a qualitative explanation of the problem, all possible factors that could operate on the Mn I line strength, should be investigated. In this paper, the influence of solar sunspots on the MnI 539.47 nm spectral line is examined. For this purpose, we have observed the spectrum of three sunspots of the NOAA 0431 complex active region.

2. Observation and reductions

The observation of the MnI 539.47 nm spectral line was made at the Heliophysical Observatory of Debrecen, Hungary, on August 18, 2003.

We have observed three sunspots in the NOAA 0431 active region which is presented in Figure 1. The arrow represents the approximate size and the orientation of the spectrograph entrance slit. The observed sunspots are labeled as b, c and d.

For each sunspot, a set of five spectra were taken. The appropriate spectra were, firstly, averaged. Thereafter, perpendicularly to the dispersion axis, the spectra were divided into several five-pixel-wide strips (boxes) which covers the nearby quiet photosphere, penumbra and the umbra of an appropriate sunspot. Then, a one-dimensional spectrum were extracted from the each strip. Finally, the spectra were normalized to the local continuum, calibrated to the wavelength and the MnI 539.47 nm spectral line profile parameters were measured.

Figure 2 illustrates the MnI 539.47 nm spectral line profile parameters variation perpendicularly to the dispersion axis. The data were normalized to the maximal relative intensity, which was proclaimed as a photospheric value.

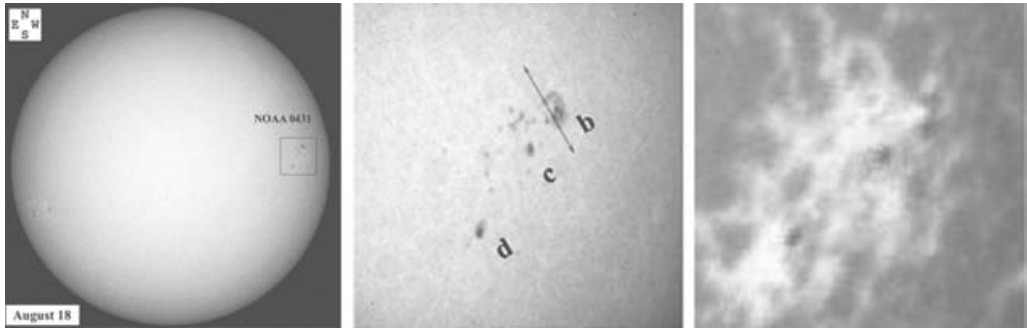


Figure 1. The white-light image of the full solar disc (left), the white-light and CaII K images of the NOAA 0431 active region with the sunspots (middle and right).

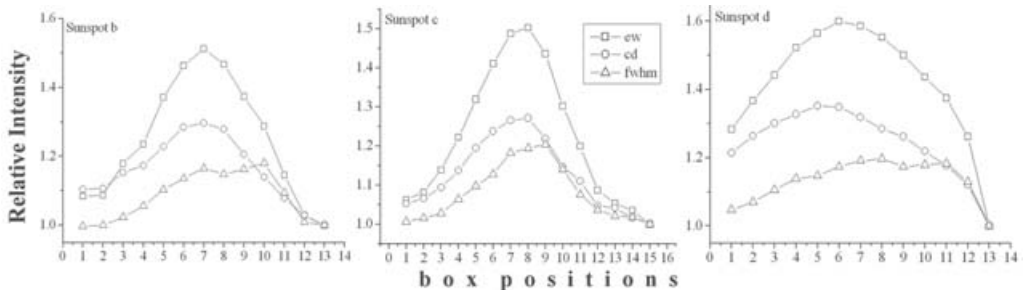


Figure 2. The Mnl 539.47 nm spectral line parameter variation perpendicularly to the dispersion axis.

The maximal change of the Mnl's EW, CD and FWHM, in the case of the Sunspot b, are 50%, 30% and 20%. The same is valid for the Sunspot c. For the Sunspot d, these values are 60%, 35% and 20% respectively.

3. Conclusions

The observed increase of the EW, CD and FWHM from the quiet photosphere to the sunspot umbra in the preceding sunspot of the NOAA 0431 active region is larger than the decrease of these parameters in the plage region (see Vince *et al.*, 2000). Since the variation of the Mnl 539.47 nm spectral line parameters in time shows anticorrelation with the Wolf's sunspot number we can conclude that the influence of the plage region on these spectral line is dominant.

References

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