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Parameters of dark mottles based on high resolution optical spectra

P. Kotrč[1], P. Heinzel[1], K. Tziotziou[2] and G. Tsiropoula[3]

[1]Astronomical Institute Ondřejov, Czech Republic, email: pkotrc@asu.cas.cz

[2] Sterrekunding Institute, Utrecht University, Postbus 80000, 3508 TA, The Netherlands
email: K.Tziotziou@phys.uu.nl

[3]National Observatory of Athens, Institute for Space Applications and Remote Sensing, Lofos Koufos, 15236 P.Penteli, Greece email: georgia@space.noa.gr

Abstract. High resolution optical spectra of hydrogen and calcium lines observed with the Echelle spectrograph of the VTT at Sacramento Peak Observatory were analyzed. The observed line profiles in some parts of dark chromospheric mottles are to be matched with theoretical ones using the cloud model and several parameters (e.g. the temperature, gas pressure, flow velocity) are to be derived. Individual steps of the procedure, as well as crucial problems are discussed.

1. Introduction

Chromospheric dark mottles are jet-like structures, their widths are in the range 0.5 - 2 Mm, heights 5 - 10 Mm and lifetimes of 5-10 min. Their temperature is of the order of 7000 - 15 000 K, electron densities of $4 \times 10^{10} - 1 \times 10^{11}\mathrm{cm}^{-3}$ and gas pressure of the order of 0.2 dyn cm^{-2}, see Tsiropoula & Schmieder (1997), Tziotziou et al. (2003). Mottles are usually organized to rosettes and their morphology is driven by the presence of magnetic flux tubes filled the plasma ejected from below and streaming outwards from a common center. Tsiropoula et al. (1994) using Becker cloud model showed that the predominant pattern of the bulk motion in dark mottles is downwards in their footpoints and upwards at their tops. Tziotziou et al. (2003) suggested that the mechanism of the magnetic flux cancellation in the dark mottles is due to the magnetic reconnection. Recently we developed grid methods allowing a rapid and precise determination of the parameters from the best fit of a synthetic profile with an observed profile. Here we would like to use spectral observations in several lines (Hα, Hβ, Ca II H and Ca II 8542 Å) made at the Echelle spectrograph of the Sac Peak VTT for deriving the plasma parameters from the cloud model improved by Heinzel et al. 1999.

2. Observation and data reduction.

We used observational photographic data obtained at the Echelle spectrograph at the Vacuum Tower Telescope of the Sacramento Peak Observatory on April 9, 1991. The data were digitized by the film scanner. Slit-jaw Hα filtergrams, see Figure 1, were used for identification of the particular regions on the solar surface, and especially to recognize individual dark mottles and other tiny solar surface structures. Each spectrogram was calibrated for intensity and wavelength using IDL codes of Havlíčková (2003). Spectral resolution used was about 100 px per Å and it allows to determine and recover the spectral profiles and their detailed shapes with a high accuracy. Calibrated spectrograms were corrected to the scattered light and the extracted profiles were used for determination of

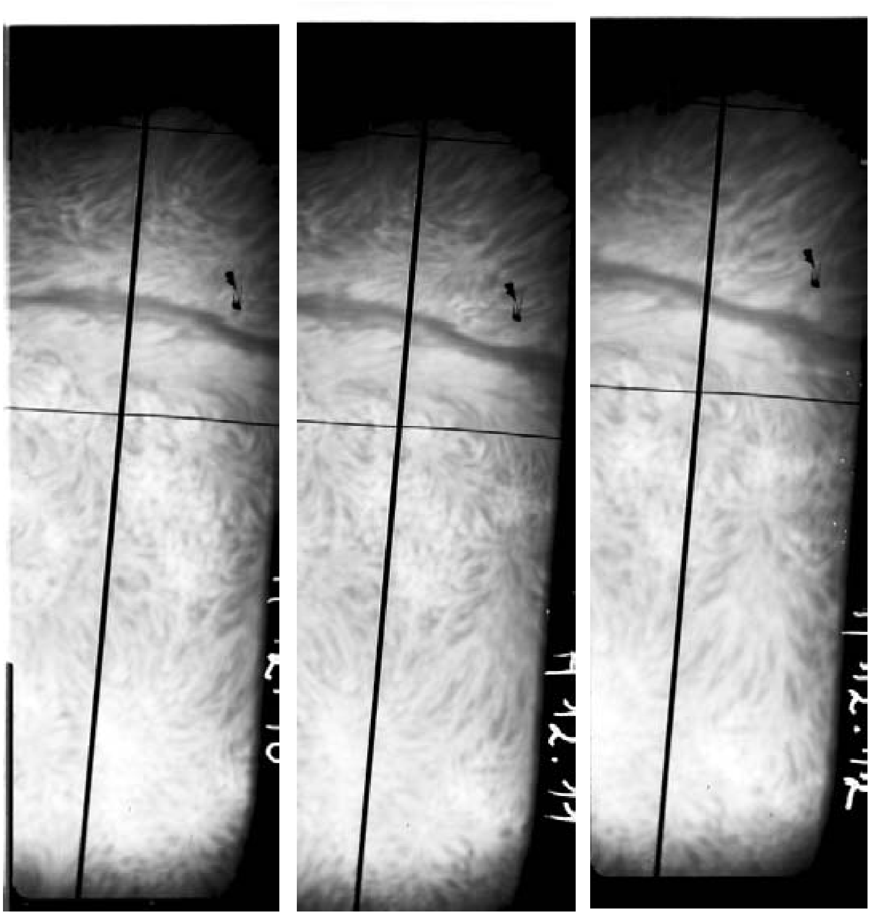

Figure 1. Hα slit jaw filtergrams of the solar chromosphere with dark mottles gathered into rosettes. The vertical line marks the slit, while the horizontal one is a hair crossing the slit.

the cloud model input values. One of the crucial problems we met was an absence of the absolutely quiet profile extracted from each individual spectrogram. The calculation of the cloud model parameters was found to be extremely sensitive to that matter.

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