FACULAR POINTS AND SMALL-SCALE MAGNETIC ELEMENTS*

J. C. DEL TORO INIESTA, M. COLLADOS, J. SÁNCHEZ ALMEIDA, V. MARTÍNEZ PILLET, and B. RUIZ COBO

Instituto de Astrofísica de Canarias, La Laguna, Tenerife, Spain

Abstract. We present spectroscopic observations, with high spatial resolution, of Ca II K bright points very near the disc centre. Magnetic concentrations have been detected in these network (facular) points by only using intensity profiles of the well-known pair of lines Fe I 5250.22 Å and 5247.06 Å. No brightening of these structures with respect to the quiet photosphere can be ascertained within an accuracy threshold of 1.2%.

1. Introduction

Magnetic field appearance on the solar photosphere is highly hierarchical. A number of magnetic structures with different sizes and strengths are detected and, usually, associated with visible counterparts. The smallest ones between them (Stenflo, 1973) remain still spatially unresolved. The debate about their association with the smallest bright structures seen in the photosphere – facular or network points – remains still open, practically, since their discovery (Mehltretter, 1974; Harvey, 1977). Recently, indirect evidence confirming such a correspondence has been reported (Schüssler and Solanki, 1988). Nevertheless, direct observational attempts fail to find any continuum intensity enhancement associated with the magnetic elements (Keller and Koutchmy, 1989).

This communication is intended to present a new trial of direct identification of both magnetic and bright structures and is based on spectroscopic observations of Ca II K bright points very near the disc centre. The magnetic detection is made by only accounting for the intensity profile properties of spectral lines (first Stokes parameter). The continuum intensity measurements are taken out directly from the spectrum.

2. Observations and Preliminary Data Reduction

The observations were carried out at the V.G.T. at the Observatorio del Teide, using the 10 m focal length grating spectrograph. The slit width was fixed at 60 µm (≈ 0.5") and covered a total of 114" in the Sun. The spectral purity allowed by this slit width was 9.2 mÅ. Photographic Kodak 101aG film was chosen as detector. It permitted fairly short exposure times of 2 s. The slit was always carefully placed across individual

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Ca II K bright points seen near the disc centre with the help of slit-jaw TV monitors. We recorded a spectral range from 5246.5 to 5251.5 Å, approximately. Twenty-one images were selected from the whole sample due to the excellent seeing conditions in which they were obtained, corresponding to 11 different quiet network points. The images were digitized with the PDS microdensitometer of the IAC using a square slit with a side of 25 μm (≈ 0.21; ≈ 4.08 mA). Subsequently, they were converted into intensities by using images of a step-wedge filter of known transmissions.

By averaging a clean continuum portion of some 245 mA of the whole spectral range, we obtained a continuum intensity measurement along the slit for all the 21 images (see Figure 1). Their quality, as far as the spatial resolution is concerned, is illustrated in Figure 2 where the mean power spectrum of the intensity fluctuations is shown. There, it is clear that power above the noise is present up to a frequency corresponding to 0.5 approximately. Thus, the diffraction-limited size is nearly reached (Wiehr and Kneer, 1988).

3. Data Handling and Results

3.1. Continuum contrasts and velocity fluctuations

We have found continuum intensity contrasts $(\Delta I/I)_{\text{r.m.s.}} \approx 0.05$ in all the images. The r.m.s. velocities are, typically, between 350 and 500 ms$^{-1}$. Velocities have been determined as the average position of the minima of four spectral lines (Fe I 5247.06 Å, Cr I