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The Photospheric Flow near the Flare Locations of Active Regions

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Extended abstract

The observation of the photospheric velocity field along with the magnetic field is very important for understanding the origin and evolution of these locations of active regions. Earlier measurements have shown a general down flow with velocities of 0.2 to 0.3 km s^{-1} in the active regions along with few locations of upflows. The localised upflows are observed in the light bridges and emerging flux regions with different speeds (Beckers & Schroter 1969). The flow patterns of flare locations in the active regions are observed by using the tower vector magnetograph (TVM) of Marshall Space Flight Centre. The line-center-magnetogram (LCM) technique has been employed to determine the active region velocities (Giovanelli & Ramsay 1971). The LCM is based on finding the wavelength in the line profile where two opposite circularly polarised Zeeman-split components change sign. If the material in the magnetic field of different locations have relative line of sight velocities, their cross-over wavelength will be seen to be Doppler shifted. In order to use the LCM with TVM, a series of Stoke-V images are made as a function of wavelength and their cross-over wavelength at each pixel is determined. We have observed 12 active regions between June 25th and August 25th, 1998. Three of these active regions (NOAA 8253, 8264 and 8307) show flare activity associated with the flux emergence and/or changes in magnetic shear during their disk passage. The images of a selected field of view in left and right circularly polarised Zeeman components in the wavelength range of 5250.12 to 5250.30 Å are obtained at 10 mÅ steps. The time taken for obtaining one set of observations is about 10-15 minutes. In this mode of operation, the start and end wavelengths are specified and the filter is tuned at desired wavelength steps. In one observing sequence, two sets of left and right circularly polarized images are produced as a function of wavelength. These sets of images are processed and merged following a certain procedure to produce a data cube. The most important requirement for the Doppler shift measurements is the repeatability of the wavelength steps. In the recent improvement, the filter tuning was achieved with accuracy better than 0.3 mÅ by using an optical encoder. However, it has been shown that insufficient spectral resolution would lead to spurious zero-crossing shift of asymmetric Stokes-V. This effect of spectral smearing in the case of observations with TVM and the present data analysis procedure has been estimated by simulation. The individual images are flat fielded and registered in order to remove the pixel sensitivity variation

over the field of view and image motion during the observations. The two Zeeman components are subtracted to obtain a set of difference images as a function of wavelength. These processed images are merged to make Stokes-V data cubes, with two spatial and one-wavelength dimensions. The integrated Stokes-V profiles are obtained by averaging the profiles of the pixels with magnetic field values higher than a certain cut-off value depending on the noise level in each data set. These Stokes-V profiles are fitted with a synthetic profile by using the multidimensional minimization method (Debi Prasad 2000). The results obtained are listed below.

- The relative "zero-crossing" velocity between the leading and following polarity of large active regions showing the chromospheric and coronal activity are found to be ~ 70–770 km s^{-1}. The small and inactive regions show negligible Doppler velocity.
- The velocities between different sub-areas joined with the coronal loop structures vary widely. It is clearly evident in the case of NOAA 8293 that out of two following polarity spots, the velocity associated with one of them was higher. The velocities of parasitic polarities with respect to the dominant magnetic feature of same polarity are higher and blue shifted. In case of active regions NOAA 8253 and 8307, these locations were associated with high magnetic shear. Although, their counterpart on NOAA 8264 did not show magnetic shear, it displayed recurrent chromospheric activity.

References

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