Spectropolarimetric inversions of the Ca 8542 and Fe I 6173 Å lines in a M-class solar flare

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Abstract

We study the M1.9 class solar flare SOL2015-09-27T10:40 UT using high-resolution spectropolarimetric observations in the Fe I 6173 and Ca II 8542 Å lines obtained with the CRISP imaging spectropolarimeter on the Swedish 1-m Solar Telescope. Spectropolarimetric inversions of these lines using the non-LTE code NICOLE are used to construct semiempirical models of the lower flaring atmosphere to investigate the evolution of the temperature and velocity structure as well as that of the photospheric and chromospheric magnetic field of the flare. Due to the integrating nature of radiative transfer, the usage of two lines sampling distinct but slightly overlapping height regions provides a much better constraint on the atmospheric parameters along with the increase in sampled range. A comparison of the temperature stratification in flaring and non-flaring areas reveals strong heating of the flare ribbon during the flare peak in the chromosphere. Analyses shows that the polarization signals of the ribbon in the chromosphere during the flare maximum become stronger when compared to its surroundings. The latter effect serendipitously allows measurements of the line-of-sight magnetic field in the flaring chromosphere. The magnetic field strength in the photosphere is unchanged during the flare.