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LINE PROFILES AND MAGNETIC FIELDS IN MASSIVE STARS

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Our aim is to analyze the influence of a magnetic field on the atmospheric structure of early B type stars. We study the behavior of the shape and intensity of He I line profiles, as well as of their equivalent widths, for different intensities of the magnetic field. We also analyze variations of the visual absolute magnitude, M_v, and color indexes, $B-V$ and $U-B$, with the magnetic field strength.

In our models we assume a H-He plane-parallel atmosphere in local thermodynamic equilibrium (LTE). We basically use the atmospheric code developed by Rohrmann (2001) and Rohrmann et al. (2002). We consider a B2V star with $T_{\rm eff} = 22\,000K$, $\log g = 4.0$, 5.6 $R_\odot$ and $\rho_{\rm He}/\rho_{\rm tot} = 0.30$. The magnetic field structure is assumed to be a central slightly distorted dipole. This magnetic configuration leads to significant surface Lorentz force (LeBlanc et al. 1994). The presence of an inward or outward directed Lorentz force is included in the hydrostatic equilibrium equation as an effective gravity term that depends on the optical depth (Valyavin et al. 2004). The Lorentz force varies with the latitude angle (θ), being maximum at the star magnetic equator, for $\theta = \pi/2$, and null at the magnetic pole, for $\theta = 0$. This last case behaves as a non-magnetic model.

We compute synthetic He I line profiles for different magnetic intensities, between 0 and 50 000 Gauss. We found that the maximum variation in the intensity and shape of the line profiles happens for magnetic field strengths between 200 and 1 000 Gauss. The line equivalent width depends on the intensity of the magnetic field and the direction of the Lorentz force. Figure 1 (top) illustrates this result for He I λ4471. When the Lorentz force is outward-directed (inward-directed) the equivalent width is smaller (larger) than the one corresponding to the non-magnetic case. A completely opposite behavior is found in the case of He I λ4921 line (Figure 1, bottom).

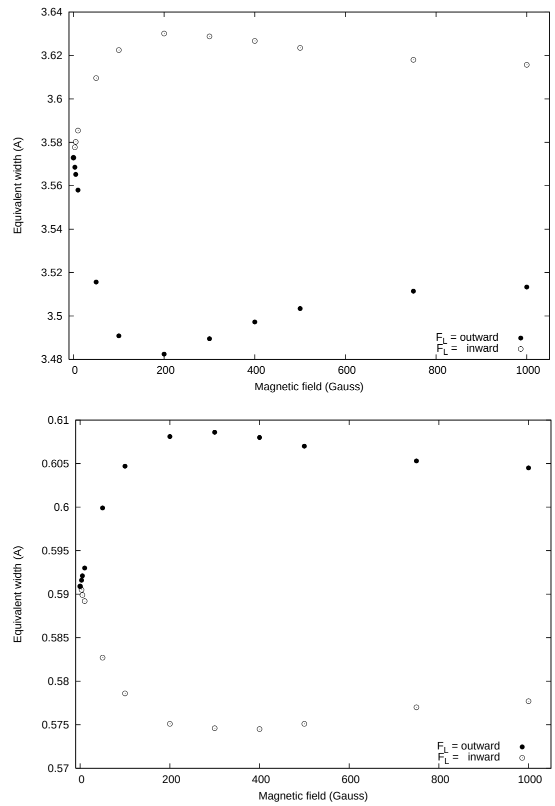

Fig. 1. Equivalent widths of He I λ4471 (top) and He I λ4921 (bottom) as function of the intensity of the magnetic field and of the direction of the Lorentz force.

The variations found in the visual absolute magnitude and color indexes as a function of the magnetic field intensity are very small, being larger for the case of an outward-directed Lorentz force. This result is in agreement with theoretical predictions done by Stępień (1978).

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