LINE PROFILES IN EXPANDING ATMOSPHERES

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1. Introduction

The analysis of the UV resonance transitions of superionized species observed in early-type stars suggests the presence of a high temperature region and an outward flow of matter (Snow & Marlborough 1976).

With the aim of contributing to the knowledge of the atmospheric structure in Be stars we computed line profiles of Mg II and C IV assuming the existence of a chromosphere in an expanding medium with spherical symmetry. In particular, we select the atmospheric models that were previously used for the computation of the Hα line profiles (Cidale & Ringuelet 1993).

2. The Atmospheric Model

Taking into account the different ionization degrees and Doppler shifts observed in the spectrum of Be stars, we assume the existence of a sequence of spherically symmetric layers with different thermodynamical and kinematical properties; that is, *i*) a classical photosphere in radiative and hydrostatic equilibrium, *ii*) an expanding high temperature region with $T > T_{\rm eff}$ (the chromosphere), and *iii*) a cool envelope with $T < 10^4$ K.

For the construction of the atmospheric model we follow, basically, the model adopted by Catala & Kunasz (1987). The velocity law increases monotonically with radius throughout the extended atmosphere until it reaches a constant value. We try with different velocity curves considering high and low velocity gradients at the base of the chromosphere (see figure 1A).

3. Results

Once the atmospheric model and the velocity field have been selected, the radiative transfer equation is treated for a spherically symmetric medium applying the comoving-frame method (Mihalas & Kunasz 1978). The statistical equilibrium equations are solved, simultaneously, for a Mg II atomic model consisting of 14 energy levels plus continuum. The solution is obtained by means of the equivalent two-level atom approach (ETLA).

We compute Mg II resonance lines for a wide range of effective temperature. Since the results related to the velocity law are valid for all spectral types, we present results corresponding to a late Be-type star ($T_{\rm eff}$ = 14000

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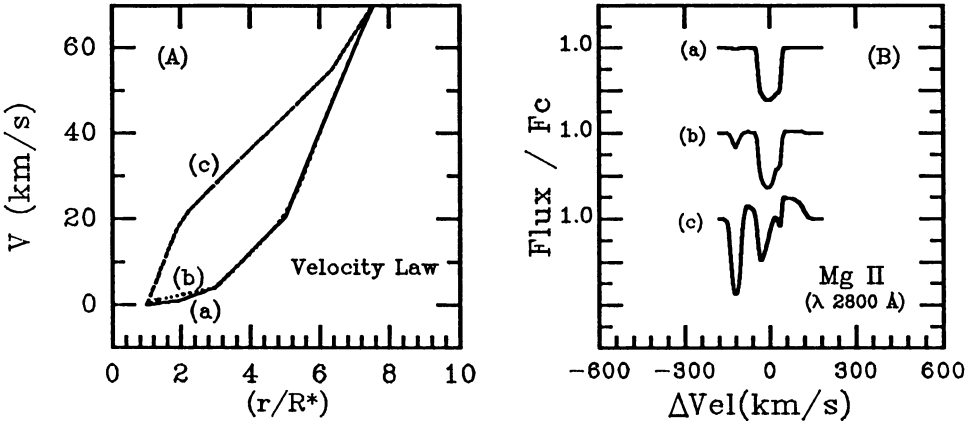

Fig. 1. A) Different velocity laws, B) A sequence of Mg II profiles computed with the velocity laws shown in figure 1A

K) obtained with different velocity laws (cases a, b, c). We observe that, 1) The shape of the resonance line profiles (multiplet *UV* 1) depend on the velocity gradients in the region next to the photosphere. Low-velocity gradients, at the base of the wind, yield a single absorption line profile; however, high velocity gradients in the same layers predict multiple components (either in absorption or in emission) as the ones showed in figure 1B. The blue shifted absorption component, when it appears, may give information about the velocity field in the most outer layers of the atmosphere. 2) In all our models multiplet *UV* 3, as well as $\lambda 4481$, appear in absorption and they are not sensitive to the radial velocity distribution. These lines present, mainly, a photospheric line-forming region. 3) Mg II lines depend slightly on the chromospheric temperature law.

Finally, we compute P Cyg profiles of C IV considering a two-level atom and a continuum. We observe that increasing the distance of the temperature maximum the emission component becomes stronger while the absorption component shifts to the blue.

All our results are consistent with observations and with the previously computed Hα profiles.

References

Catala, C., and Kunasz, P. B.: 1987, *A&A* **174**, 158
Cidale, L. S., and Ringuelet, A. E.: 1993, *ApJ* **411**, 874
Mihalas, D., and Kunasz, P. B.: 1978, *ApJ* **219**, 635
Snow, T. P., and Marlborough, J. M.: 1976, *ApJ* **203**, L87

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