ANALYSIS OF LBV CIRCUMSTELLAR ENVELOPES USING FeII LINES

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Emission and absorption lines of FeII frequently dominate the optical and UV spectra of LBVs. Many luminous blue stars possess a rich optical FeII emission line spectrum, which can be used as diagnostic of their extended atmospheres (Viotti 1976a). Since the launch of IUE several LBVs were observed in UV, and in many cases (η Car, AG Car, P Cyg, Hubble Sandage variables, etc.) their spectra were found dominated by a large amount of FeII absorptions, presumably formed in cooler envelopes. Often these absorptions are so strong as to seriously affect the UV energy distribution. In order to study line formation outside LTE of such a complex ion, the FeII line intensities in luminous stars were analyzed using the Self Absorption Curve (SAC) method by Friedjung and Muratorio (1987). The fitting of the emission line fluxes in different multiplets to theoretical SACs obtained with different wind models, leads to the determination of the relative upper and also relative lower level populations. The overlapping of the individual multiplet curves gives the observational SAC which provides an estimate of the wind parameters (column density, acceleration parameter a, mass loss rate). This method of analysis was applied to the optical and UV high resolution spectra of several luminous stars. For instance we found that in AG Car the relative population of the FeII levels from 1.6 to 8.6 eV can be fitted to the same Boltzmann distribution with an excitation temperature of Tex=7200+/-350K, whereas for the VV Cep star KQ Pup the linearity extends from 0 to about 9 eV with Tex=6700 K (Viotti et al. 1988).

The results of the analysis were used to compute the theoretical UV spectra of hot stars with cool (=FeII) envelopes to be compared with low resolution UV observations of LBVs. To evaluate the effects of different stellar and wind parameters on the FeII absorption/emission, we have computed synthetic spectra in the range T*=10000 to 20000 K, and Mbol=-8 to -10. An example is given in Fig.1. We found that the energy distribution is strongly affected by the FeII transitions which are crowded in

K. Davidson et al. (eds.), Physics of Luminous Blue Variables, 281–282.

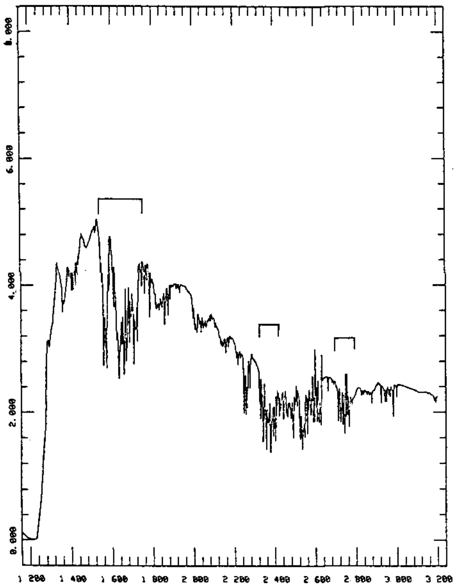

Fig.1. Synthetic spectrum of a hot star with a cool envelope. The selected FeII regions are indicated.

some characteristic broad regions (e.g. Viotti 1976b). This fact not only makes the identification of FeII in the low res spectra of faint objects easier, but also might allow a determination of the mass loss M. To study this problem we derived for each model the FeII line absorption/emission in 3 ranges (Fig.1): 1540-1750A, 2330-2420A, and 2700-2800A. Some results for a characteristic wind velocity V of 300 km/s and for different values of Mbol, M and a are shown in Fig.2. We note that an increase of M produces an increase of the line blocking in the far-UV, while in the near-UV the absorption is filled-in by the prominent emission, especially from multiplets 62 and 63. The dependence on Mbol is less important, whereas in an accelerated wind (a=2.5) the near-UV line emission is smaller (Fig.2). These results indicate that the FeII UV features can be used as mass loss indicators of LBVs of intermediate temperature.

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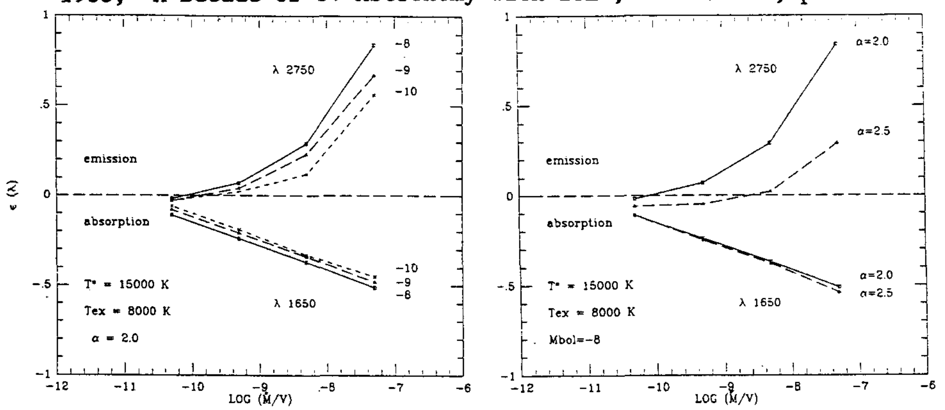

Fig.2. FeII line blocking/emission in the UV.