ON THE INTERPRETATION OF EMISSION WINGS OF BALMER LINES IN LBV'S

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The optical spectra of Luminous Blue Variables (LBV's) are characterized by strong Balmer emission lines. In many cases, the narrow emission component (FWHM $\lesssim$ 300 km/sec) shows extended emission wings reaching up to ~1000 km/sec. These wings are generally attributed to electron scattering of line photons in the dense stellar wind (Bernat and Lambert 1978). In this paper we discuss an alternative mechanism which may partly contribute to the observed line wings.

Our computations are based on the model-atmosphere program TLUSTY (Hubeny 1988). These plane-parallel NLTE atmospheres assume hydrostatic and radiative equilibrium and include H and He only. For T_{eff} = 15,000 K (a typical value for LBV's), the lowest gravity, for which a stable model exists is log g = 1.65. We emphasize that we neglect the influence of sphericity but the effect discussed here originates in deep layers, where sphericity is very likely negligible.

The run of temperature vs. mass density shows the well-known NLTE behavior. The temperature assumes a minimum value around log m $\approx$ -1 and increases further out due to increased heating in the Balmer continuum. The location of the temperature minimum is sensitive to log g; the lower log g, the deeper the temperature minimum is shifted in the atmosphere. This behavior can be understood in terms of the lower gas pressure at a given log m resulting from lower gravity. A lower pressure is associated with lower number densities and thus lower opacity so that optical depth unity in the relevant transitions occurs at smaller column density. Abbott and Hummer (1985) discussed the analogous effect for O stars.

Figure 1 shows the resulting H_α profiles of the three NLTE models with log g = 2.5, 2.0, 1.65, and for comparison, of a log g = 1.65 LTE model. The lowest log g NLTE model shows pronounced emission wings extending a few hundred km/sec to each side of the line center. They are due to an NLTE coupling of the Balmer continuum and the Balmer lines. The wings are formed at the region of the temperature minimum where $S_\nu(H\alpha) > B_\nu$. We have $S_\nu(H\alpha) > B_\nu$ since the n = 2 level of hydrogen is depopulated relative to LTE by photoionizations in the Balmer continuum. The rate of photoionizations is higher deeper in

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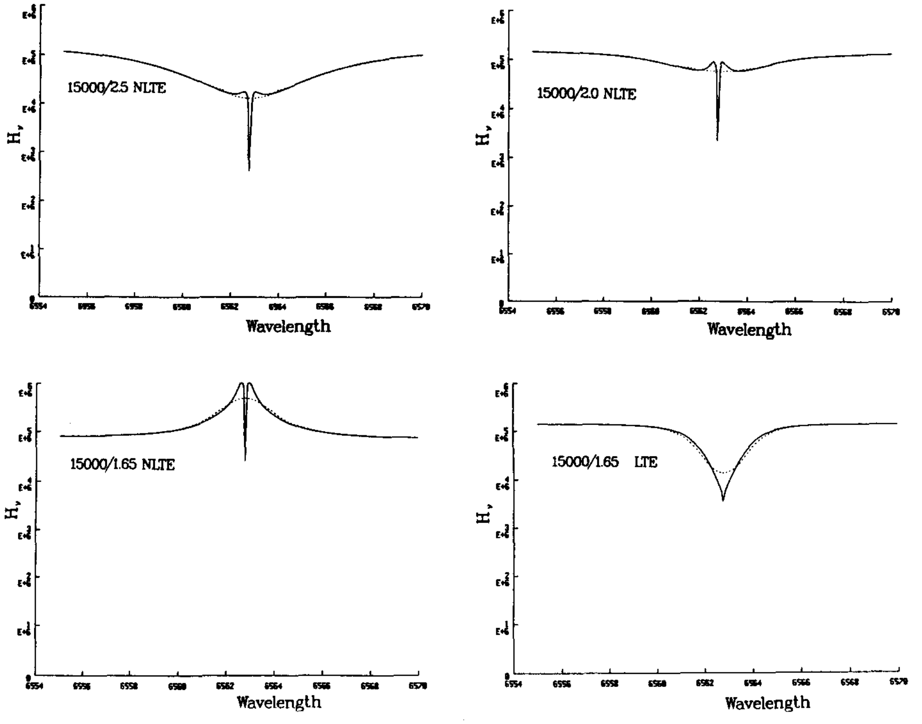

Fig. 1 NLTE H_α profiles for different values of log g. For comparison, the corresponding LTE profile is also shown. The dashed lines are rotationally broadened profiles with vsin i = 50 km/sec.

the atmosphere so that this effect is more pronounced if the wings are formed deeper in the atmosphere, i.e., if log g is lower.

The emission wings in H_α produced by a hydrostatic, plane-parallel, low-gravity NLTE atmosphere are in qualitative agreement with the observations although they are still weaker. For even lower log g values (which are derived in LBV's), however, the emission wings can be expected to strengthen considerably. In realistic models (including the photosphere and the stellar wind), the traditional electron-scattering mechanism and the effect discussed here will operate. A determination of wind properties assuming the wings are purely due to electron scattering may therefore be misleading.

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