NON-THERMAL VELOCITIES IN THE STELLAR WIND OF EARLY-TYPE STARS

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Abstract. Turbulence is known to be important in the stellar wind of early-type stars. We explore the influence of turbulence that depends on the distance to the star.

1. Introduction

The P-Cygni profiles seen in UV resonance lines are due to the presence of a stellar wind. The SEI (Sobolev with Exact Integration) method as developed by Lamers et al. (1987) provides a semi-empirical model for fitting these profiles. Contrary to the more classical Sobolev approach, this method takes into account the intrinsic broadening of the spectral line (due to thermal and turbulent velocities).

Groenewegen and Lamers (1989) found that a best fit could only be obtained by assuming a large intrinsic broadening, of the order of 100-300 km/s, which they called "turbulence". It is suspected that this "turbulence" is somehow related to the instabilities found in the time-dependent models of stellar winds (Owocki et al., 1988).

In their work Groenewegen and Lamers assumed a "turbulence" that was constant in the wind. We investigated the effect of a "turbulence" that varies with distance to see whether a better fit could be obtained. Knowledge of the radial dependence of this "turbulence" could put constraints on the ab-initio calculations of the time-dependent radiatively driven wind. In our exploratory study we specifically tried the following law for the turbulent velocity: $v_{turb}/v_\infty = 0.01 + 0.09(v(r)/v_\infty)^3$ and applied it to ζ Pup.

2. Results and Conclusions

Fig. 1 shows the best fit we obtained with this variable turbulence law compared to a constant law ($v_{turb}/v_\infty = 0.1$) for a saturated profile (C IV). Fig. 2 shows a similar comparison for an unsaturated profile (N IV). The turbulence law we studied does not result in an obvious improvement over the constant turbulence. It should be stressed however that in future we shall explore the large parameterspace possible with these variable turbulence

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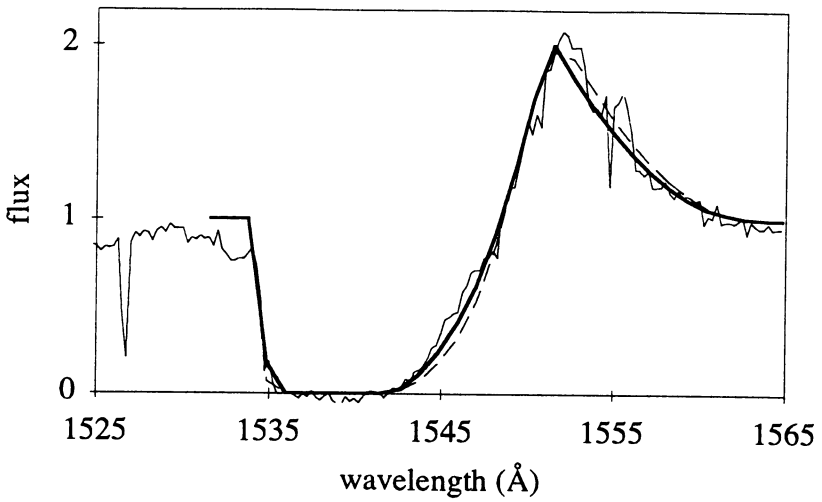

Fig. 1. The variable turbulence (full line) compared to the constant turbulence (dashed line) for C IV. The observed profile is also shown

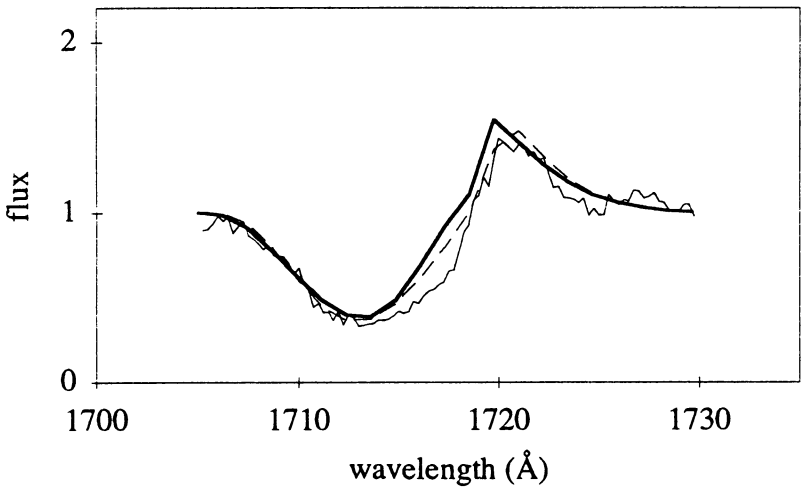

Fig. 2. The same as Fig. 1 but for N IV

laws and that in some cases we might find an improvement over constant turbulence.

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