Contrib. Astron. Obs. Skalnaté Pleso **38**, 425 – 426, (2008)

Multicomponent stellar winds of B stars

J. Krtička[1], J. Kubát[2] and V. Votruba[2,1]

[1] *Ústav teoretické fyziky a astrofyziky, Přírodovědecká fakulta Masarykovy univerzity, CZ-611 37 Brno, Czech Republic*

[2] *Astronomický ústav, Akademie věd České republiky, CZ-251 65 Ondřejov, Czech Republic*

Received: November 22, 2007; Accepted: November 30, 2007

Abstract. We study multicomponent effects in the stellar winds of B type stars. For stars with highest mass-loss rates the usual one-component approach is sufficient. For stars with weaker winds multicomponent effects become important. For even less dense winds hydrogen and helium fall back on the stellar surface or even a pure metallic wind is possible.

Key words: stars: winds, outflows – stars: early-type – hydrodynamics

The stellar wind of hot stars has a multicomponent nature. The wind is accelerated mainly due to the line transitions of heavier elements (Fe, C, N, O, e.g., Krtička, 2006). The received momentum is transferred via Coulomb collisions to the dominant wind component, i.e. hydrogen and helium. The multicomponent wind nature may influence the wind structure. The wind temperature can be affected by frictional heating or the wind components may become dynamically independent, i.e. the components can decouple. There are several types of multicomponent stellar wind (Fig. 1, Babel, 1996):

Winds with negligible multicomponent effects. Stars with large luminosities have dense wind for which the relative velocity differences between wind components are small, i.e. for these stars the multicomponent effects can be neglected. Consequently, the stellar winds of OB supergiants, O giants and most of O main sequence stars can be adequatelly modelled as one-component.

Winds with frictional heating. Stars with lower luminosities (i.e., late O and early B main sequence stars) have less dense winds. For these winds frictional heating may be important (Krtička; Kubát 2002 and references therein), either due to phosphorus (for late O stars) or due to other elements (e.g., nitrogen, Krtička, 2006).

Winds with the decoupling of wind components For later B-type stars the wind components may decouple (Babel, 1996; Votruba, 2007). If the decoupling occurs for velocities lower than the escape velocity, then the hydrogen component may fall back on the star.

The helium decoupling was proposed by Hunger and Groote (1999) as an explanation of helium overabundant regions on the surface of helium-rich stars.

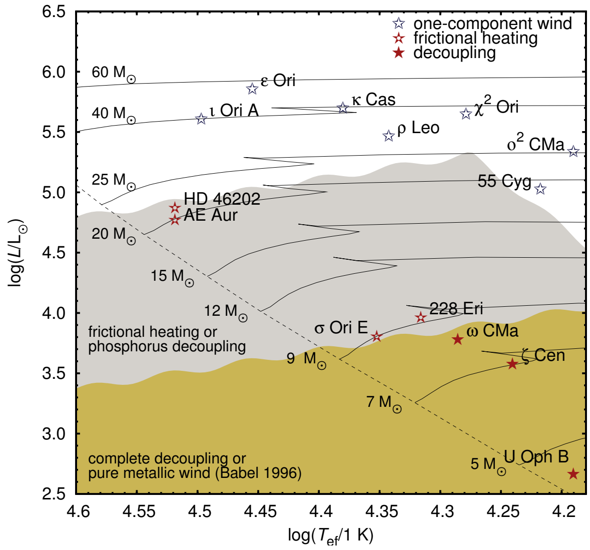

Figure 1. The regions of different types of a multicomponent stellar wind on the HR diagram. The position of selected stars is denoted in the graph. Overplotted are the evolutionary tracks of Schaller *et al.* (1992).

However, Krtička *et al.* (2006) showed that helium decoupling in the wind is unlikely, due to helium coupling with hydrogen.

The wind phosphorus decoupling may occur also for some late main-sequence O stars. This effect likely does not significantly influence the wind dynamics.

Pure metallic wind. For stars with lowest metallicities a purely metallic wind may exist only, which was studied in detail by Babel (1996).

Acknowledgements. This work was partly supported by grants GAČR 205/07/0031 and GA AV ČR B301630501.

References

Babel, J.: 1996, *Astron. Astrophys.* **309**, 867
Hunger, K., Groote, D.: 1999, *Astron. Astrophys.* **351**, 554
Krtička, J.: 2006, *Mon. Not. R. Astron. Soc.* **367**, 1282
Krtička, J., Kubát, J.: 2002, *Astron. Astrophys.* **388**, 531
Krtička, J., Kubát, J., Groote, D.: 2006, *Astron. Astrophys.* **460**, 145
Schaller, G., Schaerer, D., Meynet, G., Maeder, A.: 1992, *Astron. Astrophys., Suppl. Ser.* **96**, 269
Votruba, V., Feldmeier, A., Kubát, J., Rätzel, D.: 2007, *Astron. Astrophys.* **474**, 549