DISCRETE COMPONENTS IN OB AND Be STARS: THE SHOCKING TRUTH?

Paul K. Barker
Astronomy Department
University of Western Ontario
London, Ontario N6A 3K7
Canada

Abstract. Preliminary calculations of the absorption profiles produced if multiple shells are ejected from the photosphere into a non-monotonic wind, suggest that this geometrical model can reproduce a wide variety of simple and complex profiles observed in the discrete components in OB and Be stars.

THE MODEL

A variety of observational and theoretical evidence suggests that the winds from luminous stars may contain shocks, and also that shells or parcels of material may be released into the wind, perhaps as a result of non-radial pulsation or the release of magnetic energy. In a simple geometrical fashion it is possible to calculate the observed profile resulting from the ejection of multiple shells into a stellar wind with non-monotonic velocity structure, provided one is interested only in the absorption produced by material in the line of sight column seen projected on the photosphere.

An ambient wind velocity law is adopted in the usual way, with superposed shock structure as shown for a typical example in Figure 1. At the photosphere, square wave density pulses of C IV are released into the wind. For each ejected shell, the given velocity law permits calculation of the mean radial velocity, velocity width, and column density as functions of distance above the photosphere. The method developed by Henrichs et al. (1983) to fit observed discrete absorption components is then inverted, to calculate the contribution from each shell to the model C IV λλ1548, 50 absorption profile. Convolution of all the model shell profiles produces the net observable discrete component profile.

The major free physical parameters include: the mean wind velocity power law; shock parameters such as the time interval in the flow between shocks, the time into the flow of the first shock, the fraction of time between shocks for which C IV is permitted to be visible, and the amplitude of the shocks as a function of radius; and the shell parameters of density, ejection period, and time between ejections.

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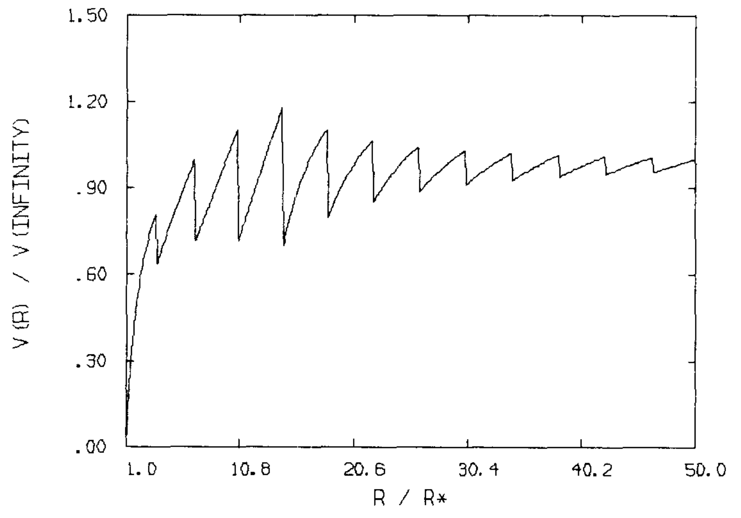
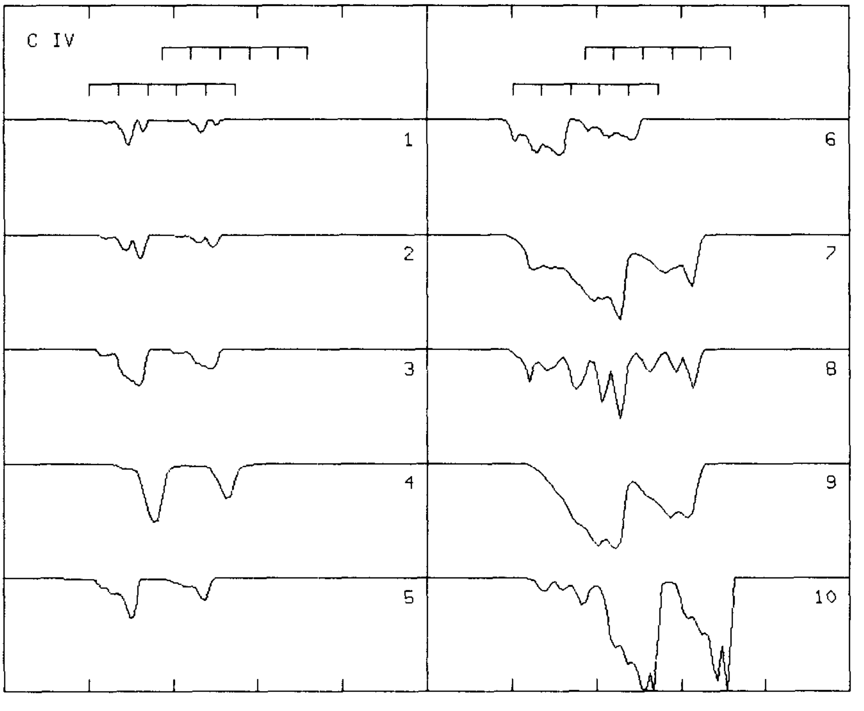


Figure 1. Top: Typical non-monotonic wind velocity law into which multiple shells are ejected. Bottom: Typical discrete component profiles produced by the model. Vertical tick marks at the top of each column show velocities from 0 to 1000 km/s in increments of 200 km/s.



Typical model profiles are shown in Figure 1. Profiles 1 and 2 are identical to those seen in ζ Pup (Prinja 1984) while profiles 3 to 10 reproduce essentially all of the complex forms seen in 66 Oph and other Be stars (Barker & Marlborough 1985). Thus, even preliminary exploration of parameter space indicates that the model does have the interesting property of reproducing many, if not all, features of observed discrete components.

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REFERENCES

Barker, P.K., & Marlborough, J.M. (1985). Ap. J., 288, 329.
Henrichs, H.F., Hammerschlag-Hensberge, G., Howarth, I.D., & Barr, P. (1983). Ap. J., 268, 807.
Prinja, R.K. (1984). M.N.R.A.S., 207, 157.

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