LONG-TERM PERIODIC VARIABILITY IN UV ABSORPTION LINES OF THE Be STAR γ Cas: ON THE RELATION WITH V/R VARIATIONS IN THE Hβ LINE

JOHN H. TELTING and LEX KAPER
Astronomical Institute Anton Pannekoek and Center for High Energy Astrophysics, University of Amsterdam, Kruislaan 403, 1098 SJ Amsterdam, Netherlands

Abstract. We present a quantitative study of the variability in ultraviolet resonance lines of N V, Si IV and C IV of the Be star γ Cas, following up on the work of Henrichs et al. (1983). For this purpose we used 133 IUE spectra obtained over a period of eleven years. Variability occurs in the form of discrete absorption components (DACs), which are formed in the fast-outflowing radiatively driven part of the stellar wind. We constructed a template spectrum from spectra containing no or minor extra absorption due to DACs and modelled the isolated DACs in the obtained quotient spectra. Besides the frequently observed narrow components (v_t typically $\leq$ 250 km/s) at high velocity, we found several broad components occurring at low and intermediate wind velocities.

We confirm the finding of Doazan et al. (1987) who reported that the number of observed DACs is associated with the cyclic V/R variability of the Balmer-emission lines. This V/R variability most probably originates in the slowly outflowing high-density equatorial disc-like wind of the star (see e.g. Telting et al. 1993 for the case of γ Cas). We show that when V/R<1 the central optical depth of DACs is significantly lower than when V/R>1. In our interpretation this is due to a correlation between the column density associated with the DACs and the phase of the V/R cycle.

We find that the Hβ observations of Doazan et al. are consistent with a model in which the cyclic V/R variability is due to a global, one-armed oscillation moving through an equatorial disc (Okazaki 1991, Papaloizou et al. 1992, Savonije and Heemskerk 1993). We suggest that the higher column density of DACs in phases of V/R>1 is the result of the higher density in the region of their origin, namely close to or in the part of the equatorial disc which is rotating towards the observer.

For a thorough description of the analysis and our results we refer to our article Telting and Kaper (1994) which is currently in press for publication in A&A main journal. In Fig. 1 we present a concise version of the discussion of that article.

References

Doazan, V., et al.: 1987, Astronomy and Astrophysics 182, L25
Henrichs, H.F., et al.: 1983, Astrophysical Journal 268, 807
Okazaki, A.T.: 1991, Publications of the ASJ 43, 75
Papaloizou, J.C., et al.: 1992, Astronomy and Astrophysics 265, L45
Savonije, G.J., Heemskerk, M.H.M.: 1993, Astronomy and Astrophysics 276, 409
Telting, J.H., et al.: 1993, Astronomy and Astrophysics 270, 355
Telting, J.H., Kaper, L: 1994, Astronomy and Astrophysics 284, 515

L. A. Balona et al. (eds.), Pulsation, Rotation and Mass Loss in Early-Type Stars, 376–377.

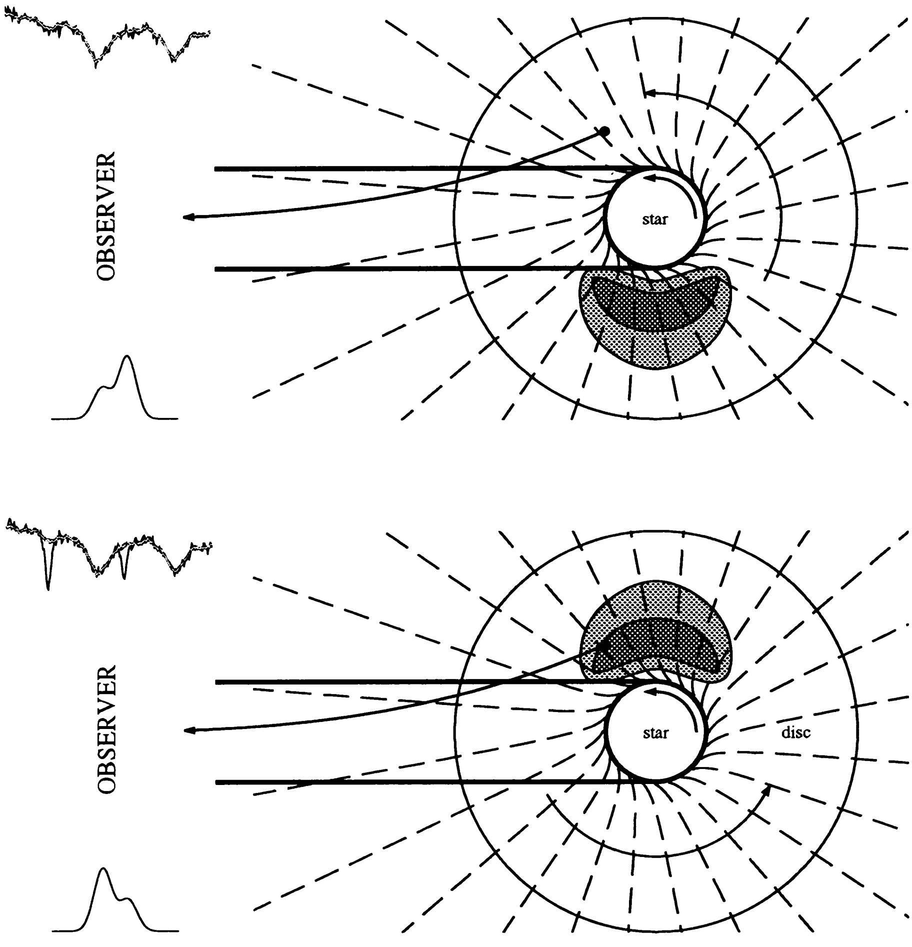

Fig. 1. Schematic model for V/R variations and DACs in spectra of γ Cas. We show a projection of the equatorial and polar winds onto the equatorial plane. The grey areas in the disc represent the high-density part of a one-armed oscillation of the disc (Okazaki 1991, Papaloizou et al. 1992, Savonije and Heemskerk 1993). This high-density part revolves around the star on the time scale of the V/R variations of the Balmer lines. The dashed lines are trajectories of individual free stellar wind particles, based on a beta law for the radial velocity (i.e. the polar wind). The solid curve represents the path of a density enhancement of the polar wind, as is suggested by comparison of V/R variations and DAC variability. The structure starts off close to the star, near the equatorial plane, and gradually moves away from the star. Its trajectory will be ruled by the motions in the wind: outflow and rotation. Only for a particular azimuthal start-off position the structure ends up in the line of sight, where it can cause a DAC if its density is high enough. **Top)** The high-density part of the equatorial disc moves away from the observer; the emission lines have V<R. Structures of the fast polar wind that end up in the line of sight are formed near the low-density part of the equatorial disc: DACs are weak (or too weak to be detected). **Bottom)** The high-density part of the equatorial disc moves towards the observer; the emission lines have V>R. Now the structures of the polar wind travelling to the line of sight are formed near the high-density part of the equatorial disc: the observer finds numerous (strong) DACs