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Kinematical study of the wind-blown bubble NGC 6888

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Abstract. A detailed kinematical analysis of wind-blown bubble ring nebula NGC 6888 swept-up by the wind of the Wolf-Rayet star WR 136, combining high resolution echelle [OIII] spectra, high resolution *HST* imaging and high resolution ground base imaging, is presented. The kinematics is compared to new theoretical models for the dynamics of WR bubbles based on a three-winds scenario. The actual visible nebula is formed by the red supergiant wind swept-up by the fast WR wind. We conclude that the intringuing filamentary morphology, mainly formed by clumps, tails and ripples are explained by the actuation of Vishniac instabilities on the swept-up shell during the expansion of a red supergiant wind, as predicted by the gas dynamical simulations. The kinematics confirm that NGC 6888 is actually on a breakout process at the NW side, as derived from the blowouts. The blowouts are formed by shocked gas which is directly interacting with the cavity formed by the main sequence wind. The fact that these blowouts are bounded by shocks suggests that the cooling is efficient in a main sequence bubble during the evolution.

1. Introduction

NGC 6888 (S 105) is the most famous Wolf-Rayet ring nebula and associated with the star WR 136 (= HD 192163). Its proximity has made this nebula the common focus of multiple studies during the whole century. Esteban & Vilchez (1992) pointed out that the central star must have gone from a main sequence O-type star to a red supergiant phase before reaching the current WR phase. Inspired by these results, García-Segura & Mac Low (1995, GM) have modeled the structure of a WR bubble. To test the numerical results of GM, we have carry out detailed kinematic observations.

2. Kinematics

Figure 1 shows the slits located at PA = 134°, at the NW edge. Two blow-out structures are seen. Due to the projection effect, we can only measure a projected

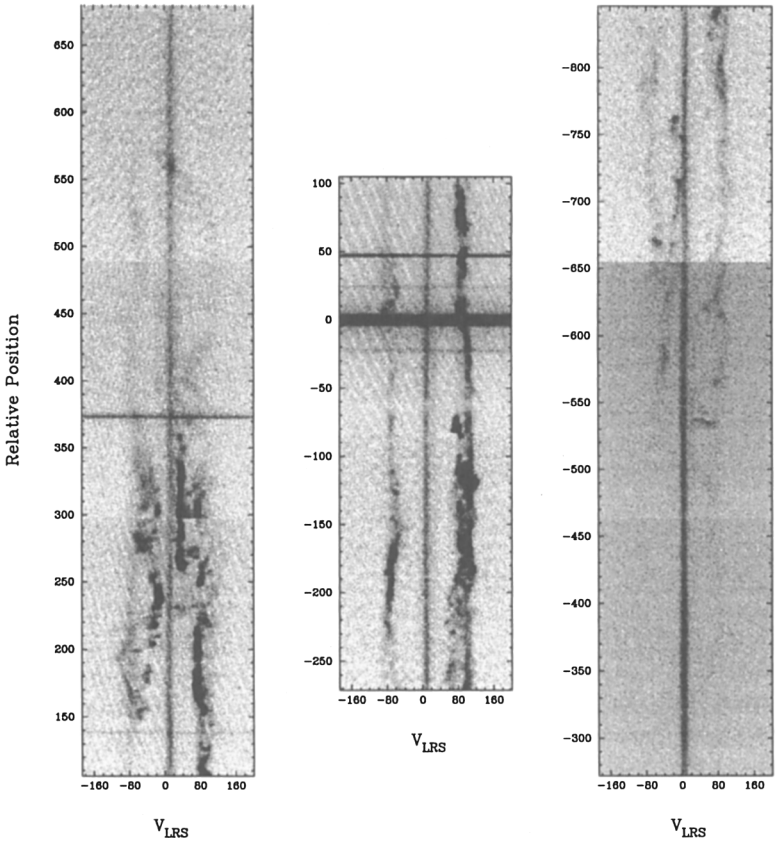

Figure 1. High resolution spectra of NGC 6888 in the line of [OIII] of the minor axis at PA = 314°.

velocity of 109 km s^{-1} for this blow-out. However the velocity at the head should be much higher. As we move East from the blow-out we reach the bright NW part of the nebula. There a complex clump structure is observed. Moving south from the central star, slower clumps are also seen. At the SE edge of the nebula, we see that the velocity does not reach the tangent.

References

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