UBVRI POLARIMETRY OF WR STARS

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Abstract. Five-colour polarimetry of a sample of twelve southern WR stars is presented. We suggest a method for separation the interstellar and intrinsic polarization components. Based on the observed data, a dependence of λ_{max} on the terminal velocity v_∞ is suggested. Its possible origin could be related to circumstellar envelopes.

Key words: stars: Wolf-Rayet – polarization

The existence of large number of free electrons in WR winds causes high intrinsic polarization over the stars' disks, but the net polarization can be observed only in asymmetric winds. Therefore polarization gives us a tool for studying the shape of the winds. The observed polarization is a vector sum of intrinsic and interstellar components, and their separation is not trivial. In this paper we present a method for separating intrinsic and interstellar polarization, and attempt to connect the properties of interstellar (circumstellar) polarization and the stars' physics. The existence of a correlation between them could be attributed to circumstellar shells.

We use the following properties of interstellar polarization to separate it from the observed polarization: (a) the wavelength dependence of the polarization follows from Serkowski's law (Serkowski *et al.* 1975); (b) the position angle of interstellar polarization should be constant in the case of the absence of circular polarization (Robert & Moffat 1989). This means that in the Q,U diagram the polarization vectors at different wavelengths are co-linear.

We observed twelve southern WR stars from 1991 May 21 to June 3 with the *UCT* photometer/polarimeter (Crowper 1985) at the 0.75m telescope of *SAAO*. For each star, we fitted all observations in all filters obtained in different nights with a straight line in the Q,U diagram. The angular coefficient gave us the interstellar component. Next, we fitted the projections of all observed Q and on this line with Serkowski's law, with parameters P_{max}, λ_{max}, and K. Then we calculated the interstellar component using these parameters. The analysis of the residual intrinsic polarization will be published elsewhere. The values of λ_{max} obtained for all stars are plotted against terminal velocity v_∞ (Fig. 1). All stars, except the WC9 stars WR69 and WR103, show a good correlation. The small number of stars does not allow to draw general conclusions, but we will try to speculate about the possible origin of this fact. The correlation coefficient for the remaining ten stars is 0.91. The probability that this value is due to a coincidence is 0.05%. Rejecting the null-hypothesis of a chance phenomenon we suggest a simple

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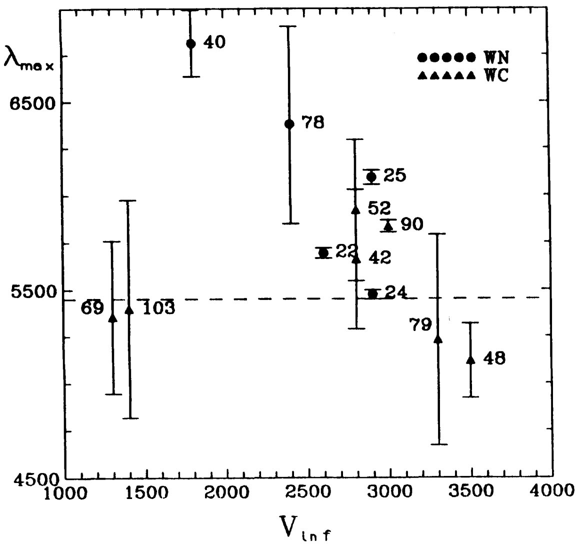

Fig. 1. The obtained values of λ_{max} plotted against v_{∞}. The dashed line shows the median value of λ_{max} (Serkowski *et al.* 1975).

explanation based on wind-circumstellar interaction. The large λ_{max} values are observed in WR stars, but not in their close neighbours (Serkowski *et al.* 1975). Therefore the correlation observed seems to be caused by circumstellar envelopes around WR stars. The scatterers are not electrons, because of the wavelength dependence of polarization. We can interpret the correlation in Fig. 1 as a result of different acceleration of these scatterers by the winds with different velocities. The faster winds evaporate larger scatterers and λ_{max} becomes small, but the slower ones coagulate them and λ_{max} becomes large. The distribution of the scatterer sizes depends on the wind velocity and produces the observed correlation. The WC9 stars WR69 and WR103 have the slowest winds, but also the most dens environments (according to the observed IR excesses). A high collision rate balances the coagulation and the scatterer size distribution remains unchanged. The number density of the scatterers (and therefore the degree of polarization and the observed IR excess) does not correlate with λ_{max}.

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