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Narrow-band photometry of the eclipsing WN7+O binary WR 22

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Abstract. In the present paper, we discuss photometric observations of the February 1996 eclipse of the very massive WR+O binary WR 22. Our data were obtained with a set of narrow-band filters, specially designed for the study of WR stars.

1. Introduction

The WN7+abs+O binary WR 22 ($P_{\rm orb} = 80.3$ d) displays a shallow eclipse around its periastron passage, when the WR star is in front of its companion (Balona *et al.* 1989; Gosset *et al.* 1991). Such an atmospheric eclipse results from the phase-dependent opacity along our sightline towards the O star and is a common feature among WR+O binaries with orbital periods shorter than 30 days (Lamontagne *et al.* 1996).

In the case of WR 22, as a result of the combination of the inclination of the orbit, of its eccentricity ($e \simeq 0.56$), and of the argument of the periastron ($\omega \simeq 272°$), only the secondary eclipse near periastron is present, whereas no occultation is observed near apastron (Gosset *et al.* 1991; Rauw *et al.* 1996).

2. Narrow-band photometry of WR 22

Photometric observations, through specially designed narrow-band filters, of the secondary eclipse of WR 22 were acquired during five nights in February 1996 (JD 2450125–129) at the Bochum 0.6 m telescope (La Silla, Chile) equipped with the DLR CCD camera using a Tektronix 1024×1024 chip (pixel size 23 μm). For a detailed description of the characteristics and performances of our set of narrow-band filters, see Royer *et al.* (1998). The data were reduced using the algorithm described by Manfroid (1993).

Given the incomplete phase-coverage of the eclipse by the narrow-band observations, we have fitted the data with the mean light-curve, as derived from a more extensive data set obtained in the Strömgren y filter, keeping the depth of the eclipse as the only free parameter (see Fig. 1). The Strömgren data set will be discussed and analysed in a forthcoming paper (Rauw *et al.* in preparation).

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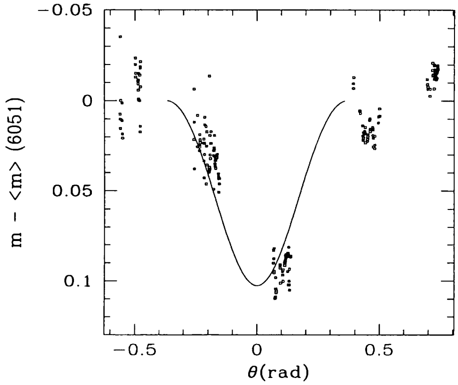

Figure 1. Light-curve of WR 22 as observed with a filter centered on 6051 Å. Differential magnitudes are shown as a function of $\theta = \psi - \frac{3\pi}{2} + \omega$ where ψ is the true anomaly and ω the argument of the periastron (orbital elements from Rauw *et al.* 1996).

As expected, the eclipse as observed with the filter centered on the He II λ 4686 emission line is shallower than with the continuum filters (centered on λ 5057 and λ 6051). The fitted depths are $\Delta\,\mathrm{m}(\lambda\,4686) = 0.062$, $\Delta\,\mathrm{m}(\lambda\,5057) = 0.112$ and $\Delta\,\mathrm{m}(\lambda\,6051) = 0.102$. The depths of the eclipse in the continuum filters provide upper limits on the luminosity ratio $\mathrm{L_{WR}/L_O}$ of 9.2 (λ 5057) and 10.1 (λ 6051). We have performed numerical simulations to quantify the contribution of the He II λ 4686 line to the integrated flux in the narrow filter as a function of the line's orbital Doppler shift. On the average, the emission line contributes for some 42% of the total flux and hence accounts for the depth difference of the eclipse as observed with the He II λ 4686 filter compared to the continuum filters. During the phase interval $\phi = 0.97 \rightarrow 0.03$, the radial velocity of the He II λ 4686 line increases from ~ 0 to $\sim +120\,\mathrm{km\,s^{-1}}$. Due to the Doppler shift of the line within the narrow filter passband, our simulations, accordingly, yield an apparent faintening by 0.007 magnitude during this phase interval, *i.e.*, too small an effect to be detected in our data given their accuracy and the intrinsic variability of the WN7+abs star. In contrast to most of the light-curves of eclipsing WR+O systems reported by Lamontagne *et al.* (1996), the light-curve of WR 22 displays a rather *narrow shape without prominent extended wings*, pointing towards a rather low mass-loss rate ($\log\dot{M} \leq -4.8$, Rauw 1997).

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