POLARIZATION IN WOLF-RAYET BINARIES: MONTE CARLO SIMULATIONS

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Abstract. We present some results on circumstellar envelopes using a Monte Carlo code we are developing. In contrast to analytical approaches, the effects of multiple scattering and the finite sizes of sources and envelope have been incorporated in the models. As an illustration, we fit the light-curve of V444 Cyg as well as the modulation of the linear polarization throughout its orbit.

Key words: stars: Wolf-Rayet – binaries – polarization – radiative transfer – circumstellar envelopes

1. Introduction

The scattering of light by electrons in the copious stellar wind of a Wolf-Rayet star is a source of polarization. A net linear polarization can hence arise if either the WR wind is asymmetric or the WR star is member of a binary system. The polarization will typically be time dependent and give information about the wind structure, while binary WR data can provide additional information, such as physical and geometrical parameters of the binary system.

2. The Monte Carlo method

The high number crunching capability of today's workstations has allowed the use of the Monte Carlo Method in an increasingly large number of astrophysical situations. The radiative transfer problem can be solved by simulating the optical path of a great number of photons, so that the statistical behavior of the ensemble is obtained. Non-trivial boundary conditions as well as complex physical mechanisms may be addressed, including multiple scattering.

3. An application: V444 Cyg

We have applied our code to the light-curve and linear polarization of V444 Cyg. It is an eclipsing WN5+O6 binary in a circular orbit. Our fit is shown in Fig. 1. The model parameters we obtain are consistent with those of Cherepashchuk *et al.* (1984) and St-Louis *et al.* (1993). We intend to further

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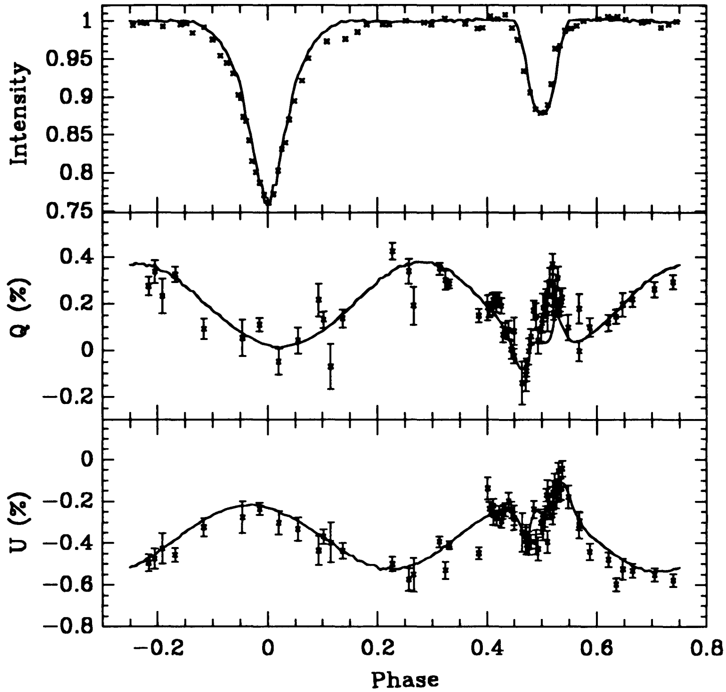

Fig. 1. Light-curve and linear Stokes parameters of the eclipsing binary V444 Cyg obtained from the simulation of electron scattering in the WR envelope. The data are from Kron & Gordon (1943) (light-curve) and St-Louis *et al.* 1993 (polarization). The full line is the model fit with: $R_{WR} = 4\ R_\odot$; $R_O = 10\ R_\odot$; the distance between components $a = 40\ R_\odot$; $L_{WR}/L_O = 0.18$; $n_e(R_{WR}) = 1.02 \times 10^{12}\ \mathrm{cm}^{-3}$, which implies $\dot{M} = 0.9 \times 10^{-5} M_\odot\ \mathrm{yr}^{-1}$.

develop our code in order to study wind inhomogeneities and the polarization of WR binaries with eccentric orbits.

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