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AXISYMMETRIC STELLAR WIND MODELS

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The effects of stellar rotation on the shape of a star are included in the radiation-driven wind theory in order to study their influence upon disk formation in Be stars. For this purpose, we consider a rotationally oblated star and obtain the line force parameters consistently with the hydrodynamic momentum equations. We discuss the influence of the rotation and the bi-stability mechanism in the formation of a two-component wind (fast wind in polar latitudes and slow wind in equatorial regions).

The equations that describe the rotating radiation-driven winds yield to the traditional m-CAK solution (Kudritzki et al. 1989). However Curé (2004) showed that the standard solution (hereafter 'fast solution') does not exist anymore when rotation velocity is higher than 70 % of the critical value, and that a new solution appears. This new solution corresponds to a slower and denser wind (hereafter, 'slow solution'). Combining the slow solution that describes the behaviour of the wind in the equatorial plane and the fast solution for the polar wind, an hybrid model with a two-component wind is obtained. In this scenario, Curé et al. (2005) investigated the disk formation in B[e] supergiants, obtaining values for the density contrast of about 100. However, they considered fixed values for the parameters of the radiation force, corresponding to temperatures above and below the bi-stability limit and a spherical central star.

In this work we obtain some expected values for the density contrasts between polar and equatorial regimes in the wind of rotationally deformed stars. The physical variables that contribute to the wind acceleration (temperature, density, local gravity, etc.) are strongly affected by the rotational flattening of the stellar photosphere, so we calculate consistently the radiation force and the hydrodynamics equations solution.

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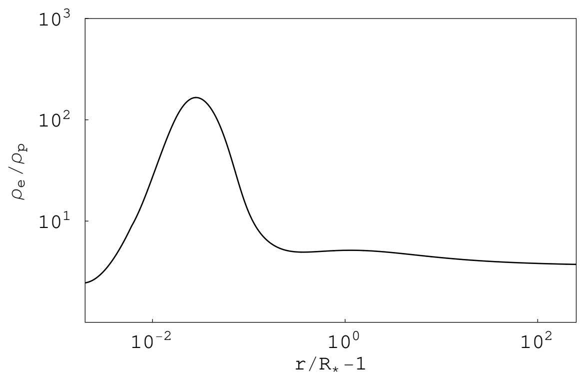

Fig. 1. Density contrast.

We compute the radiation force for a star with $T_{\rm eff}$ = 25000 K, $\log g = 3$ and $M/M_\odot = 10$. All possible transitions involving the first six ionization stages of the chemical elements from H to Ni are considered.

For $\omega = 0.9$, being ω the ratio between the equatorial and the critical rotational speed, the equatorial-to-polar radius ratio is $R_e/R_p = 1.2$, yielding a temperature difference of 5000 K from polar to equatorial regions. Considering this difference, we compute in an iterative way, the force multiplier parameters for the physical conditions of each region (temperature and velocity). Radiation fluxes are from Kurucz's models (1979).

The obtained values for the free parameters, α and K, that fit the computed force multiplier $M(t)$ (Abbott 1982), show in a straight way the presence of the bi-stability mechanism. Based upon these self-consistent fitting, we compute the corresponding density distributions. Figure 1 shows the density contrast, ρ_e/ρ_p. The formation of a circumstellar disk can be observed in the equatorial region close to the star ($r < 2\,R_*$), where the density is 100 times greater than in the pole. However, in the outer regions, this density contrast is ~ 10.

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