Hydrodynamic disk solutions for Be stars using HDUST

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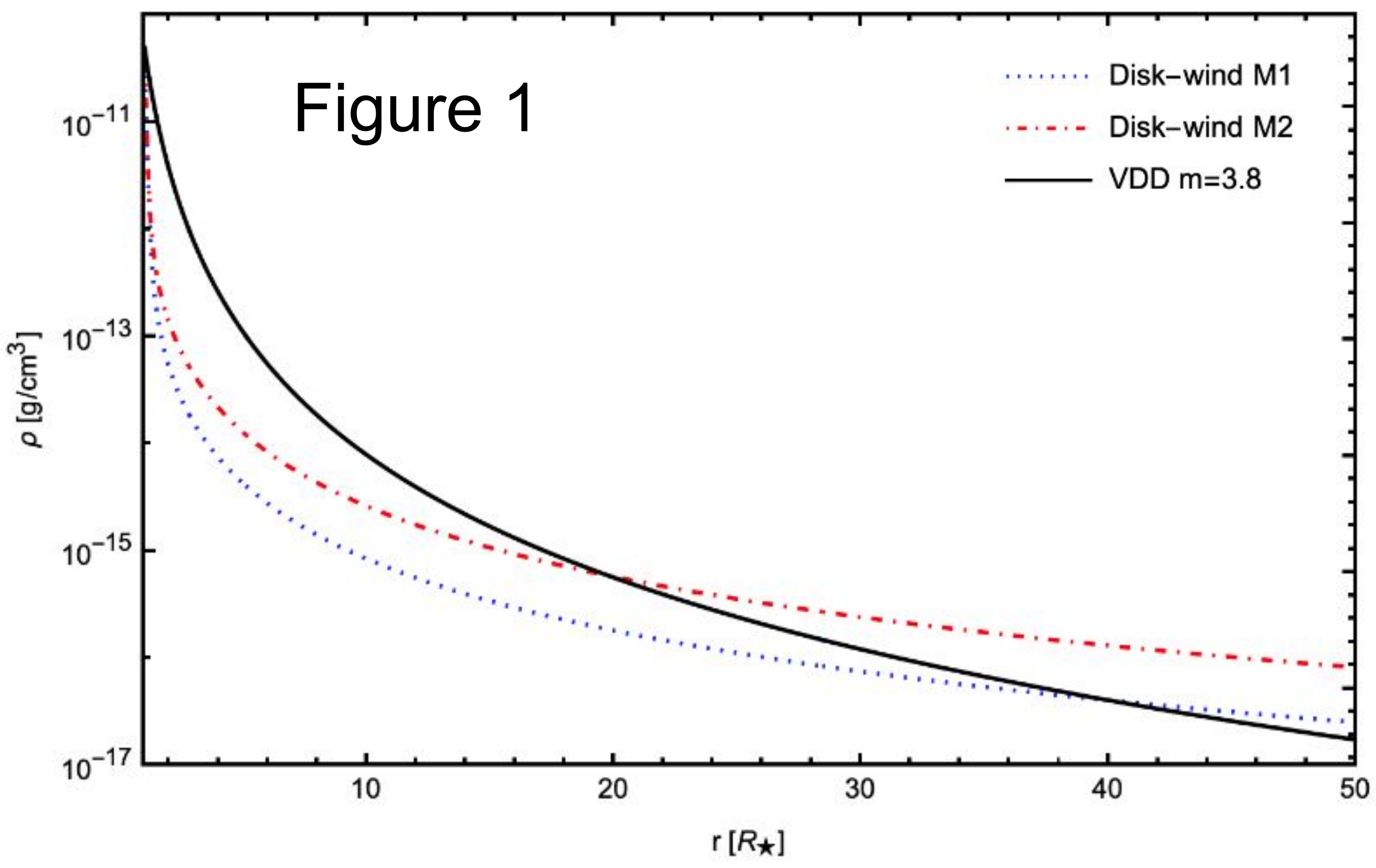
Context

We implemented a hydrodynamical solution for fast rotating stars, which leaves high values of mass-loss rates and low terminal velocities of the wind. This 1D density distribution adopts a viscosity mimicking parameter which simulates a quasi-Keplerian motion. Then, it is converted to a volumetric density considering vertical hydrostatic equilibrium using a power-law scale height, as usual in Viscous Decretion Disk (VDD) models. Here, we compare the theoretical Hα line profiles computed with the code HDUST. Our disk-wind structures are in agreement with VDD models.

I. VDD model

The parametric model for the volumetric density, ρ_0, distribution in the disk depends on the radial distance from the star, r, and the height, H, above the equatorial plane, z, and has the form:

$$\rho(R,Z) = \rho_0 \left(\frac{R}{R_\star}\right)^{-n} \exp\left(-(Z/H)^2\right)$$



II. Ω-slow solution

It is characterized by a slow wind with high mass-loss rates (Curé 2004). However, it assumes angular momentum conservation and its terminal velocity is too fast to explain the Be disks (which are quasi-Keplerian motion). Therefore, we implemented a radiative force that increases near the stellar surface and after particular distance decay in terms of the r coordinate. This was made with an ensemble of optically-thin lines (Chen et al. 1994) and implementing a mimicking viscosity parameter γ_{vis} in the azimuthal velocity Vϕ of the wind (de Araujo et al. 1995). This last, with the aim to get a usual VDD.

$$V_\phi = \Omega \sqrt{\frac{GM(1-\Gamma)}{R}} \left(\frac{R}{r}\right)^{\gamma_{vis} \geq 0.5}$$

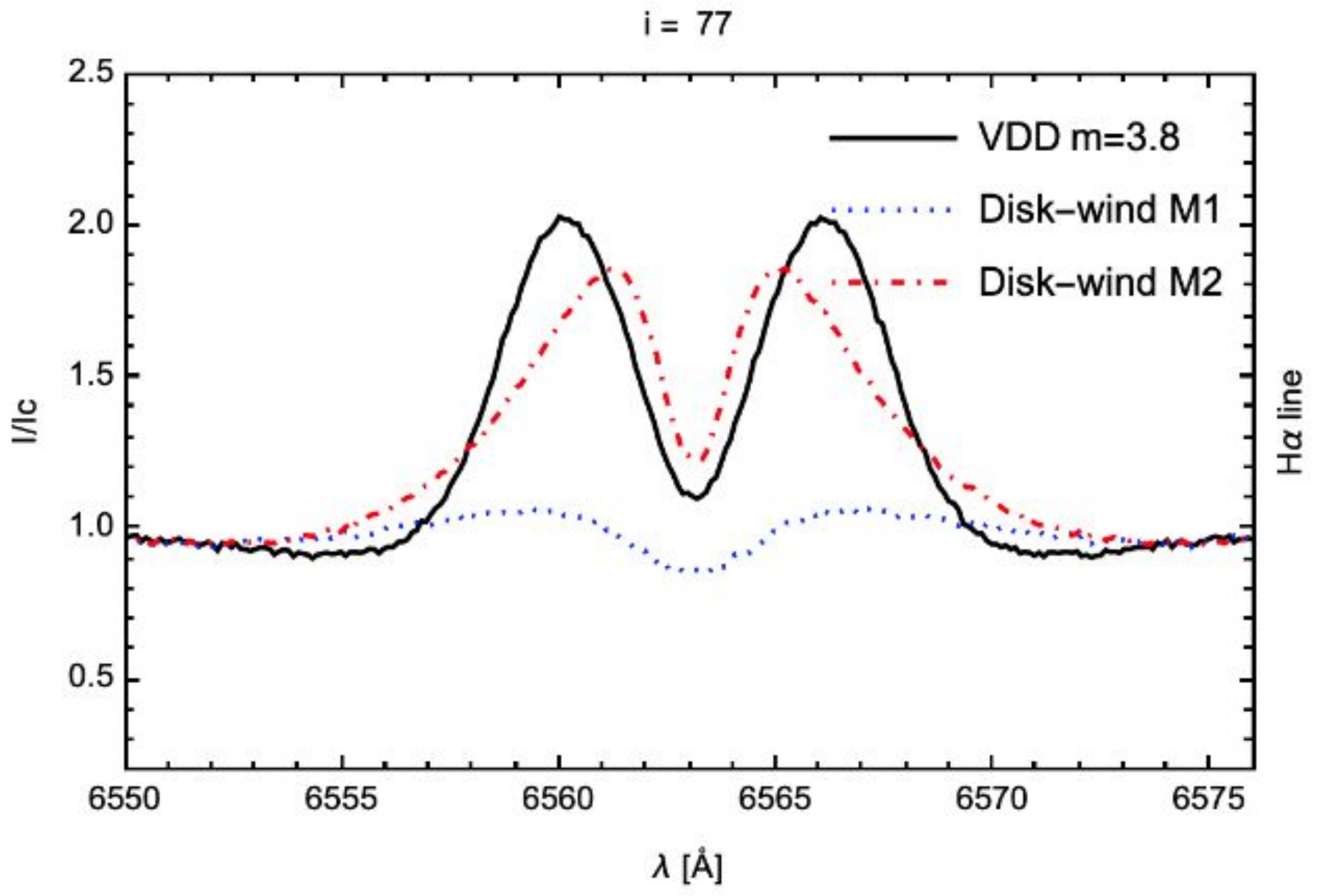
We compare two wind density distributions (Fig.1, M1 and M2) generated with Ω=0.99 and fixing line-force parameters δ=0 and k=0.2 for a γ_{vis}=0.51; with a VDD model of exponent 3.8. The stellar parameter are for a B2V star.

The wind parameters obtained are summarized in the following table, where a slower solution is obtained compared to the standard fast solution.

Model	α	k	γ_{vis}	$\dot{M}$ (10^{-8} M$_\odot$/yr)	v_∞ (km/s)
M1	0.50	0.2	0.51	1.17	101
M2	0.62	0.2	0.51	4.98	131

III. Disk-wind structure

With these solutions we computed the theoretical Hα line profiles and compared with the standard VDD, obtained a disk-like structure.



Future work

We are working on find m-cak solutions with high mass-loss rates and low terminal velocities. Comparison with observations still must be done.

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