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Analysis of the parameters in the evolution of viscous accretion disks in Be stars for the L spectral band

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In our research, we employ Bayesian inference techniques to determine the parameters of disk models for 24 Be-type stars located in the northern galactic region. We compare these models with the observed fluxes in the L band of the infrared spectrum. Our analysis focuses on distinctive spectral lines, such as Brackett α, Pfund γ, and Humphreys 14. We have discovered a significant correlation between key parameters like surface mass density and the ‘n‘ parameter in a potential equation.

Main sequence Be stars are stars that have shown or currently show emission lines. These stars are surrounded by a circumstellar disk, making them ideal candidates for studying stellar variability, also known as the Be phenomenon (Porter & Rivinius, 2003).

One way to classify the variability of disks is through the Lenorzer diagram, which allows the identification of stars in groups I or II according to the classification proposed by (Mennickent et al., 2009). These groups are distinguished by the ratios between the characteristic lines Brackett α, Pfund γ, and Humphreys 14, belonging to the L-band of the infrared spectrum Figure 1.

One way to compare and gather information about the disks is by using synthetic spectra, which were modeled using the HDUST code (Carciofi & Bjorkman, 2006). This comparison is made using Bayesian models, which allow for the determination of the posterior distribution of the parameters. Specifically, we use a grid of BeAtlas stellar models, defined by the prior expressed in equation (1):

$$\pi(\theta \mid \mathcal{H}) \propto M^{-2.3} f_{\mathrm{Be}}(M) \exp\left(-\frac{(W-\langle W\rangle)^2}{2\sigma_W^2}\right) \Theta(\theta \mid \mathcal{H}, \quad (1)$$

where, the factor $M^{-2.3}$ represents the initial mass function (IMF) as defined by Kroupa (2001), and $f_{\mathrm{Be}}(M)$ indicates the fraction of Be stars compared to the total number

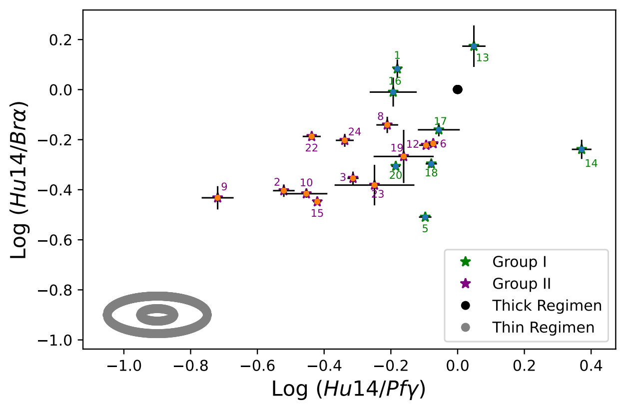

Figure 1. Lenorzer diagram for Group I and II stars, where the grey area represents the optically thick regime.

of B and Be stars. Additionally, the Gaussian factor is derived from the distribution of rotational velocities W in the Be star sample, based on (Rivinius et al., 2006). This assumes an average rotational velocity $\langle W\rangle = 0.81$ and a standard deviation $\sigma_W = 0.12$. Lastly, Θ is a parameter vector associated with various factors including the star’s mass $M_\odot$, disk surface density Σ_0, disk inclination *cosi*, rotational velocity W, and ‘n’, representing the power law of the potential.

By using the Emcee code to estimate the disk parameters, we have found that this analysis enables us to effectively crossmatch theoretical and observational data. This is crucial for validating the accuracy and relevance of our models in the astrophysical study of Be star disks, in the infrared region for the L-band.

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