Stellar parameters, disk-phases changes and new insight about the line-profile variability of π Aquarii

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π Aquarii

π Aquarii is a bright, rapidly rotating classical Be star observed for over 100 years, exhibiting significant mid- and long-term variability. Here, we analyzed Hα profile variability over 23 years (2001-2023). We used the BeSOS[**1**] and BeSS[**2**] surveys. A total of 23 spectra from both databases cover the complete visible range. Regarding only the Hα spectral region, we recollected 516 spectra from 2001 to 2022 (see Fig. 1).

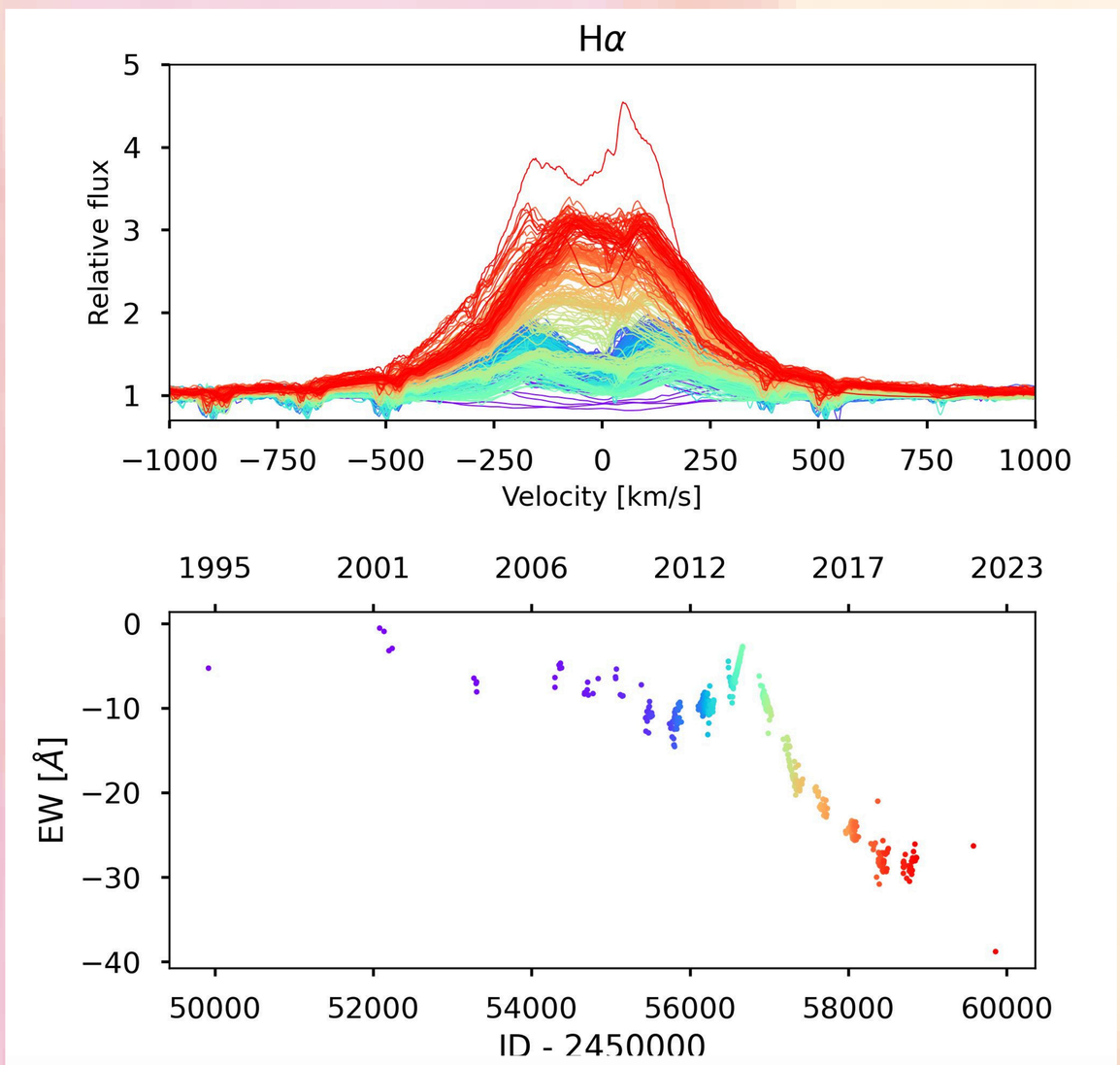
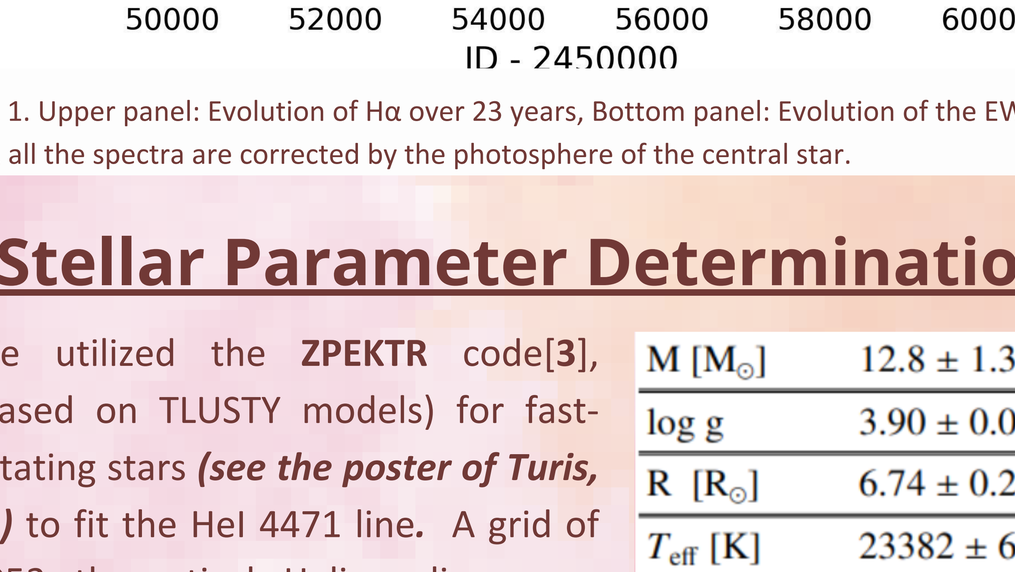


Fig. 1. Upper panel: Evolution of Hα over 23 years, Bottom panel: Evolution of the EW of Hα, all the spectra are corrected by the photosphere of the central star.

Stellar Parameter Determination

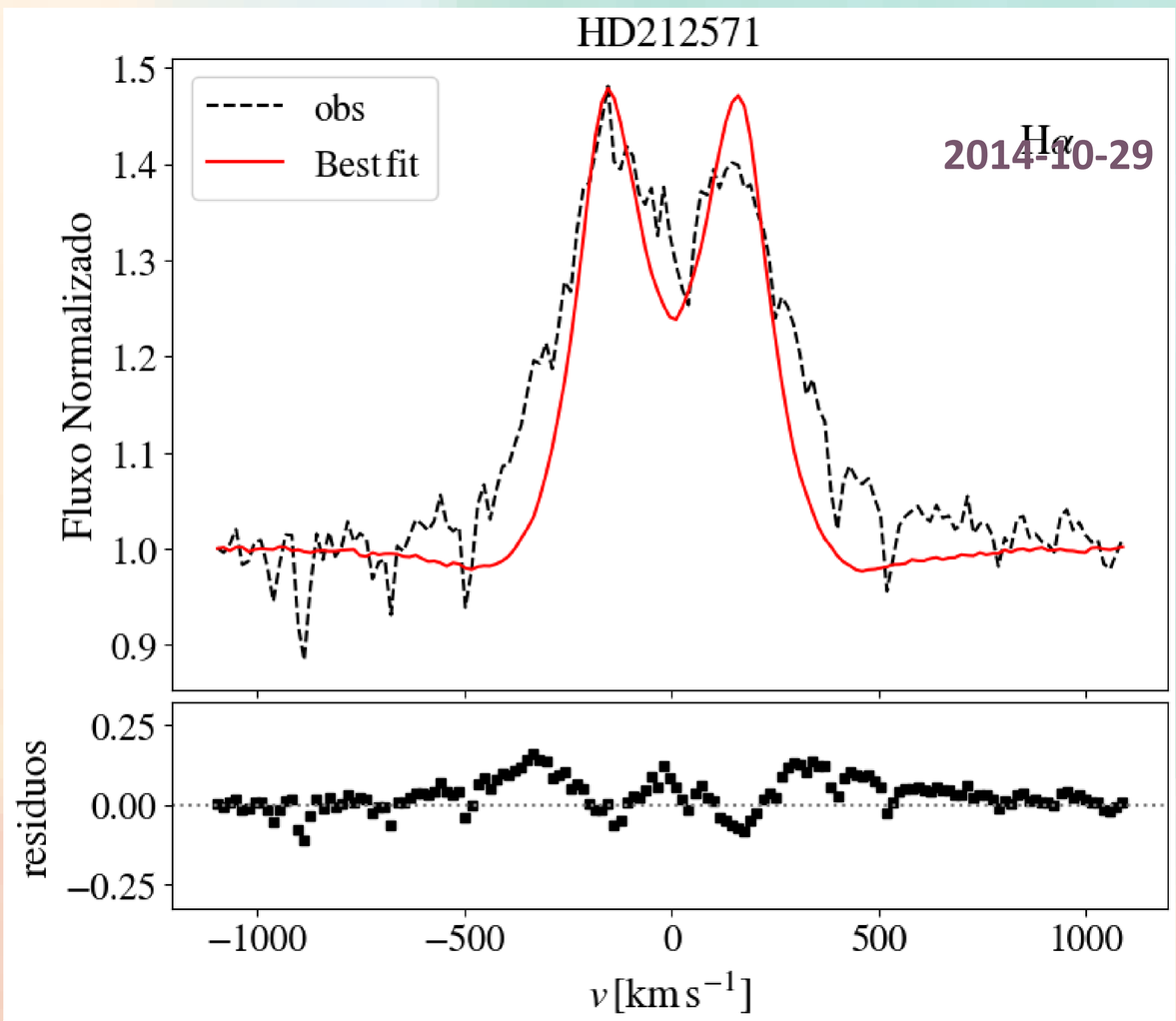
We utilized the **ZPEKTR** code[**3**], (based on TLUSTY models) for fast-rotating stars ***(see the poster of Turis, D.)*** to fit the HeI 4471 line. A grid of 1053 theoretical Helium lines was created, varying the stellar parameters to find the best match (Chi-square test) to the observed spectrum (see Table for the derived parameters and Figure below for the median of 56 best models).

M [$M_\odot$]	12.8 ± 1.3
log g	3.90 ± 0.04
R [$R_\odot$]	6.74 ± 0.22
T_{eff} [K]	23382 ± 616
L [$L_\odot$]	12217 ± 802
R_p [$R_\odot$]	6 ± 1
R_e/R_p	1.275 ± 0.088
T_p [K]	25428 ± 405
v sin i [km/s]	282 ± 13
i°	44 ± 6



Results

We used the BeAtlas grid[***4***] **(see the poster of Souza, T.)**, based on the HDUST[**5,6**] code and considered a power-law for the density distribution in the disk. The grid contains 13,800 models of the Balmer lines and SED ranging from 0.10 μm to 2.45 μm. The model parameters include mass (M⋆), oblateness (Re/Rp), the base surface density of the disk (Σ0), volume density distribution index (n), and disk inclination angle (cos(i)). The best-fit model was determined using the EMCEE code[**7**]. We selected 13 spectra showing a change in the Halpha emission line: four in 2001, three in 2011, three in 2014, and three in 2018. An example of the fit (in red) is shown in the figure below for the date 2014-10-29 (dashed line). The disk parameters are shown under the figure.



(Σ0) = 0.12 ± 0.06, Re/Rp= 1.18 ± 0.05, ω = 0.84 ± 0.05, n = 3.36 ± 0.22 and i° = 47.31 ± 1.23.

Work in progress

- We are improving the models of the Balmer lines by using the BeATLAS code. We will consider the non-coherent electron scattering, which affects the disk and thereby the shape of line profiles by broadening the wings of the line [**8**].
- The final results including the EW, V/R, and RV variations over time will be published soon in a scientific journal.

References

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