# The Enigma of Hydrogen Emission in T Tauri Stars



# Summary

- CTTSs are known for their hydrogen emission lines, magnetospheric accretion and mass outflow<sup>1</sup>.
- By comparing synthetic hydrogen profiles from the RT code TORUS<sup>2</sup> with observations of CTTSs, we aim to constrain and provide insight into the physics.
- Our initial parameter study indicates that the existing line broadening mechanisms are insufficient to account for the observed hydrogen emission.

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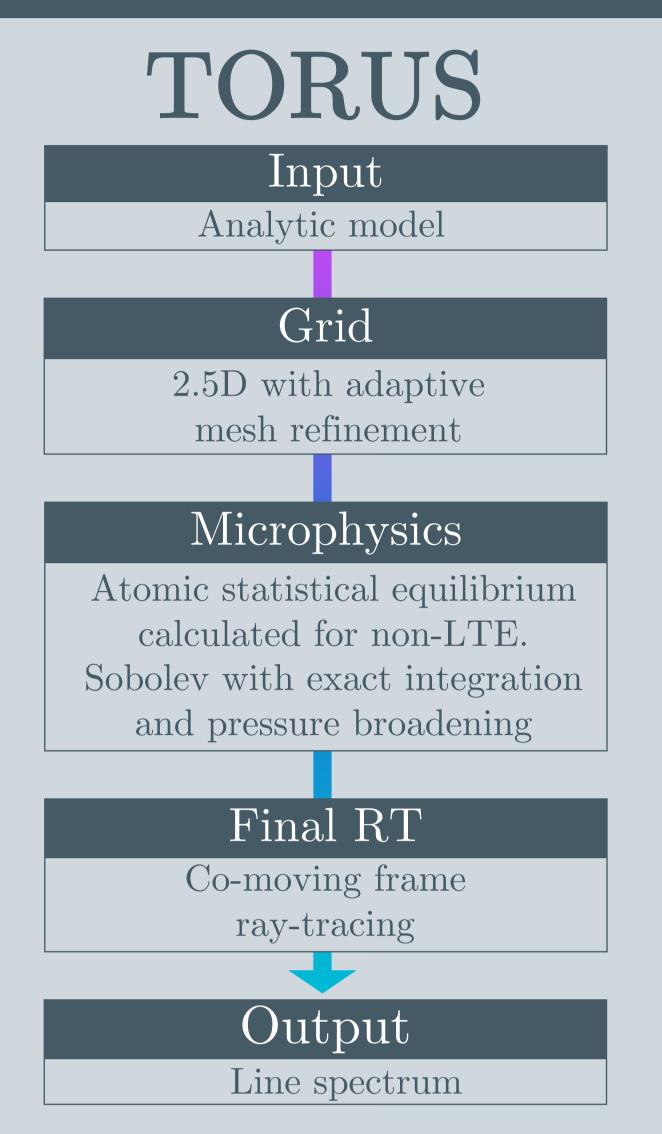
S. Matt, T. J. Harries &

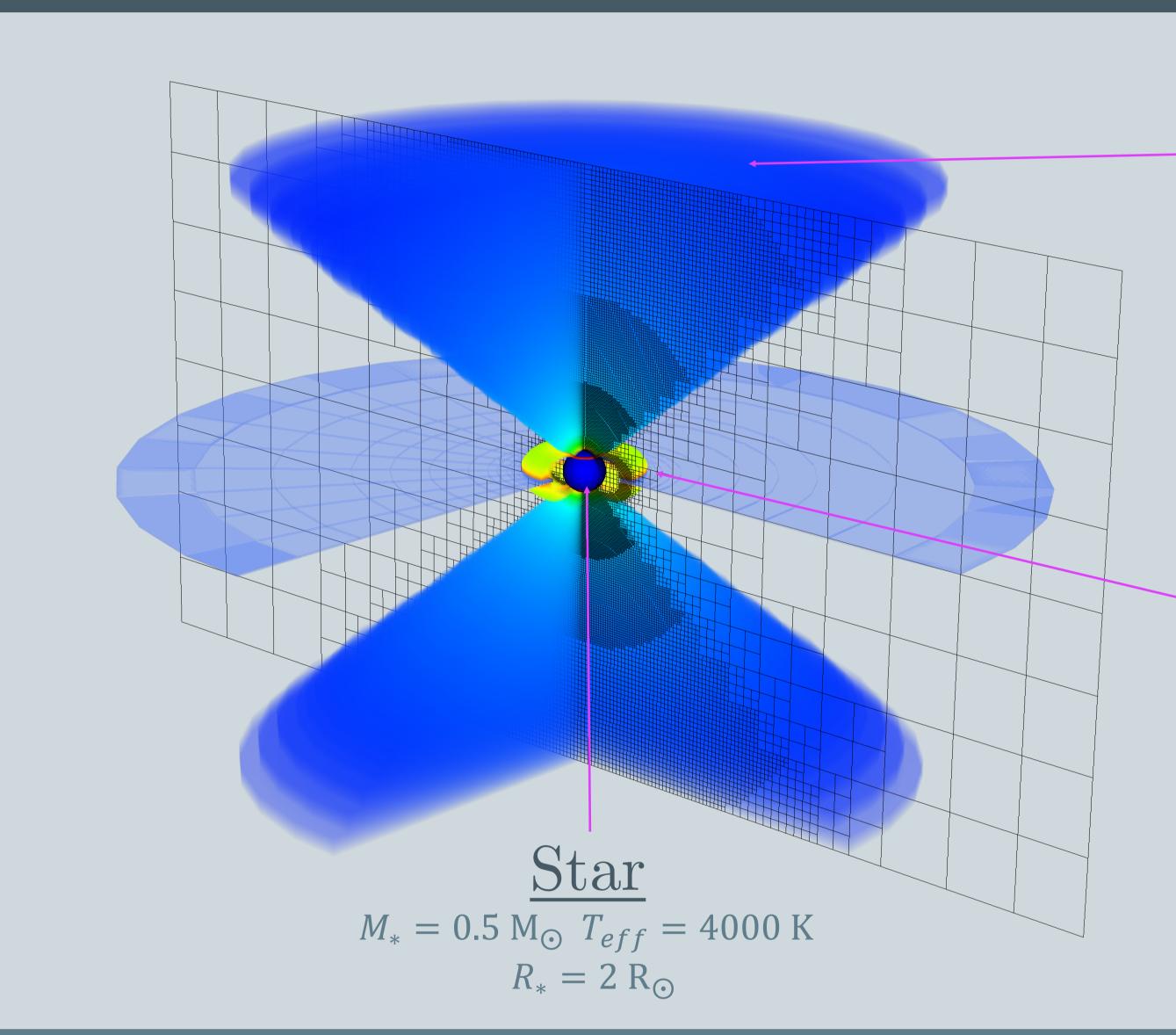
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## Radiative Transfer Model



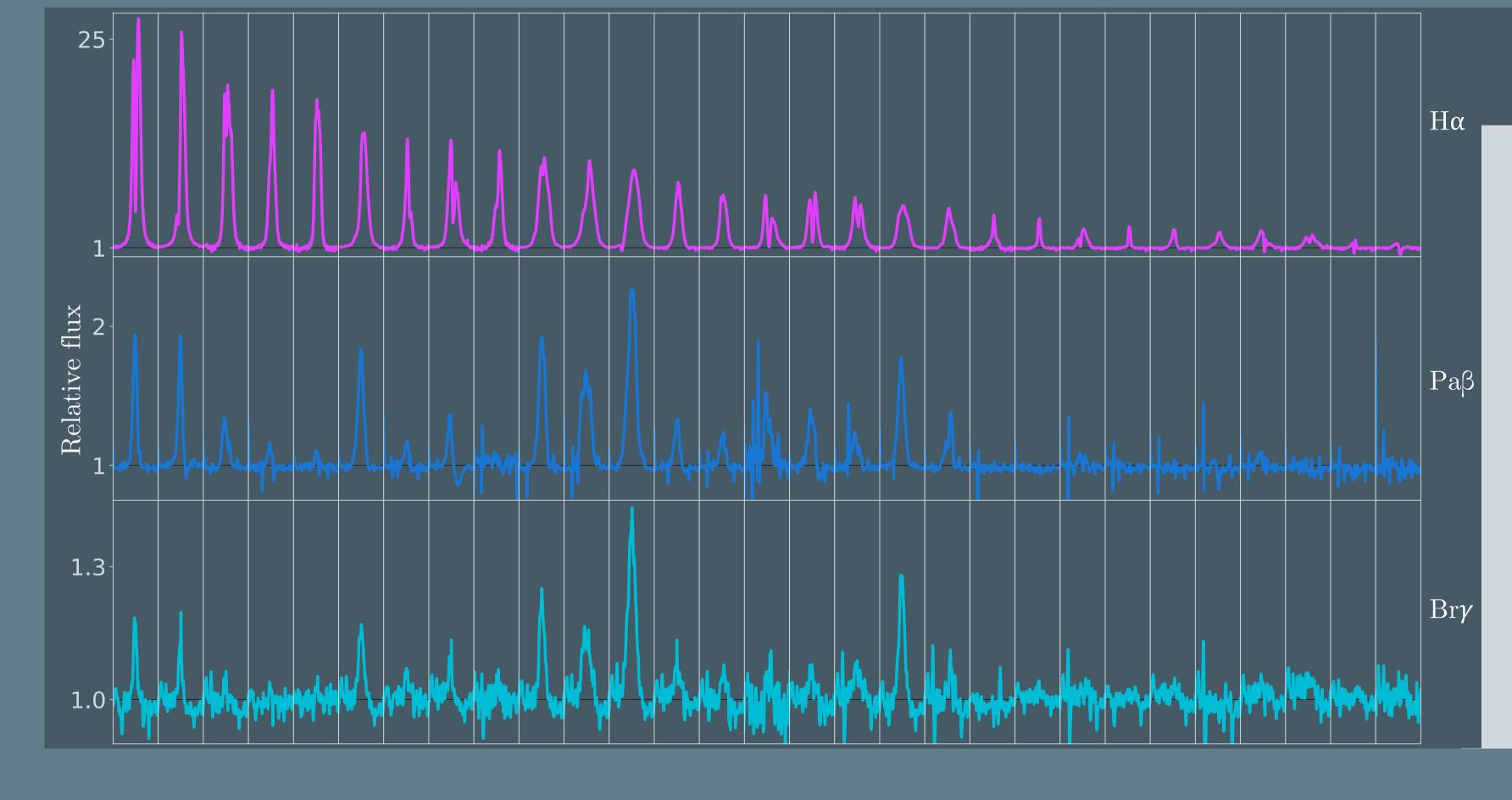


#### Stellar wind $v_r(r) = v_{\infty} (1 - \frac{R_*}{r})^{\beta}$ $v_{\infty} = 1.3 \ v_{esc} \ \beta = 2.89$ $\dot{M}_{\rm SW} = 0.1, 0.01 \dot{\rm M}_{\rm acc}$

 $T_{sw} = 6000, 8000, 10000 \text{ K}$ 

### Accretion funnel

 $\dot{M}_{acc} = 10^{-7}, 10^{-8}, 10^{-9} M_{\odot} \text{yr}^{-1}$  $T_{acc} = 6500, 7500, 8500, 9500 \text{ K}$ 



## Observations

- Figure shows line profiles for 29 T Tauri stars (columns) from the ESO Archive, selected to have an  $\Delta \dot{M}_{acc} \sim 10^4$ . The stars are ordered by  $H\alpha$  peak intensity.
- High resolution:  $R \sim 1100$  (infrared) and  $R \sim 1800$  (optical) spectra from VLT's X-Shooter, observed in Jan 2010.
- Near simultaneous observations of  $H\alpha$  (top),  $Pa\beta$  (middle), and Bry (bottom). The x-axis is velocity with a range of  $600 \text{ to } -600 \text{ kms}^{-1}$ .
- A strong correlation of shape and intensity is seen between the infrared lines, but not between  $H\alpha$  and the infrared observations.

## Comparison

- The figure shows the FWHM vs. half width at 10% maxima (HW10%). The synthetic observations are clipped so that the  $H\alpha$  data points lie near the observed parameter space.
- Synthetic and observed  $H\alpha$  lines show a good accord between the measured parameters of Reipurth classification, W, FWHM, and HW10%.
- Synthetic lines for Paß and Bry are found to be too narrow and Stark broadening is unable to account for the difference. This suggests another form of broadening needs to be invoked.
- Inverse P-Cygni profiles are commonly predicted by the simulations for Paß and Bry yet this is not reflected in the observations.<sup>5</sup>

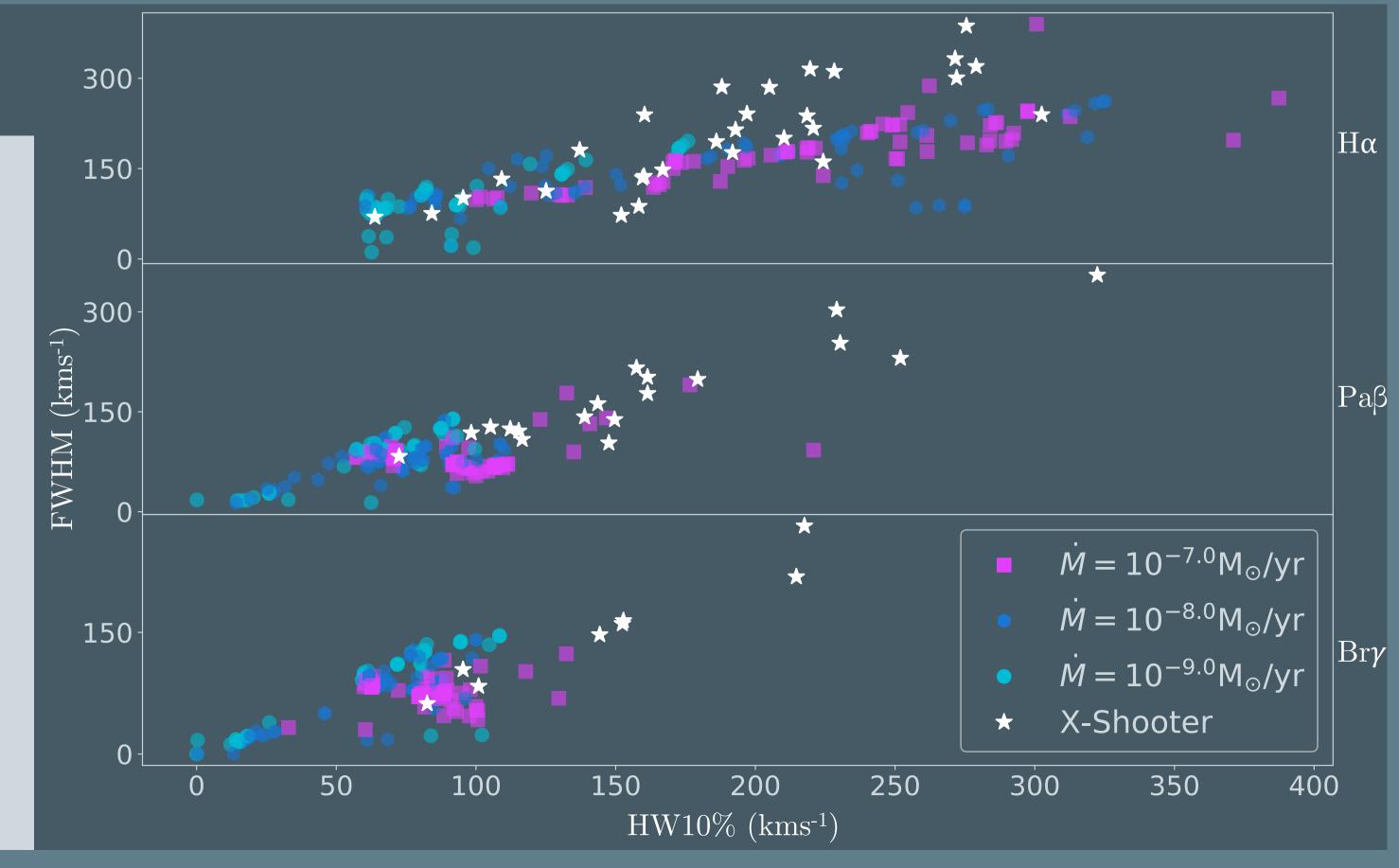
This research

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the services of





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