

Summary

- CTTSs are known for their hydrogen emission lines, magnetospheric accretion and mass outflow¹.
- By comparing synthetic hydrogen profiles from the RT code TORUS² 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.

Tom J. G. Wilson

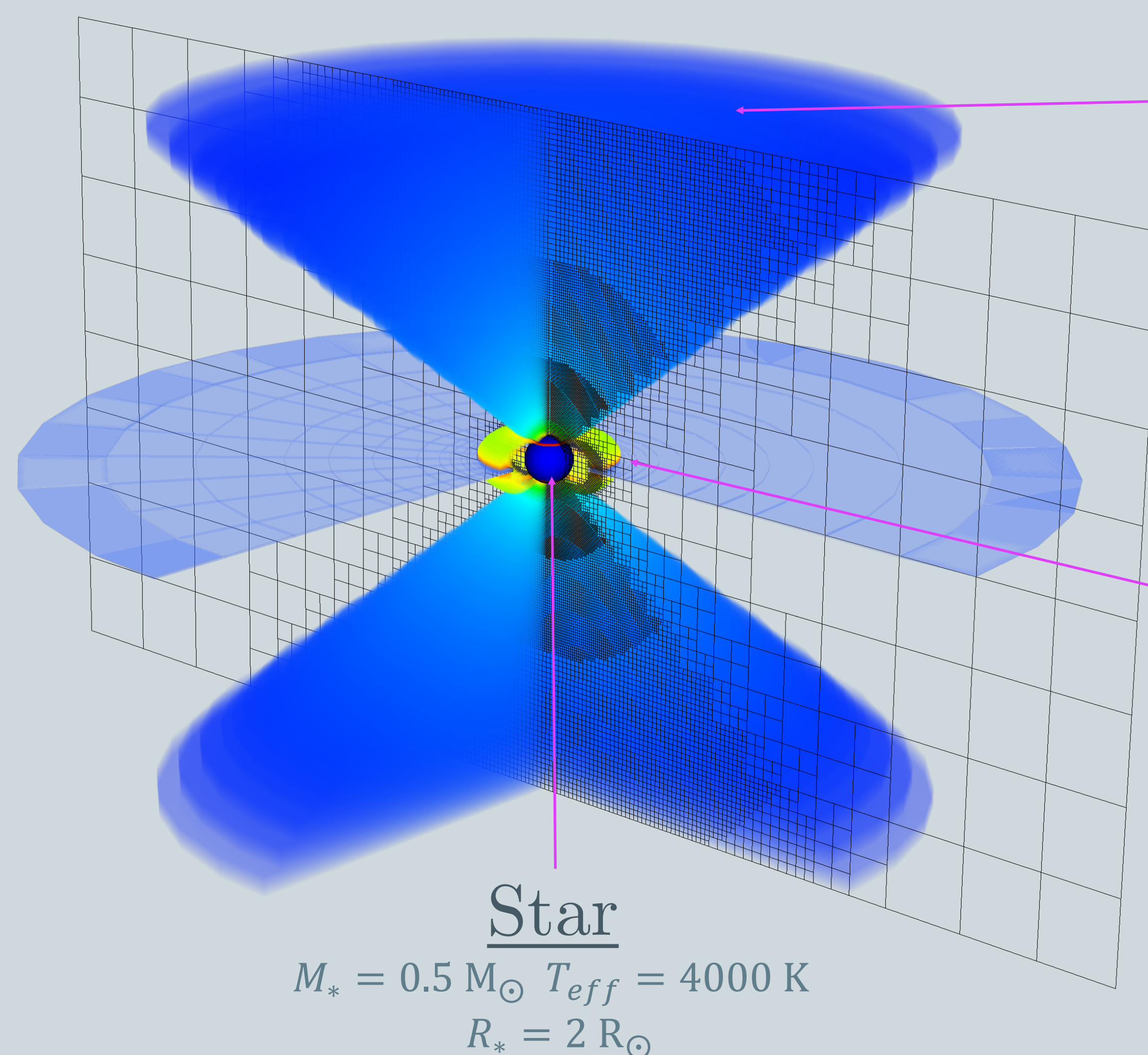
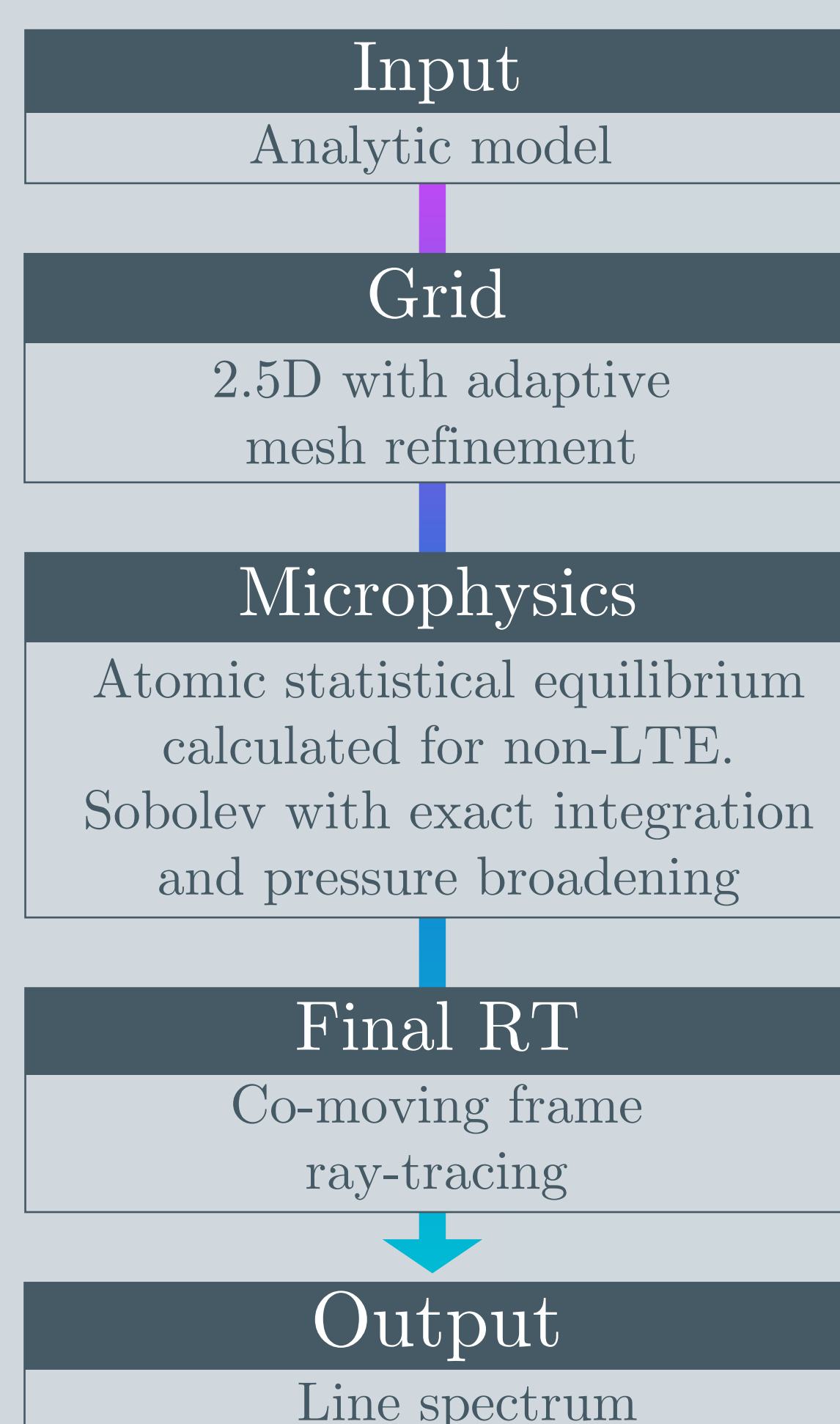
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Radiative Transfer Model

TORUS



Stellar wind

$$v_r(r) = v_\infty \left(1 - \frac{R_*}{r}\right)^\beta$$

$$v_\infty = 1.3 v_{esc} \quad \beta = 2.89$$

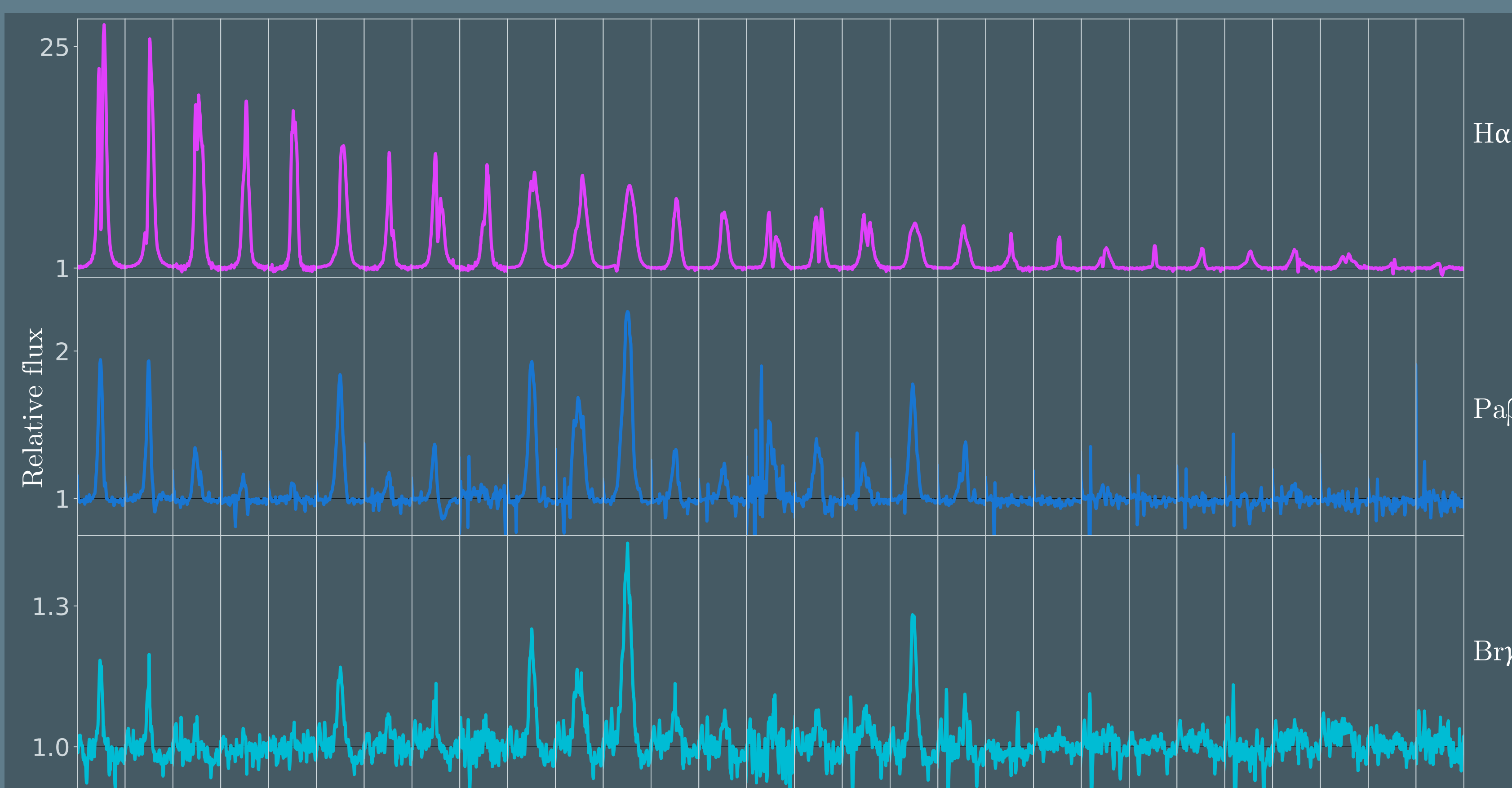
$$\dot{M}_{sw} = 0.1, 0.01 \dot{M}_{acc}$$

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

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,³ selected to have an $\Delta \dot{M}_{acc} \sim 10^4$. The stars are ordered by H α 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 α (top), Pa β (middle), and Br γ (bottom). The x-axis is velocity with a range of 600 to -600 km s^{-1} .
- A strong correlation of shape and intensity is seen between the infrared lines, but not between H α 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 α data points lie near the observed parameter space.
- Synthetic and observed H α lines show a good accord between the measured parameters of Reipurth classification,⁴ W_λ , FWHM, and HW10%.
- Synthetic lines for Pa β and Br γ 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 Pa β and Br γ yet this is not reflected in the observations.⁵

