# Classical T Tauri stars with XShooter

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**Abstract.** We observed a sample of 20 Classical T Tauri stars (CTTS) covering a range of ages and evolutionary stages with VLT/XShooter (085.C-0764(A)). Its wide wavelength coverage allows to simultaneously observe HI lines in the Balmer, Paschen and Brackett series which supposedly originate from the accretion funnels. These lines can be used to determine temperature and density in the emission region. HI lines with common upper level whose flux ratio is independent of the physical conditions in the gas can also be used to probe the reddening due to the dust in the stellar environment. Additionally, several tracers of winds and accretion can be compared. We present information on the sample and the data as well as first results.

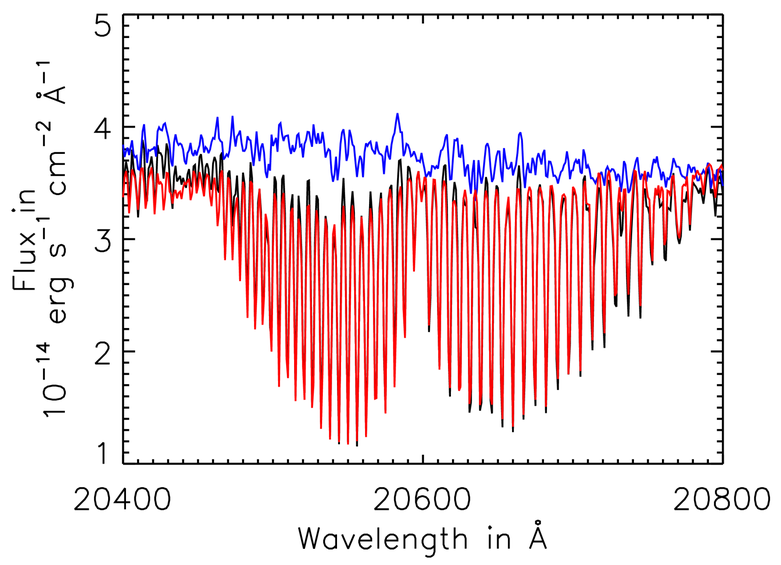
## The sample.

| Object | Spectral Type | EW Hα in Å | EW Hα in Å (Literature examples) | log $\dot{M}$ in $M_\odot$/yr [a] |
|---|---|---|---|---|
| TW Hya | K6 | 154 | 86, 142, 194, 240 | -7.9 |
| MP Mus | K1 | 35 | 23, 37 | -8.7 |
| EX Lup | M0 | 19 | 31,43 | -9.7 |
| GQ Lup | K7 | 47 | 3, 32 | -7.8 |
| HO Lup | M1 | 139 | 220, 239 | -8.5 |
| IM Lup | M0 | 8 | 7 | -10.2 |
| RU Lup | G5 | 170 | 96, 136, 216 | -7.8 |
| V853 Oph | M4 | 78 | 41, 46 | -9.2 |
| V2058 Oph | K4 | 73 | 67, 84, 100 | -7.8 |
| V2062 Oph | K3 | 76 | 54, 58 | -7.9 |
| V2129 Oph | K5 | 21 | 6, 12, 23 | -9.5 |
| V2251 Oph | K5 | 37 | 36 | -7.9 |
| V2252 Oph | M0 | 35 | 45 | -8.5 |
| V4046 Sgr | K5 | 42 | 33, 42, 60 | -8.5 |
| V895 Sco | K5 | 198 | 123 | -7.1 |
| V1279 Sco | K8 | 23 | 37 | -9.0 |
| VV Sco | M1 | 42 | 42 | -8.8 |
| Sz 77 | M0 | 8 | 9, 17 | -10.1 |
| S CrA | A: G5, B: K5 | 63 | 65, 90, 120 | -6.5 |
| GY 92-168 | A: K4-M5, B: K7-M5 | 73 | 24 | -7.9 |

[a] using Hα FW@10% (Natta et al. 2004, A&A, 424, 603)

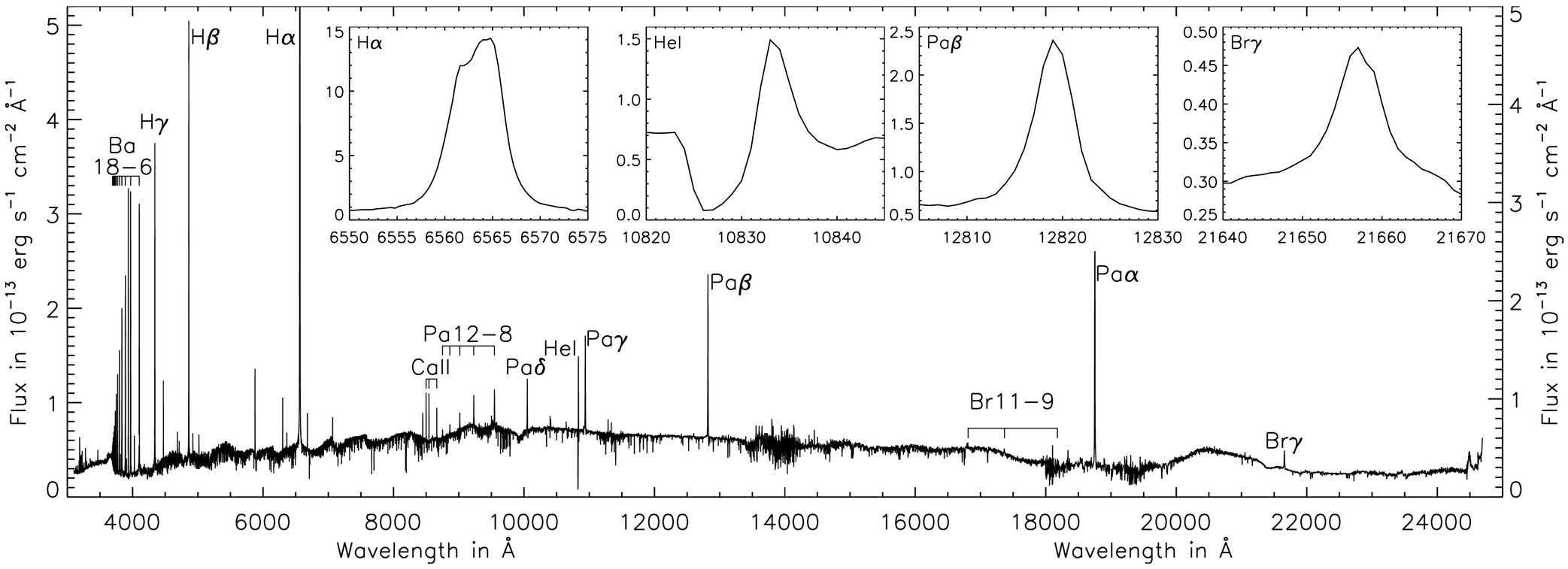
## Removal of telluric lines.

Following the approach of Seifert et al. (A&A, 524:A11, 2010) we simulated atmospheric transmission spectra using the LBLRTM (Line-By-Line Radiative Transfer Model) code, that was originally developed for use in climatology. After convolving the simulated spectrum with a Gaussian, the observed spectrum is divided by it to remove the telluric lines.




Example demonstrating removal of telluric $CO_2$ absorption from a spectrum of TW Hya. Black: observed spectrum, red: simulated transmission (convolved with Gaussian, arbitrarily scaled for displaying purposes), blue: final spectrum

## Example spectrum...




Flux calibrated, telluric line removed spectrum of TW Hya. Some important lines are marked and the profiles of Hα, He I 10830 Å, Paβ and Brγ are shown in insets with the same flux scale.

## … and what we can learn from it.

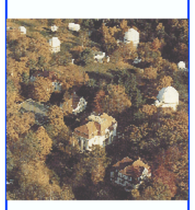
Mass accretion, its rate and winds:
- Hα equivalent width (cf. Table)
- Hydrogen line profiles (esp. Hα, Paβ, Brγ, cf. Figure)
- He I 10830 Å
- Accretion spot hydrogen Paschen and Brackett continuum
- Ca II IR triplet
- UV and optical veiling

Reddening due to dust in the stellar environment:
- Paschen and Brackett lines with common upper level

Temperature and density of the emitting gas:
- Decrements within Balmer, Paschen and Brackett series

Other things:
- Age (Li I 6708 Å)
- Spectral type

**The wide wavelength coverage of XShooter will allow us to compare and relate *simultaneously* obtained tracers of mass accretion.**



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