# HST FUV monitoring of TW Hya

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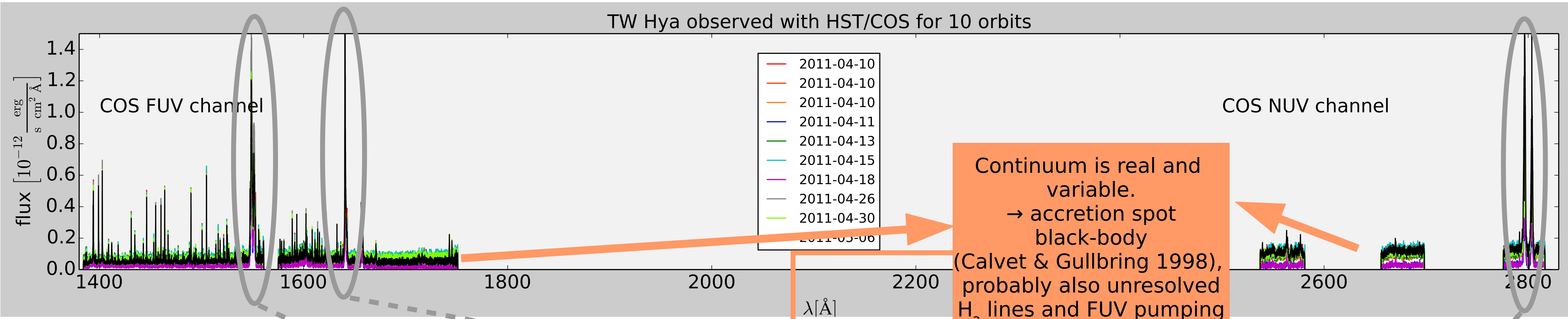
**C**lassical **T T**auri **S**tars (CTTS)

CTTS are young (< 10 Myr), cool stars that actively accrete matter from a disk. They show strong, broad and asymmetric FUV emission lines. Neither the width, nor the line profile is understood. Likely, different mechanisms influence the line profile; the best candidates are accretion, winds and stellar activity. We monitored the C IV 1548/1550 Å doublet in the nearby, bright CTTS TW Hya with the Hubble Space Telescope Cosmic Origin Spectrograph (HST/COS) to correlate it with i) the cool wind, as seen in COS NUV Mg II line profiles, ii) the photometric period from joint ground-based monitoring, iii) the accretion rate as determined from the UV continuum and iv) the H$\alpha$ line profile from independent ground-based observations. The observations span 10 orbits distributed over a few weeks to cover the typical time scales of stellar rotation, accretion and winds.
On this poster we describe a model with intrinsically asymmetric C IV lines. We will separately analyze a scenario where part of an intrinsically Gaussian C IV line is absorbed by a hot wind (Dupree et al 2005, 2014).

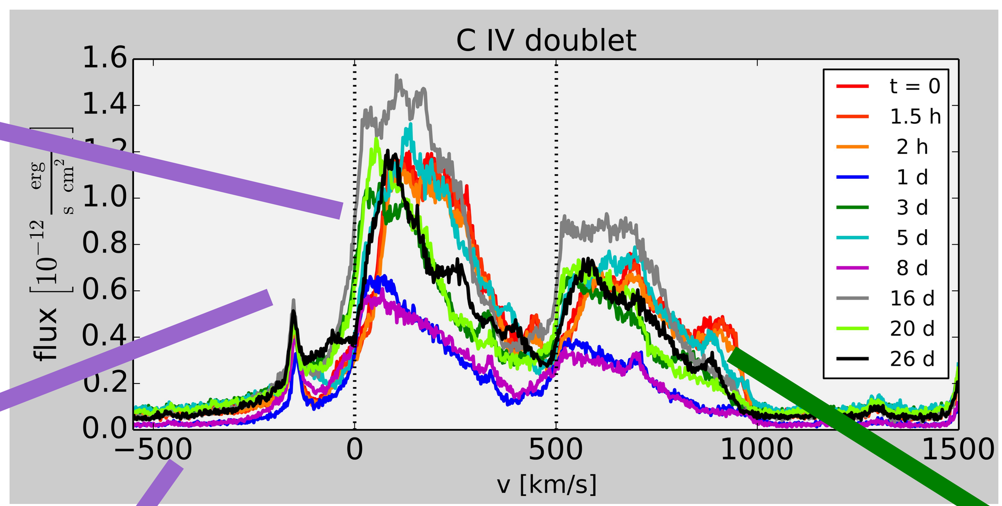


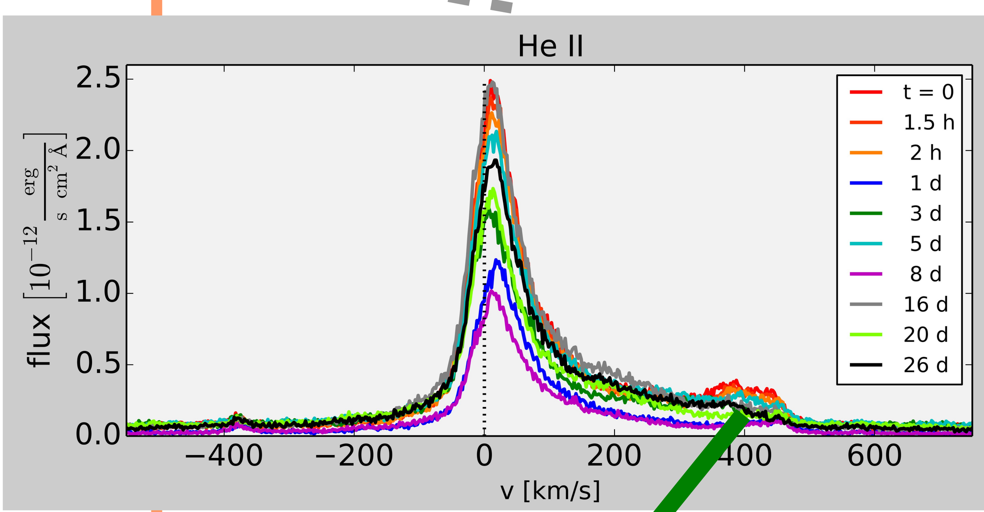

Continuum is real and variable.
→ accretion spot black-body (Calvet & Gullbring 1998), probably also unresolved $H_2$ lines and FUV pumping (Herczeg et al. 2004)

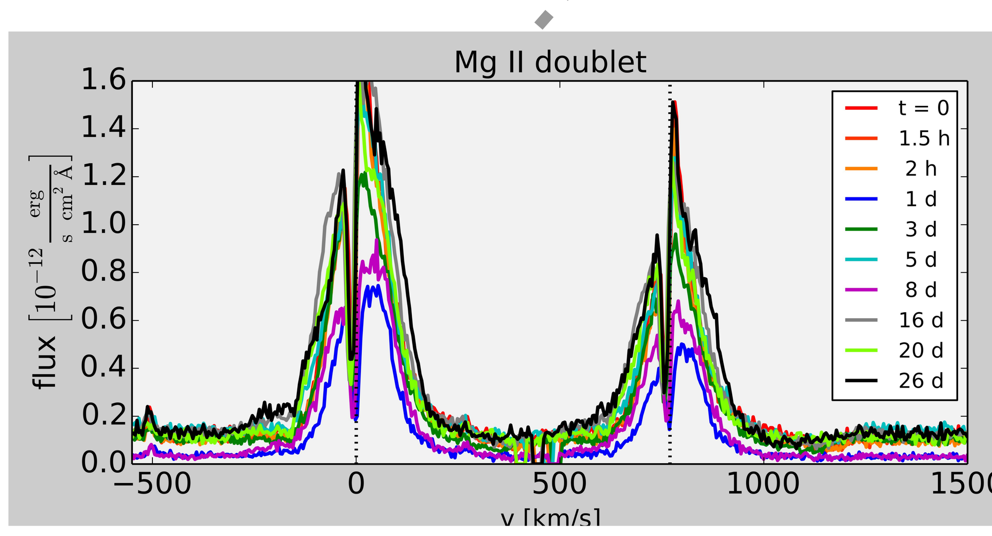
The line rises always at slightly red-shifted velocities between 0 to +100 km/s. This value varies but we do not have enough points in time to find a pattern.
→ Absorption happens between the accretion spot and us.

$H_2$ line not absorbed (Johns-Krull & Herczeg, 2007)
→ No hot wind with C IV between the disk and us.

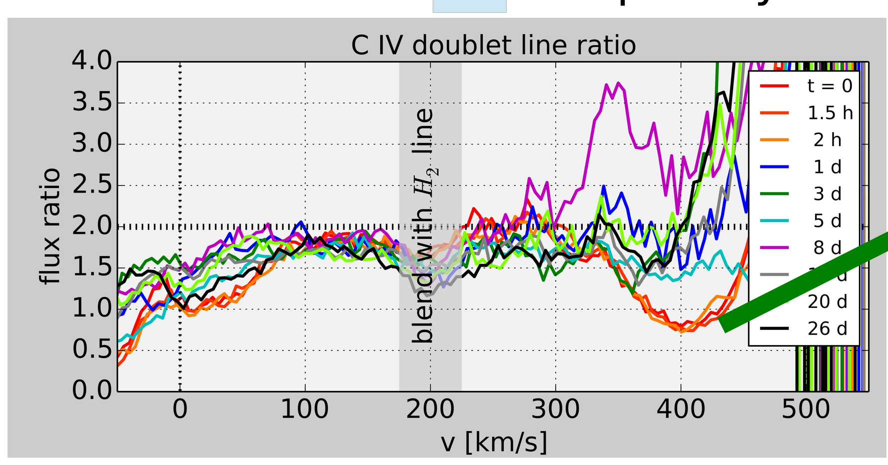
No P-Cyg-like absorption
→ No hot outflow with C IV between continuum emission and us.



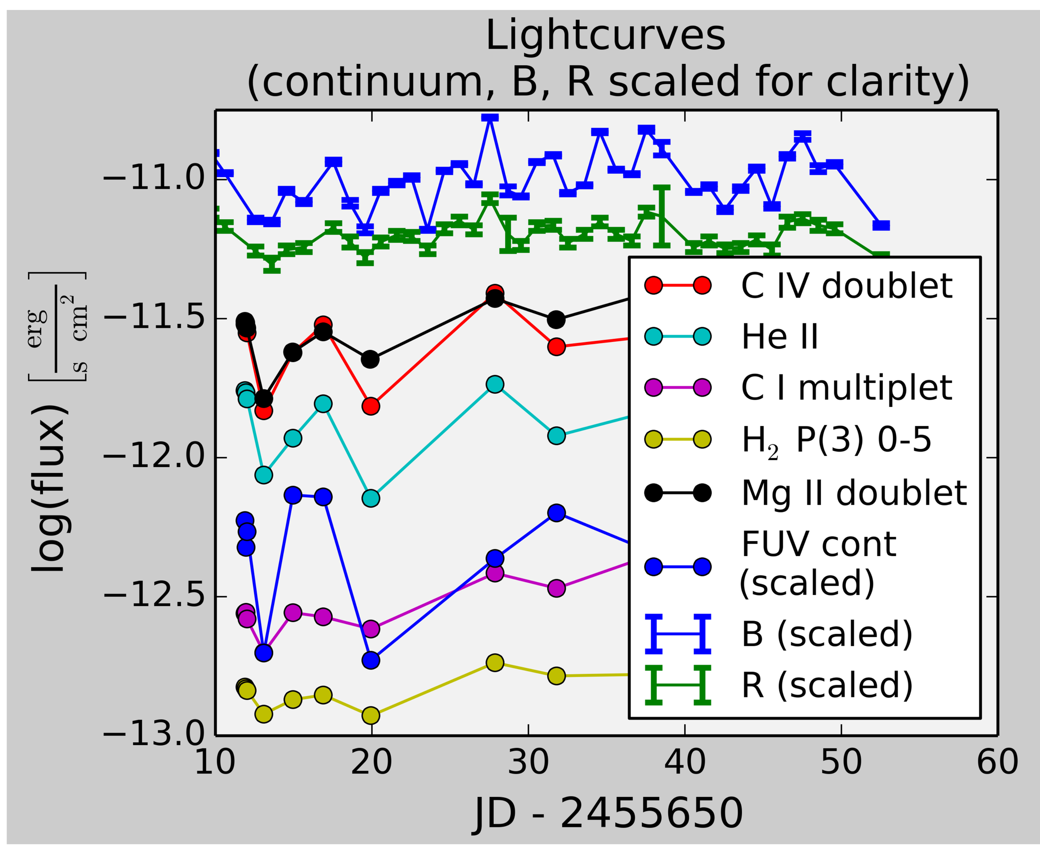




C IV line ratio = 2 for optically thin lines




Some optical depth is seen on the red side of the line, but the shock is not completely buried. We use a line profile from Lamzin (2003) for our model.
Our monitoring revealed intermittent optically thick, dense emission around 400 km/s. This can be interpreted as an accretion event.

Some spectra have an optically thick extra emission bump at 400 km/s in both C IV and He II
→ Pre-shock region optically thick depends on accretion rate, viewing angle (line transport was simulated by Lamzin 2003)

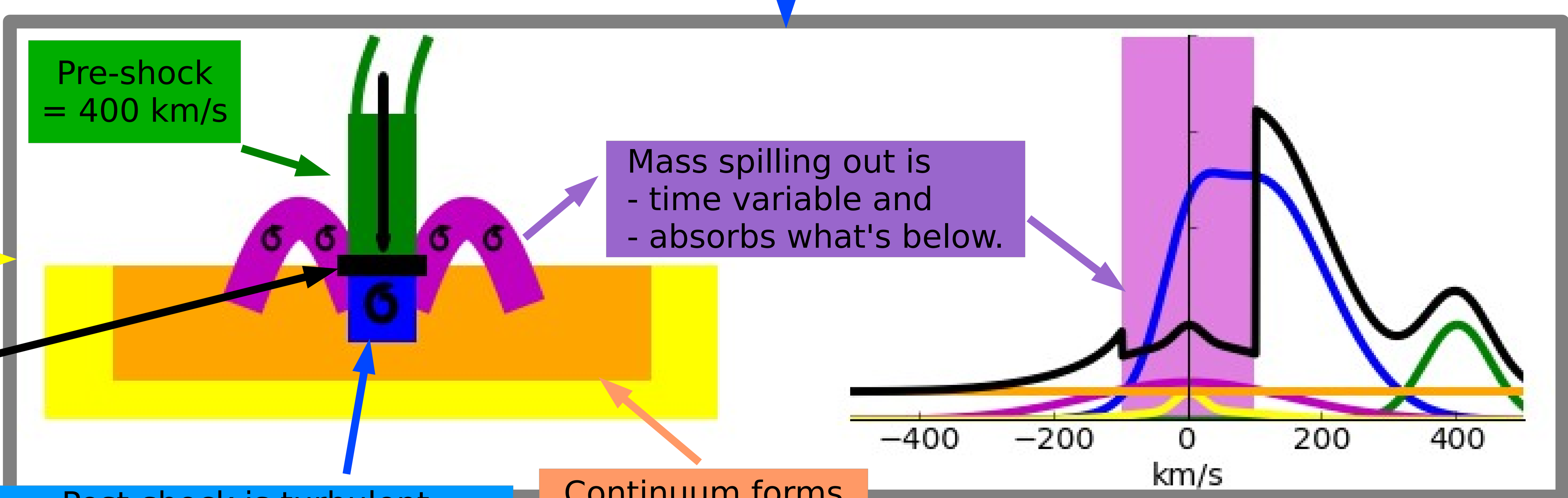



Our time series clearly reveals that the hot FUV lines (C IV), cool lines (C I, Mg II), the FUV continuum and the optical emission (B and R band) are correlated.
→ They are all regulated by the same process (accretion).
Spectral investigation of the time series will show the detailed connection.

## Our model for FUV emission in CTTS

Colored boxes explain individual components
Consistent with X-ray observations (Brickhouse et al. 2010) and MHD simulations (Orlando et al. 2010)

Non-accreting TTS also show some C IV emission (Ardila et al. 2014).




Based on observations with the Hubble Space Telescope and SMARTS. The Analysis uses Ipython and astropy (www.astropy.org).

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