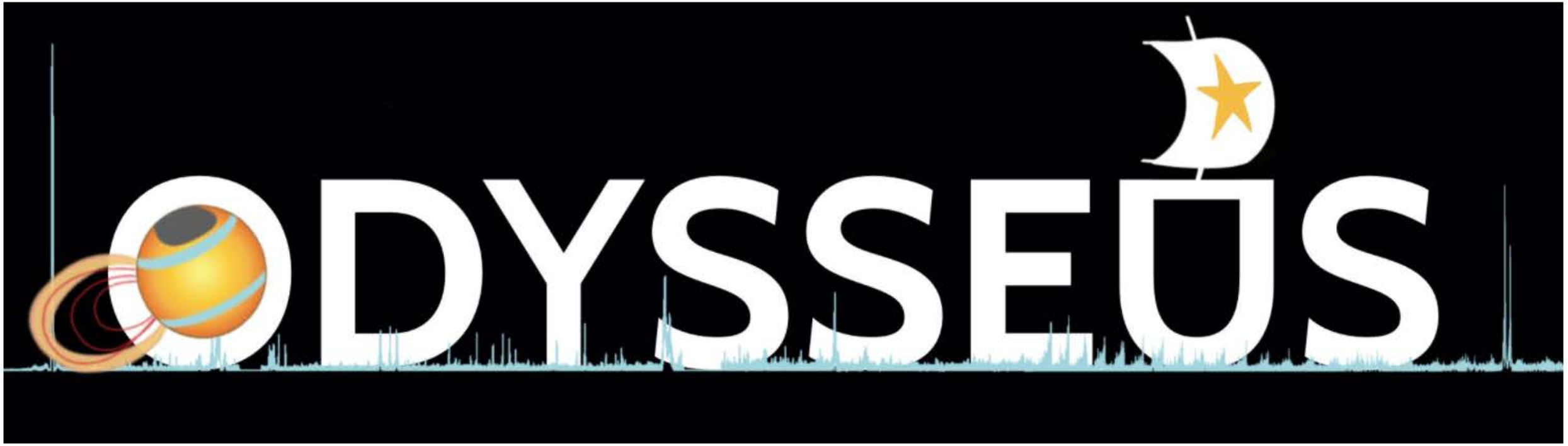


Gregory Herczeg (KIAA/Peking University), Catherine Espaillat (Boston University), Nuria Calvet (University of Michigan), Kevin France (University of Colorado), Carlo Manara (ESO), Will Fischer (STScI),

and dozens of others

https://sites.bu.edu/odysseus/

ULLYSES DDT Program (PI Roman-Duval)

- Accreting young stars (classical T Tauri stars)
  - 400 orbits for survey of ~60 stars
  - 100 orbits for monitoring
    - 1400-1700 A mid-res spectra
    - 2500-3100 A low-res spectra
    - 4 targets, 2 sets of 12 epochs
    - TW Hya, BP Tau, GM Aur, RU Lup
- Hot stars (other programs)

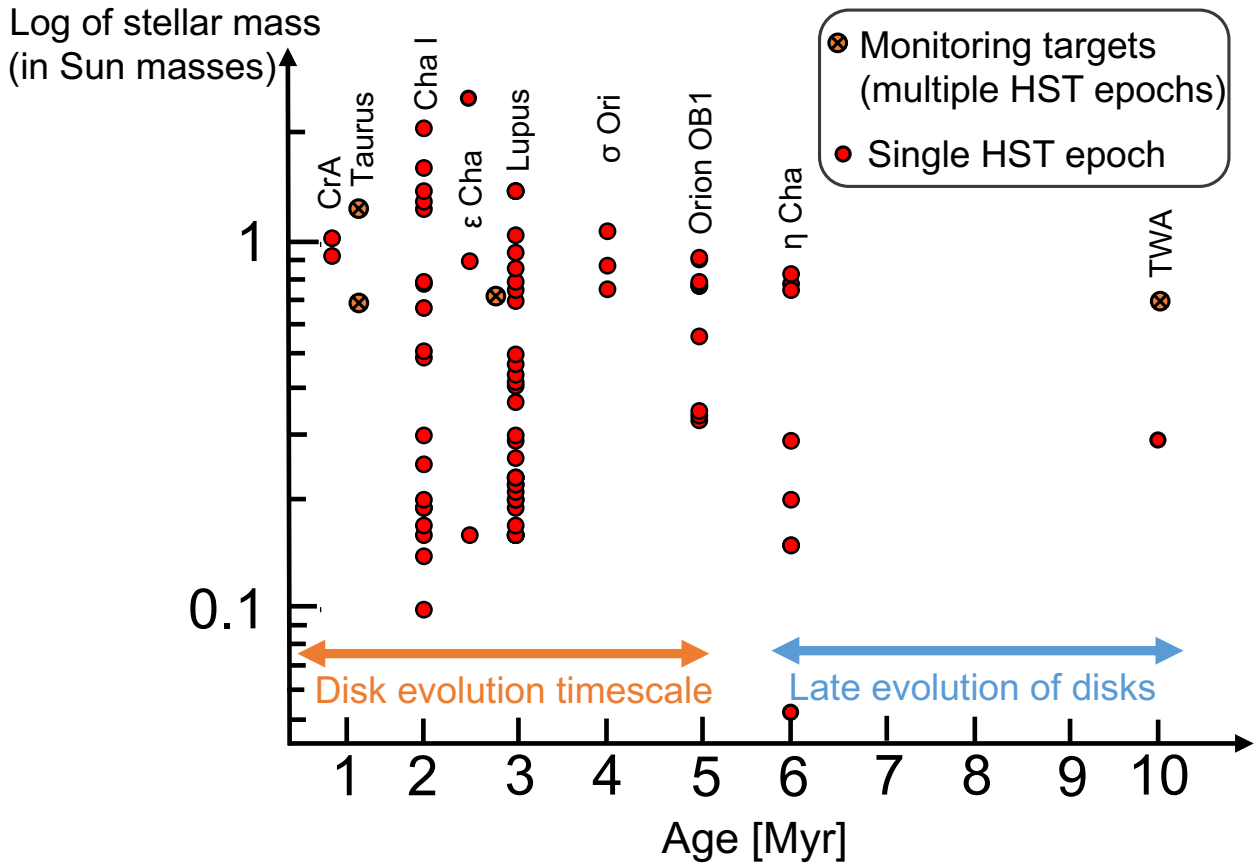
https://ullyses.stsci.edu/

ULLYSES survey of accreting young stars

(Roman-Duval et al. 2020; Proffitt et al. 2021)

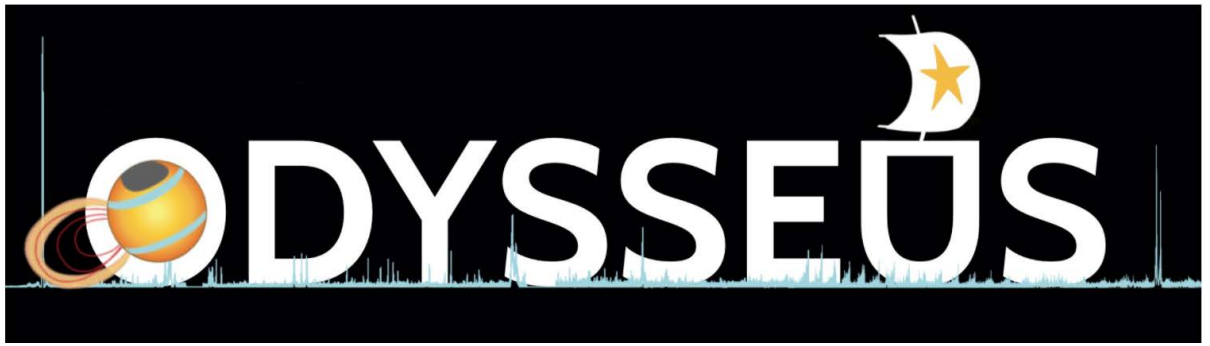
- 2-4 orbits of COS spectra (R=18,000 from 1100-1800 A)
- 1 orbit of low-resolution STIS spectra from 1700—10000 A

- More than double high-quality FUV spectra of T Tauri stars
  - Far better coverage of low-mass stars and low accretion rate
  - Better “age” coverage by including multiple star-forming regions
- Optical: must be contemporaneous because o accretion rate and extinction variability on short timescales



ODYSSEUS Archival Program

PI Herczeg, co-PI Espaillat
management team: Calvet, France, Manara, (Fischer)



85 team members

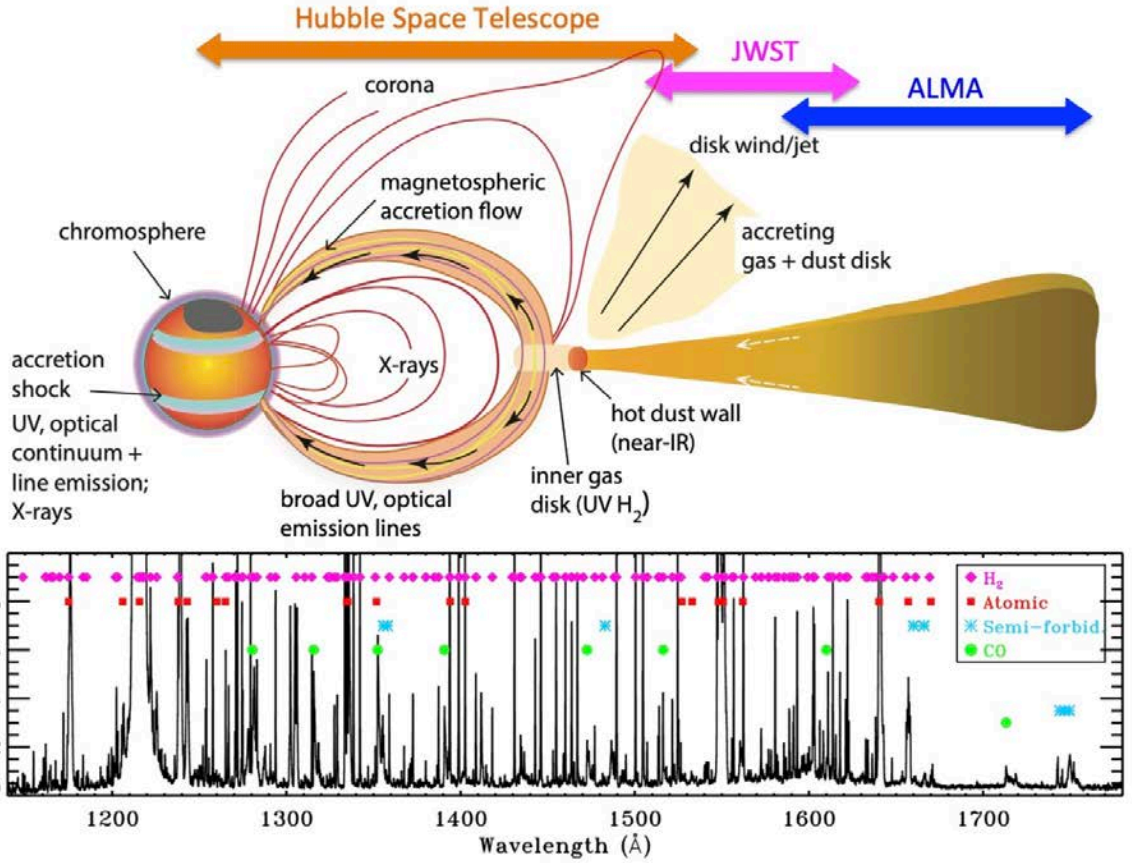
- Coordinate analyses
- Coordinate simultaneous photometry & spectroscopy

PENELLOPE: VLT Large Program

PI Manara

X-Shooter & ESPRESSO spectra

HERA: XMM-Newton, NICER, Chandra (PI Schneider, Günther)



First Results: Accretion, Ejection, and Disk Irradiation of CVSO 109; Espaillat et al. submitted)

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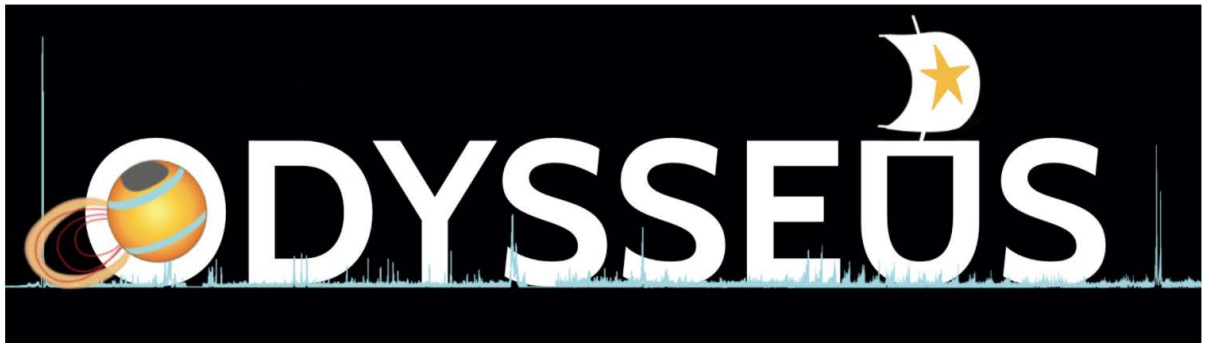

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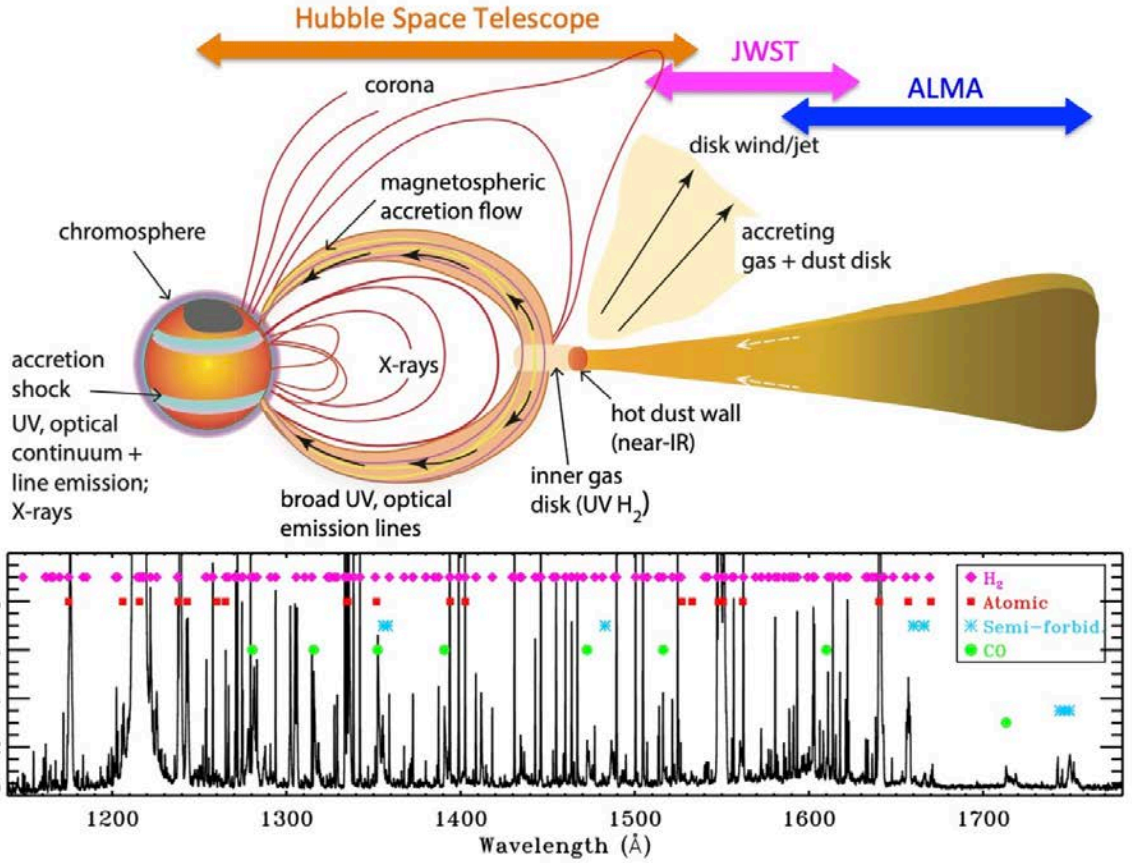

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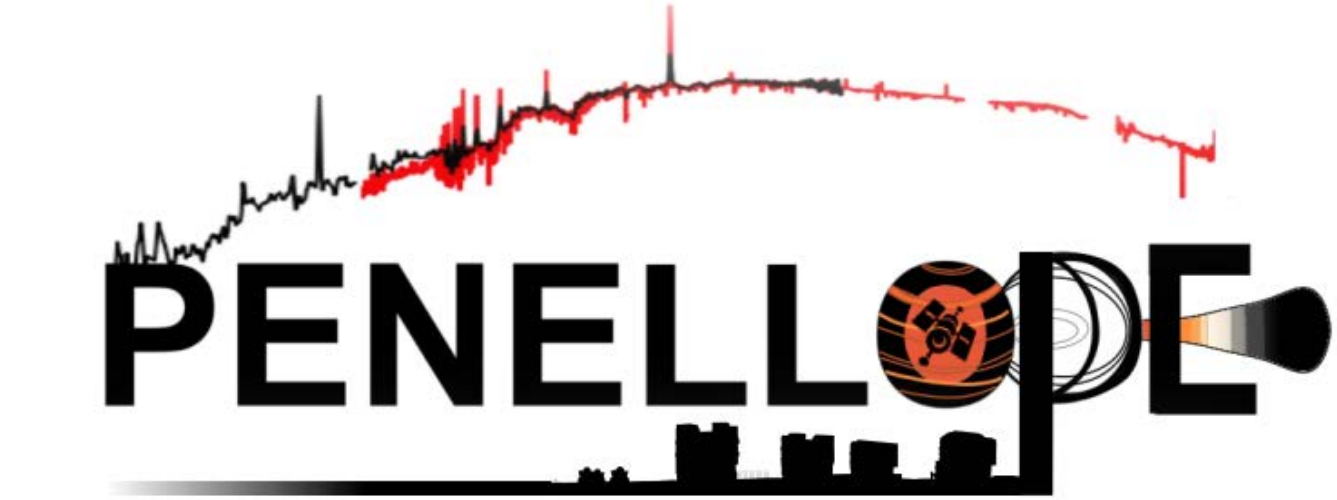
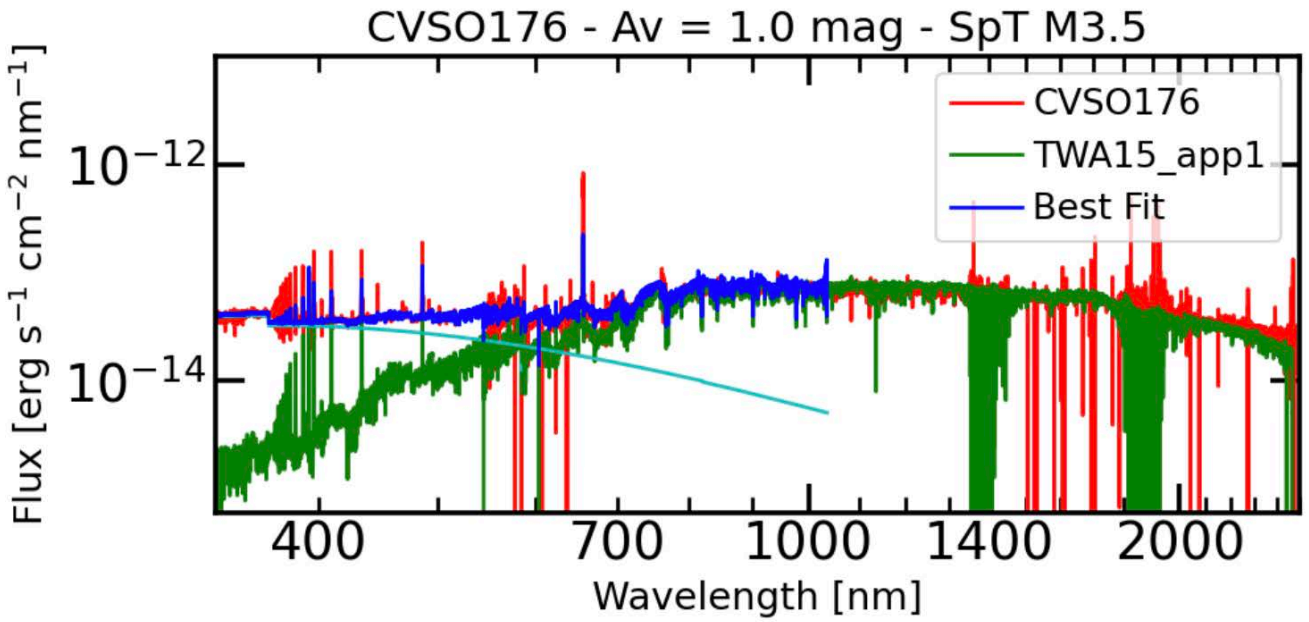
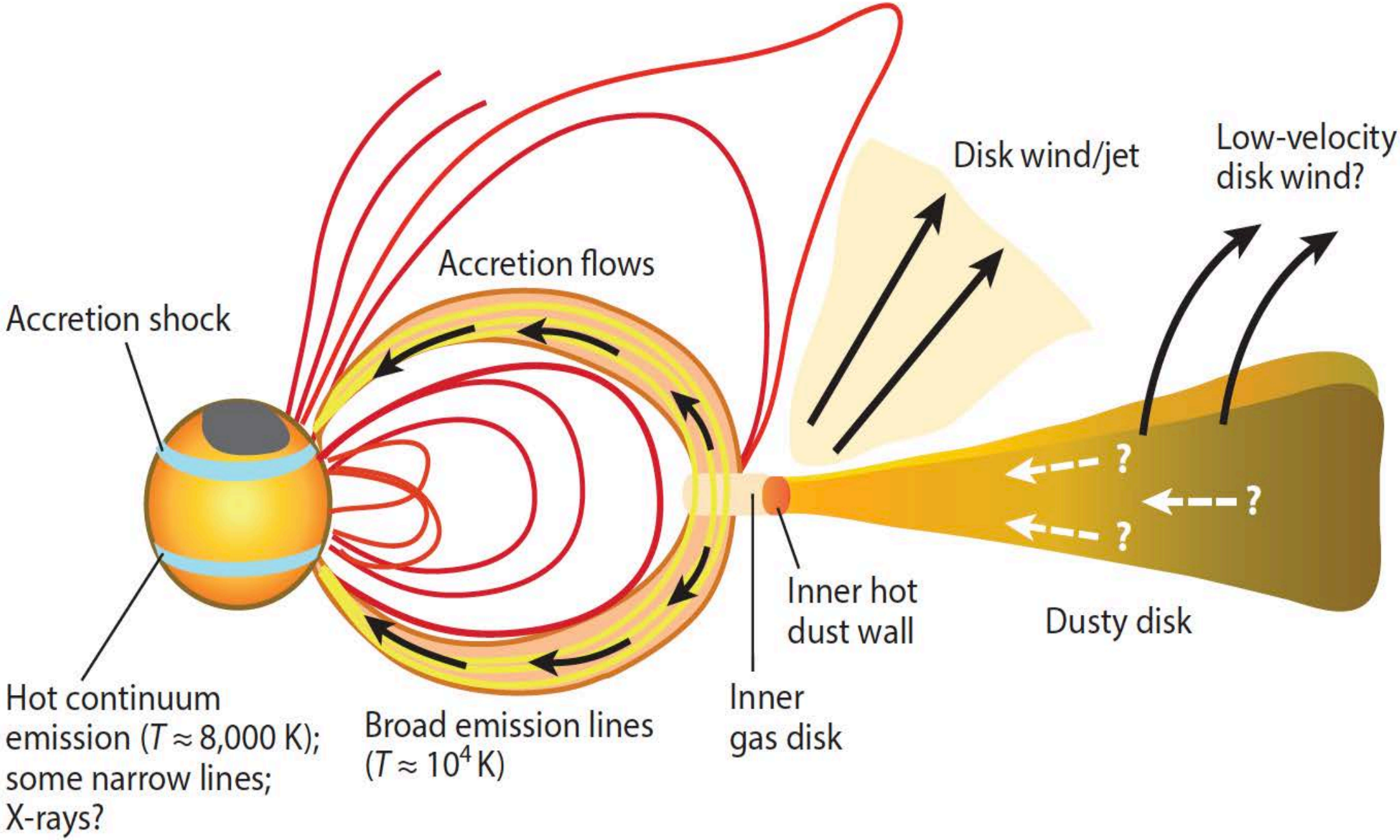




PI Manara, 250 hrs for a public survey on VLT

- X-Shooter: 300-2500 nm at R=15,000
  - Flux calibrated
  - Stellar, accretion properties with extinction
- ESPRESSO: v sin i, radial velocity, veiling, line kinematics, line profiles

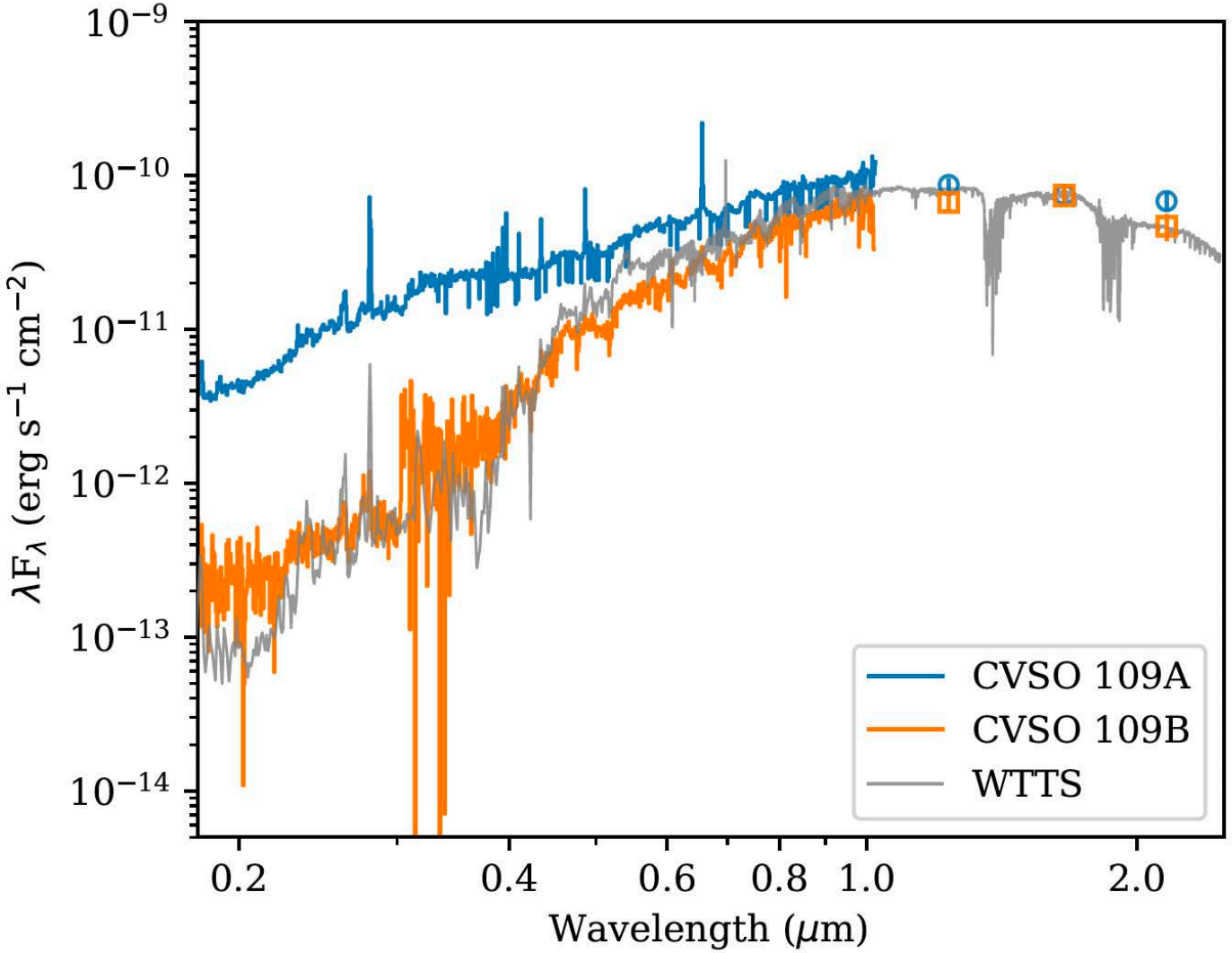
(Manara+2021; Frasca+2021)


Disk wind/jet
Low-velocity
disk wind?
Accretion flows
Accretion shock
?
?
?
Inner hot
dust wall
Dusty disk
Hot continuum
emission ($T \approx 8{,}000$ K);
some narrow lines;
X-rays?
Broad emission lines
($T \approx 10^4$ K)
Inner
gas disk

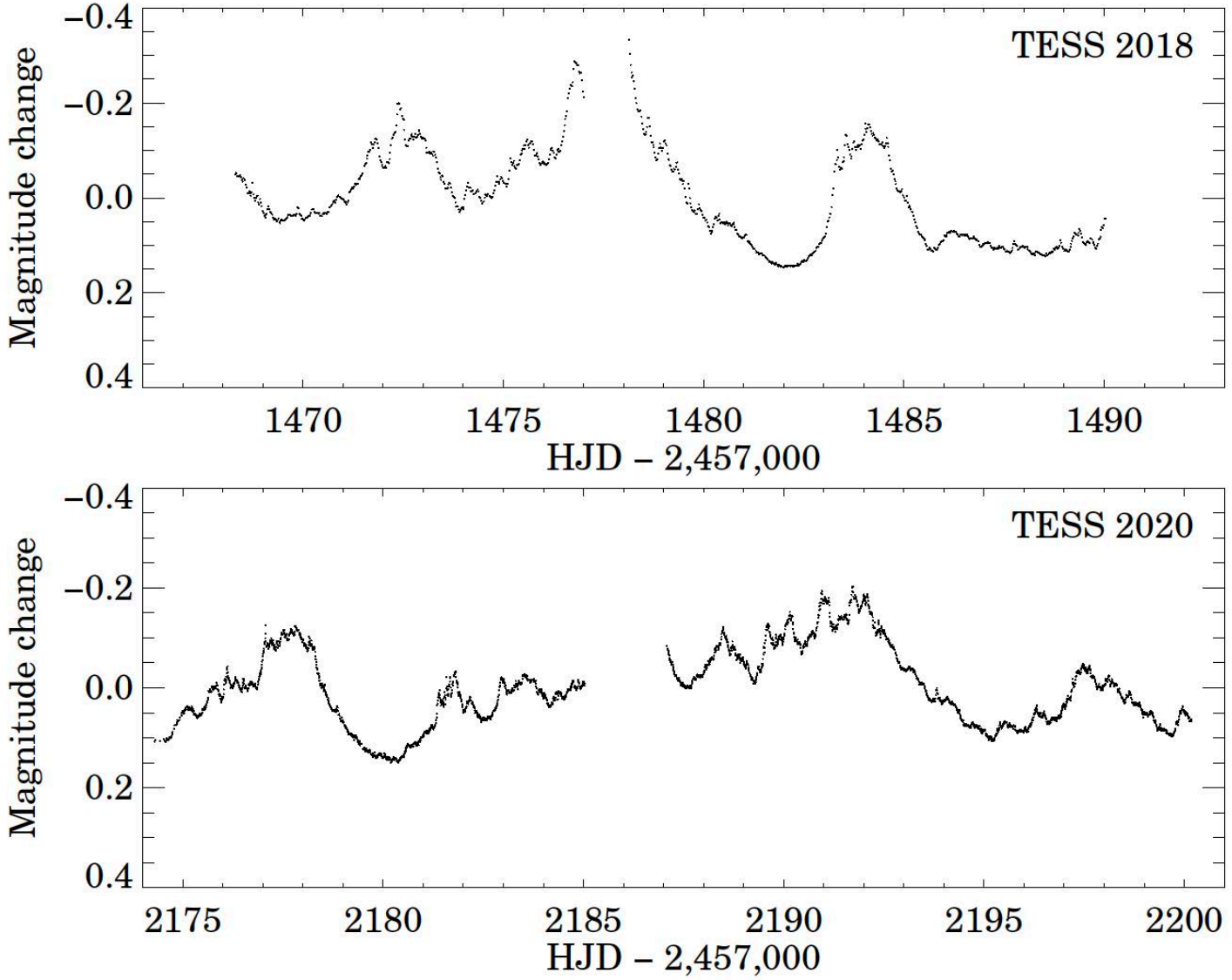
CVSO 109: a CTTS+WTTS binary in Orion

- Orion (400 pc)
- M0+M1 binary
  - (0.5/0.42 Msun)
- M0 component has disk

STIS spectra: separate components

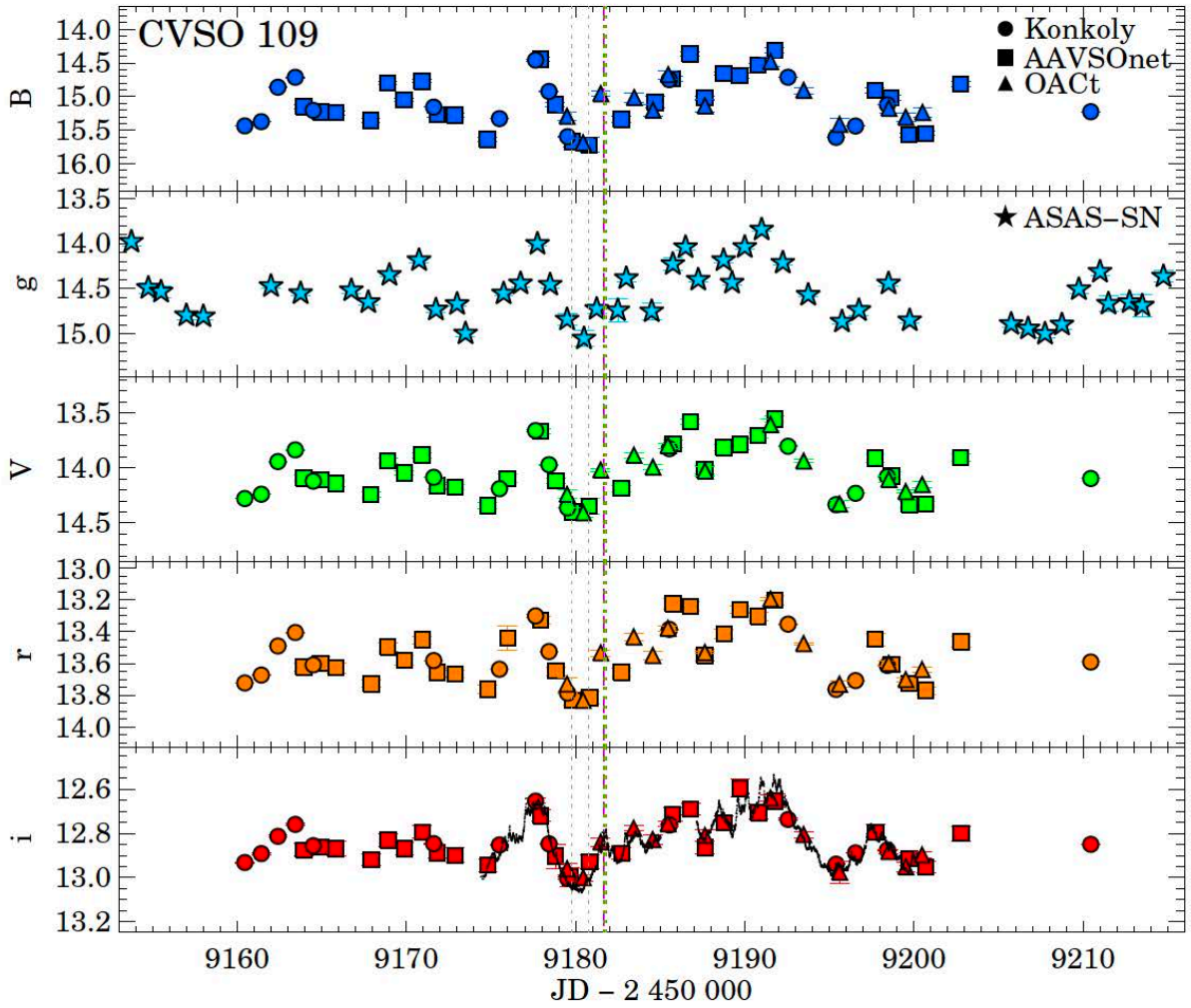


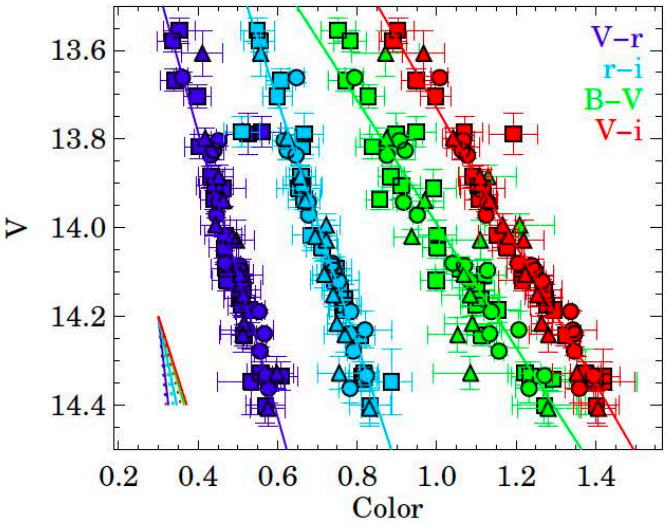
TESS photometry: 6.5 day quasi-period

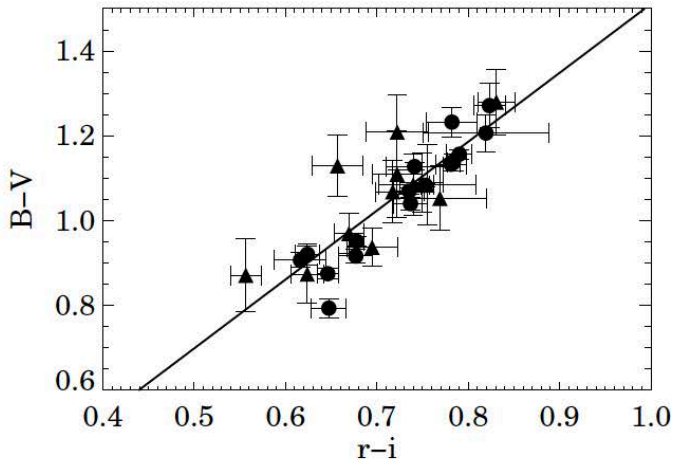


See also, Serna+ subm, Kospal+; Walter+

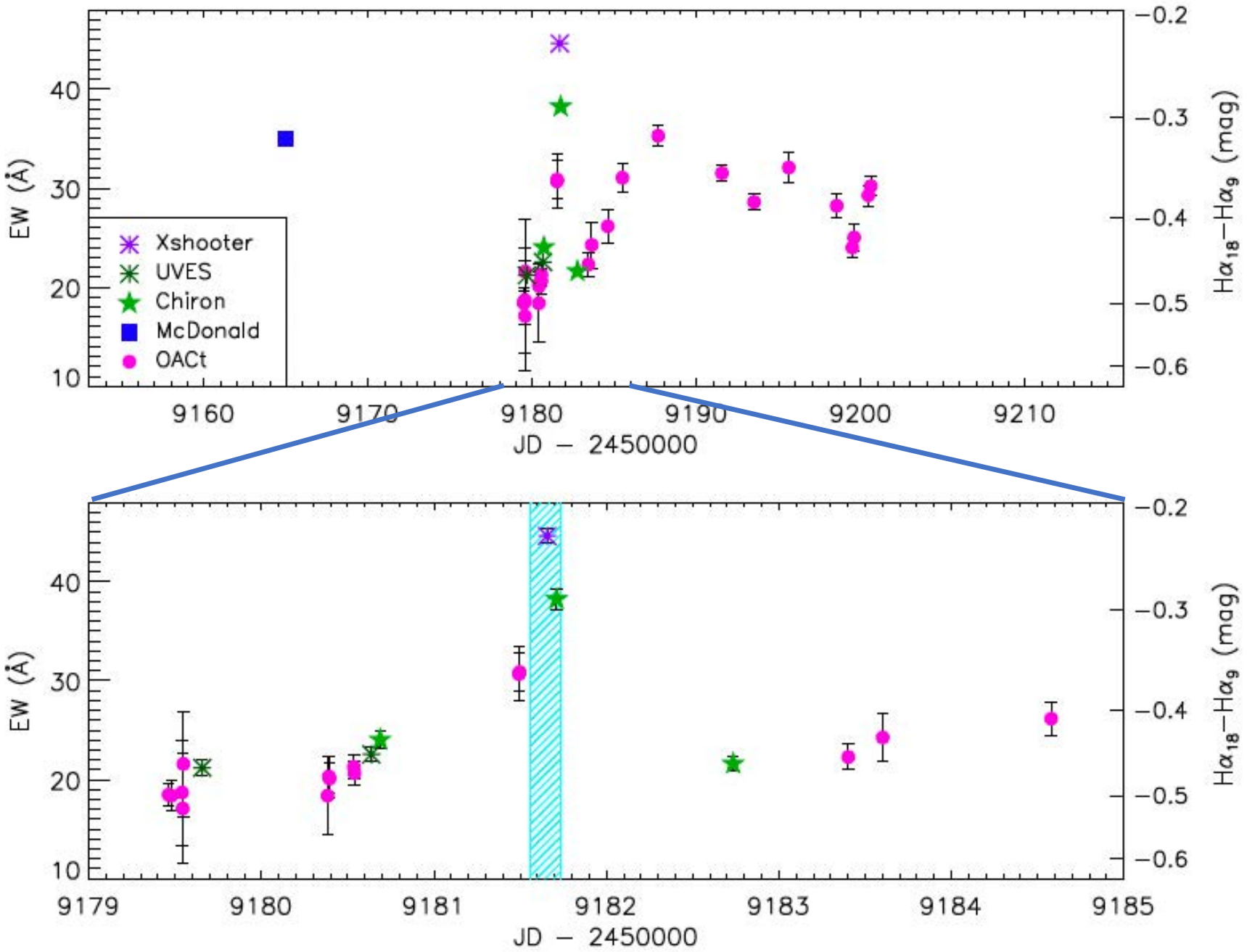
Optical photometry: Konkoly, OACt, AAVSO







Frasca, Kospal, Walter, Froebrich



H-alpha EW

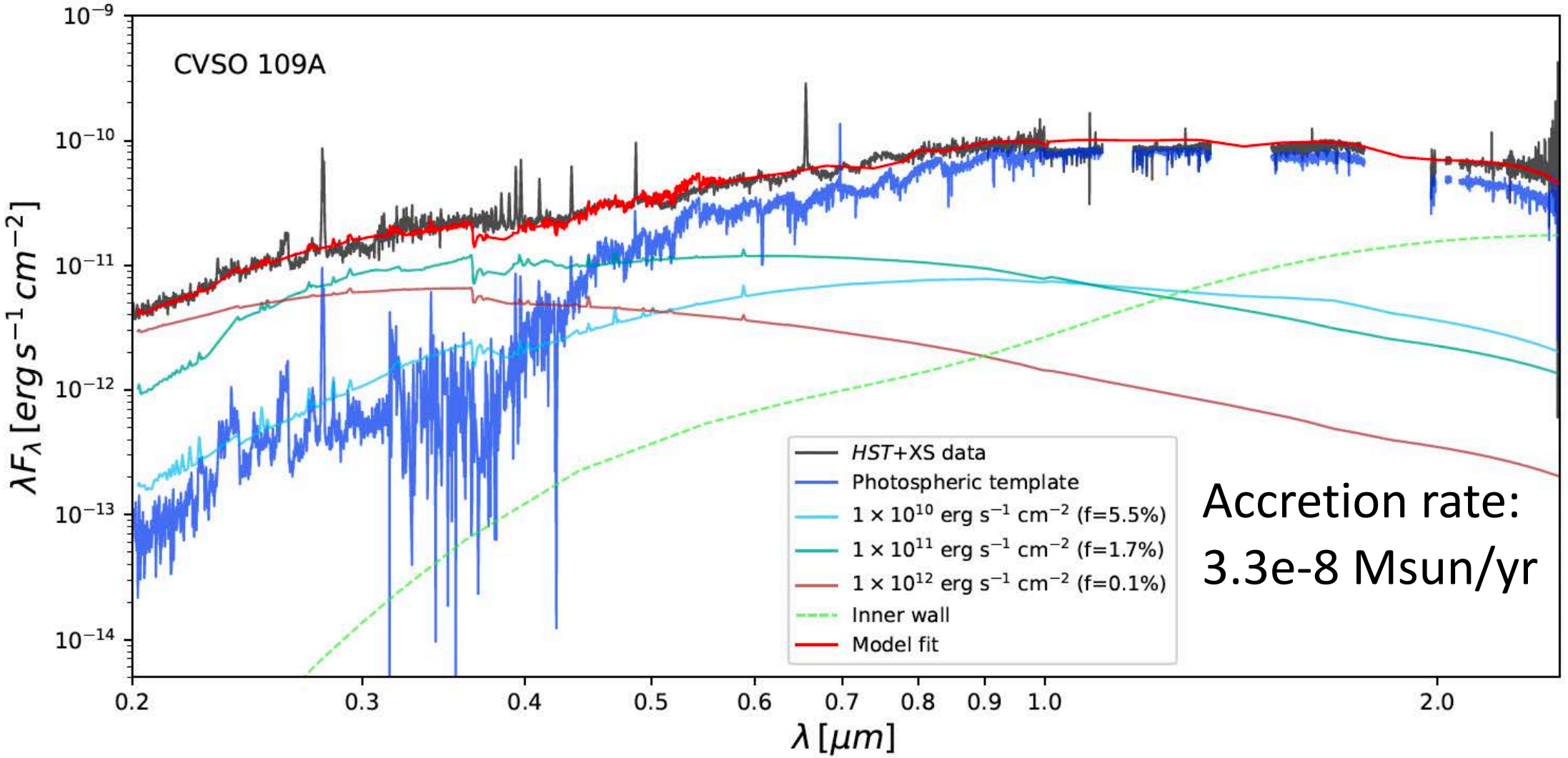
Shaded: HST observations

See also PENELLOPE results

Manara+2021; Frasca+2021

(VLT Large Program)

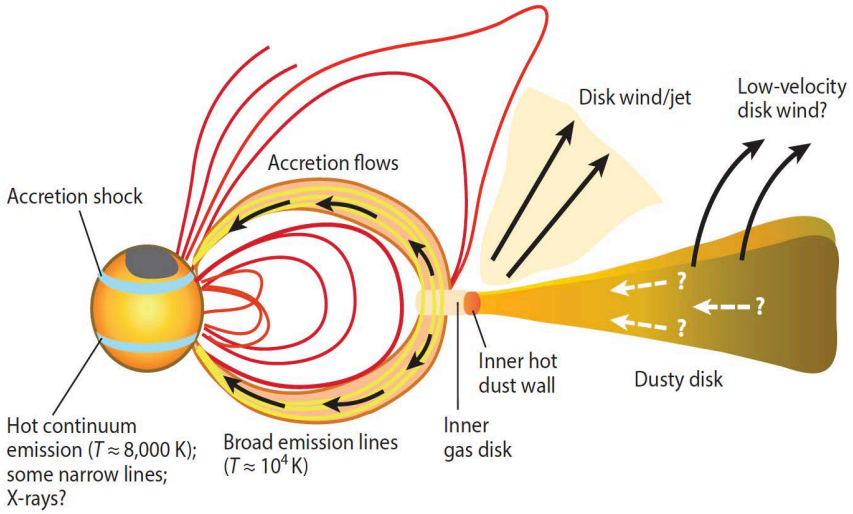
Accretion rate: multiple accretion columns
(see also Robinson & Espaillat 2019)



Accretion rate:
3.3e-8 Msun/yr

C IV: postshock prediction

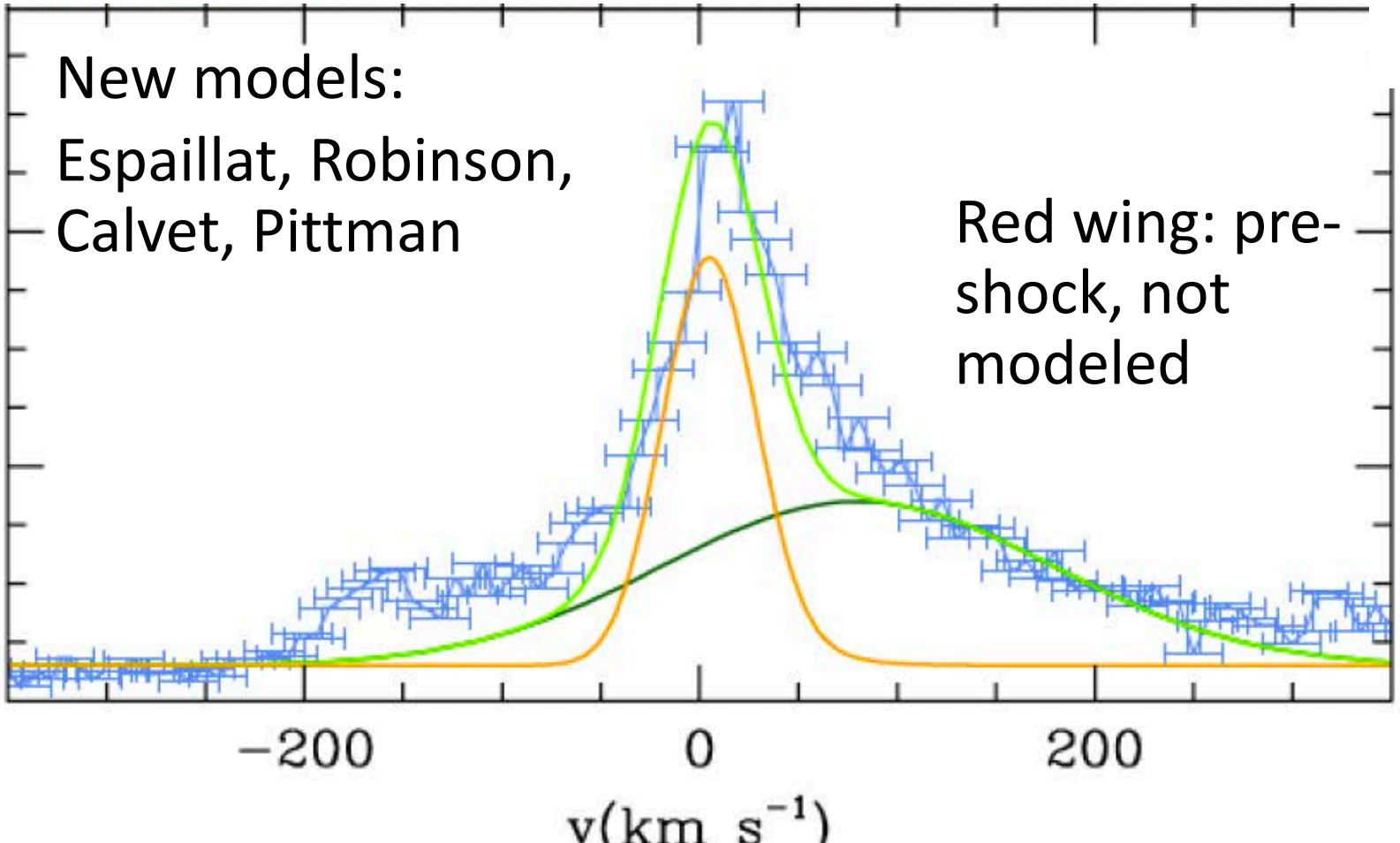
see also, profiles in Ardila+2013

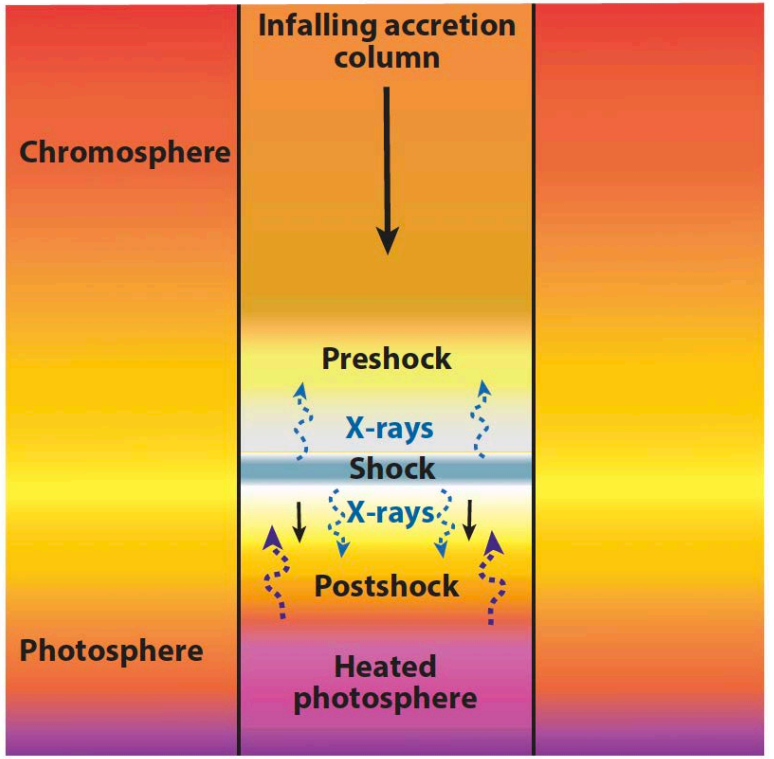


New models:

Espaillat, Robinson, Calvet, Pittman

Red wing: pre-shock, not modeled



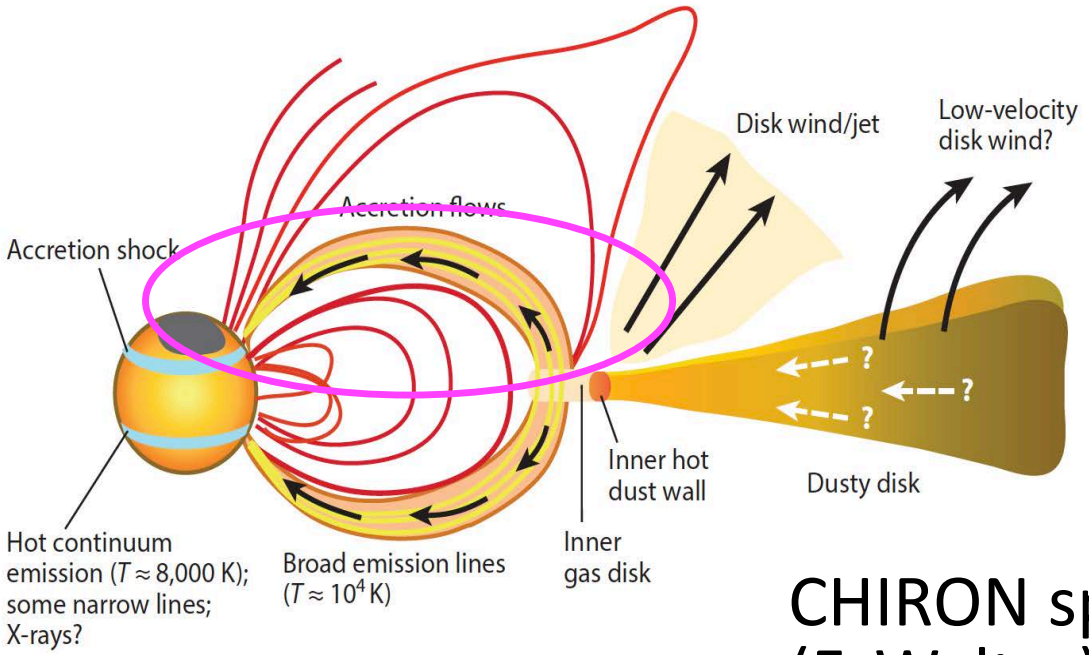


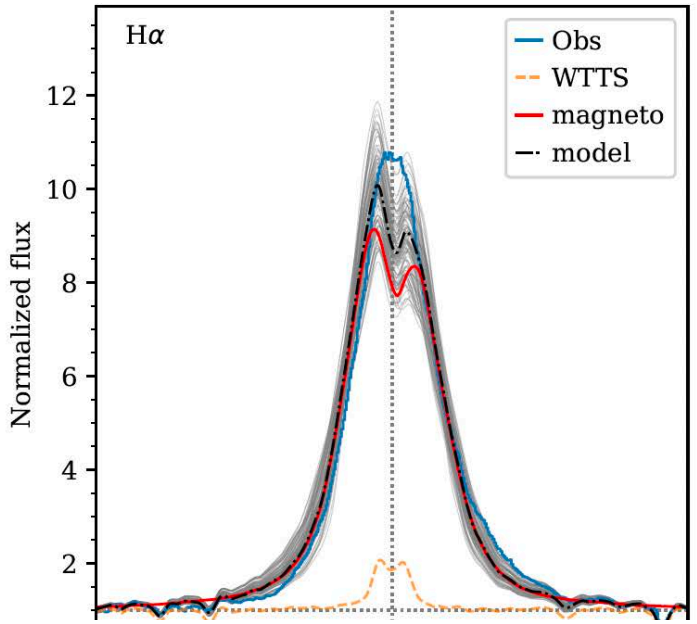
Accretion funnel flow

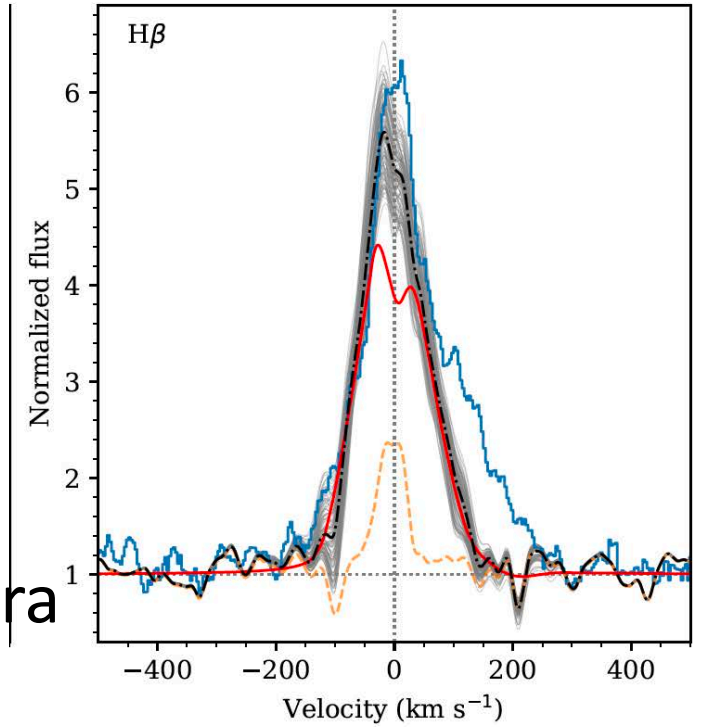
Models of H-alpha and H-beta

(Muzerolle+2001; fitting by Thanathibodee+;

see also STAR-MELT by Campbell-White & Sicilia Aguilar 2021





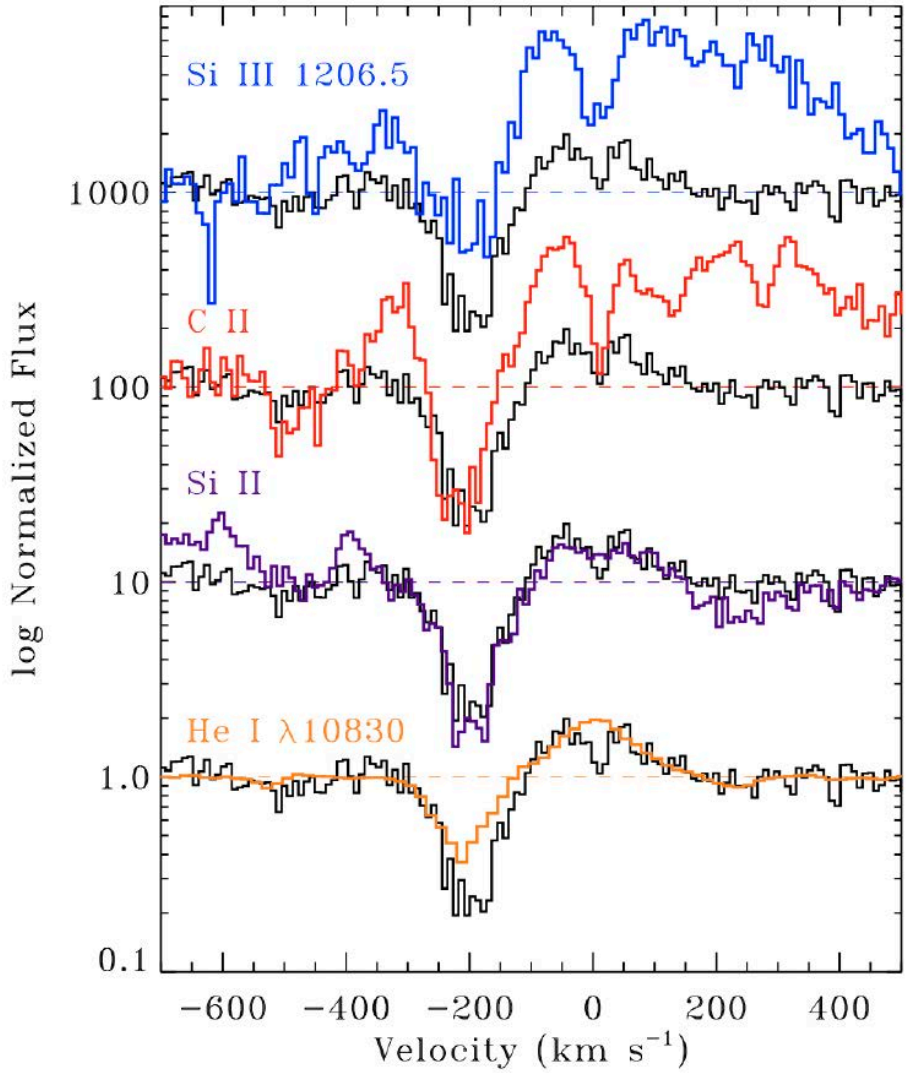


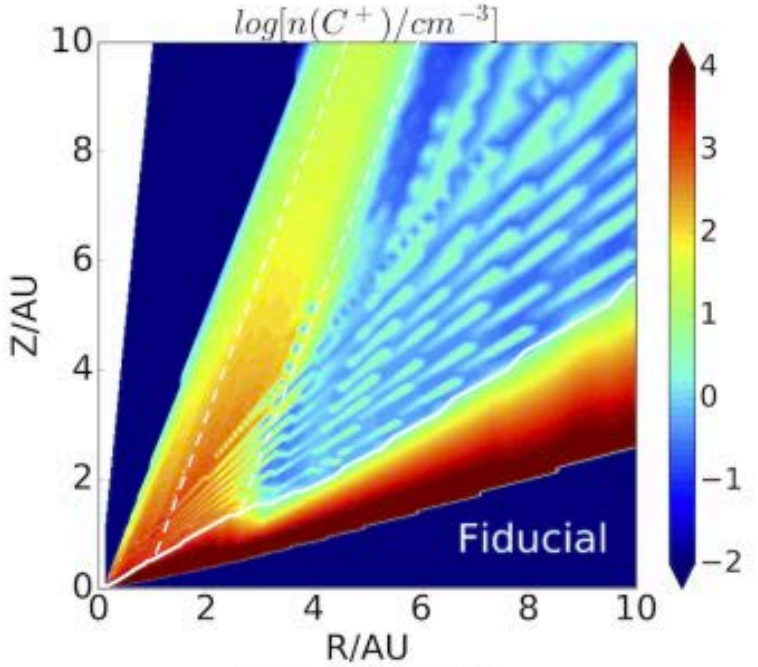
CHIRON spectra (F. Walter)

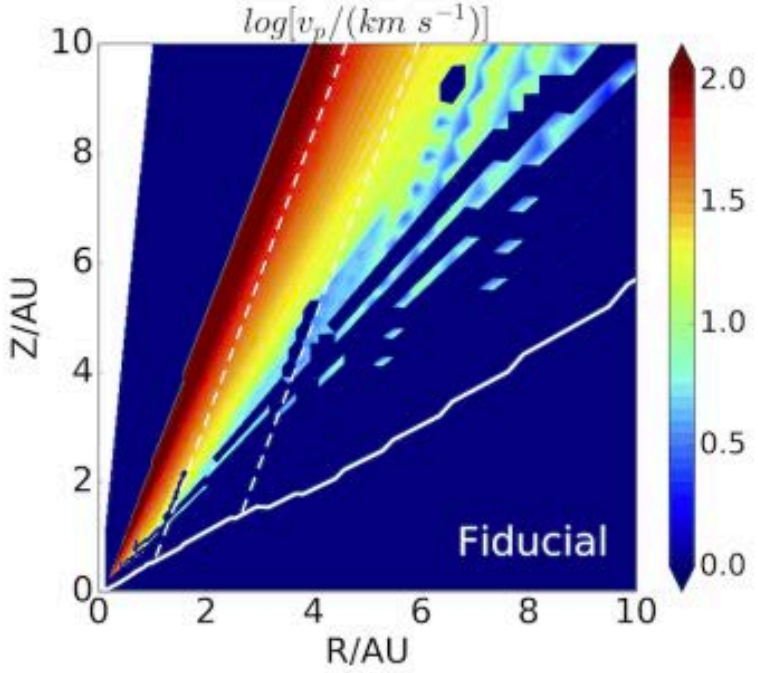
Fast, cool wind

(see also, Xu et al. 2021; Thanathibodee et al. 2020)

Absorption traces magnetic wind close to the star



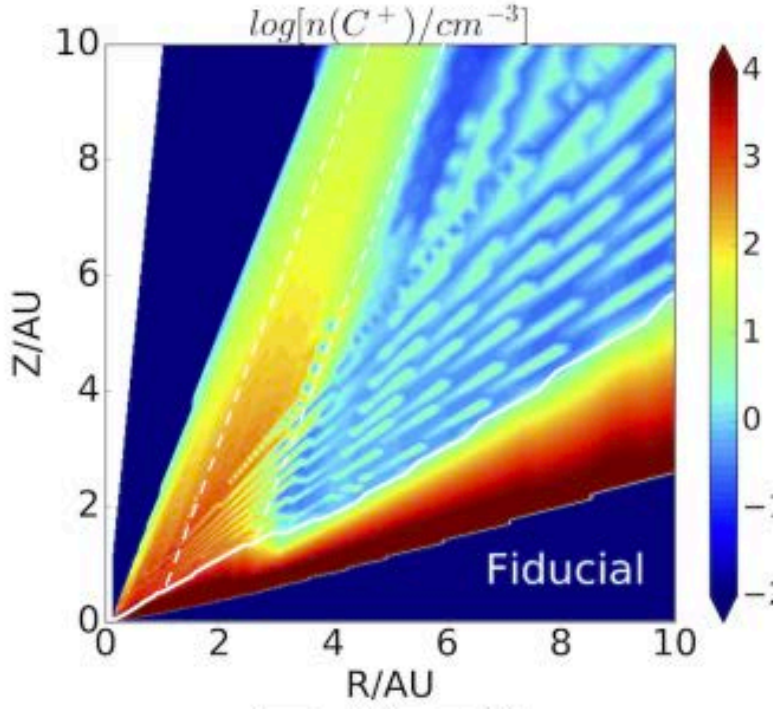


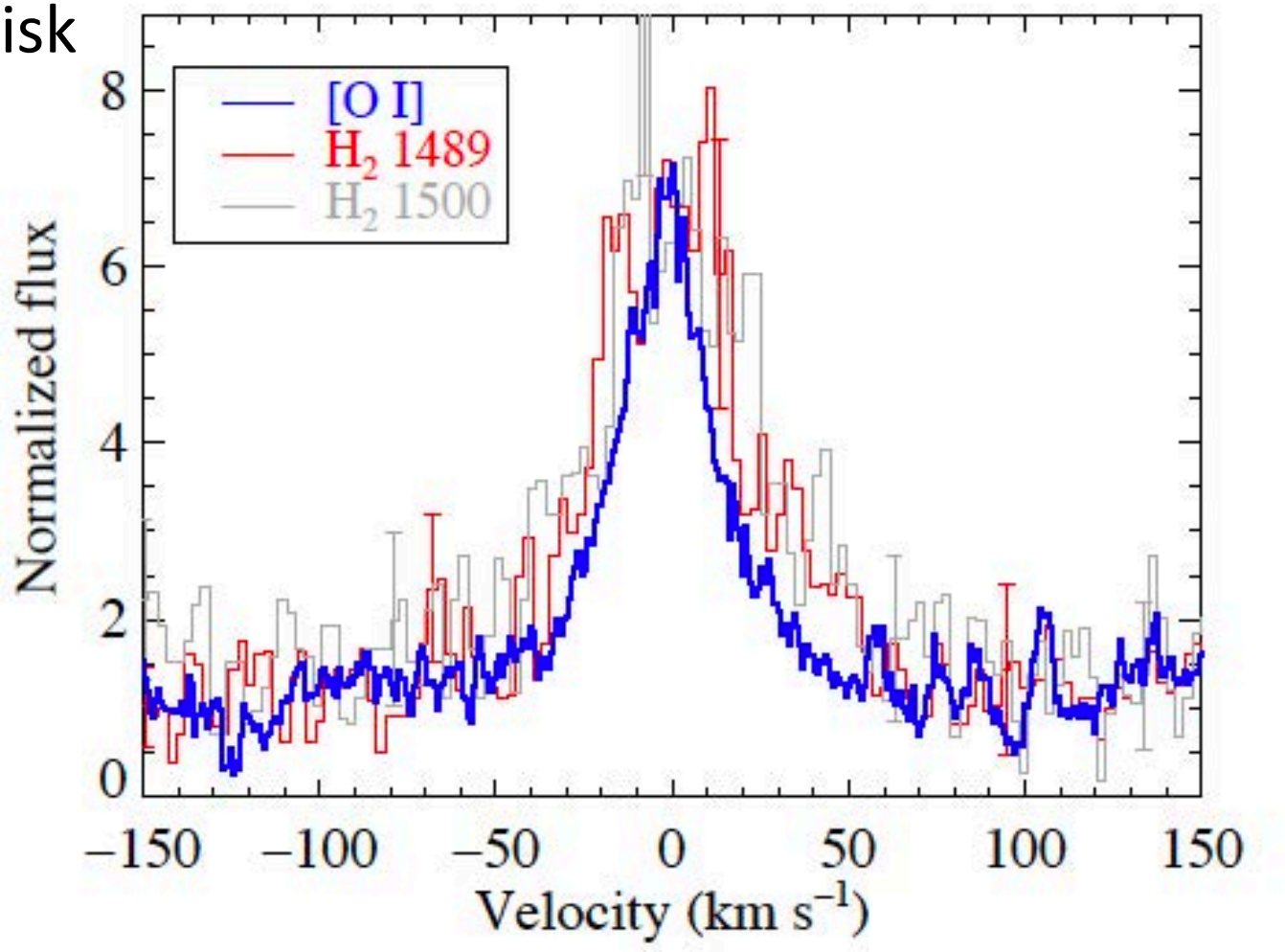


Cooler disk wind: [O I] and maybe H2?

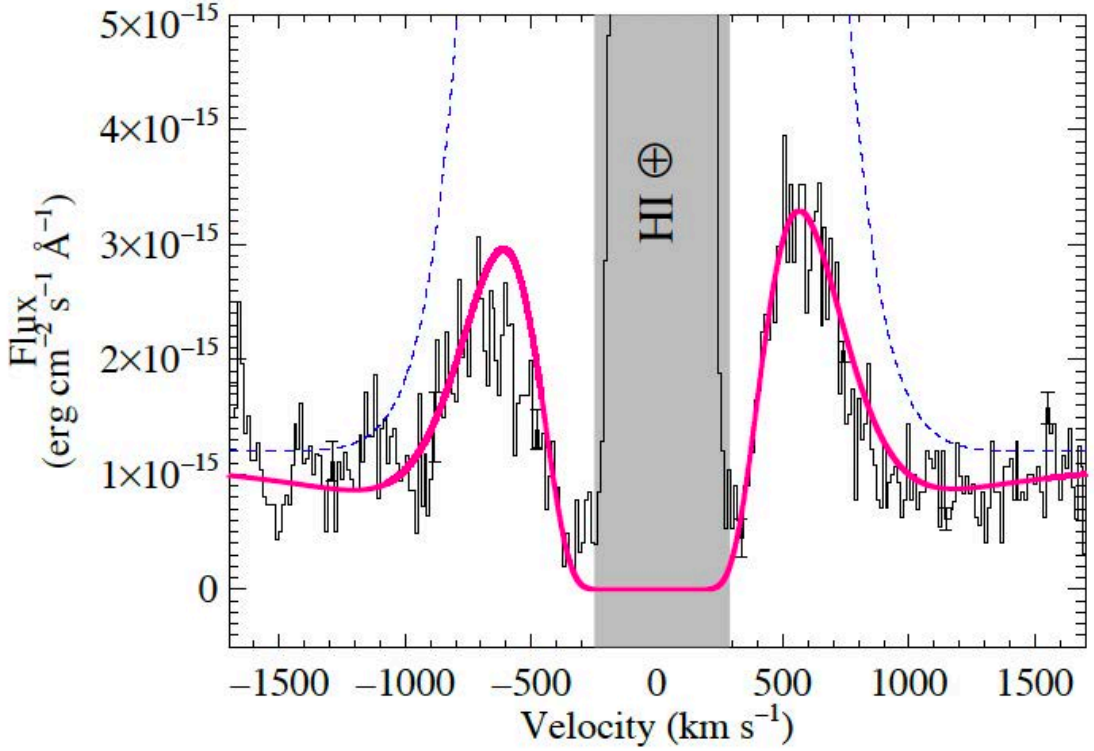
See also, Fang et al. 2019; Gangi et al. 2020

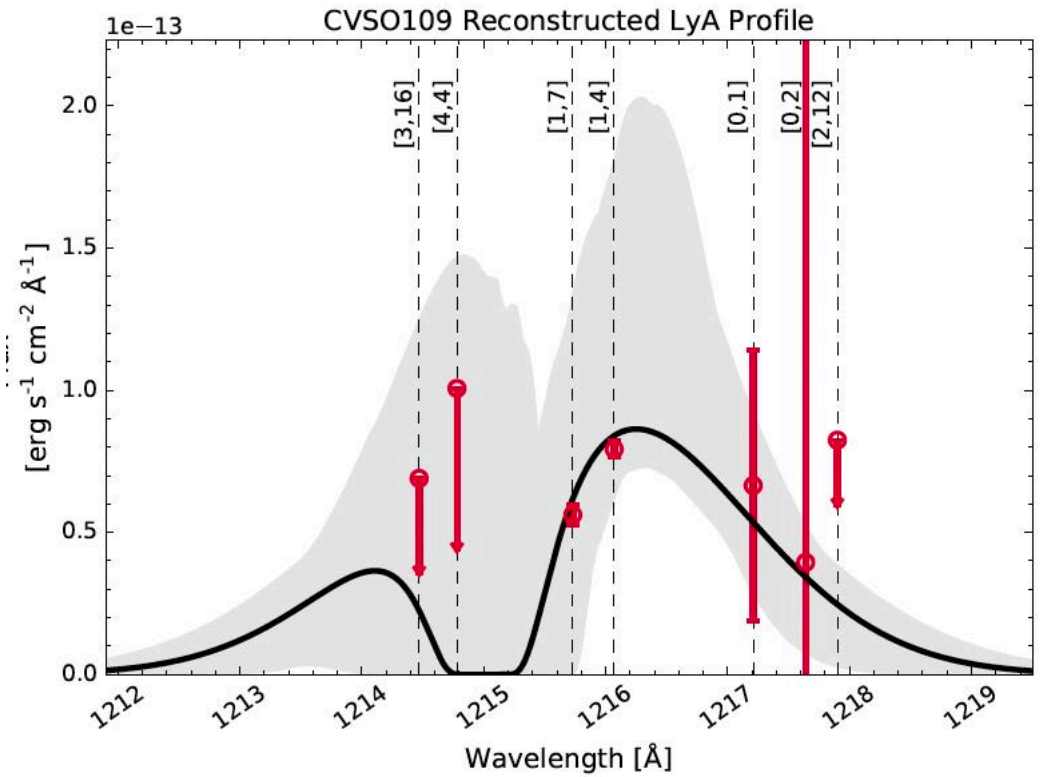
Disk wind from further out in disk



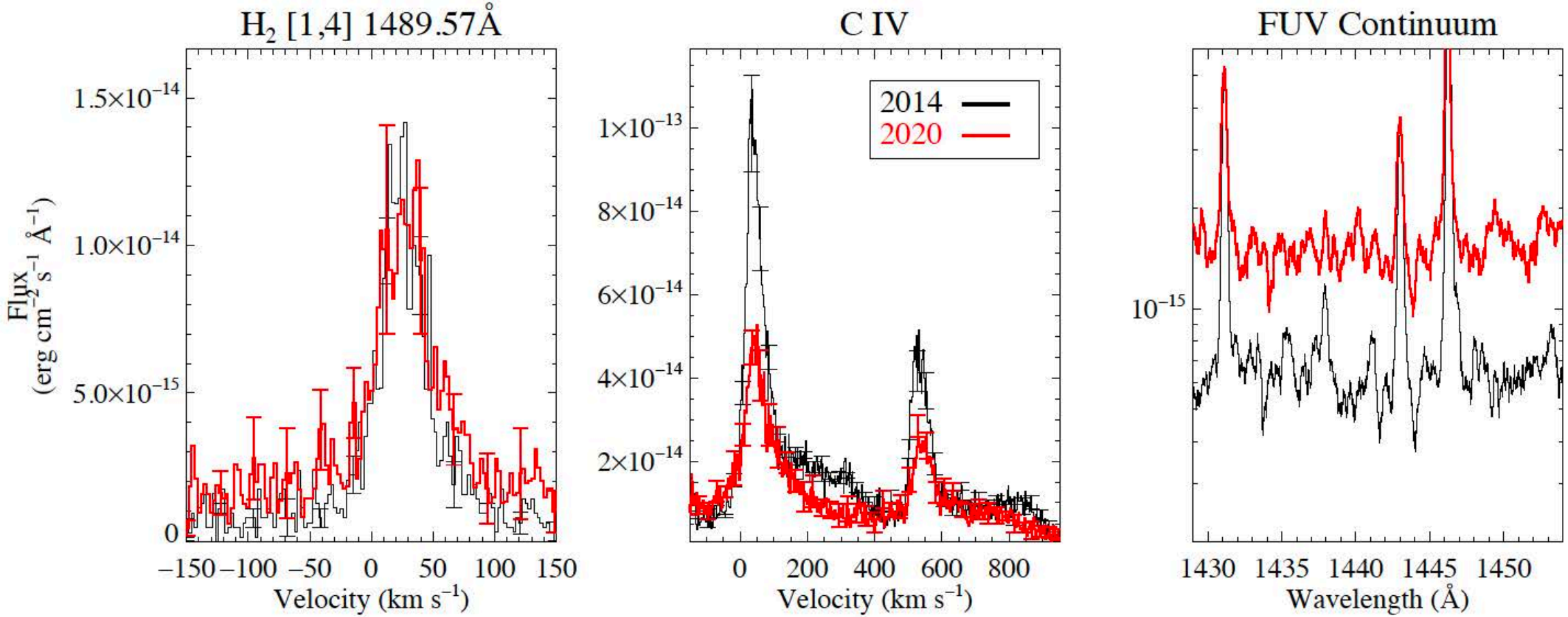


Ly-alpha profile: reconstructed with H2 lines
(see also Arulanantham et al. 2021)



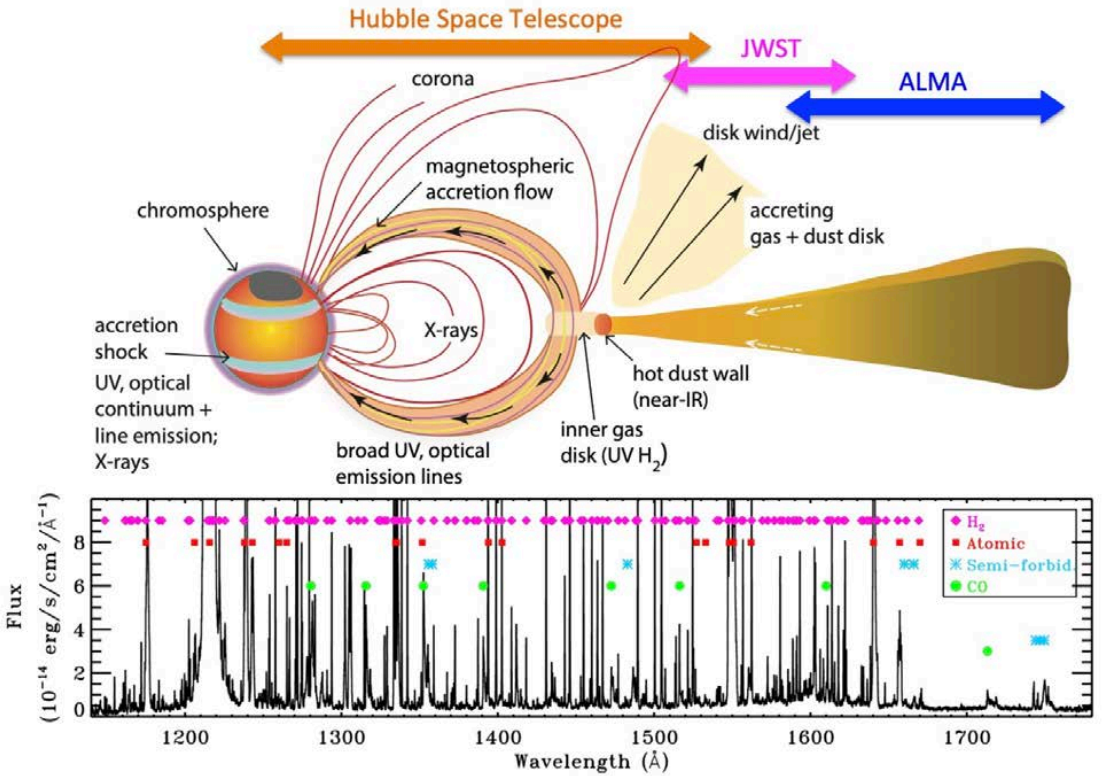


2020 versus 2014 epochs



ODYSSEUS and ULLYSES-disks

- ULLYSES observations of disks about half finished
- We are collecting simultaneous spectra and photomet
  - Most data will be made available at some point (some on zenodo)
  - ULLYSES team at STScI is building a centralized database
- Open team, welcomes additional collaborators
  - Authorship limited to substantial contributions
- Unique diagnostics: accretion, winds, irradiated disks!
  - Relationships between wind, jet, and accretion
  - Morphology of accretion, wind
  - Shock structures
  - Radiation fields, including Ly-alpha



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