A Census of the Lowest Accretors

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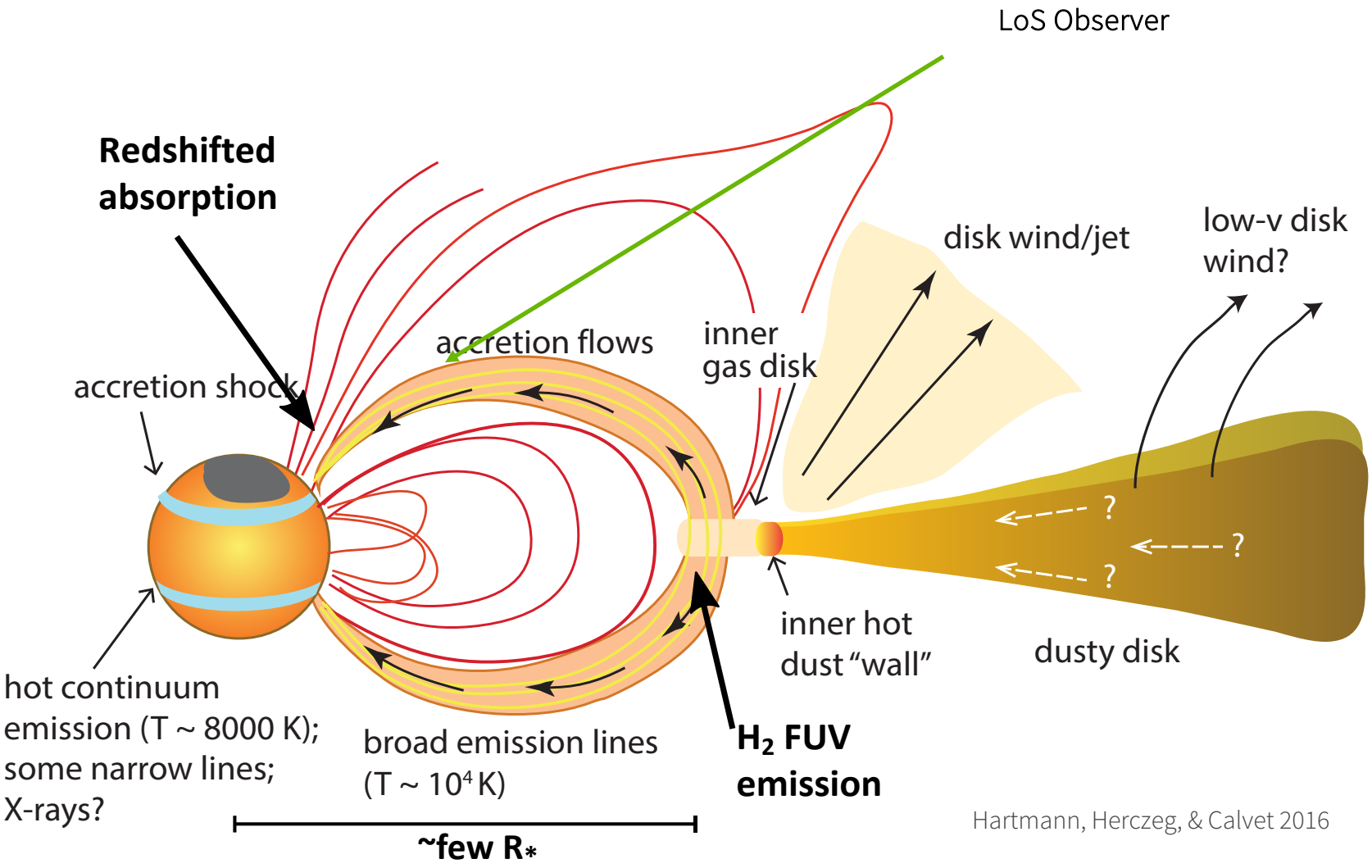
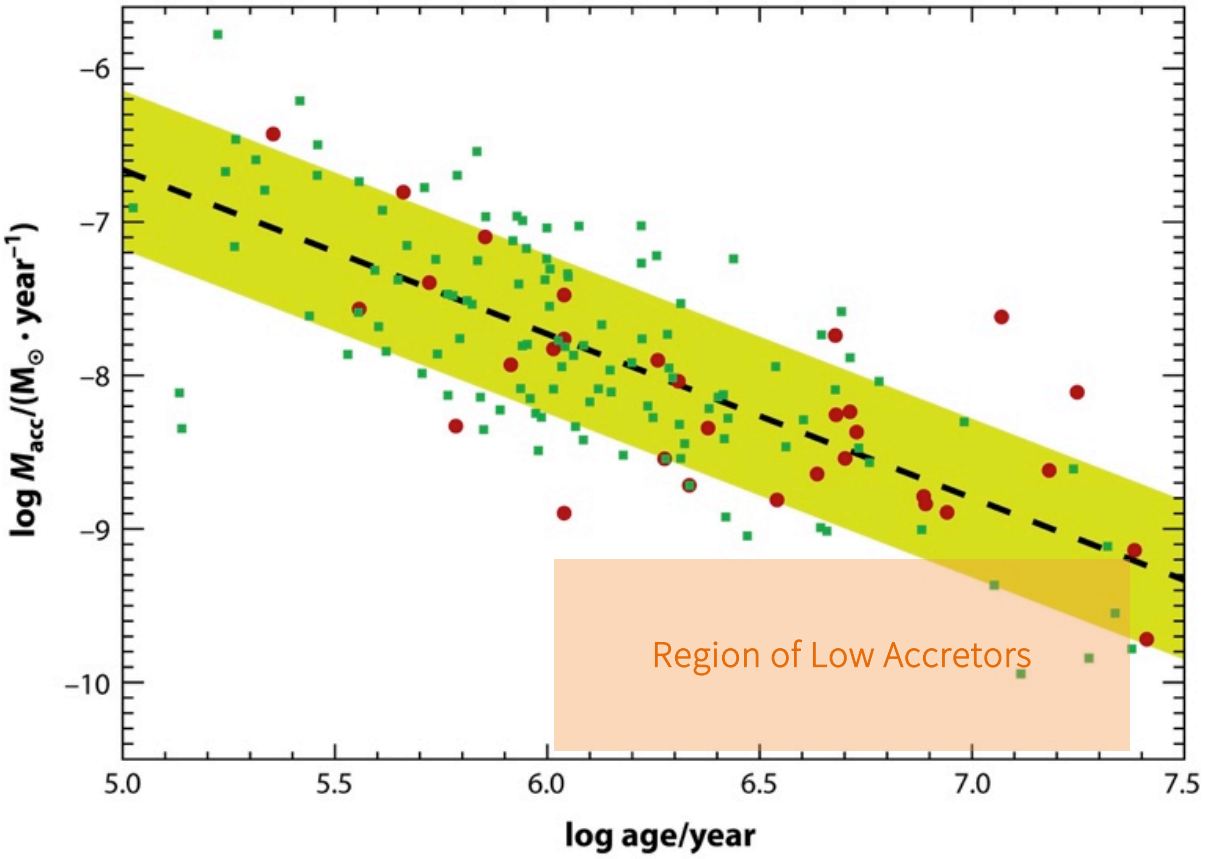
Magnetospheric Accretion



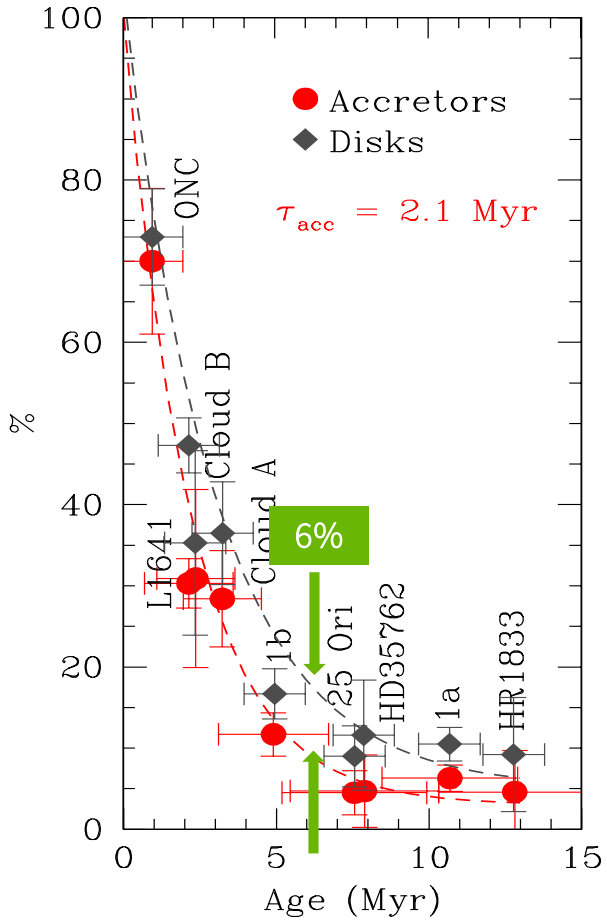
Hartmann, Herczeg, & Calvet 2016

Accretion changes with time

- Accretion rate & frequency of accretors decrease with time



Hartmann, Herczeg, & Calvet 2016



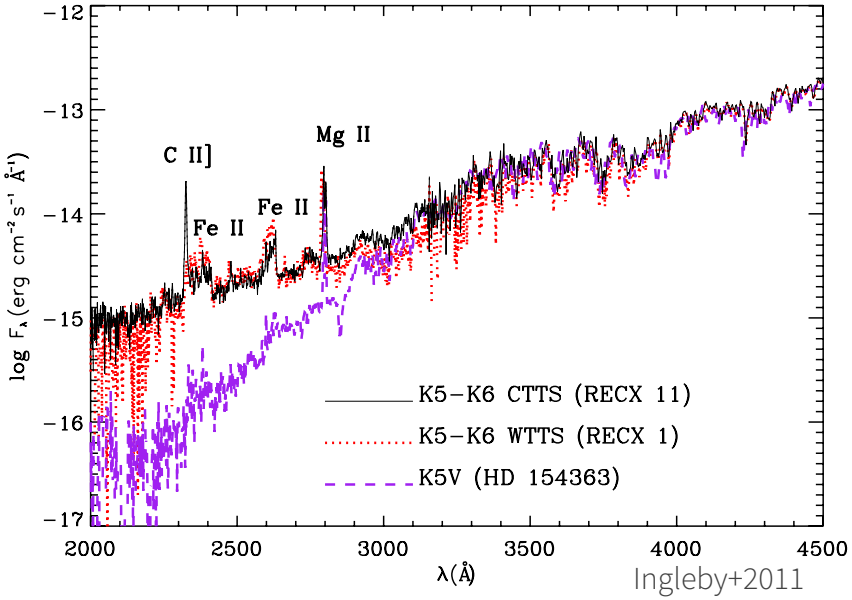
Briceno+2019

Accretor: a Star with DETECTABLE Accretion

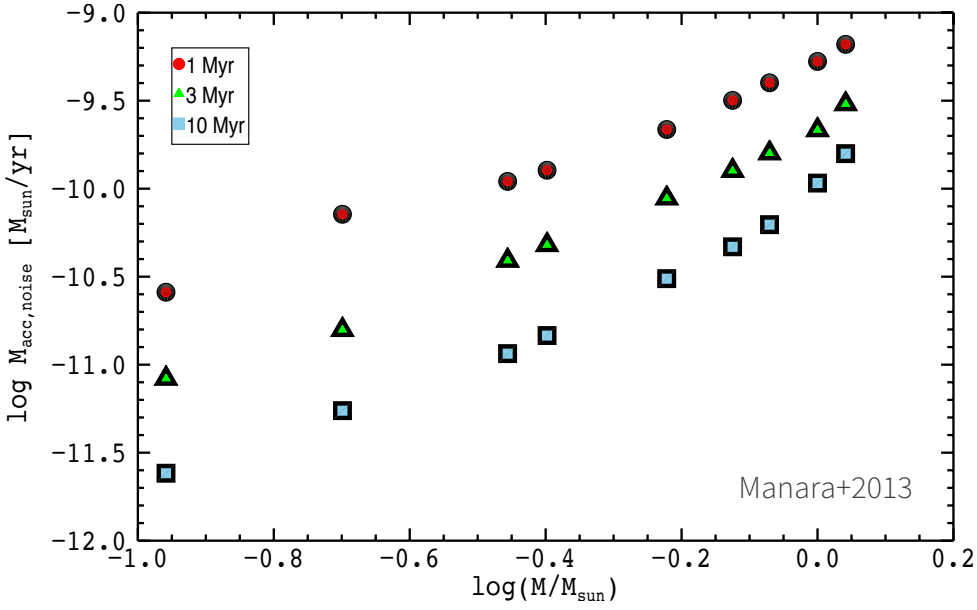
Low Accretor: an Accretor with barely detectable accretion

It's all about contrast

- Chromospheric emission is important
- Accretion scales with mass – "low accretor" category is mass-dependent
- Detectability depends on spectral type – contrast between photosphere & shock



Ingleby+2011

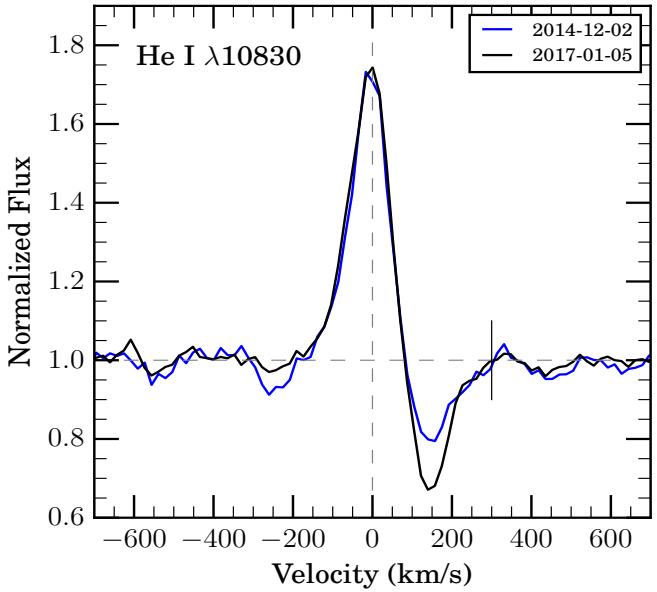


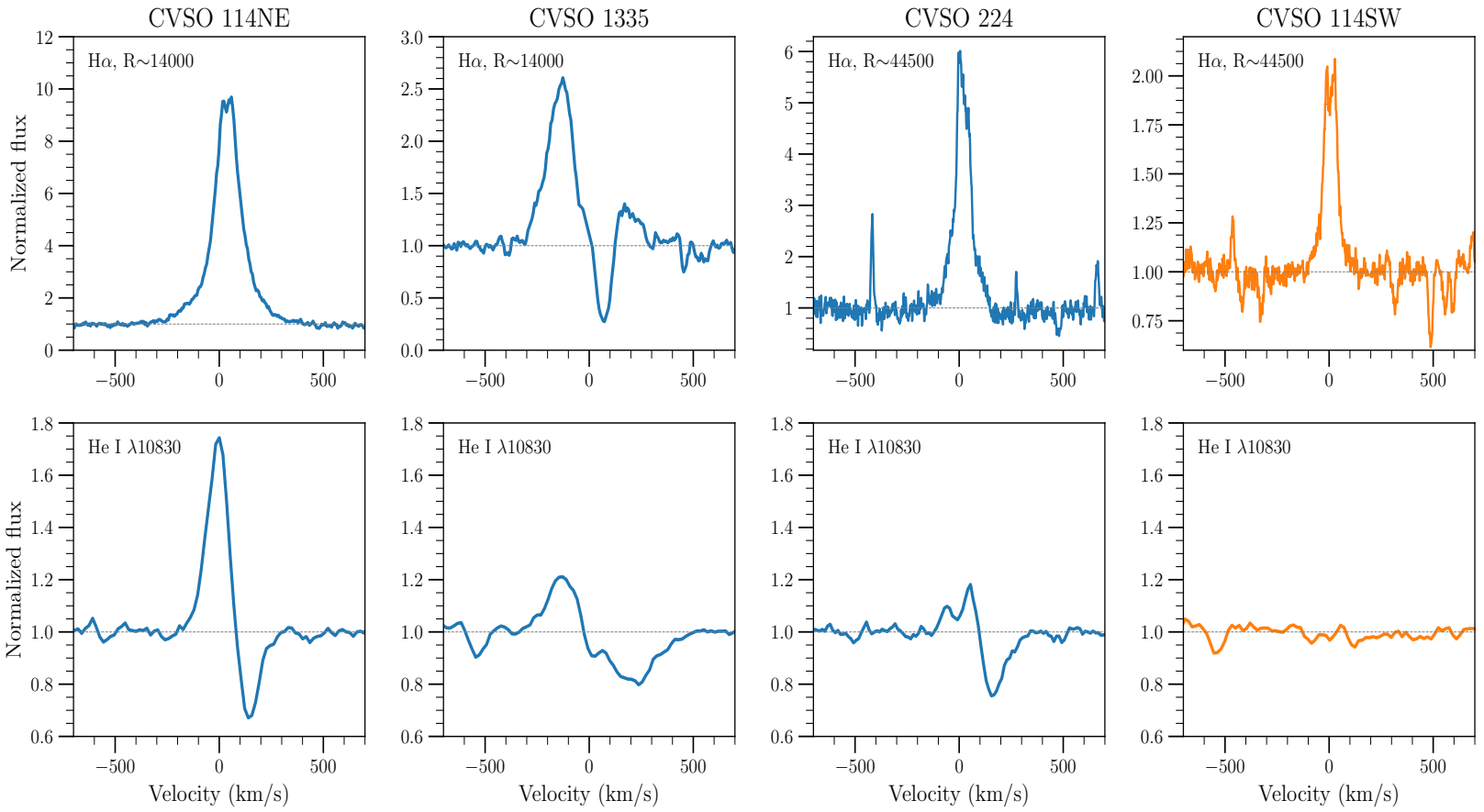
The Last Stages of Accretion

- Completing the details of magnetospheric accretion at low rate
- What causes accretion to stop?
  - Accretion occurs inside corotation radius. If the truncation radius shift outside corotation, accretion will stop.
  - (Photoevaporative/Stellar) winds can carry material away from the inner disk before they reach the star.
  - Planets take away mass that would have been accreted to the star.

He I 10830 is a superior accretion tracer

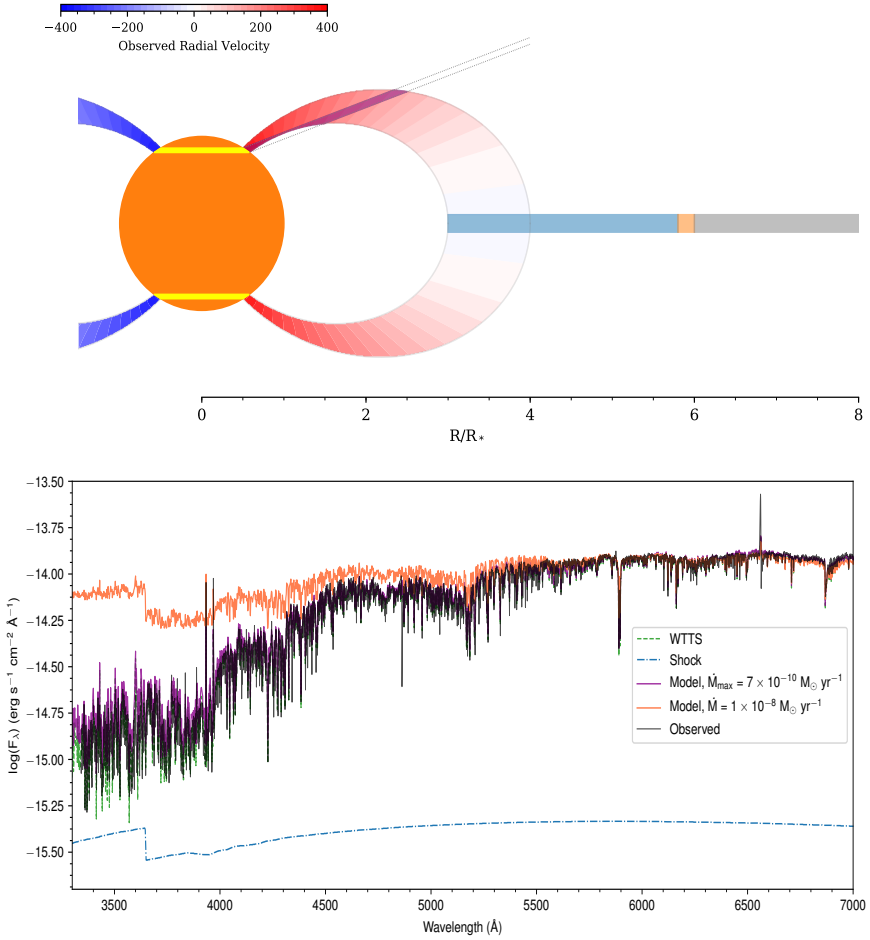
- Lower level is metastable, high gf value – sensitive at low density
- Located in J band – universal tracer
  - can be observed in all relevant SpT
  - Low extinction
- Redshifted Absorption = accretion




CVSO 114NE
CVSO 1335
CVSO 224
CVSO 114SW
Hα, R∼14000
Hα, R∼14000
Hα, R∼44500
Hα, R∼44500
He I λ10830
He I λ10830
He I λ10830
He I λ10830
Normalized flux
Normalized flux
Velocity (km/s)
Velocity (km/s)
Velocity (km/s)
Velocity (km/s)

Characterizing Low Accretors

- Using Magnetospheric Accretion Model
  - Geometry of accretion
  - Mass accretion rate
  - Muzerolle+2001
- Accretion shock model
  - Constrain on mass accretion rate
  - Calvet & Gullbring 1998

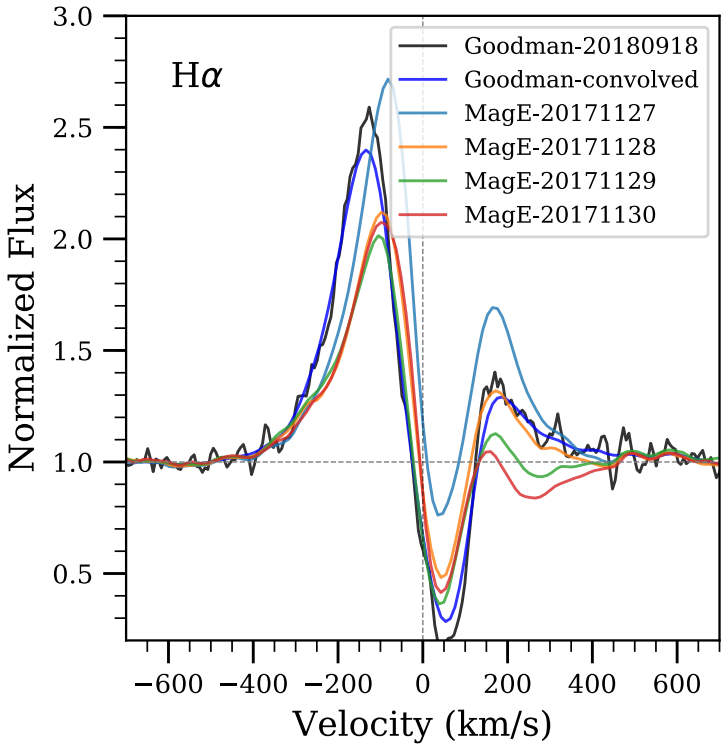


Thanathibodee+2019

Low Accretor Prototype

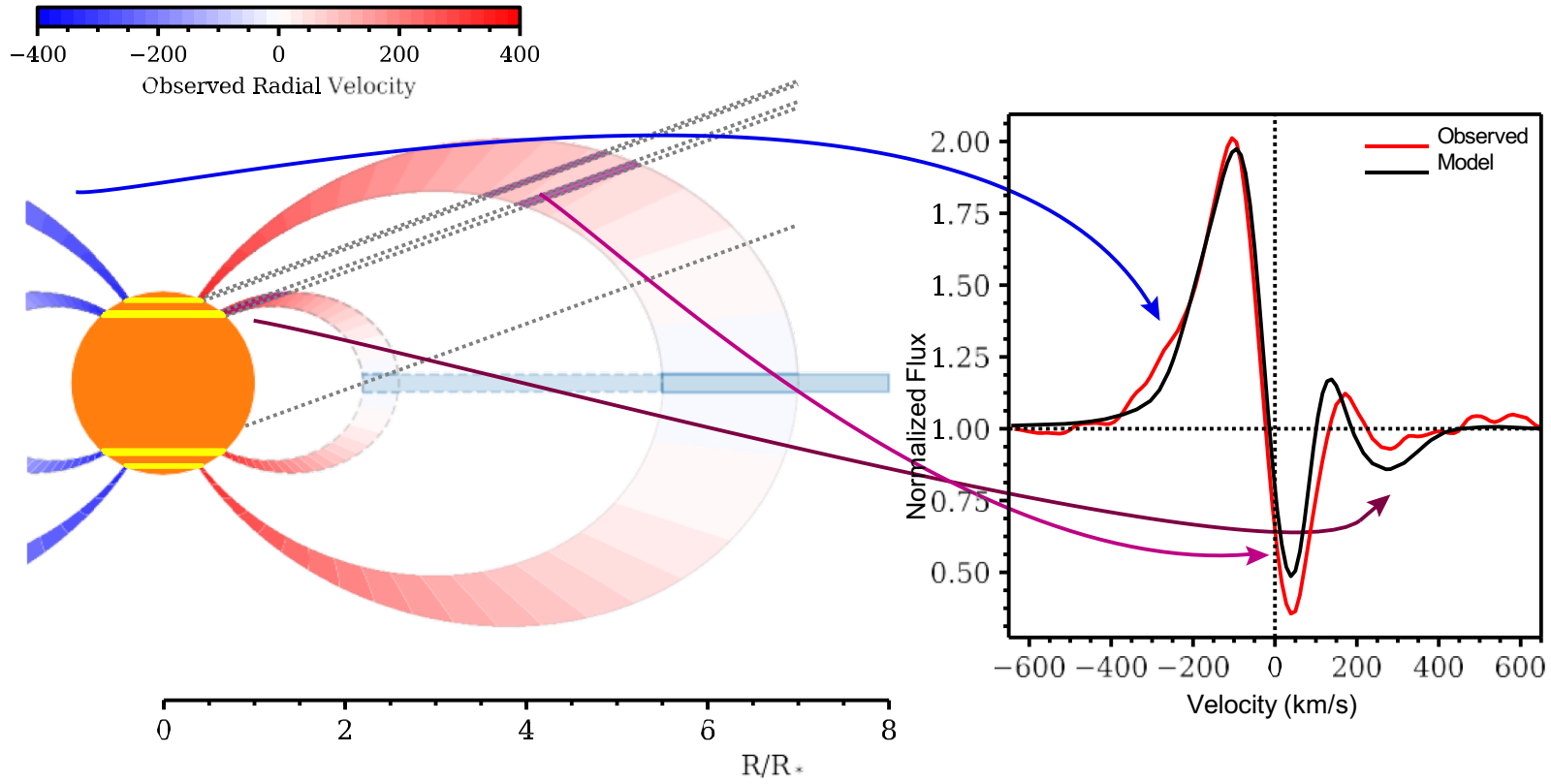
CVSO 1335

- K5 low accretors in Orion OB1b
- Typical He I 10830 redshifted absorption
- Complex H-alpha line profile



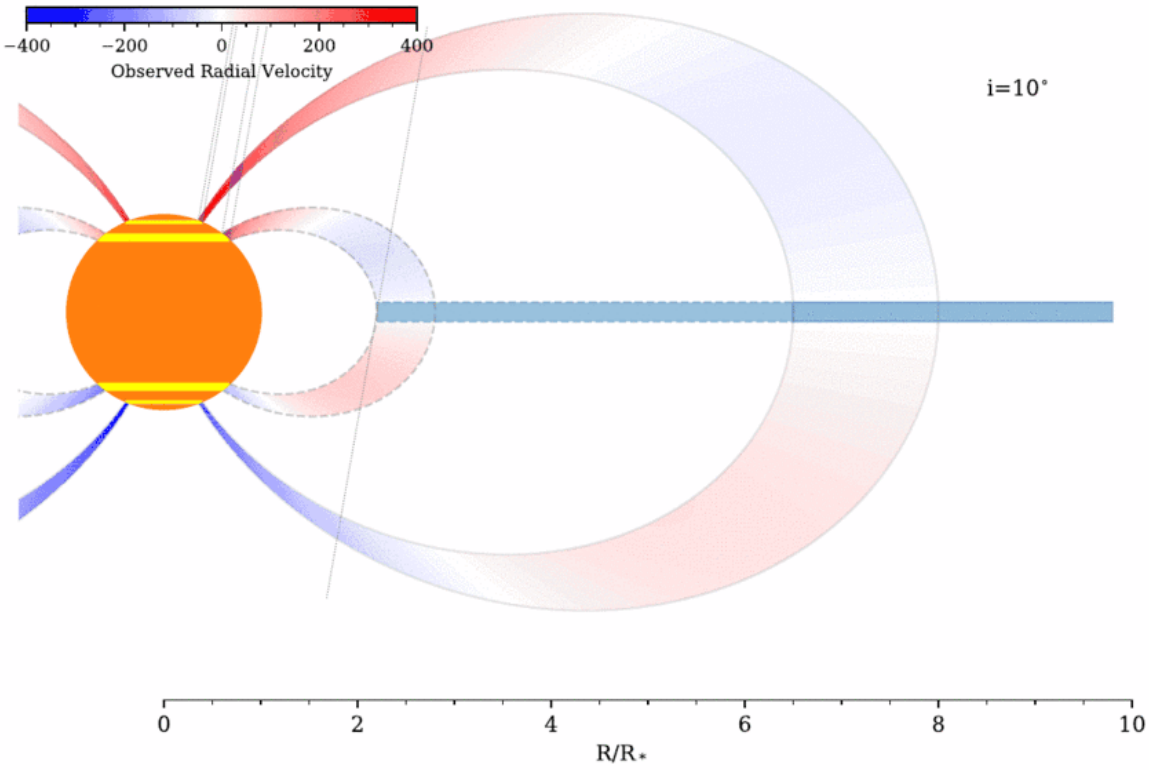
Thanathibodee+2018

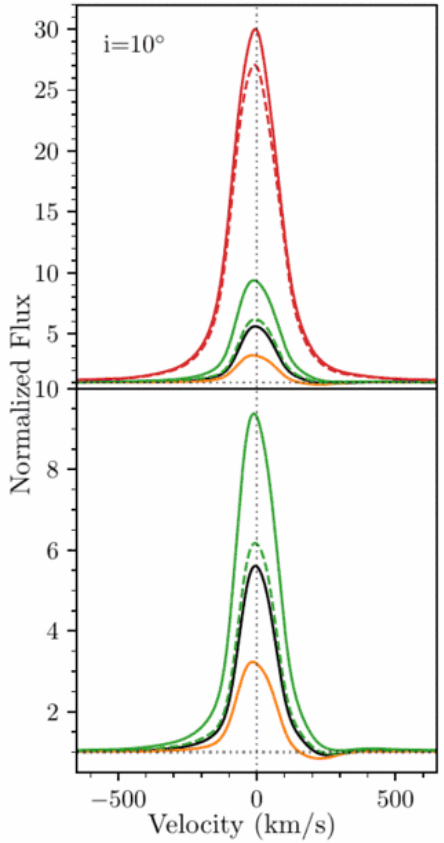
Decomposing Multiple Accretion Flows



Thanathibodee+2019

Low Accretors show clearer features





Mdot

$3x10^{-9}$

$1.2x10^{-9}$

$6x10^{-10}$

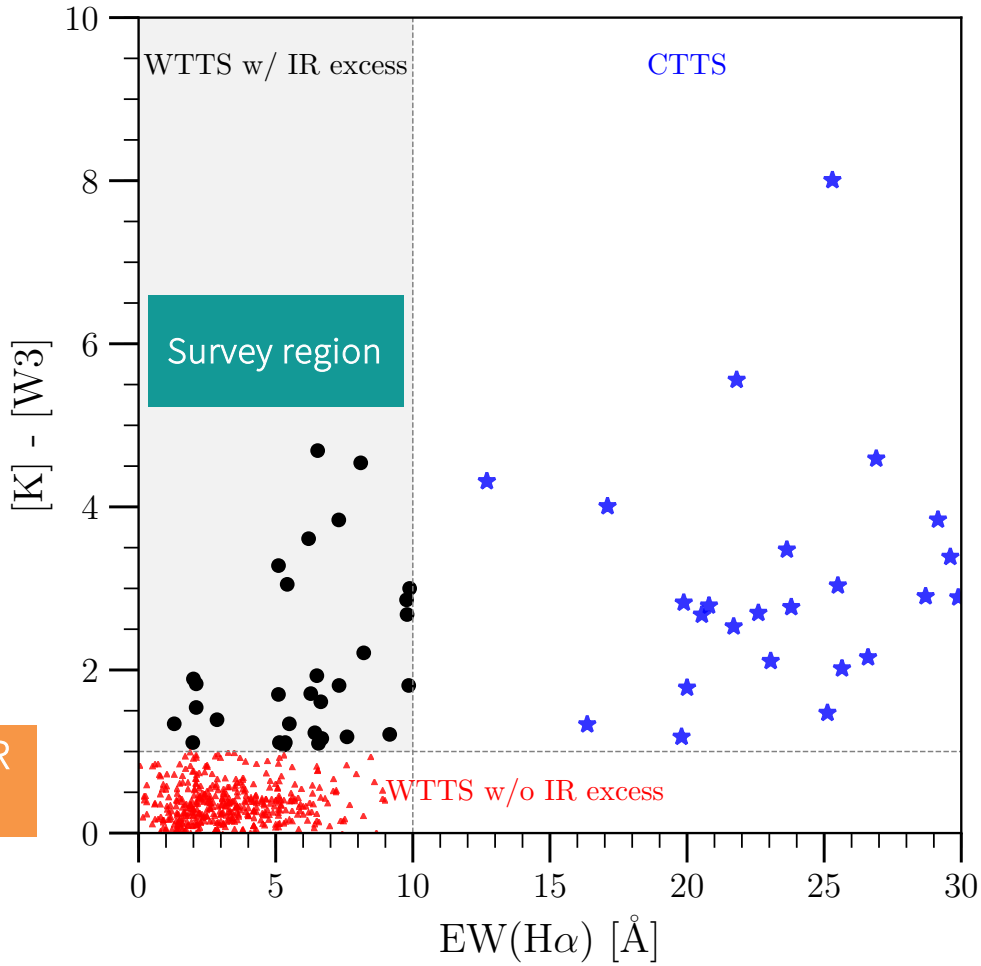
$3x10^{-10}$

Absorption features appears more prominently at low accretion rate

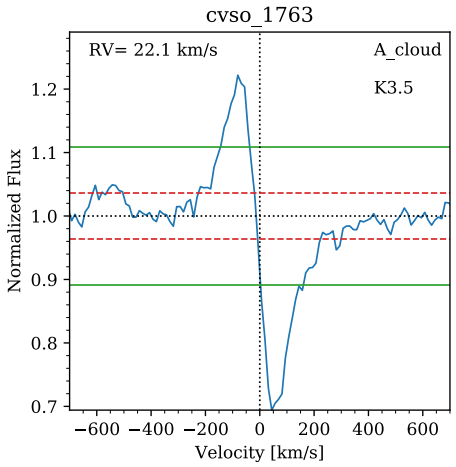
Survey of Low Accretors

- Age: 1-15 Myr
- SpT: K0-M6
- WTTS with IR excess
- Observed with Magellan/FIRE
- Regions surveyed so far
  - Orion Cloud A & B
  - Orion OB 1 a/b
  - Cha I
  - Upper Sco
  - Upper Cen-Lupus
  - Gamma Vel
- 118 targets

About 6% in a given population are WTTS with IR excess



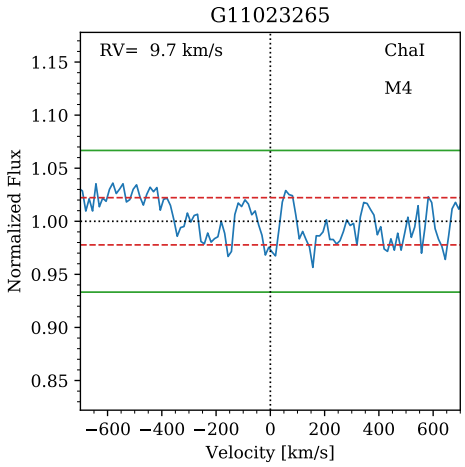
Four types of He I 10830 Profiles



Type: A ~ 12%

Clearly Accretor

Inverse P-Cygni

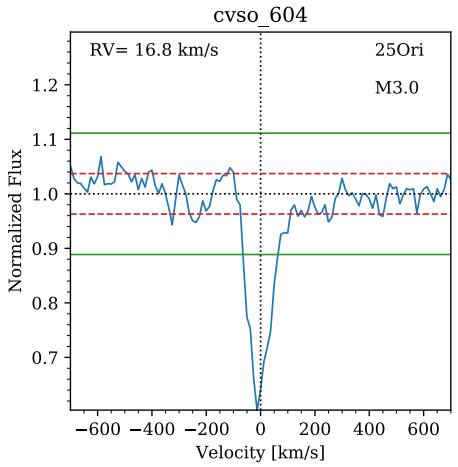


Type: N ~ 40%

Clearly Non-accretor

No absorption/emission

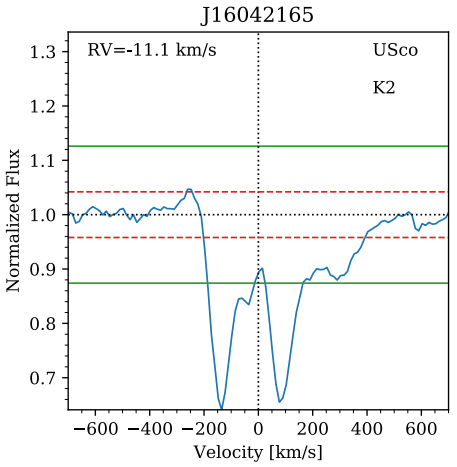
Mainly noise



Type: C ~ 34%

Central absorption

Strong central absorption



Type: P ~ 14%

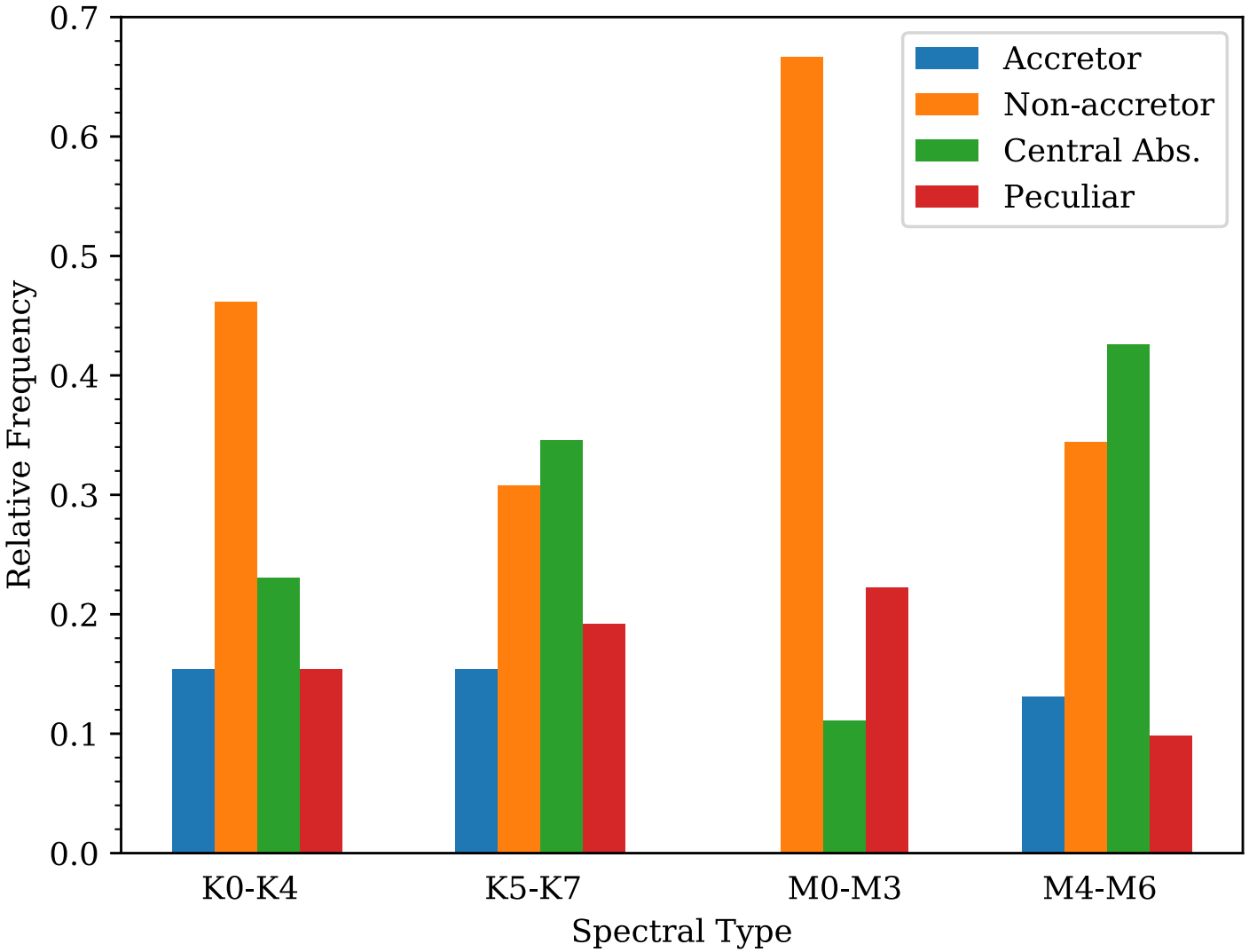
Peculiar

Strong blueshifted+redshifted absorption

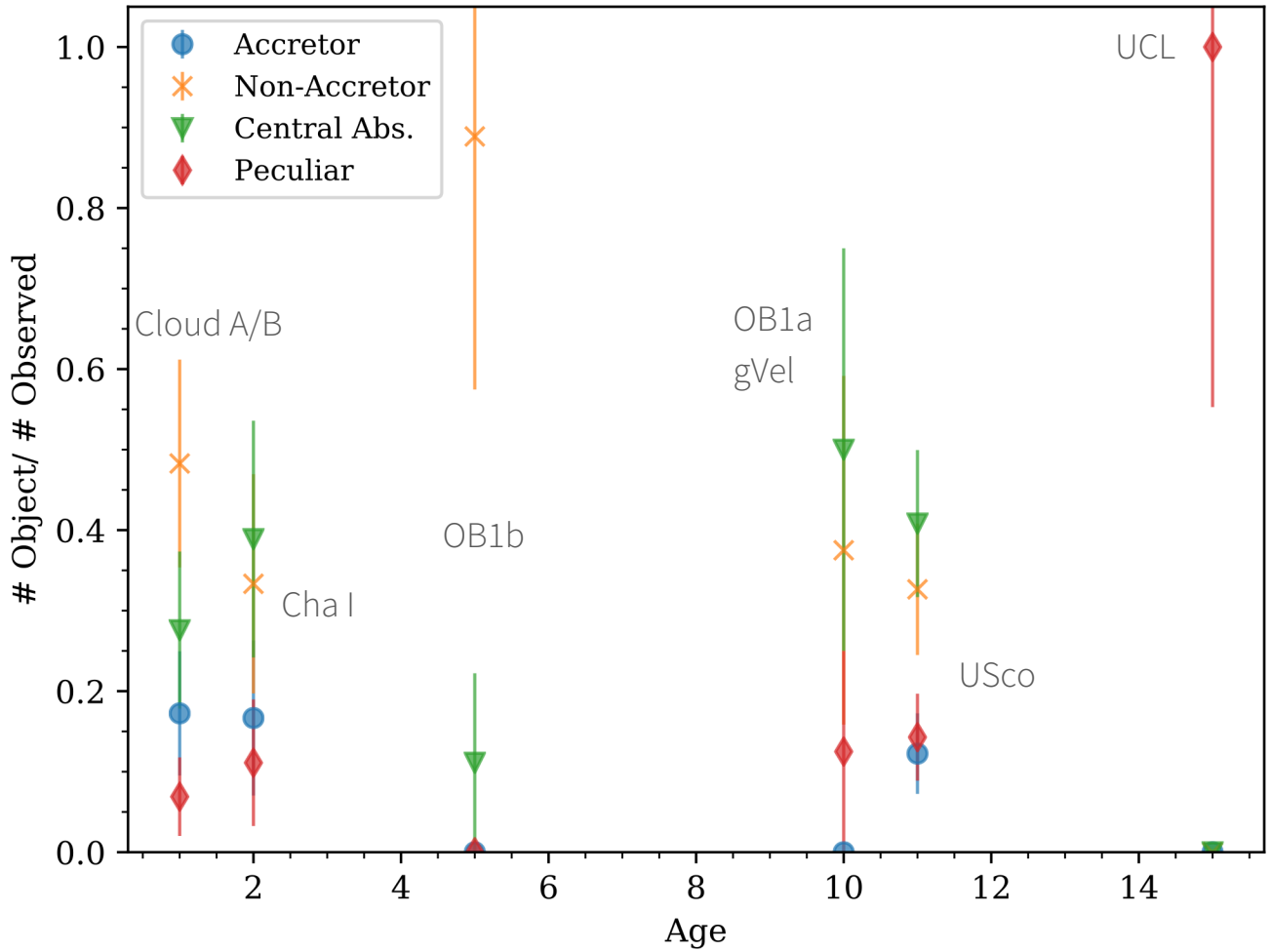
Photoevaporative wind?

Based on 118 observed WTTS with IR excess

For WTTS with IR excess, He I profile does not depend on spectral type (mass)



For WTTS with IR excess, fraction of accretors does not depend on population age



Conclusions

- Details of accretion processes are best probed in low accretors
- Identifying accretors with He I 10830 provides more completeness to population studies.
- About 10-60% of WTTS w/ IR excess are accreting.
- Fraction of “accreting WTTS” does not depend on mass/ age.