# Disk Evolution in the Orion OB1 Association


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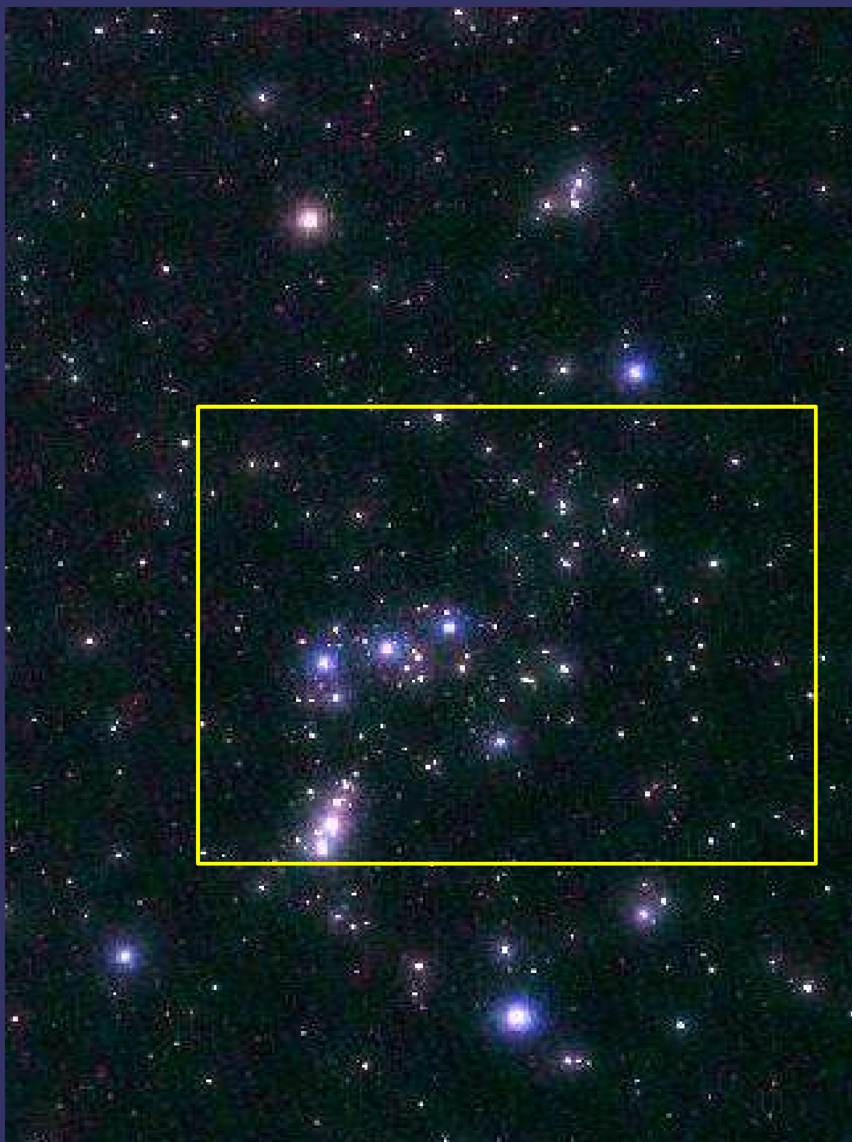
# The CIDA Orion Variability Survey:
## large scale census of the low-mass PMS population

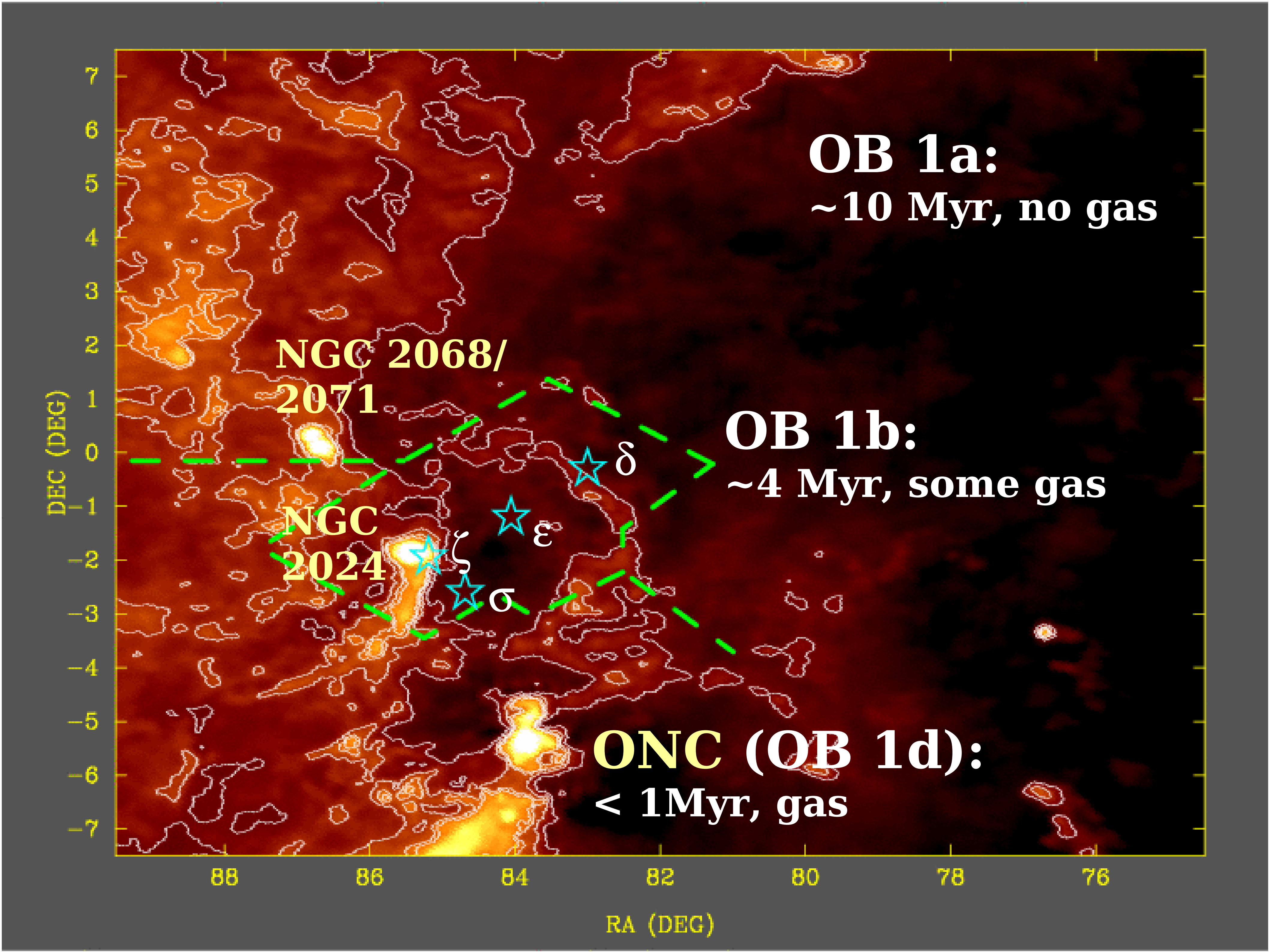


Very large area: **~180 deg$^2$ -> from the youngest to the older populations**

Why Orion?

- nearby (~400 pc)
- ages from OB stars ~1-10 Myr *(Blauuw 1964, Brown et al. 1994)* => right age range to investigate first stages in disk evolution/planet formation.
- Range of ambient conditions: effect of environment on disk lifetimes.

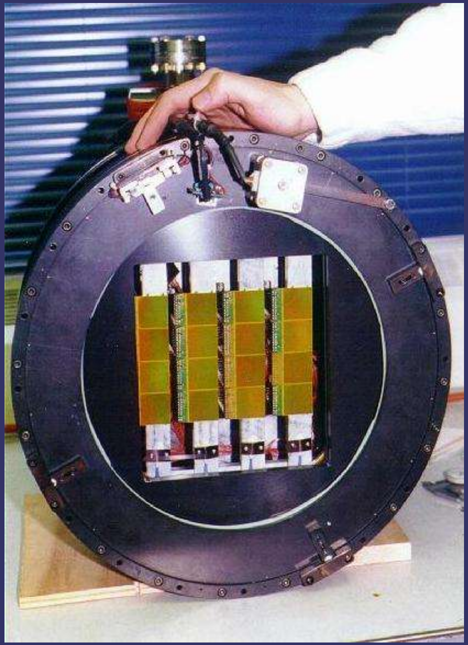
But can't use massive stars to investigate star-forming history or disk evolution -> need low-mass guys...almost nothing known about them.



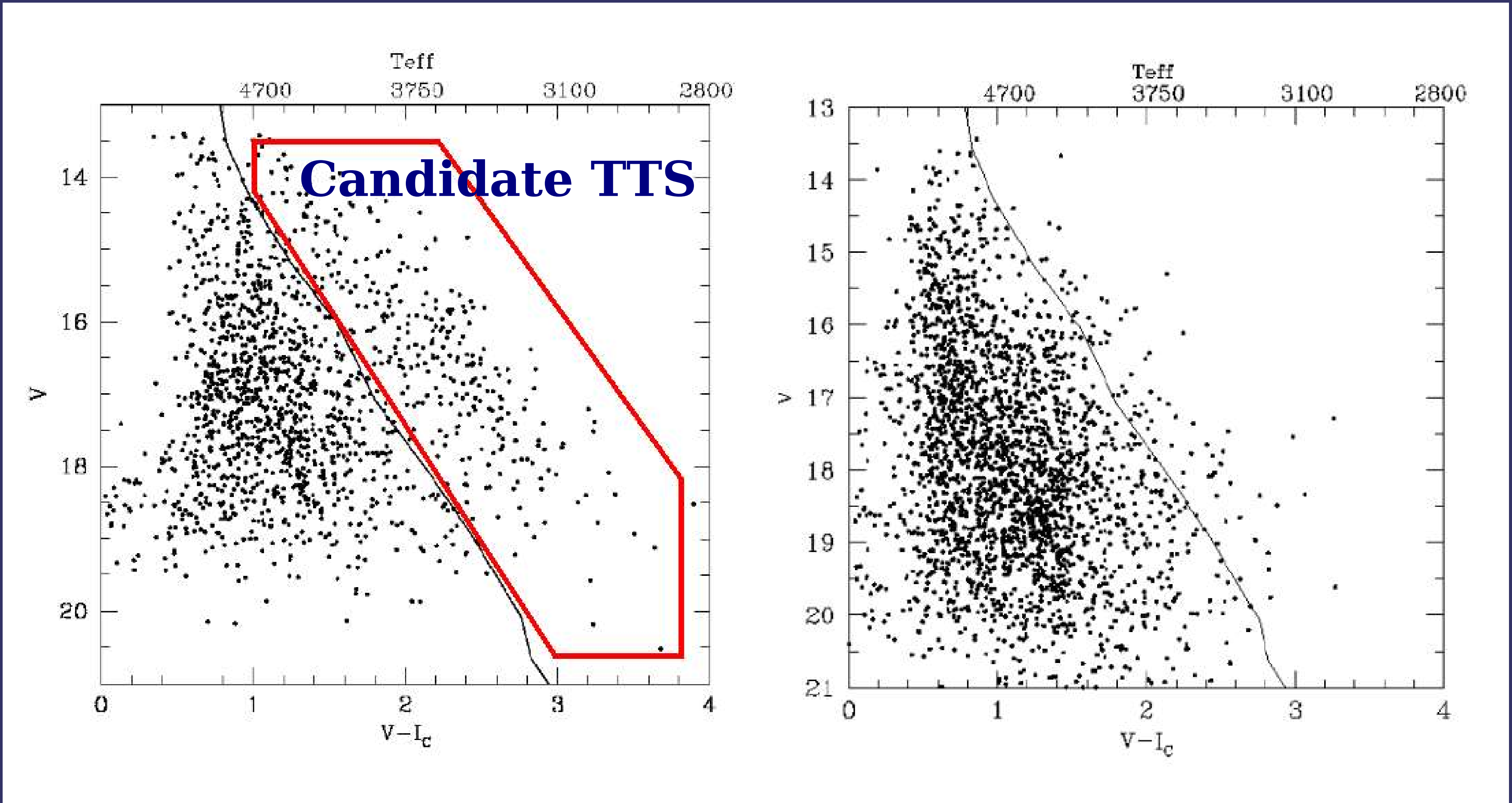
OB 1a:
~10 Myr, no gas
OB 1b:
~4 Myr, some gas
ONC (OB 1d):
< 1Myr, gas
NGC 2068/
2071
NGC
2024
δ
ε
ζ
σ
DEC (DEG)
RA (DEG)
7
6
5
4
3
2
1
0
−1
−2
−3
−4
−5
−6
−7
88
86
84
82
80
78
76

# The Photometric Variability Survey:

Wide-field telescope (Venezuela 1m Schmidt) + Drift-scan mode CCD Mosaic Camera = 34 $deg^2$/h/filter (VRIH$\alpha$)



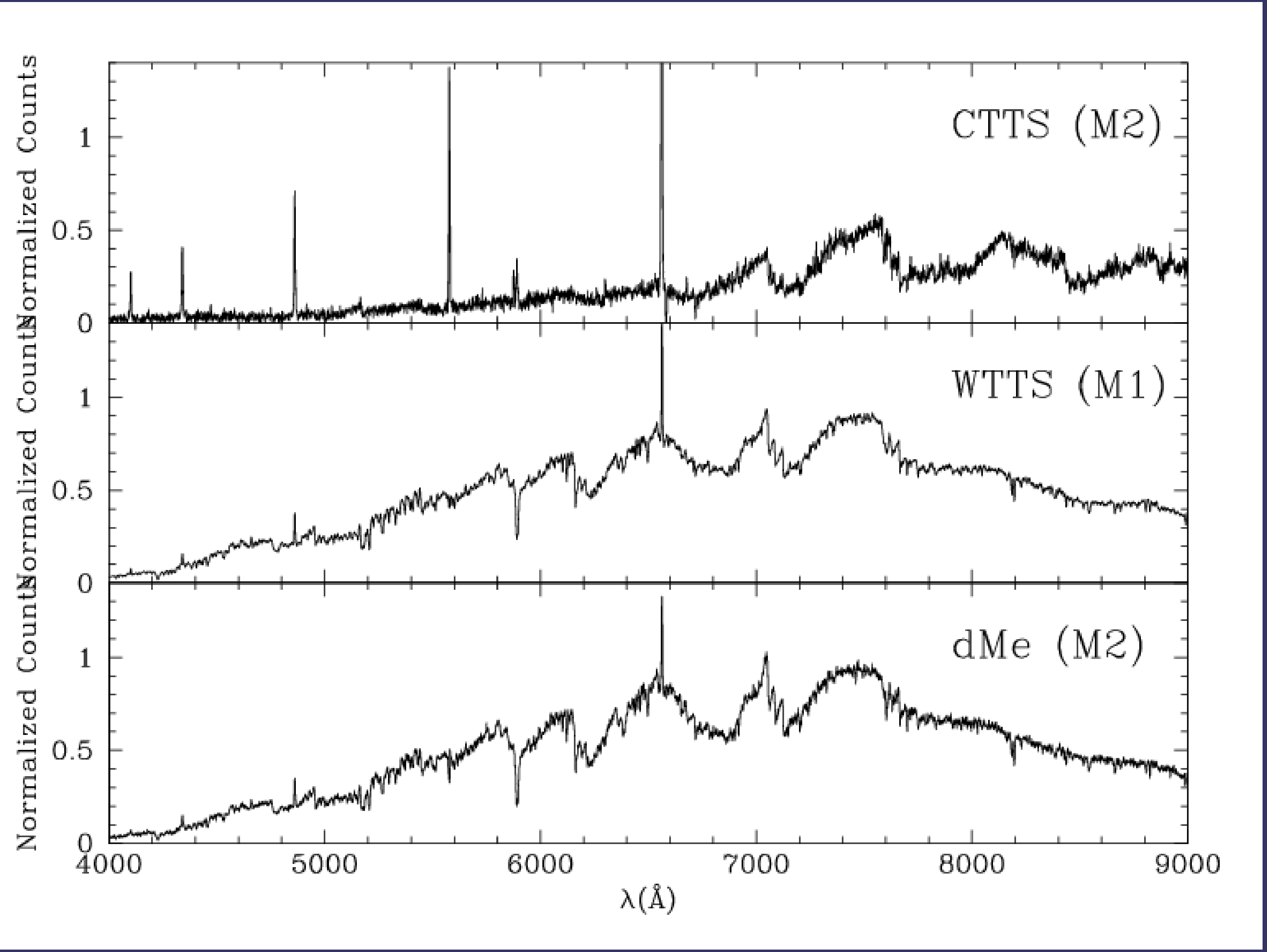
# The Photometric Variability Survey:




**Orion OB 1b** **Off-Orion field**

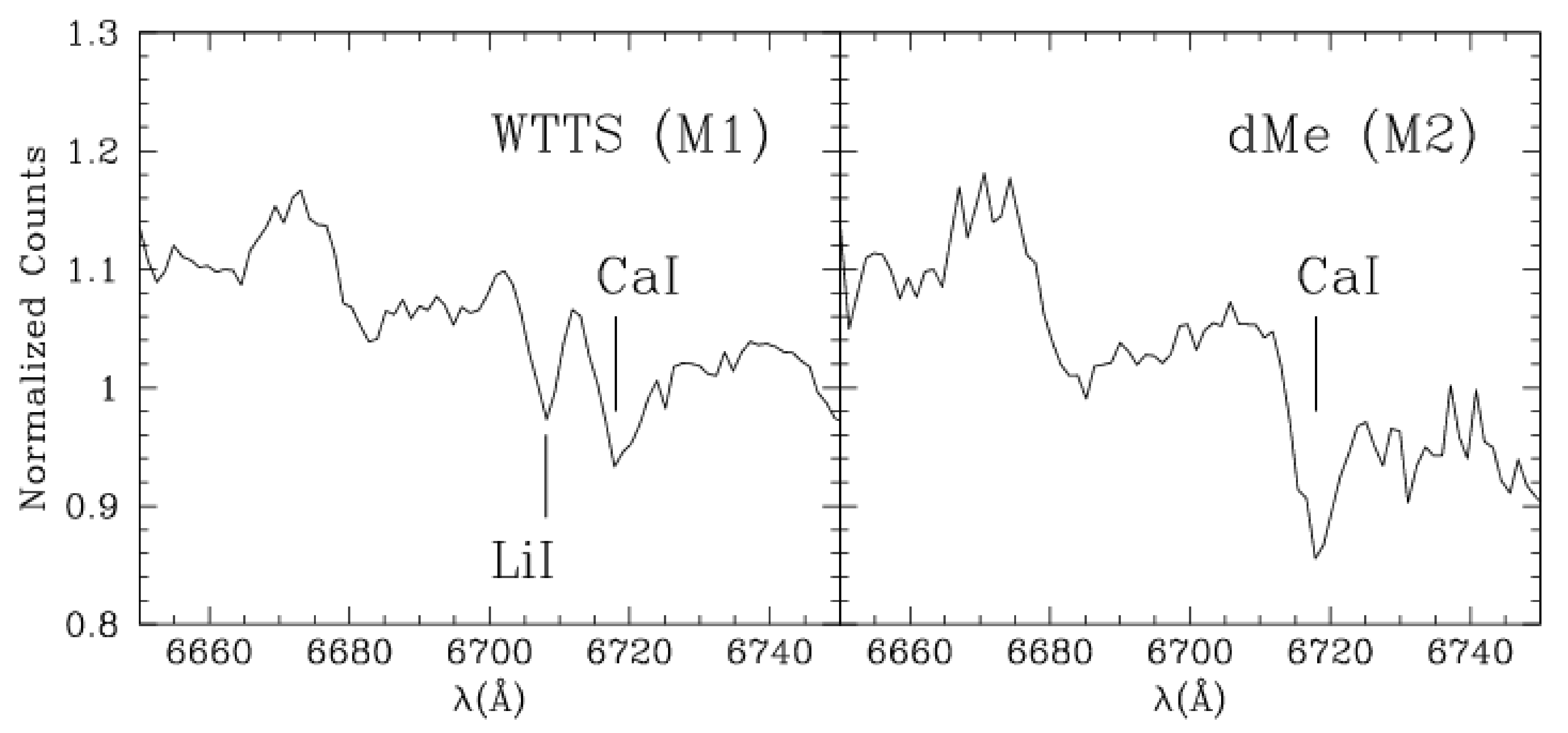
Multi-epoch: optical variability to pick candidate, low-mass PMS stars -> very efficient (~50-70%)

# The Spectroscopic Survey:



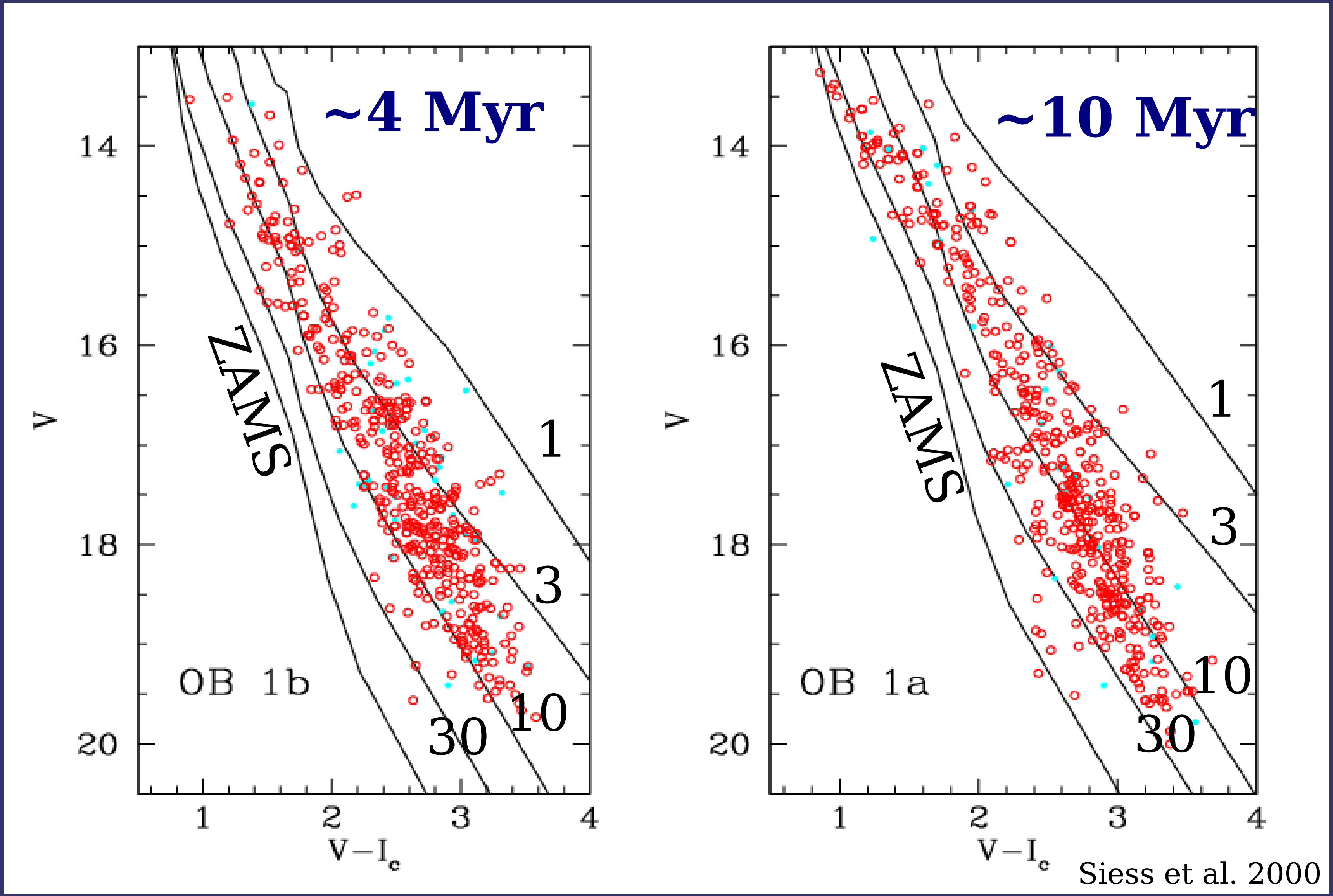

Followup spectroscopy (FAST, Hectospec, Hydra) yield membership confirmation: Hα, Li I, spectral types -> Teff, +phot -> Av

# The Spectroscopic Survey:



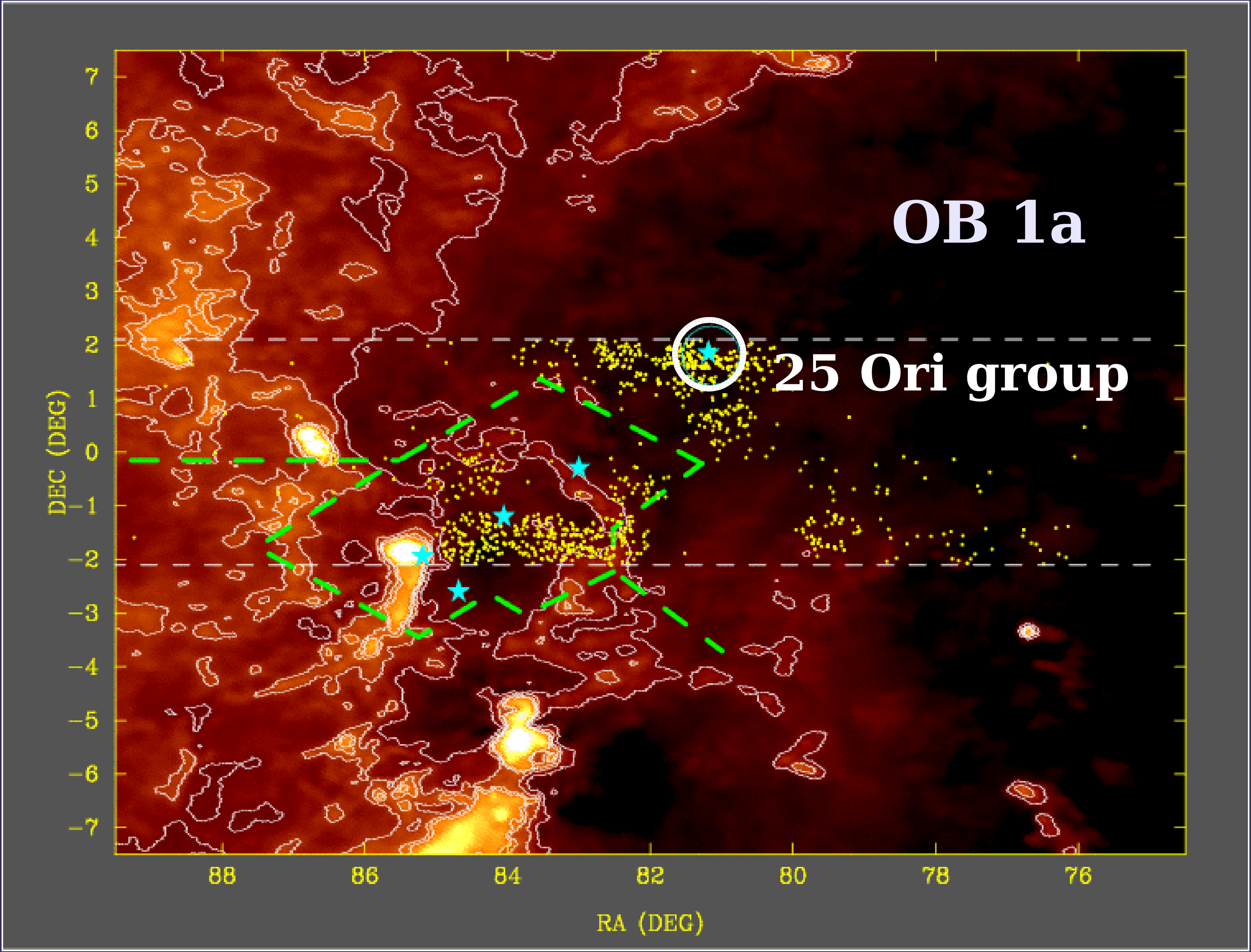

Li I 6707 Å important to distinguish WTTS from field dMe stars: contamination is significant in wide-field surveys!

# Characterizing the low-mass PMS population of Orion OB1: ages

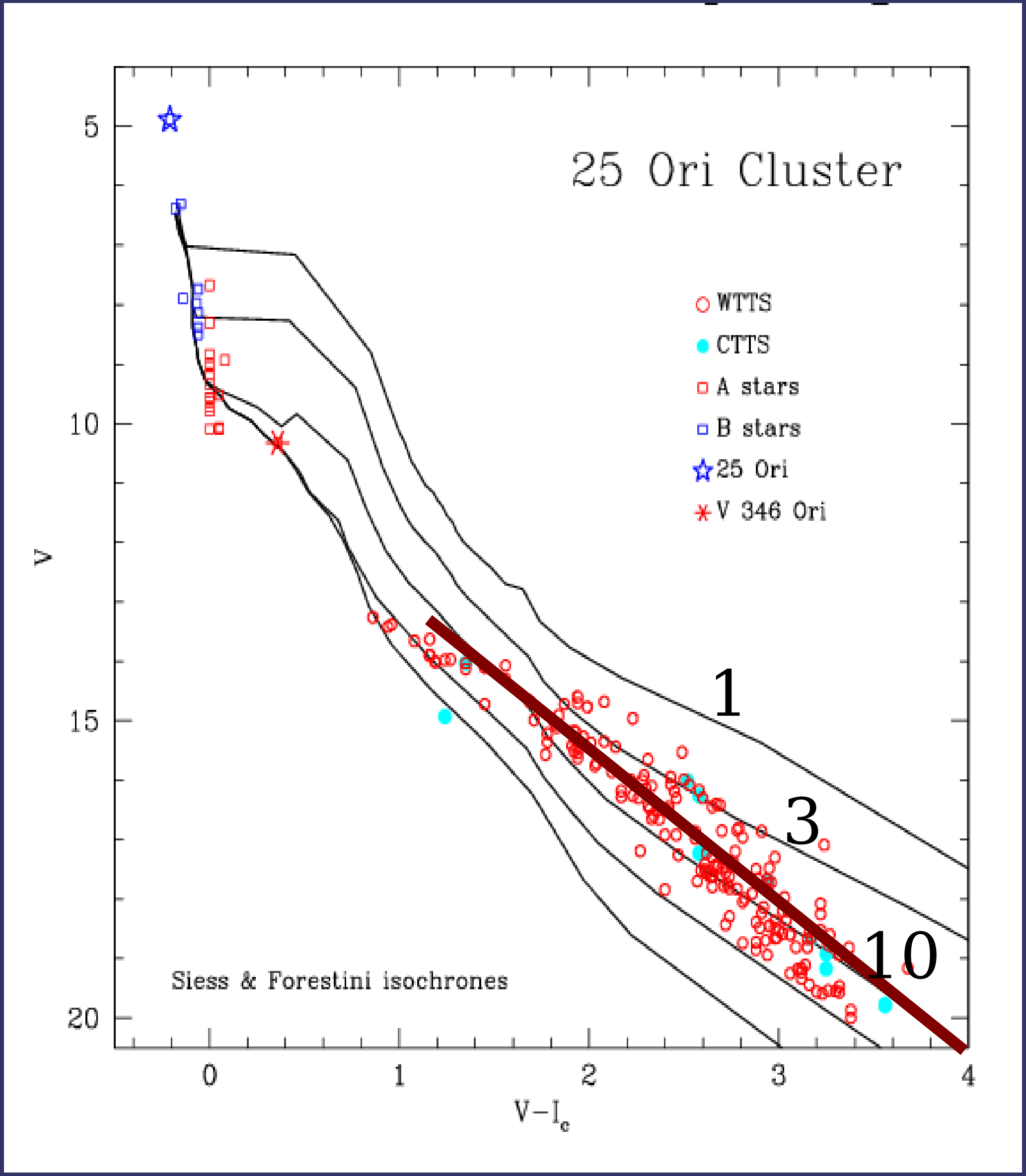


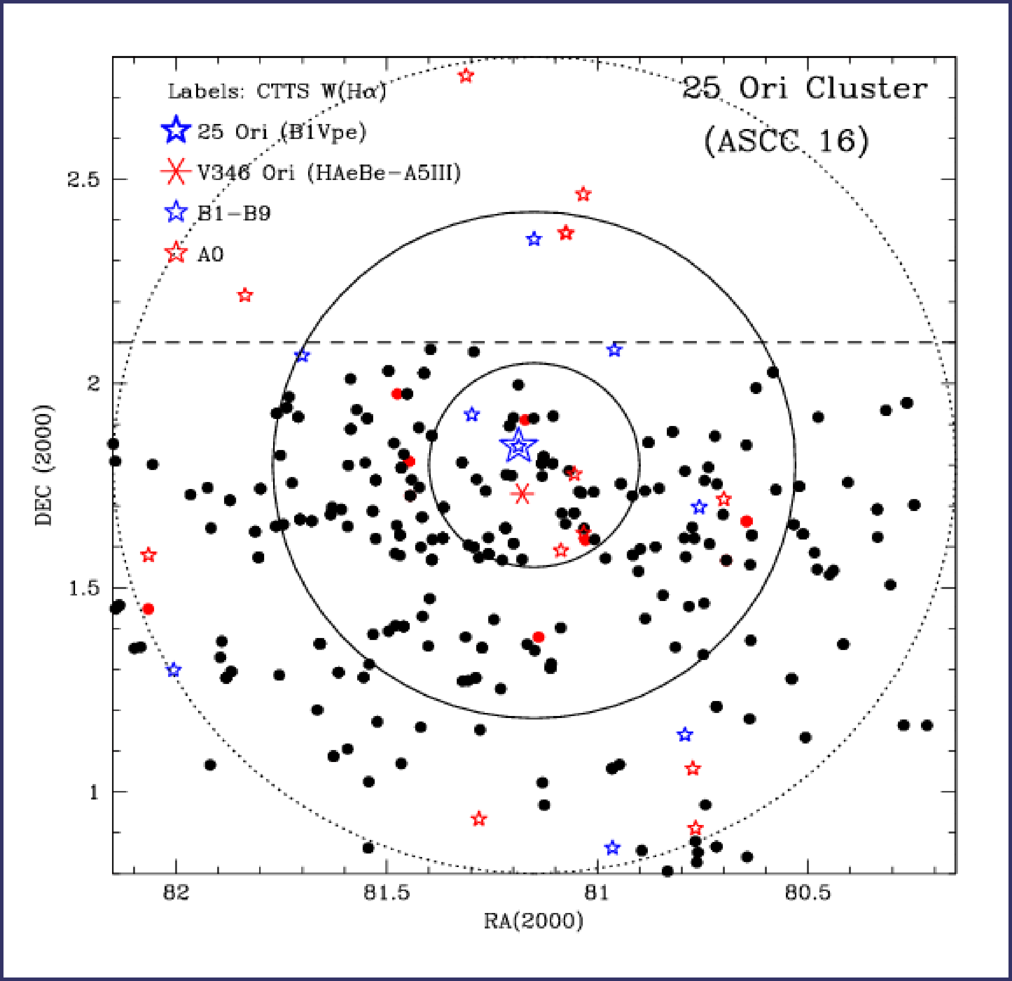

Optical photometry + spectroscopy provide ages, masses

# Characterizing the low-mass PMS population of Orion OB1: new groups



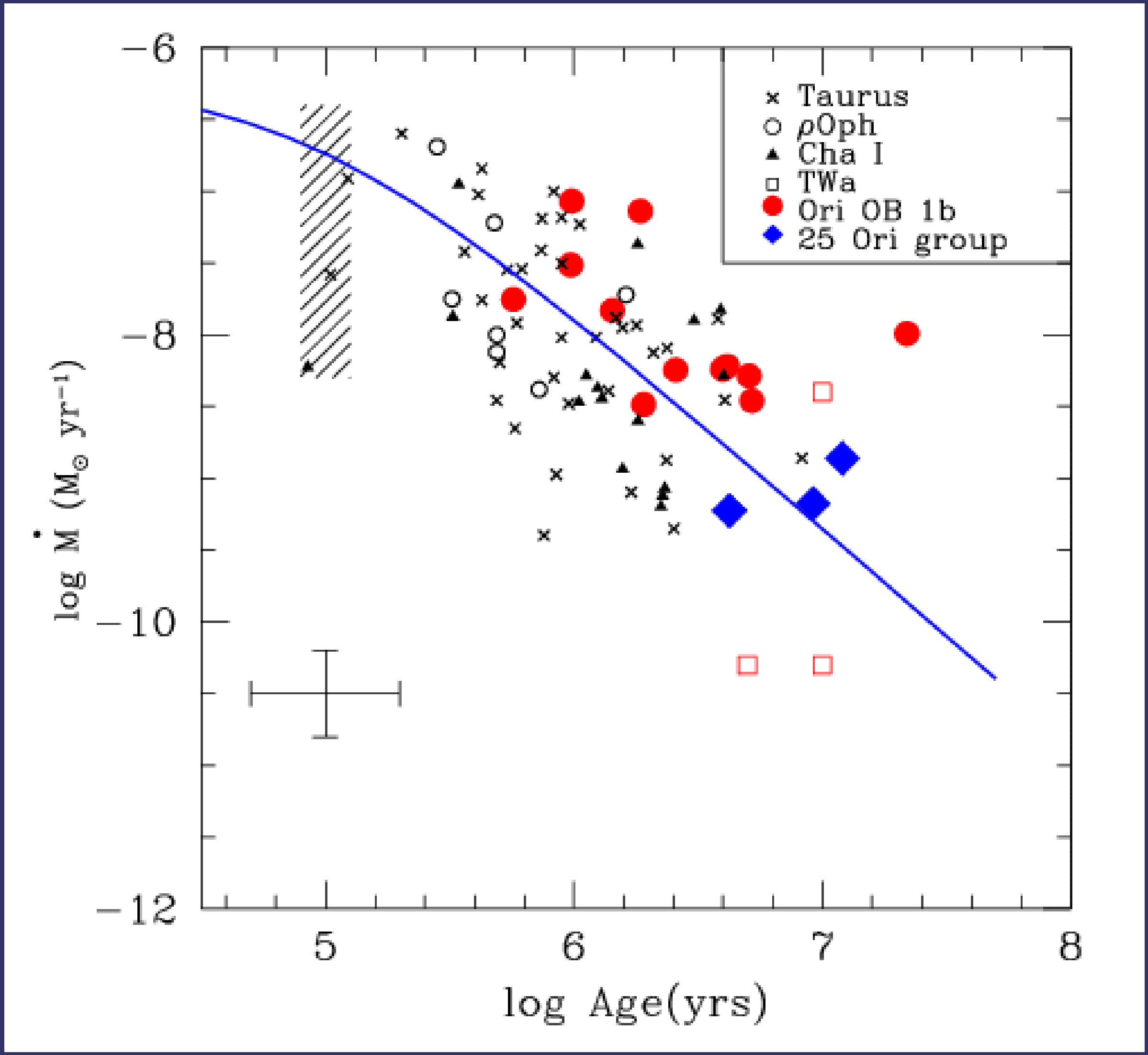
# The 25 Ori group (cluster?): a rich TW Hya analogue



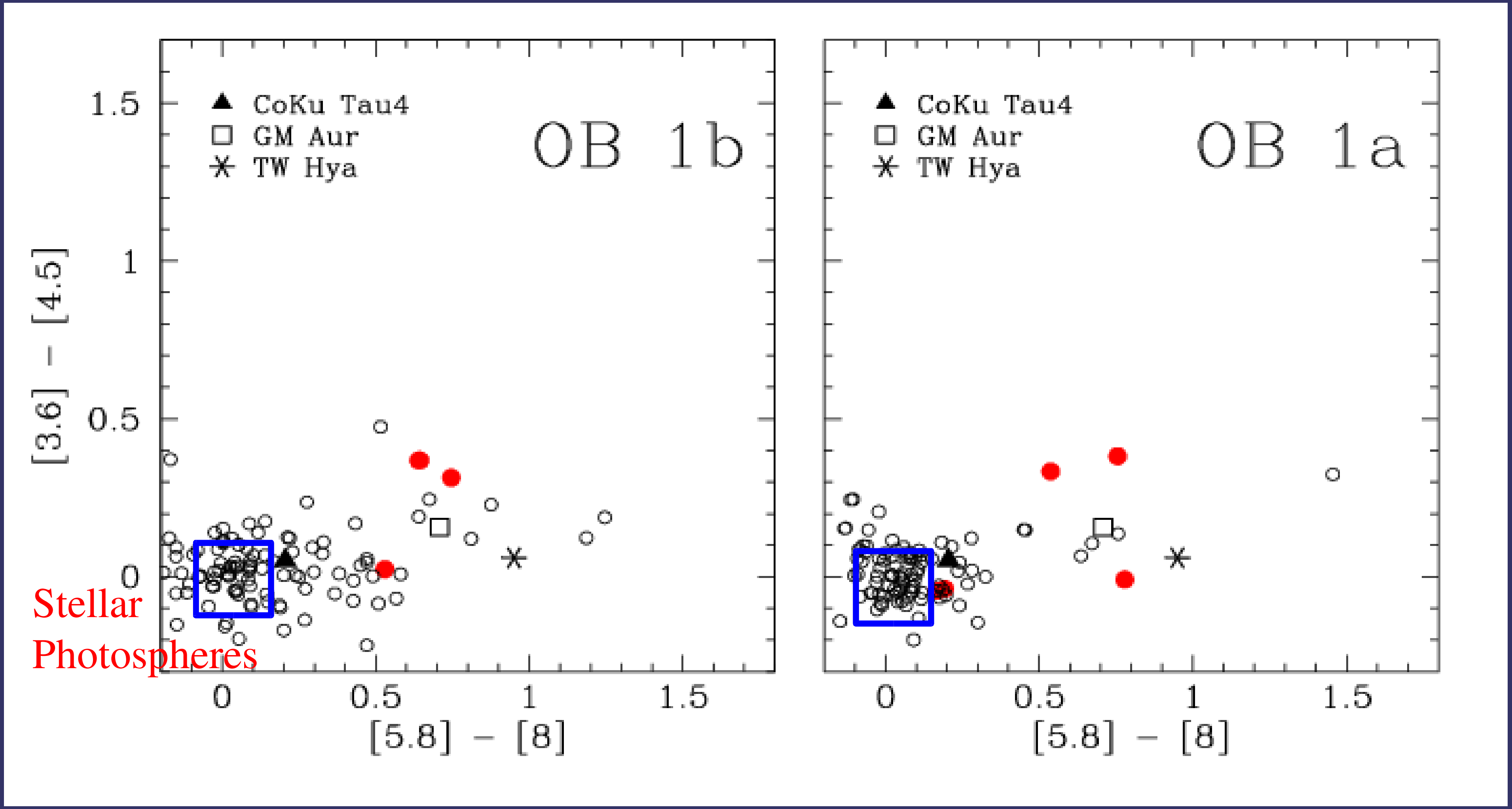

- 25 Ori: B1Ve
- V346 Ori: Herbig Ae/Be
- ~150 TTS

# Evolution of disk accretion




U-band photometry -> measure Lacc + previously determined masses and stellar radii = dM/dt -> With ages => Mdot vs Age

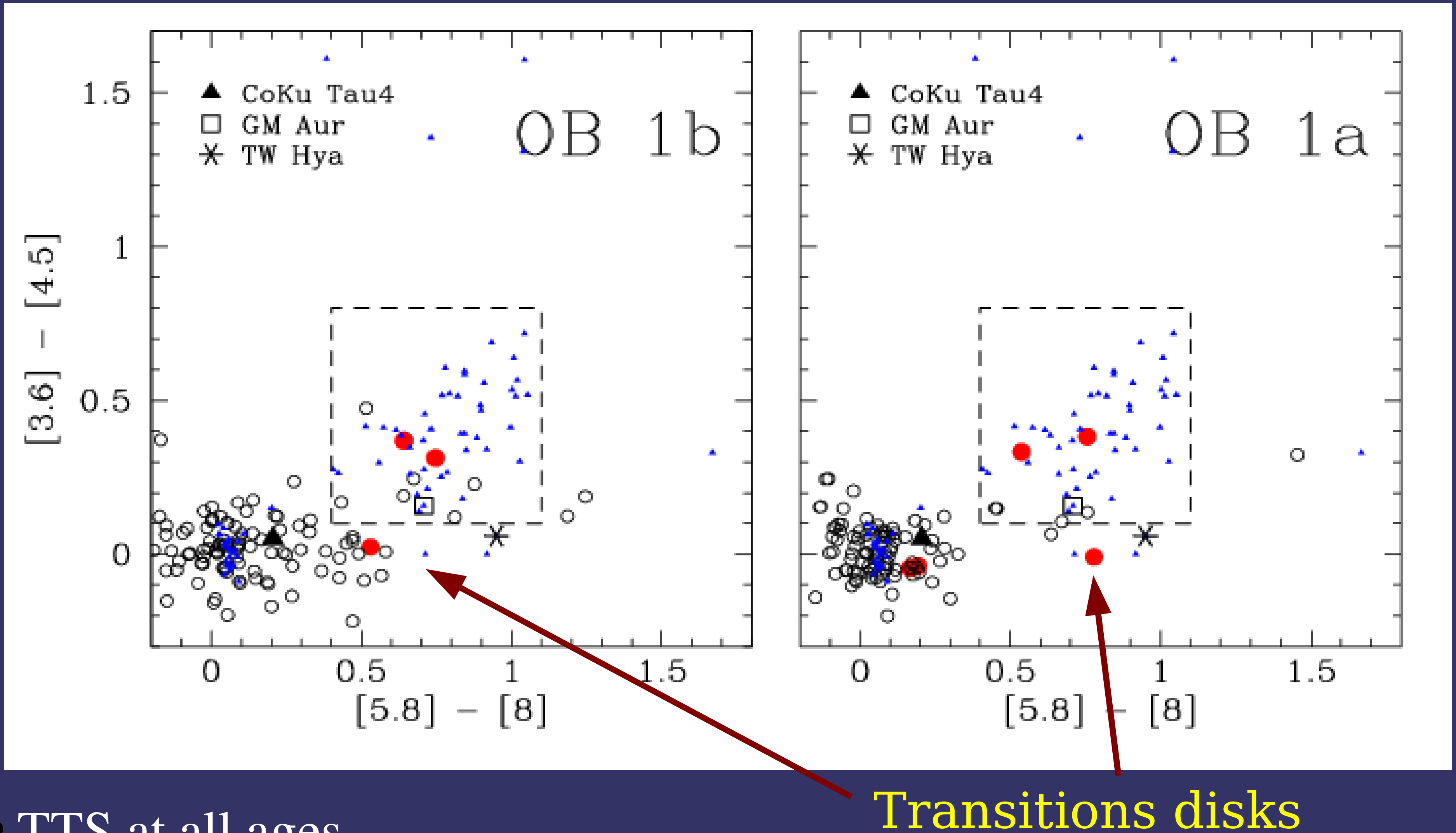
# Spitzer Observations of Orion OB1




Spitzer IRAC + MIPS observations of 2 selected regions, ~1° x 1°:

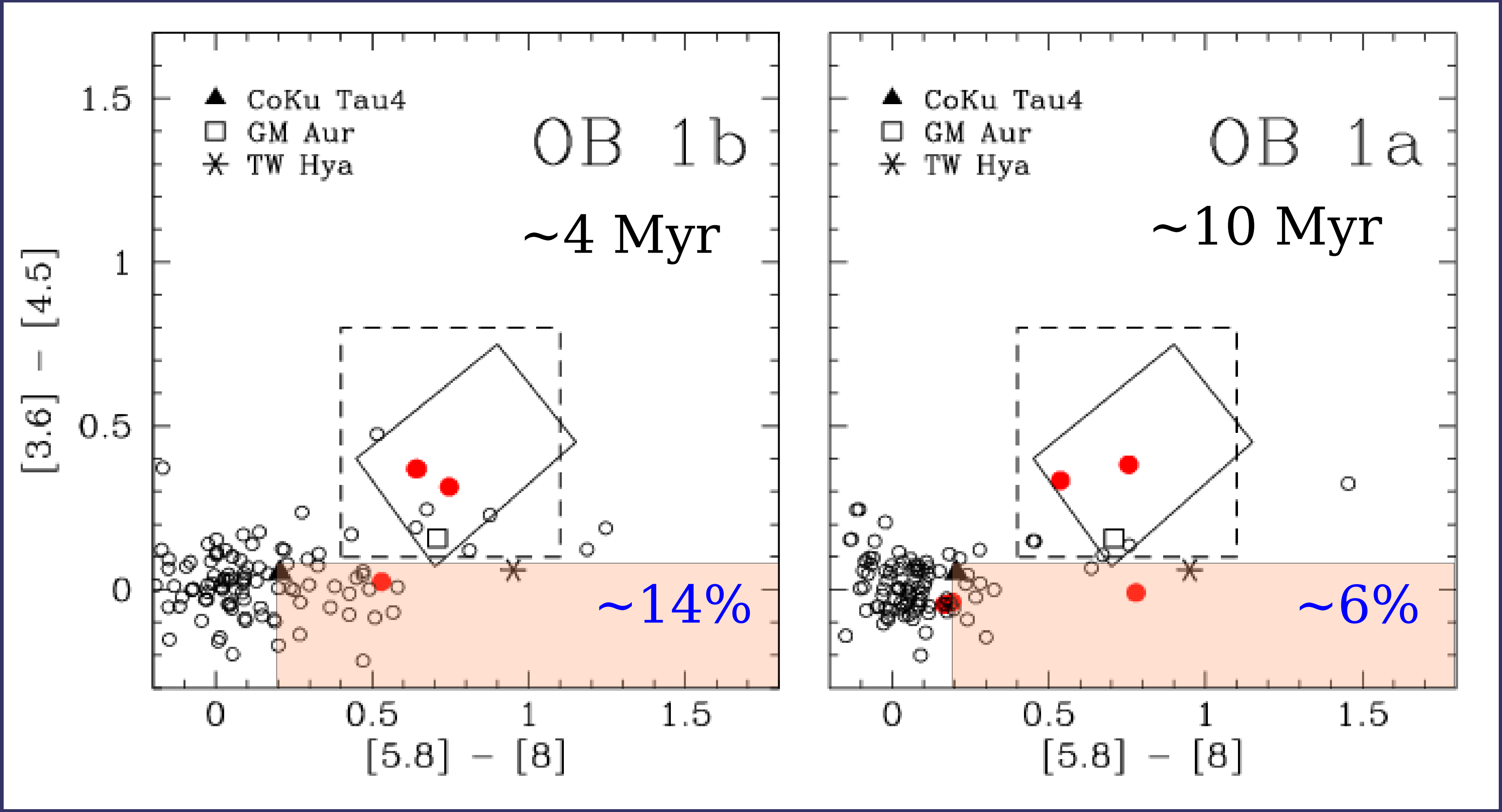
- Belt region (OB 1b)
- The 25 Ori group (OB 1a)

# Dust Evolution: from Taurus to Ori OB1



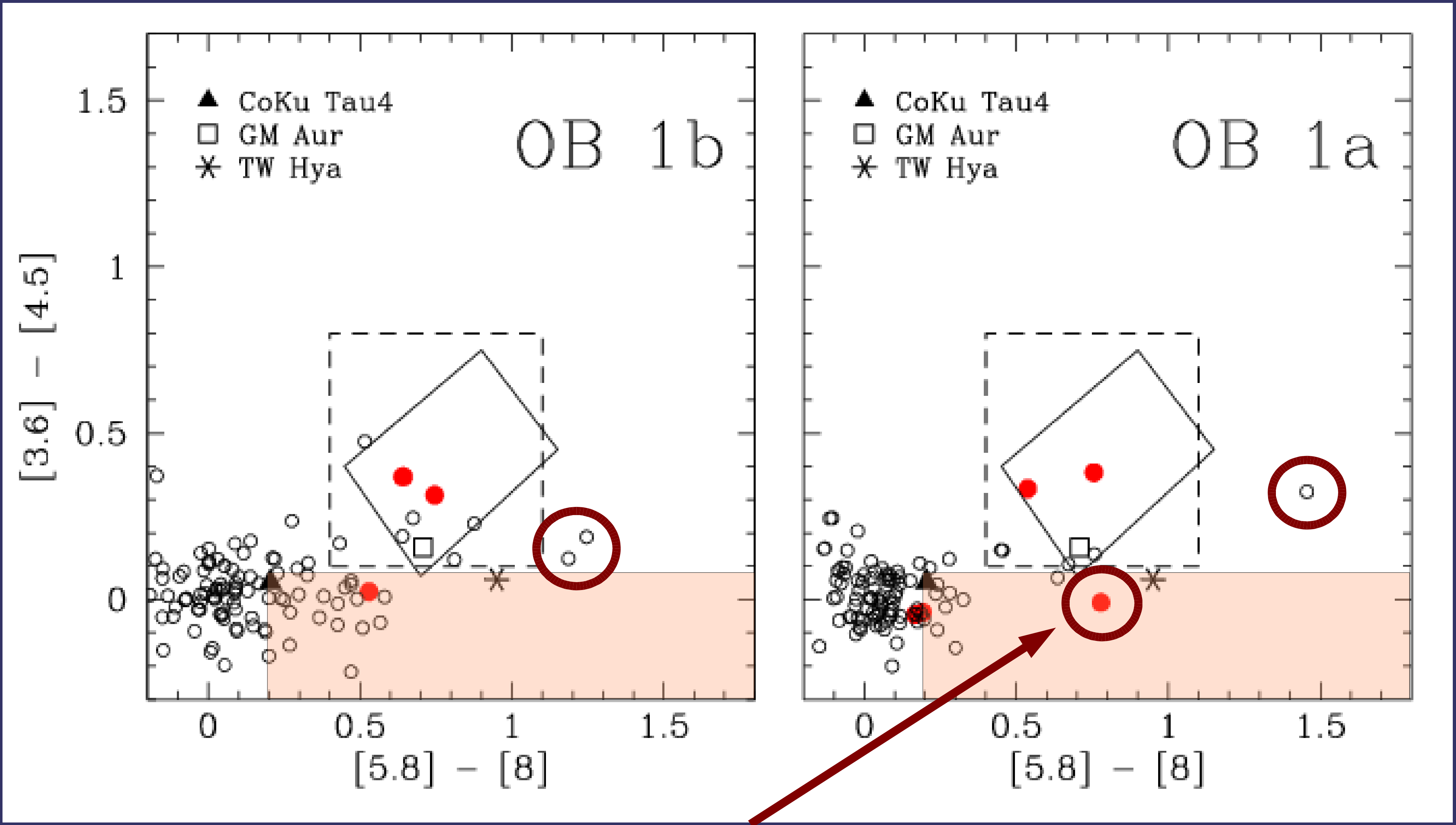

- TTS at all ages
- Orion OB1 TTS (~4-10 Myr) mid-IR emission < Taurus (~1-2 Myr)
- A number of objects in "transition disk" locus => inner disk clearing

# Dust Evolution at a few Myr



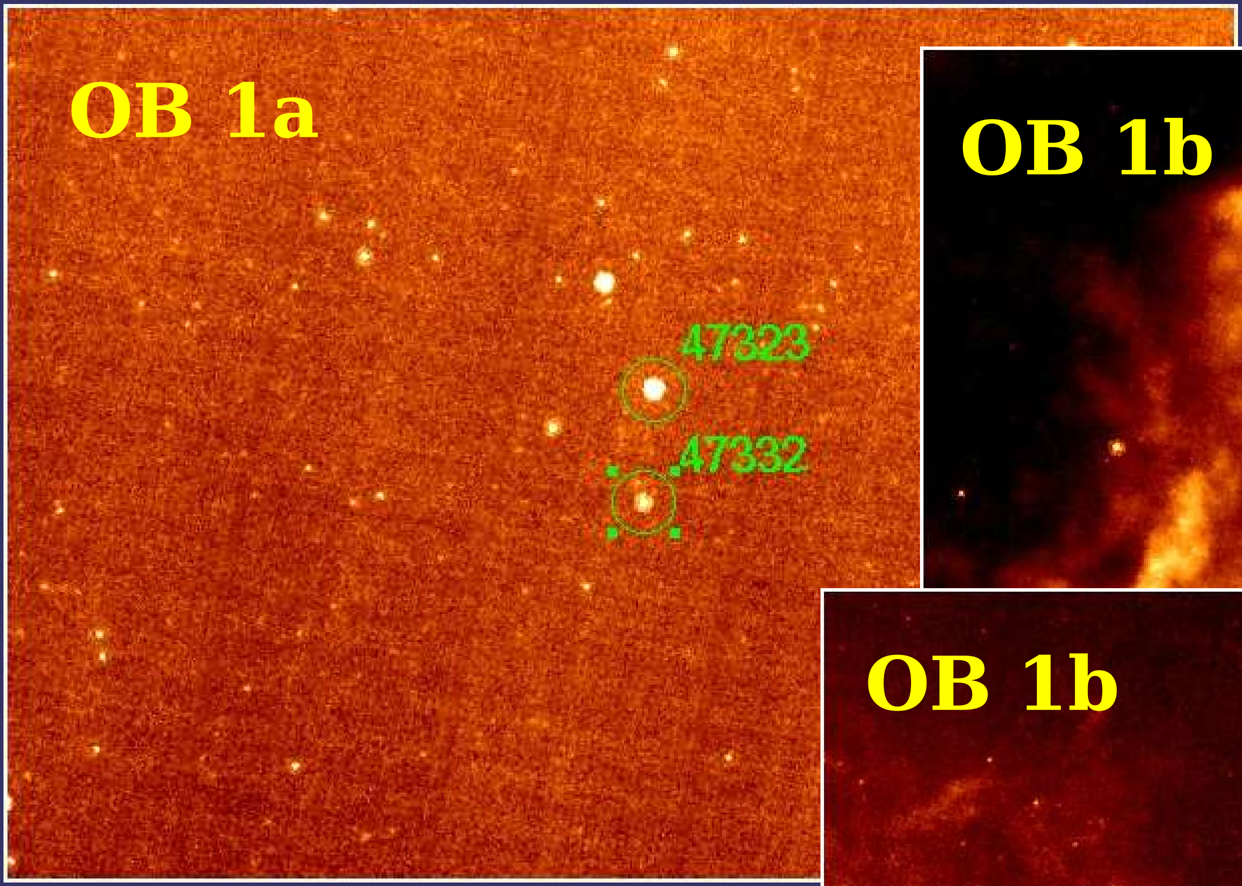

Only ~5-10% of transition disks are accreting
=> short phase (< 1 Myr)

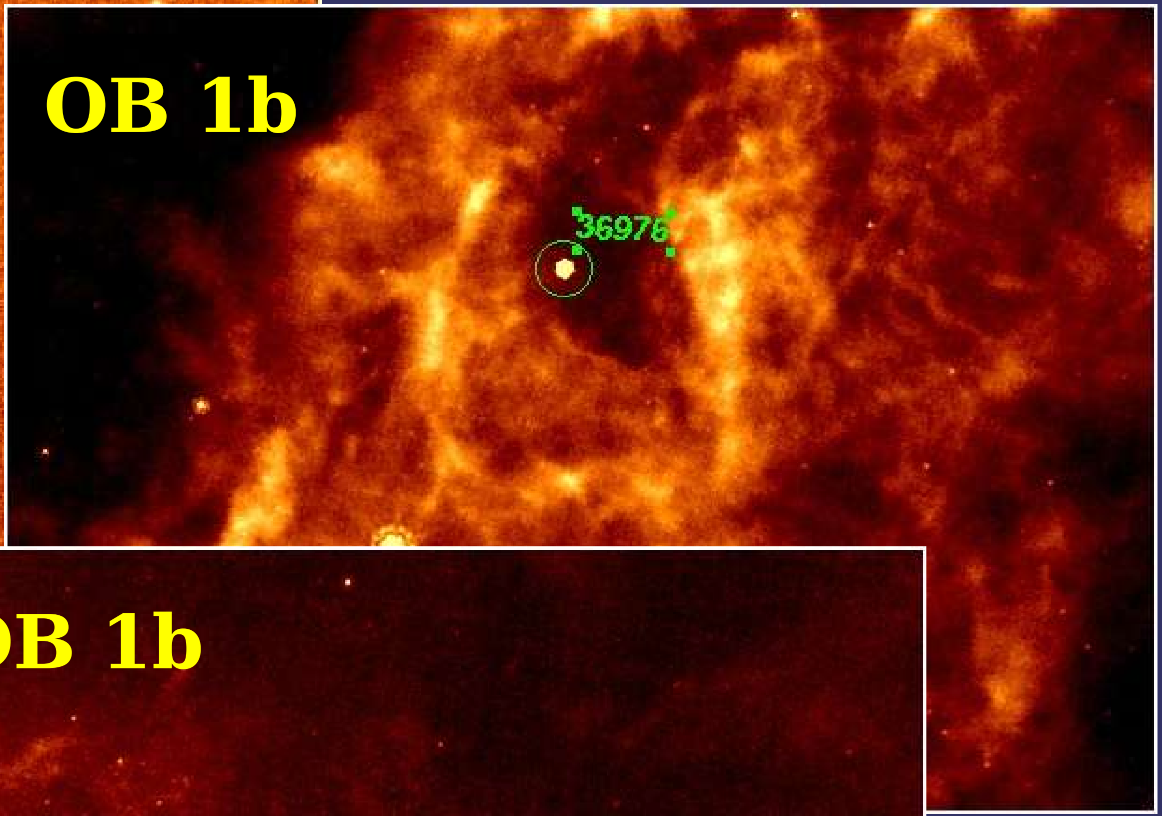
# Transition Disks in Ori OB1

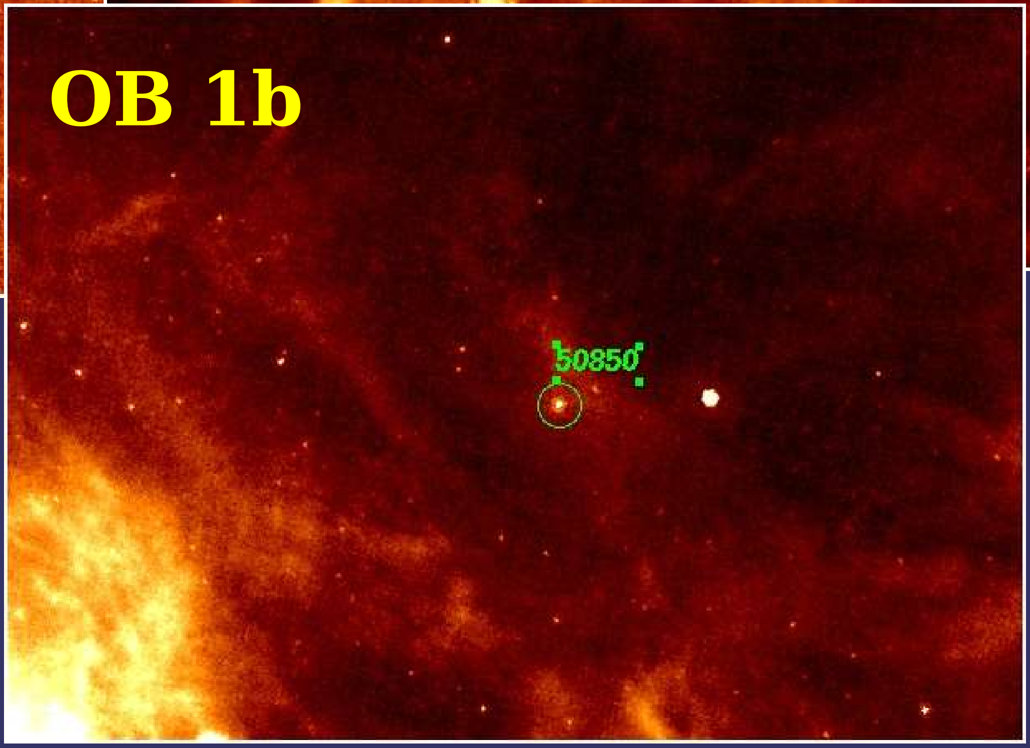



**A NEW TW HYA?**

# Transition Disks in Ori OB1 @ 24 μm



# Next Steps

- Extend spatial coverage of followup spectroscopy (FAST & Hectospec): identify members over larger area

- High resolution spectroscopy (Hectochelle @ MMT):
  - Kinematics (confirm 25 Ori group) + separate 1a/1b (also study rotation)
  - Accretion (find low accretors among “WTTS”)

- Deep U-band imaging (Megacam @ MMT): determine dM/dt for lowest mass TTS

- Disk SEDs: Spitzer + IRS