

Identifying Brown Dwarfs in Nearby Star Forming Regions

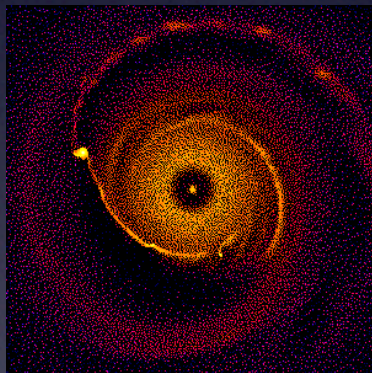
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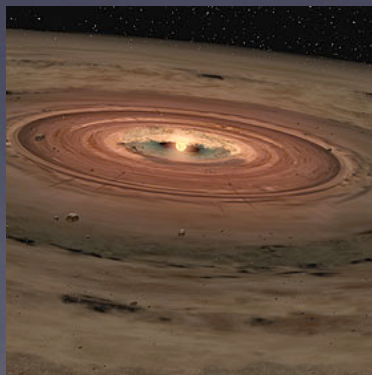
Why should we search for young brown dwarfs in SFRs?



- Exploring the ultra-low mass end of the IMF



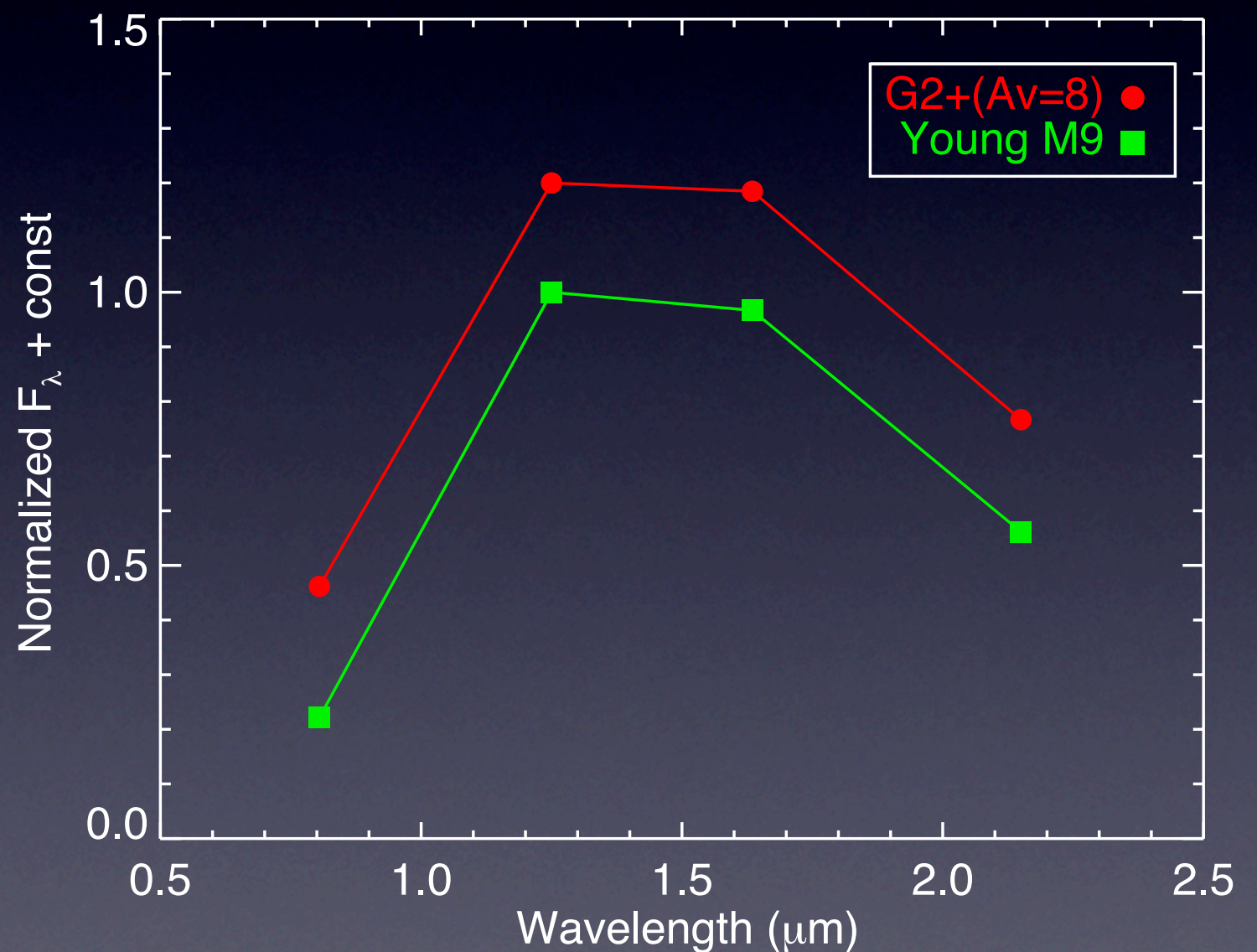
- Testing Theories of Formation Mechanism



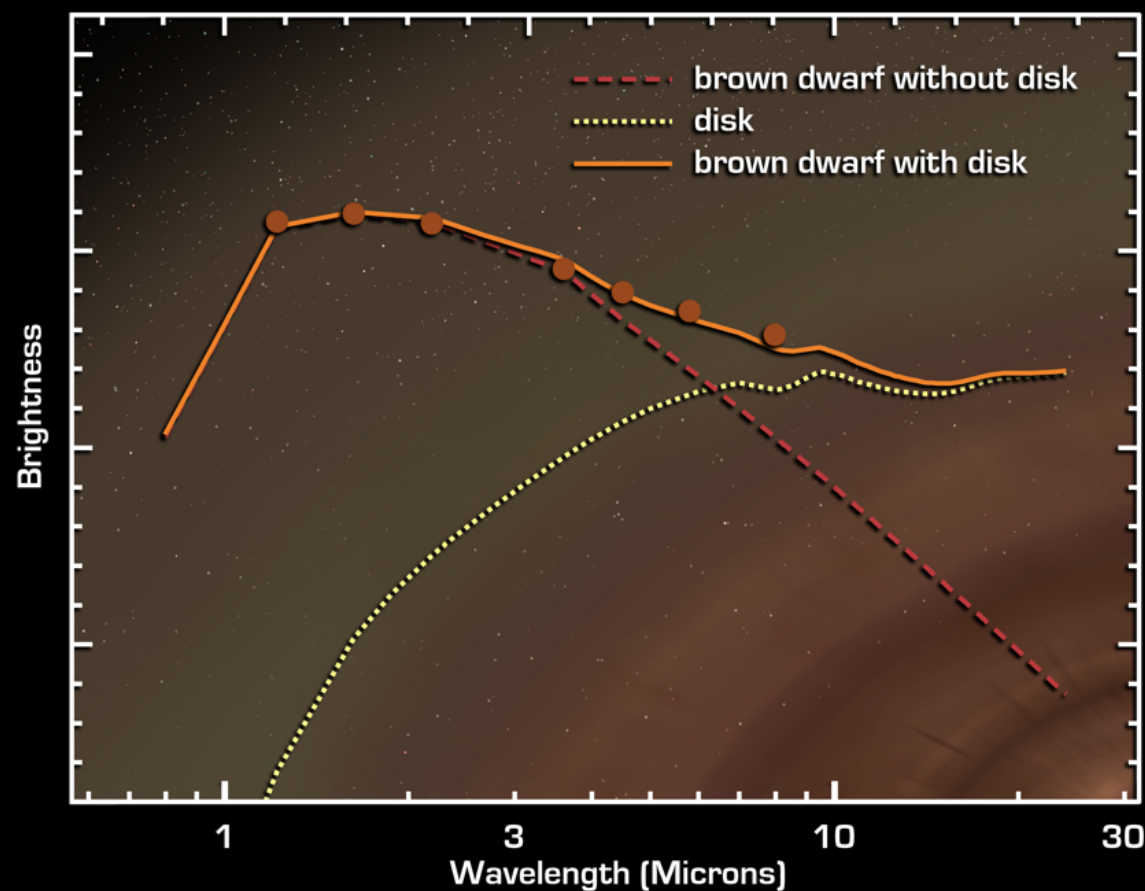
- Disks (and planets) around the lowest-mass objects

The Problem: Brown Dwarfs and Contaminants

- Reddened Background Stars (old and boring) can look like the young 'uns.
- A factor of ~ 2 more background stars per magnitude depth
- Searches for 1 Myr, $2 M_{\text{Jup}}$ objects have 200x more contaminants than searches for 12 M_{Jup}



Common ways to reduce contaminants:



Brown Dwarf With Protoplanetary Disk

NASA / JPL-Caltech / K. Luhman (Harvard-Smithsonian CfA)

Spitzer Space Telescope • IRAC

ssc2005-06

- Look for sources with disks. (e.g. Natta+ 2002; Allers + 2006; Muench+ 2007)

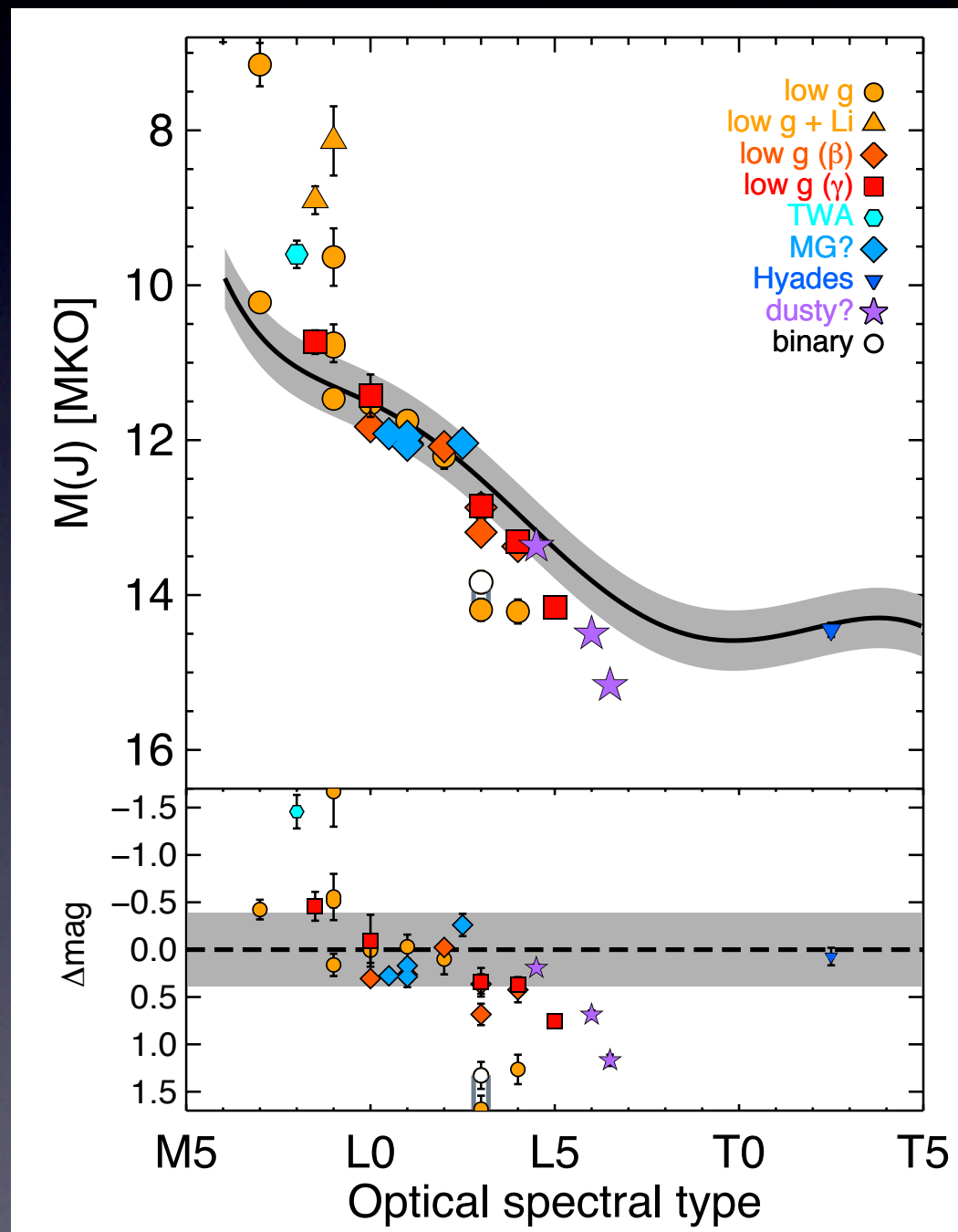
Common ways to reduce contaminants:



IPAC: 2MASS 6x of Ophiuchus

- Look for sources with disks.
- Concentrate searches on regions of high extinction. (e.g. Lucas, Roche & Tamura 2005; Wilking+ 2005)

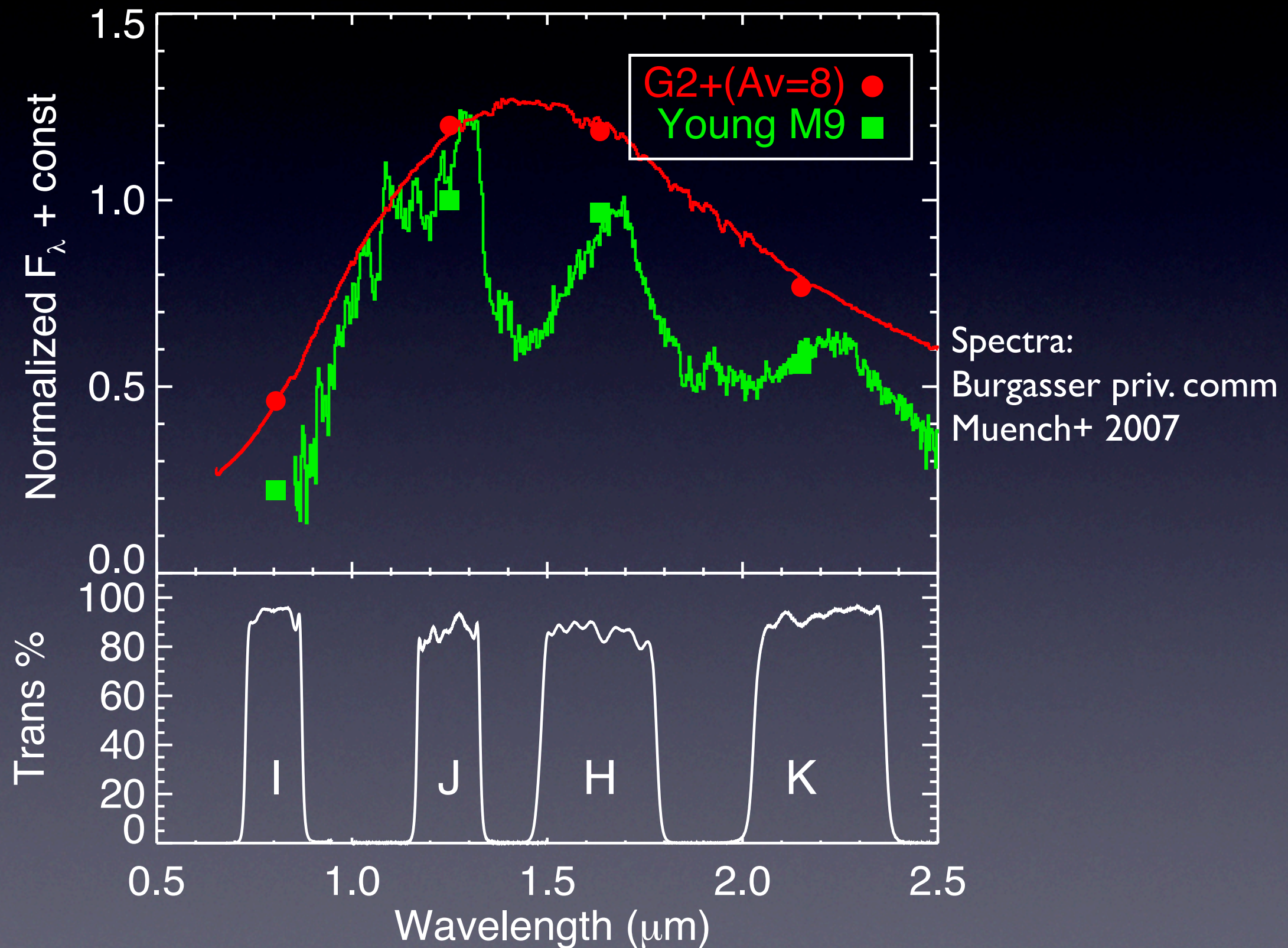
Common ways to reduce contaminants:



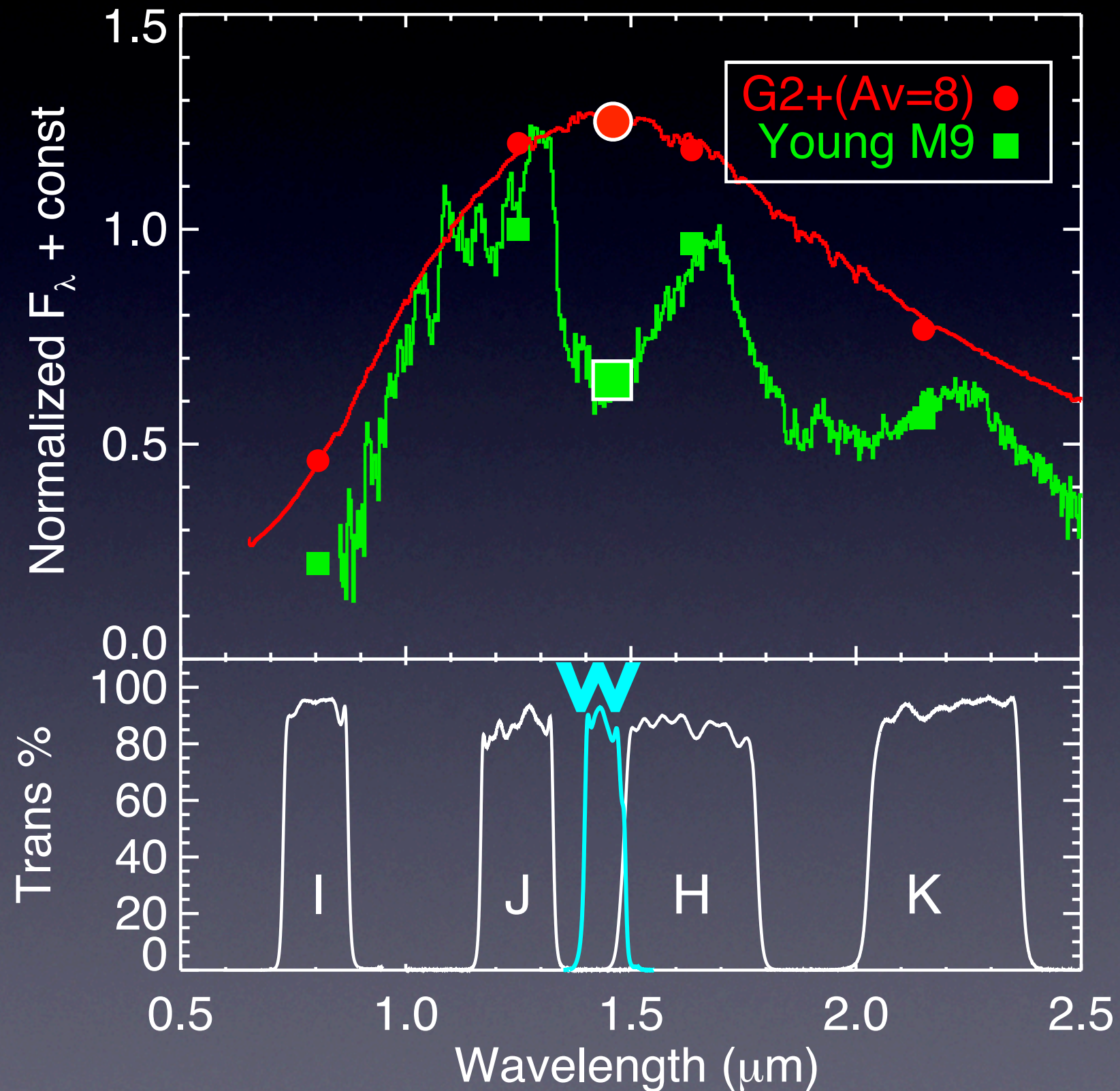
Liu, Dupuy & Allers 2013

- Look for sources with disks.
- Concentrate searches on regions of high extinction.
- Apply strict color-magnitude selection criteria. (e.g. Luhman 2007; Scholz+ 2009; Alves de Oliveira+ 2010)

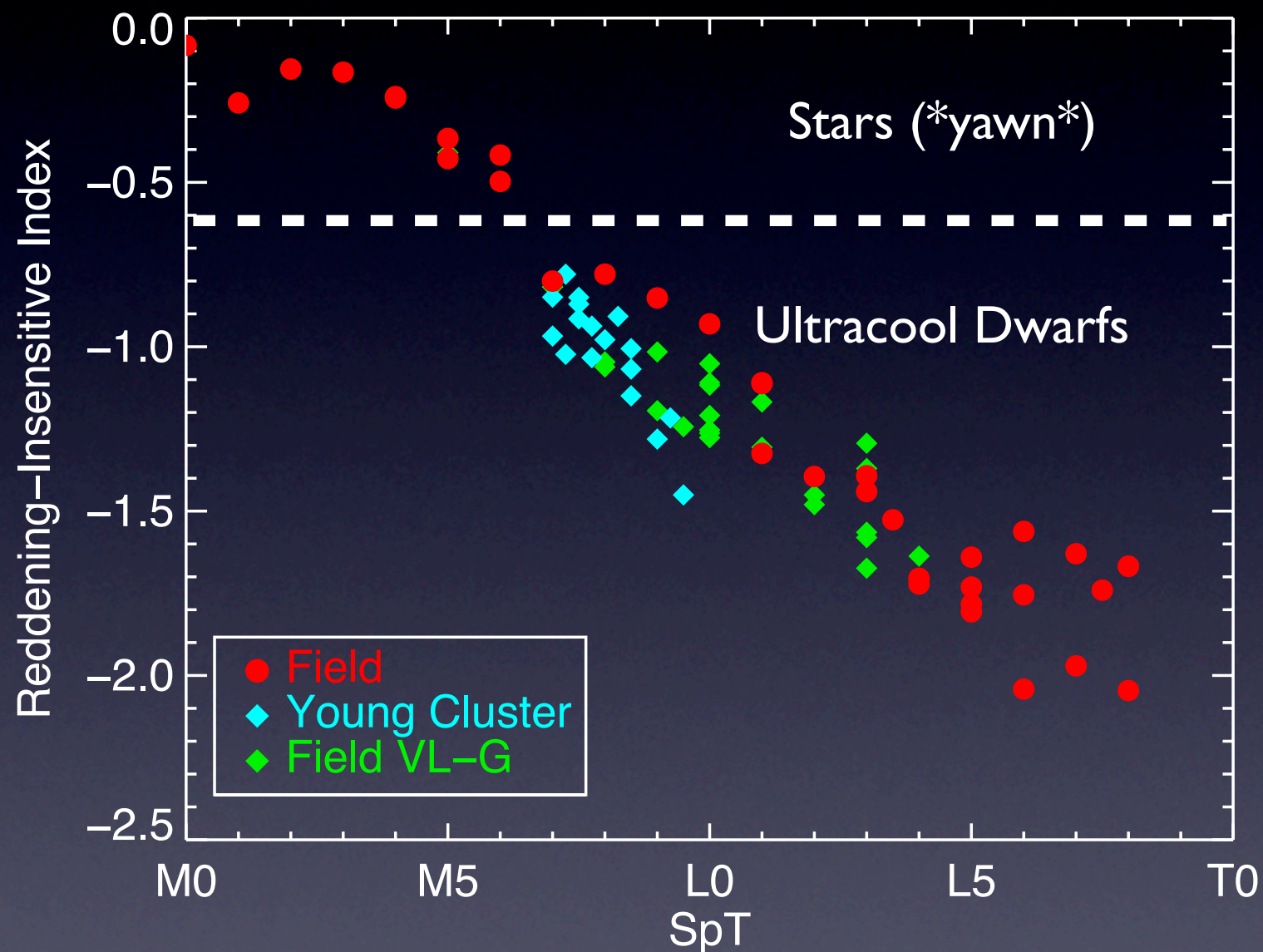
A different approach



A different approach



Nitty-Gritty of W-search



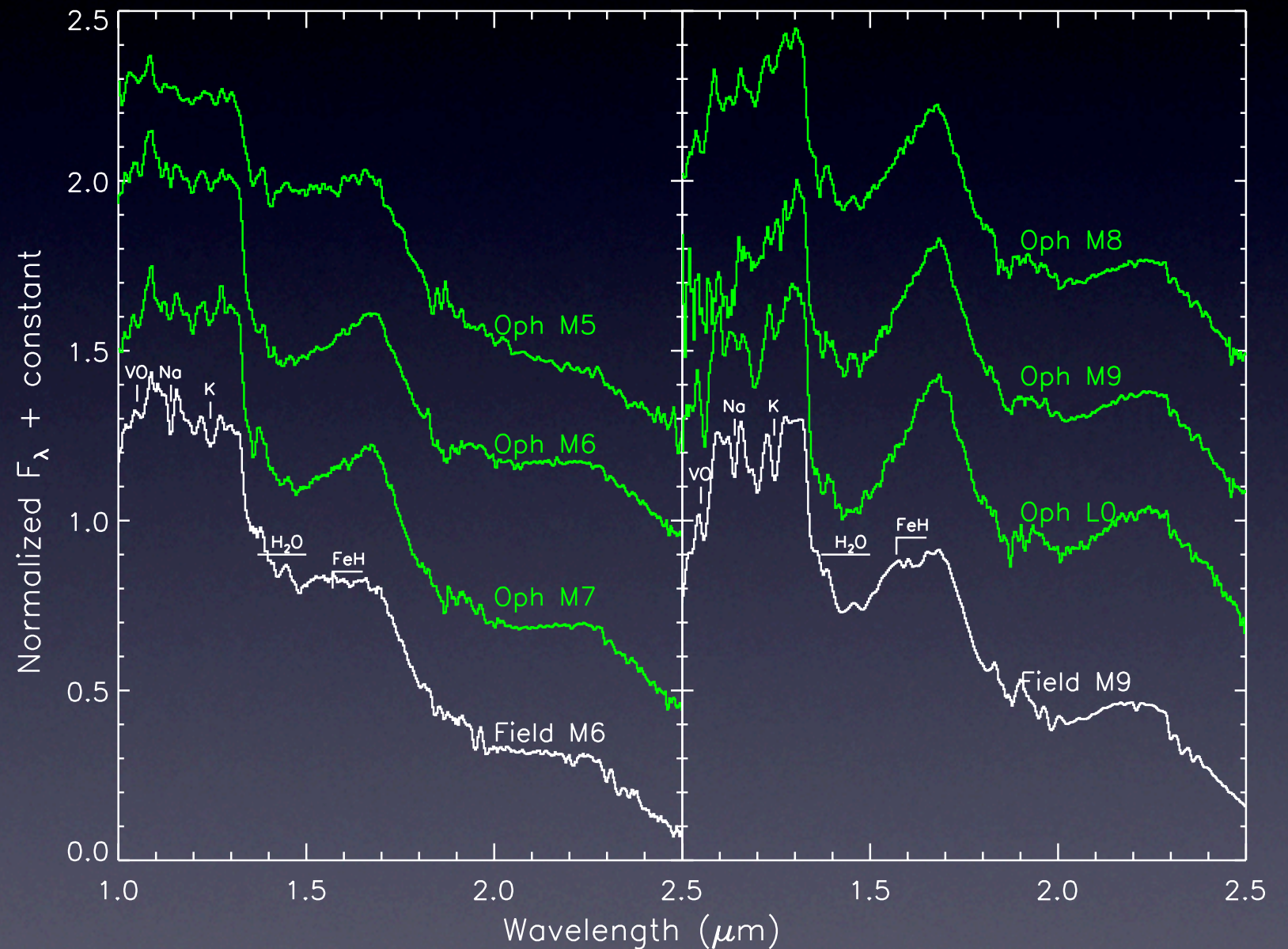
- W (~18.5 mag):
ULBCAM/UH 88"
- JH (~20, ~19 mag):
WIRCAM/CFHT,
WFCAM/UKIRT, ISPI/
Blanco
- 11 sq. deg in four
nearby SFRs
- Candidate Selection: Q
value indicates >M6 @
3 σ

$$Q = (J - W) + e(H - W)$$

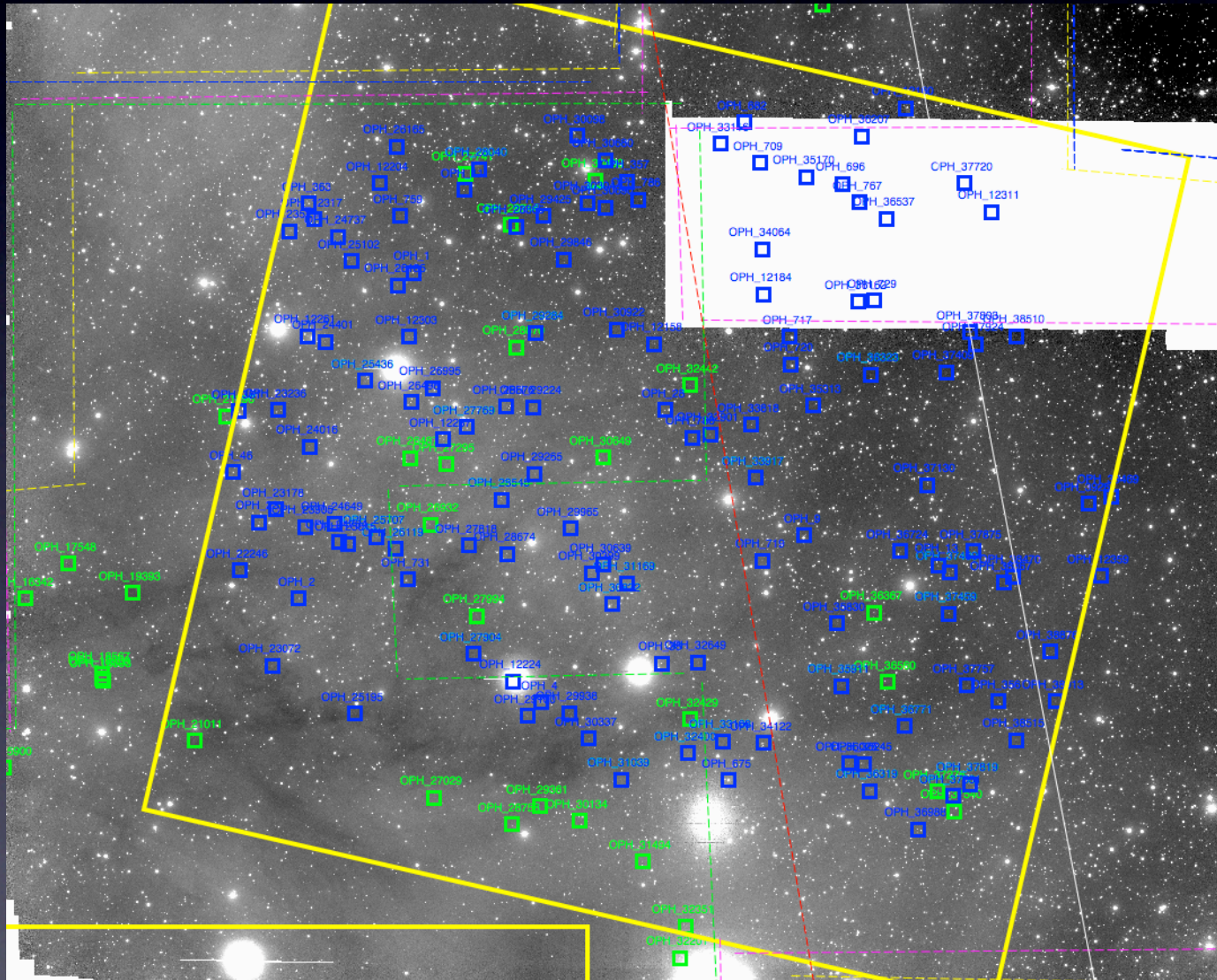
$$e = (A_J - A_W) / (A_W - A_H)$$

W-filter discoveries

- Followup with IRTF/SpeX
- 52 new young brown dwarfs
- 90% hit rate!



Assessing Reliability and Completeness

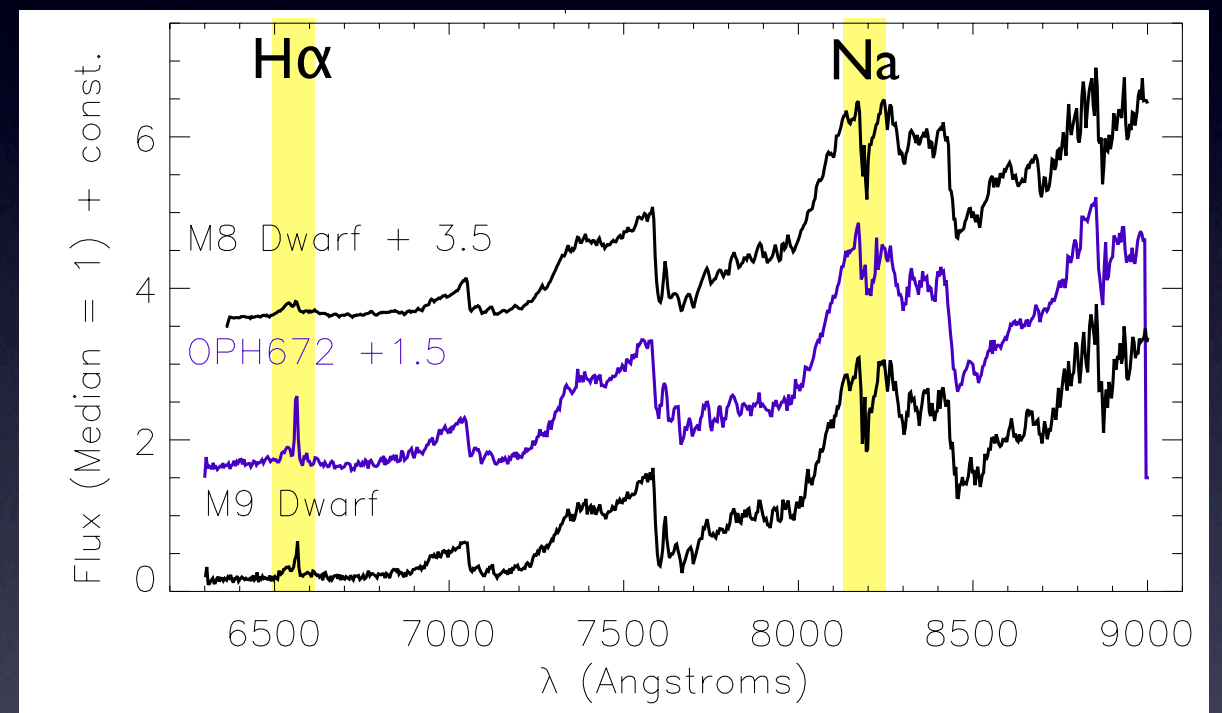


27' x 27' FOV

- IMACS $I < 21$ mags
- Relaxed Selection Criteria:
 - Broad-band $IzJHK$
 - Mid-IR Excess
 - $[1.45], J, H$

Broad band photometric selection misses $>30\%$ of BDs.

<u>Criteria:</u>	<u>Cand</u>	<u>$>M5$</u>	<u>Young</u>
IzJHK Disk WJH	7	7	4
IzJHK Disk WJH	13	10	3
IzJHK Disk WJH	7	3	2
IzJHK Disk WJH	8	7	6



M. Gully-Santiago in prep

Conclusions

- Custom Filters provide an opportunity to find young brown dwarfs without needing color-magnitude selection
- Take mass “completeness” limits with a grain of salt.
- Preliminary results suggest that there are many more (>30%) brown dwarfs and planetary objects to be found.

Interested in the W filter? Me too! We should chat...