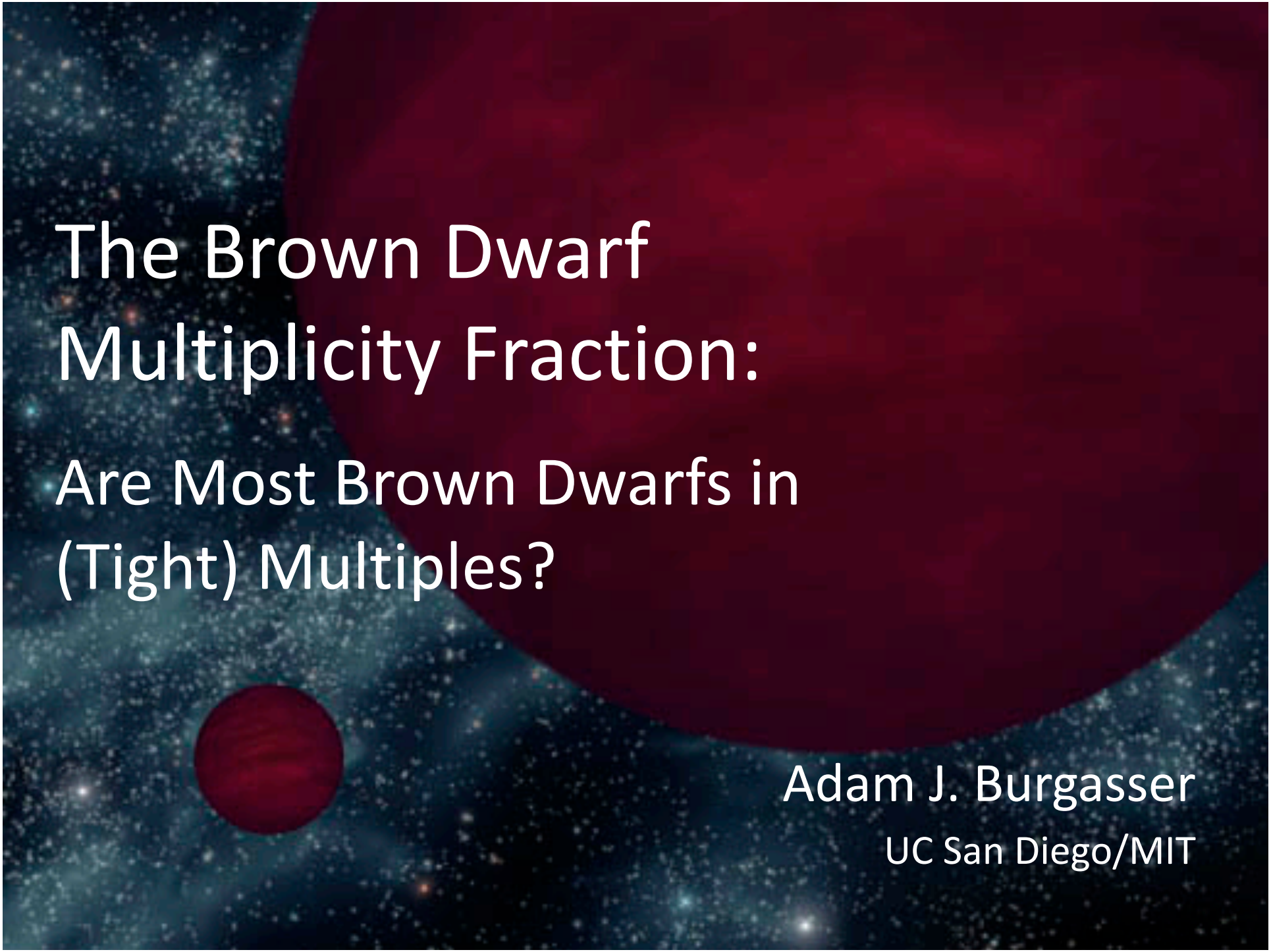

The Brown Dwarf Multiplicity Fraction:
Are Most Brown Dwarfs in (Tight) Multiples?
Adam J. Burgasser
UC San Diego/MIT

5%?

20%?

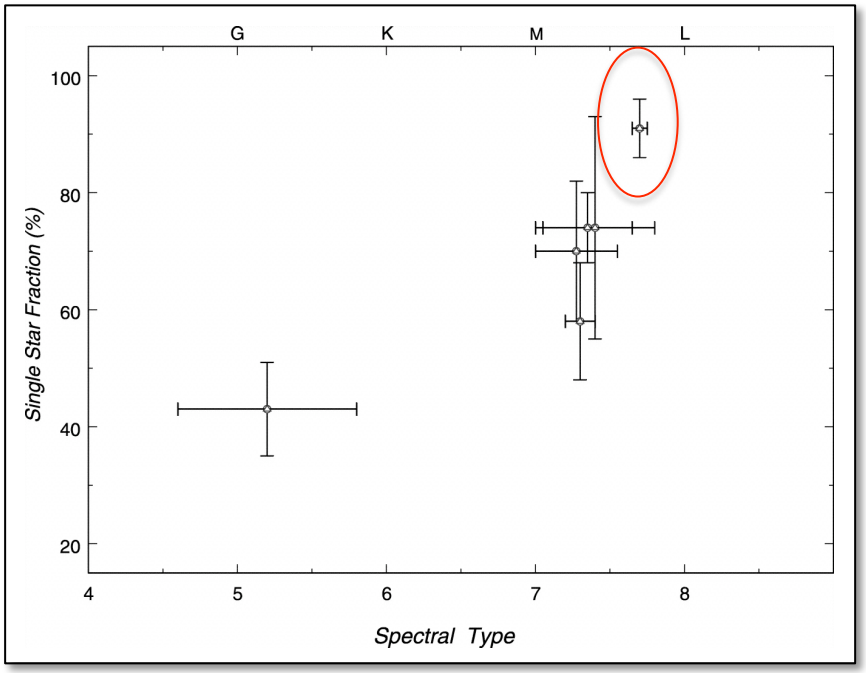
WHAT IS THE BROWN DWARF MULTIPLICITY FRACTION IN THE FIELD?

50%?

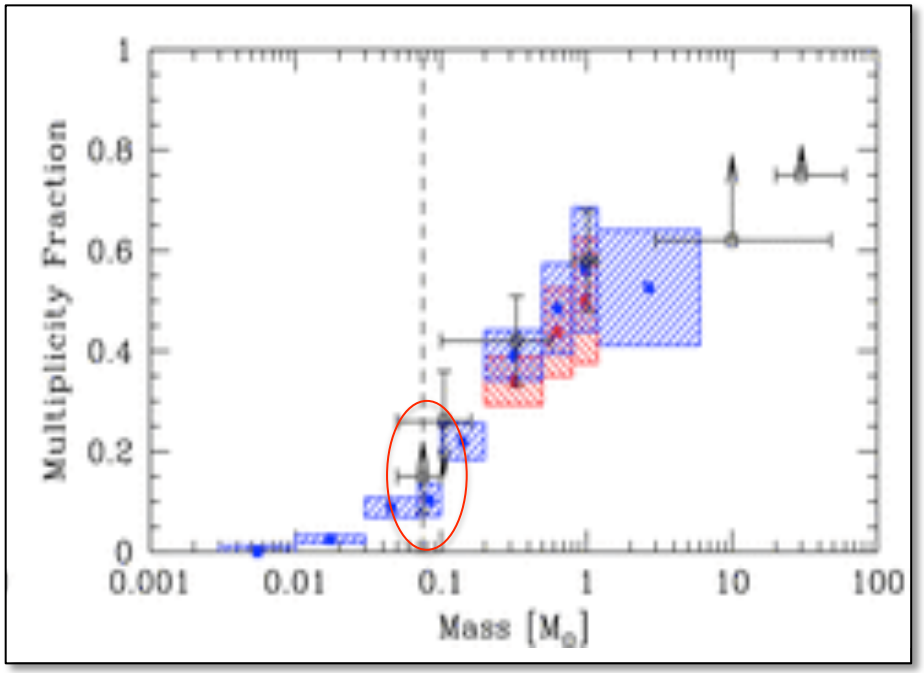
10%?

35%?

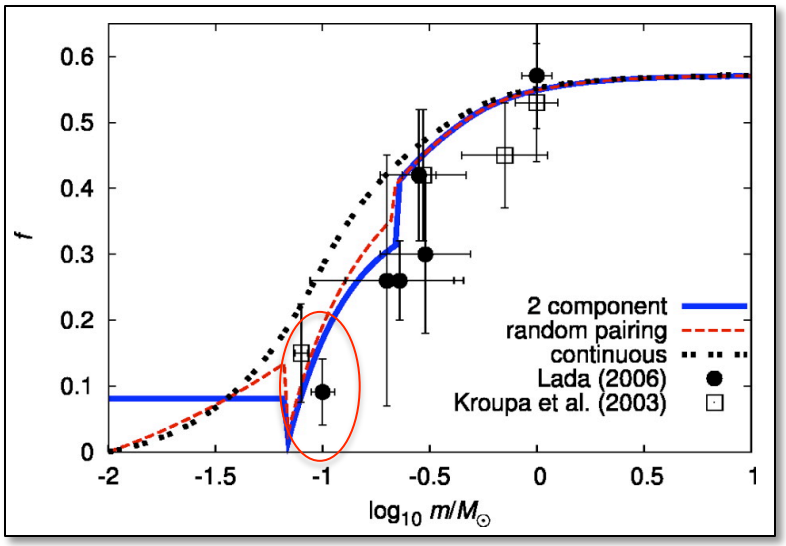
15%?



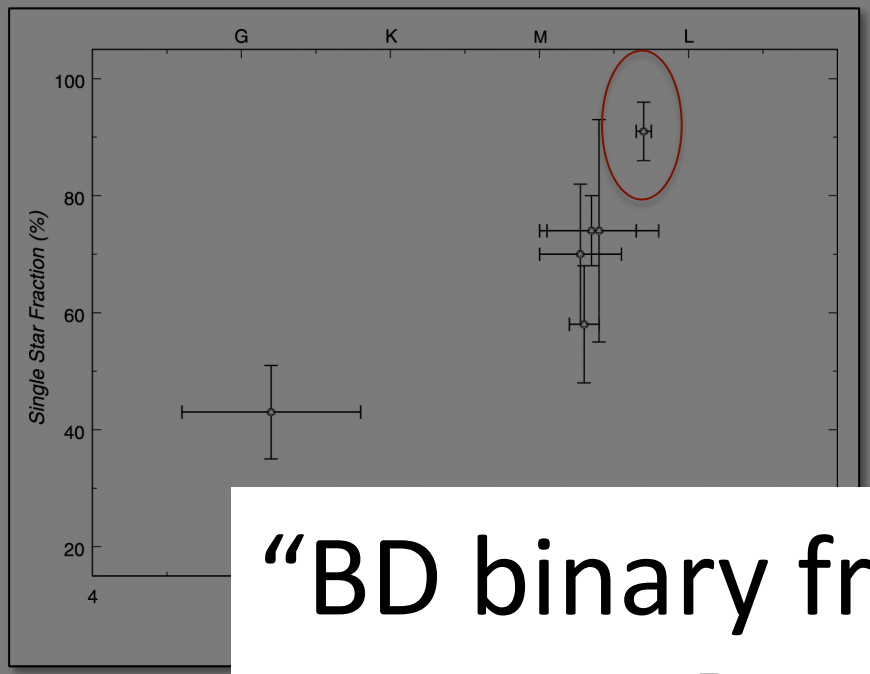
Lada (2006): 5-15%

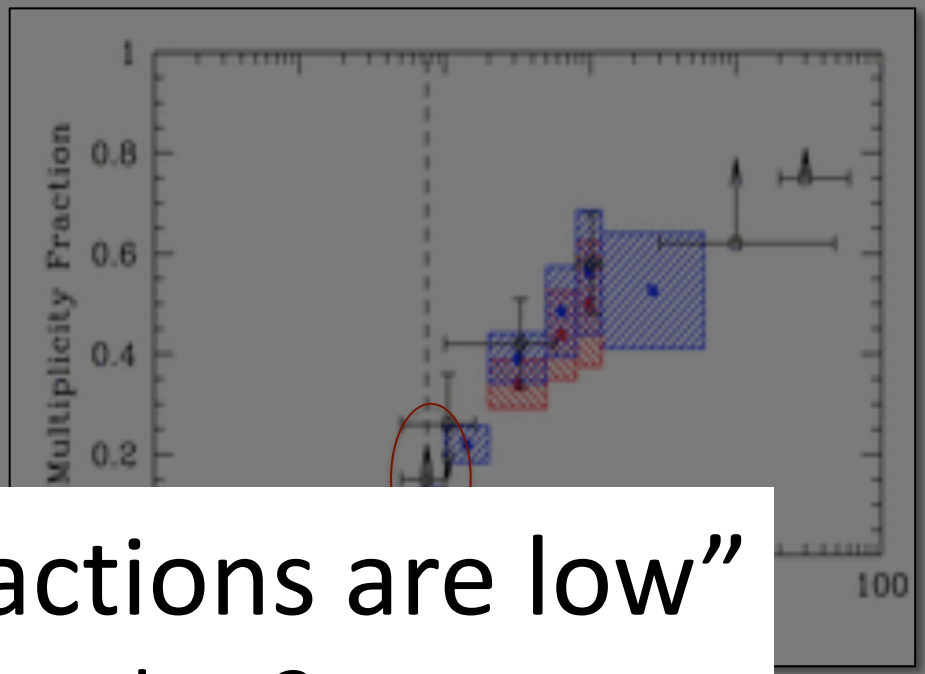


Bate et al. (2009): 5-20%



Thies & Kroupa (2007): 5-15%

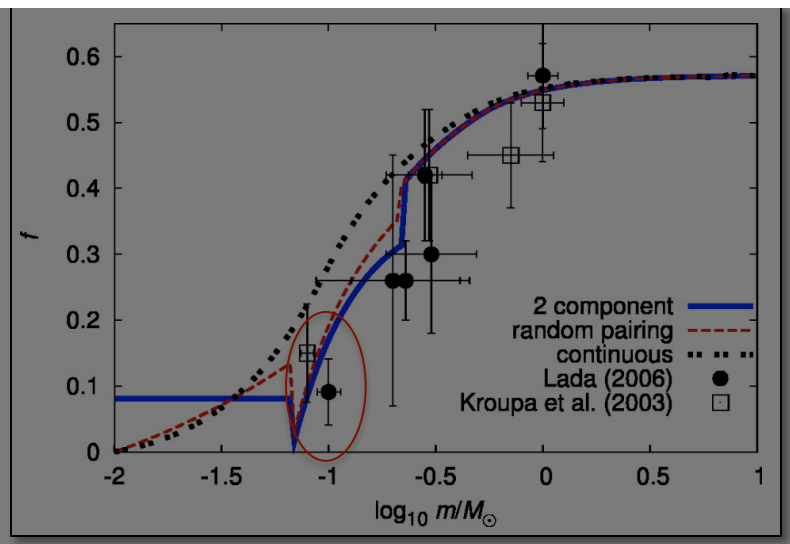




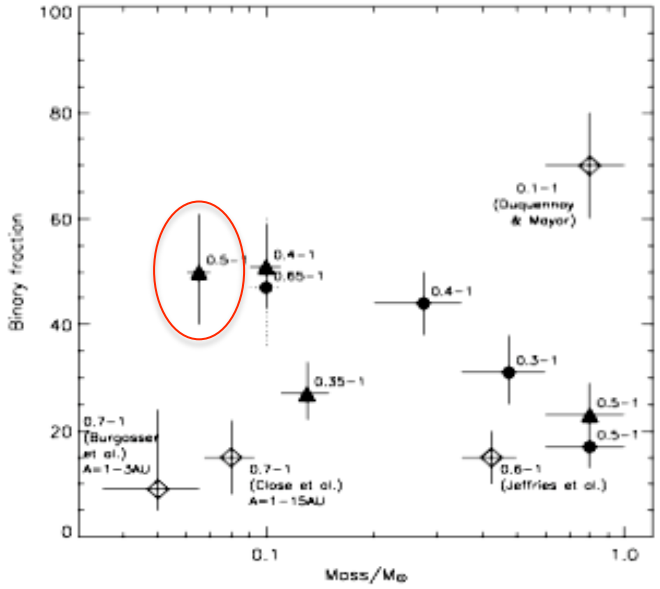
"BD binary fractions are low"

But are they?

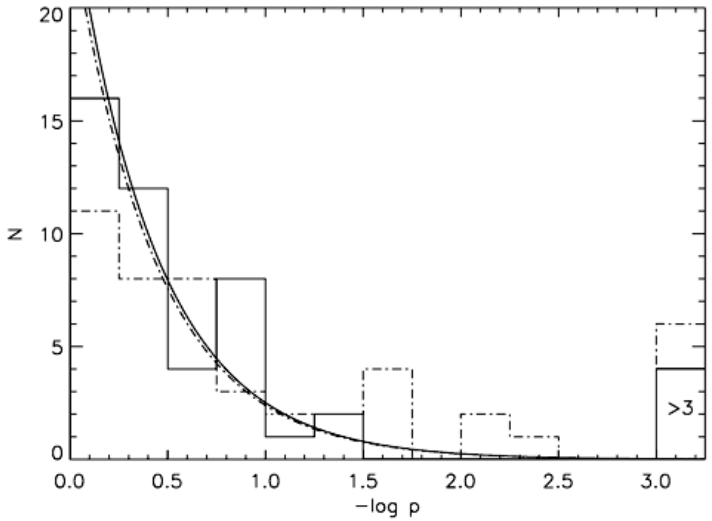
Lad 0%



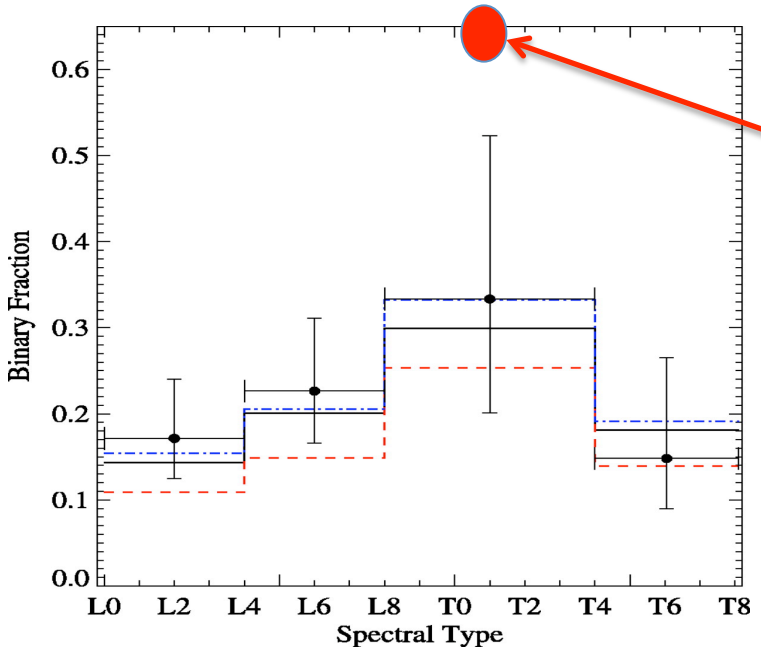
Thies & Kroupa (2007): 5-15%



Pinfield et al. (2003): 40-61%!



Maxted & Jeffries (2005): 32-45%!



If 67% L/T transition objects are binary (Liu et al. 2006) then …

Burgasser (2007): 24-53%!

Very Low Mass Binaries Archive

This page last updated on Tuesday, July 28, 2009. There are currently 99 VLM binaries listed.

This Archive contains an up-to-date list of all the stellar (and sub-stellar) binary systems with total estimated mass < 0.2 M_solar known in the literature. It targets both theorists and observers interested in understanding the empirical data of this subject. In most cases binary parameters are extracted directly from refereed journals referenced in the Table. Additional background information can be found in:

Not Alone: Tracing the Origins of Very-Low-Mass Stars and Brown Dwarfs Through Multiplicity Studies (Burgasser, A. J., Reid, I. N., Siegler, N., Close, L., Allen, P., Lowrance, P., Gizis, J. 2006, chapter in Protostars and Planets V) (Download in postscript, PDF)

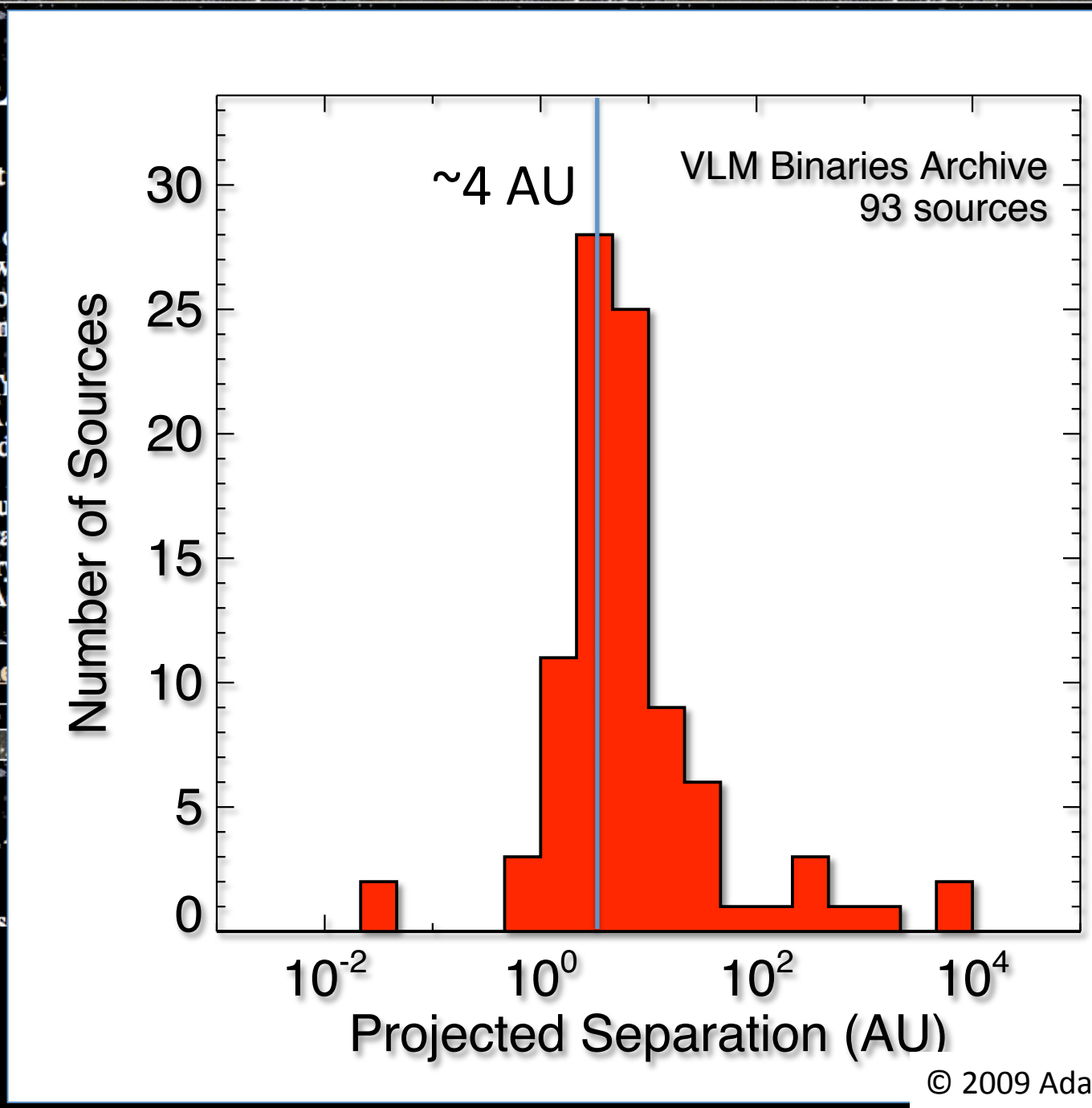
Please send suggestions, corrections, and updates to nicholas.siegler at jpl.nasa.gov. If time, I will link the star names to ADS. If this table has been useful in your research, we suggest an acknowledgment of the form "This publication has made use of the Very-Low-Mass Binaries Archive housed at http://www.vlmbinaries.org and maintained by Nick Siegler, Chris Gelino, and Adam Burgasser."

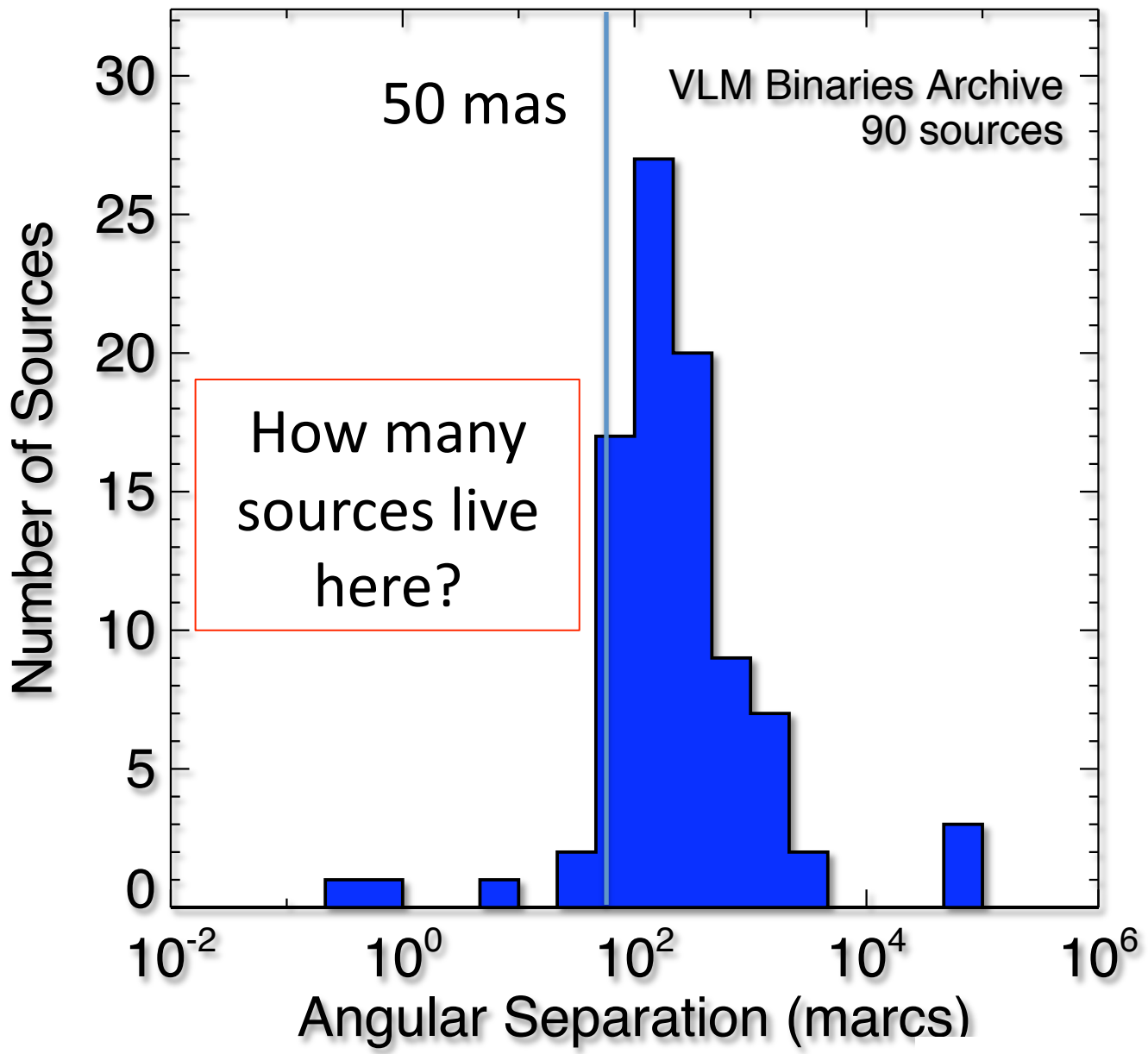
Table | References | Column Descriptions | **Export to:** Comma-separated (Excel) **or** Tab-separated (ASCII)

Table of All Known Very Low Mass Binary Systems ($M_{total} < 0.2\ M_{solar}$)

To see the description for a column hover the cursor over it, click on the "?" next to the column name, or click on "Column

http://www.vlmbinaries.org





"Easy" Ways to Find Tight BD Binaries

- Radial velocity variables (e.g., Joergens 2006,2008; Basri & Reiners 2006; Blake et al. 2008)

  Pros: samples tight physical separations (<1-5 AU); direct mass measurement

  Cons: expensive, impossible for faint sources, difficult to characterize components

- Overluminosities in CMD (e.g., Pinfield et al. 2003; Chapelle et al. 2005; Burgasser et al. 2008)

  Pros: no limit on separation, cheap(ish)

  Cons: contamination issues, requires cospatial sample or accurate distance measurements (not cheap), difficult to characterize components

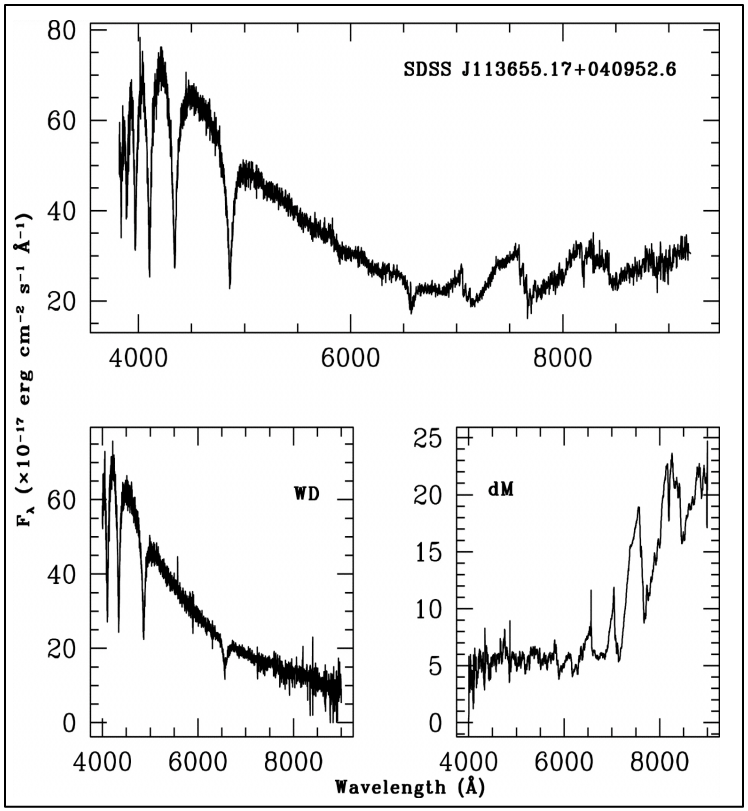
Also eclipsing, microlensing, etc.

Spectral Binaries

Combined light spectra of distinct but comparably bright components

Pros: independent of angular & projected separation, can be done with low-resolution data (cheap), can characterize components

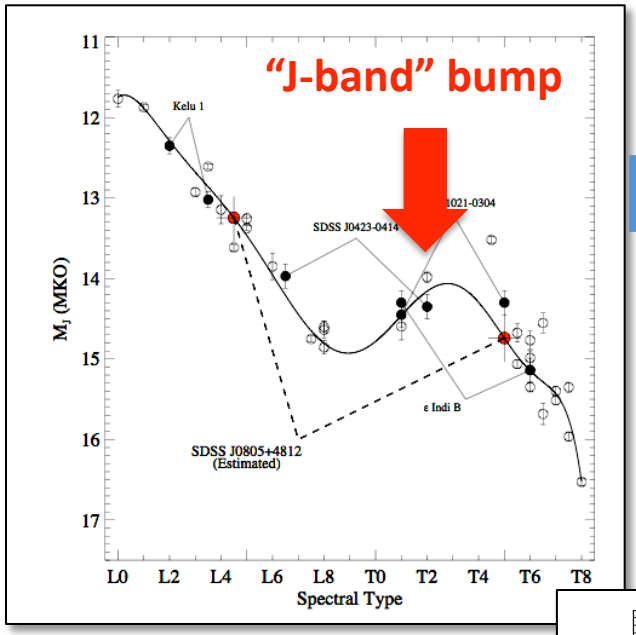
Cons: rare, no separation info, complex selection effects

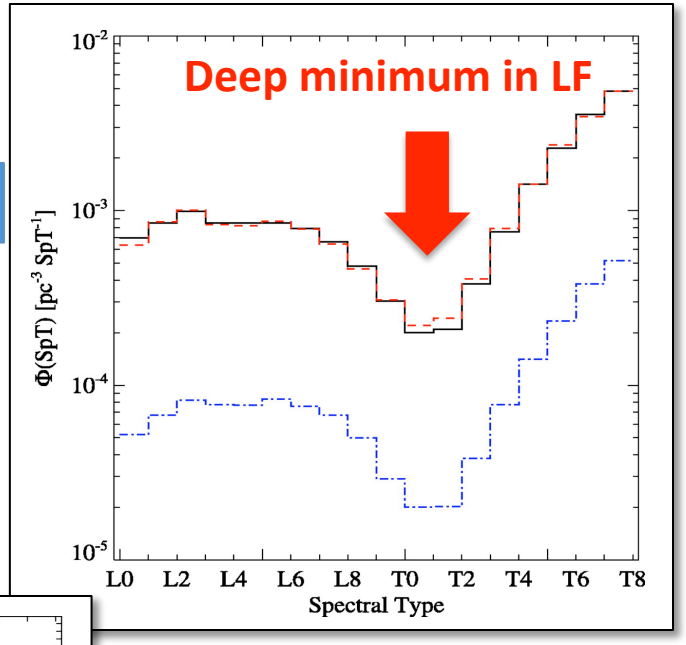


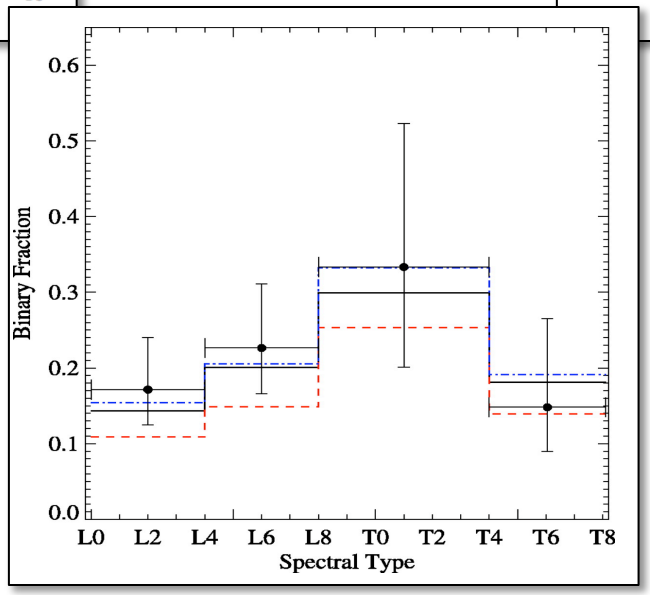
Silvestri et al. (2006)

WD-dM unresolved pair

Exploiting the L/T Transition*



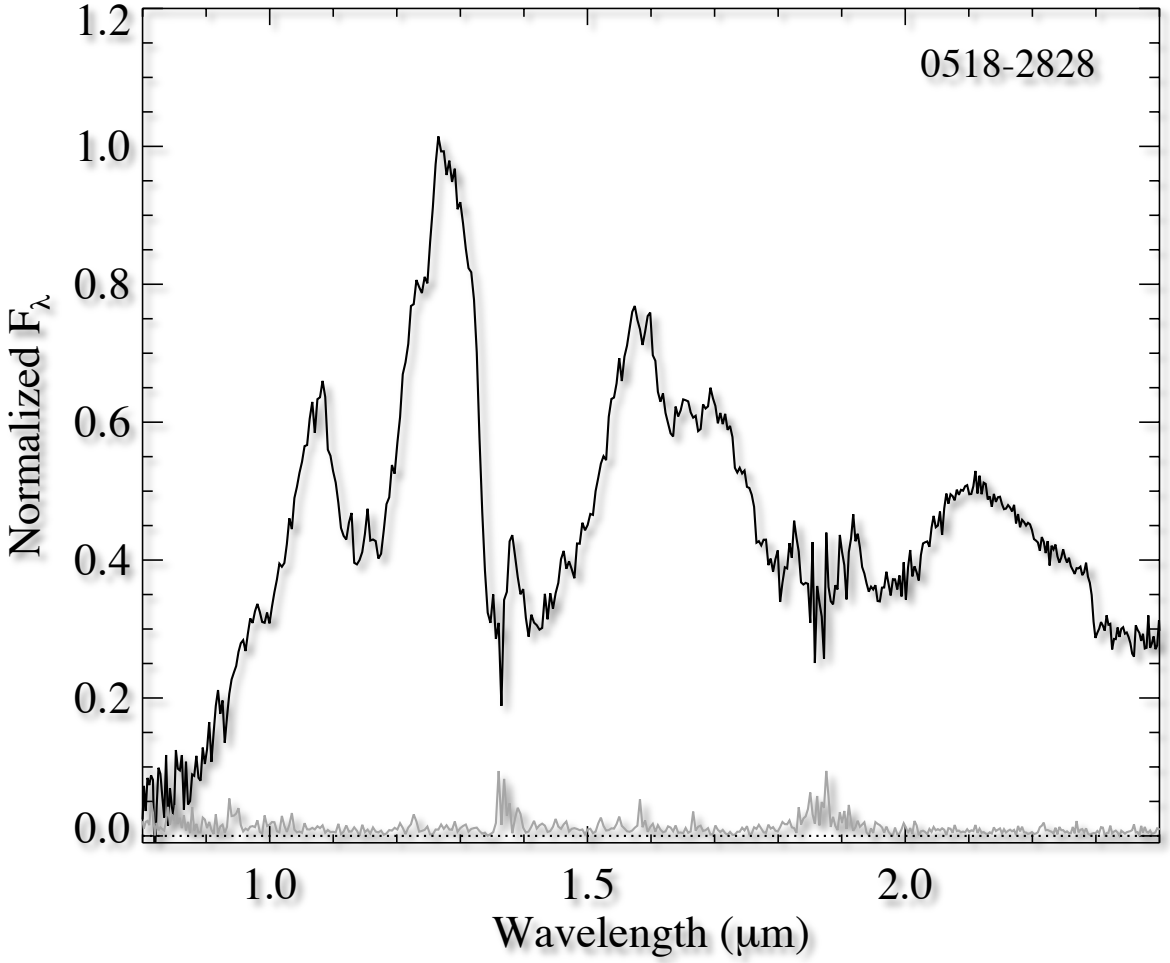




An enhanced binary fraction of equal-brightness components at the L/T transition

2M 0518-2828

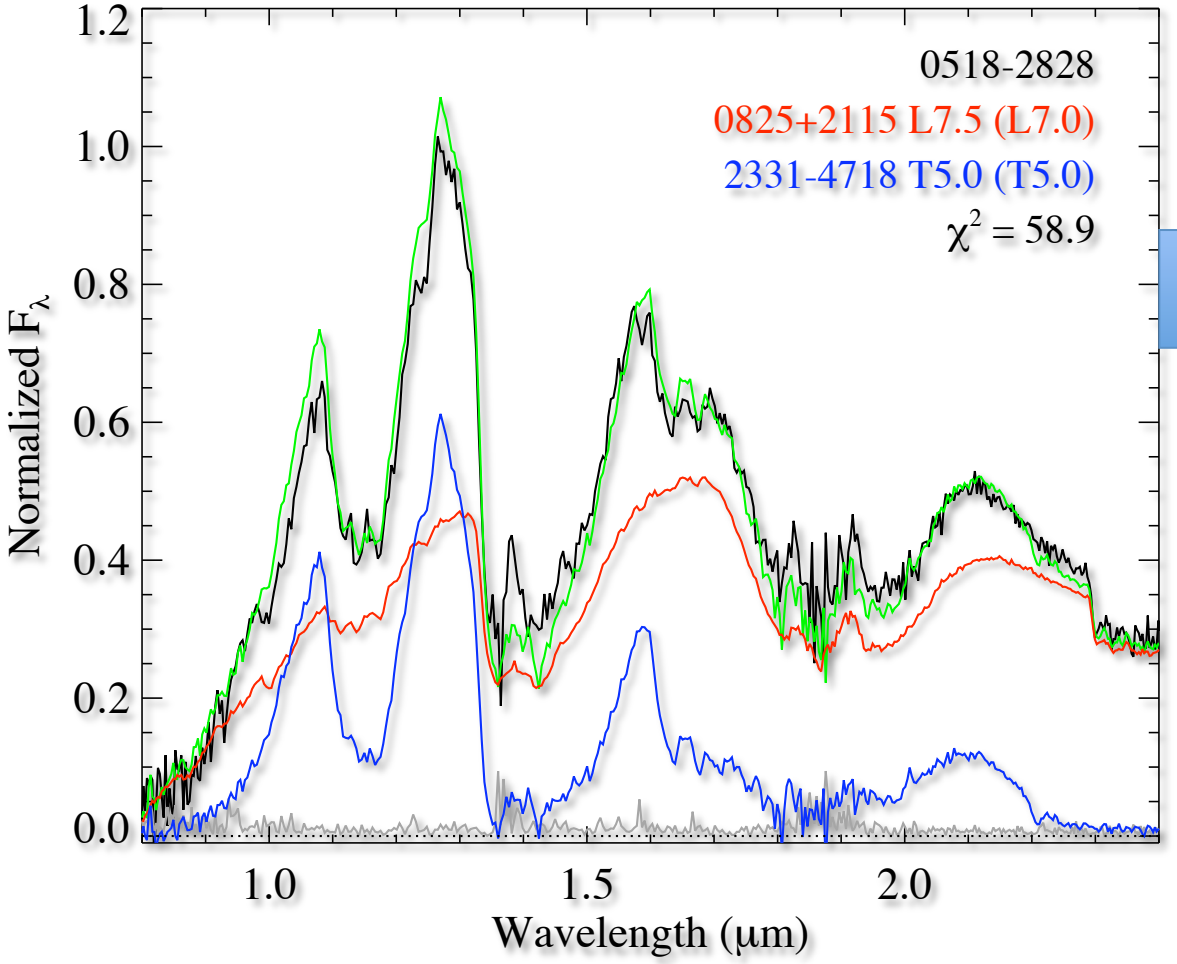
Archetype L/T Spectral Binary

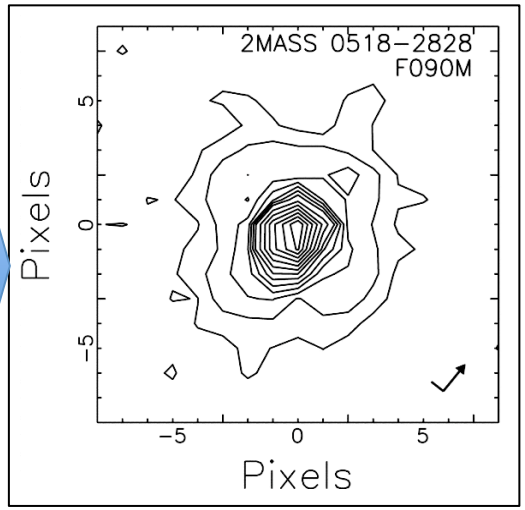


Cruz et al. (2004); Burgasser et al. (2006)

2M 0518-2828

Archetype L/T Spectral Binary



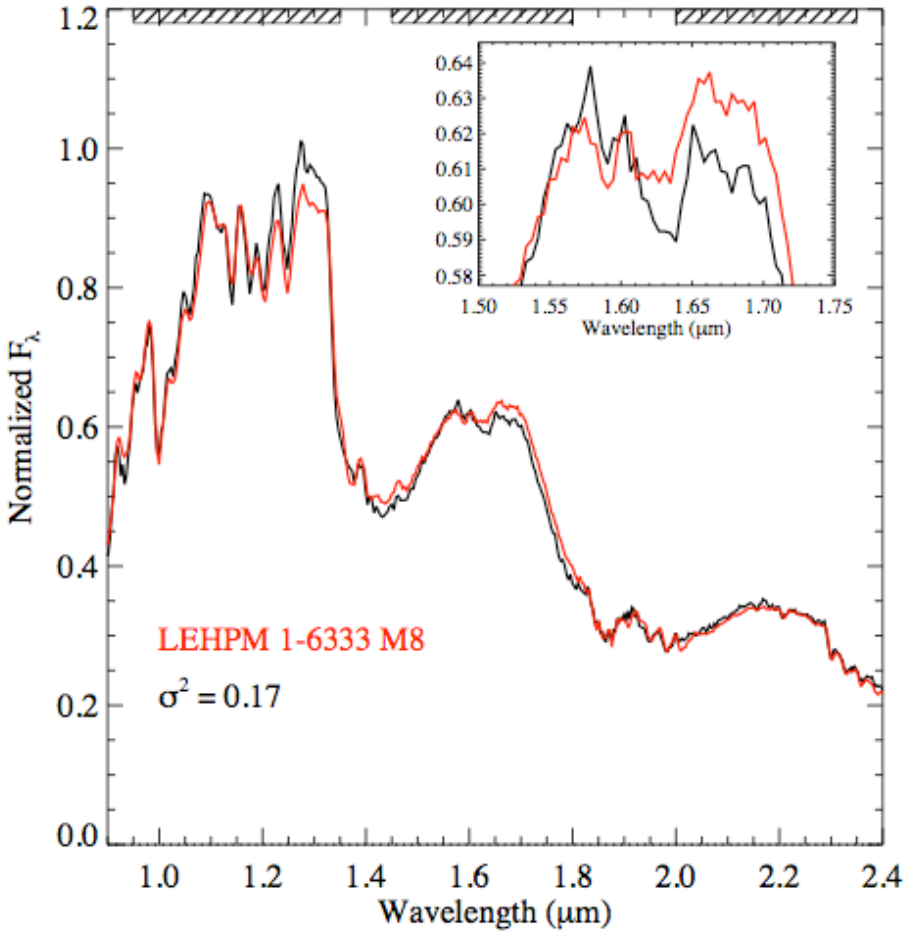


Resolved (barely) with HST/NICMOS (50 mas ≈ 1.8 AU)

Cruz et al. (2004); Burgasser et al. (2006)

2M 0320-0446

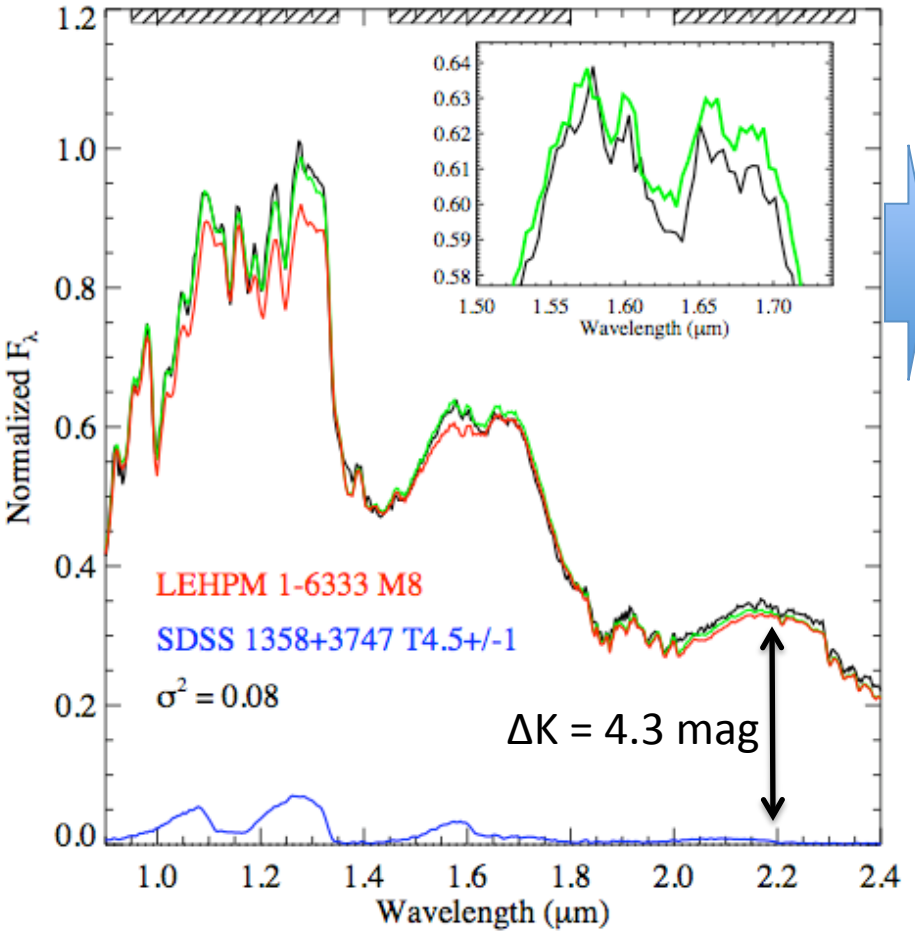
An M/T Spectral/Spectroscopic Binary

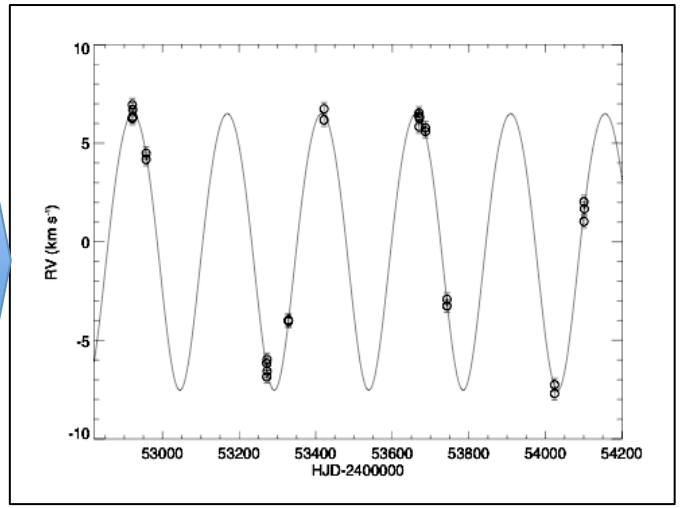


Burgasser et al. (2008); Blake et al. (2008)

2M 0320-0446

An M/T Spectral/Spectroscopic Binary





Spectroscopic binary with 0.67 yr period ($\Delta V = \pm 7$ km/s; $M_1 \approx 0.08$ $M_\odot$, $M_2 \approx 0.05$ $M_\odot$

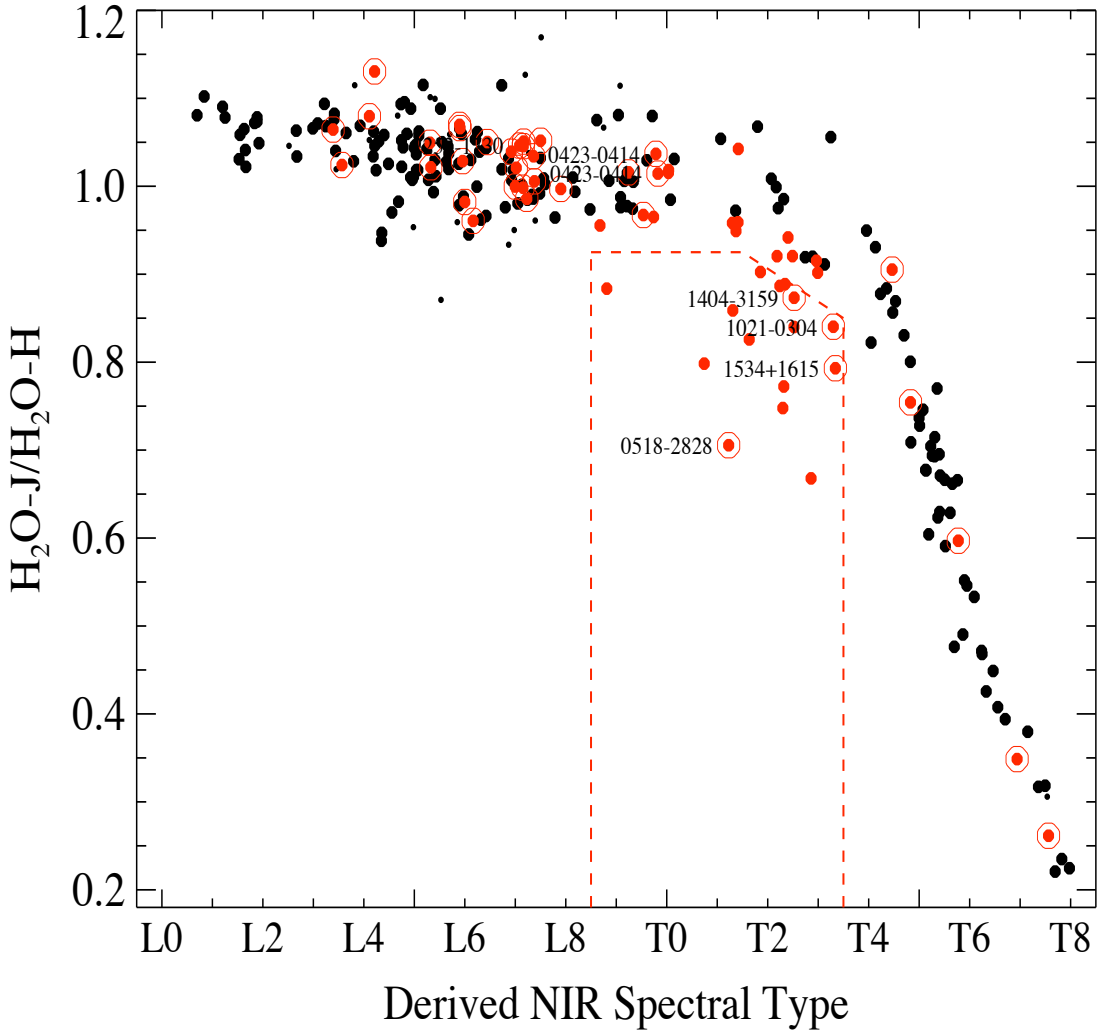
Burgasser et al. (2008); Blake et al. (2008)

Search for Unresolved L/T Binaries

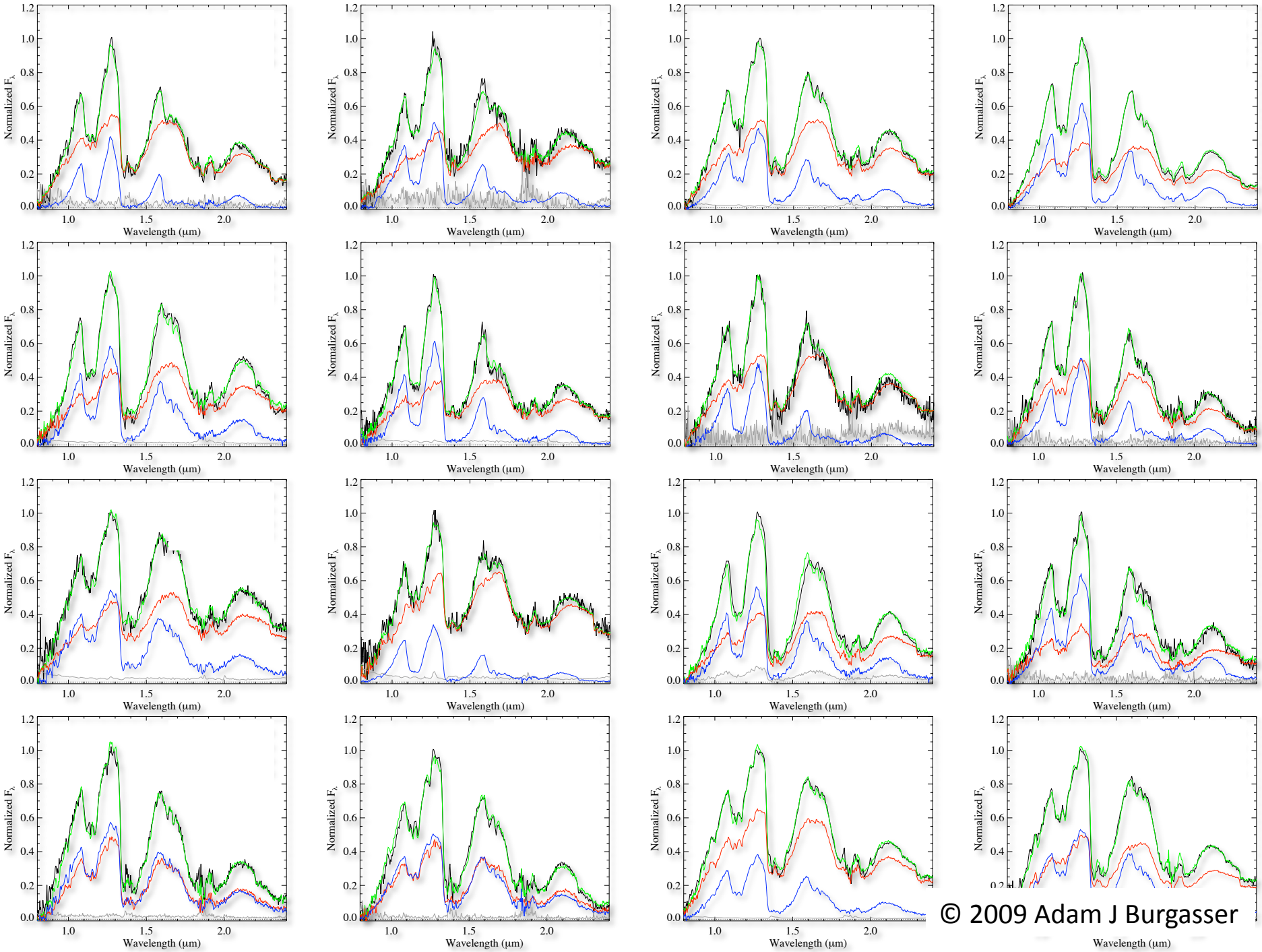
- Full sample of 253 SpeX prism spectra for 233 L3-T8 dwarfs from SpeX Prism Spectral Libraries*
- Index selection of binary candidates
- Template library of 170 spectra (reject low g, subdwarfs, low S/N, known & candidate binaries)
- Construct 13581 unique binary combinations
- Compare single and binary templates to candidates and assess statistical significance of “better fit”

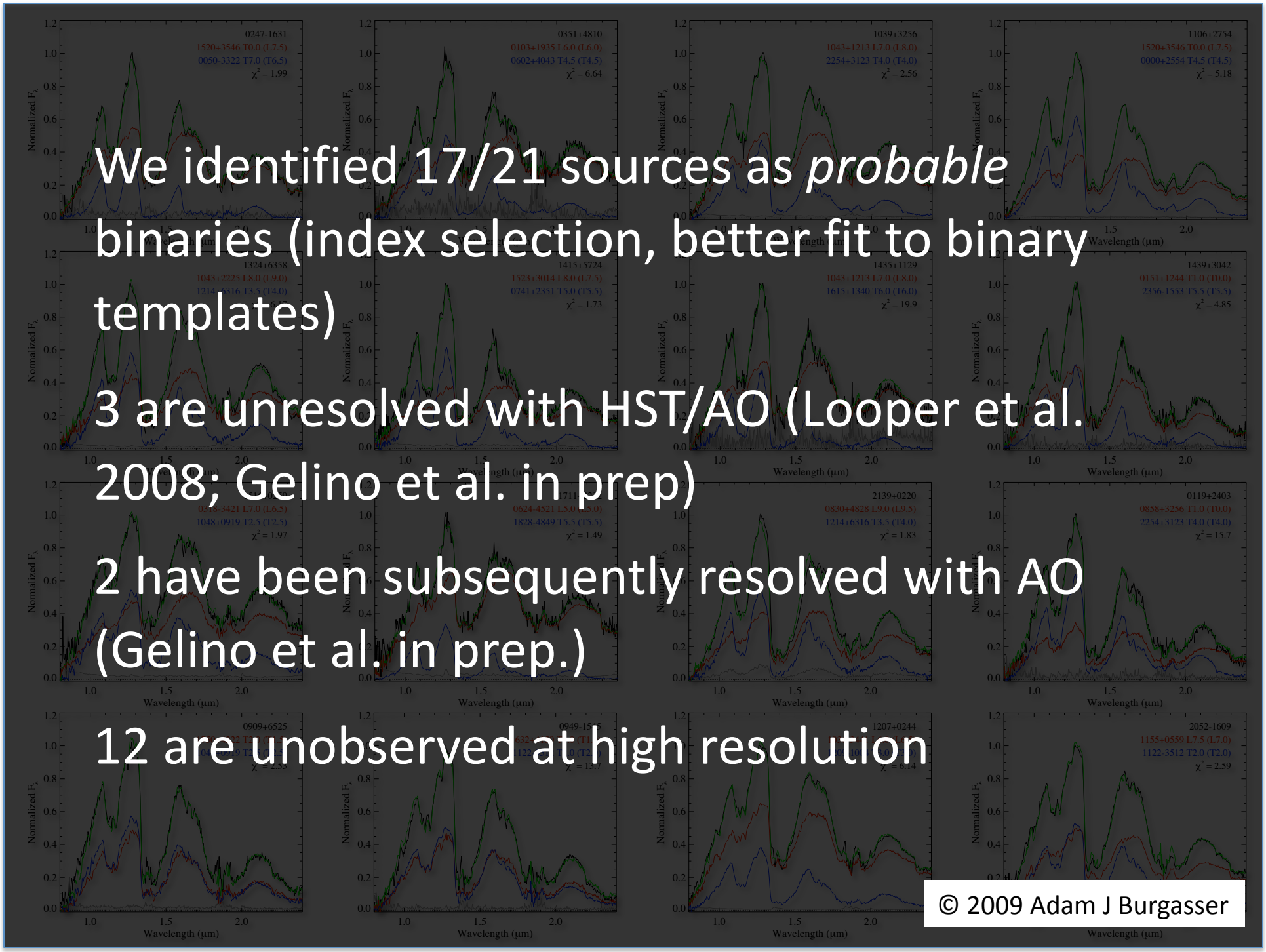
* http://www.browndwarfs.org/spexpris

Index Selection



=> 21 candidates identified (12 “strong” + 8 “weak”)





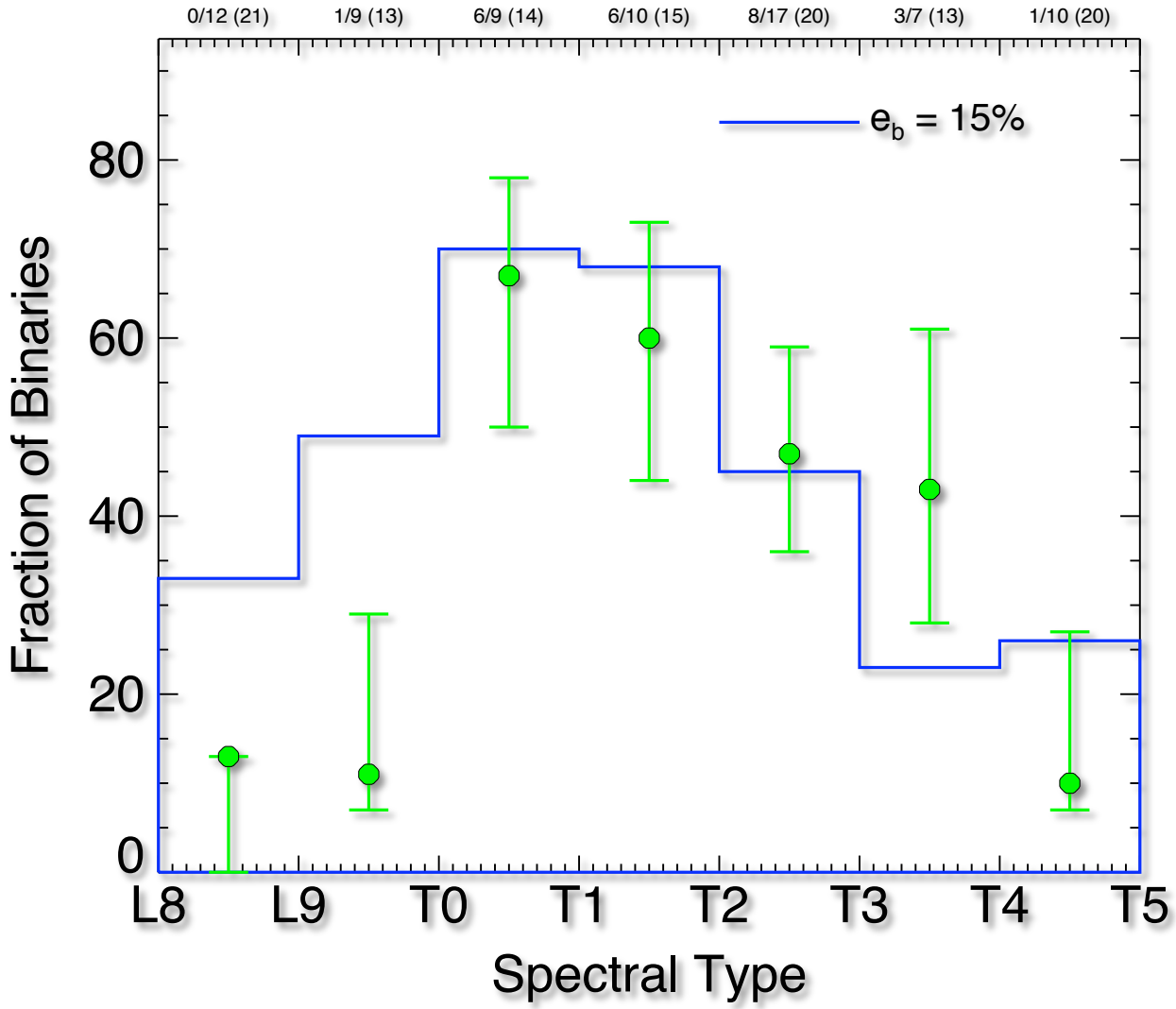
We identified 17/21 sources as *probable* binaries (index selection, better fit to binary templates)

3 are unresolved with HST/AO (Looper et al. 2008; Gelino et al. in prep)

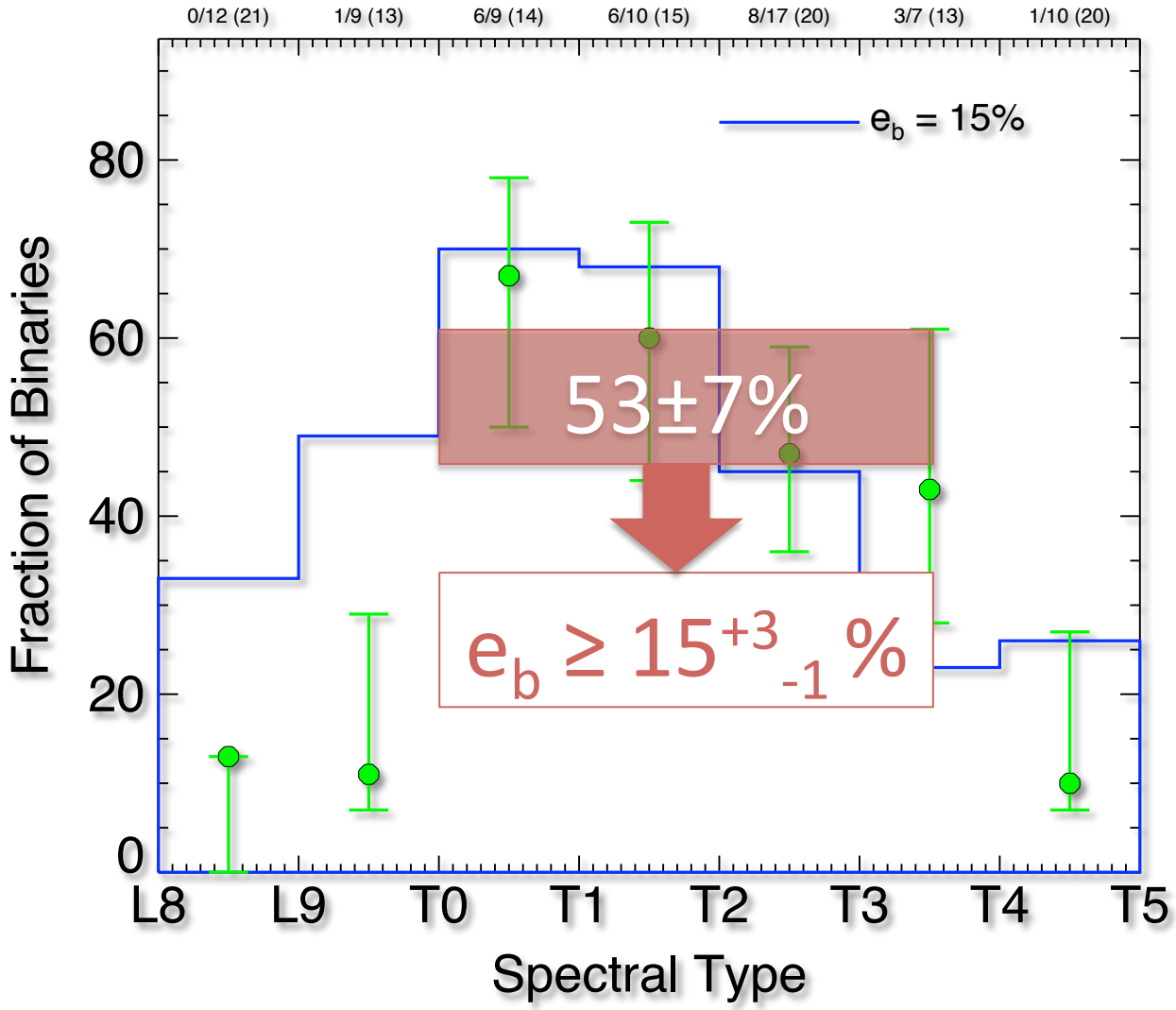
2 have been subsequently resolved with AO (Gelino et al. in prep.)

12 are unobserved at high resolution

What about the binary fraction?

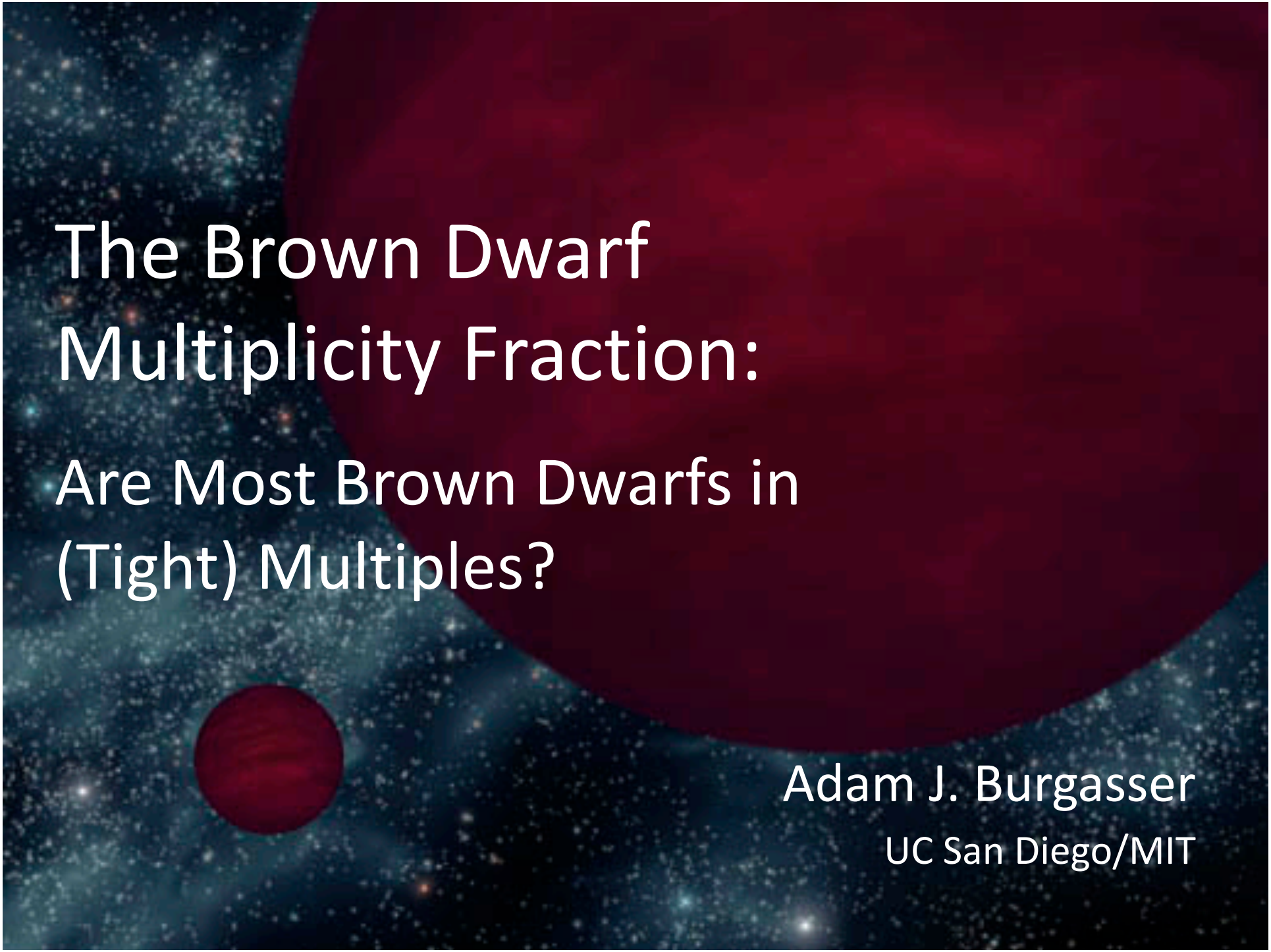


What about the binary fraction?



Conclusions

- Spectral binaries comprised of L dwarf/T dwarf pairs can measure the intrinsic BD binary fraction
  - Indep. of physical separation (tight pairs; e.g. 2m0320)
  - Indep. of angular separation (distant pairs, large samples)
  - Can be done cheap and fast with low-res spectral data
- We uncovered 17 (+3) probably binaries; a few confirmed, most awaiting follow-up
- The BD binary fraction is ≥15% independent of separation distribution


The Brown Dwarf Multiplicity Fraction:
Are Most Brown Dwarfs in (Tight) Multiples?
Adam J. Burgasser
UC San Diego/MIT