

White Dwarfs in UKIDSS



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Companions to White Dwarfs

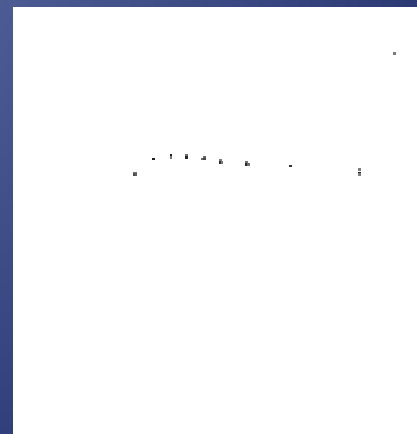
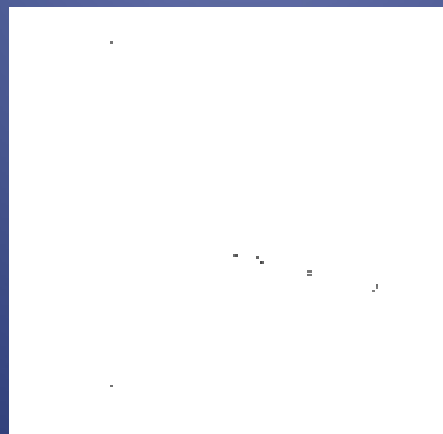
- Allows us to investigate the known deficit of BD companions to main-sequence stars. [McCarthy & Zuckerman \(2004\)](#), [Grether & Lineweaver \(2006\)](#)
- There are no empirical constraints on substellar evolutionary models at older ages (> 1 Gyr) - wide-detached systems provide benchmarks ([Pinfield et al. 2006](#))
- In close systems, irradiated BD provides a laboratory for testing models of heated substellar atmospheres.
- The closest WD+BD binaries could also represent another channel of CV evolution.
- BD companions to WDs are rare: $<0.5\%$ for L dwarfs ([Farihi et al. 2005](#)). Only 4 confirmed systems to date.

White Dwarfs in UKIDSS DR5

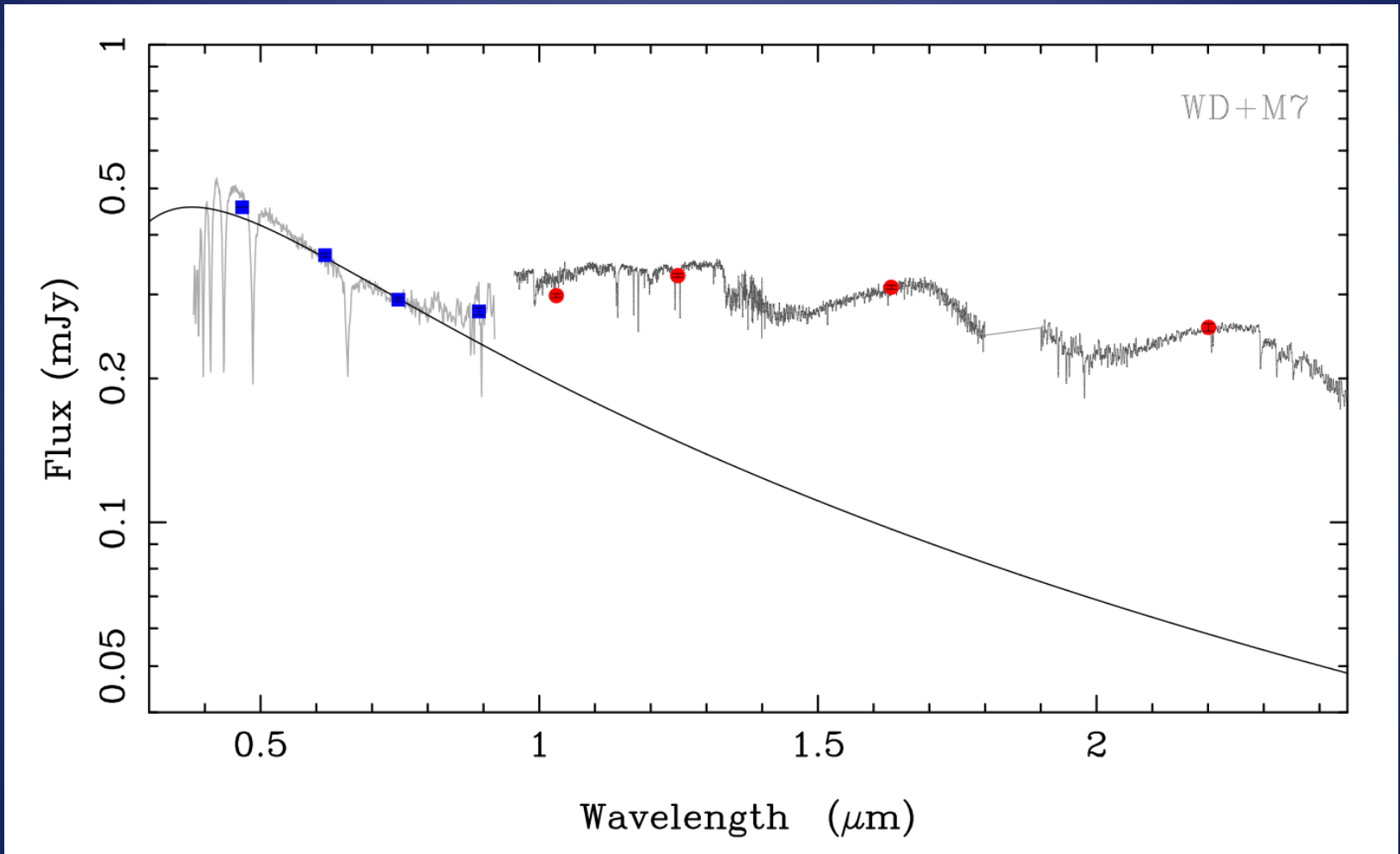
- Large, deep near-infrared surveys ideal for searches...
- X-Correlated [Eisenstein et al. \(2006\)](#), online August 2006 version of McCook & Sion catalogues.
- Searched for white dwarfs within 5σ limits of UKIDSS YJHK.
- Produced 1161 matches with SDSS, 489 with McCook & Sion.
- 106 of the McCook and Sion were not in the SDSS catalogue giving a total sample size of **1267**.
- Removed 11 misidentified objects (Visual Check).

Identifying Candidate Systems

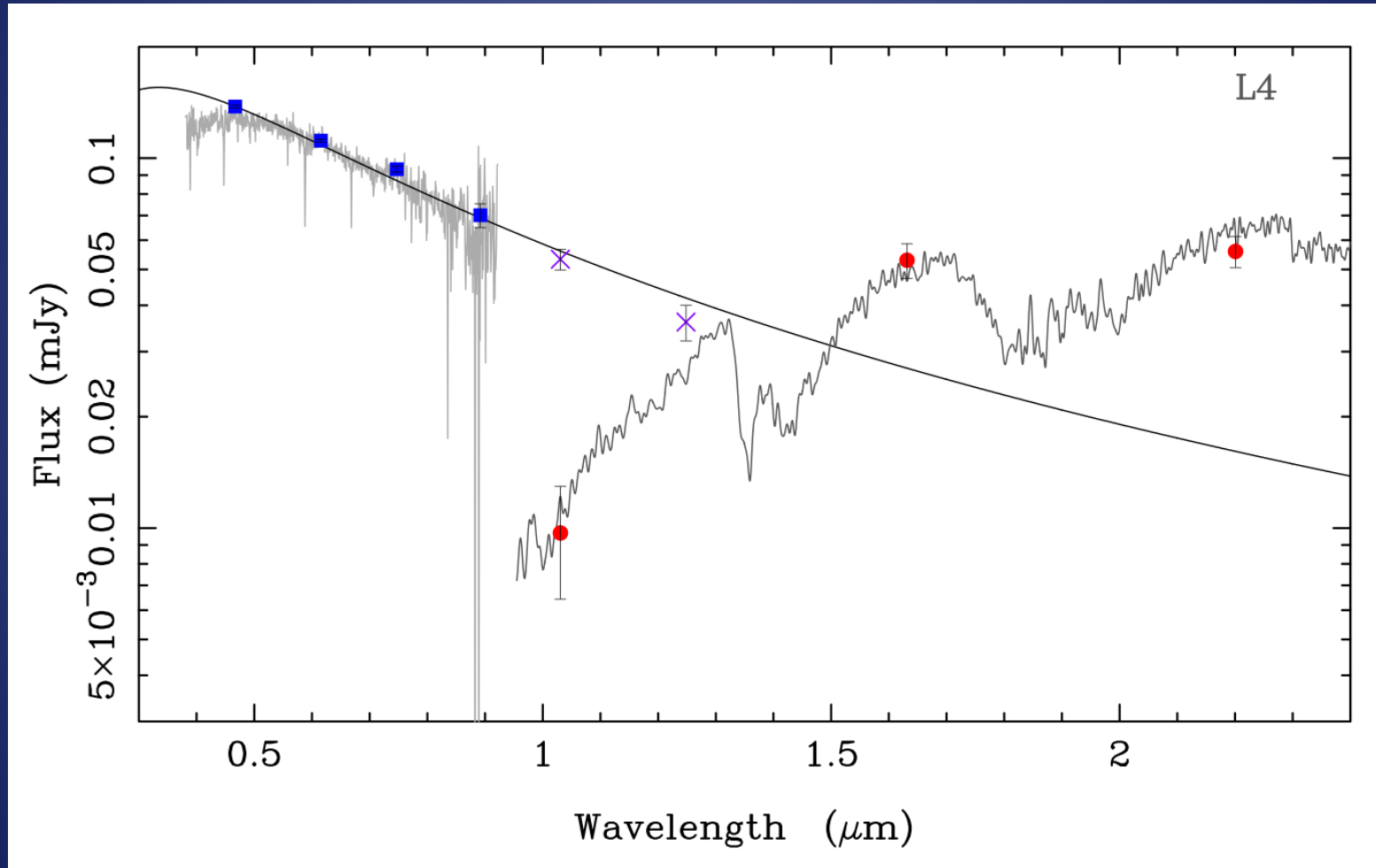
- Predicted white dwarf NIR photometry (JHK) using the Bergeron models.
- Scaled models to each white dwarf using their i' or V mag.
- We then compared the models to UKIDSS near-infrared photometry and identified those with a $> 3\sigma$ excess in H and K (or K only).



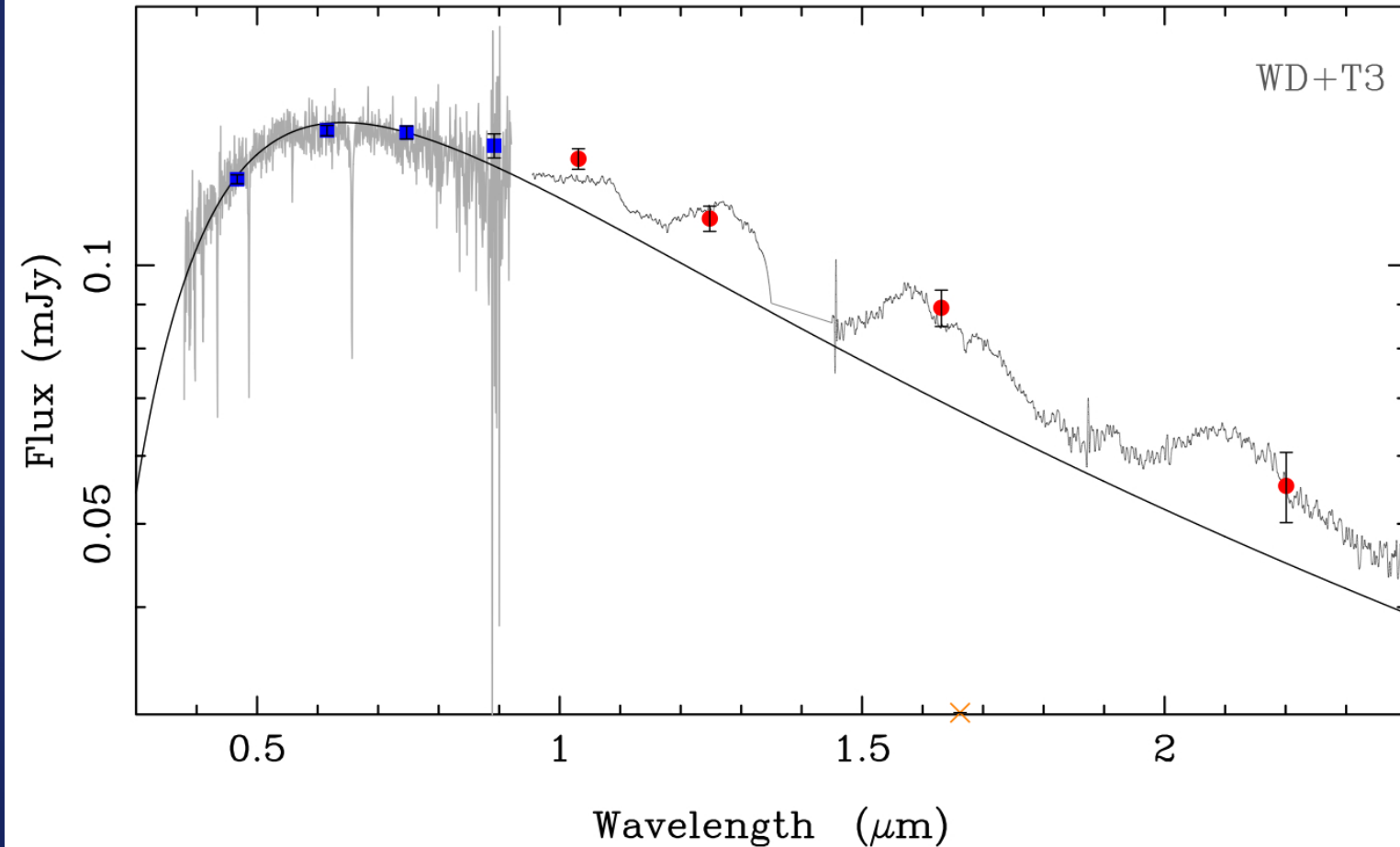
Example I: DA+dM



Example II: DB+dL

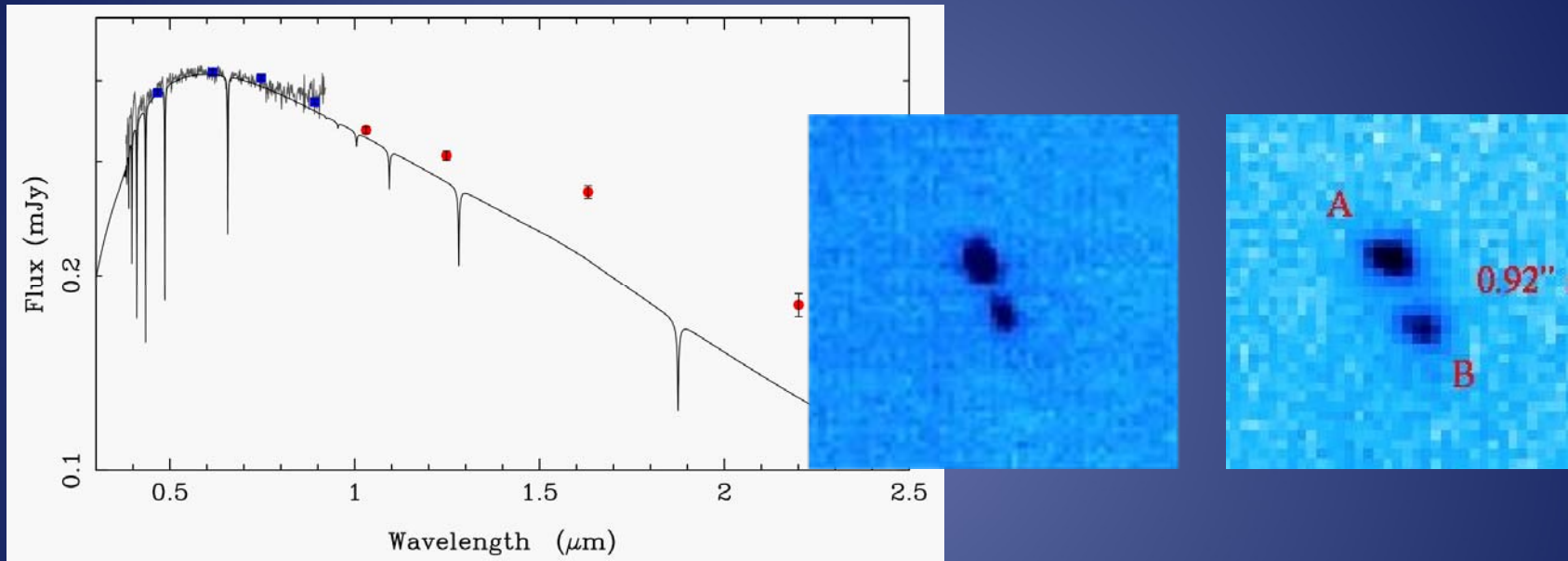


Example III: DA+dT



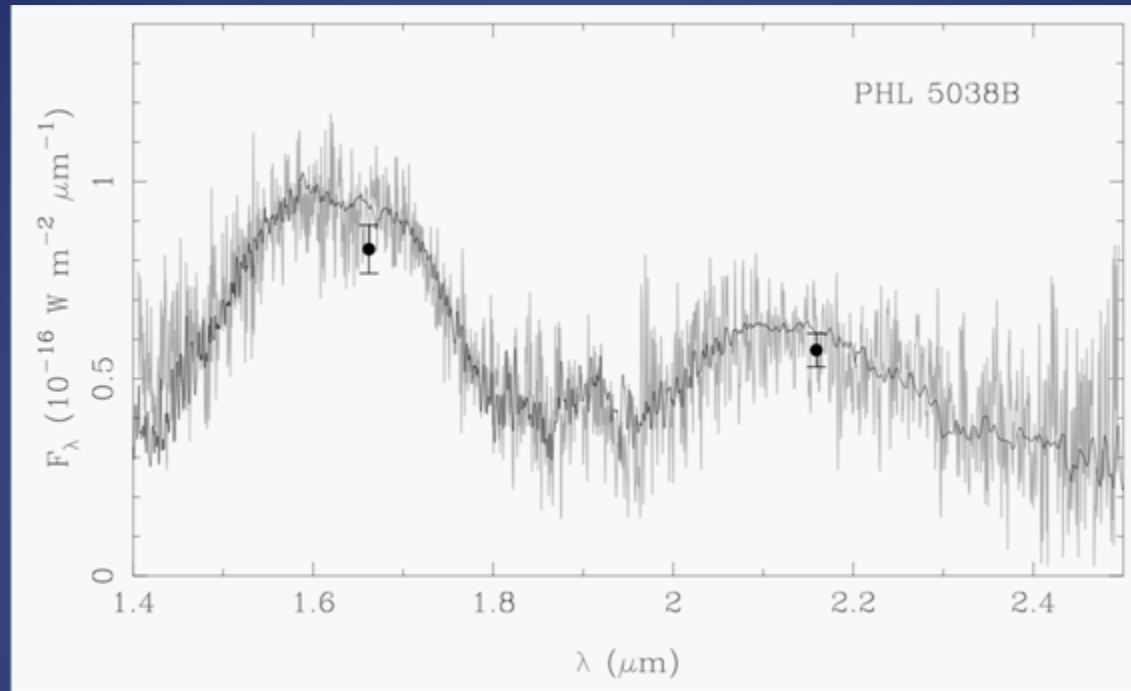
PHL 5038

(=SDSSJ222030.68-004107.3)



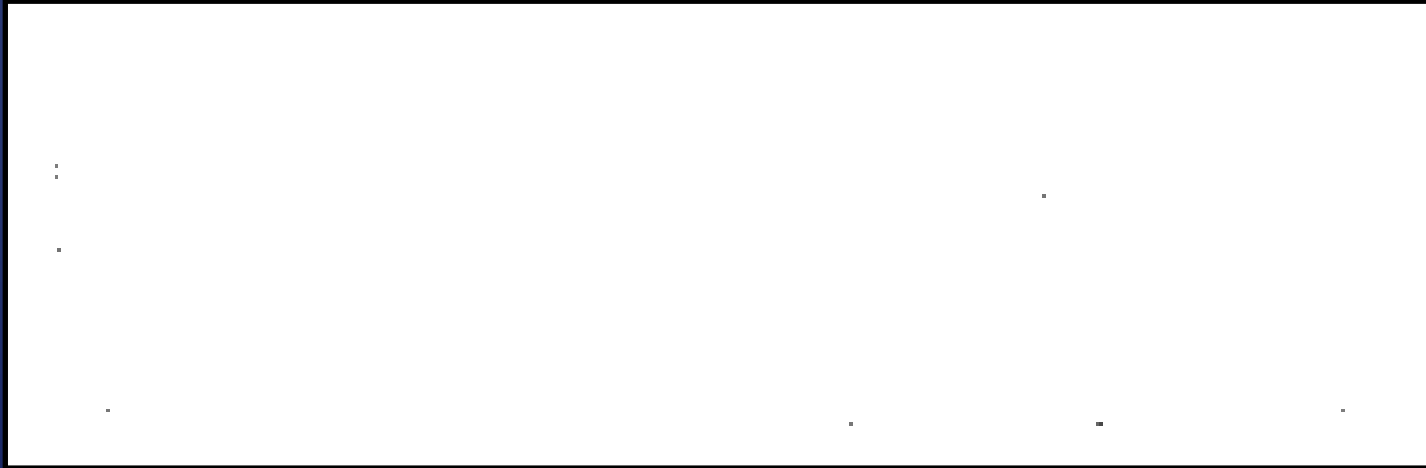
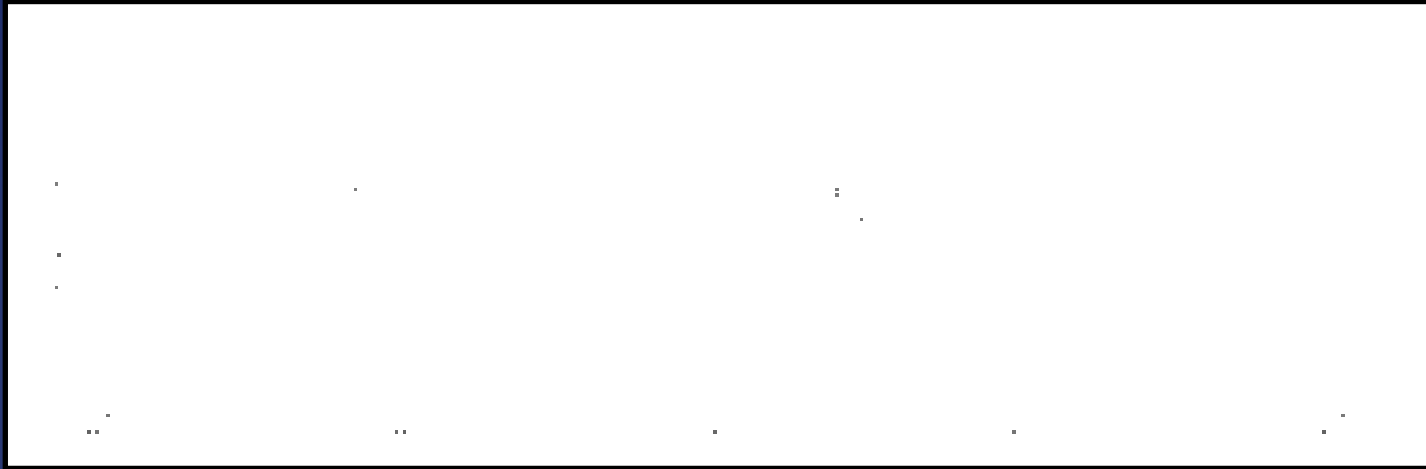
- PHL5038 excess discovered in UKIDSS DR3.
- Resolved in Gemini into two components...
- An 8000K WD and an L8 BD companion (Steele et al. 2009).

PHL 5038



- PHL5038 A/B resolved at 0.92'' (=55AU projected)
- L8 companion ($T \approx 1600$ K, $M \approx 0.055 M_{\odot}$ @ 1.9-2.7 Gyr)
- 4th known WD+BD detached system, 2nd wide.
- Potential benchmark in crucial L/T transition region.

Eclipsing DA+dT?



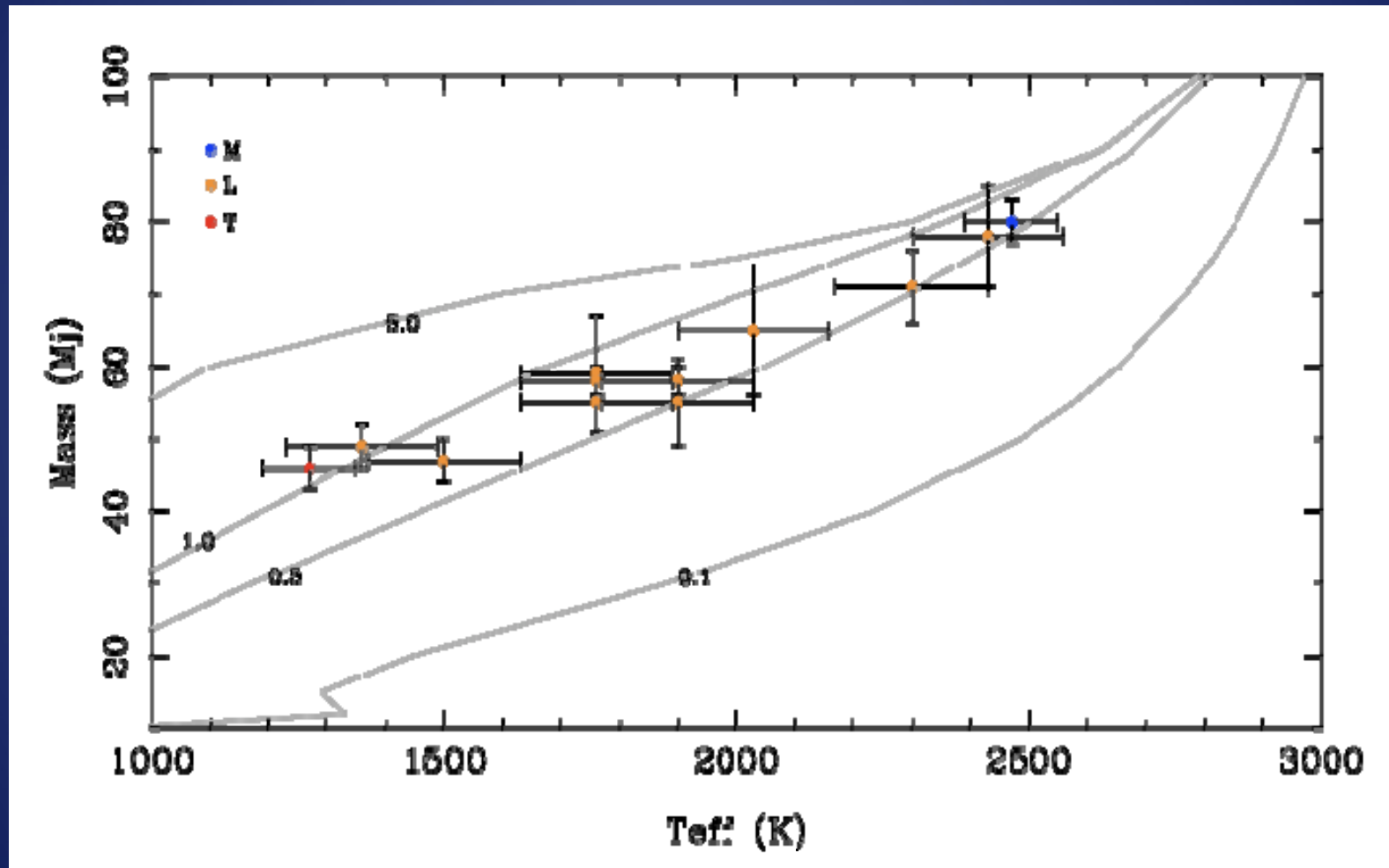
Results from UKIDSS DR5

- DA+dM: 10 (1 x M3, 2 x M6, 5 x M7, M8, M9)
- DA+dL: 12 (2 x L0, L1, L2, 2 x L3, L4, 3 x L5, L7, L8 (Confirmed))
- DB+dL: 1 (L4)
- DA+dT: 1 (T3)

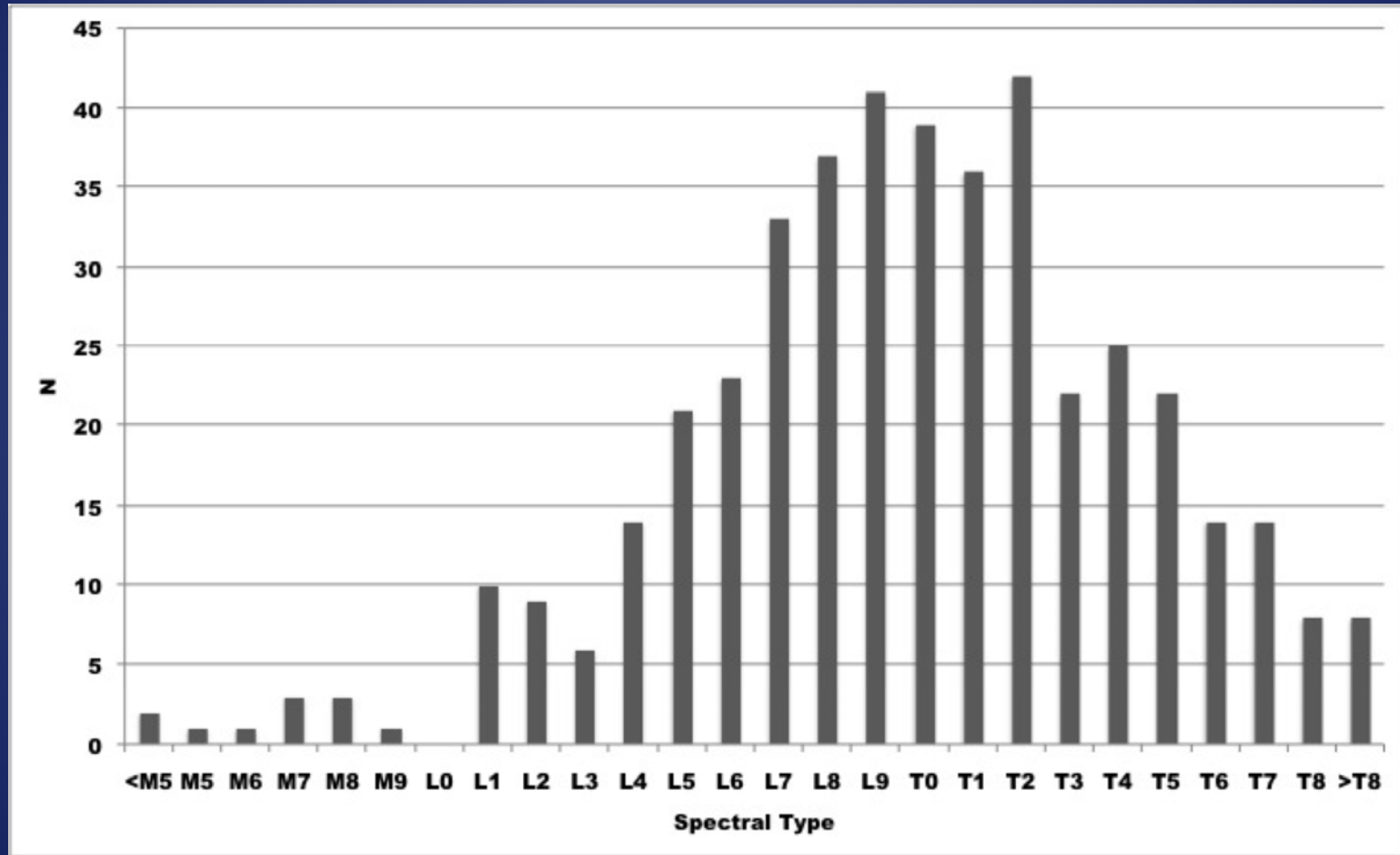
- **N.b. Photometric candidates only!**



Low Mass Star or Brown Dwarf?



Limits on Companions



Future Work

- White Dwarfs in UKIDSS DR5 (Steele et al. 2009, in prep.)
- Spectroscopically confirm remaining candidates.
- Place tighter constraints on WD+BD binary fraction.
- Identify further wide benchmark systems.
- Determine periods and secondary masses for close systems.
- Confirm our eclipsing candidate DA+dT?
- XSHOOTER time to look at PHL5038.
- Follow up further candidates from further UKIDSS data releases.

Thank you.