A Volume-Limited Search for L/T Transition Brown Dwarfs with the Pan-STARRS 1 and WISE Surveys

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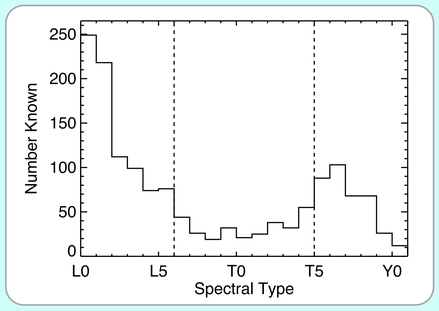
- **We have searched ~30,000 deg² in the Pan-STARRS 1 (PS1) 3π and WISE All-Sky surveys for brown dwarfs in the L/T transition.**
- **Previous large-scale searches have been incomplete for L/T transition dwarfs because these objects are faint in optical bands, and have near-infrared colors that are difficult to distinguish from background stars.**
- **We have cross-matched the PS1 (optical) and WISE (mid-IR) catalogs to produce a unique multi-wavelength database.**
- **We have obtained near-IR SpeX spectra for 138 candidates and confirmed that 82 are new L/T transition dwarfs, 33 with 25 pc.**
- **These new discoveries will...**
  - **substantially improve the completeness of the 25 parsec L/T dwarf census;**
  - **refine the constraints on the local substellar mass function;**
  - **help us to better understand and model the evolution of brown dwarf atmospheres through the L/T transition.**

Why L/T Dwarfs?

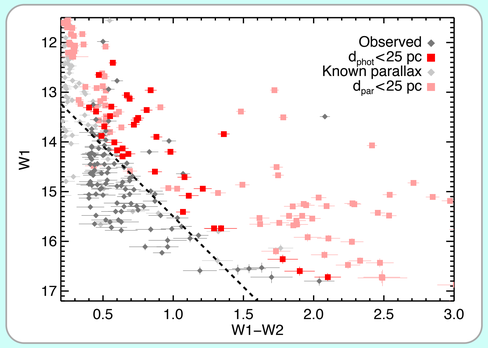
- Only ~20% of known brown dwarfs are in the L/T transition (spectral types ≈ L6–T5).



- Previous all-sky searches based on 2MASS have found few L/T objects.
- Objects undergo drastic spectral changes across the L/T transition (≈ 1300–900 K), which models find difficult to reproduce.
- Weather-related periodic variability has been observed in some L/T dwarfs.
- A larger, well-defined sample of L/T transition dwarfs will **improve constraints on the substellar mass function, and provide more templates for brown dwarf atmospheric models.**

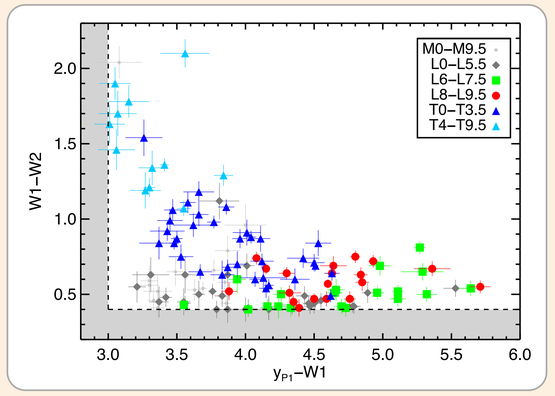
Volume-Limited at 25 pc

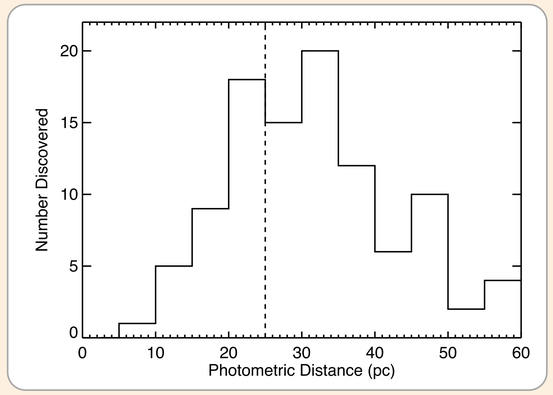
- **We want to characterize the L/T transition population within 25 pc**, the same volume as the PMSU M dwarf survey and the Gliese catalog.
- Empirically, we find that ultracool objects with **W1 ≲ 2.833×(W1–W2) + 12.667** have photometric (W2) distances < 25 pc.

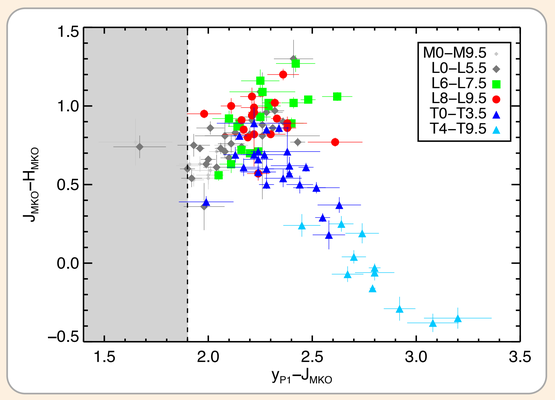


CMD of objects for which we obtained spectra (dark grey diamonds), highlighting those with photometric distances < 25 pc (red squares). Overplotted are ultracool dwarfs with parallaxes from Dupuy & Liu (2012), in light grey and pink.

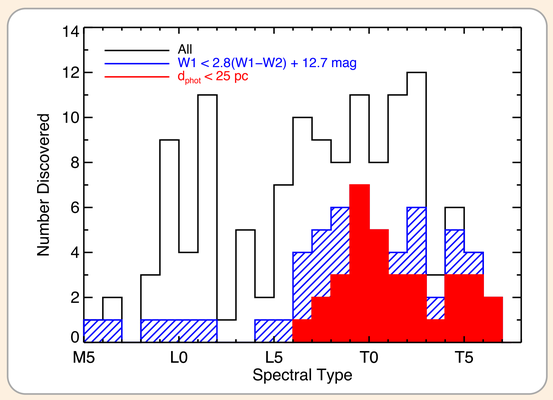
New Discoveries





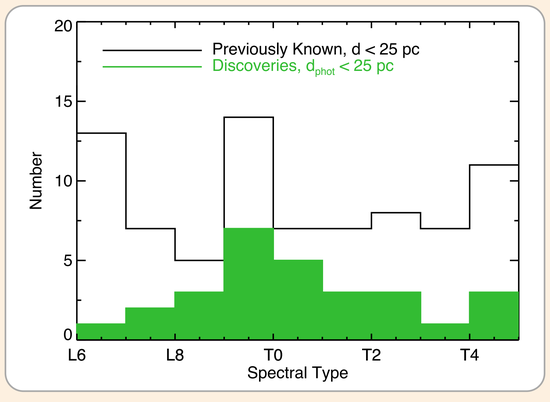


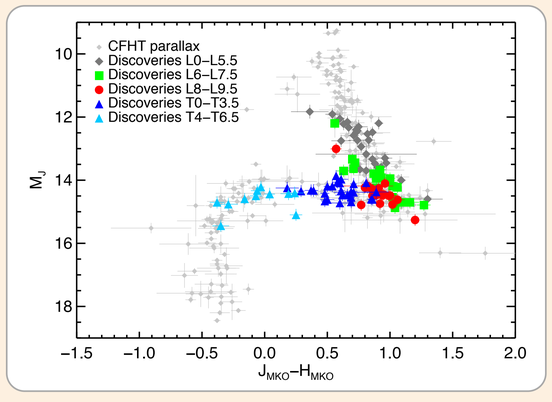
Colors of spectroscopically confirmed discoveries. **The PS1 y-band helps to distinguish late L-dwarfs from earlier-type objects.** Shaded regions show colors excluded by our search.



Results of spectroscopic observations. **We have identified 82 L/T transition dwarfs so far, including 33 with photometric distances < 25 pc.**

Comparison to Previously Known Objects





Left: L/T transition dwarfs within 25 pc: previously known (black) and new discoveries (filled green). Distances are from parallax if available, else from W2 photometry. Right: All our L and T discoveries overplotted on a near-IR CMD of known ultracool dwarfs. **Our search is substantially increasing the L/T transition census.**

PS1 3π Survey

PS1 has mapped the entire sky north of Dec = –30° several times to date in five *grizy* filters, including y_{P1} down to ~20.3 mag (single epoch), equivalent to ~1 mag deeper than SDSS. PS1 3π is mapping the entire search area twelve times over 4 years (finishing in March 2014) in five filters, enabling internal proper motion and parallax measurements.

Search Status

Our survey is nearly complete, and we expect to finish the remaining observations later this month.

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