



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

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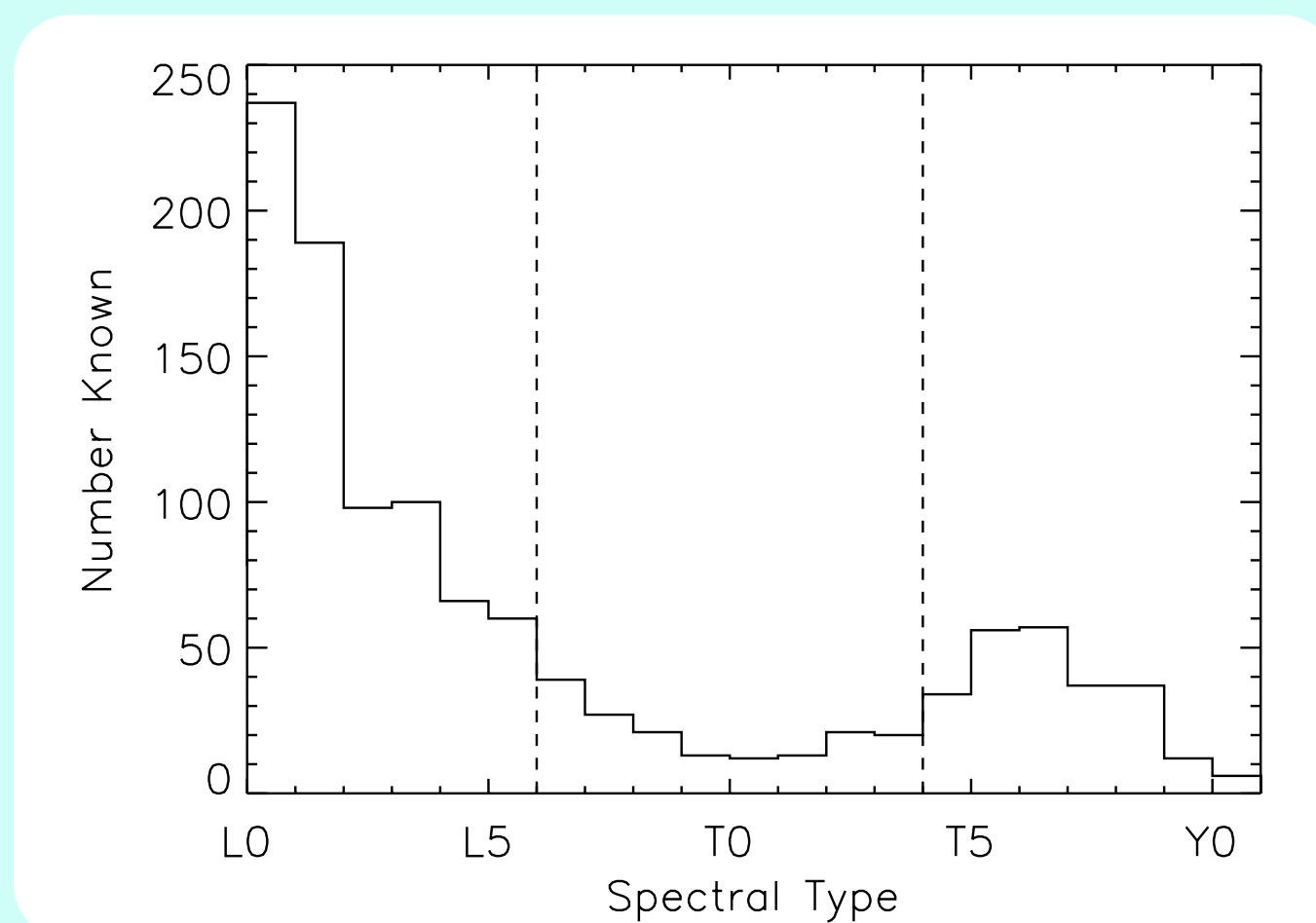
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- We have searched $\sim 30,000 \text{ deg}^2$ in the Pan-STARRS 1 (PS1) 3π and WISE All-Sky surveys for brown dwarfs in the L/T transition.
- Previous large-scale searches have been incomplete for L/T transition dwarfs because these objects are faint 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 spectra for 66 candidates and confirmed that 49 are new L/T transition dwarfs.
- We are on track to double the census of L/T dwarfs within 25 pc.
- These new discoveries will...
 - ▶ significantly improve the constraints on the local substellar mass and luminosity functions;
 - ▶ help us to better understand and model the evolution of brown dwarf atmospheres through the L/T transition.

Why L/T Dwarfs?

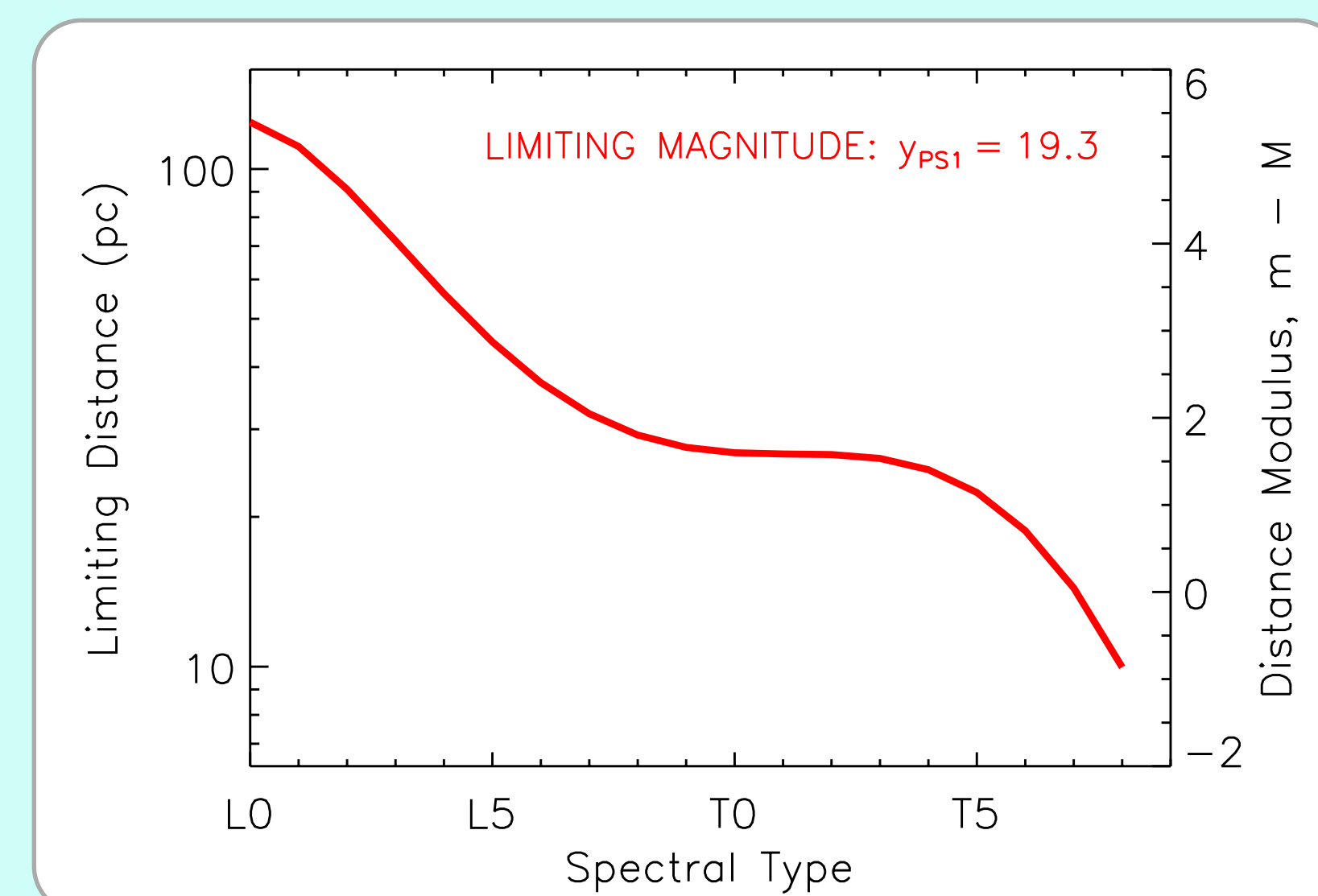
- Only $\sim 10\%$ of known brown dwarfs are in the L/T transition (spectral types $\approx \text{L6-T3.5}$).



- Previous searches using near-IR surveys (e.g. 2MASS) have found few L/T objects.
- Objects undergo drastic spectral changes across the L/T transition ($\approx 1300\text{--}900 \text{ K}$), 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.**

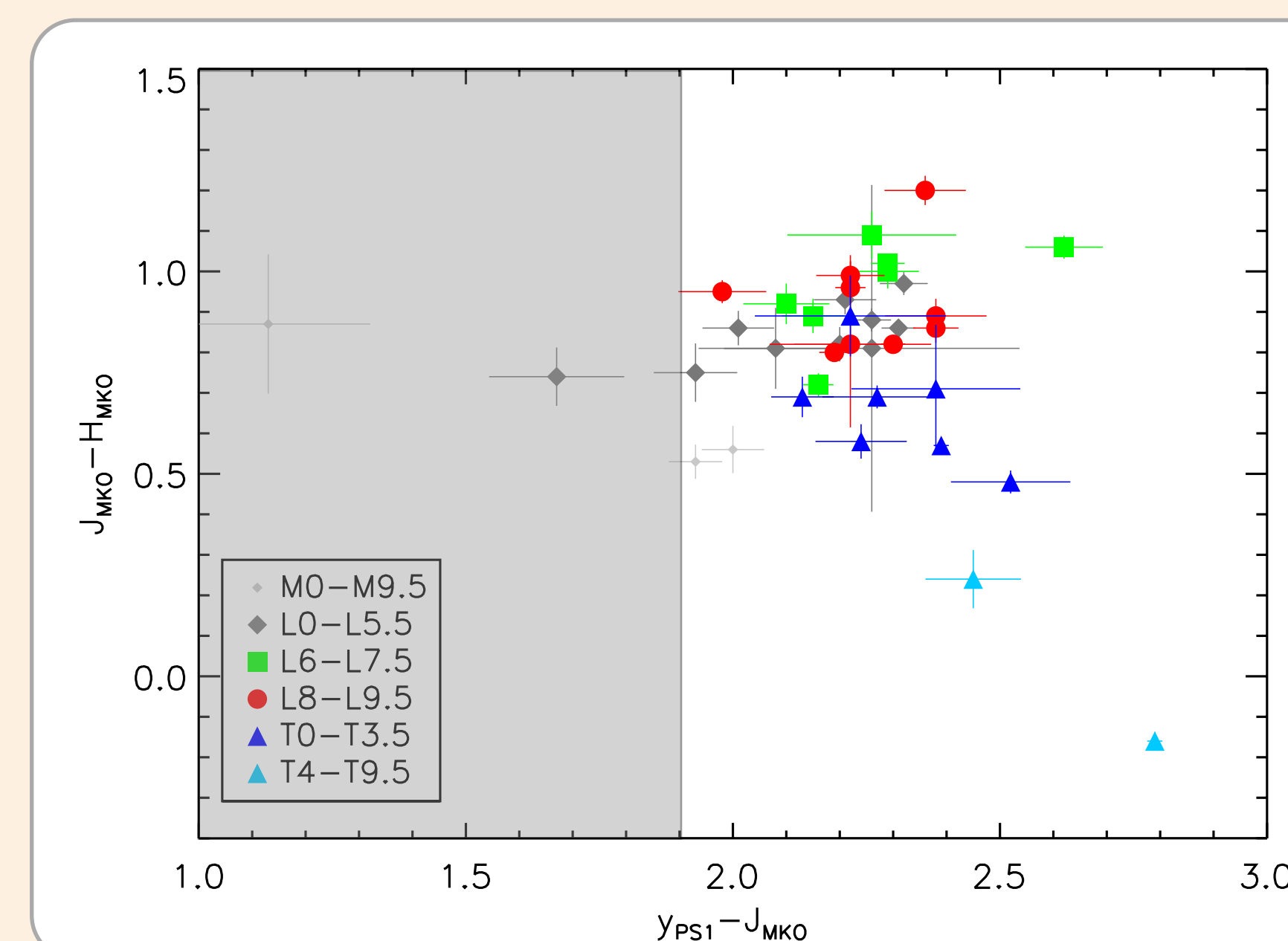
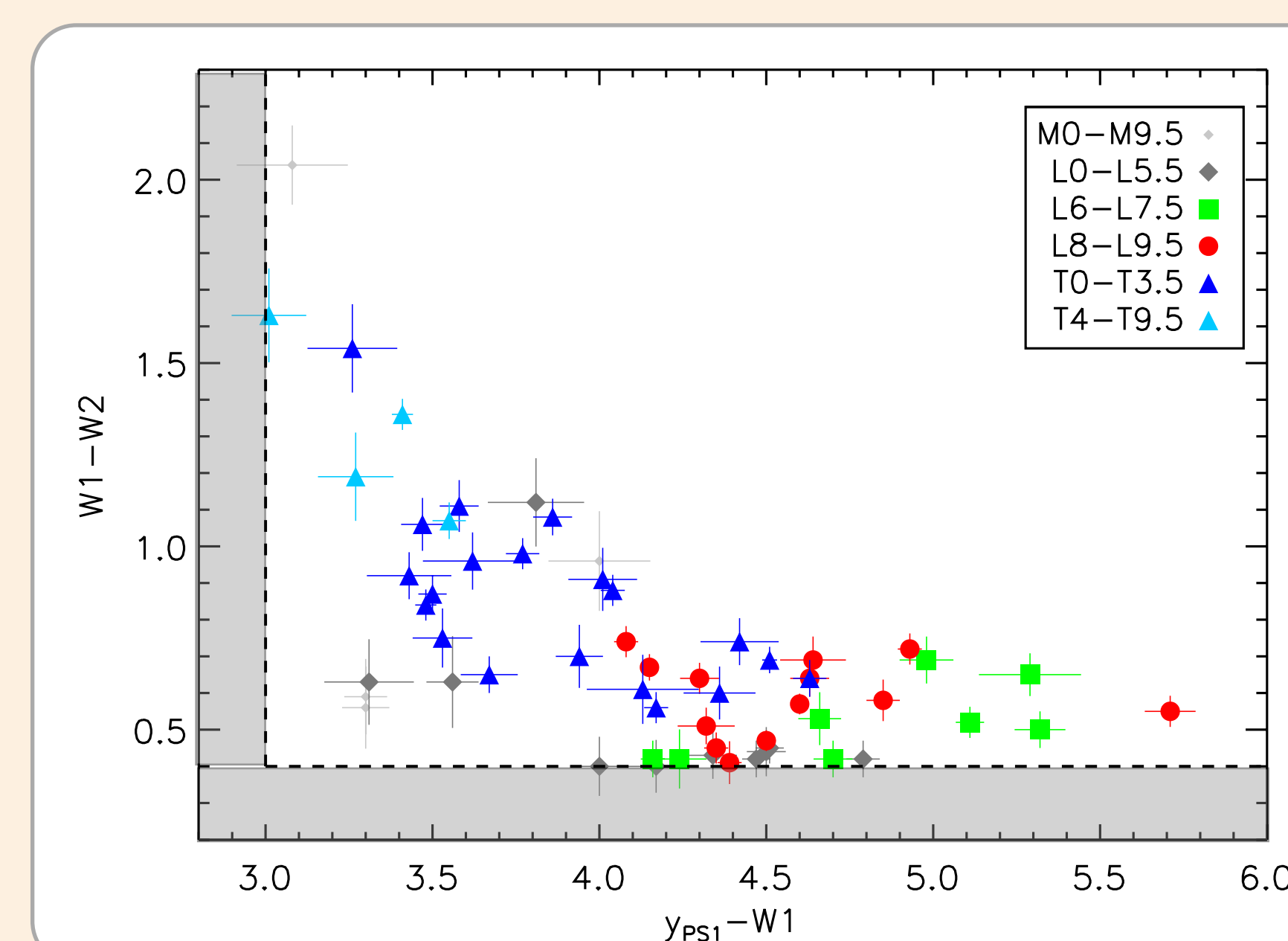
Volume-Limited at 25 pc

- y_{PS1} is fairly constant across the L/T transition, so a magnitude-limited sample will be similar to a volume-limited one (for single objects).
- $y_{\text{PS1}} \approx 19.3 \text{ mag}$ corresponds to a distance of 25 pc, the same search radius as the PMSU M dwarf survey and the Gliese catalog.

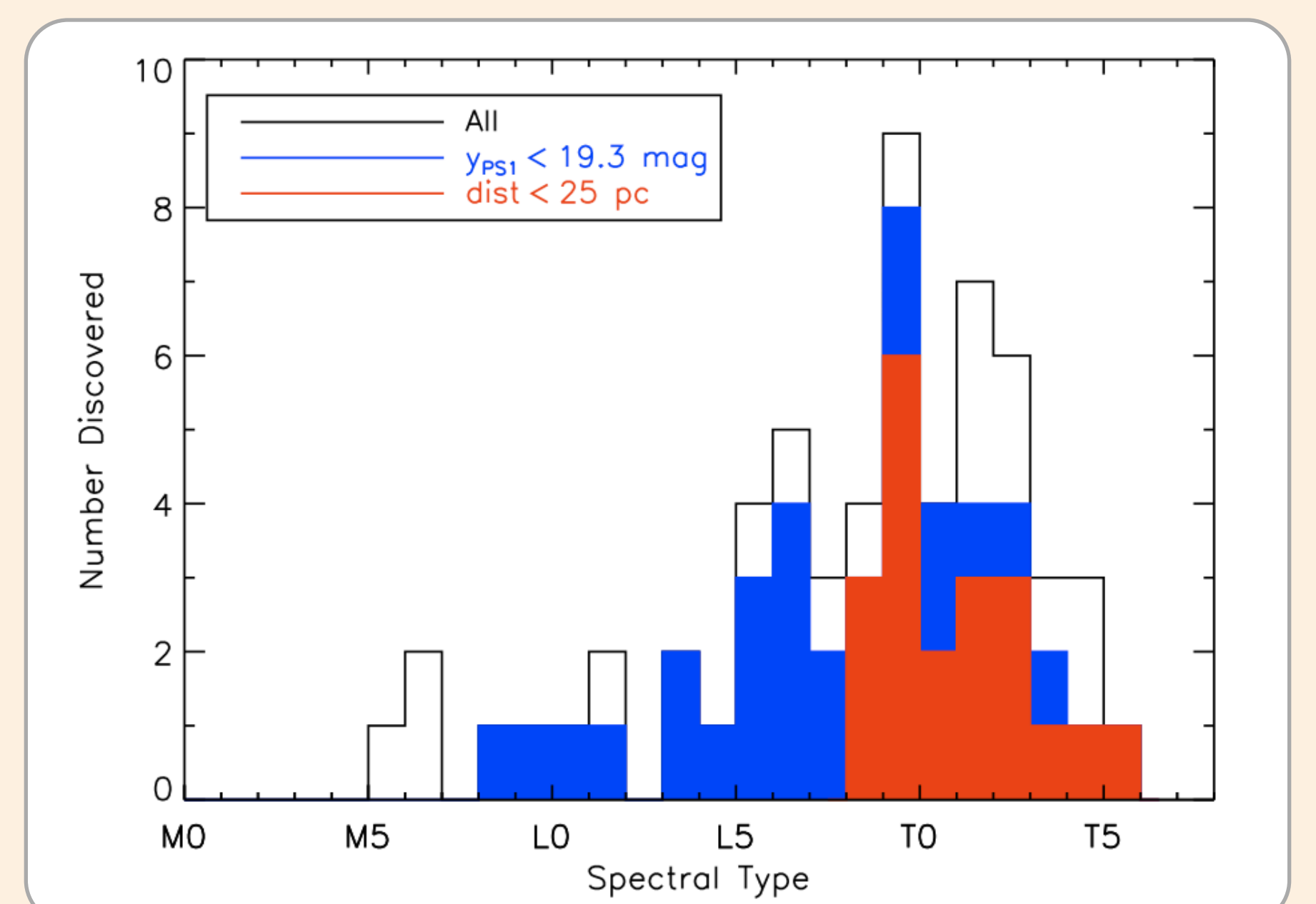
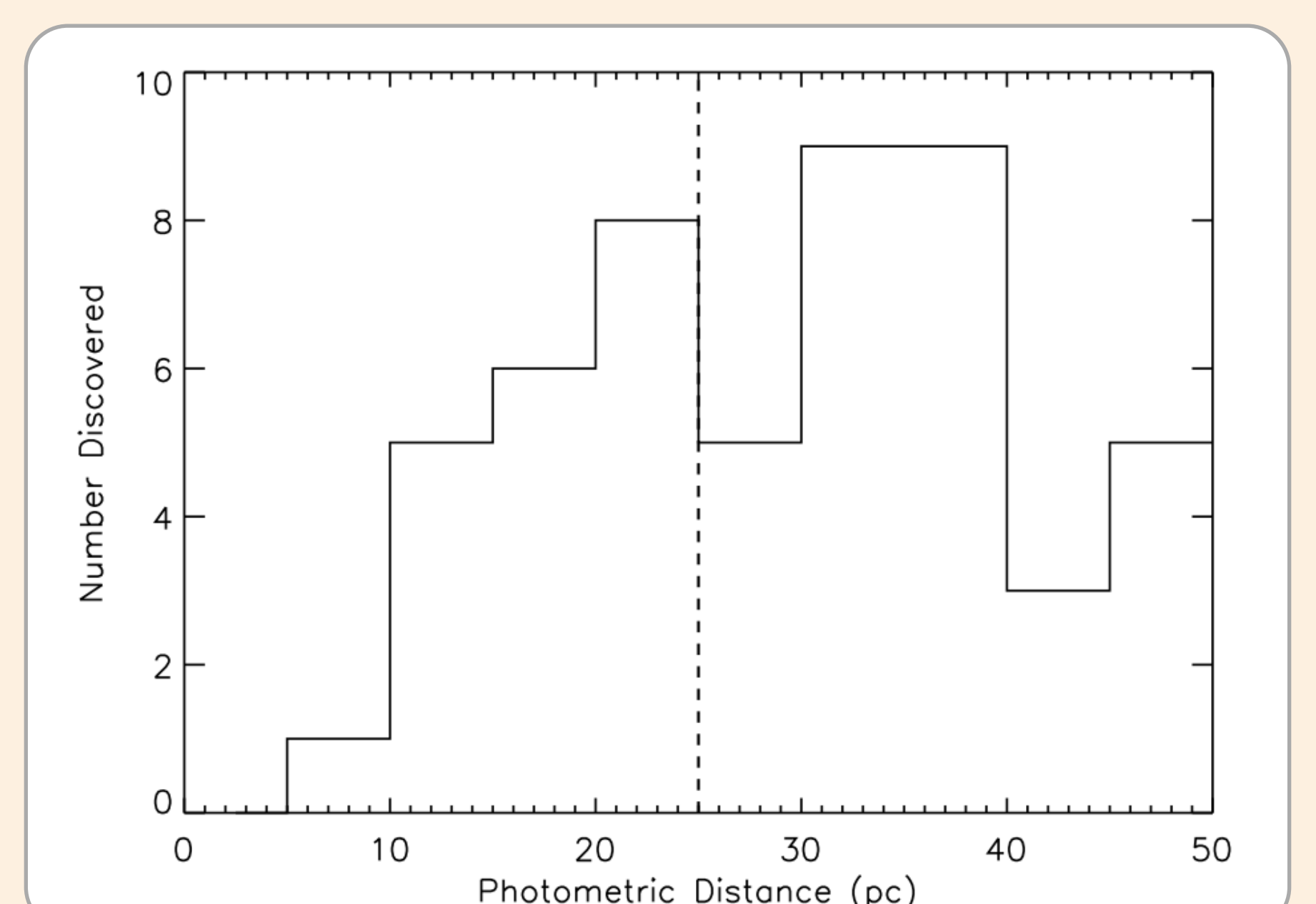


Limiting distances for brown dwarfs with $y_{\text{PS1}} \leq 19.3$ ($S/N \approx 12$), using magnitudes for known brown dwarfs detected in y_{PS1} . Parallax distances are used where available; otherwise, photometric distances are used.

New Discoveries

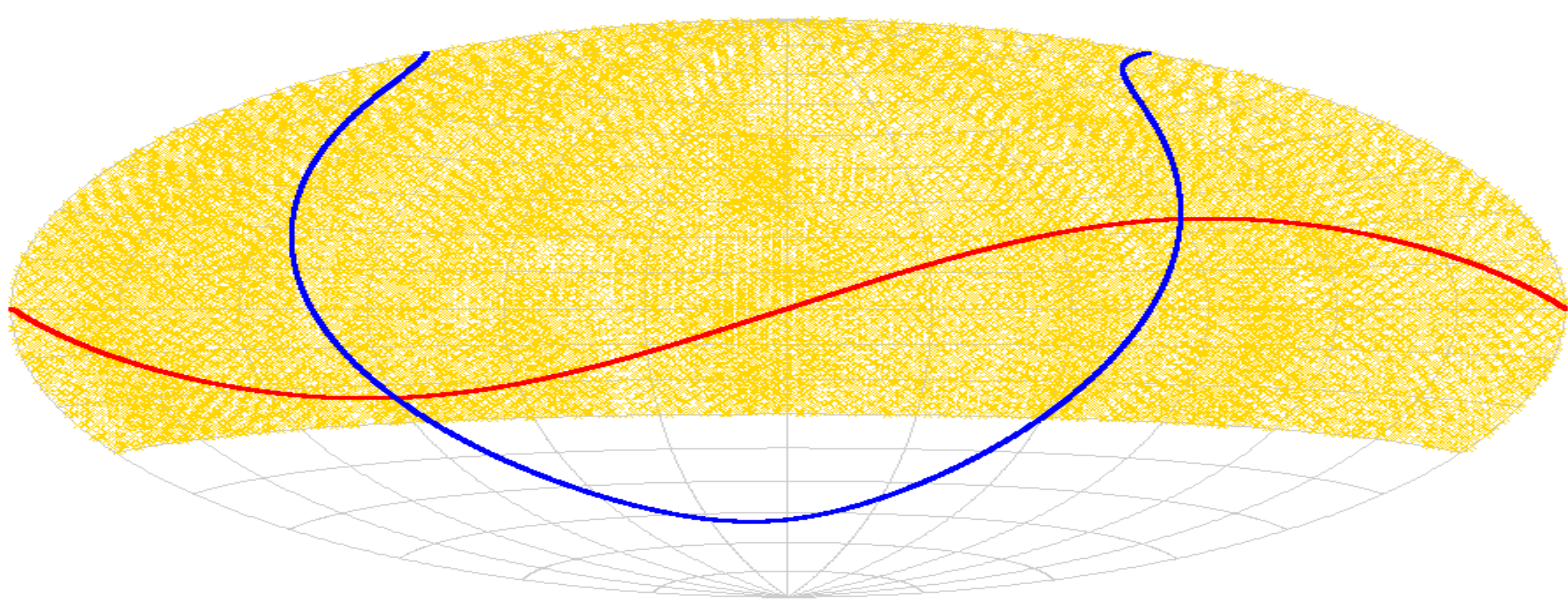


Colors of candidates selected for spectroscopic follow-up. JHK photometry was obtained from UKIDSS and UKIRT/WFCam observations. Shaded regions indicate rejected colors.



Results of spectroscopic observations. We have identified 20 brown dwarfs within 25 pc so far, all with spectral type L8 or later.

PS1 3π y -band Sky Coverage



PS1 has mapped the entire sky north of $\text{Dec} = -30^\circ$ several times to date in five filters, including y_{PS1} down to $\sim 20.3 \text{ mag}$ (single epoch), equivalent to $\sim 1 \text{ mag}$ deeper than SDSS.

Binaries

$\sim 30\%$ of the newly discovered objects have near-IR spectral features that may indicate the object is a binary. Previous searches have found L+T binaries with colors of single L/T transition objects. Resolved binaries are important benchmarks, as their masses can be determined from orbital dynamics.

Survey Status

Our survey is complete for about $1/4$ of the search area, and we expect to finish most of the remaining observations later this year.

Will Best is a second year graduate student at the University of Hawai'i.



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