A Continuation of WISE Brown Dwarf Science into the WFIRST-AFTA Era

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zastavki.com

Why study brown dwarfs?

They're the lowest mass byproducts of star formation.

They provide time capsules across the age of the Galaxy.

They show what low-T_{eff} atmospheres look like.

They represent some of our closest neighbors in space.

The Solar Neighborhood (within 8 pc)

Main graph
Within 8 pc, stars outnumber brown dwarfs 6:1

Inset
Within 2.3 pc, stars outnumber brown dwarfs 1.7:1

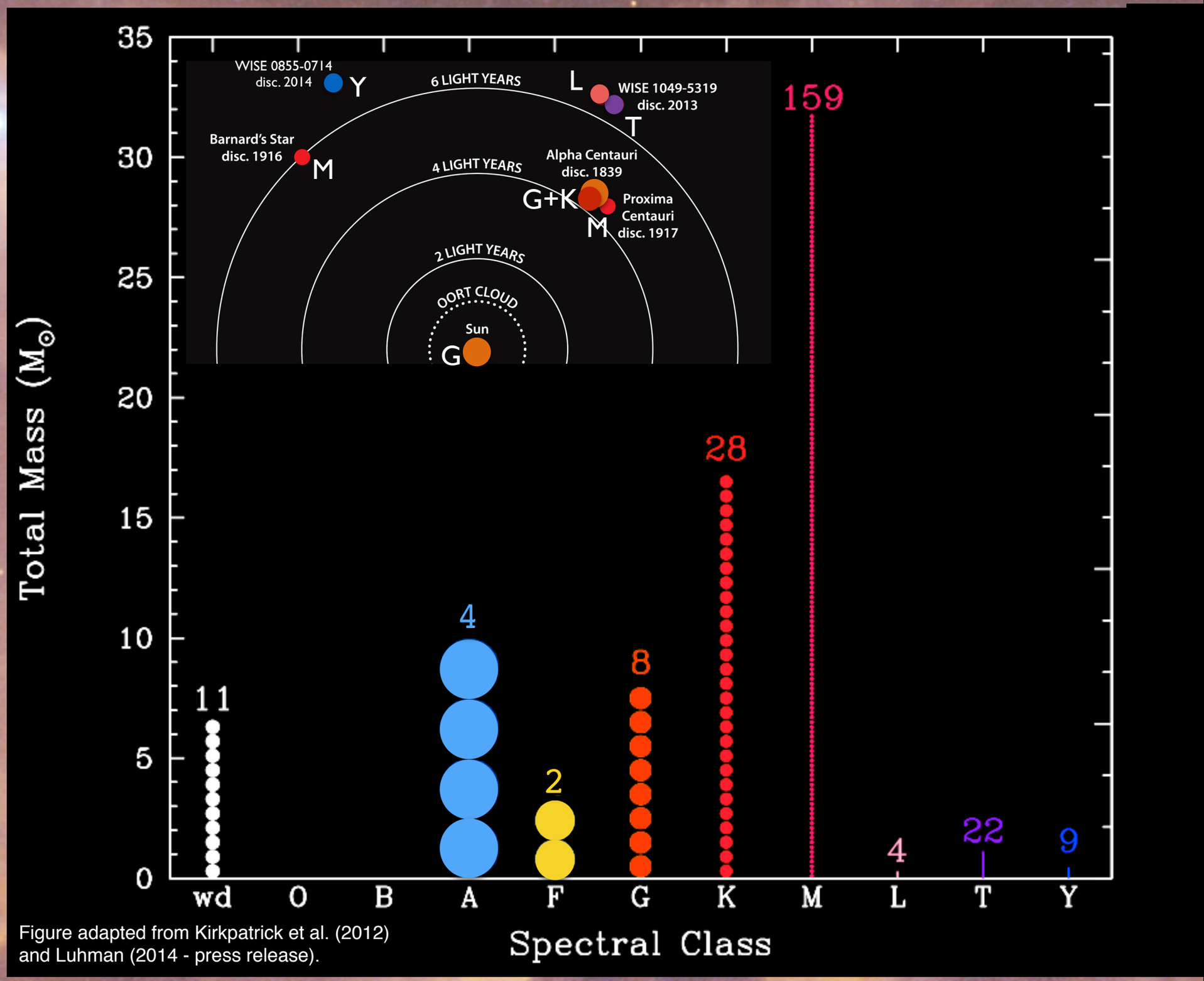
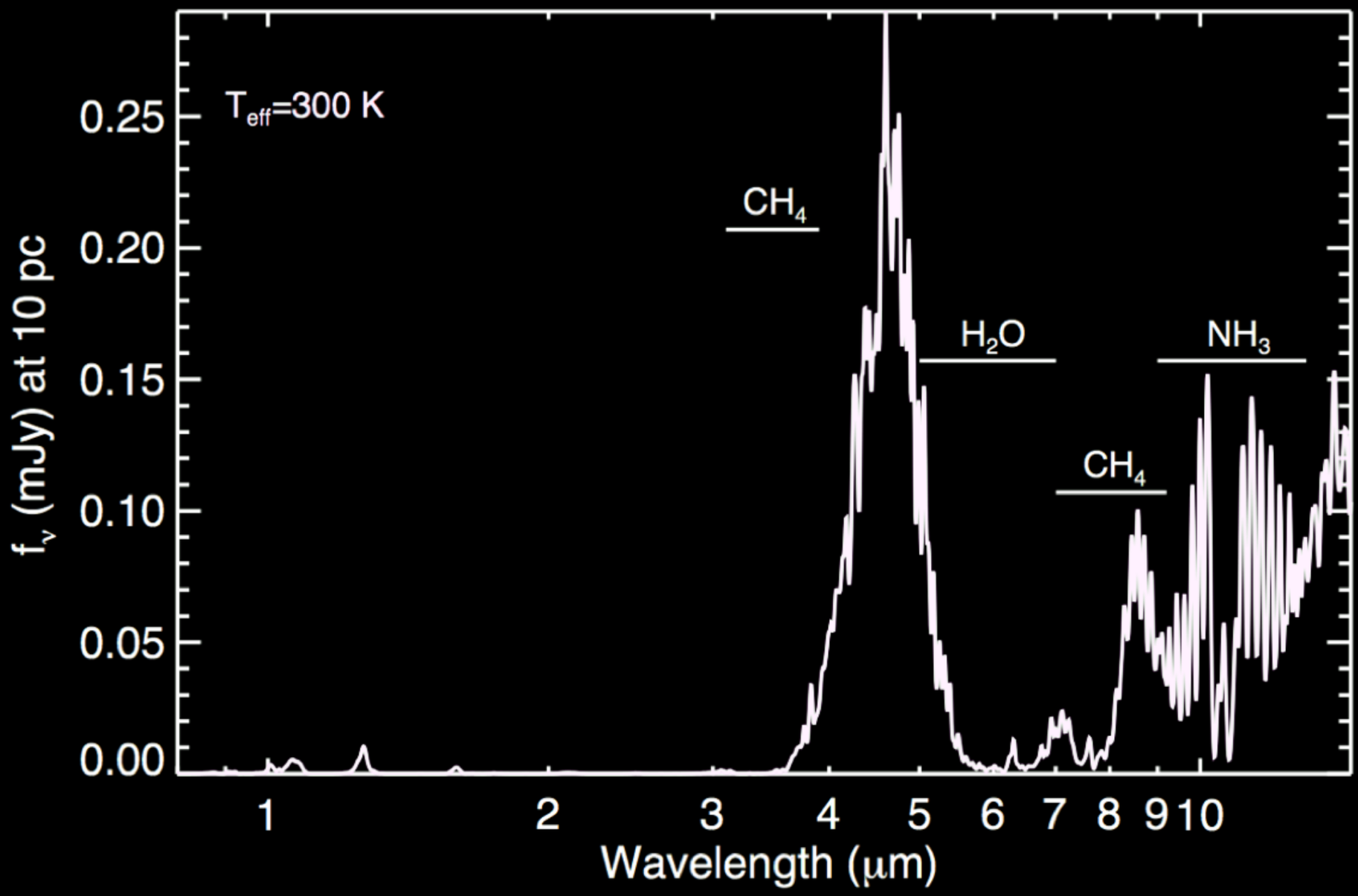


Figure adapted from Kirkpatrick et al. (2012) and Luhman (2014 - press release).

WISE vs. WFIRST-AFTA wavelength coverage

Theoretical model from Mark Marley (priv. comm.)



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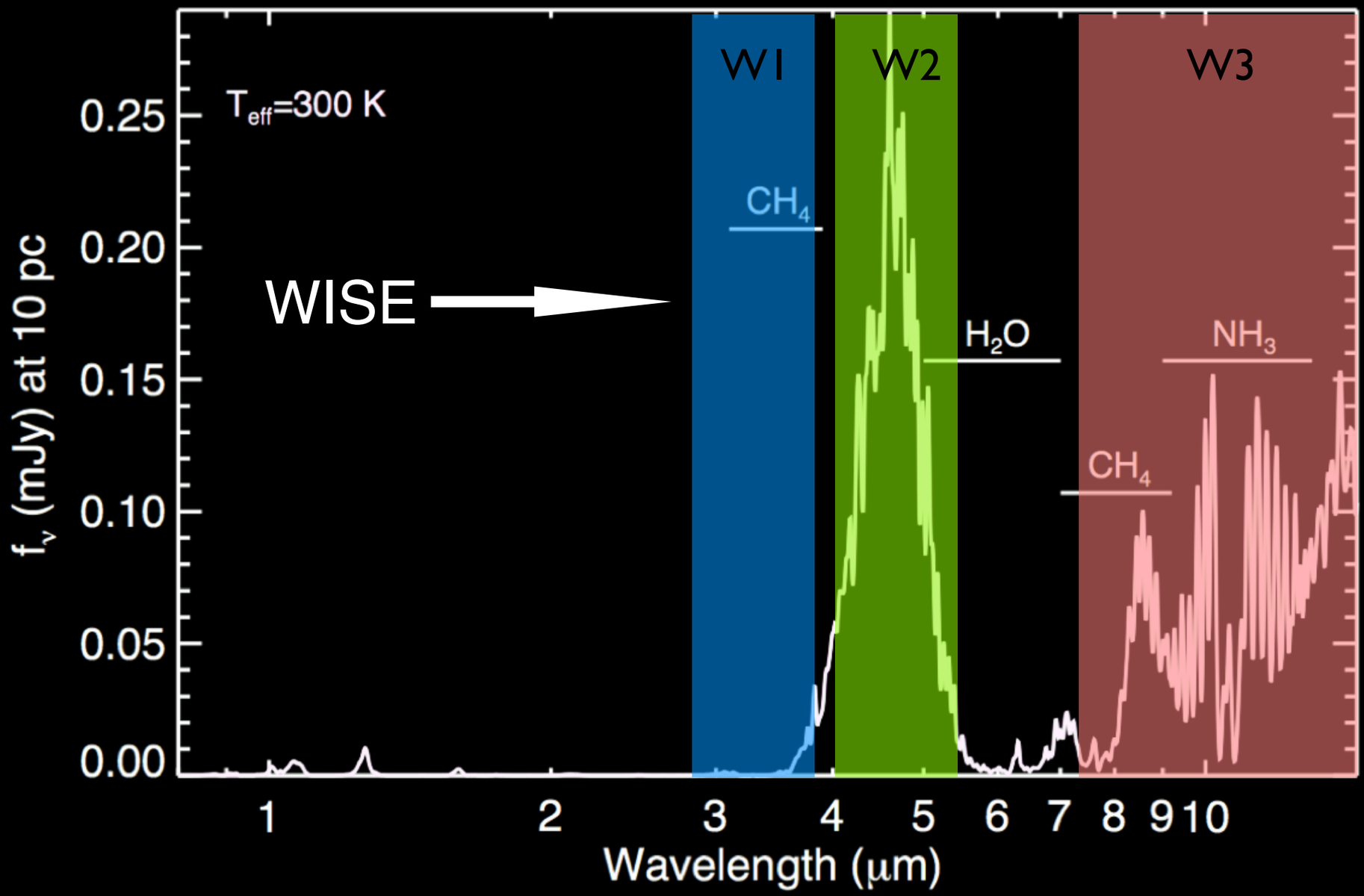

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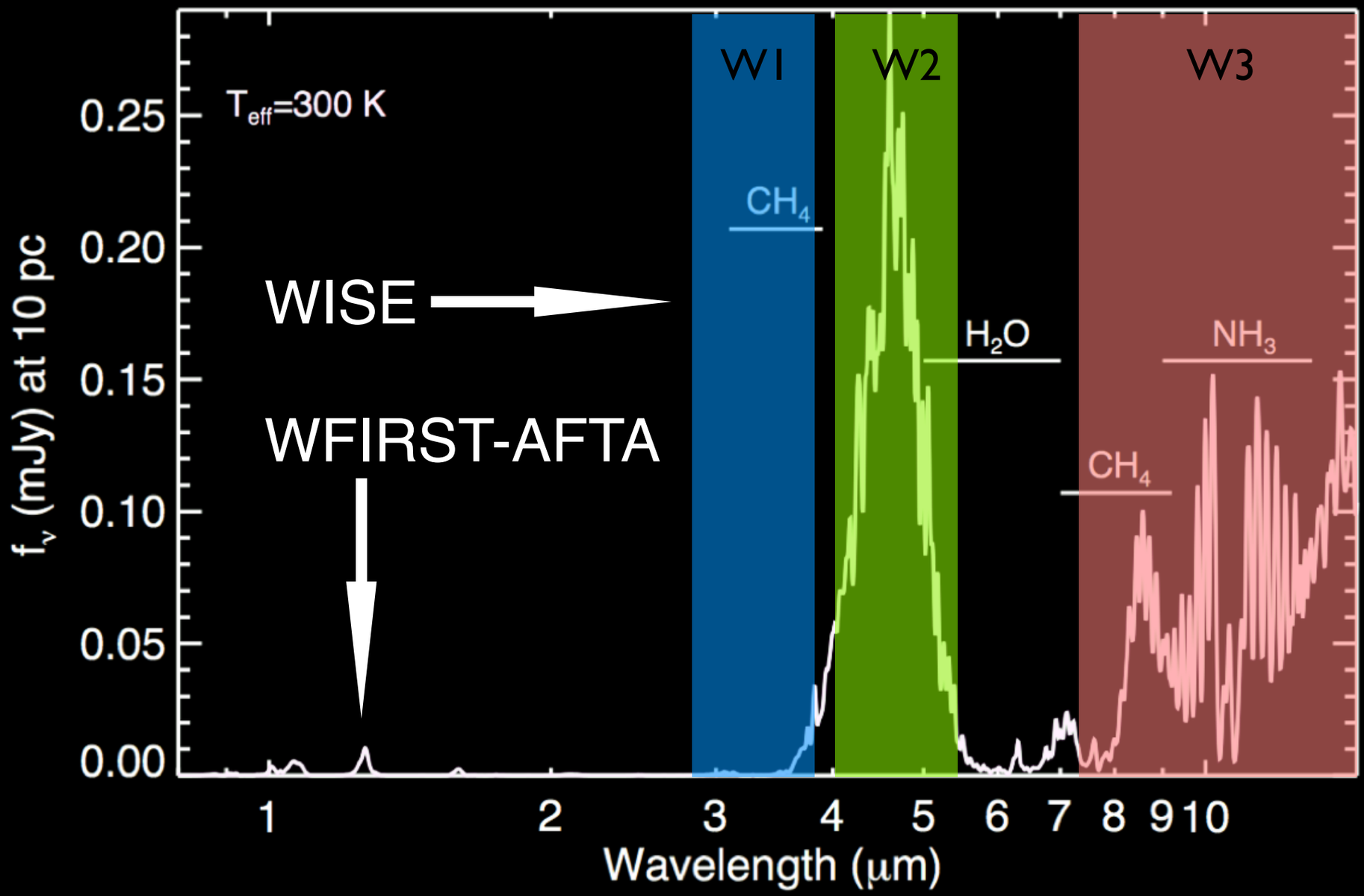
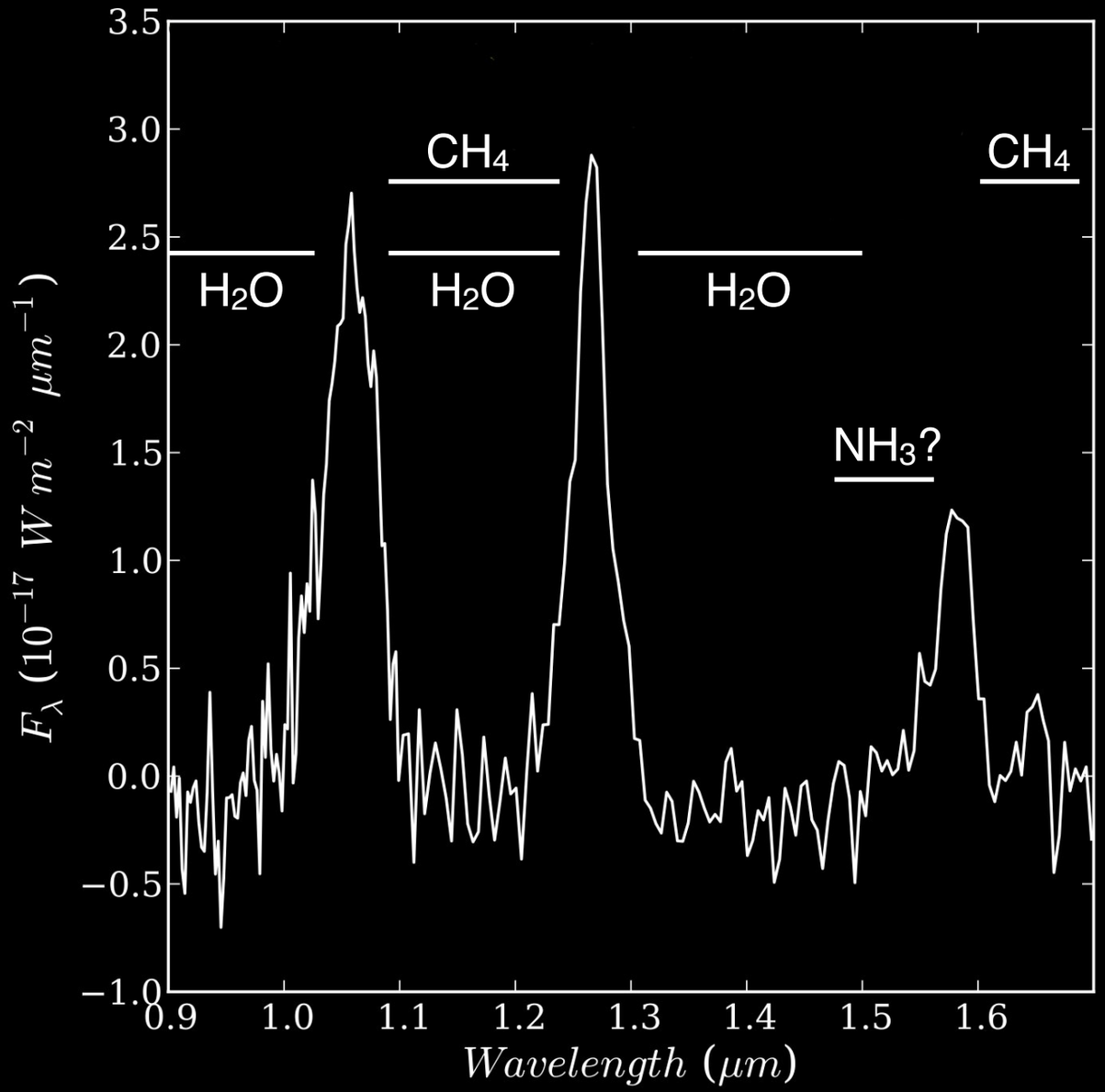


WISE vs. WFIRST-AFTA wavelength coverage

Observational spectrum of a Y1 dwarf from Schneider et al. (submitted)



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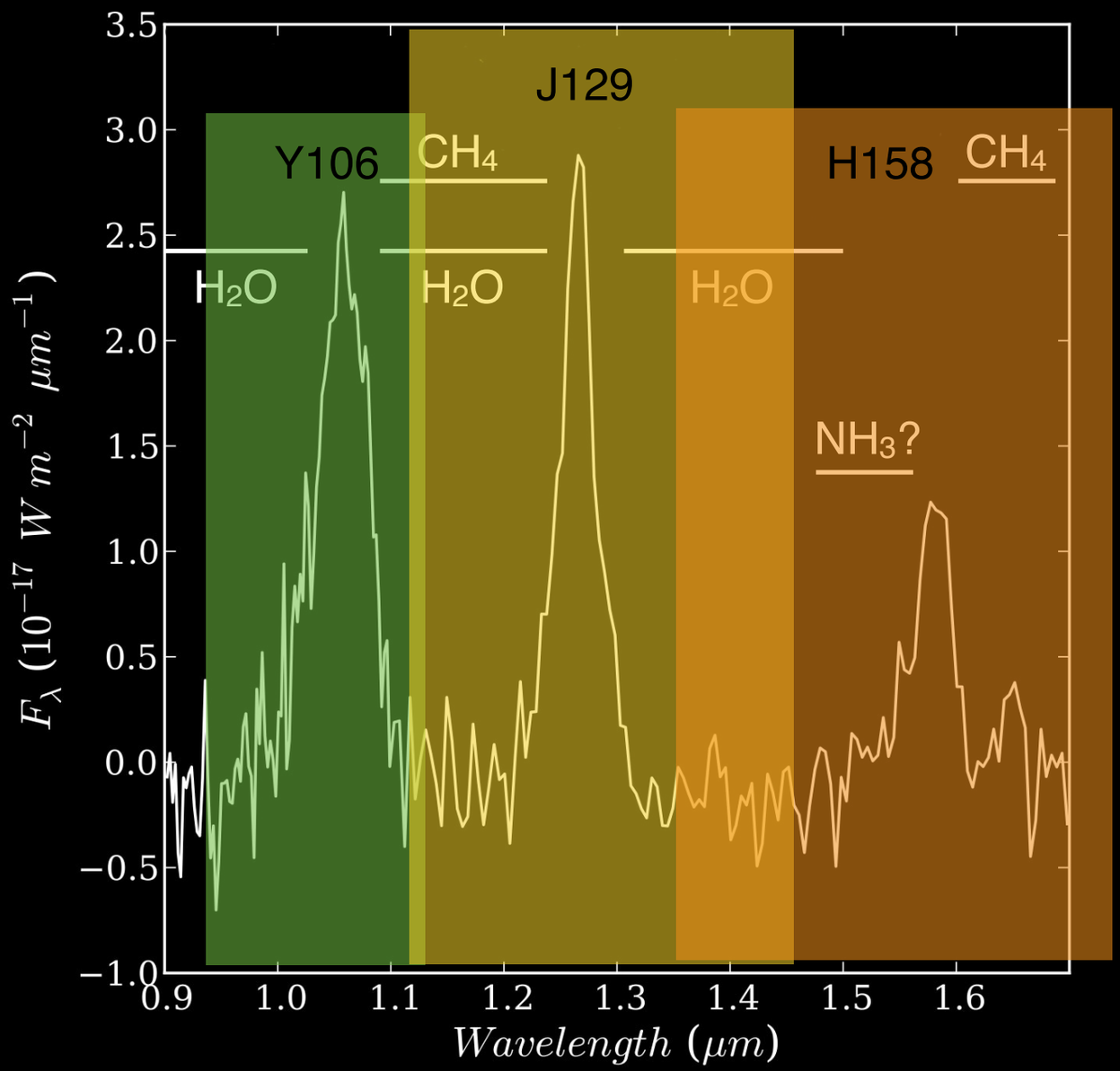

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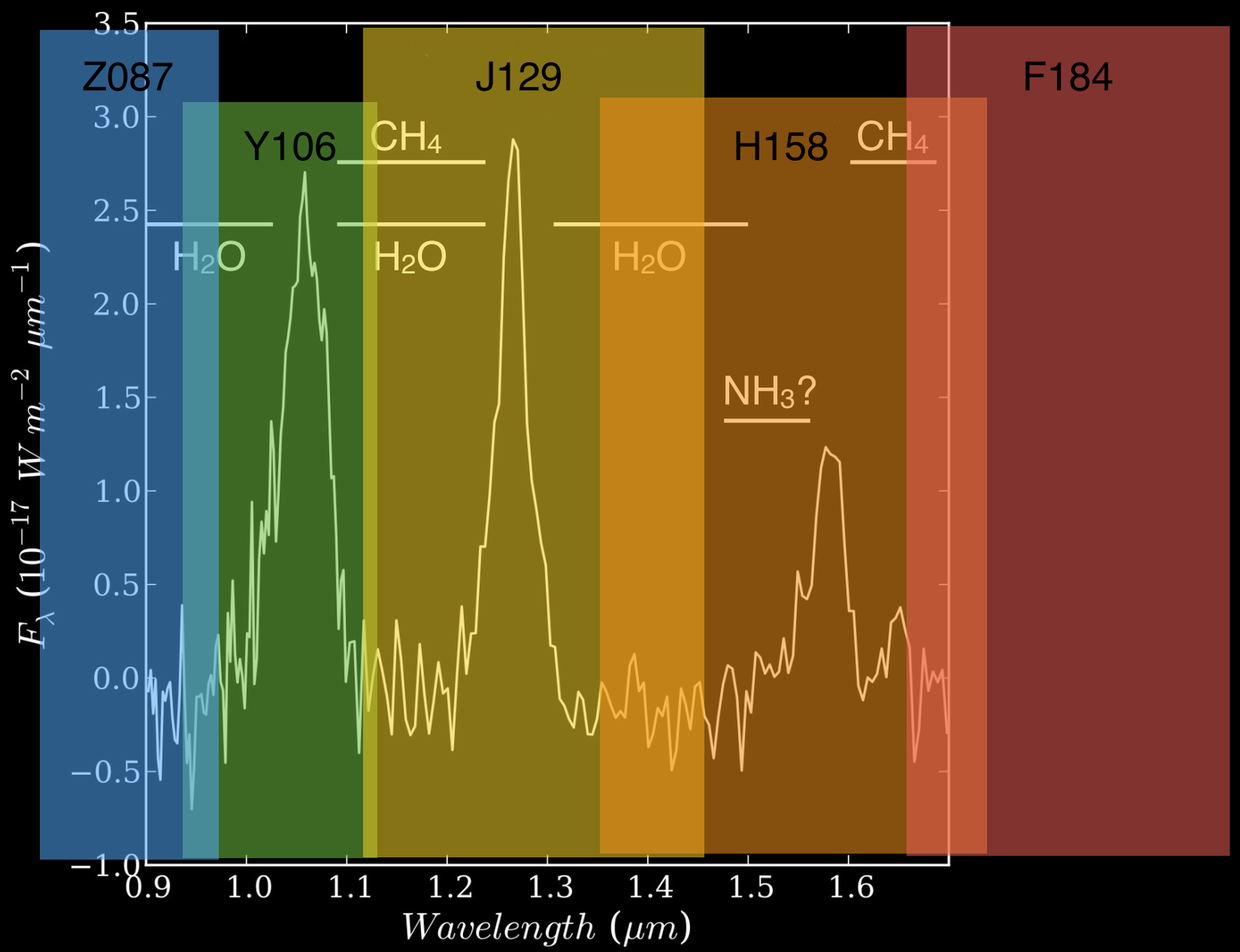

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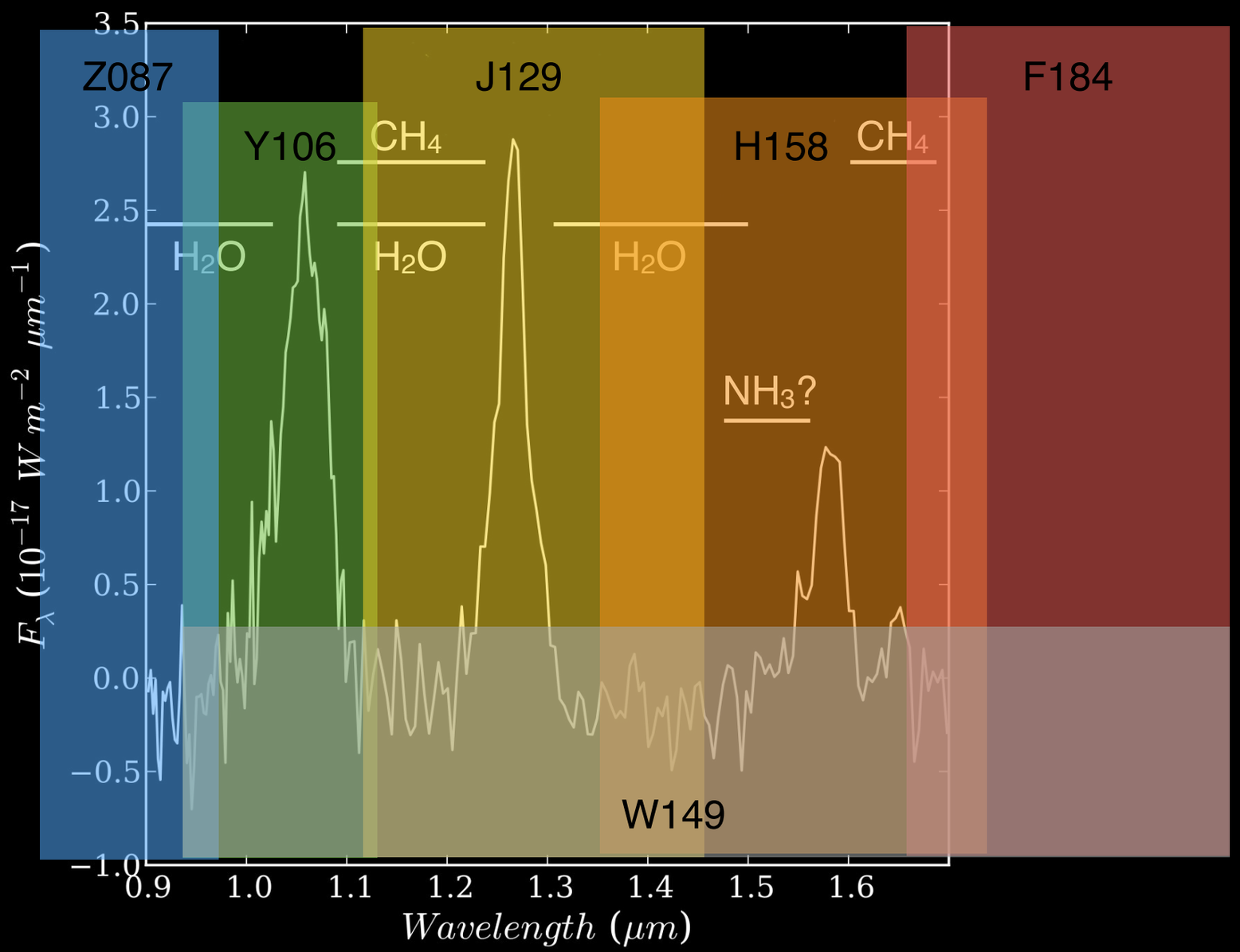
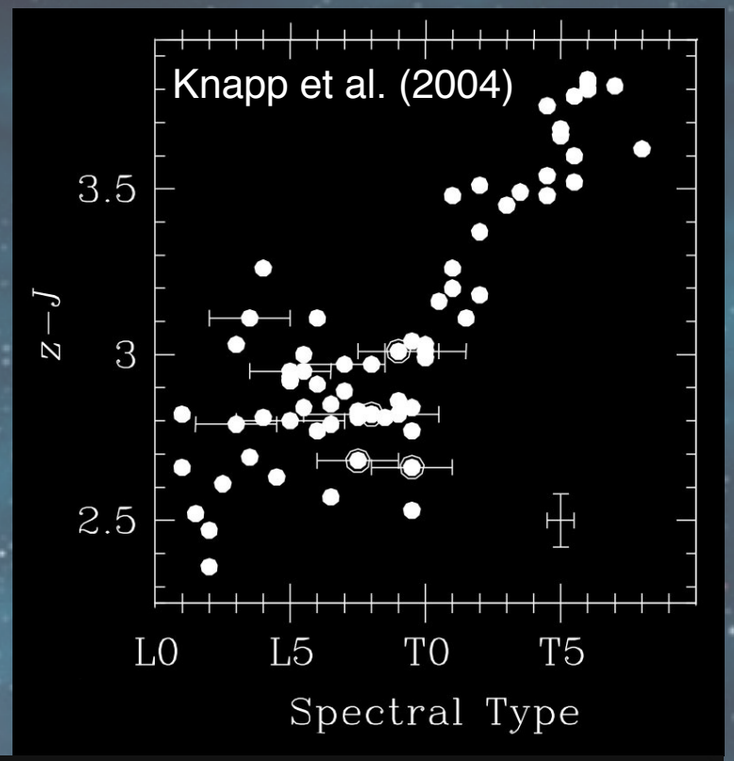
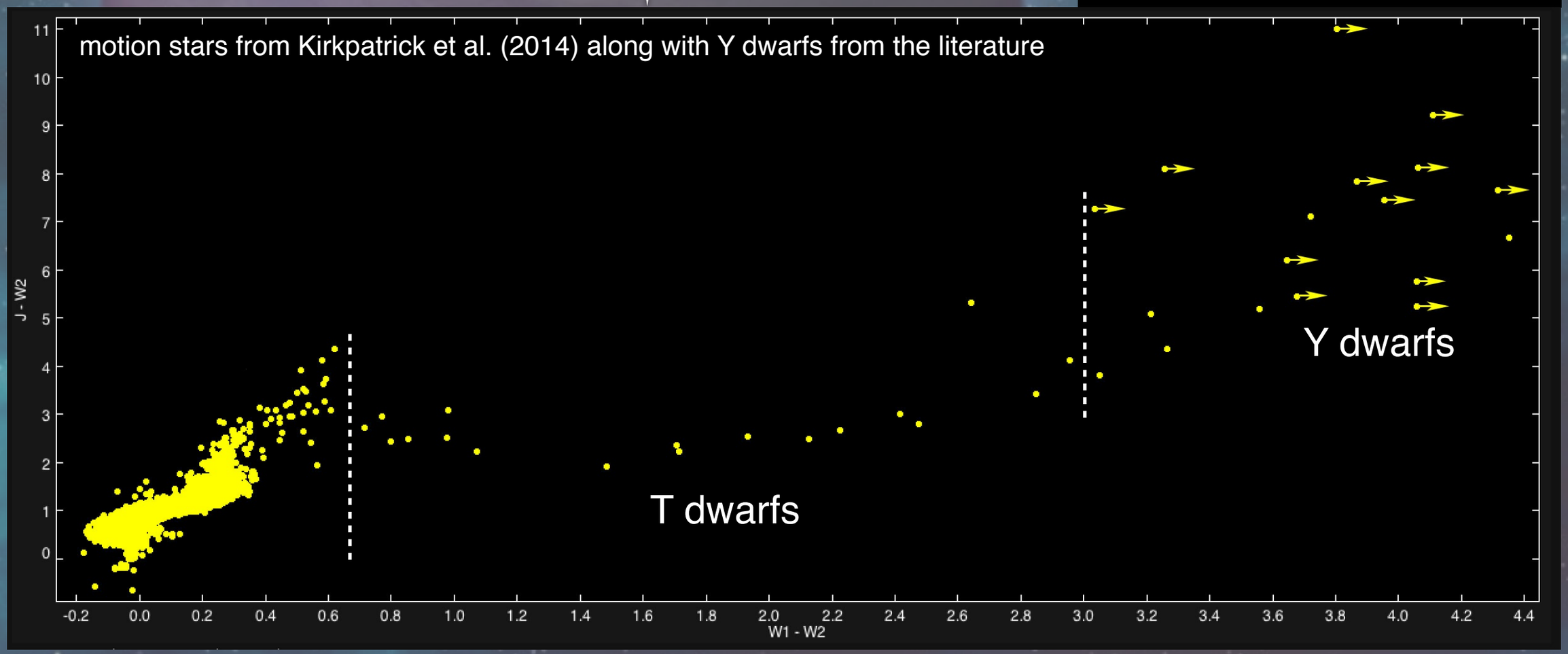


WFI High-Latitude Survey

WFIRST-AFTA photometry alone can be used to select candidates (e.g., via Z087-J129 color).

These can be combined with WISE photometry for extra leverage.





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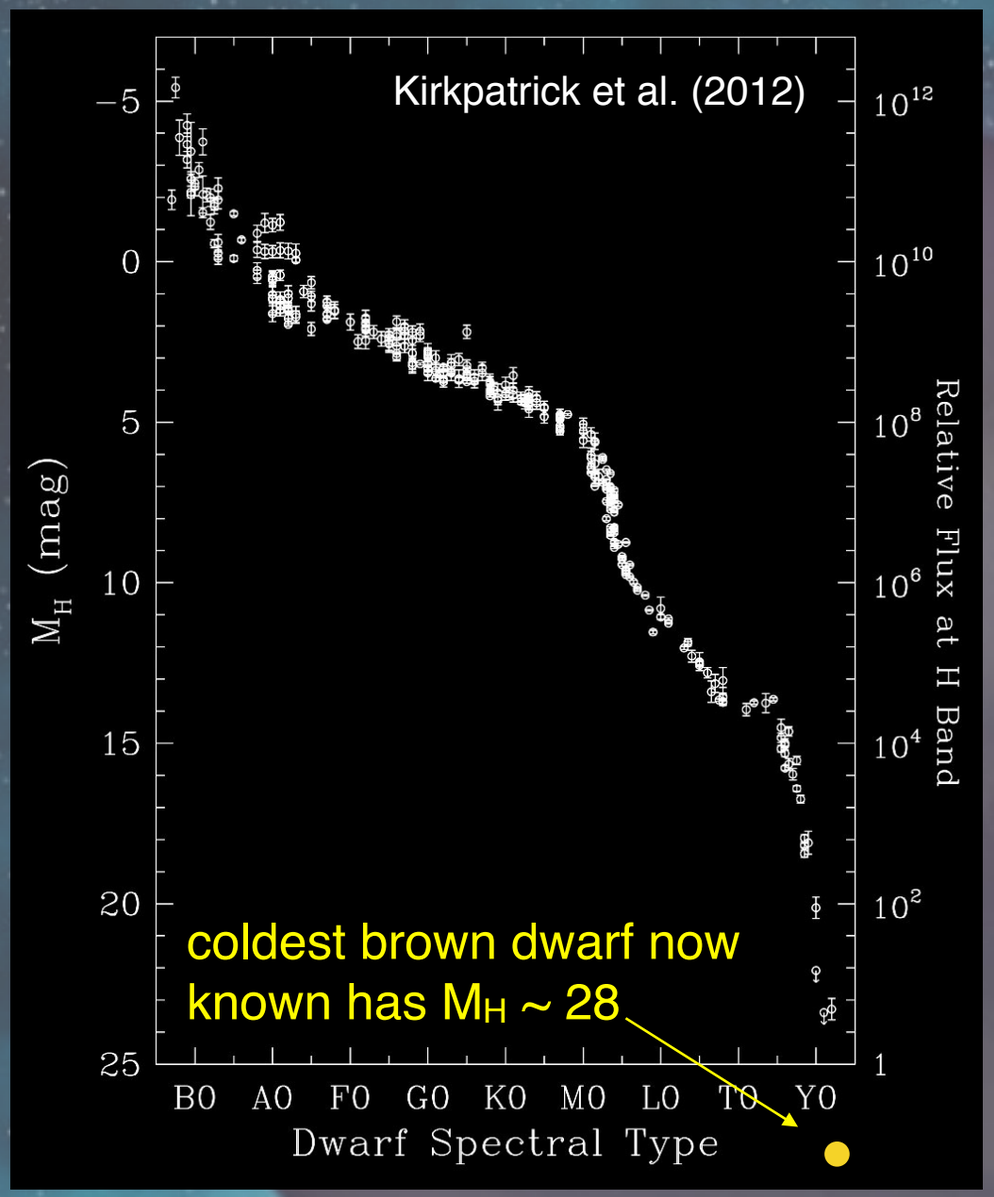
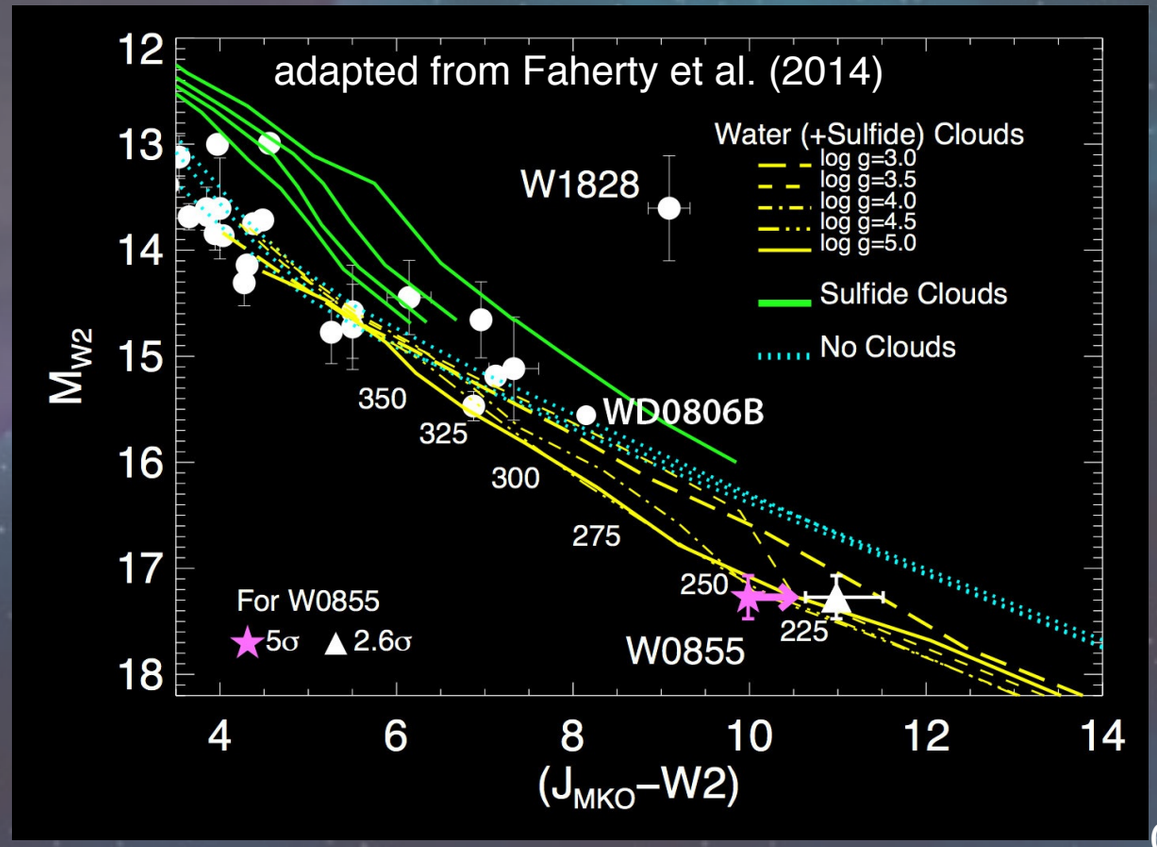


Assuming WFIRST-AFTA can probe to Vega mags of J~H~25.5, then we can see:

- Y0 dwarfs to 125 pc
- Y1 dwarfs to 50 pc
- WISE1828-type dwarfs to 50 pc
- WD0806B-type dwarfs to 25 pc
- WISE0855-type dwarfs to 3 pc

In 2400 sq deg, given space densities from Kirkpatrick et al. (2012), we should detect:

- 900 Y0 dwarfs
- 20 Y1 dwarfs
- unknown numbers of the others

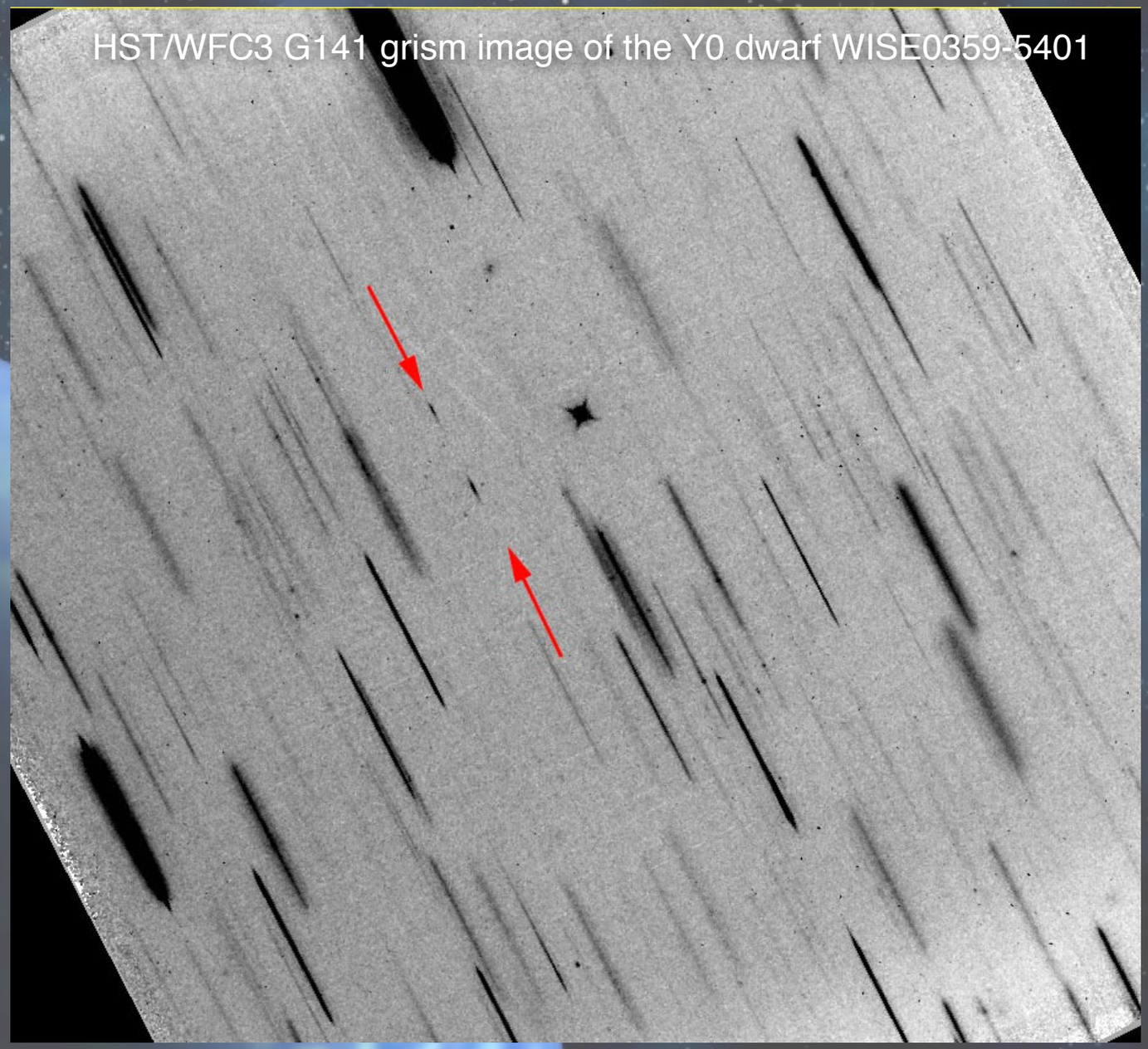


WFI Grism Survey

WFIRST-AFTA provides the capability of identifying Y dwarfs directly via their spectra, independent of any color selection.

These data can check of the robustness of color selections by providing confirmation of color-selected candidates and by identifying Y dwarfs missed via color cuts.

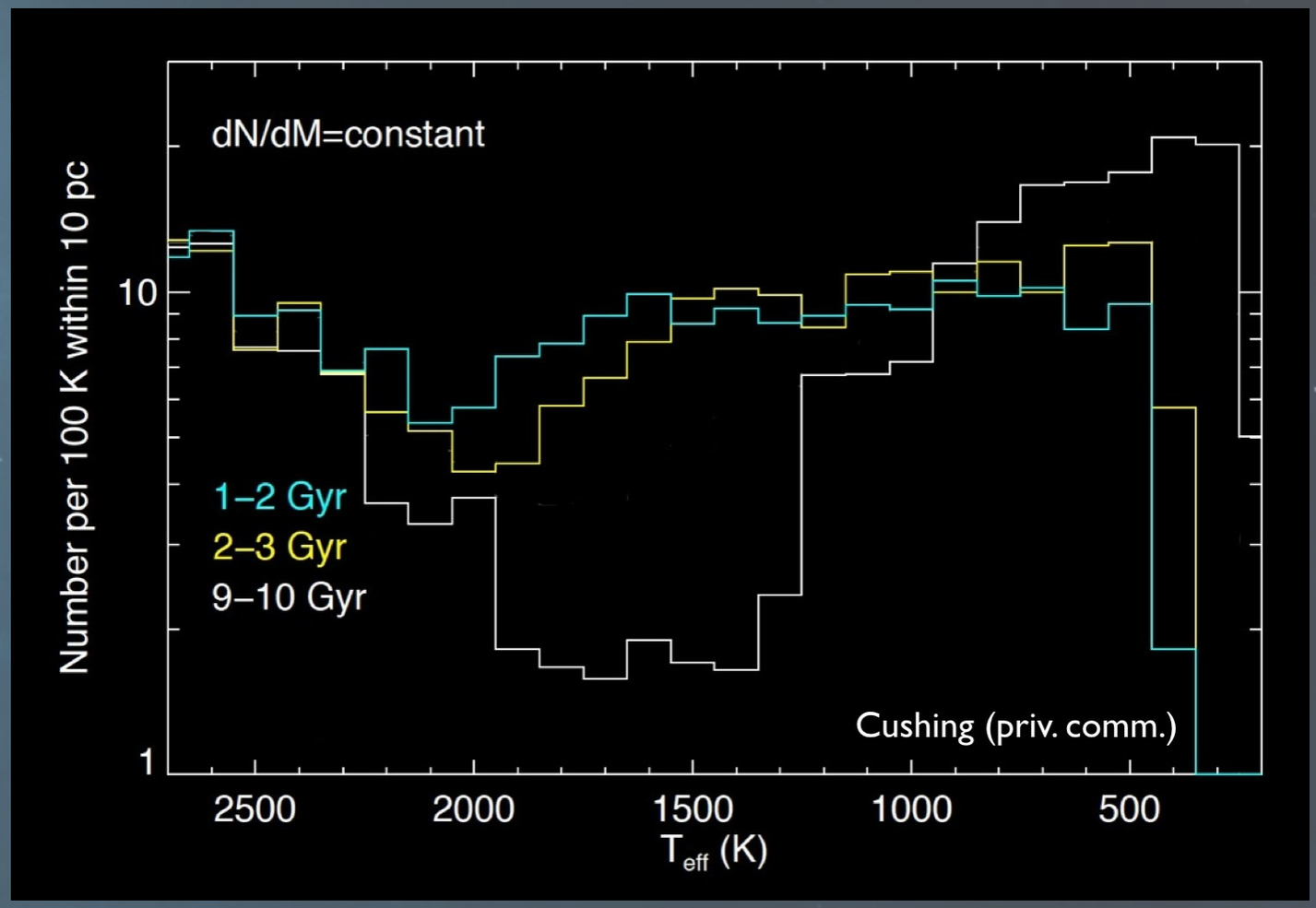
Grism data go surprisingly deep for Y dwarfs because the light in concentrated at only a few discrete wavelengths.



Re-imaging of early WFI fields (via GO time)

Can perform a proper motion search using the exquisite astrometric precision of WFIRST-AFTA.

A proper motion search is well geared to finding low-metallicity (old) L and T dwarfs since these are bright to WFIRST-AFTA and have high proper motions.

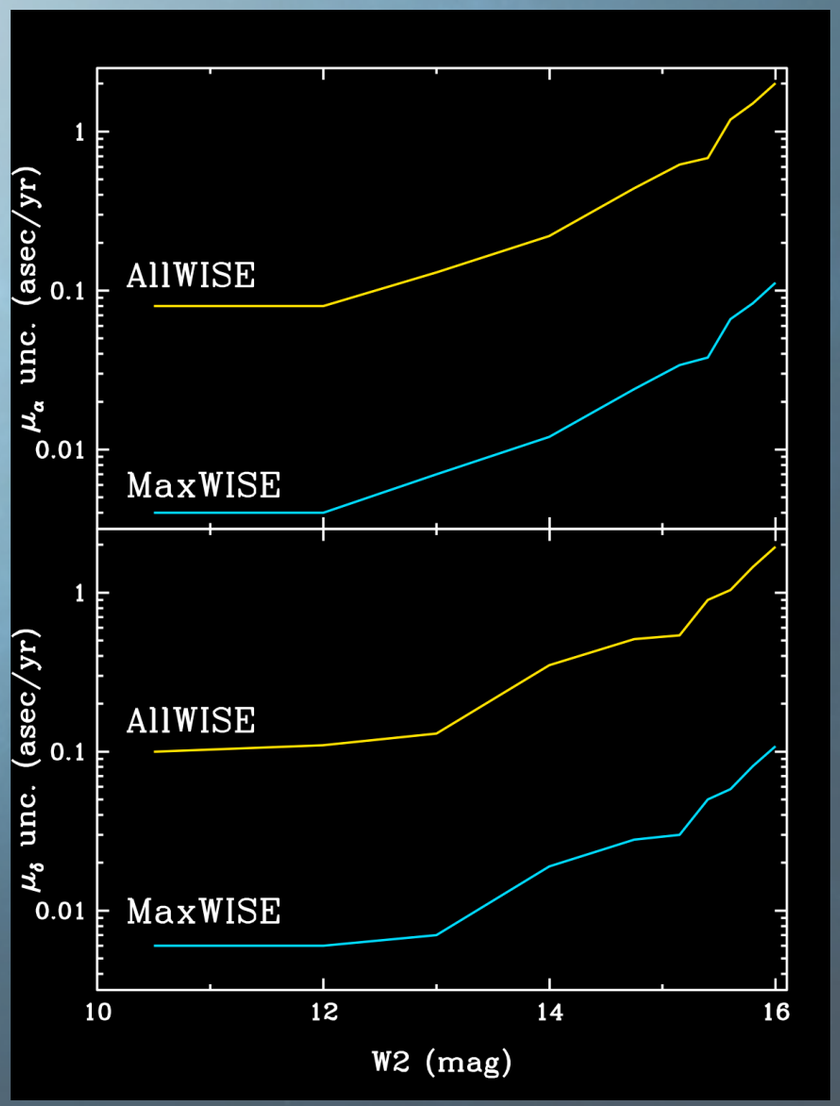


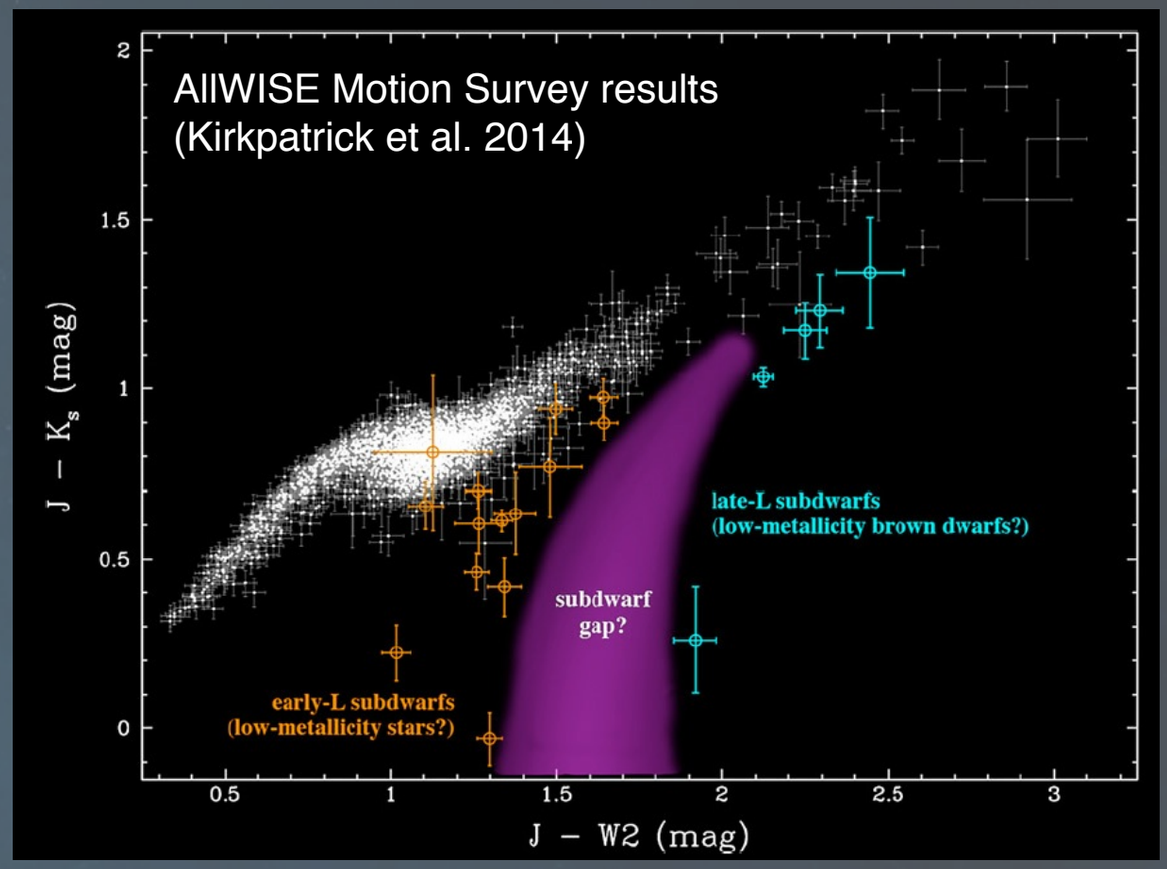
Can be used

- to test cooling theory
- as empirical measure of stellar cutoff at low-Z
- as "simpler" atmospheres against which to test exoplanet models
- test of formation efficiency at low-Z

How Many Re-Imaged Fields do We Need?

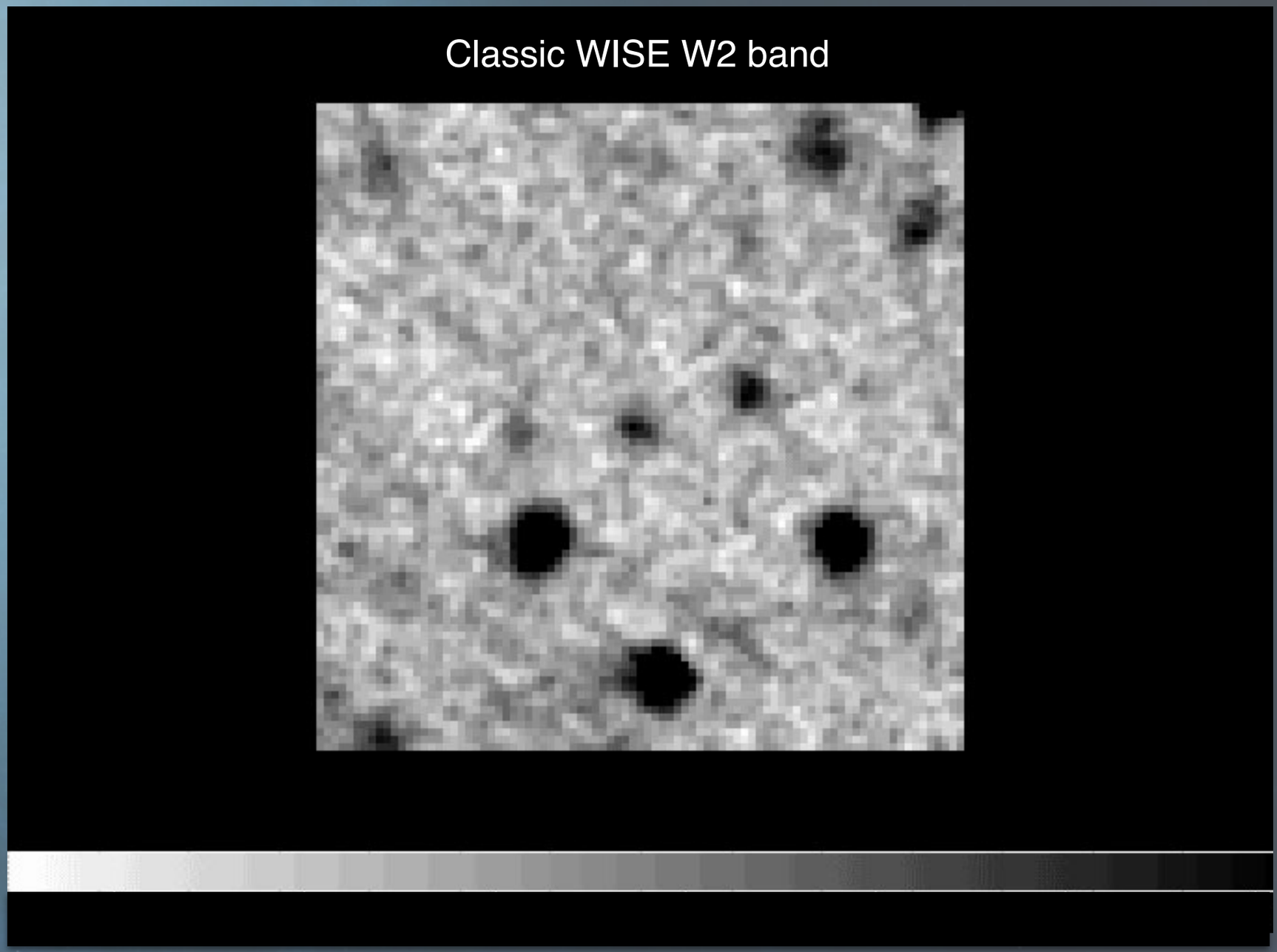
The number of WFIRST-AFTA fields needed can be guided by observations, but more robust statistics are required.





Larger numbers of the closest examples should be identified first. This needs all sky; i.e., a MaxWISE-type effort to compare old WISE data to new NEOWISER data.

A Motion Discovery using WISE-to-NEOWISER Baseline



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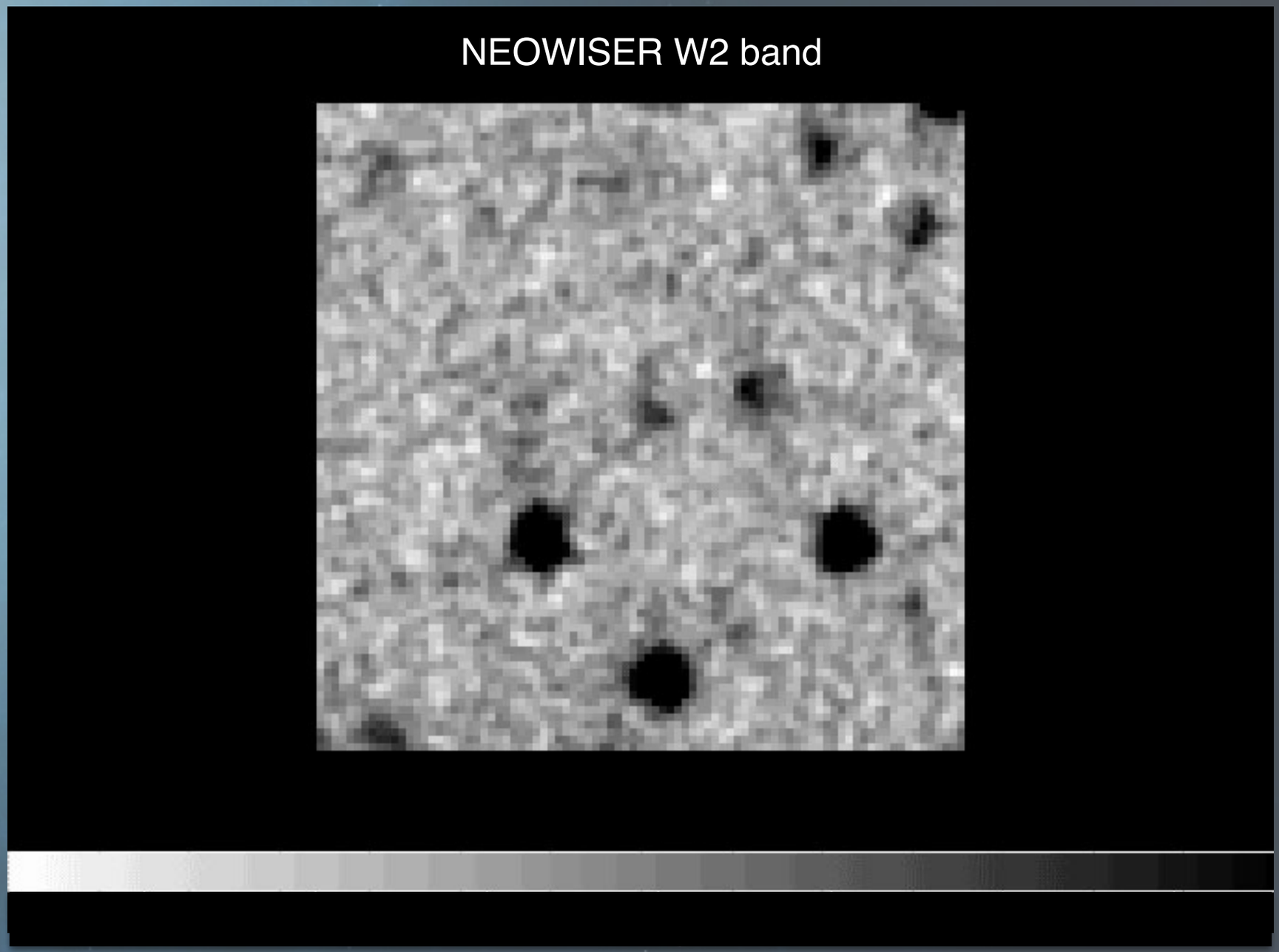

Summary

WFI High-Lat Survey: Hundreds of Y dwarfs will be detected.

WFI Grism Survey: Y dwarfs will be discovered independent of color selections

Redo of early WFI fields: Motions will permit discovery of objects spanning the subdwarf "gap".

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Thank you!

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