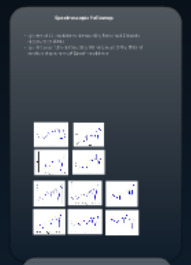
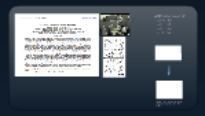



To Kiev!

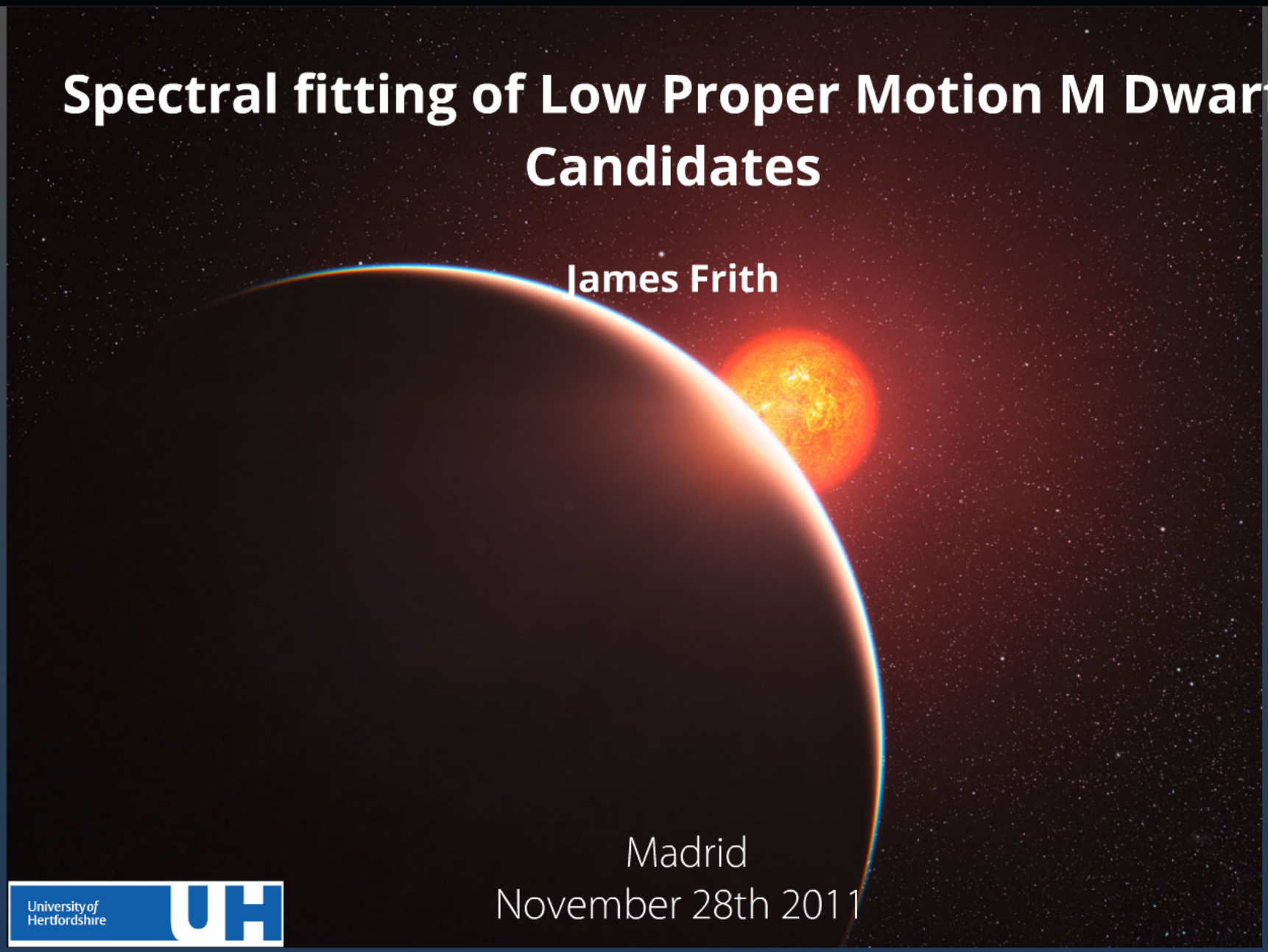



Removing Contamination


Current and Future Work

Spectral fitting of Low Proper Motion M Dwarf Candidates

James Frith



Madrid
November 28th 2011

University of Hertfordshire

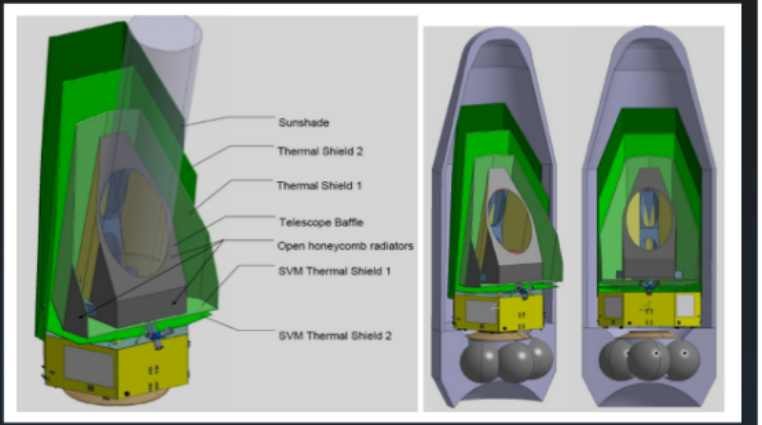
Background

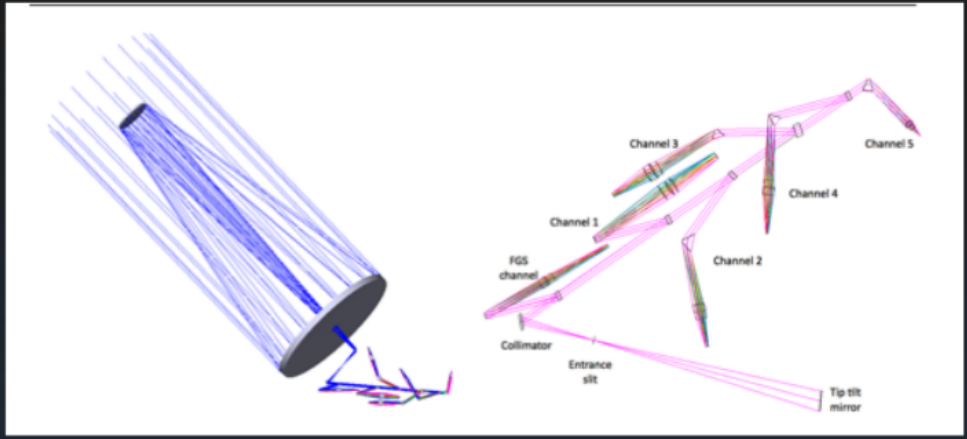
- Working with Ropacs' Industrial Partner, Astrium
- Work on site in Stevenage
- Collaborate with the exoplanet science community to help liaise between industry and their ultimate costumer

Exoplanet Characterization Observatory (EChO

- An M3 ESA space mission
- Now in its industrial bidding stage
- Goal is to characterize nearby exoplanets' atmospheres using secondary transit method

Invitation to tender sent out in October





Echo's Current Configuration

- ~ 1 meter primary
- Multi chanel spectrometer 0.4 – 11 microns (hoping for 16)
- L2 orbit
- To be launched in the 2022

→ Needs transiting planets around bright stars with contrast ratios above the noise floor of the instrument

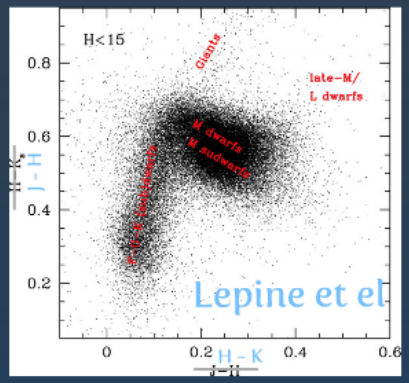
Strategy

Employ use of a new catalog: PPMXL

- Combination of 2MASS and USNO B1
- This gives JHK mag and two epochs in the visible.
- V > 11

Color cuts

- J - K > 0.7
- H - K > 0.15
- J - H < .75

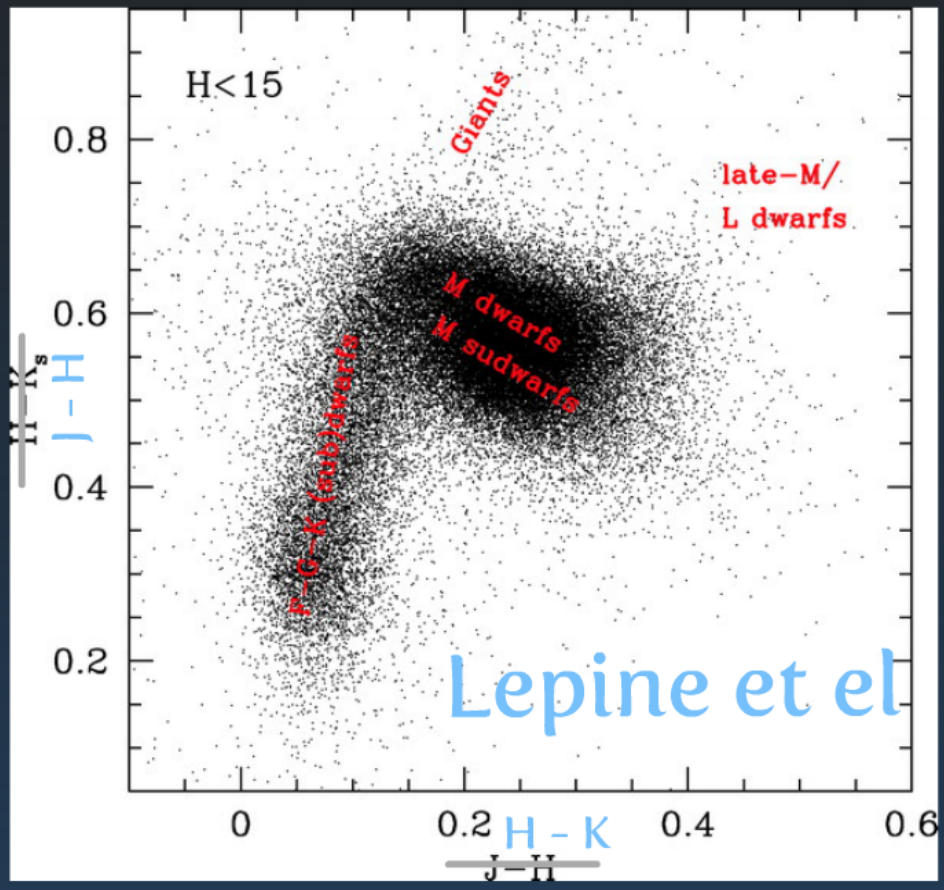


K mag < 9

PM < 150 mas

Color cuts

- J - K > 0.7
- H - K > 0.15
- J - H < .75



the visible.

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Color cuts

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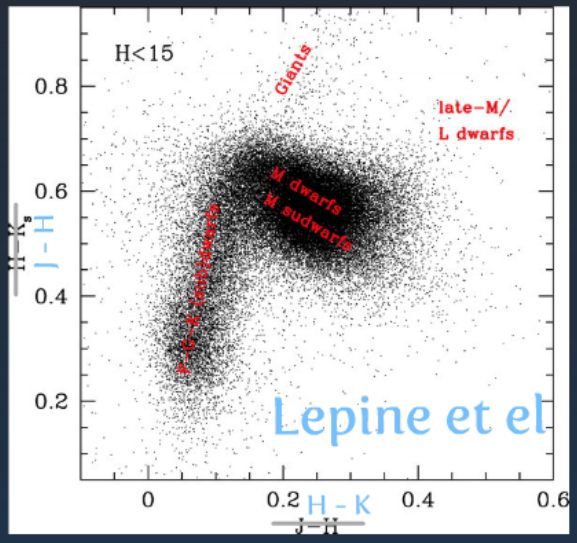
- J - H < .75



K mag < 9

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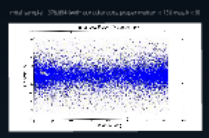
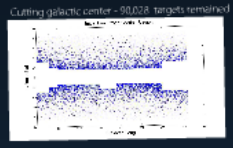
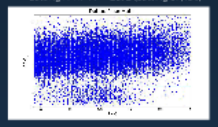
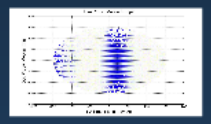
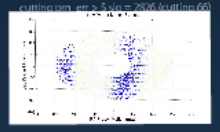
Removing Contamination

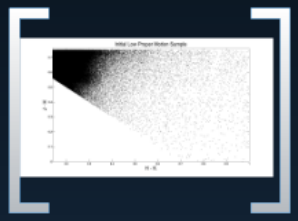


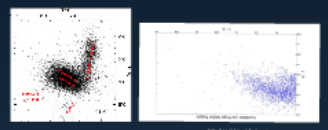




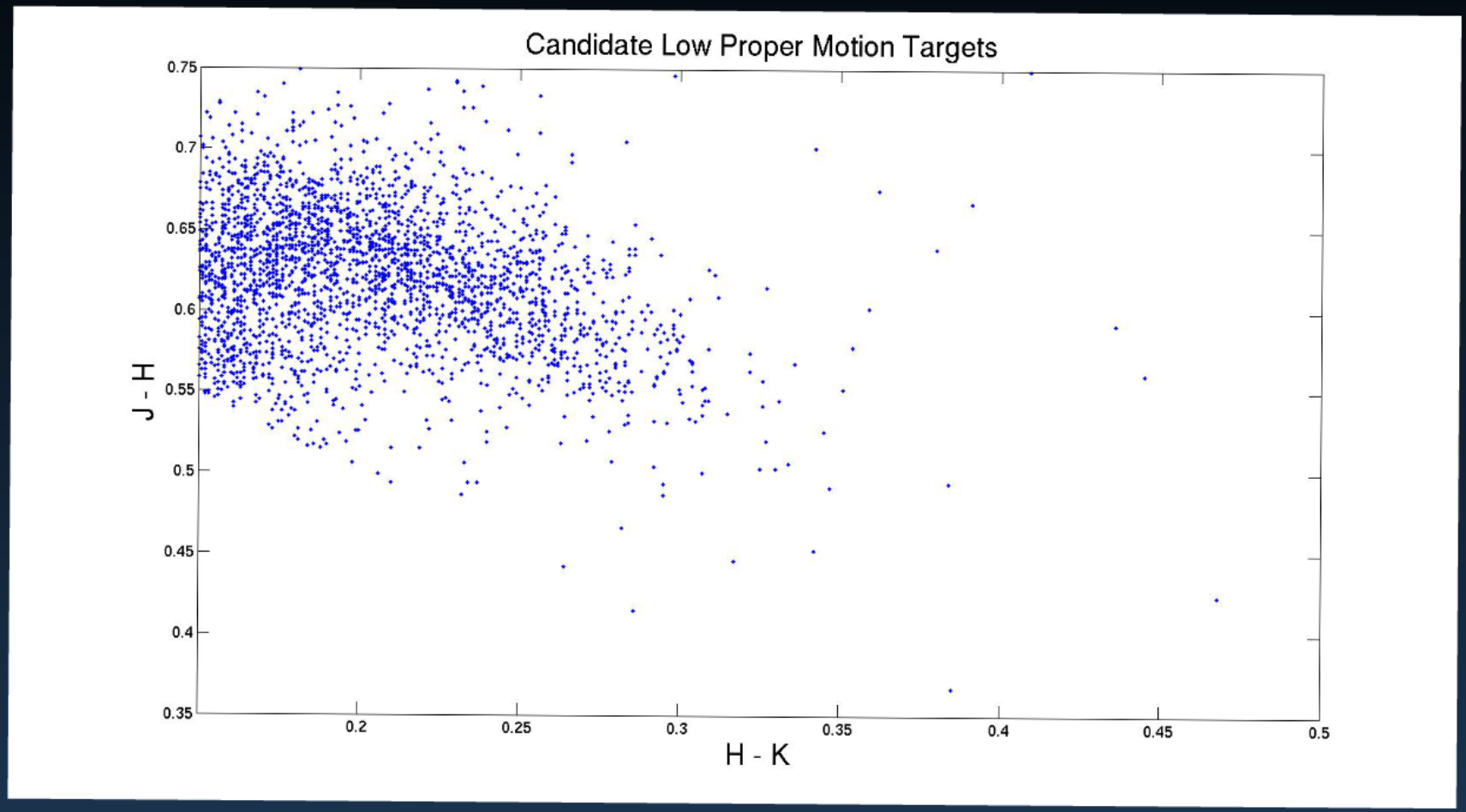


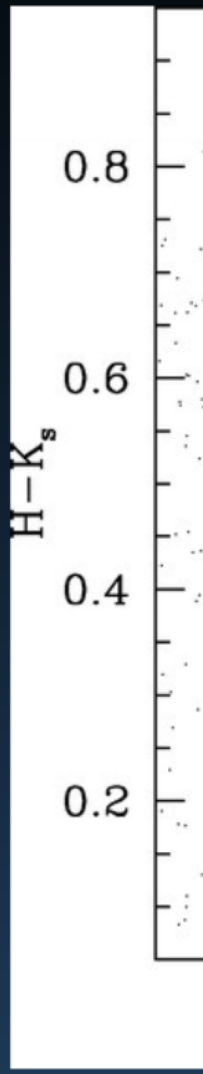






Low Proper Motion M Dwarfs





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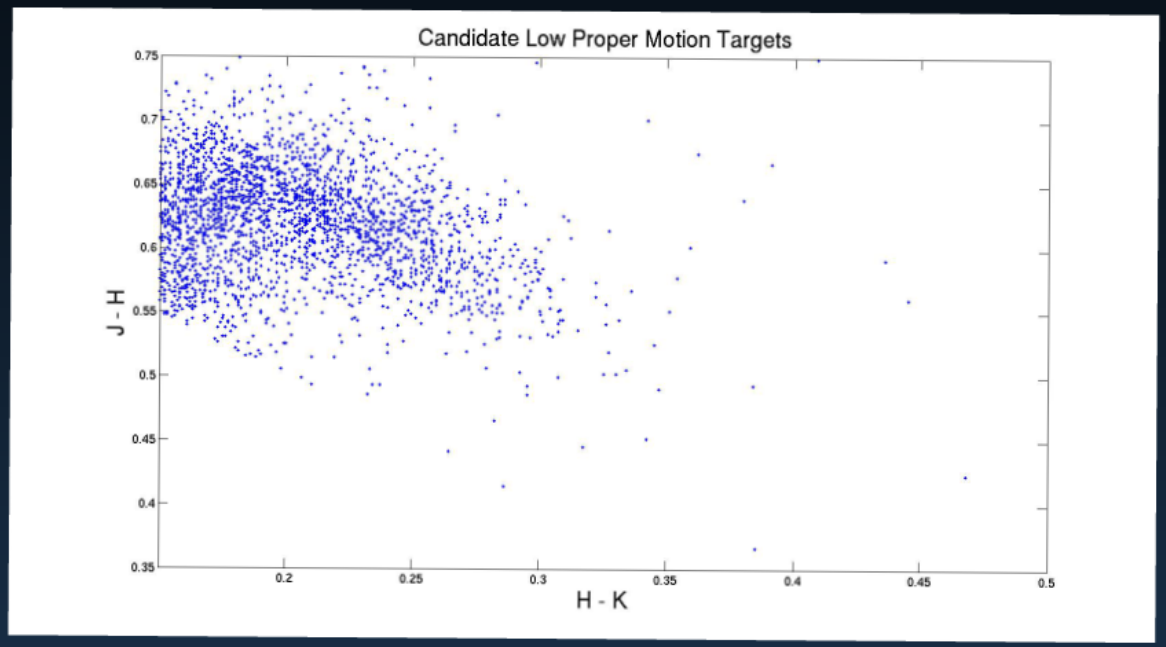

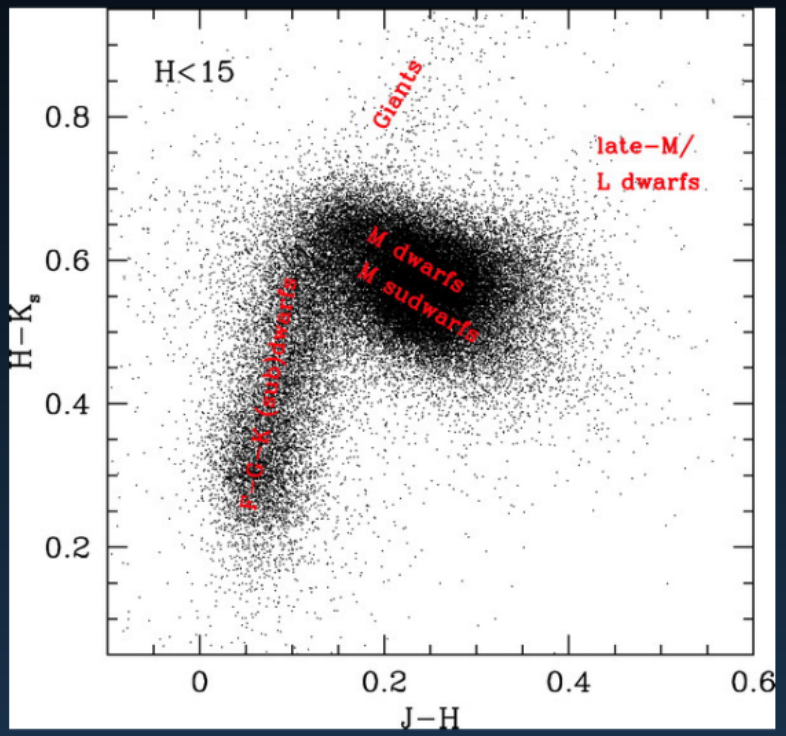

2582 M dwarf candidates with PM<150 mas/yr and K<9
Cross-matched with CDS

2582 M dwarf candidates with PM<150 mas/yr and K<9

Cross-matched with CDS

- ~65% are un-catalogued

~35% are from;

- Objective prism surveys
- LPM end of some 2MASS HPM searches
- X-ray emitting M dwarfs – e.g. 2MASS/Rosat cross-match
- Prism survey stats suggest ~30% late K contamination

1800 M dwarfs in selection

The Astronomical Journal, 142:138 (15pp), 2011 October doi:10.1088/0004-6256/142/4/138

AN ALL-SKY CATALOG OF BRIGHT M DWARFS

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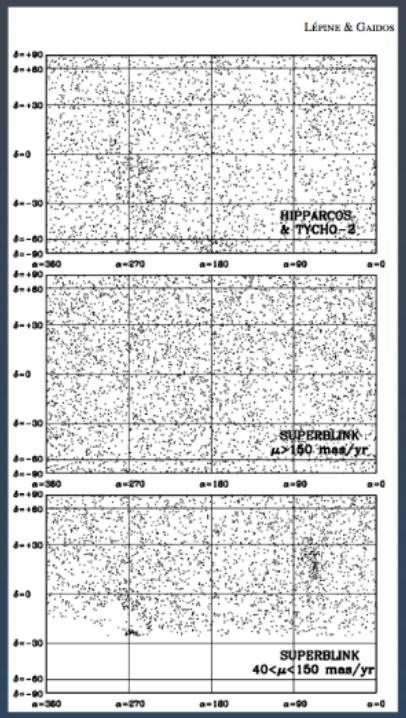
[1] Department of Astrophysics, Division of Physical Sciences, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024, USA
[2] Department of Geology & Geophysics, University of Hawaii, 1680 East-West Road, Honolulu, HI 96822, USA
Received 2011 May 12; accepted 2011 August 12; published 2011 September 16

ABSTRACT

We present an all-sky catalog of M dwarf stars with apparent infrared magnitude $J < 10$. The 8889 stars are selected from the ongoing SUPERBLINK survey of stars with proper motion $\mu > 40$ mas yr^{-1}, supplemented on the bright end with the *Tycho-2* catalog. Completeness tests which account for kinematic (proper motion) bias suggest that our catalog represents ≈75% of the estimated ∼11,900 M dwarfs with $J < 10$ expected to populate the entire sky. Our catalog is, however, significantly more complete for the northern sky (≈90%) than it is for the south (≈60%). Stars are identified as cool, red M dwarfs from a combination of optical and infrared color cuts, and are distinguished from background M giants and highly reddened stars using either existing parallax measurements or, if such measurements are lacking, using their location in an optical-to-infrared reduced proper motion diagram. These bright M dwarfs are all prime targets for exoplanet surveys using the Doppler radial velocity or transit methods; the combination of low-mass and bright apparent magnitude should make possible the detection of Earth-size planets on short-period orbits using currently available techniques. Parallax measurements, when available, and photometric distance estimates are provided for all stars, and these place most systems within 60 pc of the Sun. Spectral type estimated from $V - J$ color shows that most of the stars range from K7 to M4, with only a few late M dwarfs, all within 20 pc. Proximity to the Sun also makes these stars good targets for high-resolution exoplanet imaging searches, especially if younger objects can be identified on the basis of X-ray or UV excess. For that purpose, we include X-ray flux from *ROSAT* and FUV/NUV ultraviolet magnitudes from *GALEX* for all stars for which a counterpart can be identified in those catalogs. Additional photometric data include optical magnitudes from Digitized Sky Survey plates and infrared magnitudes from the Two Micron All Sky Survey.

Key words: catalogs – proper motions – solar neighborhood – stars: kinematics and dynamics – stars: low-mass – surveys

Online-only material: color figures, machine-readable and VO tables



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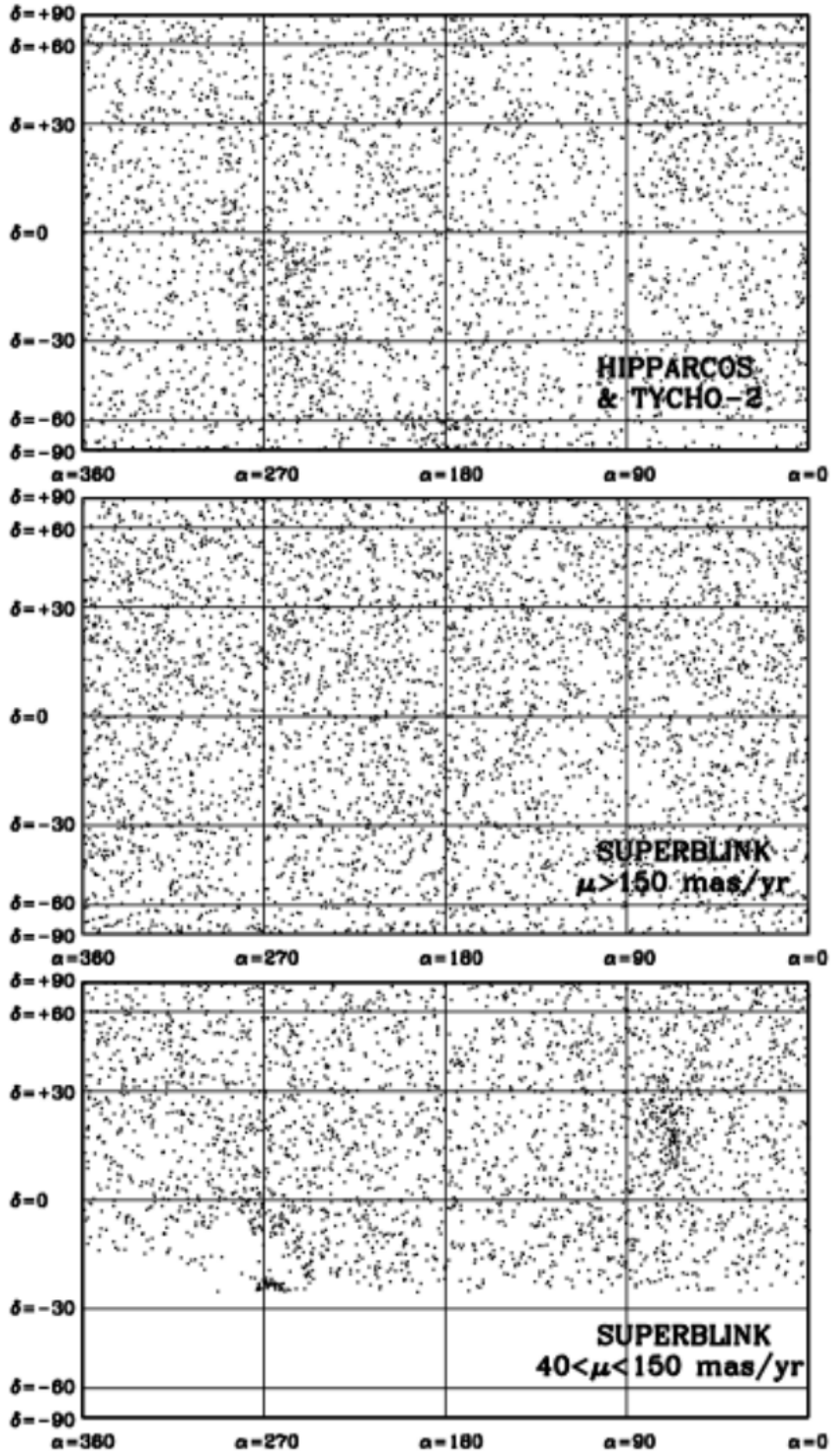
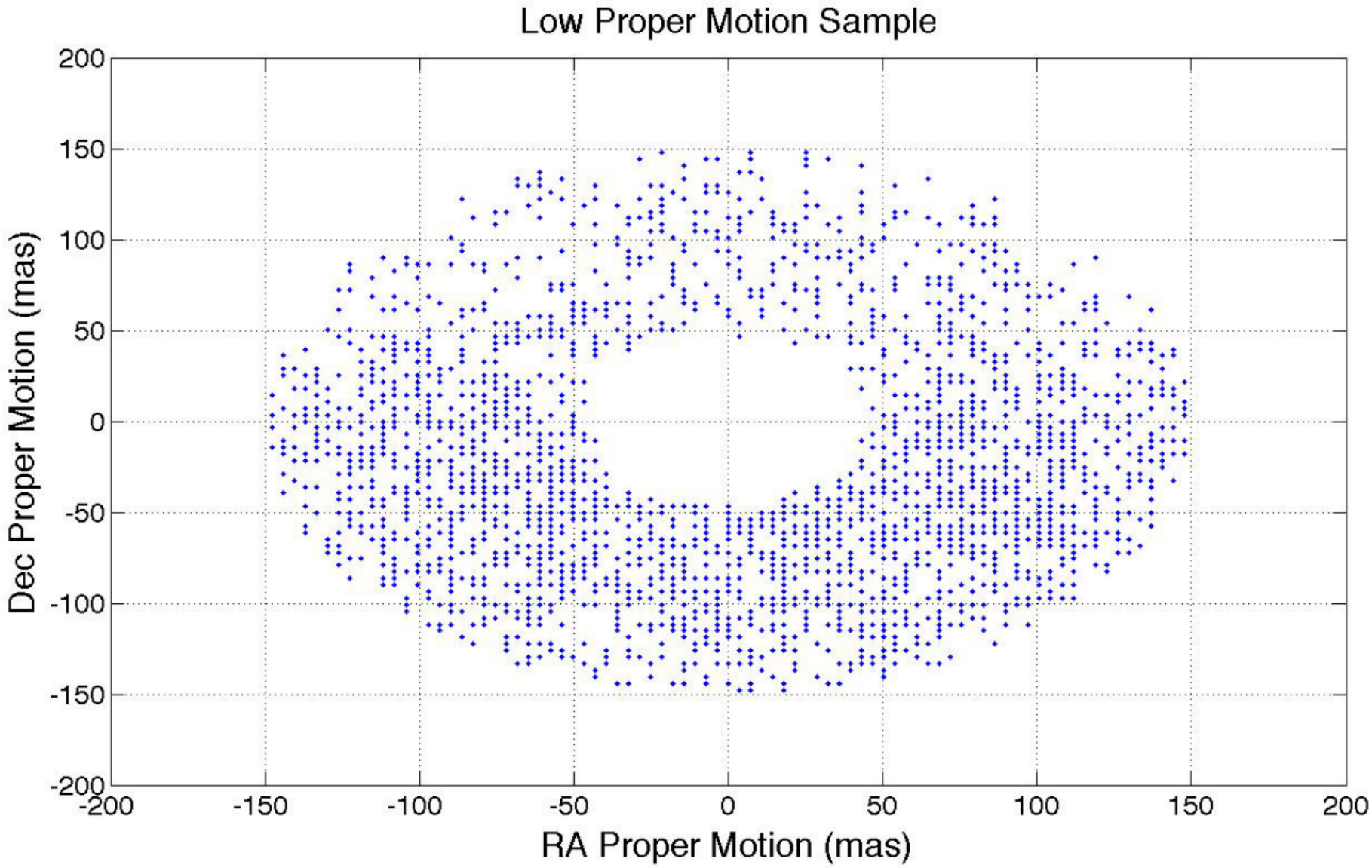
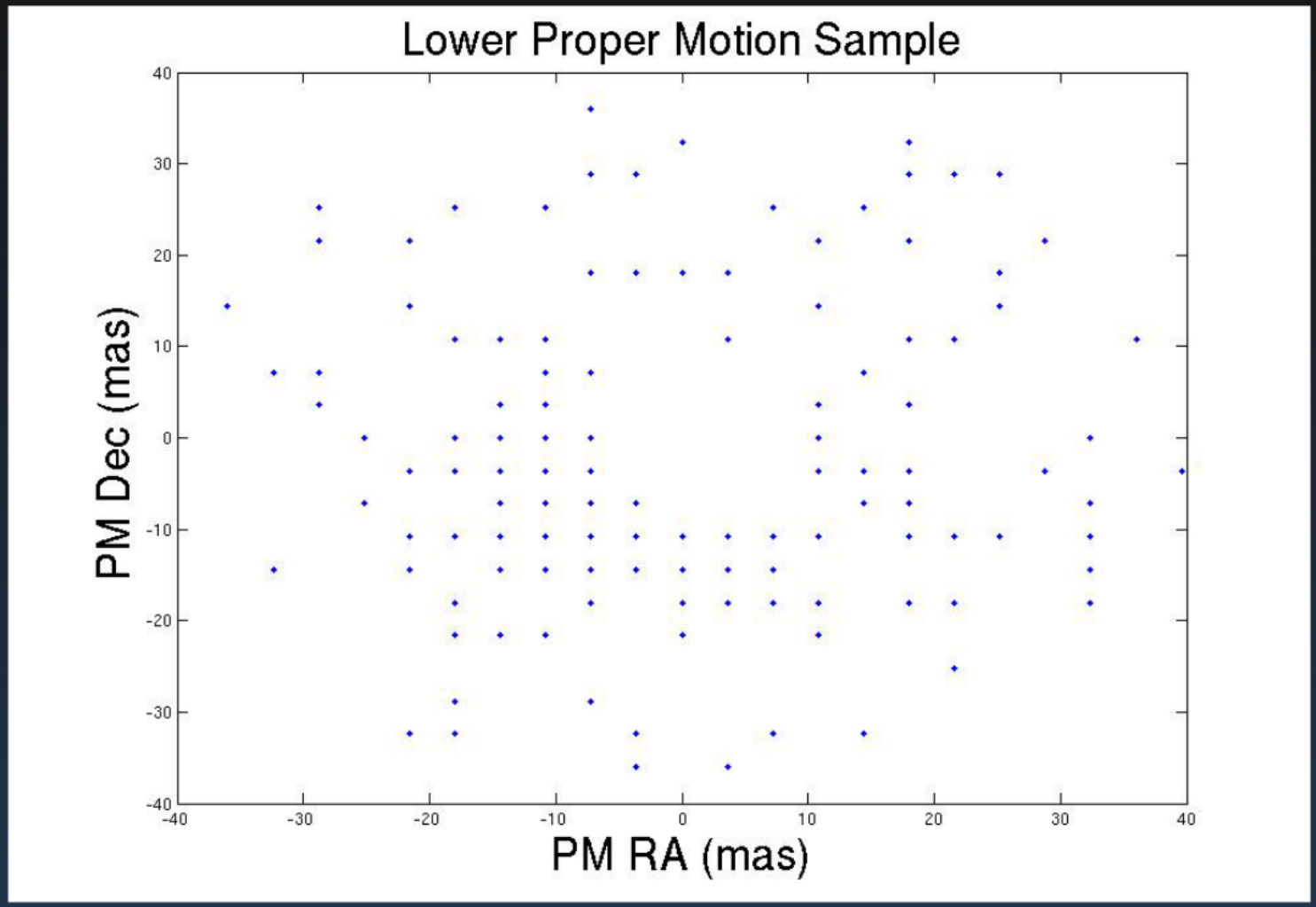



Low Proper Motion Sample
Dec Proper Motion (mas)
RA Proper Motion (mas)
200
150
100
50
0
-50
-100
-150
-200
-200
-150
-100
-50
0
50
100
150
200



Currently, 180 M dwarf candidates with PM <40 including objects below the -30 Dec for all sky

Sample Numbers

- 1800 M dwarfs in LPM selection
- 2600 in HPM selection
- Mean K Mag of sample = 8.5
- Better sky coverage, PM calculations than Lepine Sample

Total M dwarf candidates with K < 9 in sample (LPM+HPM) = 4400
The LPM sample is 41% of the full sample

Are they M Dwarfs?

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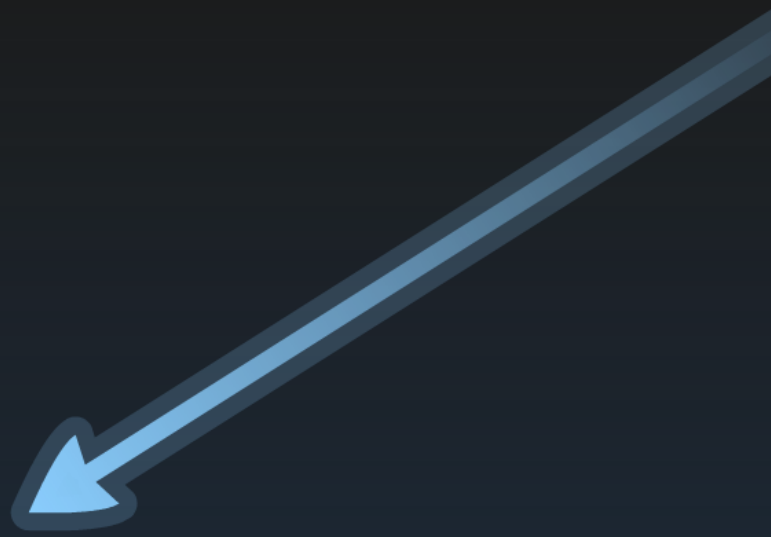
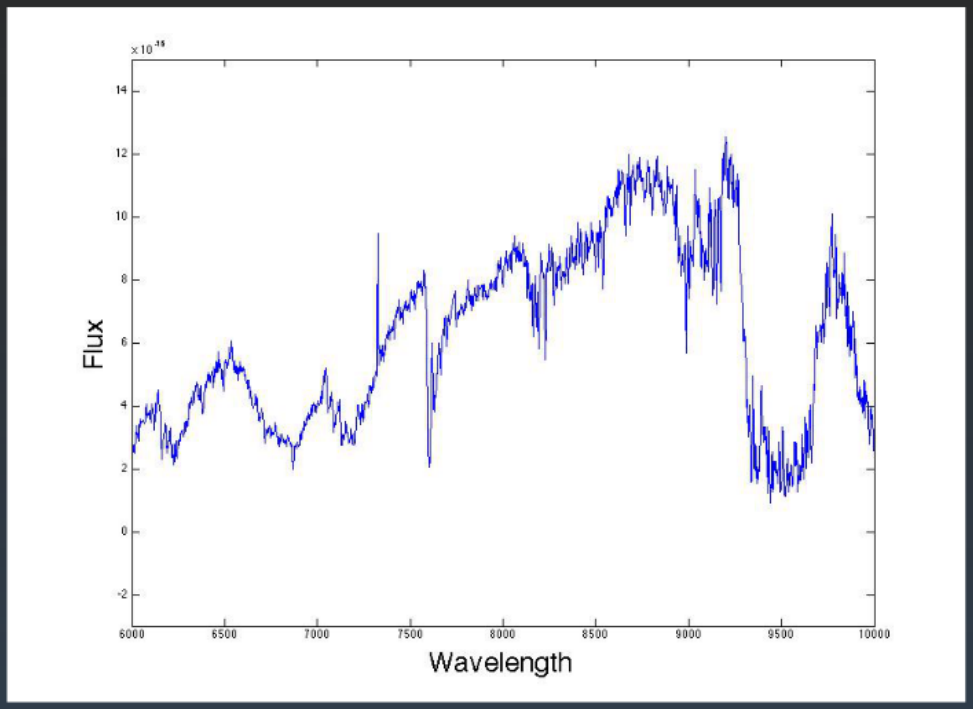
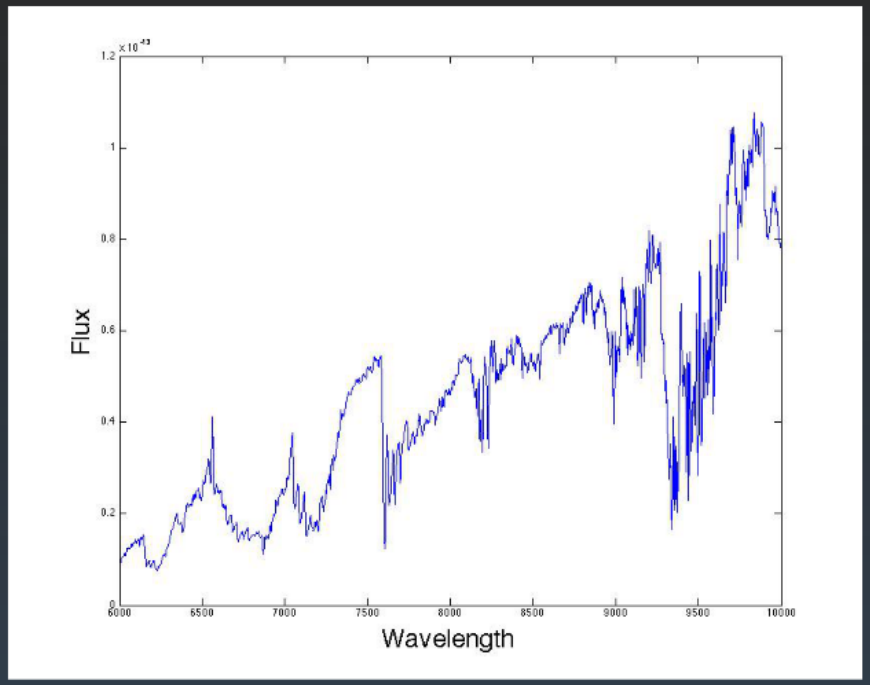


Are they M Dwarfs?

Spectroscopic Followup

- Spectra of 13 candidates obtained by Rama and Eduardo observers at KPNO
- Spectra were also obtained by UH observers at the TNG of another dozen or so M Dwarf candidates


Flux
Wavelength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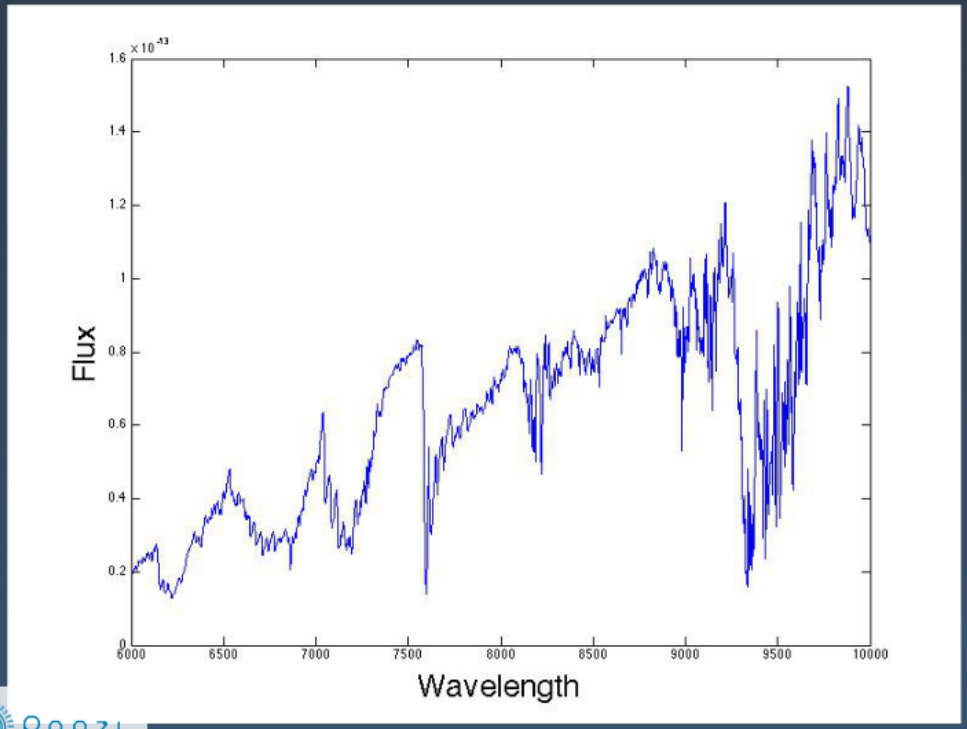
Wavelength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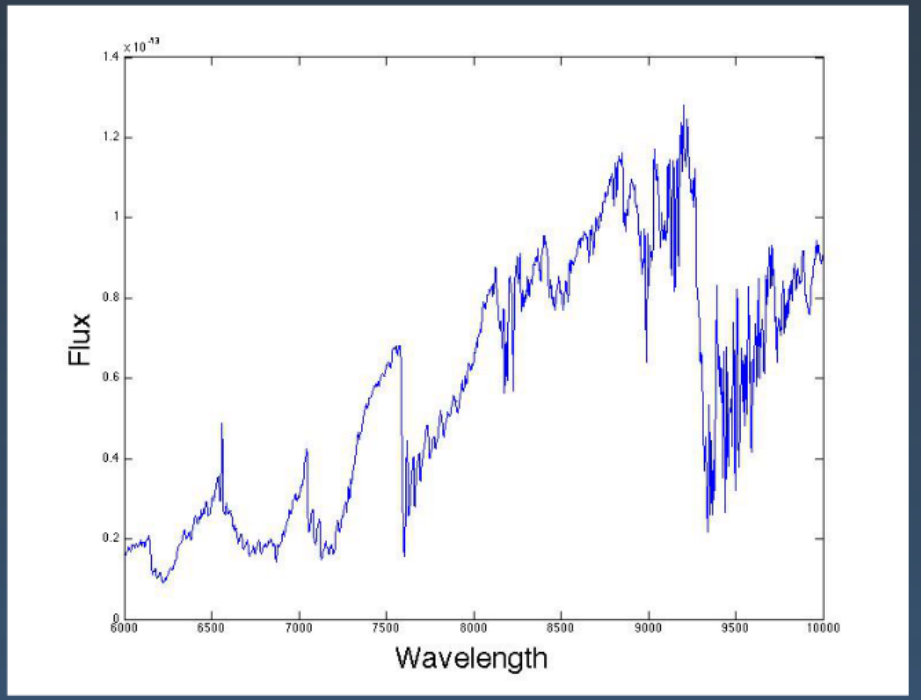
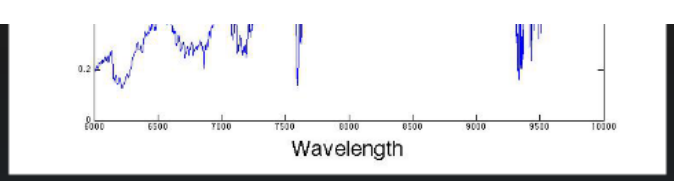
Wavelength


Flux
Wavelength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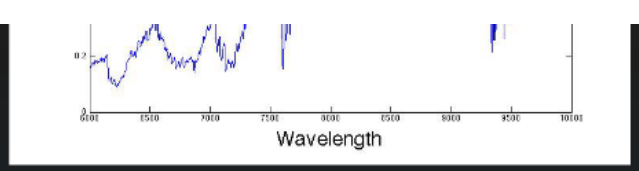
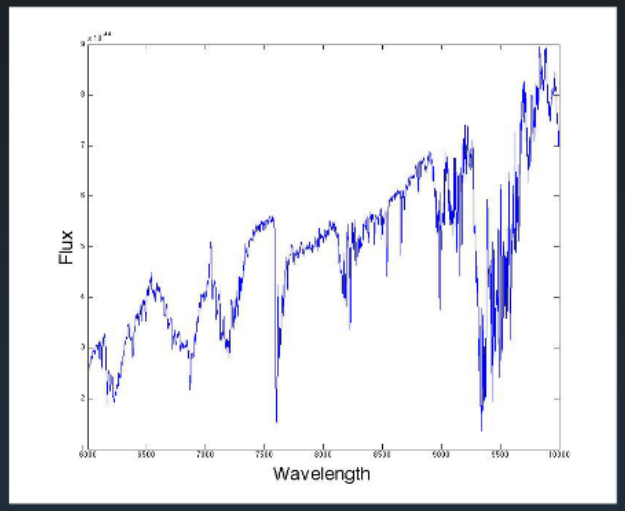

Wavelength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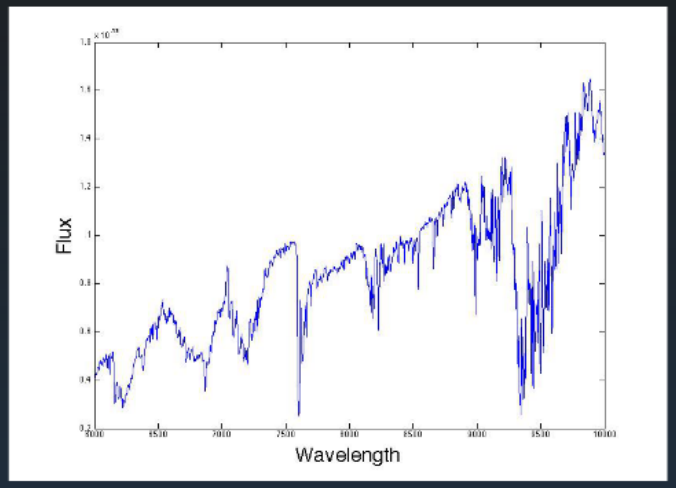
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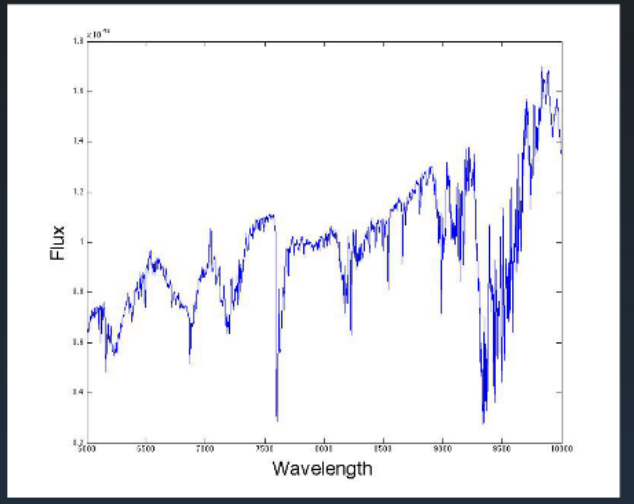
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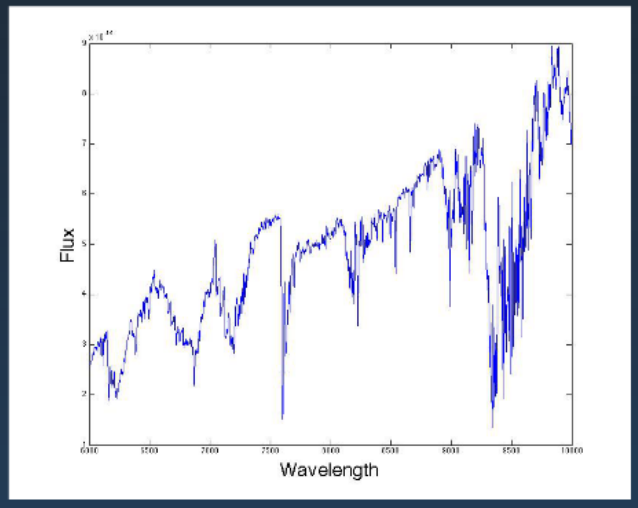
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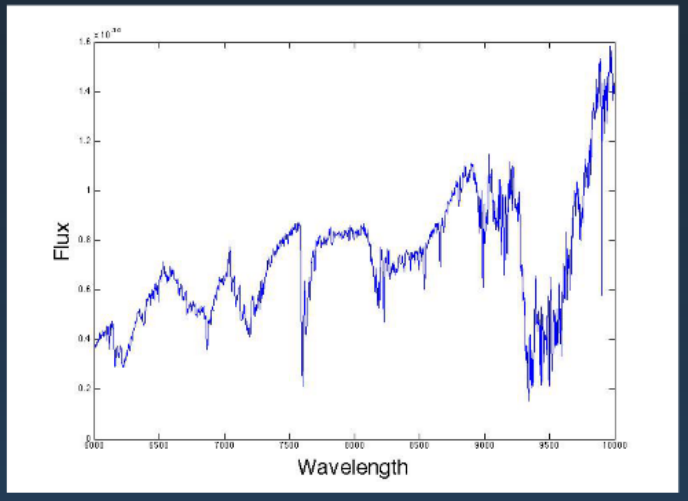
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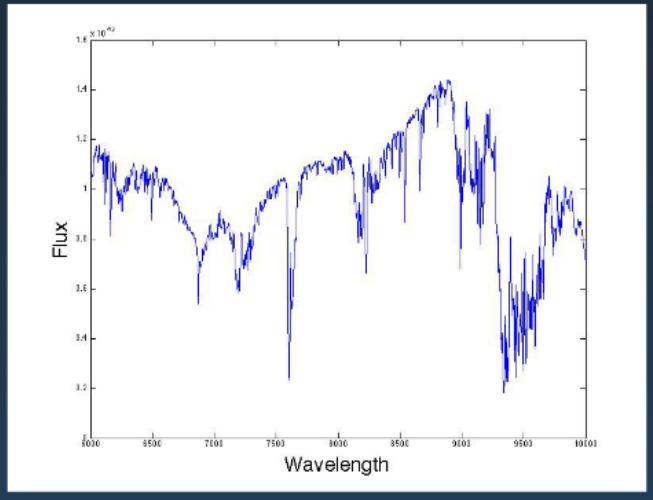
Flux
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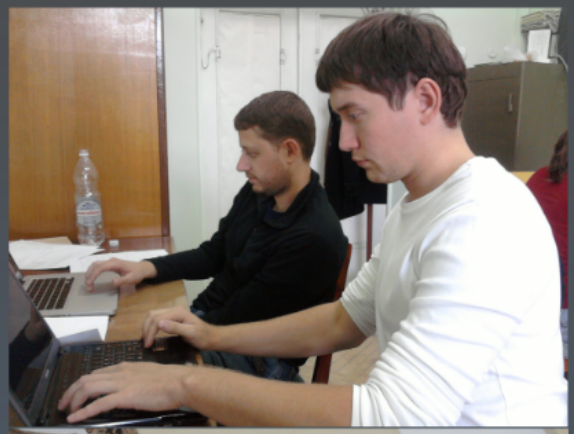
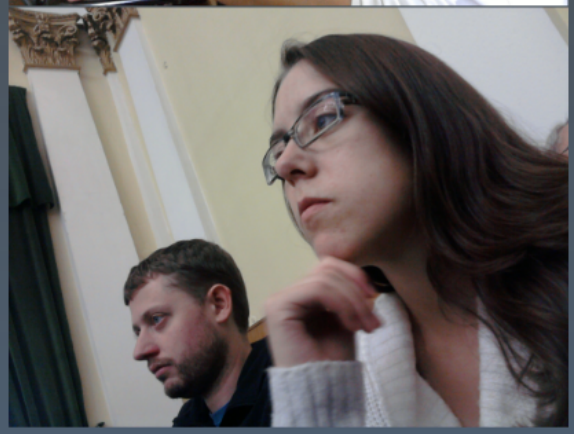
To Kiev!





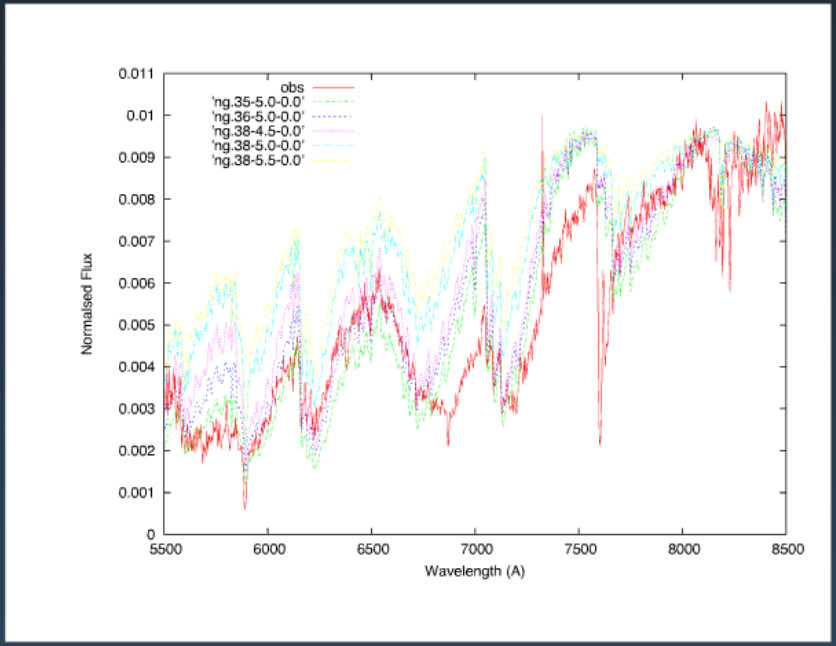
Model Spectra Fitting

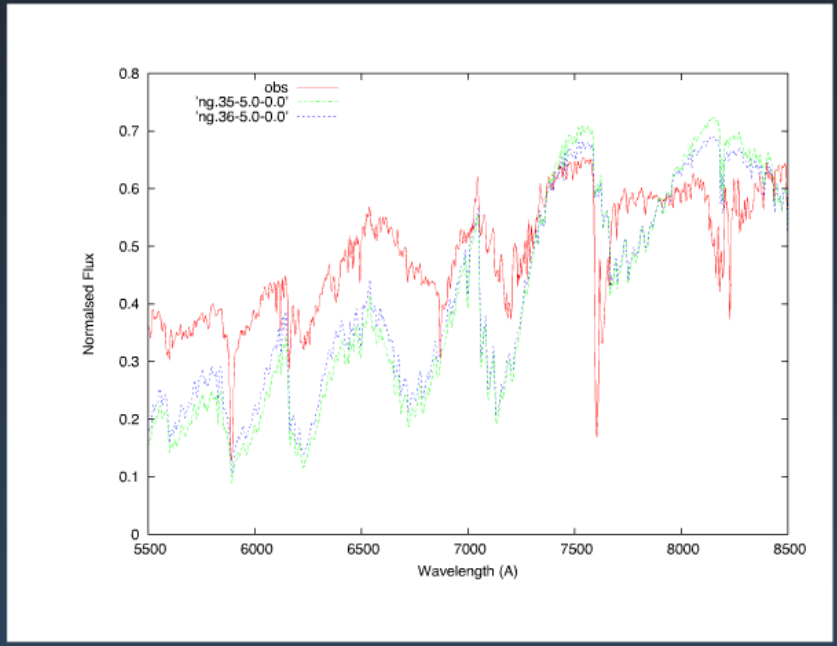
- Initial temperature esitmatations
- Model spectra creation that include a range of values for Teff, Log g, and Fe/H
- Fit model spectra to observed interactivily and minimize residuals

Intiail estimates

Candidates	Sp_Class(M)	Teff
f_pmc1	4.9	2900
f_pmc2	4.3	3200
f_pmc3	4.4	3100
f_pmc4	3.8	3200
f_pmc5	3.5	3700
f_pmc6	2.9	3100
f_pmc7	2.4	3500
f_pmc8	2.1	3500
f_pmc9	2.6	3500
f_pmc10	2.4	3500
f_pmc11	2.3	2400
f_pmc12	1.7	3700
f_pmc13	3	3100

The Fits





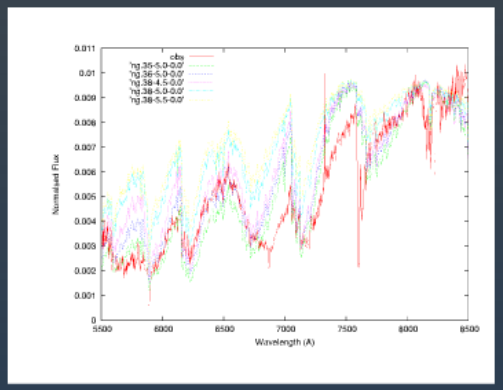
Initial Results of fits

Candidiate	Teff	Log g	Fe/H
f_pmc1	3700 K	5	0.5
f_pmc2	3400 K	4.5	0
f_pmc3	3500 K	5	0
f_pmc4	4000 K	5	0.5
f_pmc5	3600 K	4.5	0
f_pmc6	3800 K	5.5	0.5
f_pmc7	4000 K	5	0
f_pmc8	3800 K	5.5	0
f_pmc9	3200 K	5	0
f_pmc10	3100 K	5	0
f_pmc11	3400 K	4	0.5
f_pmc12	3400 K	5	0.5
f_pmc13	3100 K	5	0.5

Current and Future Work

Continue Follow up Spectra Analysis

- Continue to refine model fits with Yakiv and Max
- Analyze TNG spectra and compare
- More data?



- Identify common proper motion candidates in M dwarf sample
- Publish the (vastly superior) catalog

- Colaborate with existing and planned transit surveys to help update target list
- Telescope time?

- Work with Astrium to further define science requirements for their Echo bid

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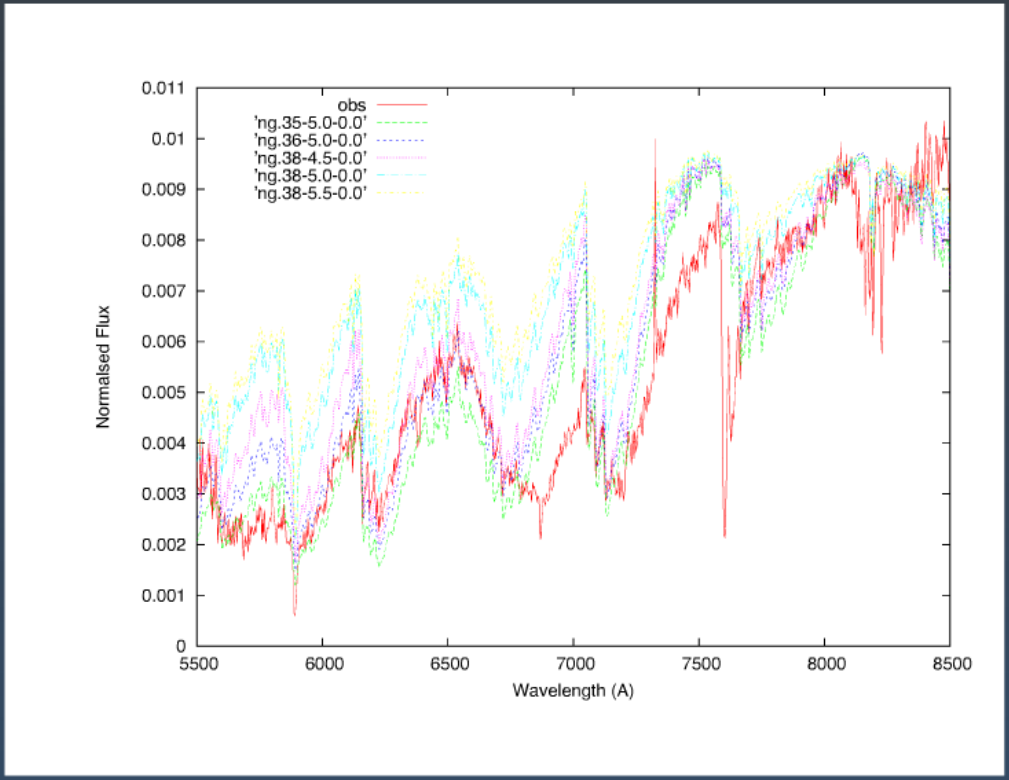

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