

Purple Dwarfs: New L subdwarfs from UKIDSS and SDSS

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Outline

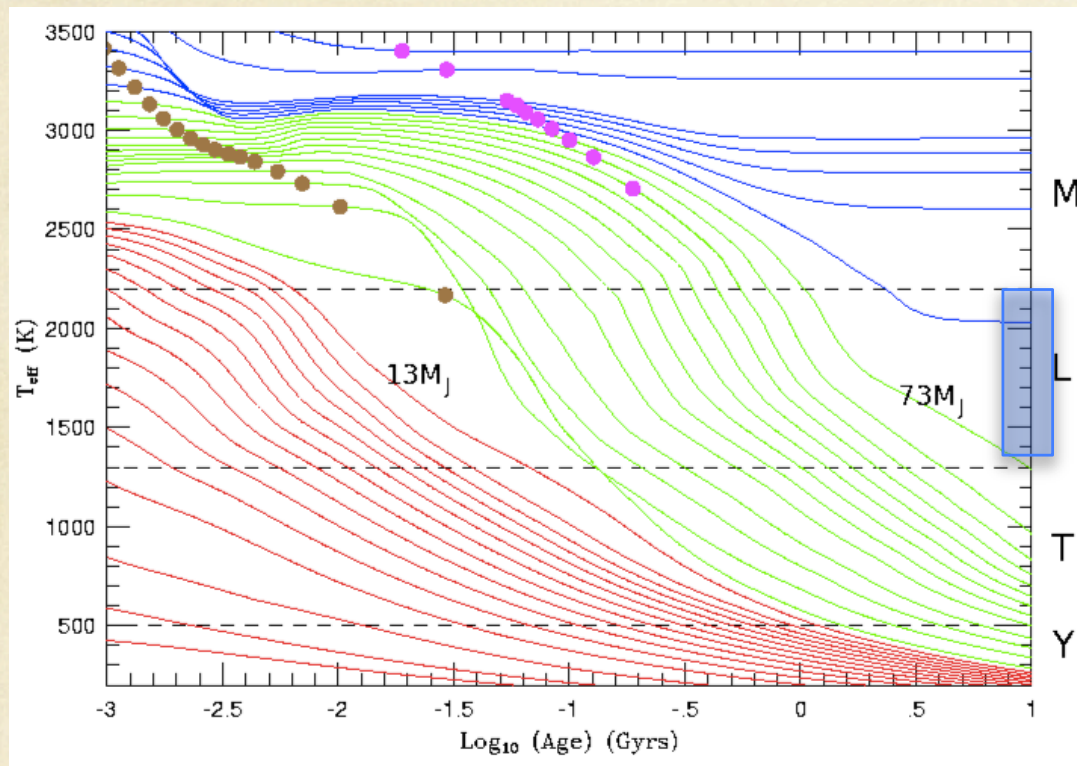
- Background
- UKIDSS+SDSS L subdwarf project
- Future work

Why brown dwarfs are interesting?

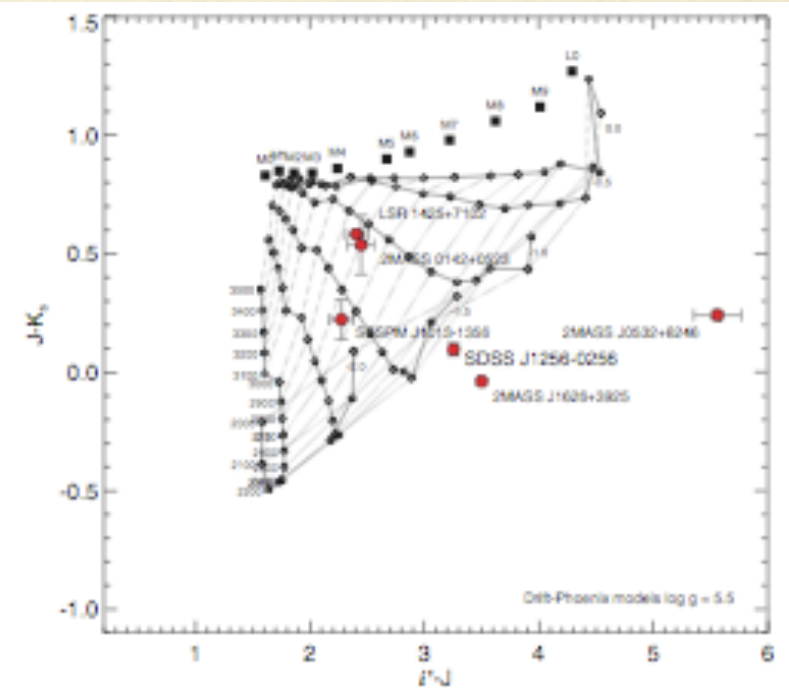
- Sensitive to mass function (e.g. Bate & Ian 2005, MNRAS, 356, 1201)
- Fossilized records of star formation history
- Ultracool atmosphere studies
- Nearest planet hosts

(Kirkpatrick 2011, ASPC, 448, 323)

Evolutionary & Atmospheric Models



Burrows 2001



Drift-Phoenix (e.g. Witte et al. 2009).
Figure is from Burgasser et al. (2009)

Too few known L subdwarfs!

Name	SpT ^a	SpT ^b	SDSS <i>i</i>	SDSS <i>z</i>	<i>J</i>
2MASS J05325346+8246465	sdL7	esdL7	20.37±0.05	17.58±0.02	^c 15.18±0.06
2MASS J16262034+3925190	sdL4	esdL4	17.9±0.01	16.16±0.01	^c 14.44±0.03
SDSS J125637.13-022452.4	sdL3.5	esdL3.5	19.41±0.02	17.71±0.02	^c 16.10±0.10 ^c 16.16±0.01
2MASS J06164006-6407194	sdL5	esdL6	—	—	^c 16.40±0.11
ULAS J135058.85+081506.8	sdL5	esdL4	21.24±0.08	19.51±0.06	^d 17.93±0.04
ULAS J033351.10+001405.8	sdL0	—	19.24±0.02	17.87±0.02	16.11±0.01
ULAS J124425.75+102439.3	sdL0.5	sdL2	19.48±0.02	18.01±0.02	16.26±0.01

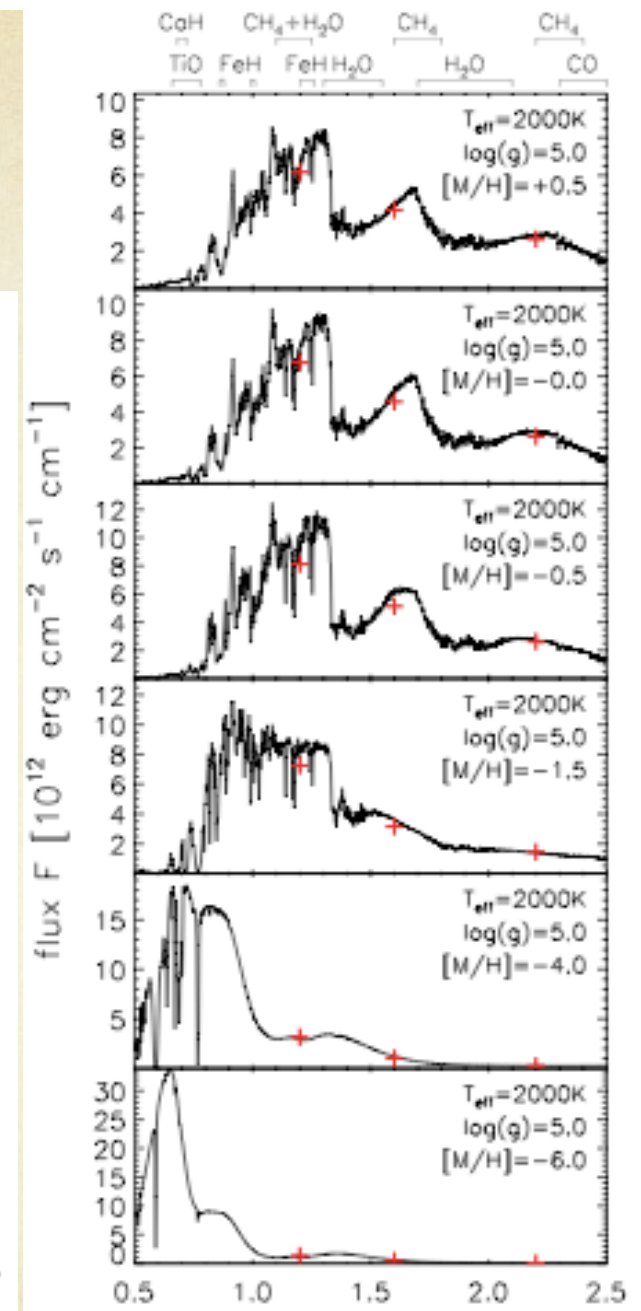
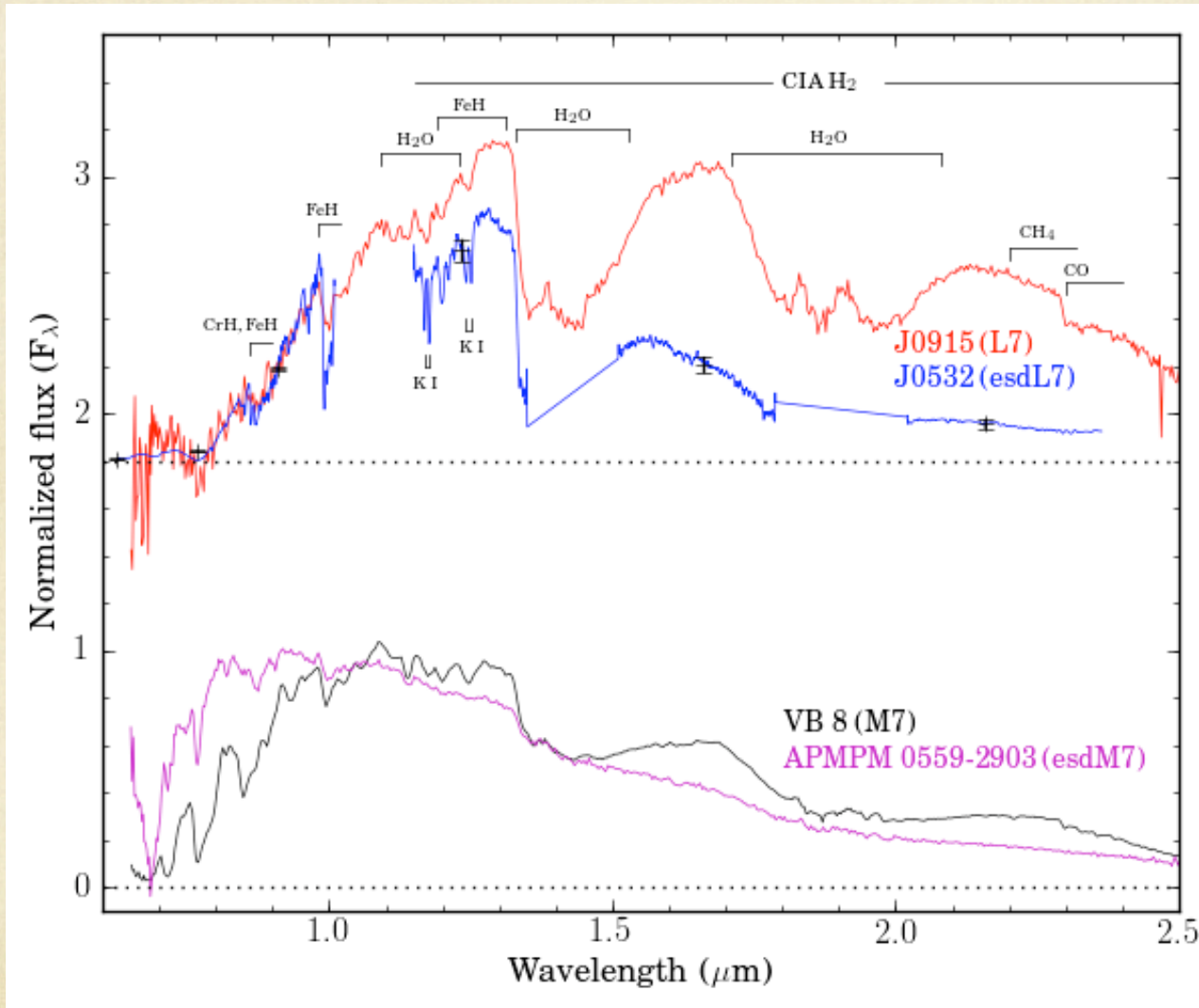
Burgasser et al. 2003; Burgasser 2004; Sivarani et al. 2009;

Cushing et al. 2009; Lodieu et al. 2010, 2012

How metallicity affects spectra?

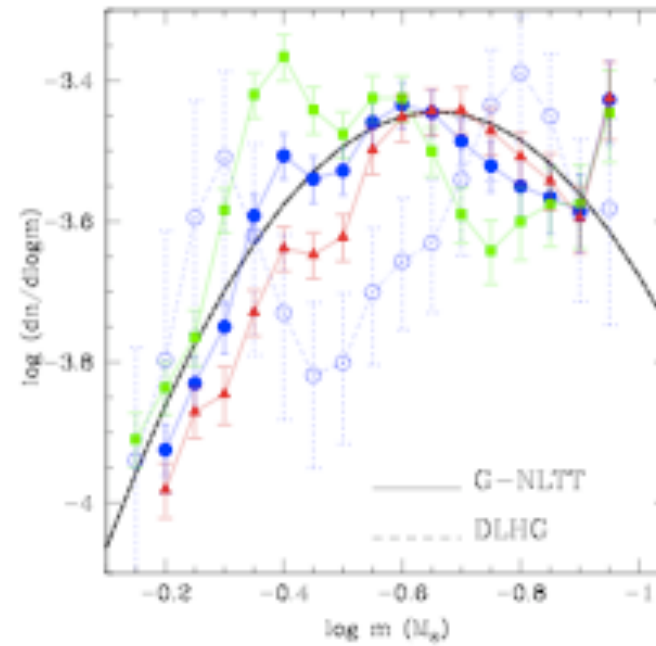
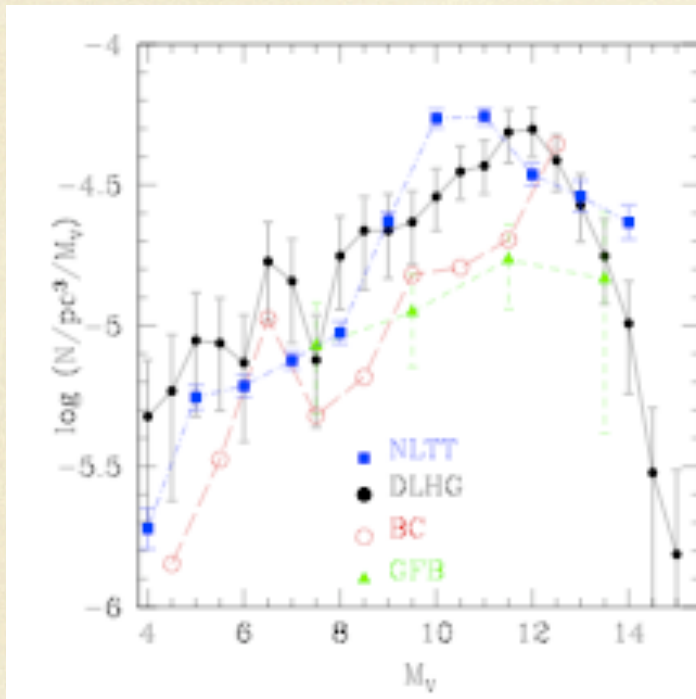
- Strong metal hydrides (e.g. FeH, CaH)
- Weak or absent metal oxides (e.g. CO, TiO, VO)
- Enhanced collision-induced H₂ absorption (CIA)

How metallicity affects spectra?



Witte et al. 2009

Halo mass function



$0.63 > M/M_{\text{sun}} > 0.12, (M5)$

Digby et al. 2003

Gould 2003

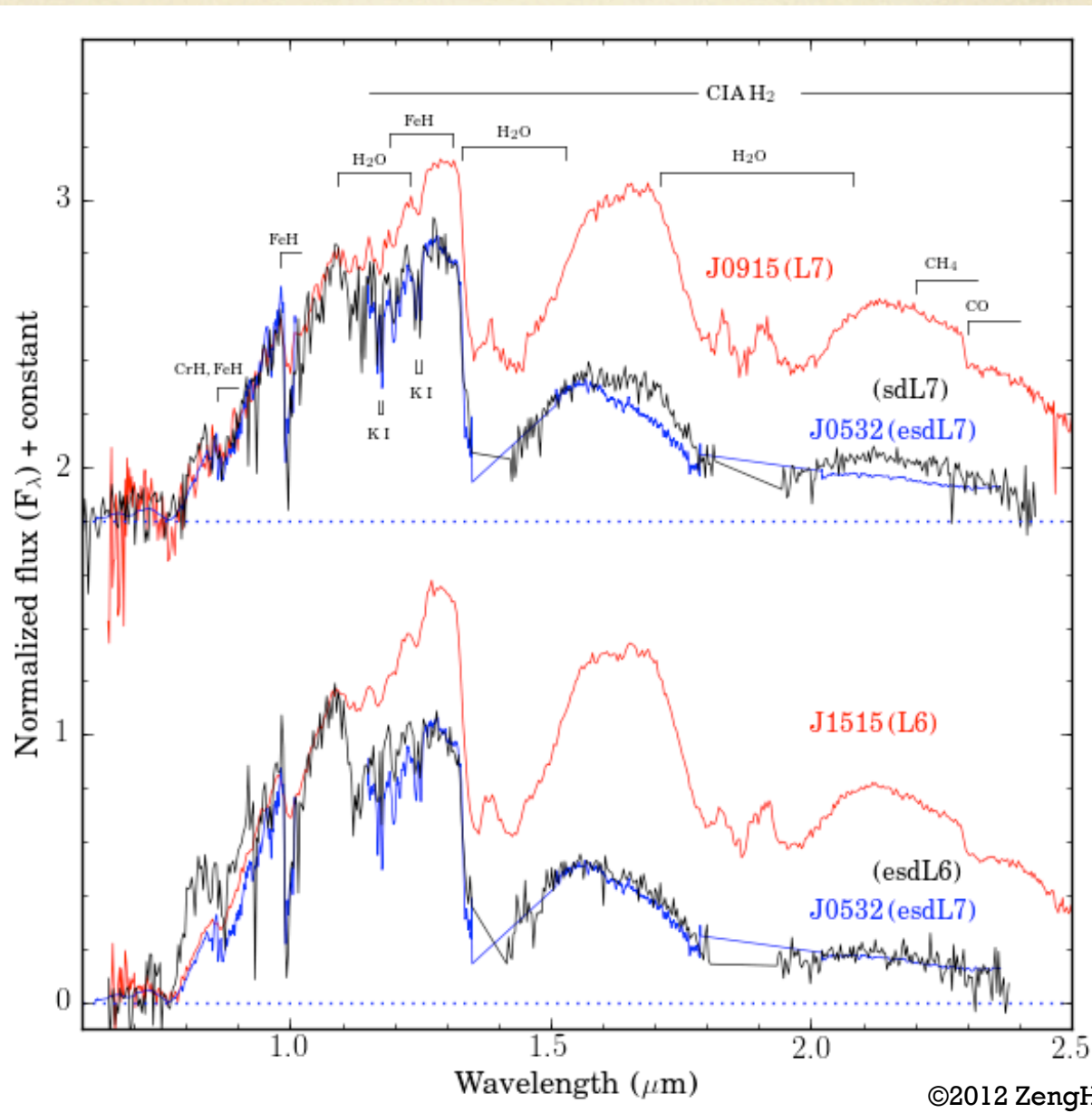
Chabrier 2003

Figure from Chabrier 2003

UKIDSS+SDSS L subdwarf project

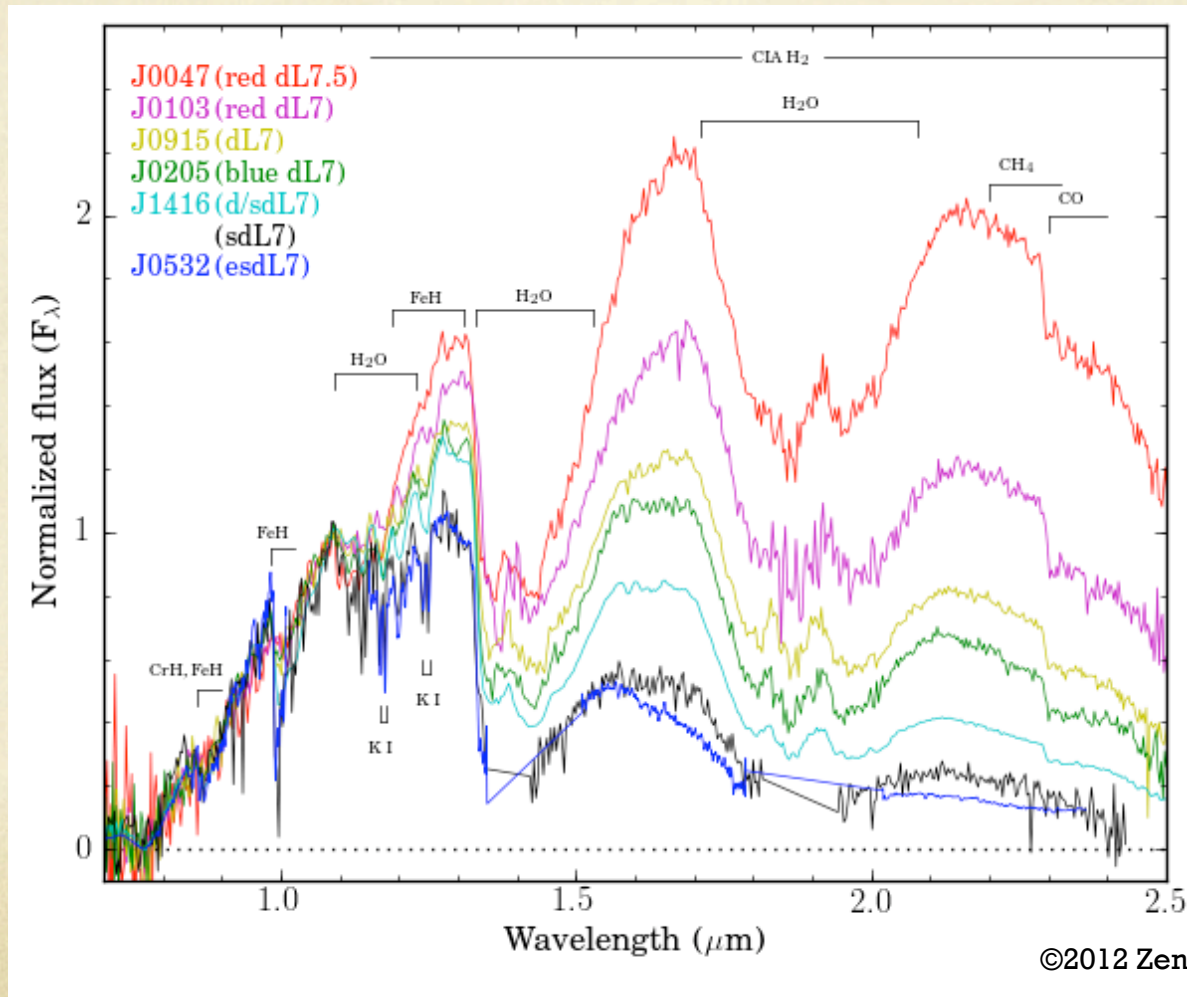
- Selection: colours, proper motions
- Follow up: VLT, Magellan, Gemini, GTC
- Three new L subdwarfs and one independent discovery
- Two targets observed with Magellan
- Following up 22 targets with GTC

New L subdwarfs



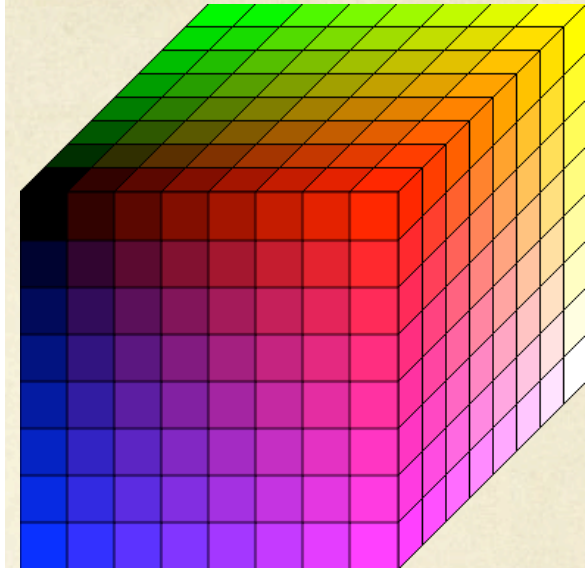
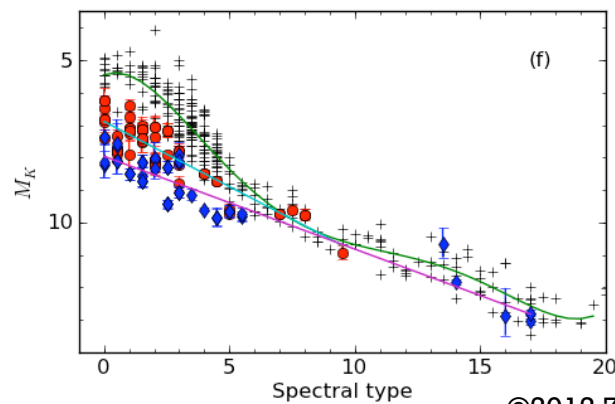
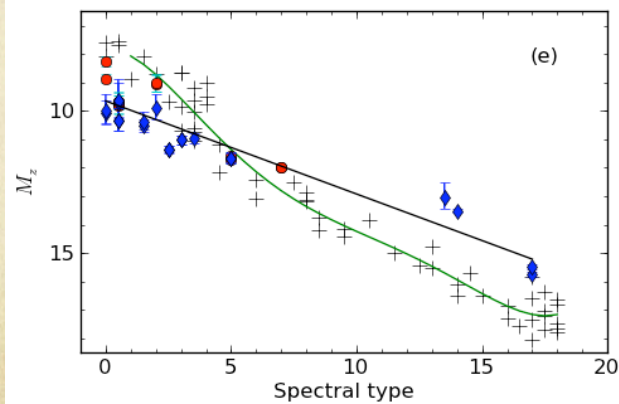
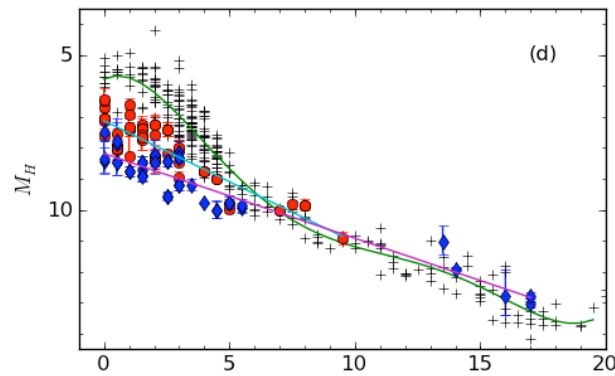
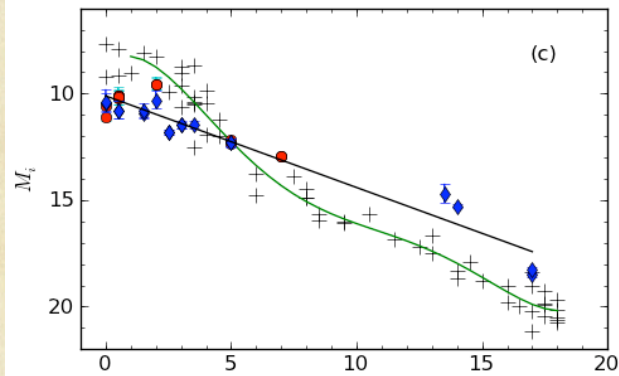
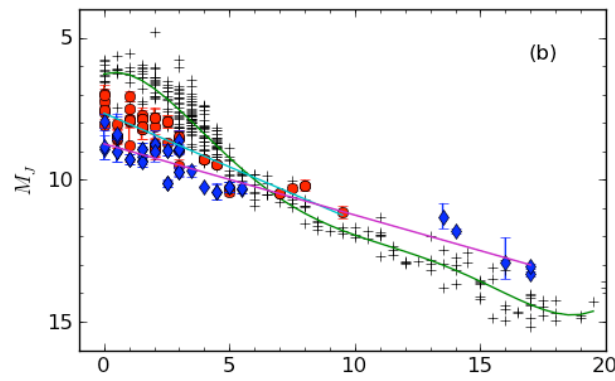
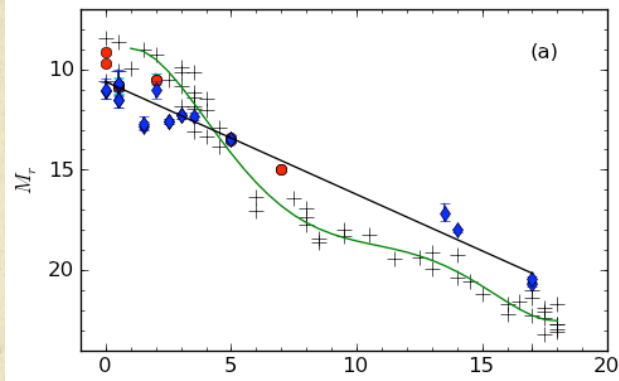
Zhang et al in prep.

L7 metal classes



Zhang et al in prep.

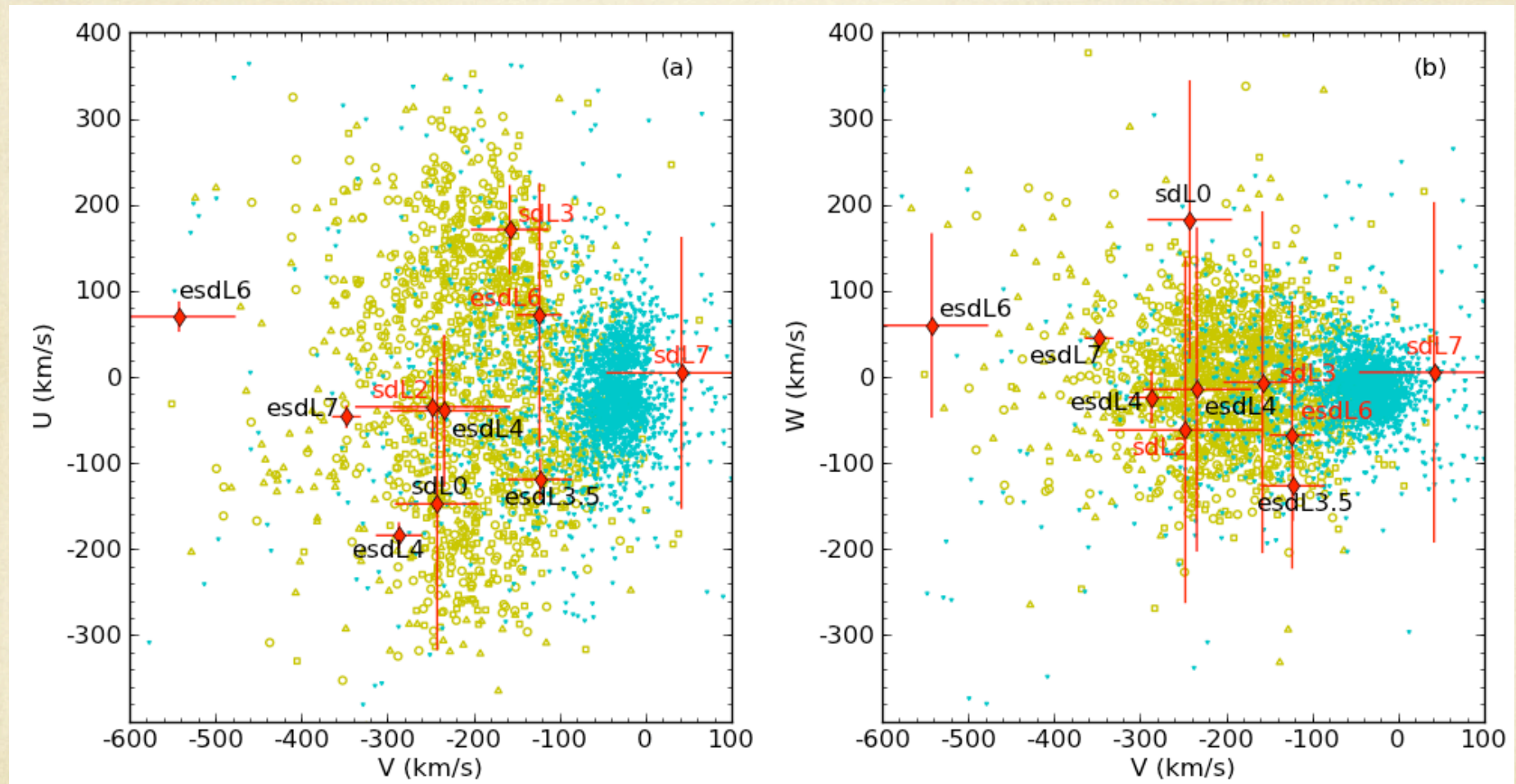
Spectral type - absolute magnitudes



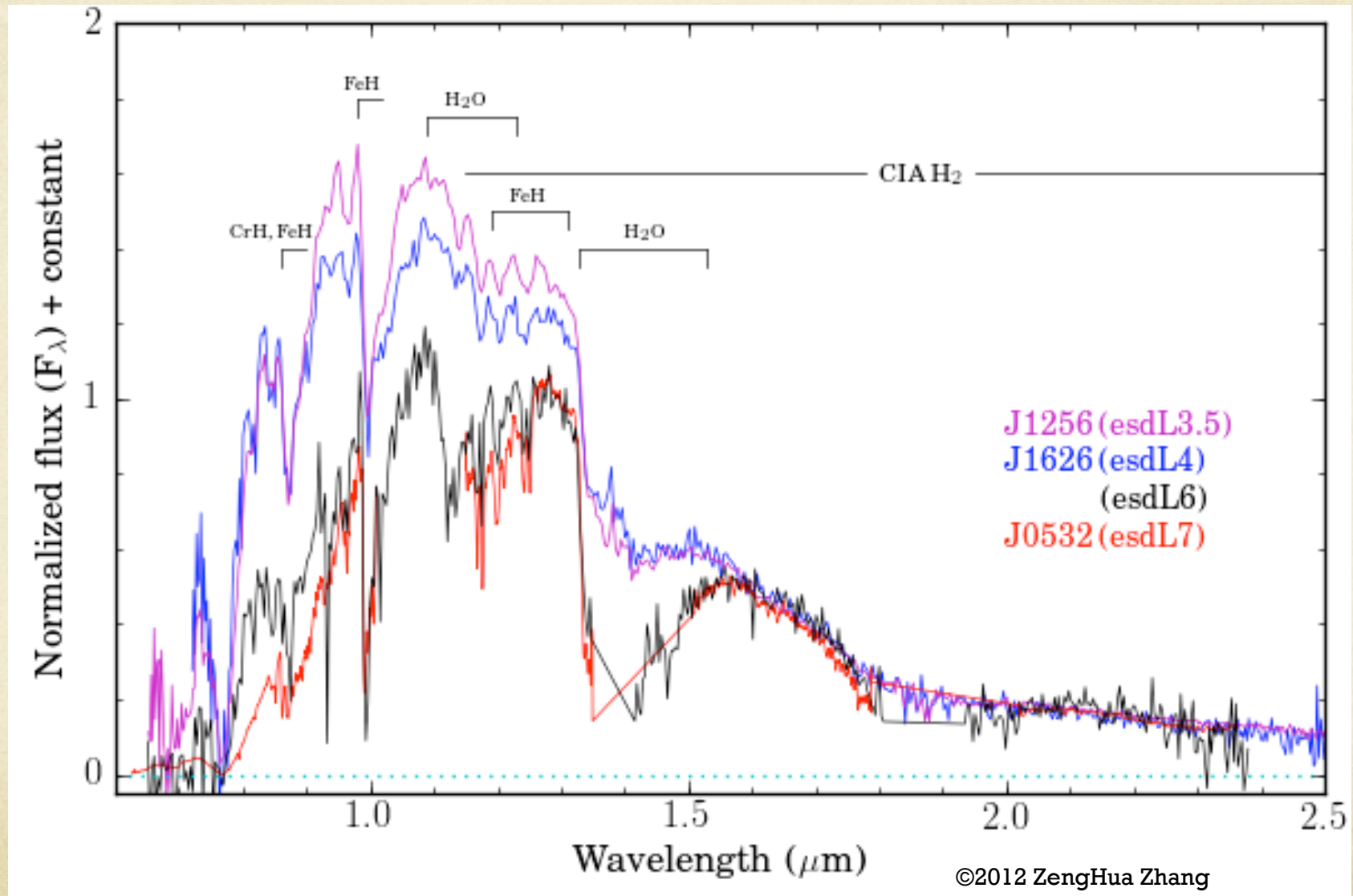
Purple
Dwarfs

Zhang et al. submitted

The Galactic velocities



Halo brown dwarfs



Future work

- Follow up UKIDSS+SDSS targets
- Search for L subdwarfs in VISTA and optical surveys
- Characterization of L purple dwarfs
- Measure the halo substellar MF
- Galactic kinematics with M and L subdwarfs
- Binary search for binaries with common PM, deep imaging, spectroscopic analysis, high resolution imaging
- Calibrating ultracool metal-poor atmospheres with binaries.