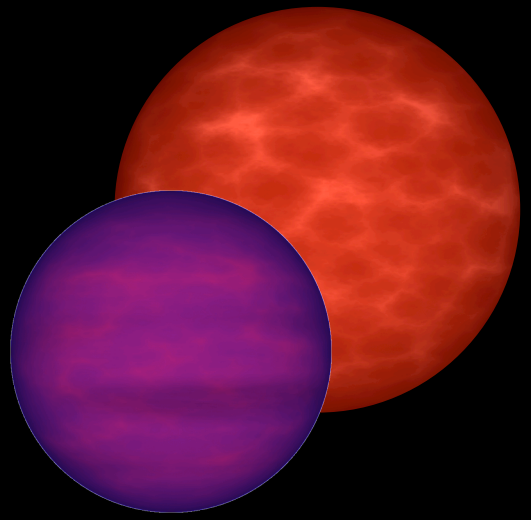

rich dwarf, poor dwarf
red dwarf, blue dwarf
unraveling the
physical properties of
substellar objects
Adam J. Burgasser (MIT)

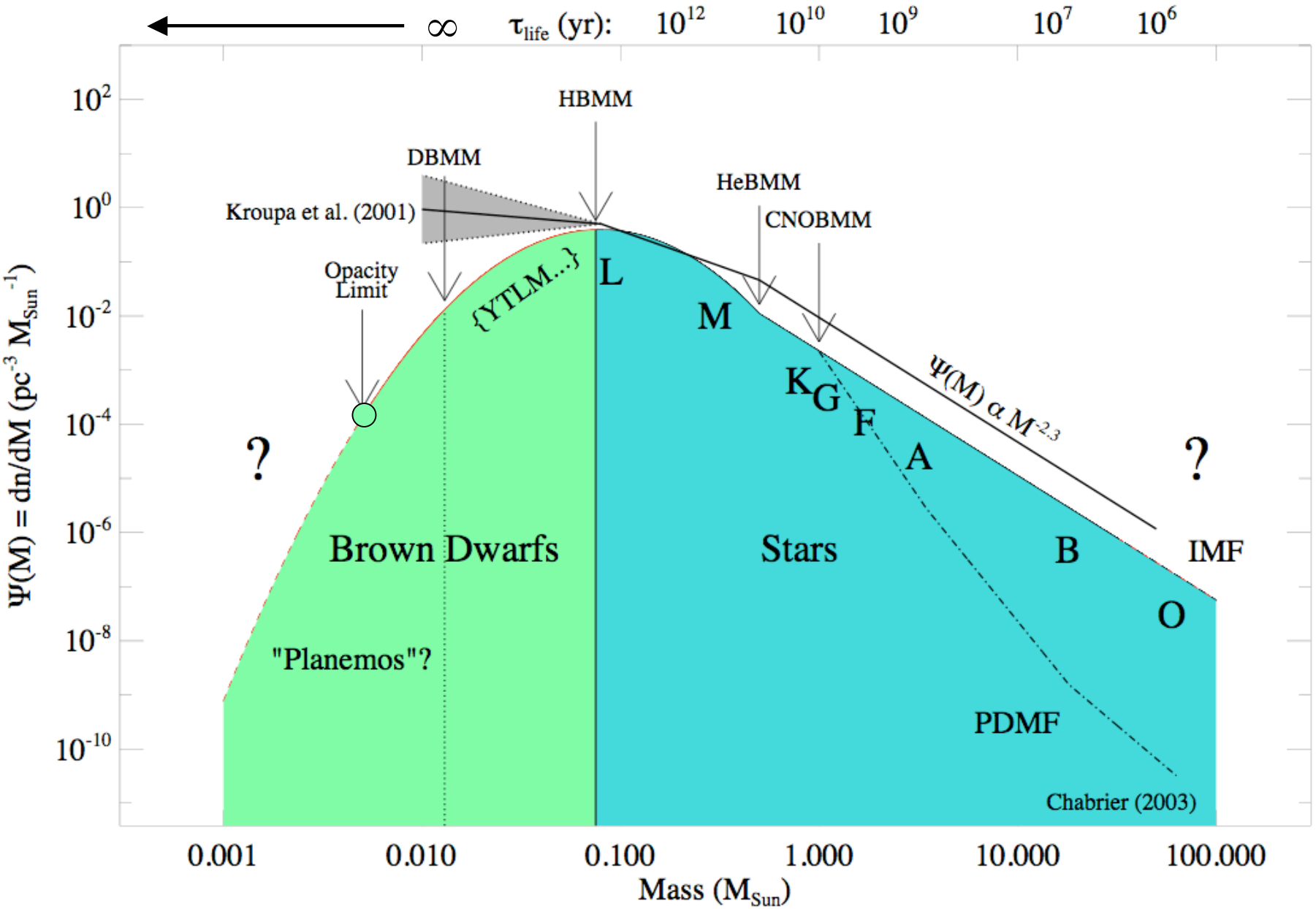


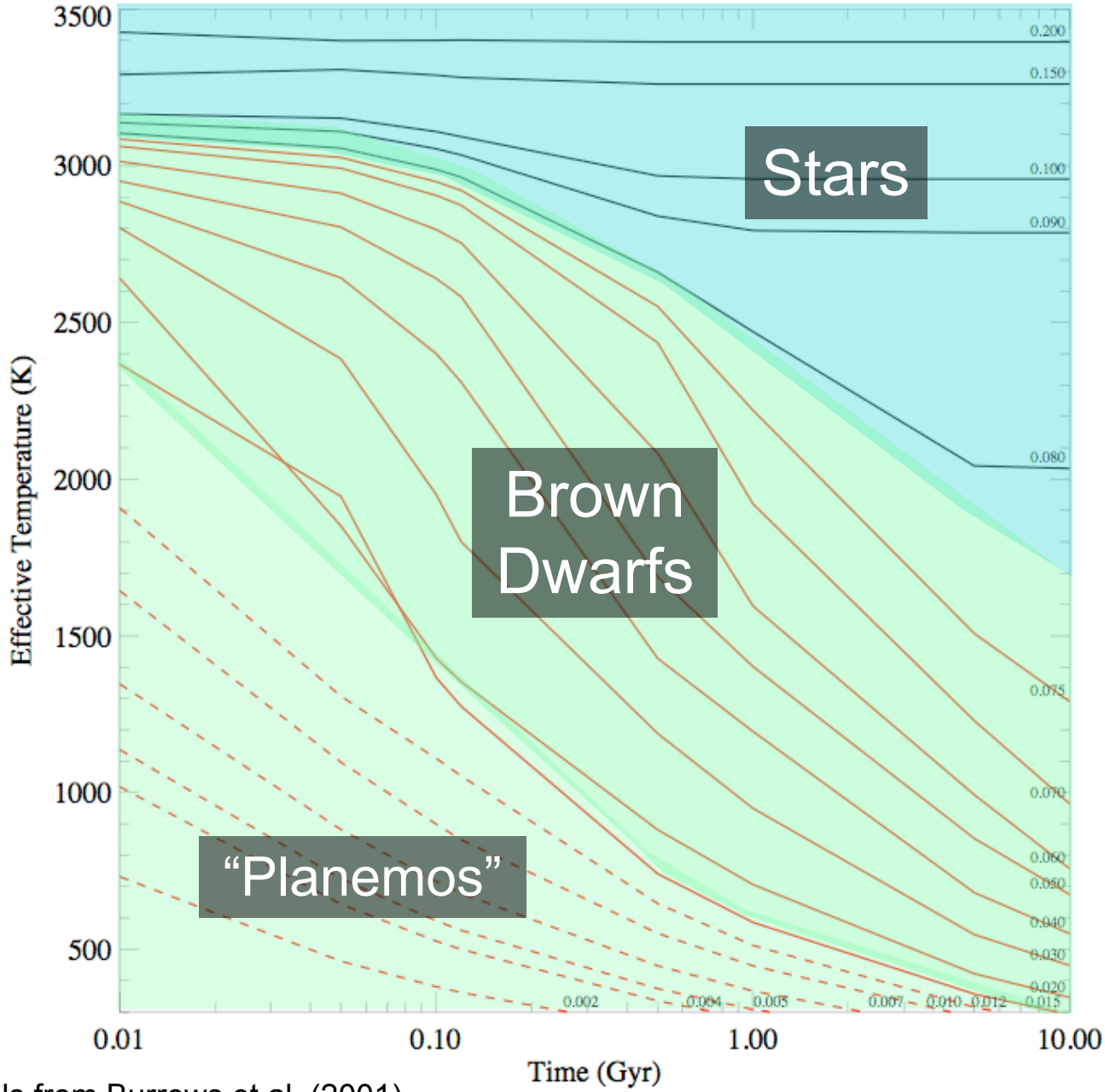
this is a talk about the very lowest-mass stars and brown dwarfs*

red dwarfs =
- metal-rich
- young
- cloudy
- low surface gravity

blue dwarfs =
- metal-poor
- old
- thin clouds
- high surface gravity

*"isolated" *(star-like)* objects with cool *(planetary-like)* atmospheres

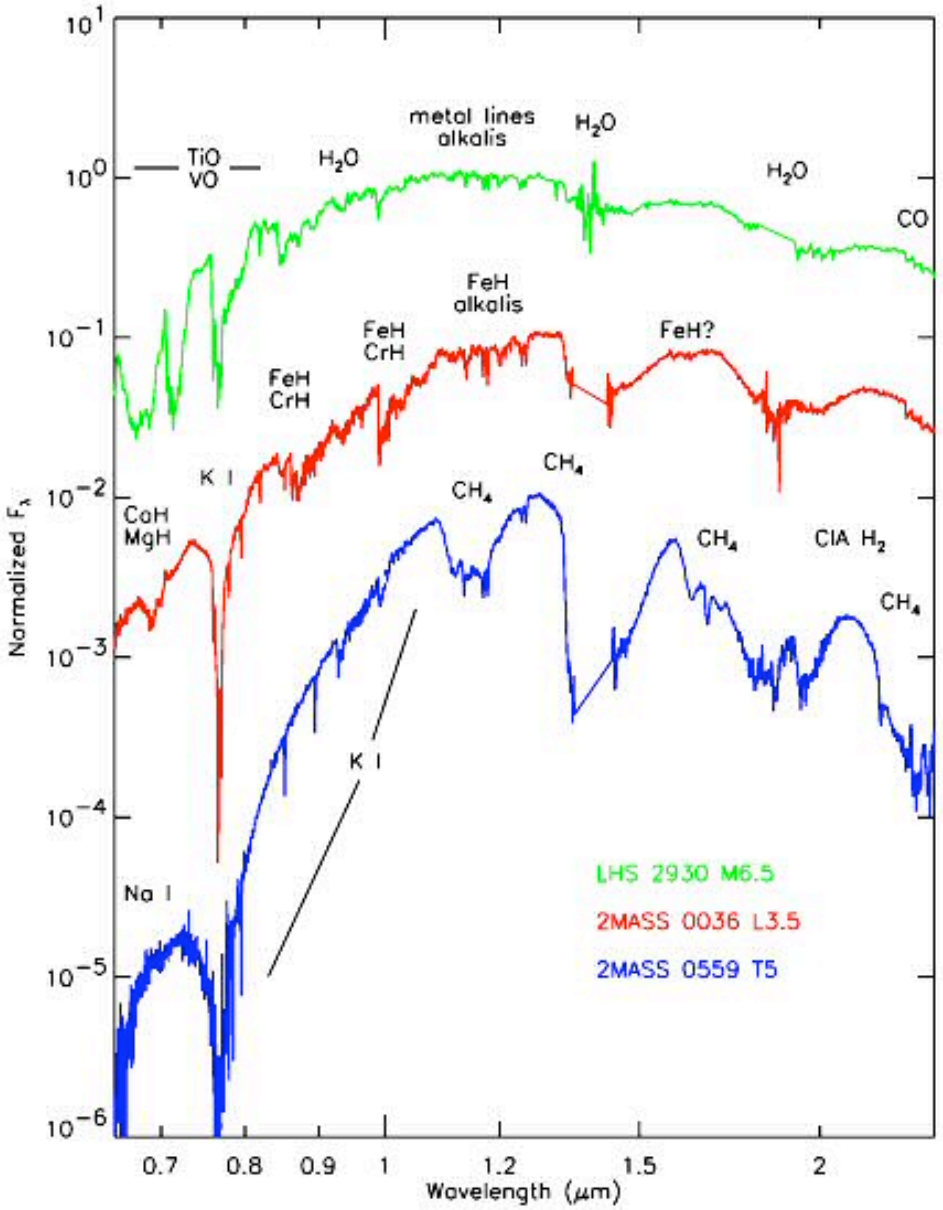




sustained H-burning

insufficient H-burning

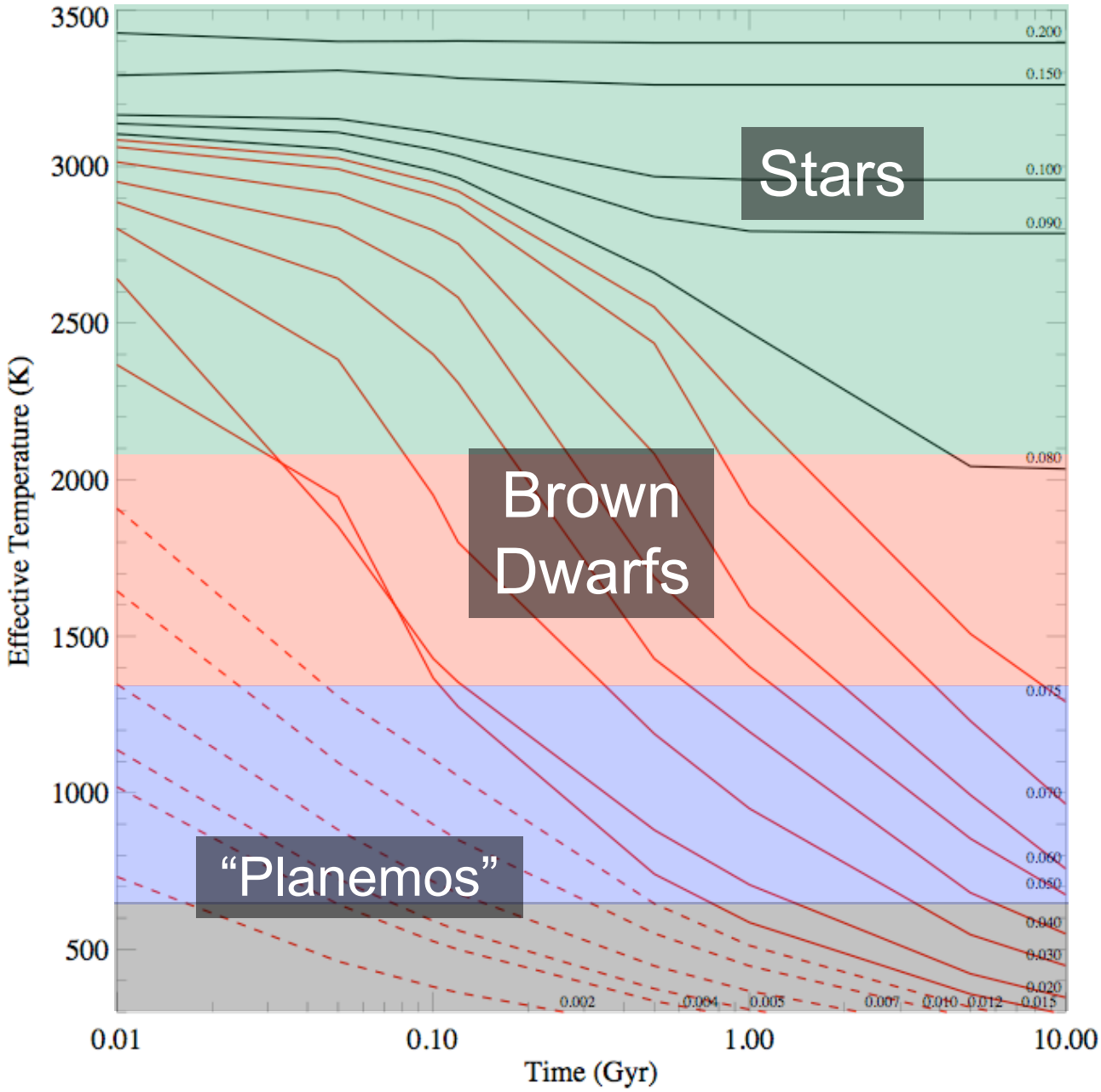
models from Burrows et al. (2001)



M dwarfs are dominated by TiO, VO, H_2O, CO absorption plus metal/alkali lines.

L dwarfs replace oxides with hydrides (FeH, CrH, MgH, CaH), alkalis are prominent, condensate clouds.

T dwarfs exhibit strong CH_4 and H_2O and extremely broadened Na I and K I.



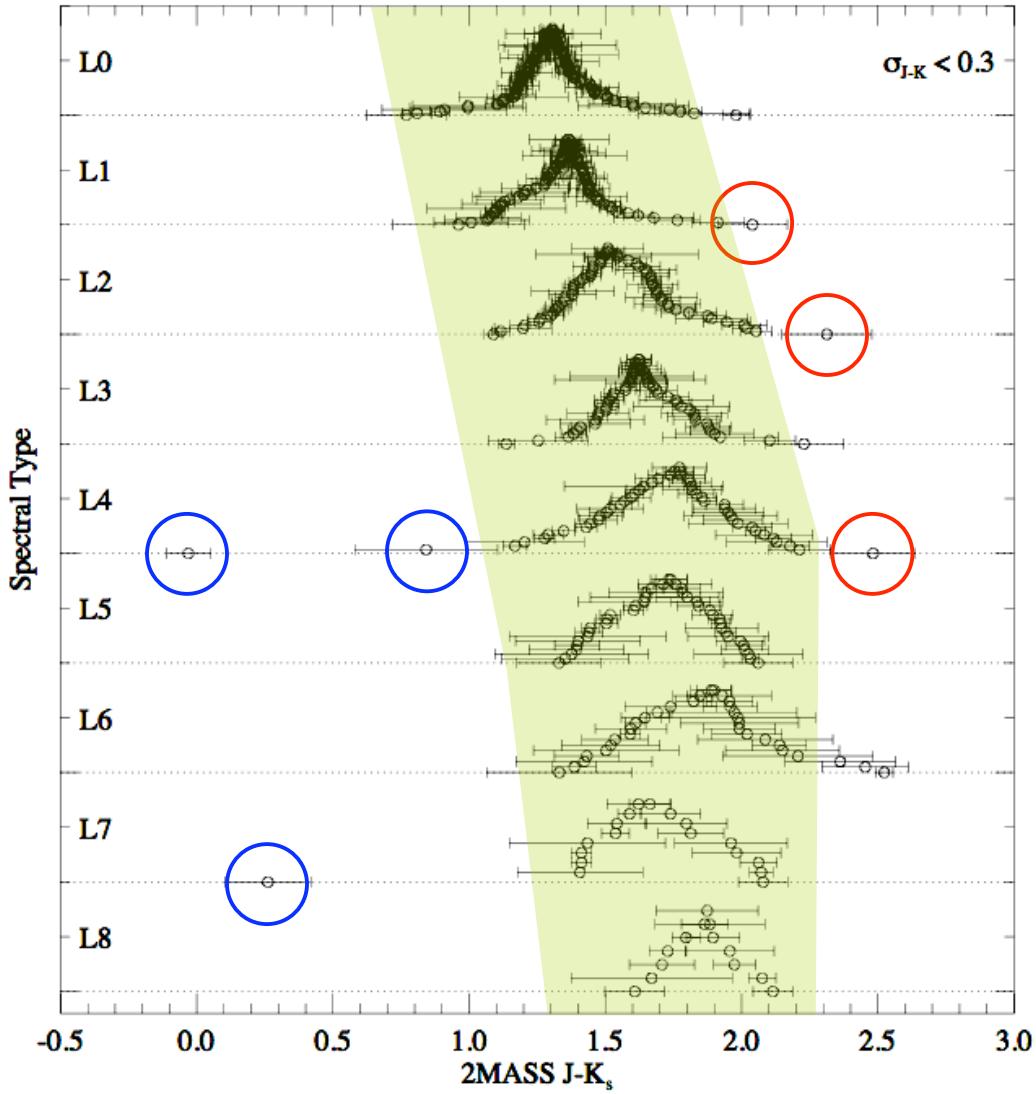
M dwarfs

L dwarfs

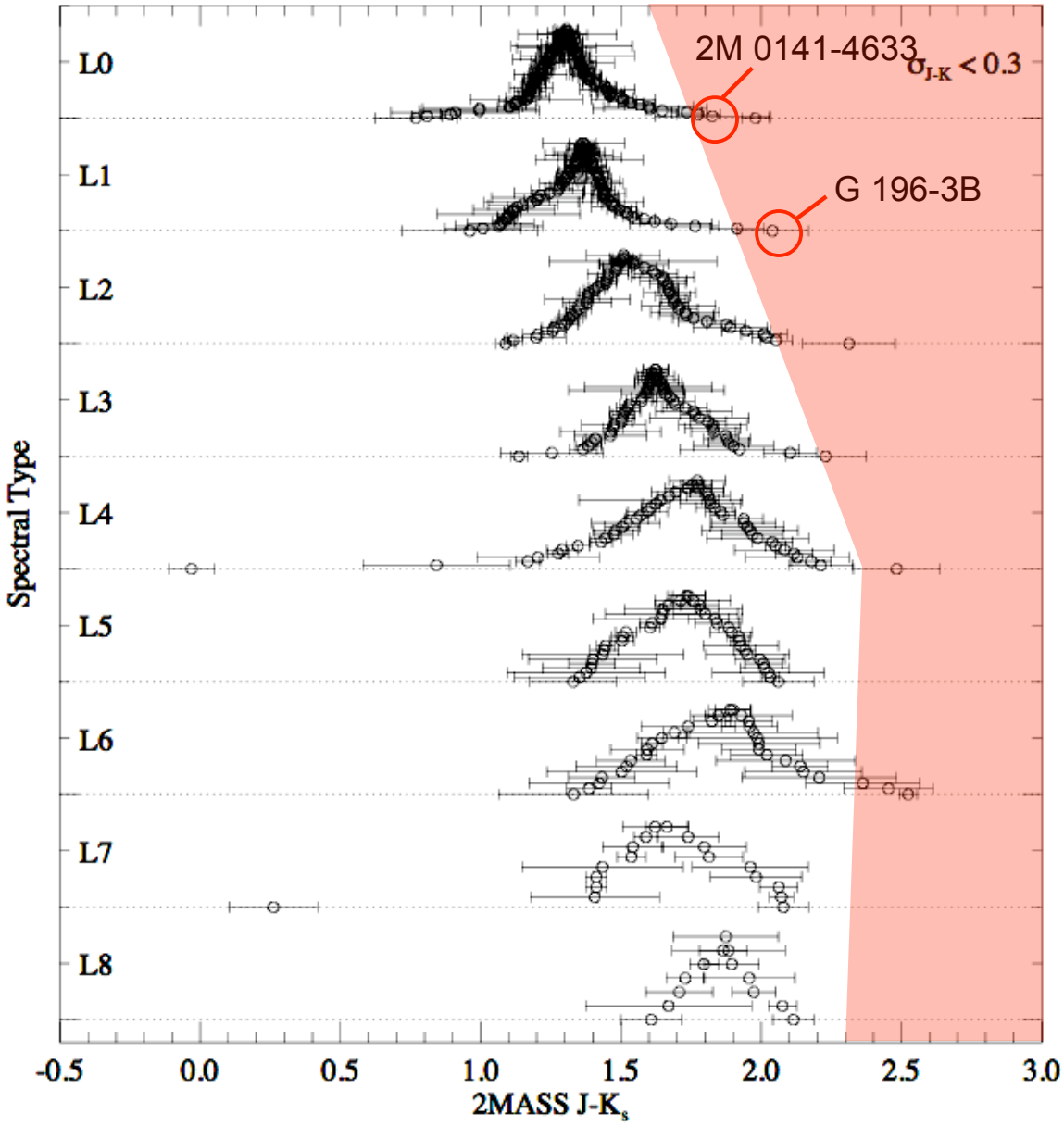
T dwarfs

Y dwarfs?

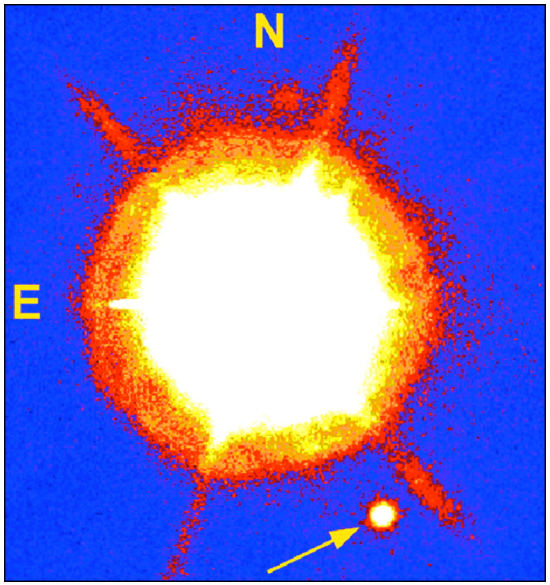
the “shrimp plot”



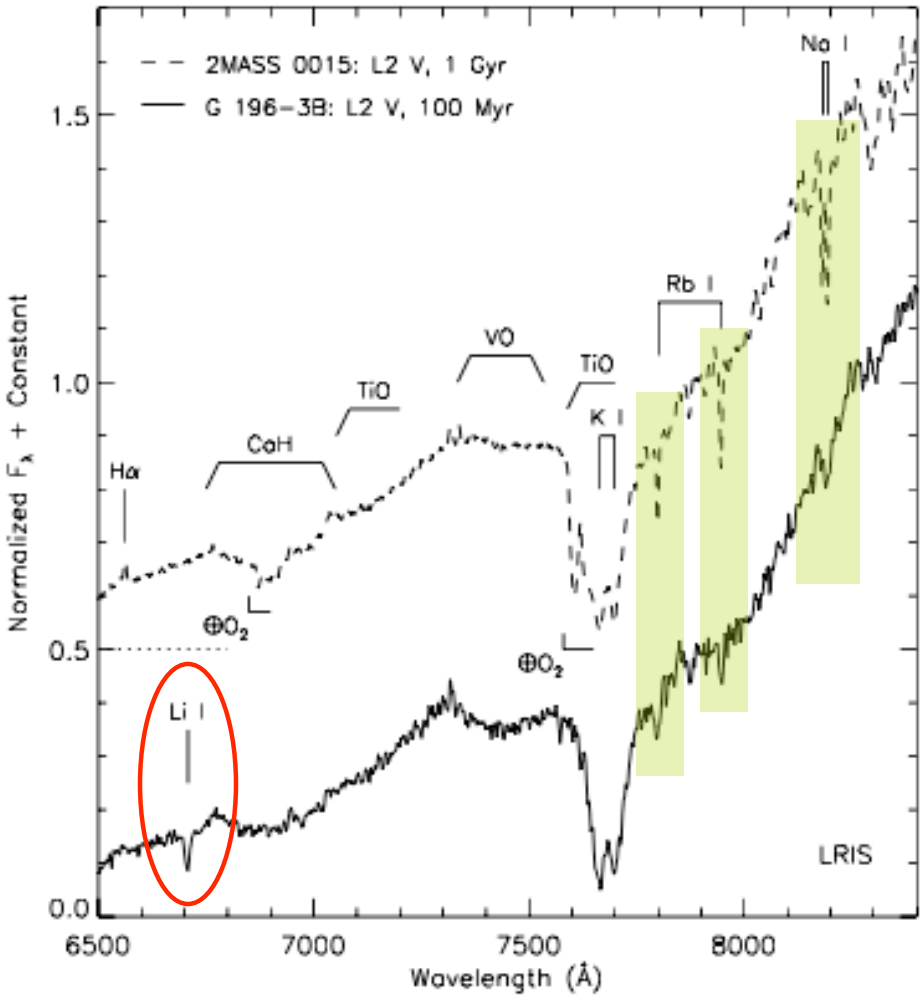
Kirkpatrick et al. (in prep.)



red dwarfs are young dwarfs

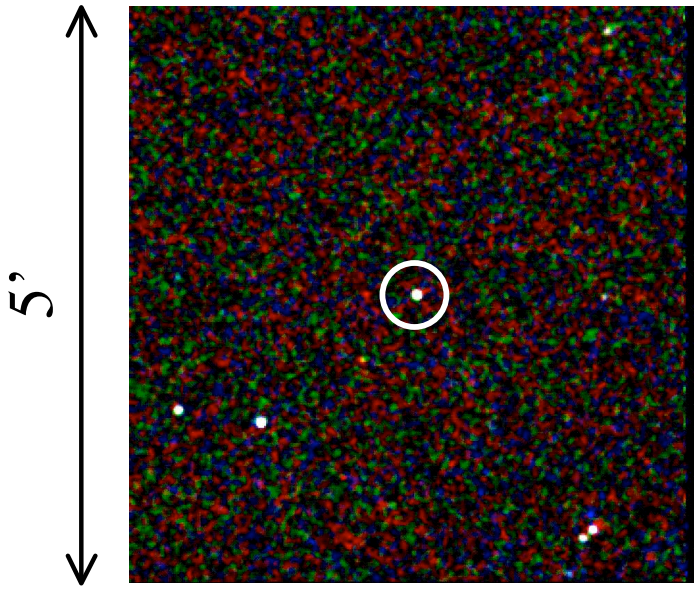


G 196-3B
companion to
~30-300 Myr
G 196-3A



Rebolo et al. (1998); Kirkpatrick et al. (in prep.)
See also Martin et al. (1999); Gorlova et al. (2003); Luhman et al. (2003); Allers et al. (2007)

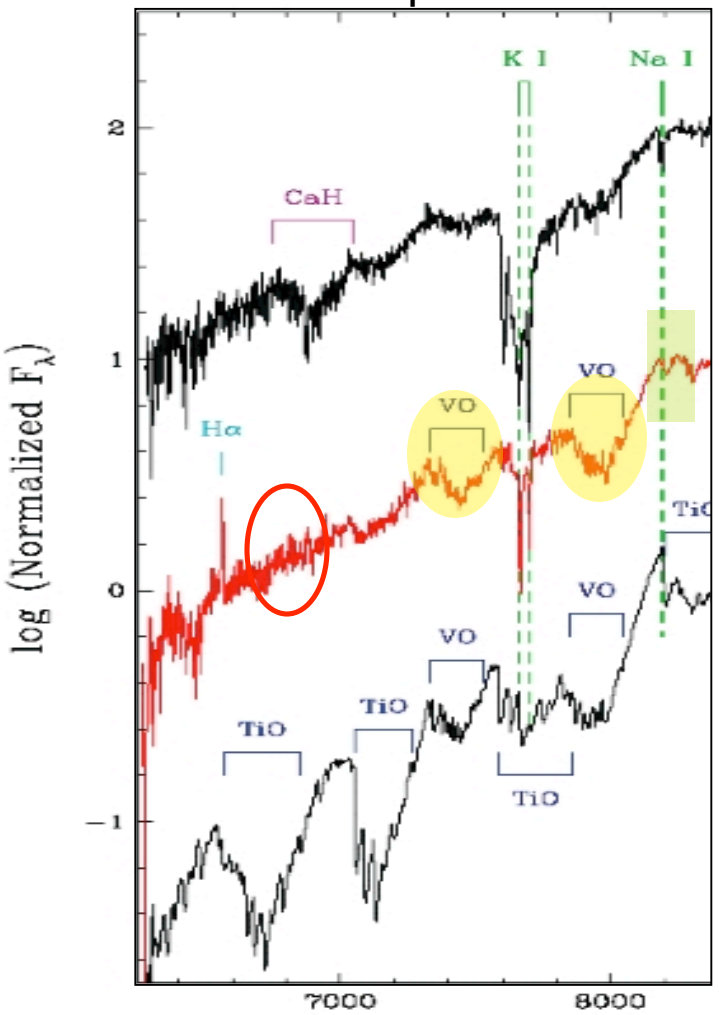
red dwarfs are young dwarfs



2MASS 0141-4633

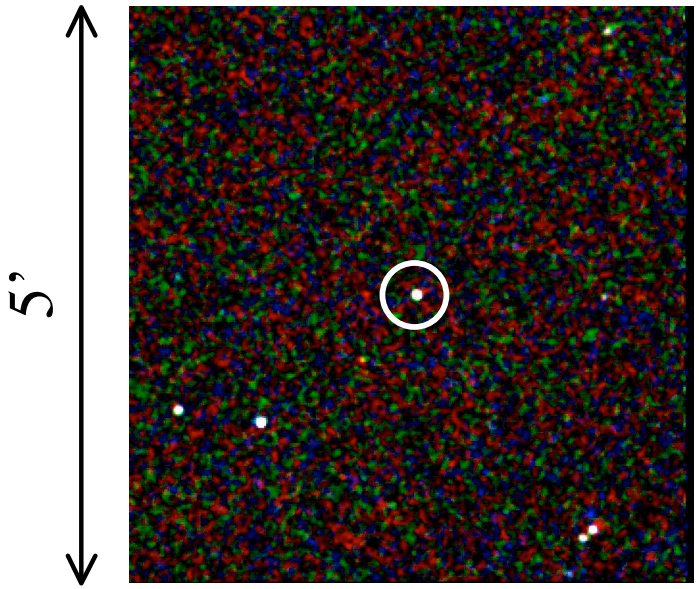
possible member of
Tucana/Horologium
moving association
~30 Myr, 6-25 $M_{Jupiter}$

red optical



Kirkpatrick et al. (2006)

red dwarfs are young dwarfs



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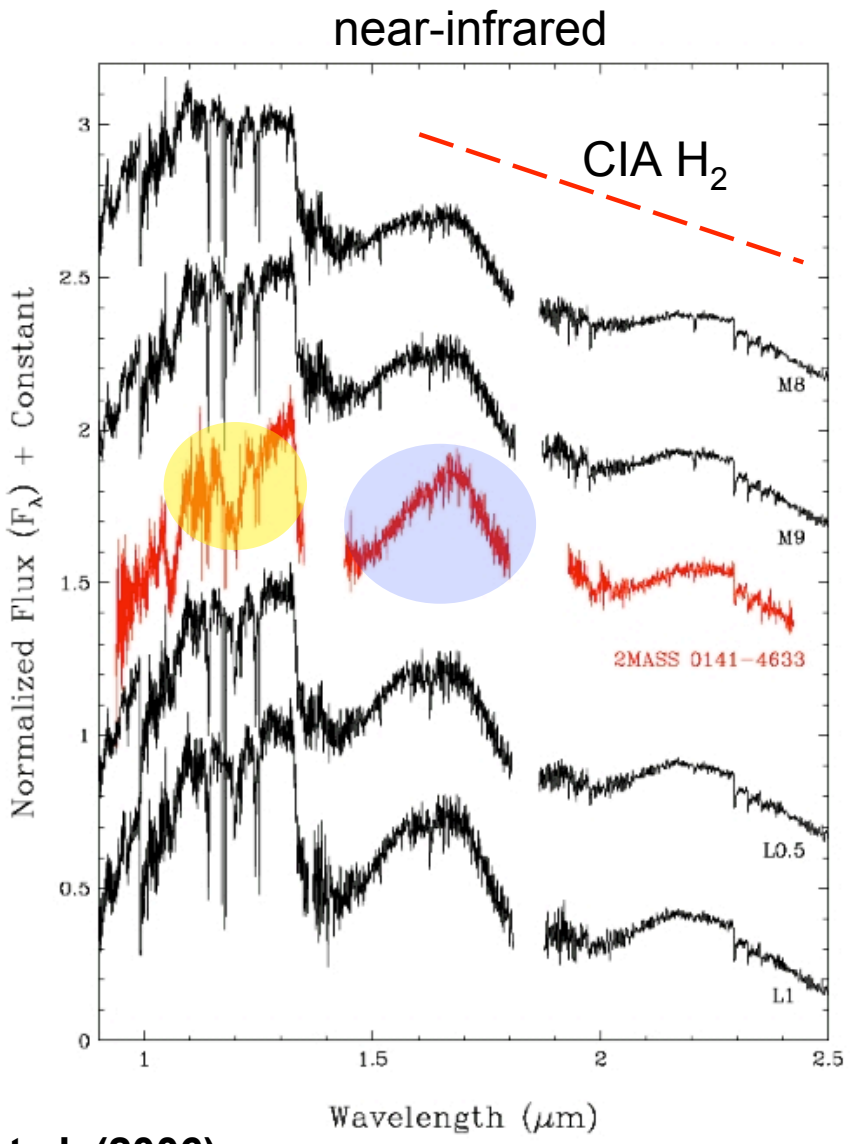
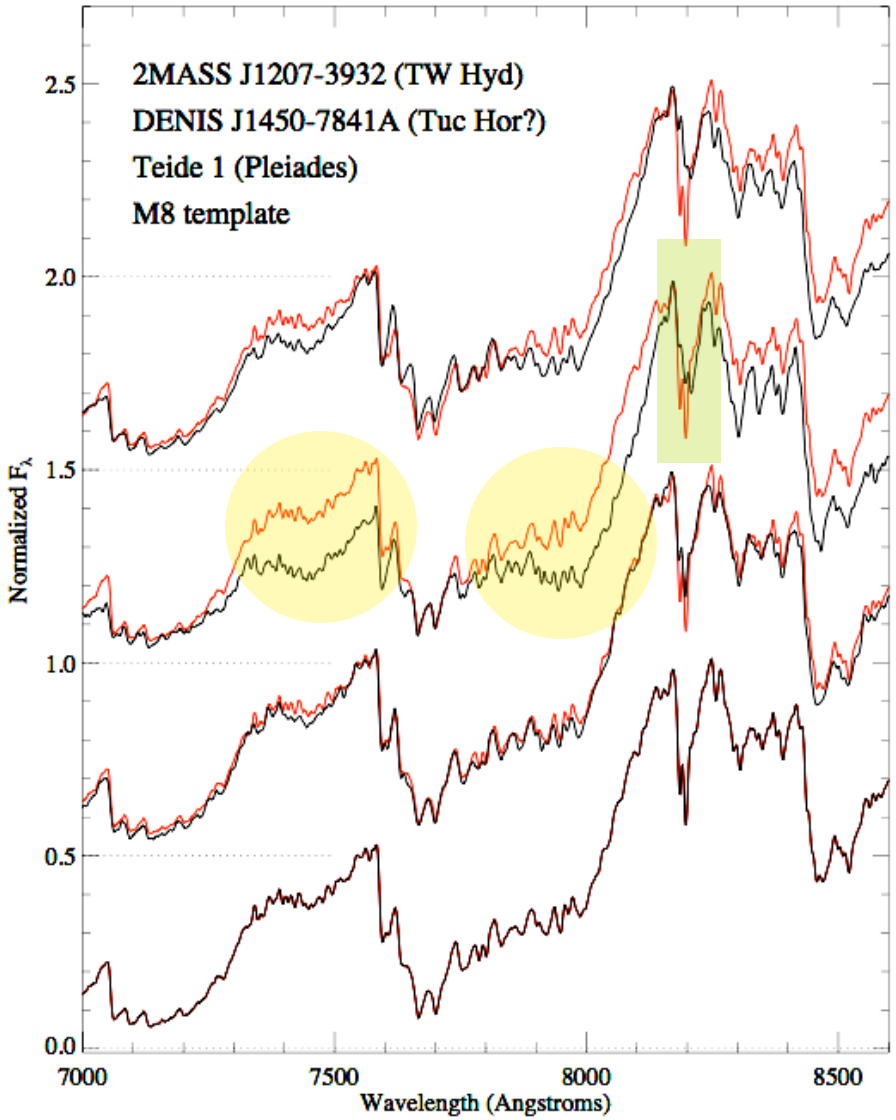
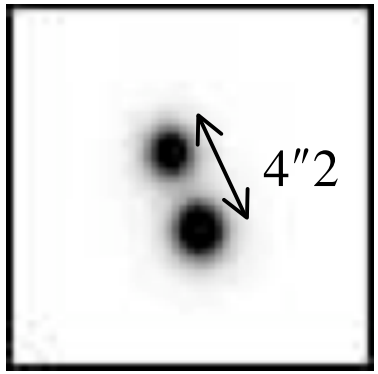


Kirkpatrick et al. (2006)





DENIS 1450-78AB

Young M8/M9 binary

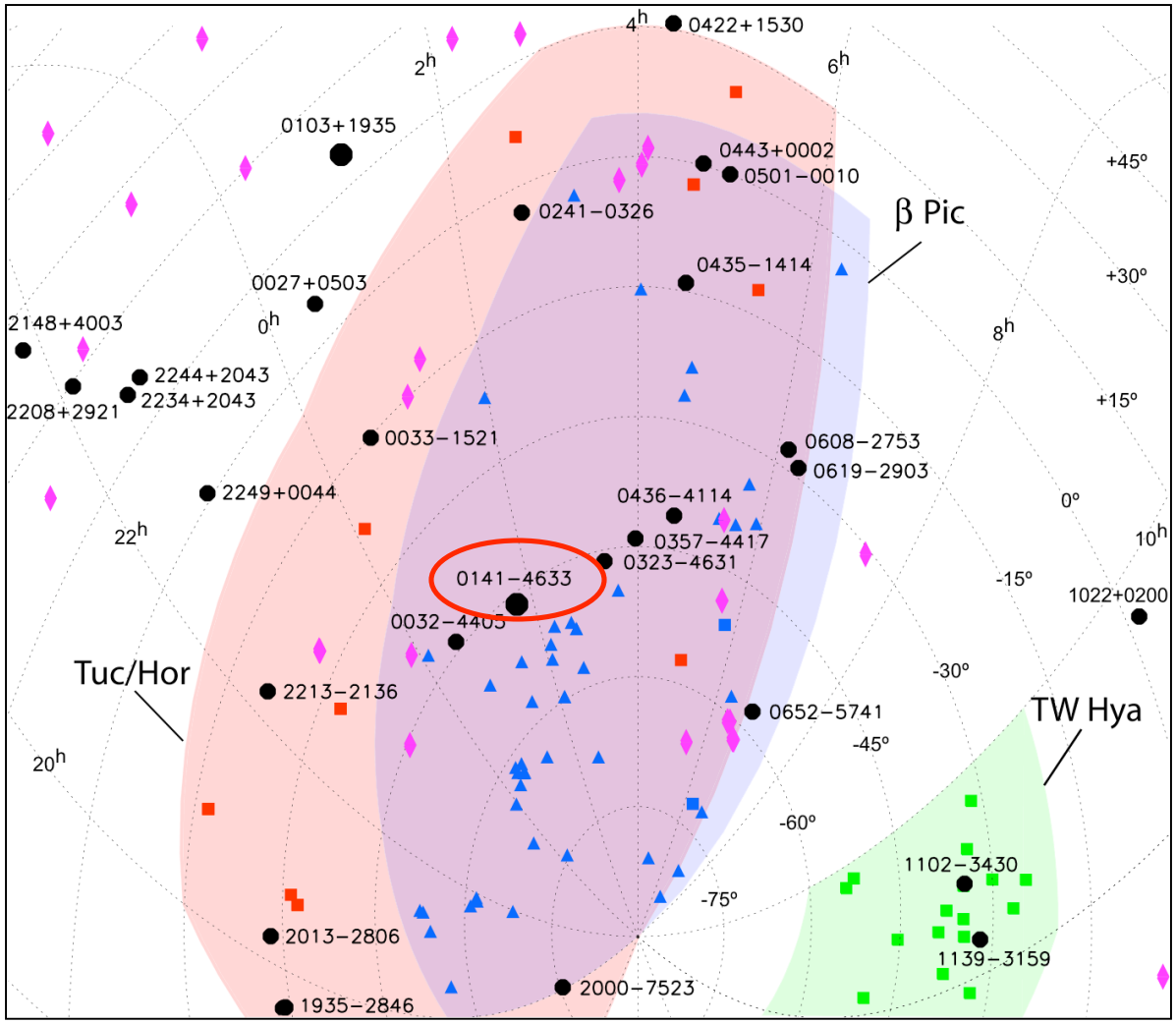
Tucana/Hor? Cha II?

Discovered with LDSS-3

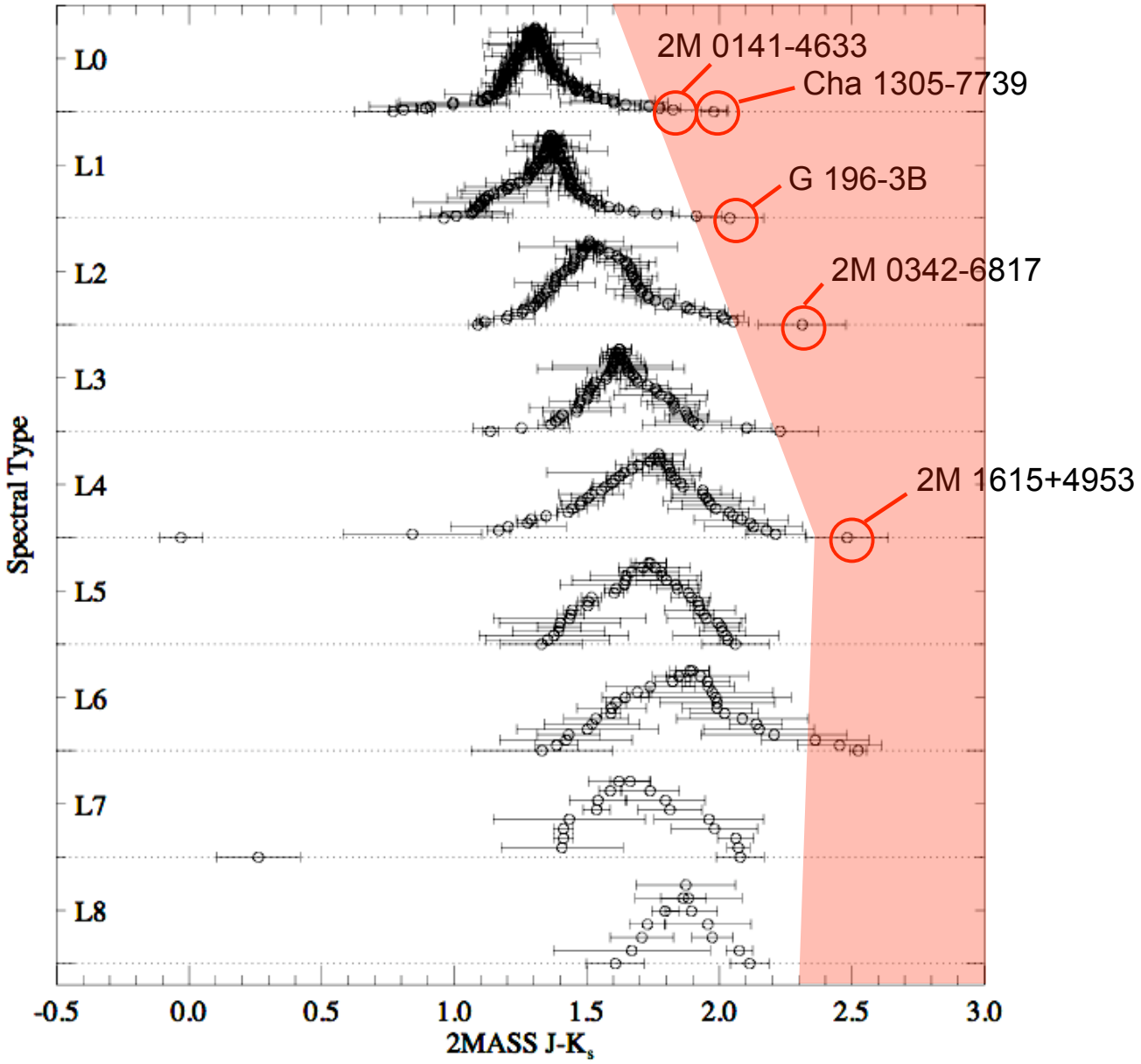
Burgasser et al. (in prep.)

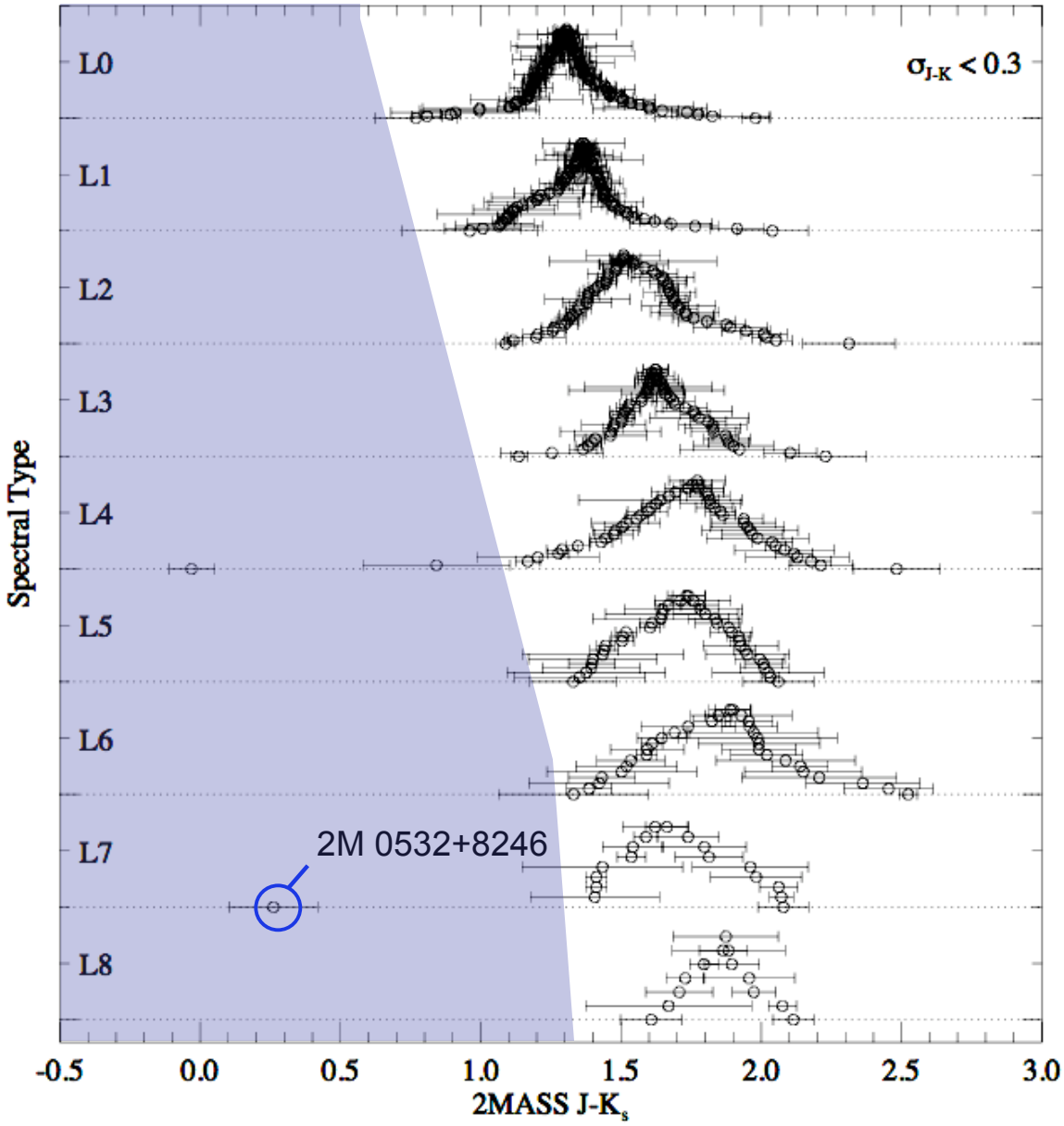
see also Luhman (2004)

10-50 Myr brown dwarfs < 100 pc from the Sun

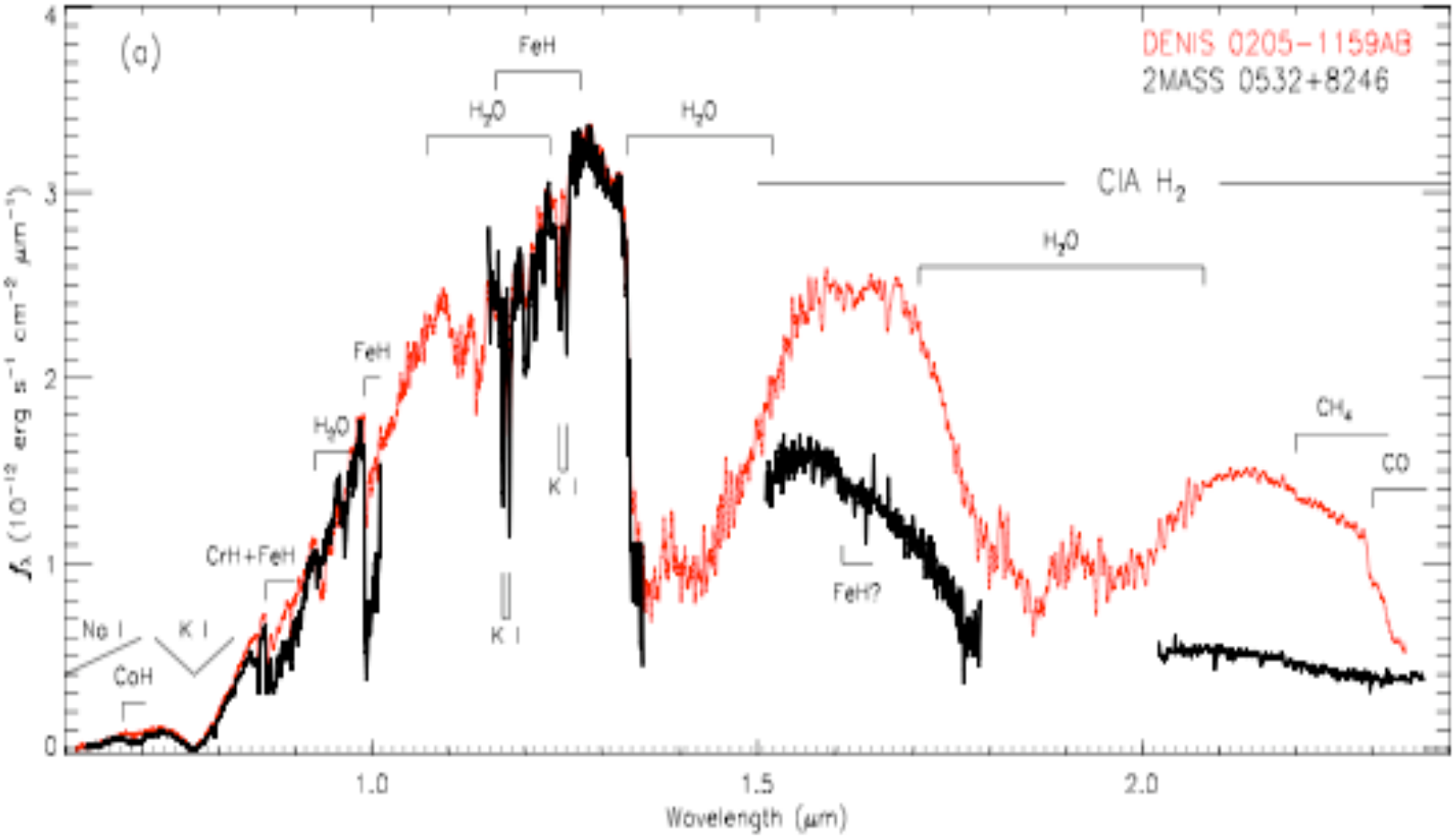


Cruz et al. (2007)
see also Zuckerman & Song (2004); Lopez-Santiago et al. (2006); Torres et al. (2006)





very blue dwarfs are metal-poor dwarfs

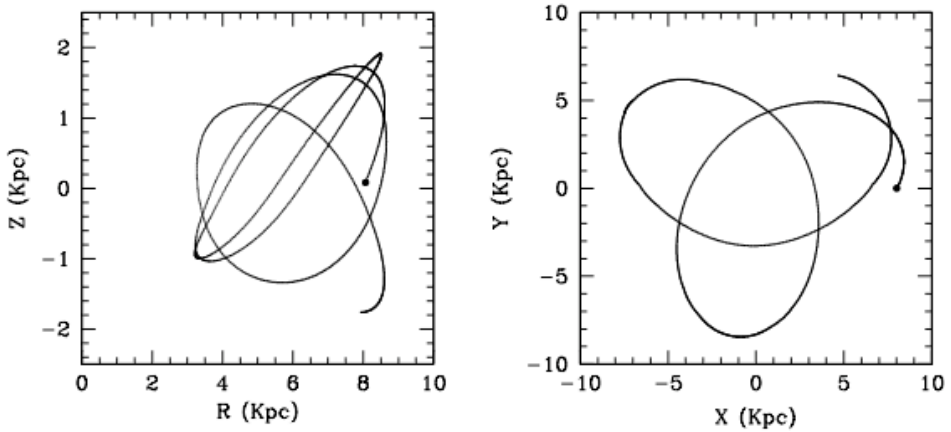


Burgasser et al. (2003)

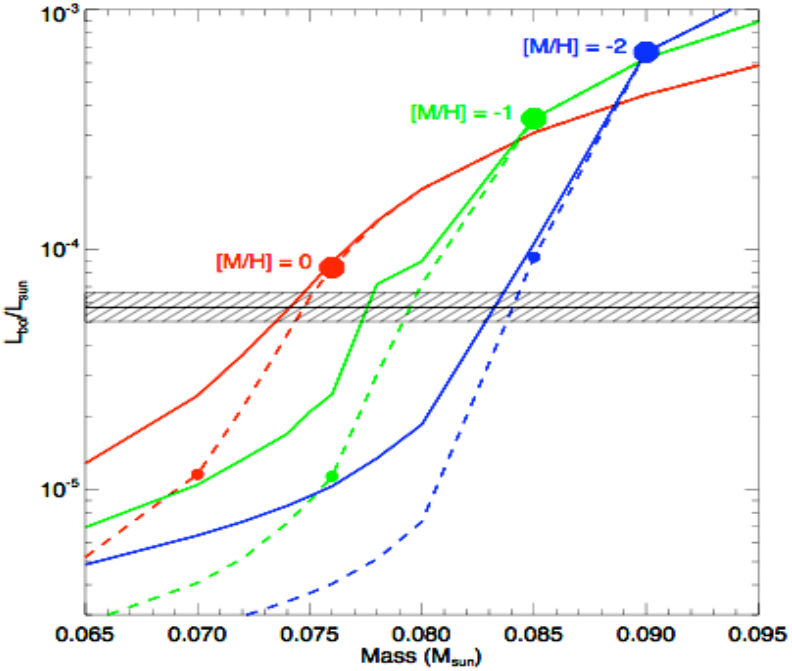
2MASS 0532+8246

J-K = 0.17±0.07 (>1.5 mag too blue)
halo kinematics (V = -350 km/s)

galactic orbit



mass/metallicity constraints



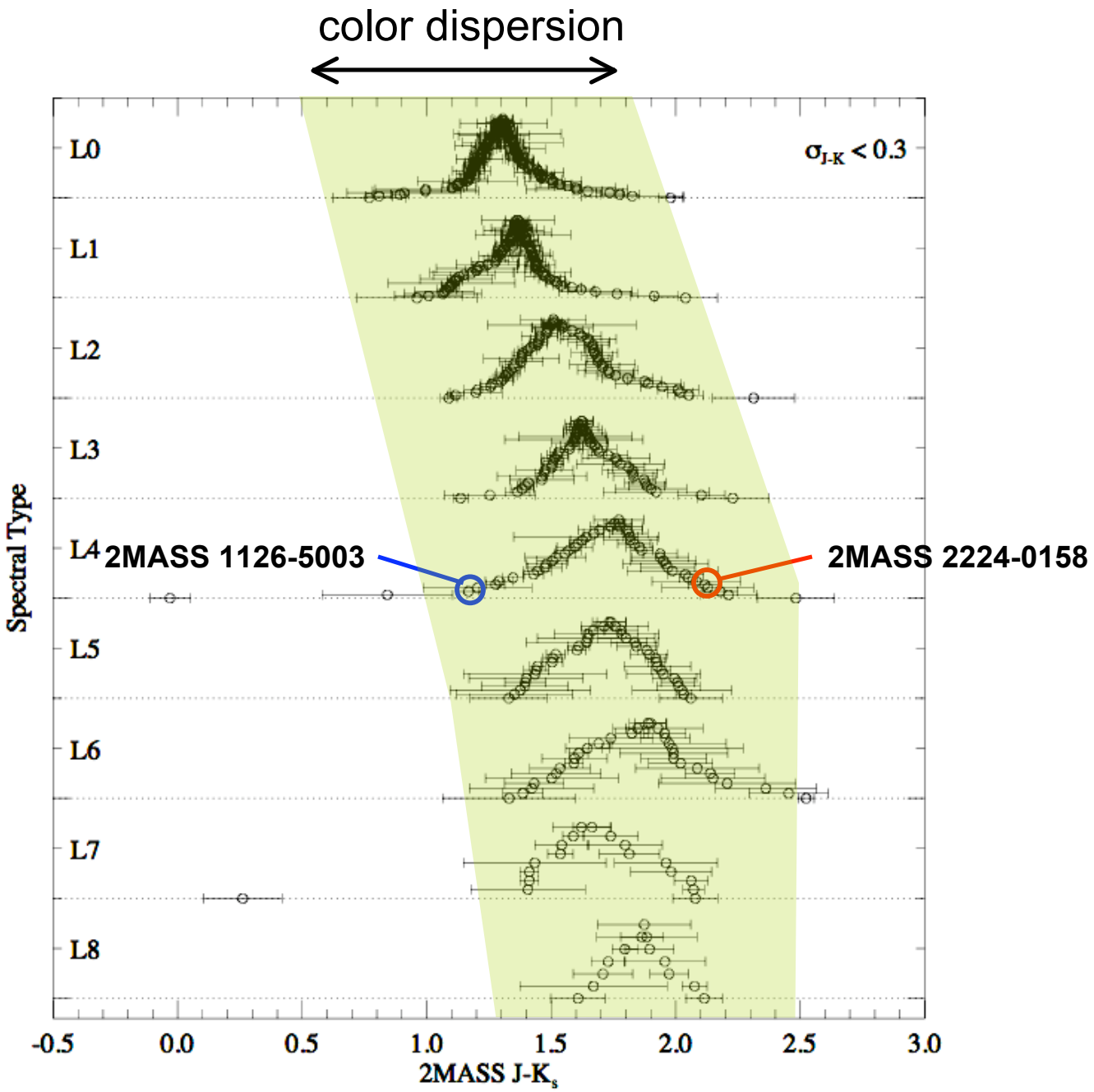
Burgasser et al. (2008)

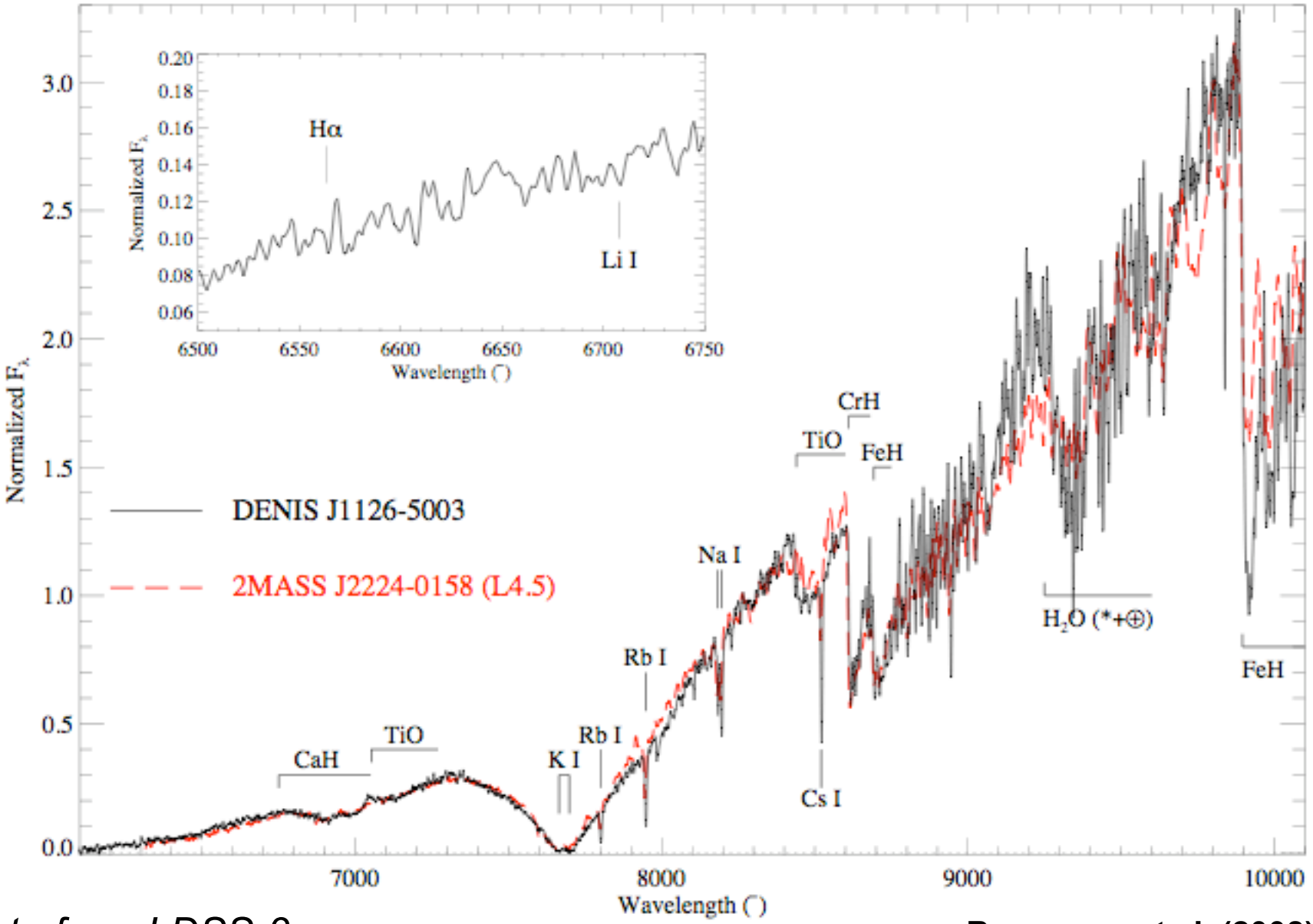
2MASS 0532+82 is a **halo L-type (sdL) brown dwarf**

4 sdLs identified to date:

Name	SpT	J-K_s
SD 1256-02	sdL3	<0.7
2M 1626+39	sdL4	-0.03
★ 2M 0616-64	sdL6	<-0.1
2M 0532+82	sdL7	0.26

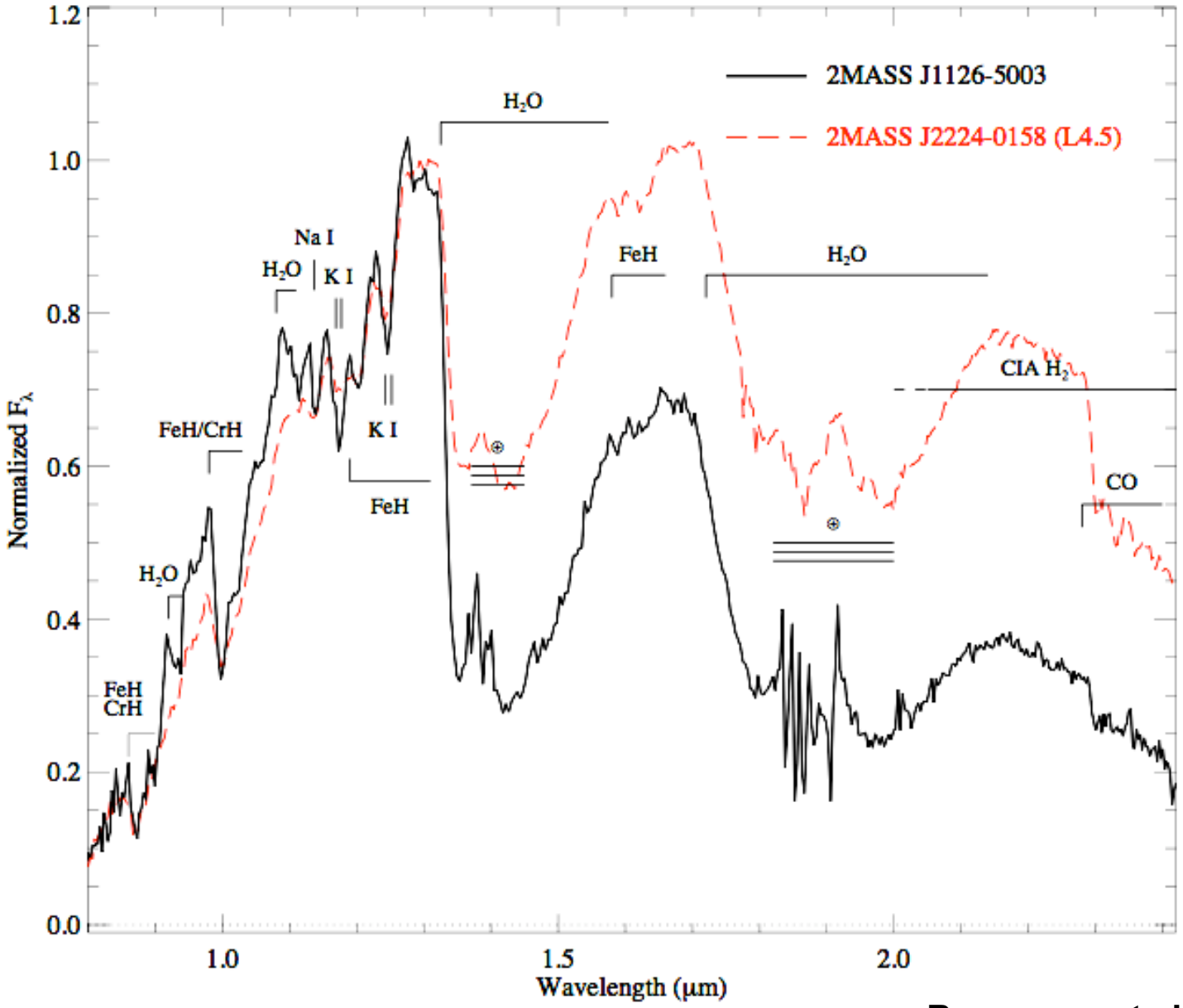
★ *Newly identified with LDSS-3* (Cushing et al. in prep.)





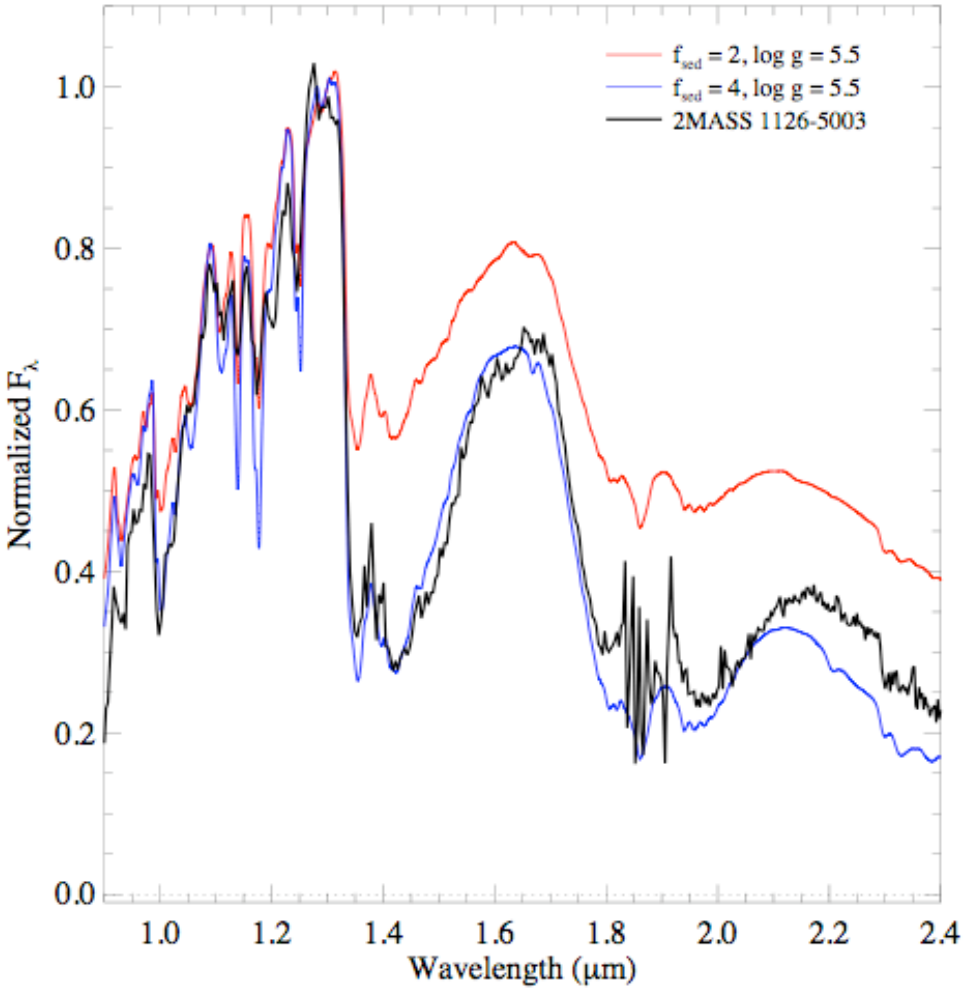
data from LDSS-3

Burgasser et al. (2008)



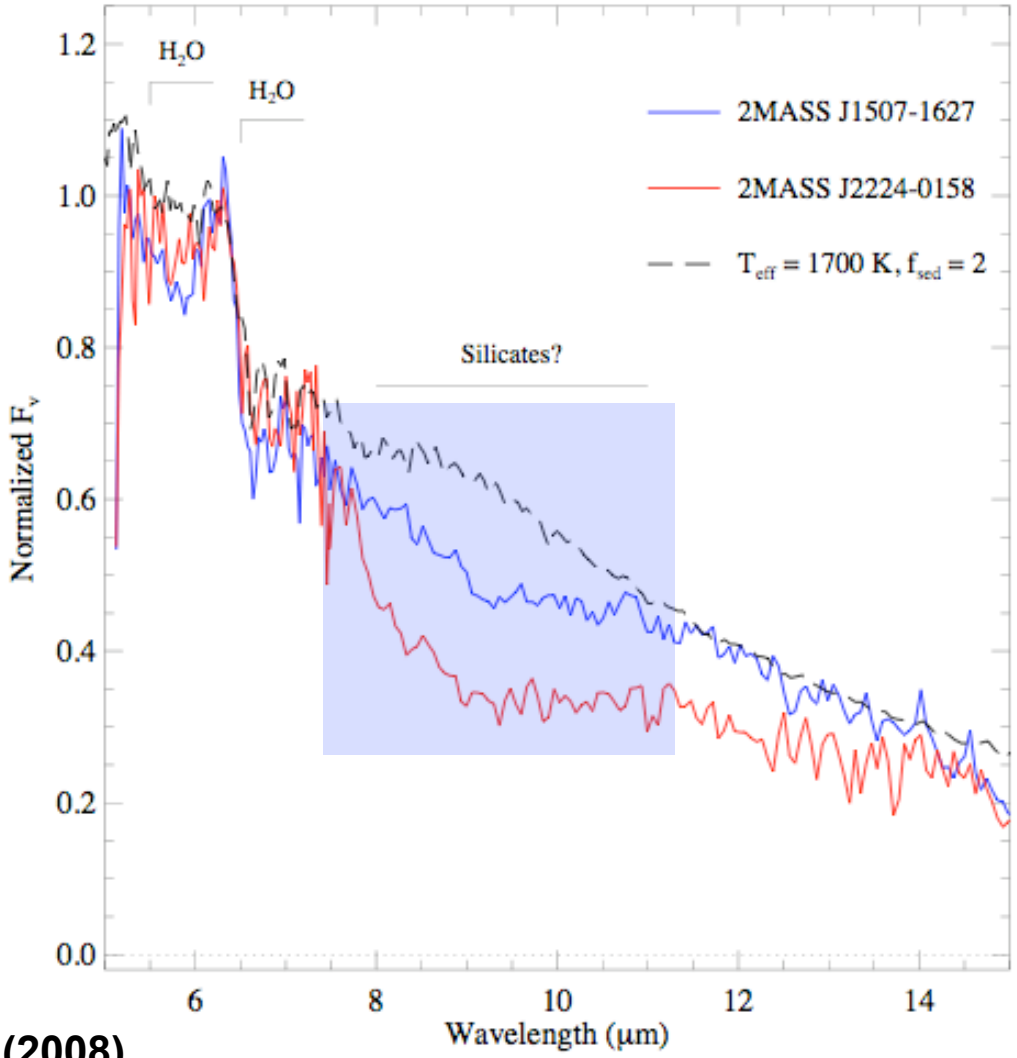
Burgasser et al. (2008)

blue dwarfs have thin clouds



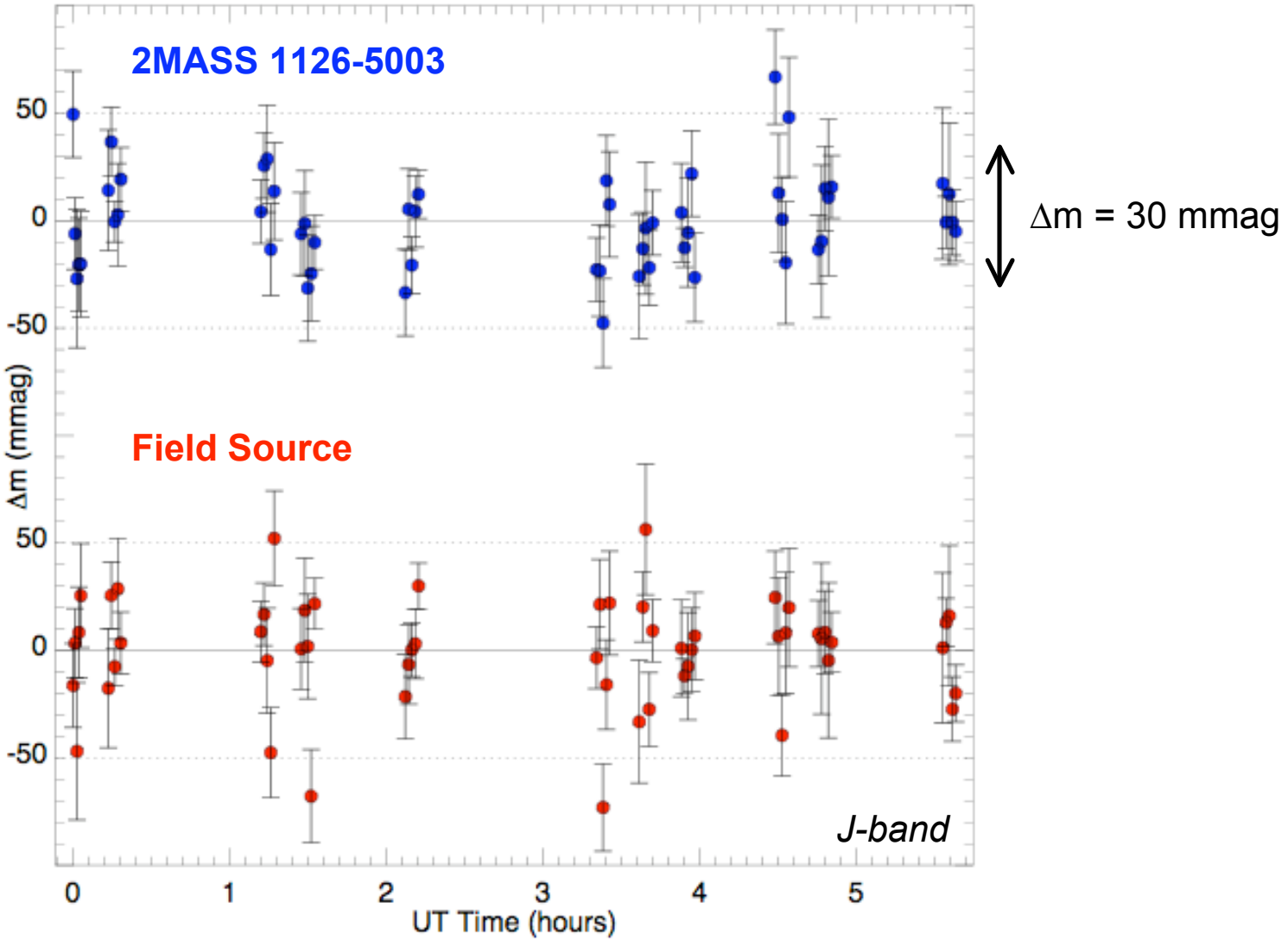
Burgasser et al. (2008)
see also Knapp et al. (2004); Cruz et al. (2007); Cushing et al. (in prep.)

blue dwarfs have thin clouds
red dwarfs have thick clouds



Burgasser et al. (2008)
data from Cushing et al. (2006)

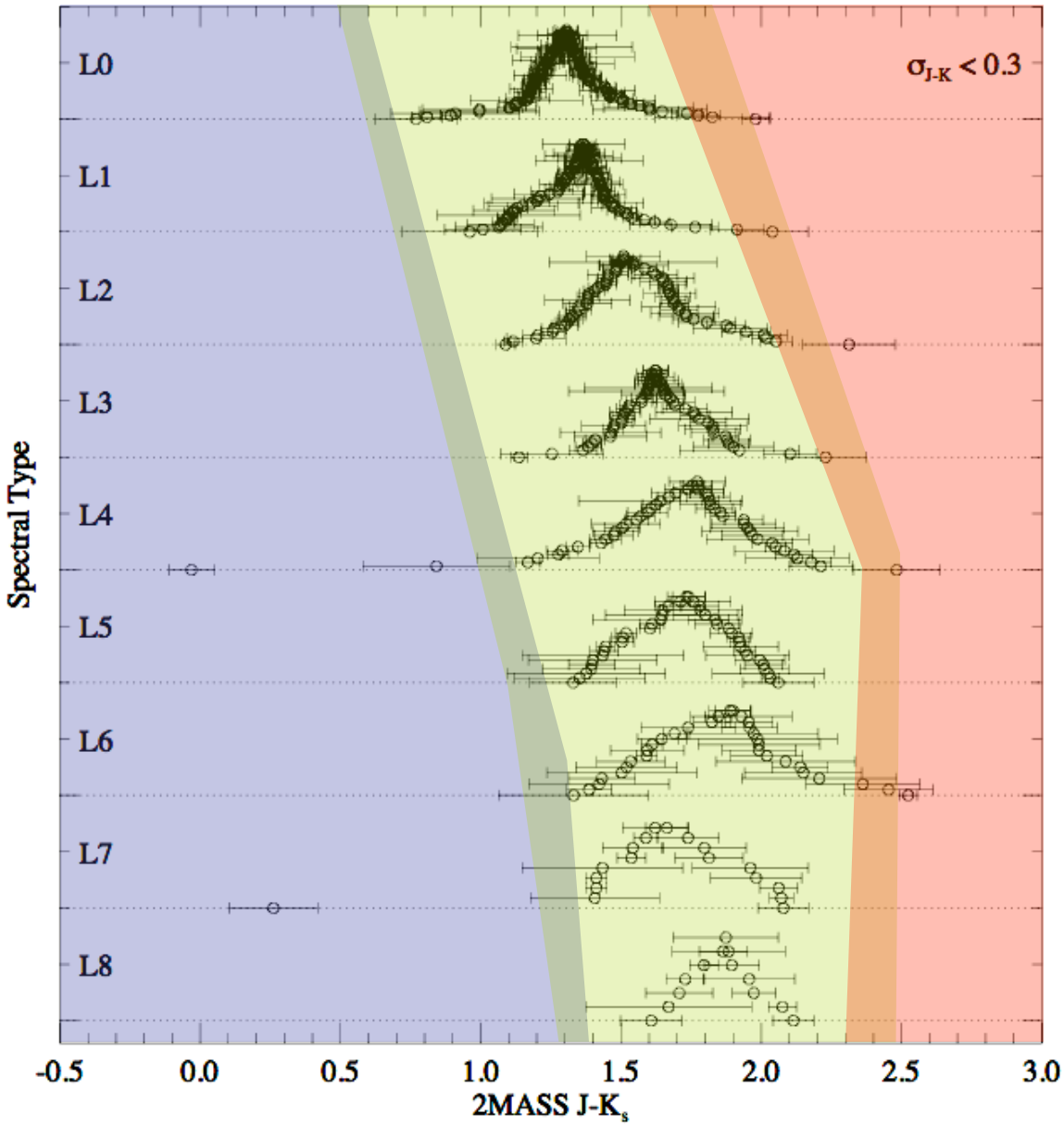
weather from clouds - variability



data from PANIC

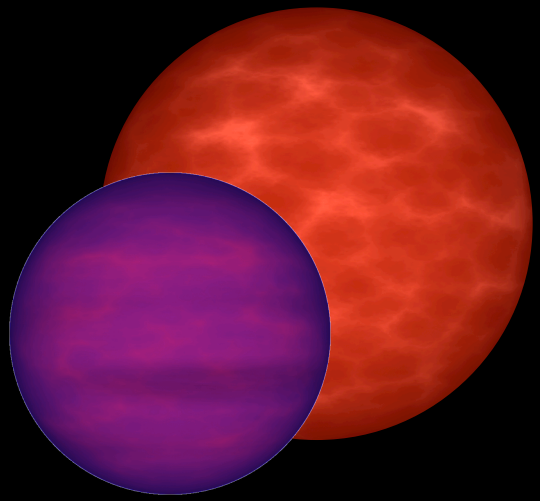
See also Bailer-Jones & Lamm (2002)

Cloud effects



old/ metal-poor

youth/ low gravity



how can we use color/spectral trends to study low mass dwarf populations?

Searches for dispersed populations in local associations (e.g. Bannister & Jameson 2007)

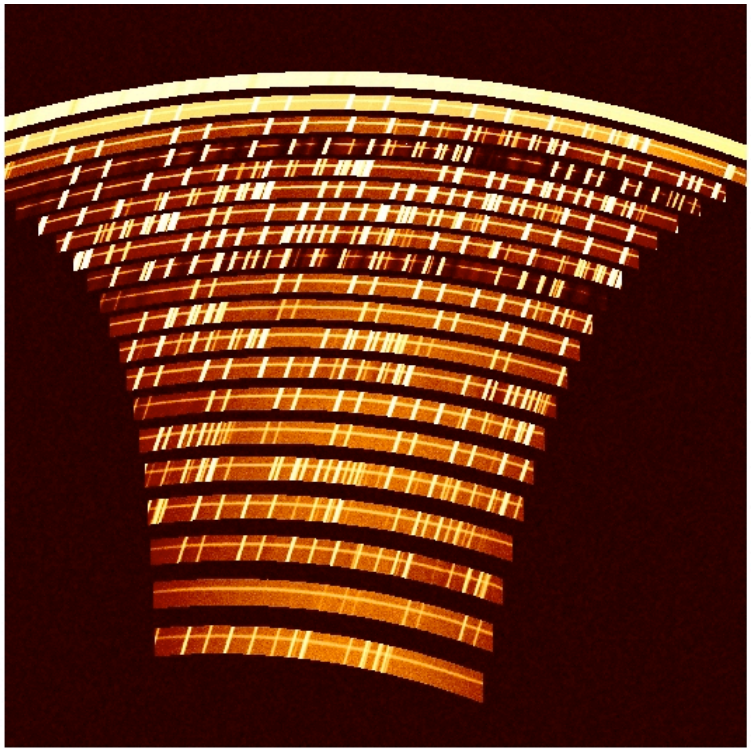
True mass function/age distribution measurements (e.g., Burgasser 2004; Allen et al. 2005)

“Planetary” companions to low mass primaries - high probability samples (e.g., Fischer & Valenti 2005)

Long-term angular momentum/magnetic field/cloud evolution (e.g. Reiners & Basri 2006)

the FIRE spectrograph

near-infrared echellette for the Magellan Telescopes



~0.85-2.35 μm in one shot

R~6000 (50 km/s; 0”6 slit)

R~900-2500 high sensitivity

commissioning ~ 2008

see poster for more information…