Mass determination of young directly imaged planets and brown dwarfs

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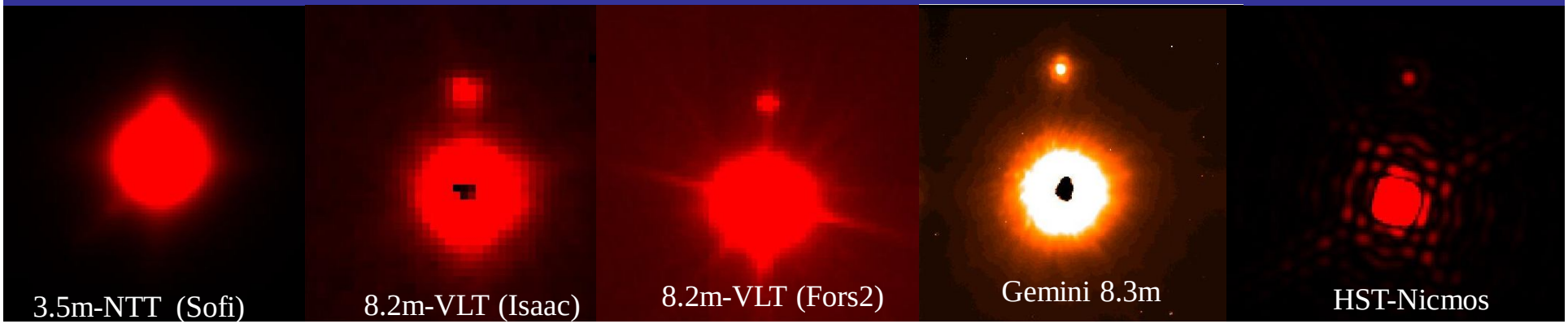
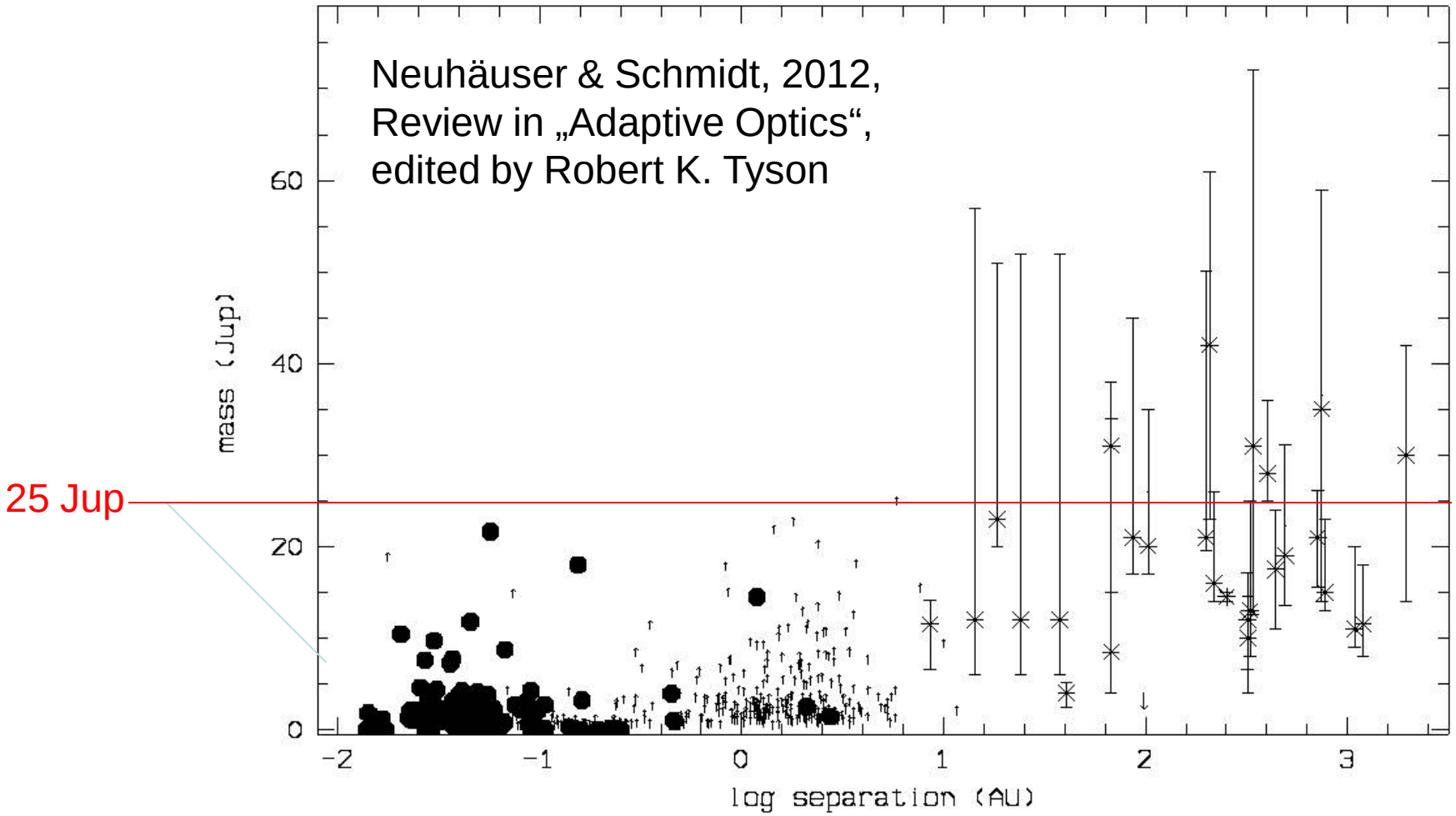
seit 1558



methods now meet at ~ 10 AU

11 objects not yet on exoplanet.eu:
GG Tau Bb, TWA 5 B, GJ 417 B & C, GSC 08047 B/b, LP 261-75 B/b,
HD 203030 B/b, Wolf 940 B/b, G196-3 B/b, PZ Tel B/b, HR 7329 B/b,



RV planets at 9-12 AU: nu Oph c, HIP 5158 b, HIP 70849 b, 47 Uma d

Imaged planets at 9-18 AU: β Pic b, HR 8799 e, PZ Tel b

CT Cha b

and Drift-Phoenix:

T= 2600 K ± 250 K

A_V= 5.2 ± 0.8 mag

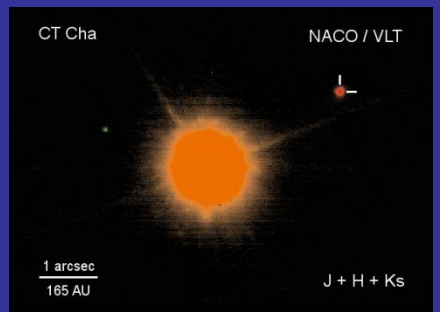
➔ Mag, A_V and distance give luminosity L ($\log(L/L_{sun})$= -2.68 ± 0.21)

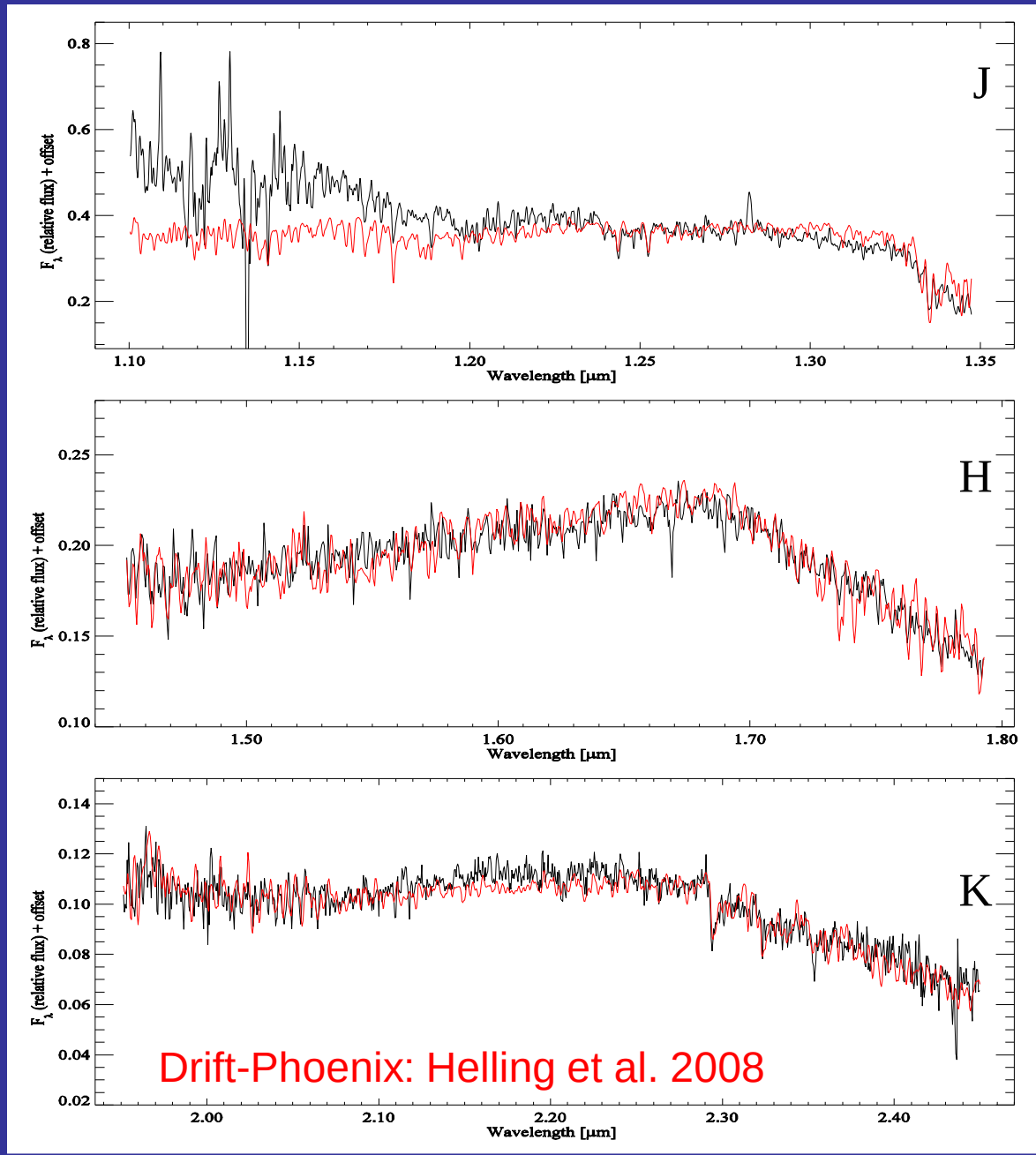
➔ L and T give radius (~ 2.2 ± 0.7 R_Jup)

➔ T, L, age give mass:

~ 17 ± 6 M_Jup

but model-dependant (planet or BD ?)





Schmidt, Neuhäuser, Seifahrt et al. 2008 A&A

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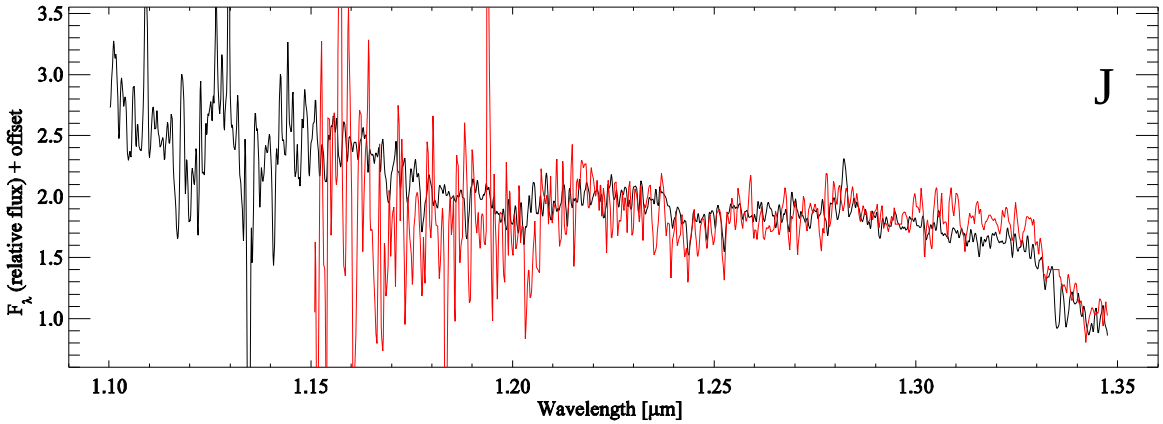
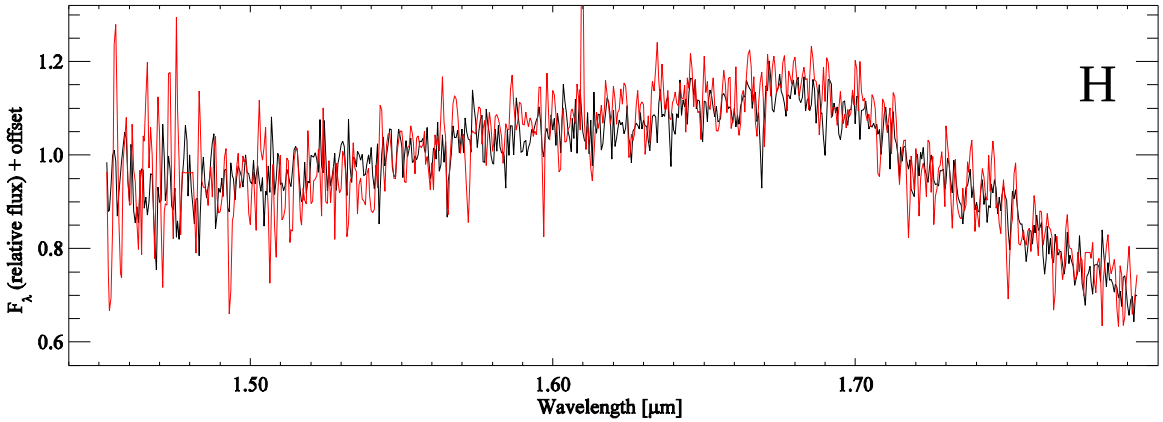
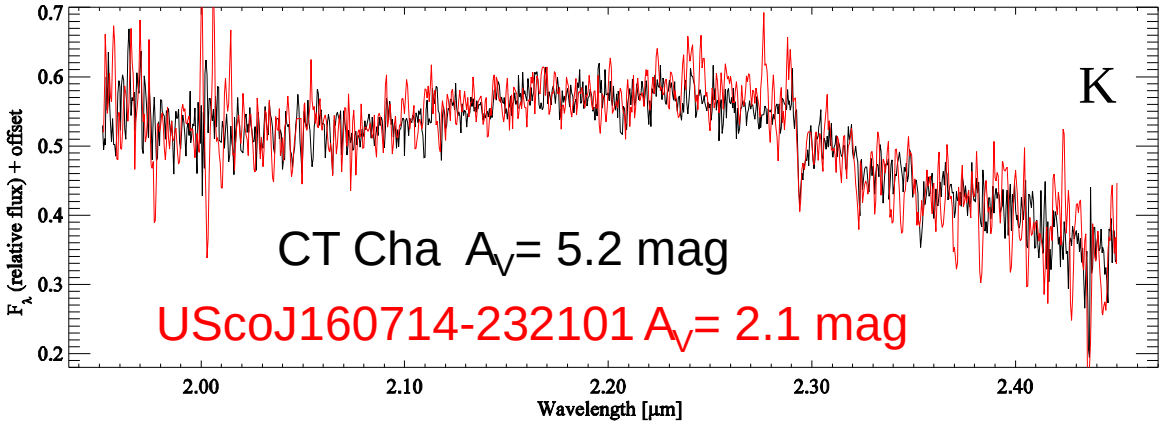
Lodieu et al. 2008



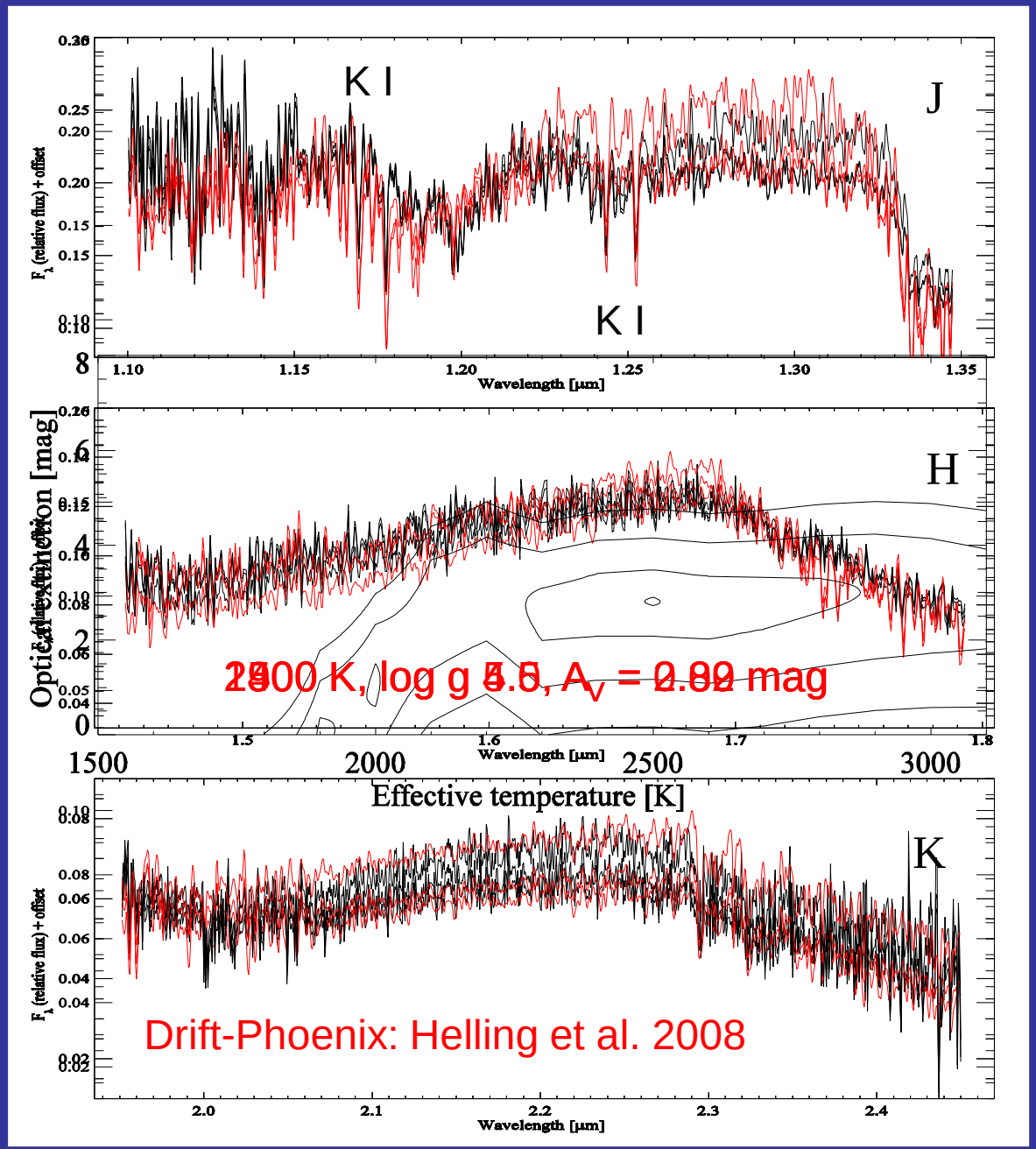


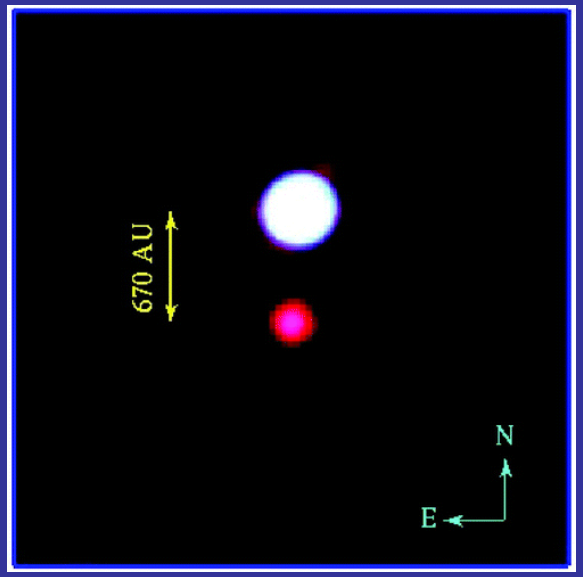


Schmidt, Neuhäuser, Seifahrt et al. 2008 A&A

UScoCTIO 108 b

(Béjar et al. 2008)





and Drift-Phoenix:

T= 2500 K $^{+\ 400\ K}_{-\ 200\ K}$

A_V= 2.8 ± 0.8 mag

Schmidt, Neuhäuser, Seifahrt 2011, in prep.

Object	Temp.	A_V
UScoJ155419-213543	2700 K	0.2 mag
UScoJ160648-223040	2700 K	0.2 mag
UScoJ160723-221102	2700 K	0.7 mag
UScoJ160847-223547	2700 K	0.7 mag
UScoJ154722-213914	2700 K	0.9 mag
UScoJ160830-233511	2700 K	1.6 mag
UScoJ161047-223949	2700 K	1.6 mag
UScoJ160603-221930	2650 K	2.0 mag
UScoJ160737-224247	2500 K	2.0 mag
UScoJ160818-223225	2500 K	2.0 mag
UScoJ160606-233513	2700 K	2.1 mag
UScoJ161302-212428	2500 K	2.1 mag
UScoJ160714-232101	2600 K	2.3 mag
UScoJ160727-223904	2500 K	2.5 mag
UScoJ160828-231510	2700 K	2.6 mag
UScoCTIO 108 b	2500 K	2.8 mag
UScoJ161441-235105	2600 K	2.9 mag
UScoJ163919-253409	2600 K	4.2 mag
UScoJ161228-215936	2700 K	4.3 mag
UScoJ160918-222923	2500 K	4.6 mag

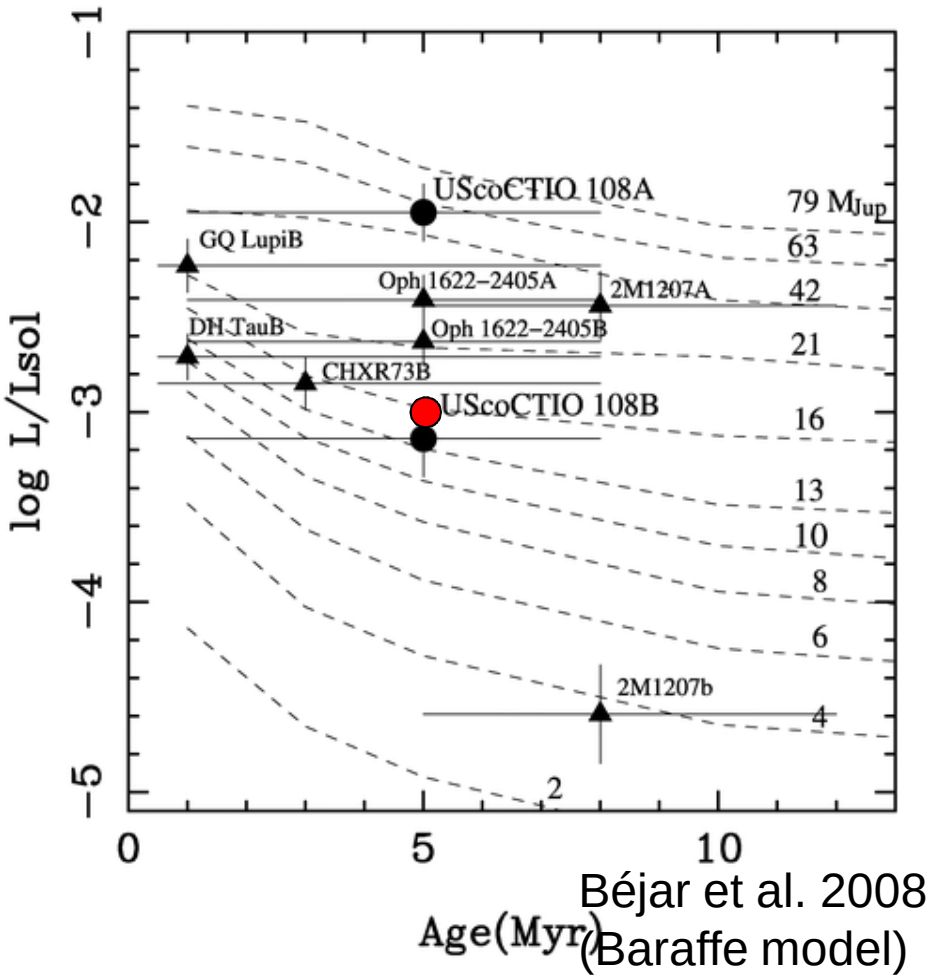
Lodieu et al. 2008

T= 2350 $^{+100\ K}_{-400\ K}$

→ T= 2500 $^{+400\ K}_{-200\ K}$

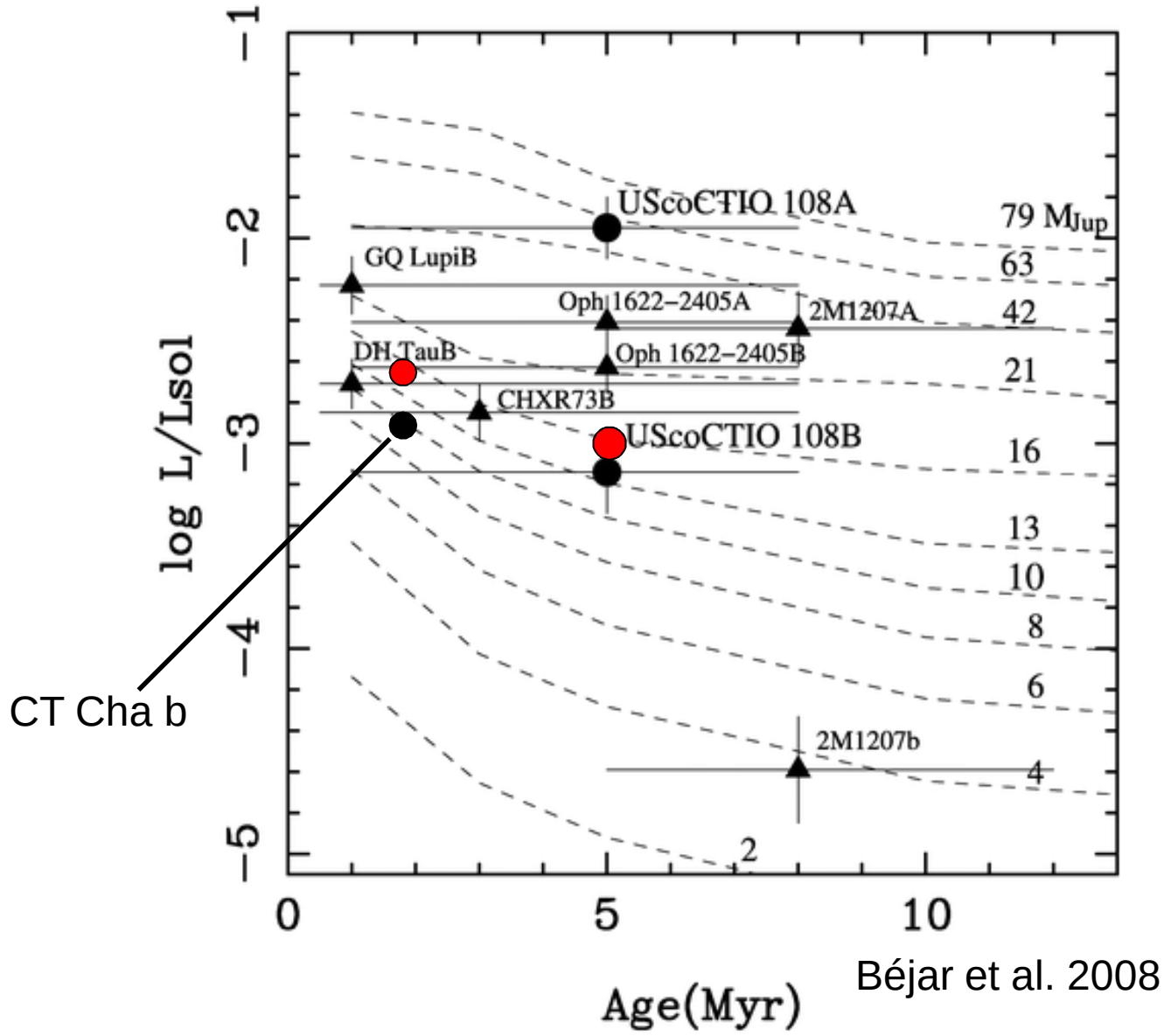
log(L/L⊙)= -3.14 ± 0.20

→ -3.01 ± 0.25



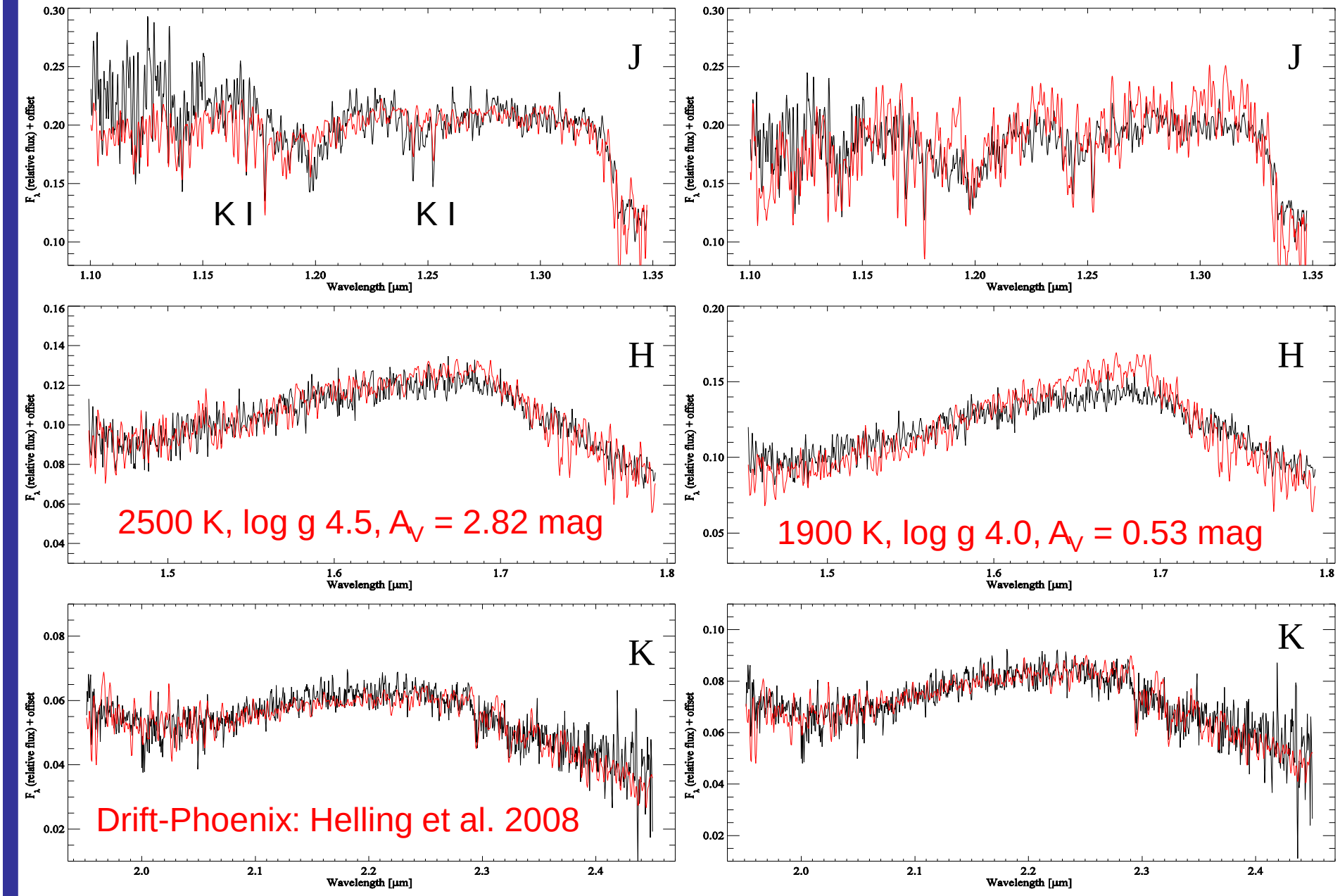
Béjar et al. 2008 (Baraffe model)

Béjar et al. 2008 (new fit)

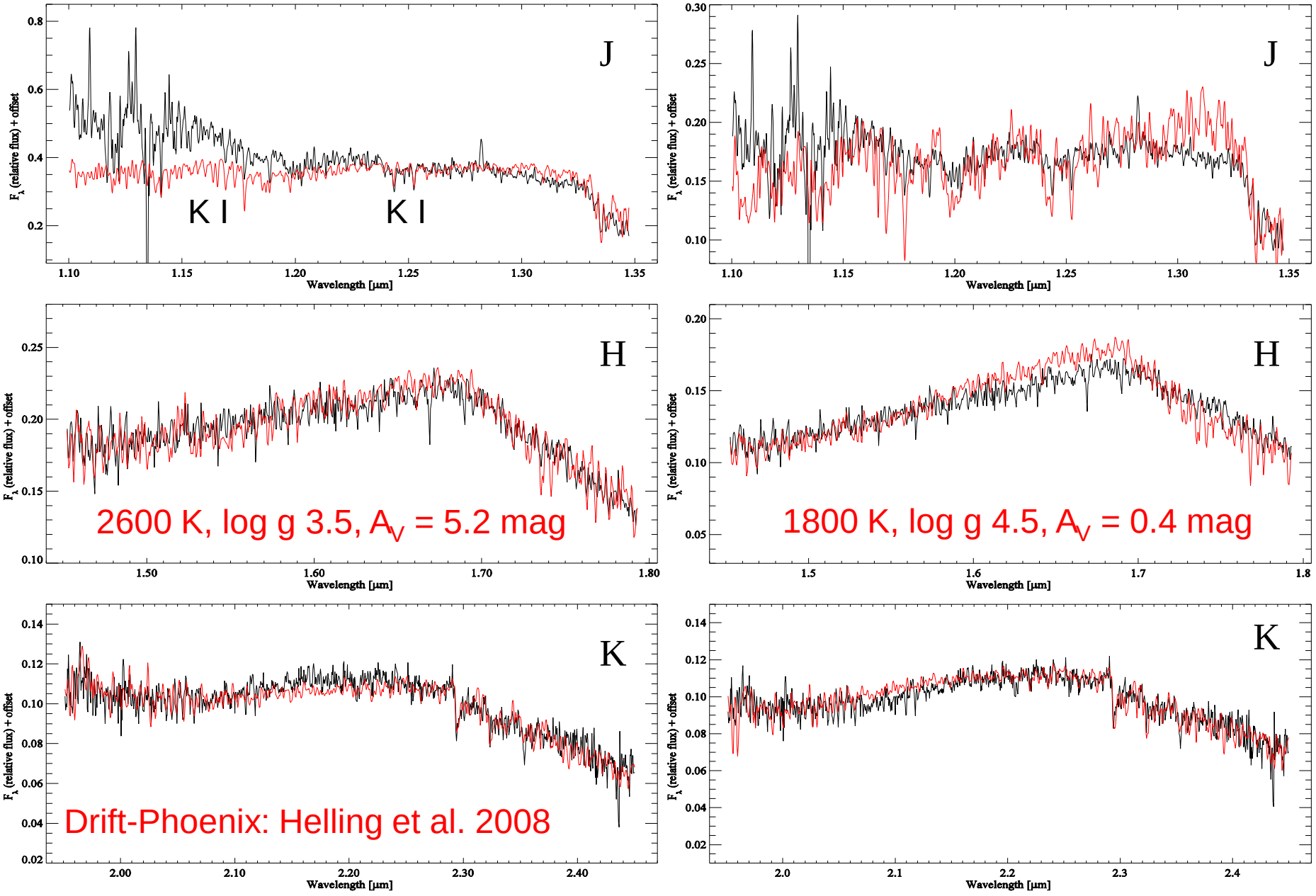


CT Cha b

Béjar et al. 2008

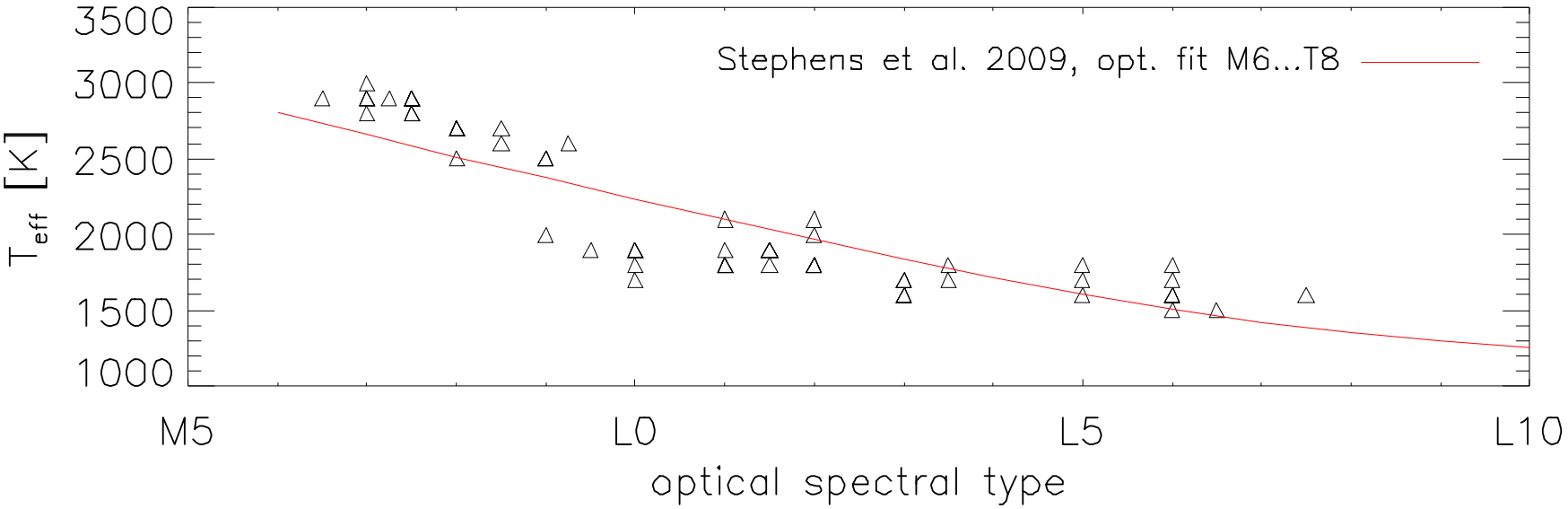


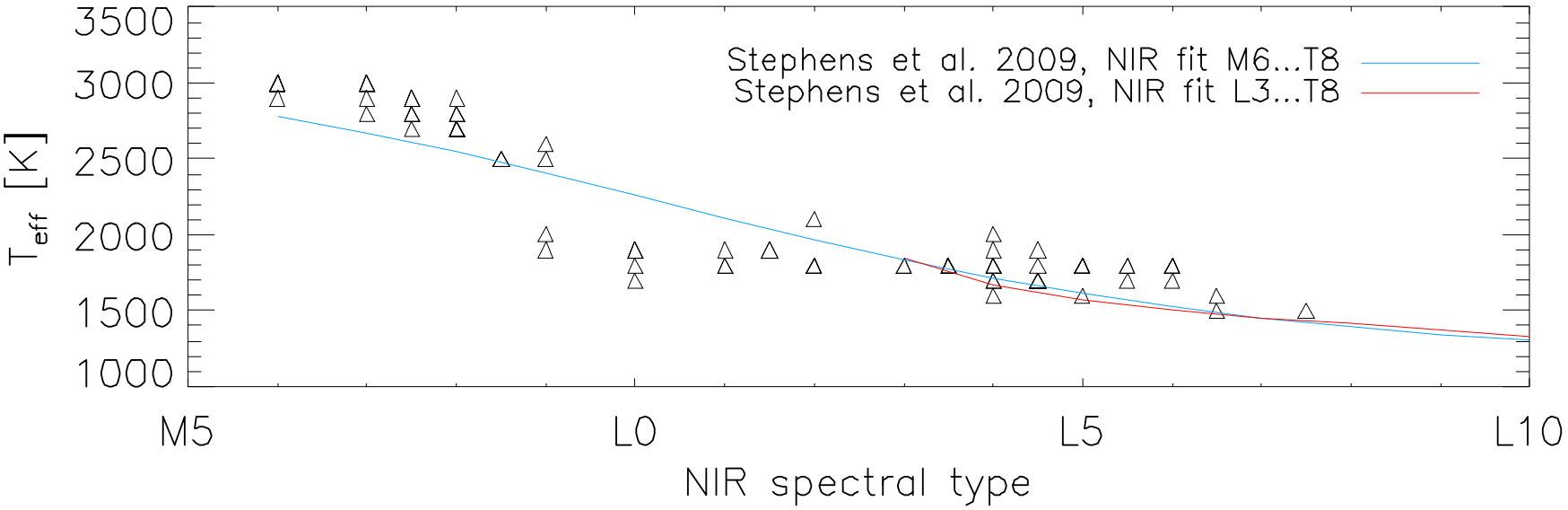
Schmidt, Neuhäuser, Seifahrt 2012, in prep.



Schmidt, Neuhäuser, Seifahrt 2012, in prep.

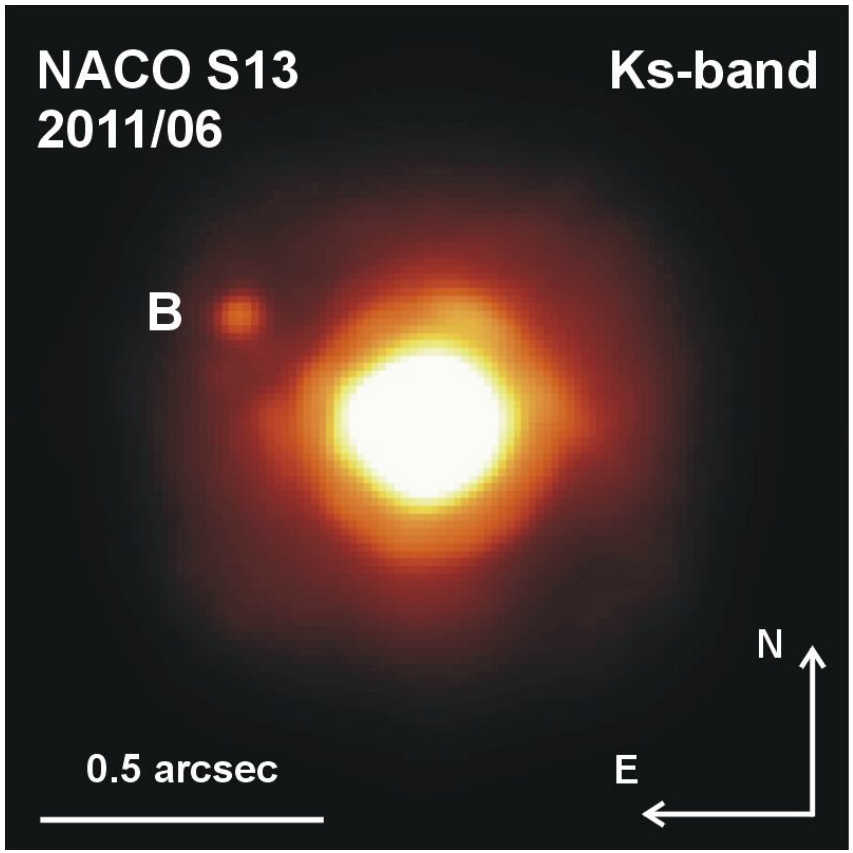
Witte et al. 2011 – Comparison with the 108 suited (e.g. single) BDs from DwarfArchives



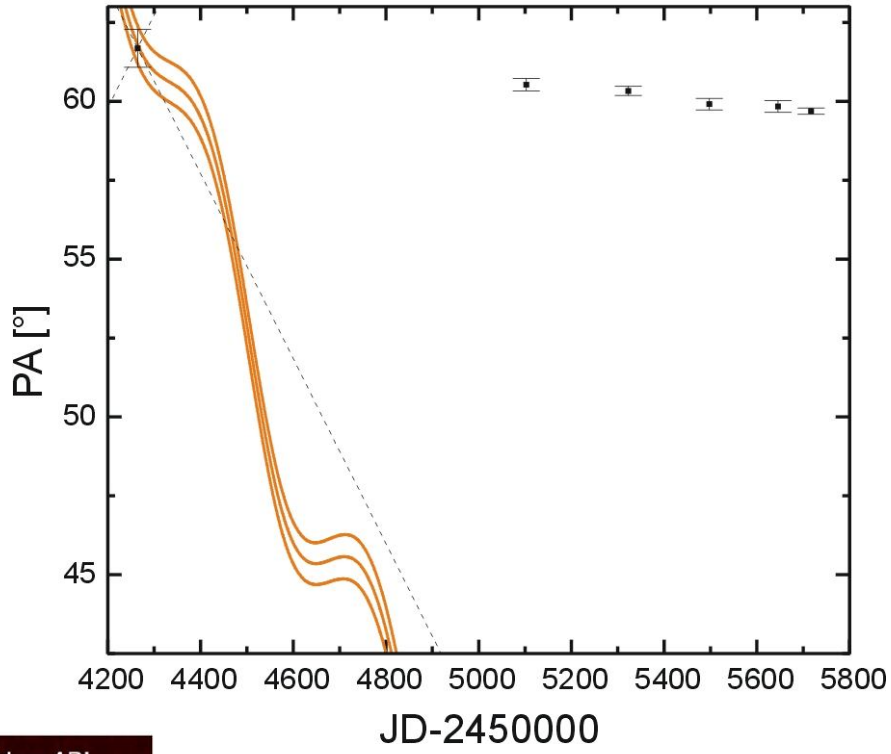


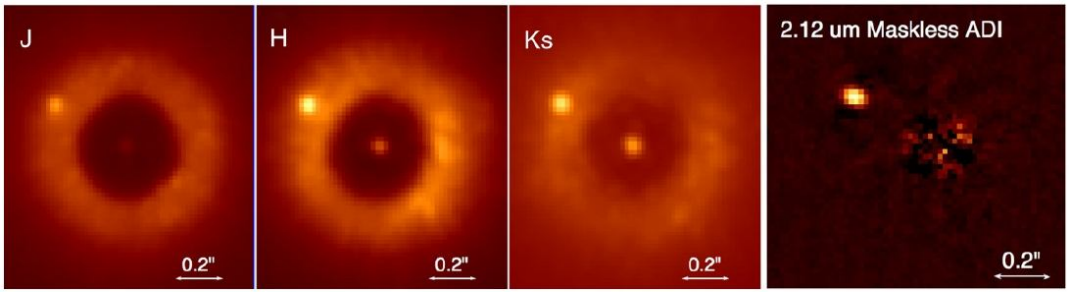
PZ Tel

12 Myrs (in β Pic moving group)

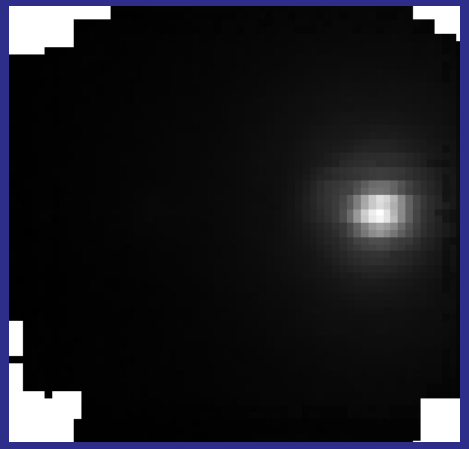


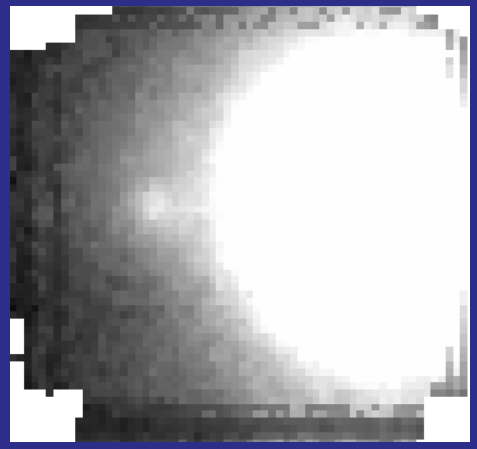
New astrometric data → please see Poster S2/P15





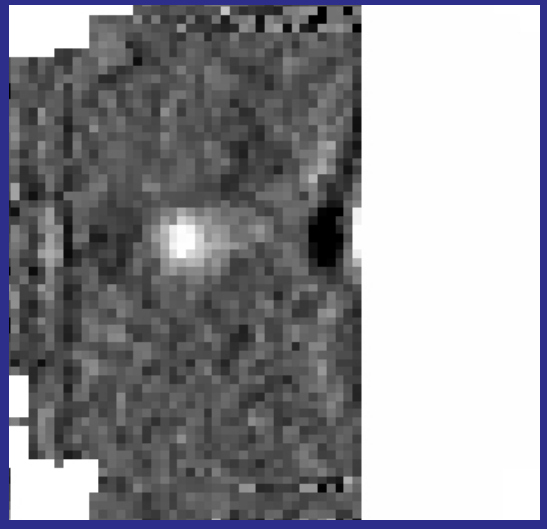
Simultaneously found by Mugrauer et al. 2010 & Biller et al. 2010

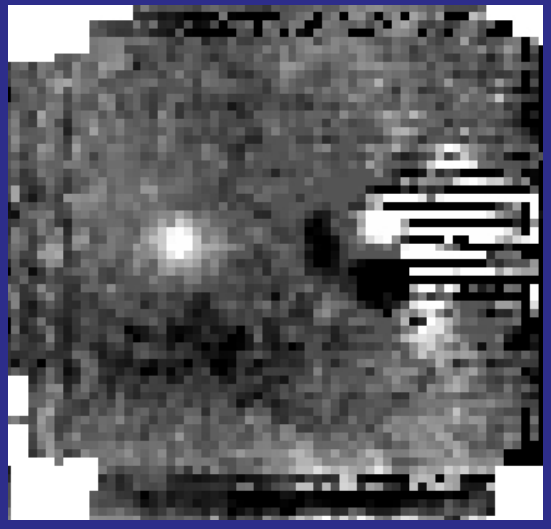




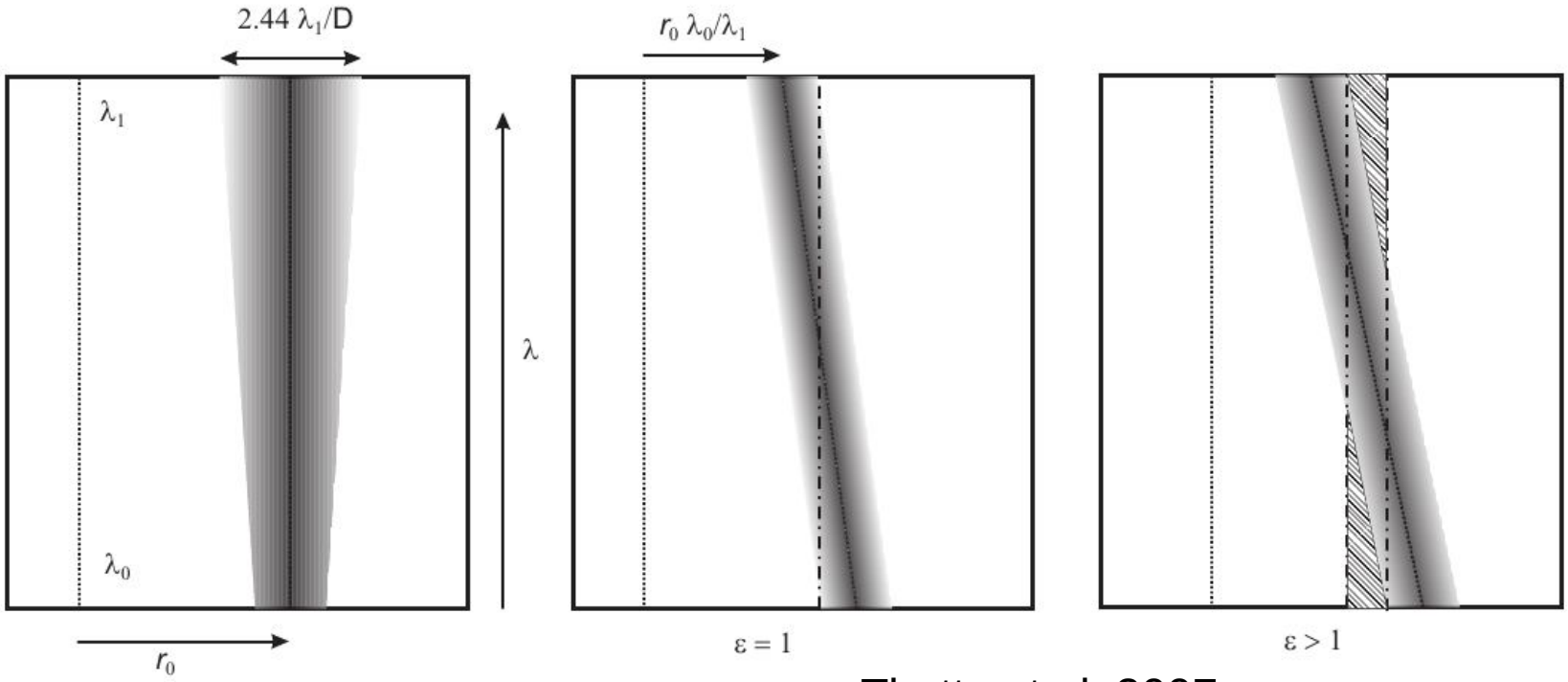
Polynomial removal

radial symmetry removal

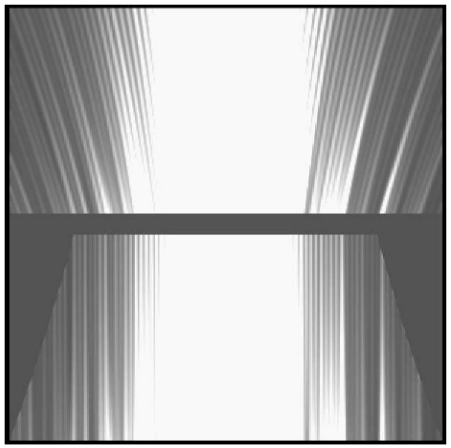




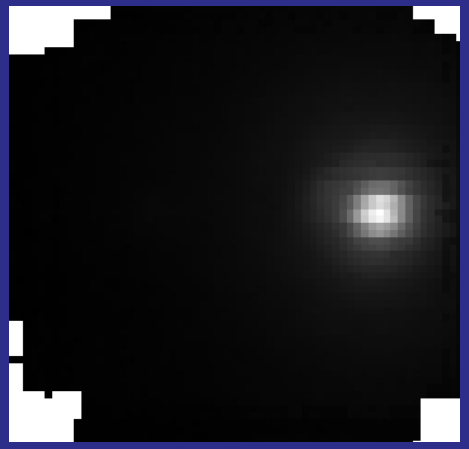
Spectral deconvolution

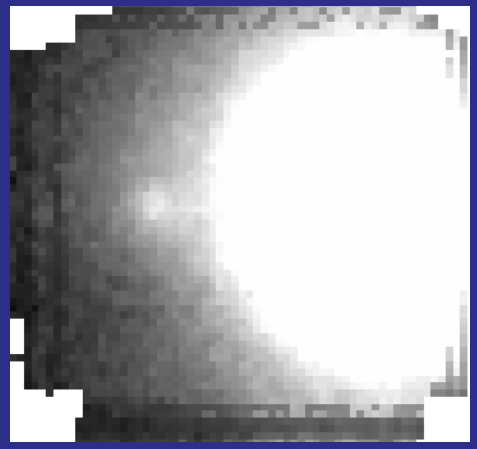


Thatte et al. 2007



Based on Sparks & Ford 2002





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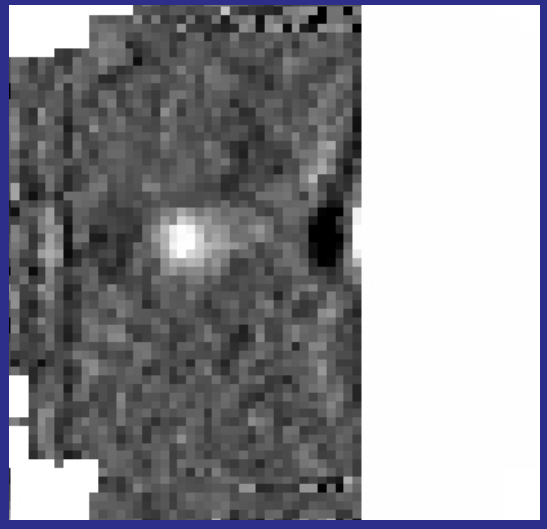
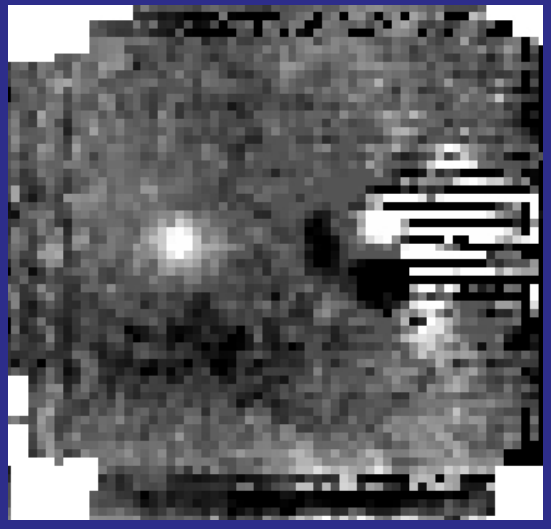
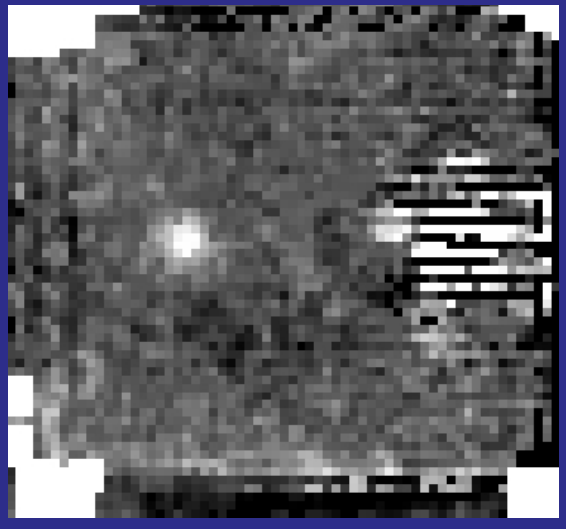
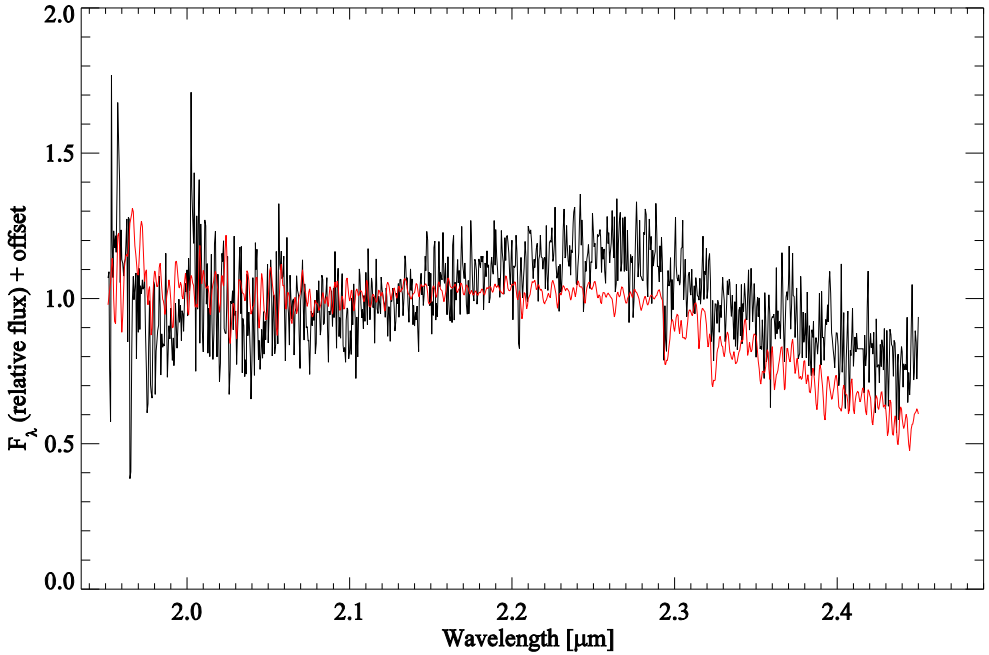




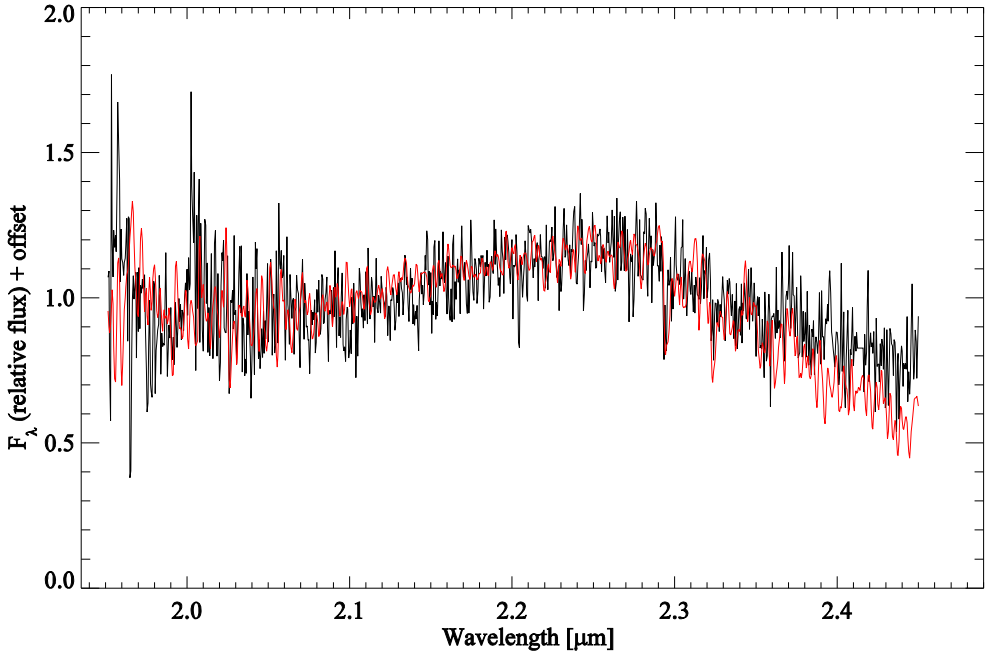




Values from Jenkins et al. 2012:

age lithium: 7 Myr
age chromosph. activity: 26 Myr
age evol. models: 22 Myr

3000 K, log g 4.5, [Fe/H] = 0.0



Best fitting values close to values of Mugrauer et al. 2010 & Biller et al. 2010:

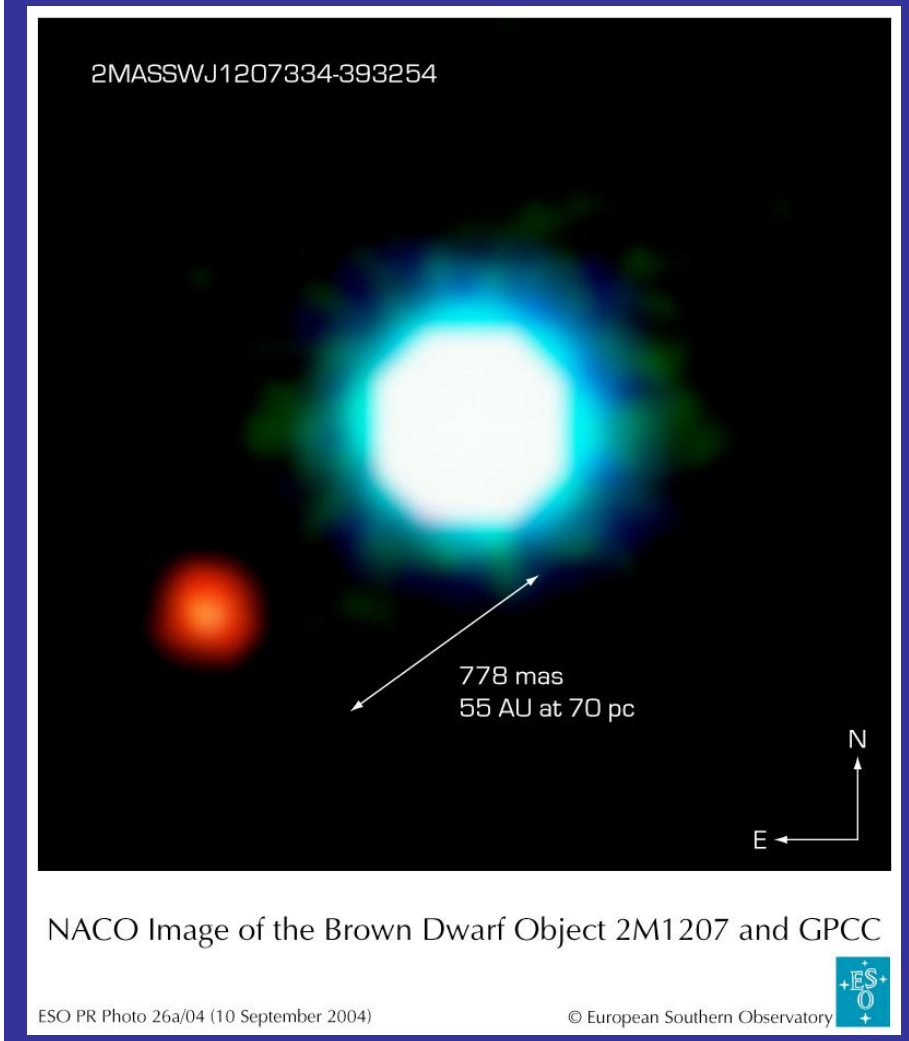
2600 K, log g 3.5, [Fe/H] = 0.3

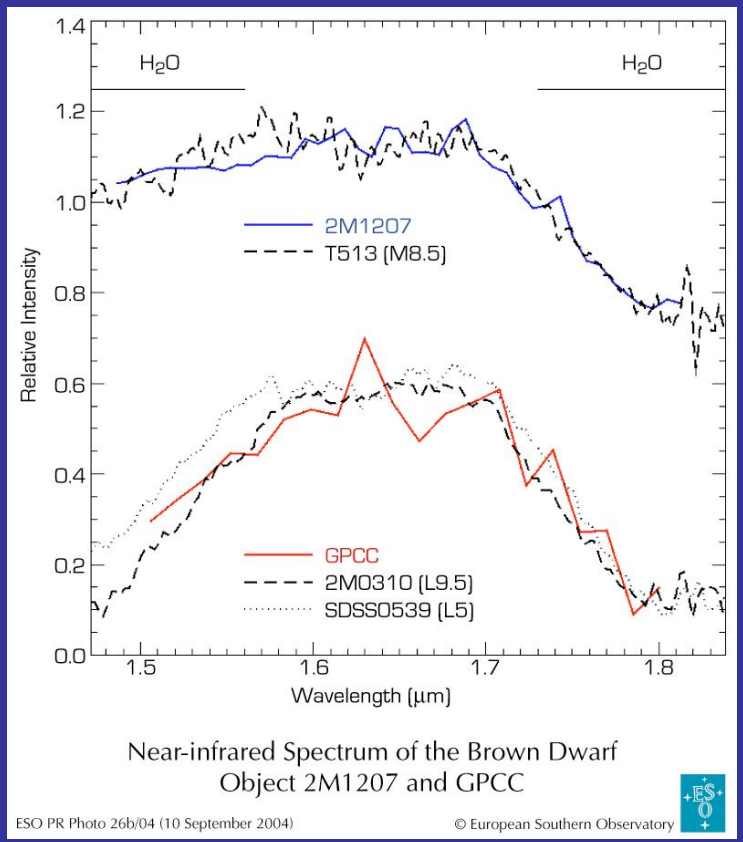
consistent with 30 Mjup object at 12 Myr

Schmidt, Mugrauer, 2012, in prep.

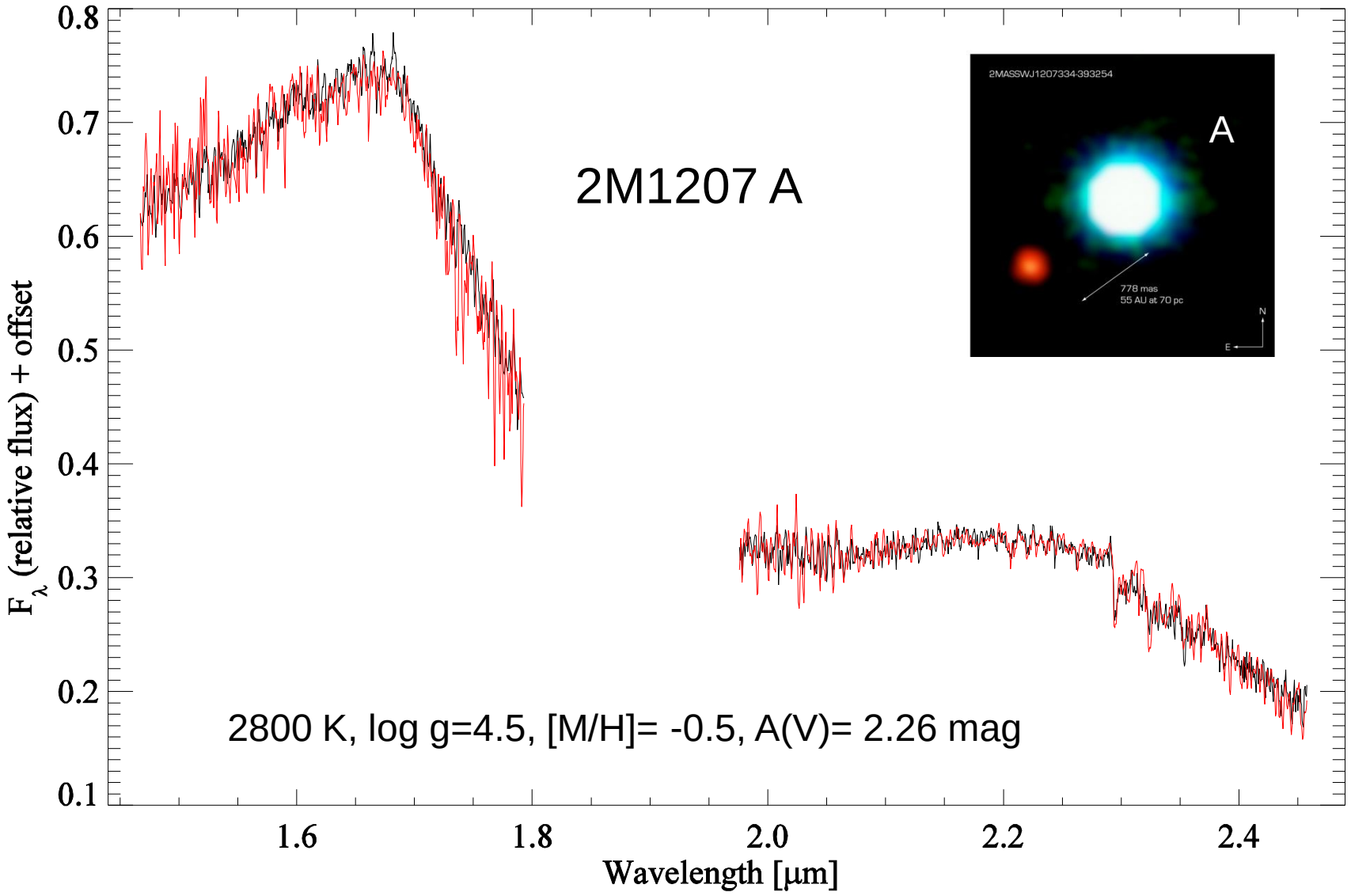
Chauvin et al. (2004): Planetary companion to 2M1207

2M1207: Possible brown dwarf in TWA, 5 to 12 Myrs, 50 to 100 pc



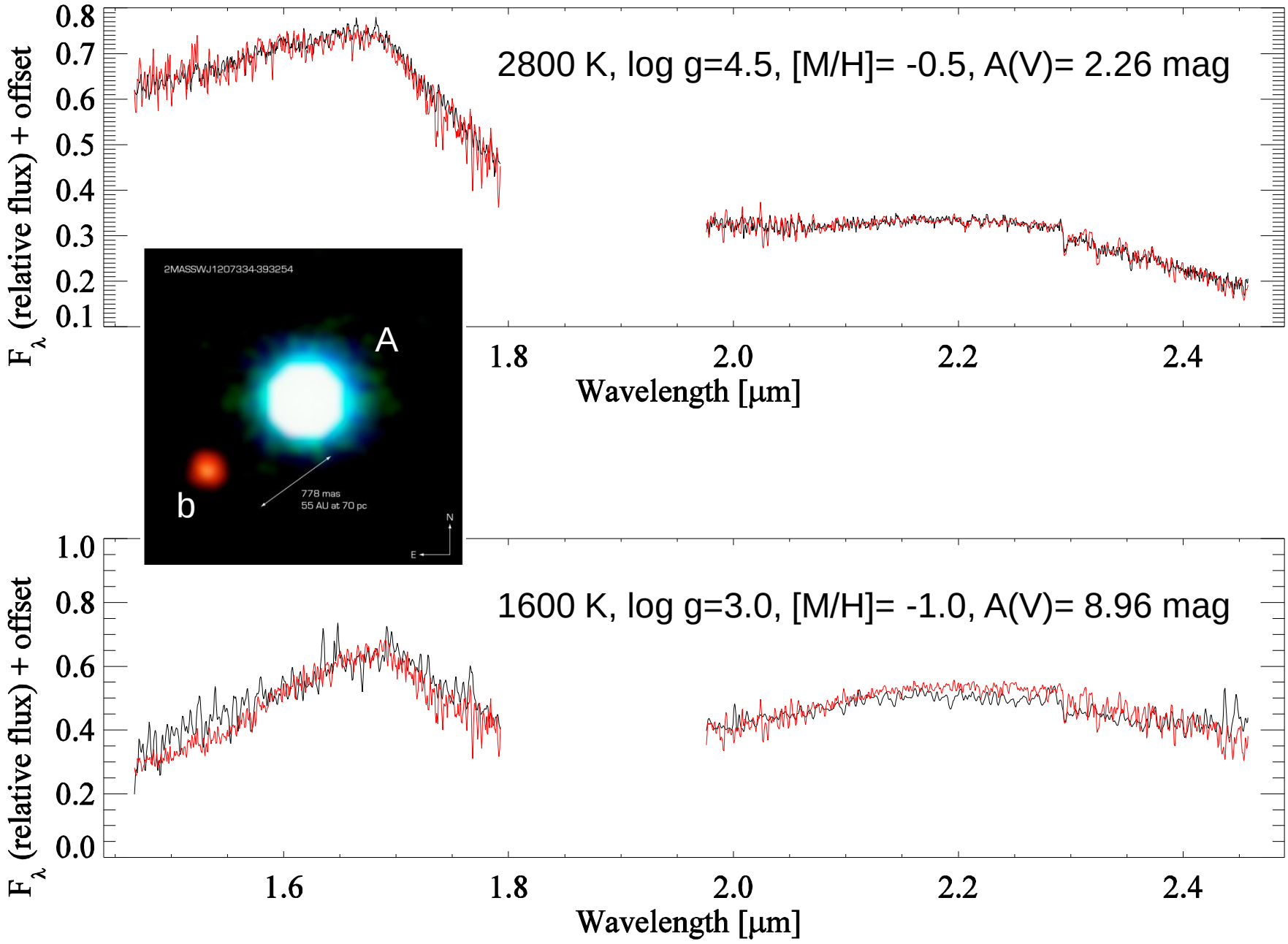


Common proper motion (Chauvin et al. 2005)

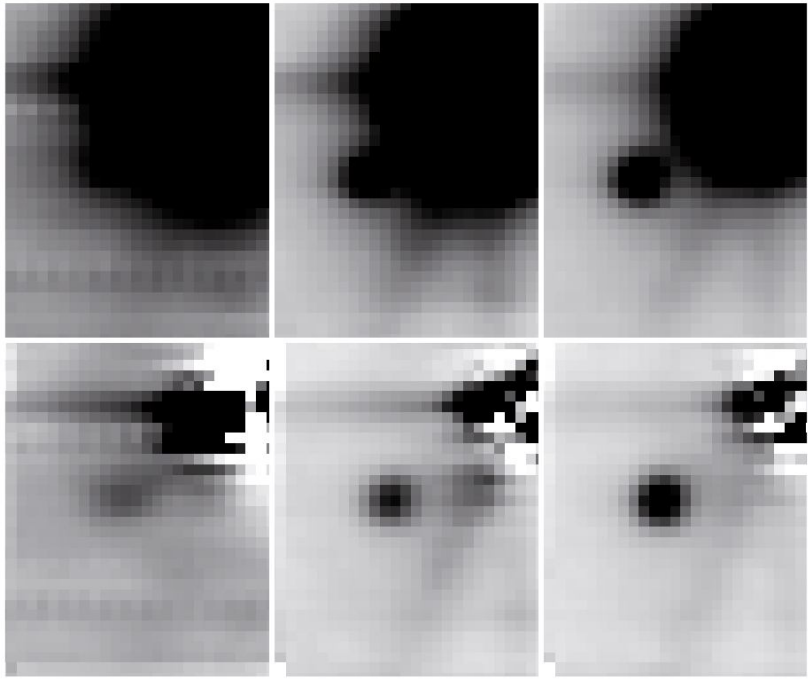


SINFONI spectrum from ESO archive

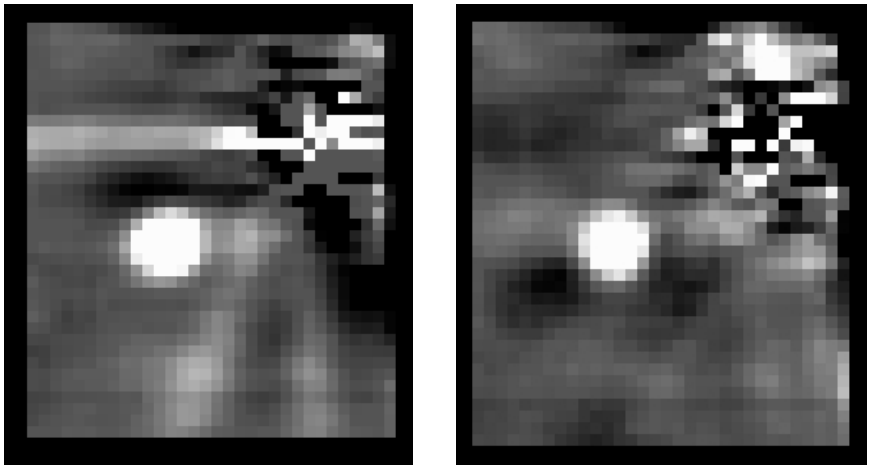
Drift-Phoenix: Helling et al. 2008

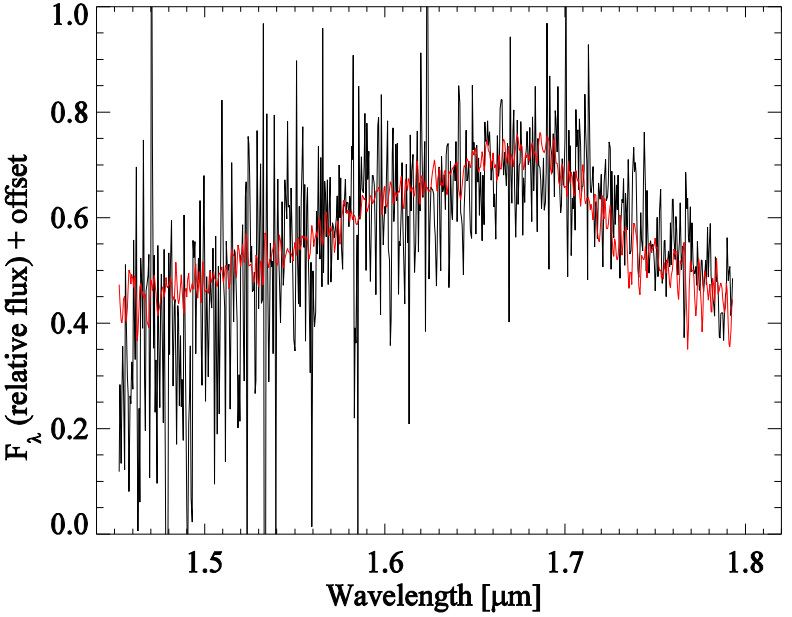


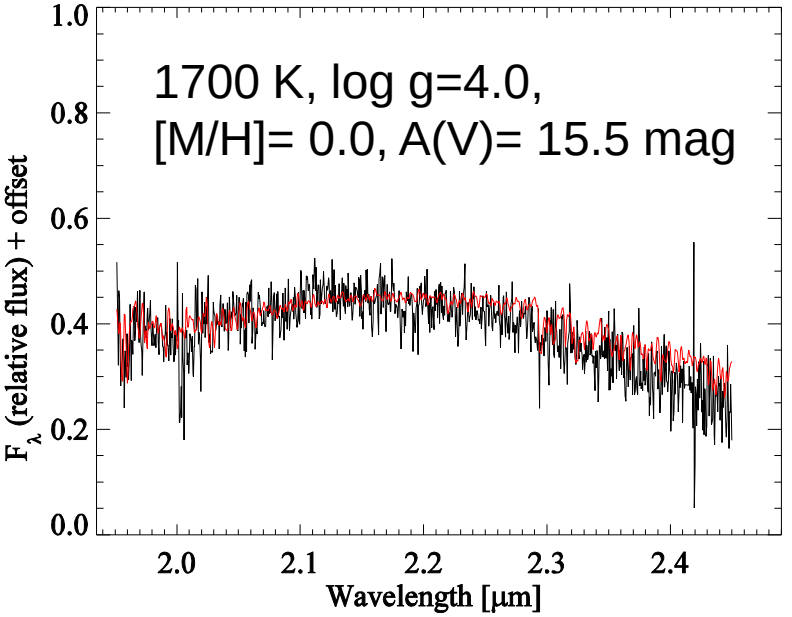
Patience et al. 2010



spectral deconvolution





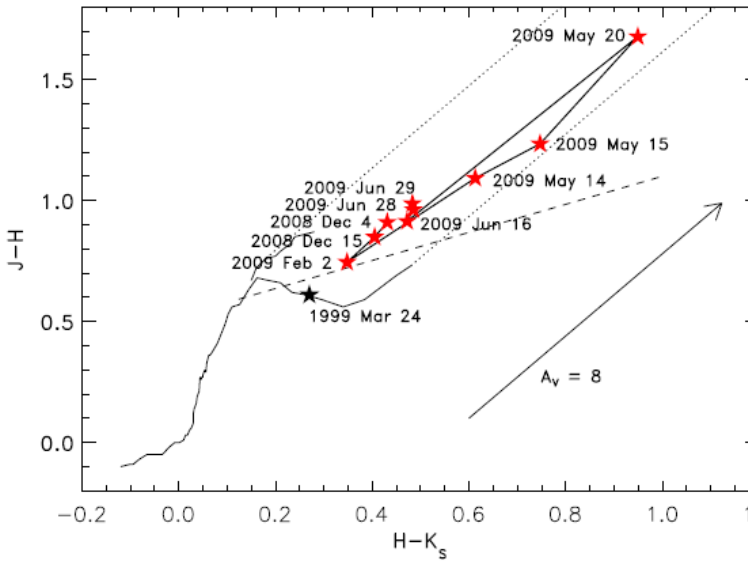


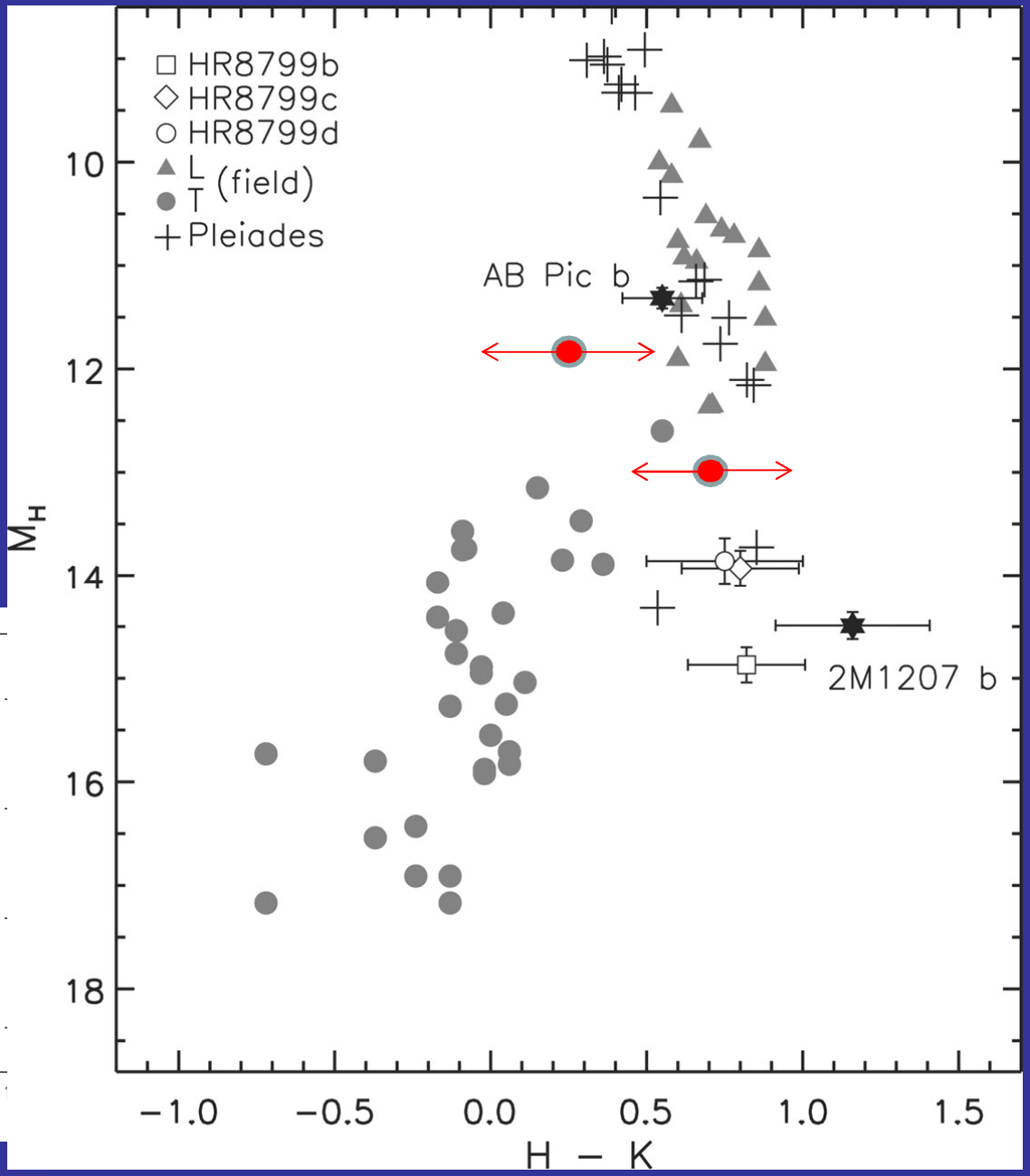
Schmidt, Quanz, Seifahrt, 2012, in prep.

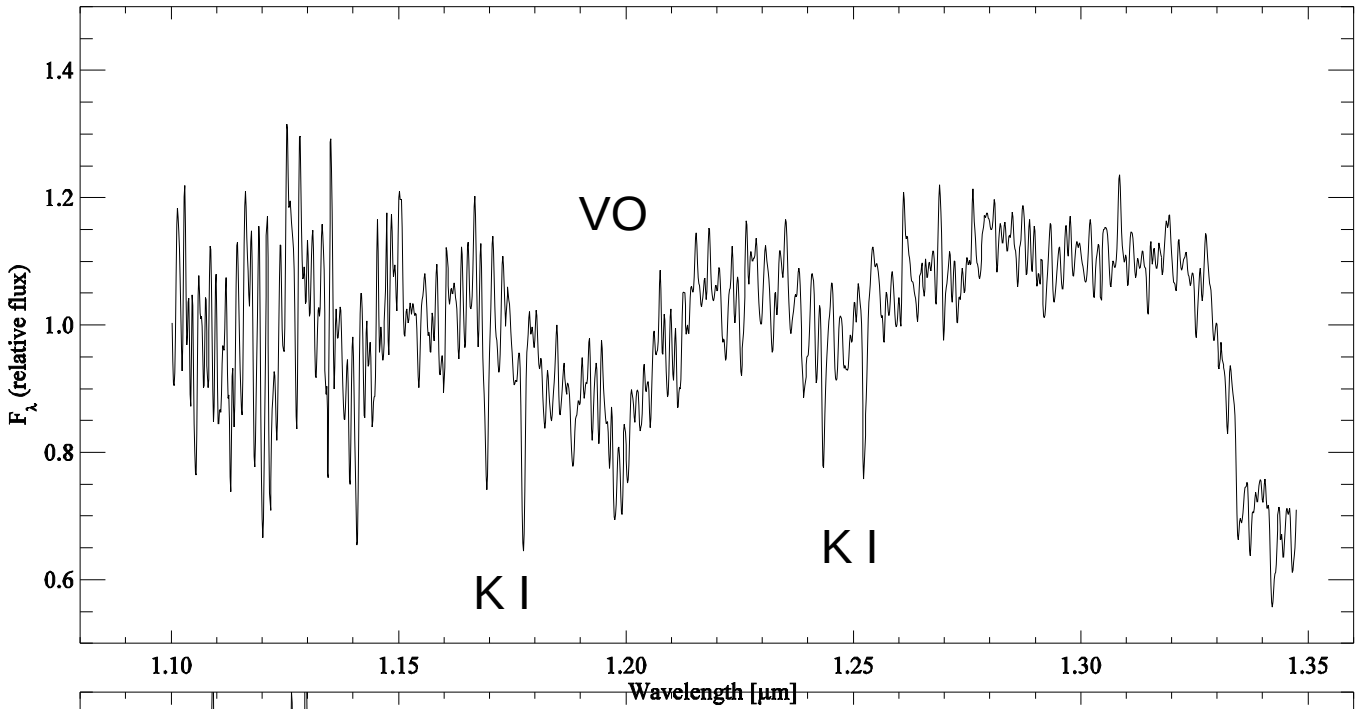
2M1207 b: A_V= 8.96 mag

log(L/L⊙)= -4.54 ± 0.1
(Mamajek et al. 2007)
→ -4.14 ± 0.2

Underluminosity:
4 – 7 times @ 5 – 10 Myr
→ 1 – 4 times @ 5 – 10 Myr

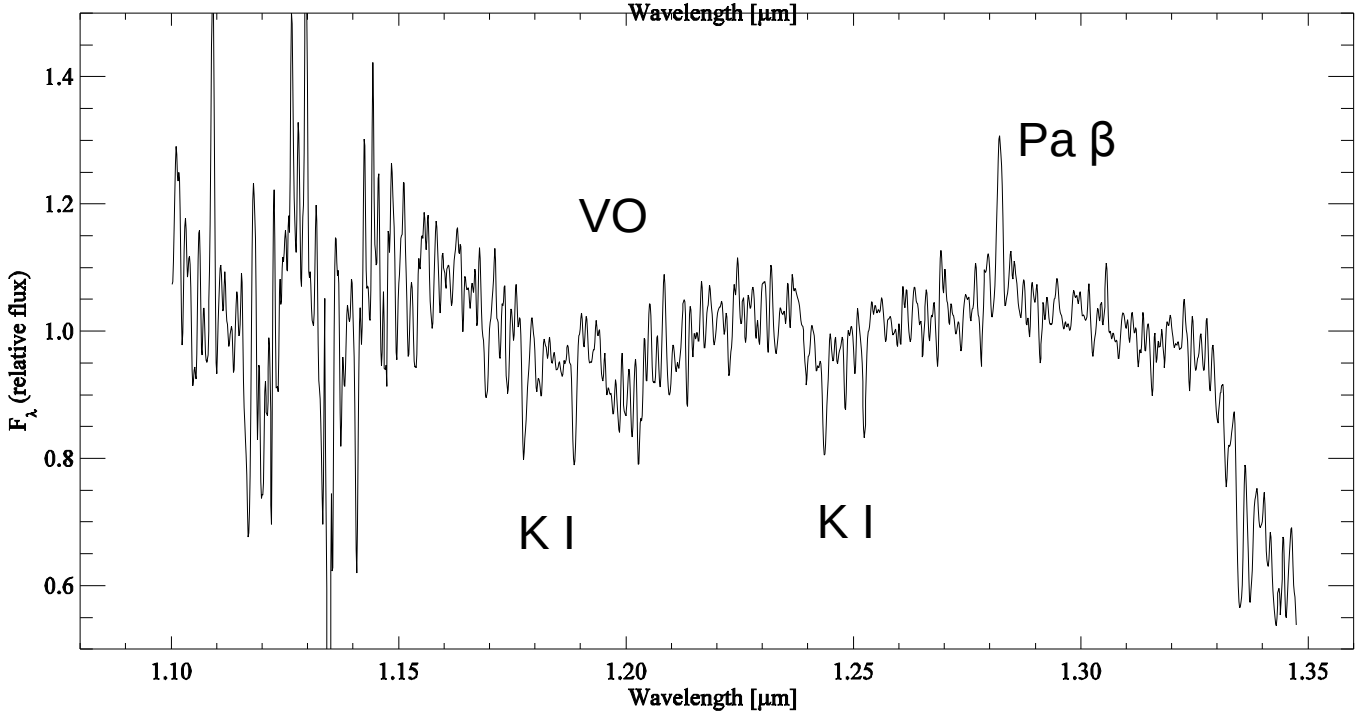






UScoCTIO 108 b

~ 5 Myr



CT Cha b

~ 2 Myr

Acknowledgements

- Nikolaus Vogt, Ana Bedalov
- David Lafrenière, Nicolas Lodieu, J. Davy Kirkpatrick, Kevin Luhman
- Christiane Helling, Soeren Witte, Peter Hauschildt, Takashi Tsuji , Mark Marley
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- FONDECYT
- DFG, DAAD