

A wide planetary-mass companion to a young M₃ star of AB Dor moving group

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Hot Planets and Cool Stars
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Background: Modified from an artist's view of CHRX 73 b. Credits: NASA, ESA and G. Bacon (STScI)



Outline

1. The survey and its sample
2. The host star
3. The planetary-mass companion
 - Characteristics
 - Confirmation
 - Further characterisation
 - New benchmark?
4. Future work

The survey

PSYM Planet Search around Young M-dwarfs

Telescope: Gemini South, Chile



Gemini Observatory/Chris Carter

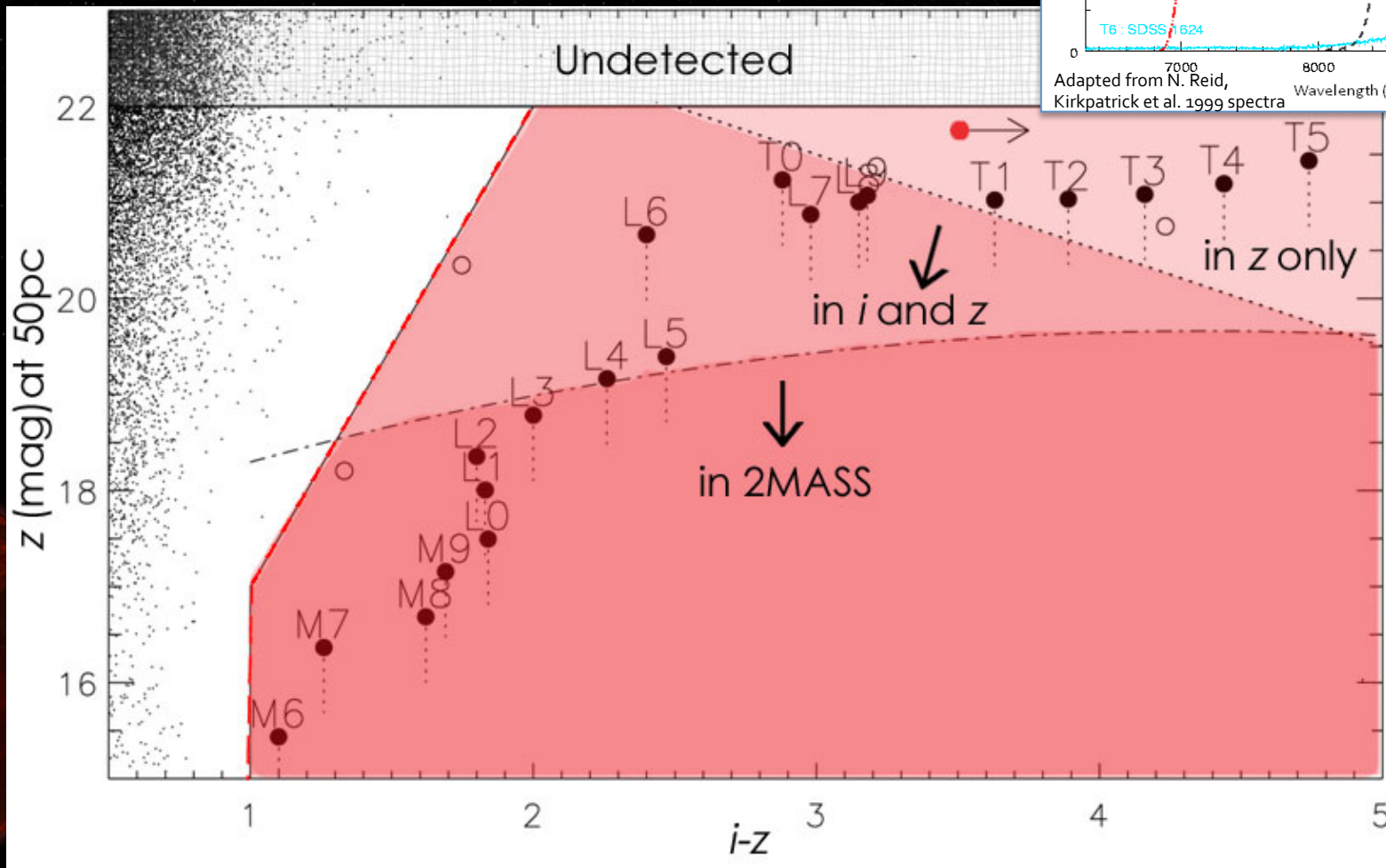
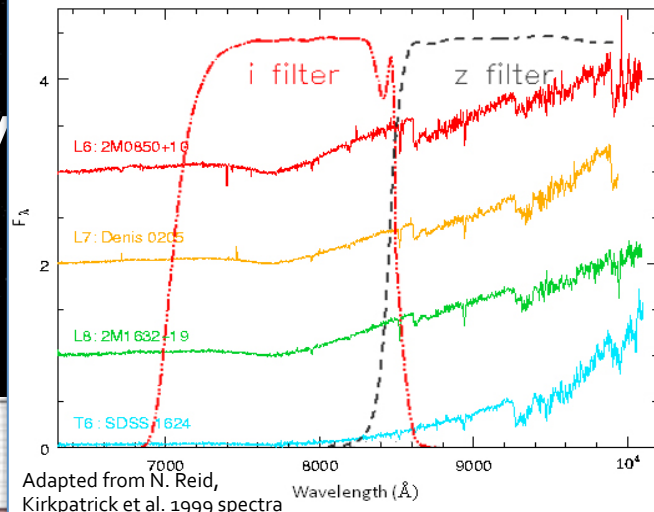
PSYM

- **Instrument:** NICI
(High-contrast Imaging: ADI+SDI in *H* filter)
- To find companions
>2M_{Jup}, 15-300 AU
- **40 stars surveyed: Now: 2nd epochs**

PSYM-wide

- **Instrument:** GMOS
Imaging in *i* (700-850nm)
z (>850nm) filters
- To find companions
>3-5M_{Jup}, 100-5000 AU
- **91 stars surveyed: Ongoing**

The strategy



The sample

Malo et al. 2012, acc in ApJ, arXiv:1209.2077v1

Name of group	Age range (Myr)	Distance range (pc)	Number of stars ^a
<i>β</i> Pictoris (<i>β</i> PMG)	12-22	9-52	31
TW Hydrae (TWA)	8-20	45-92	6
Tucana-Horologium (THA)	10-40	36-74	39
Columba (COL)	10-40	48-81	7
Carina (CAR)	10-40	80-88	2
Argus (ARG)	30-50	40-68	2
AB Doradus (ABDMG)	50-120	15-56	33

^a Members with published Hipparcos trigonometric distance only.

Bayesian analysis:

- IN: $l, J, \mu_{\alpha} \cos \delta, \mu_{\delta}, RA, DEC$ of ★ and known members
- OUT: Membership prob. (%)

Observations to confirm:

- Compare predicted and measured v_{rad} and/or plx

The sample

Malo et al. 2012, acc in ApJ, arXiv:1209.2077v1

- **Nearby** (<100pc)
- **Low-mass** (K₅V-M₅V)
- **Young** (≈ 150 Myr) & **constrained age**
 - With **youth indicators** (H α , X-ray)
 - Confirmed **members of young local associations**

The host star

- M₃V star

V	13.6
R	12.9
J	10.2
Ks	9.4

The host star

- M₃V star
 - Kinematic member of AB Dor MG
 - 96.9% *a priori* membership
 - $v_{\text{rad,meas}}$ coherent with $v_{\text{rad,pred}}$
 - Other signs of youth:
 - $\text{Log}(L_x/L_{\text{bol}}) = -2.99$
 - $H_\alpha \text{EW} = 5.7 \text{ \AA}$
 - $\text{Li EW} \lesssim 10\text{-}30 \text{ m\AA}$
 - $P = 1.0362 \text{ day} = \text{rapid rotator}$
- $\text{Age}_{\text{AB Dor MG}} = 50\text{-}120 \text{ Myr}$

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AB Dor Moving Group	
Age range	50-120 Myr
Distance range	15-56 pc

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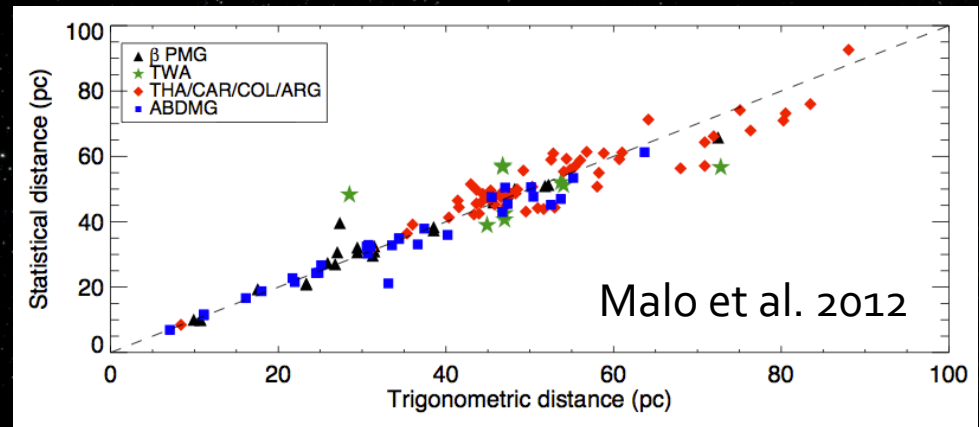
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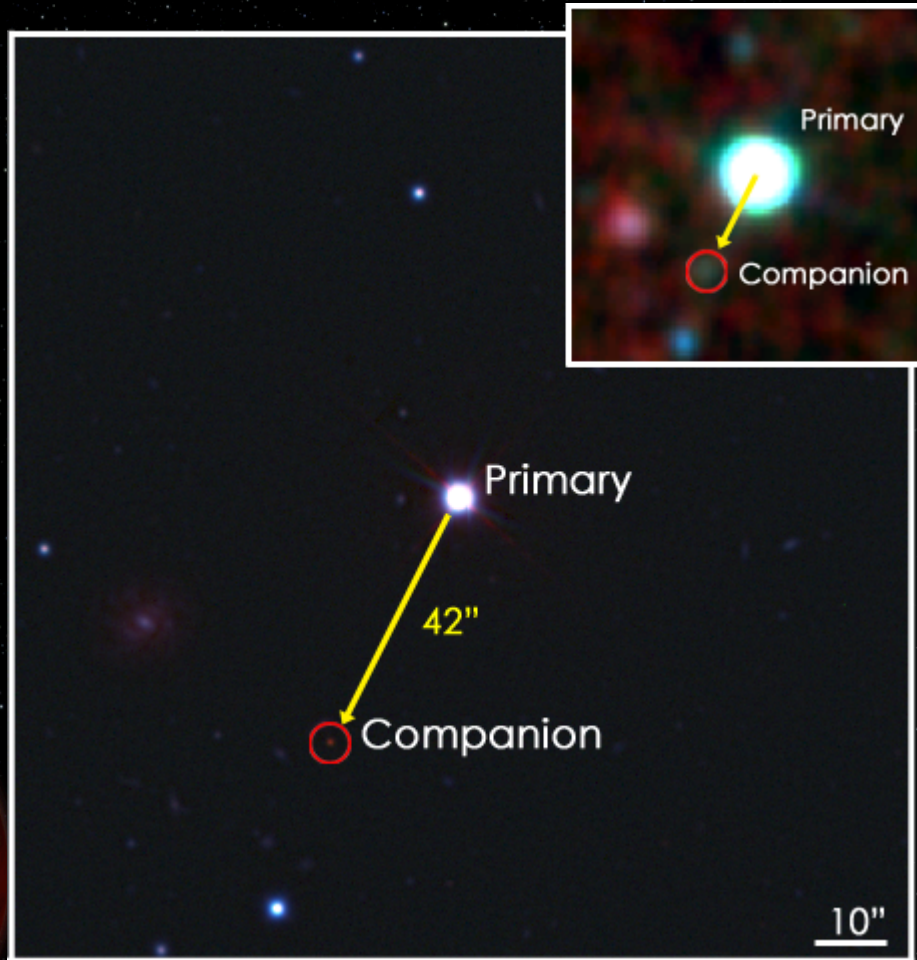
→ $\text{Age}_{\text{AB Dor MG}} = 50\text{-}120 \text{ Myr}$

→ $d_{\text{stat}} = 48 \pm 2 \text{ pc}$

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The companion

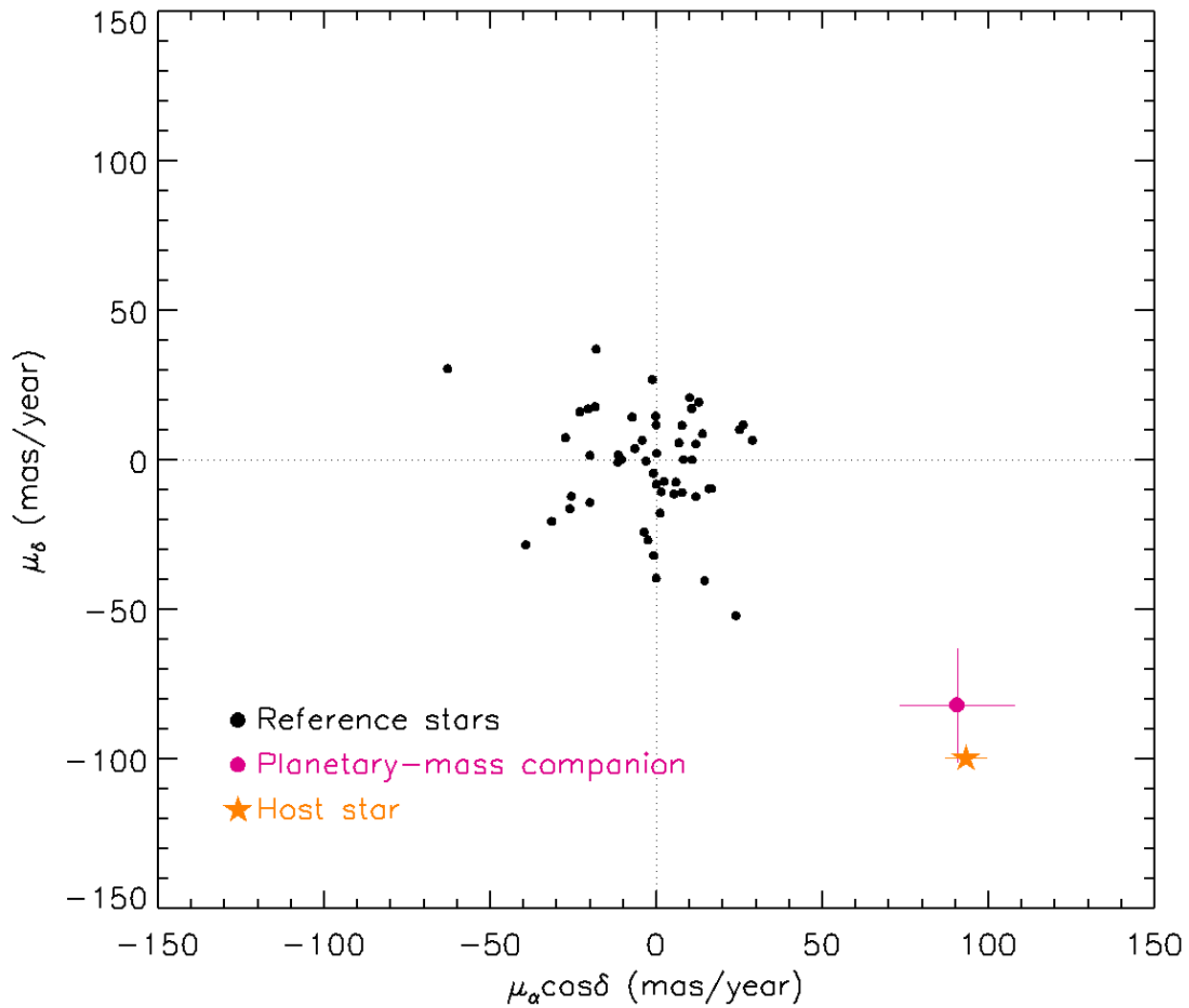


i_{AB}	$>25.28 (3\sigma)$
z_{AB}	21.76
Y_{MKO}	19.37
J_{MKO}	18.12
H_{MKO}	17.68
Ks_{MKO}	17.36
W1 (3.4 μ m)	15.8
W2 (4.6 μ m)	15.0

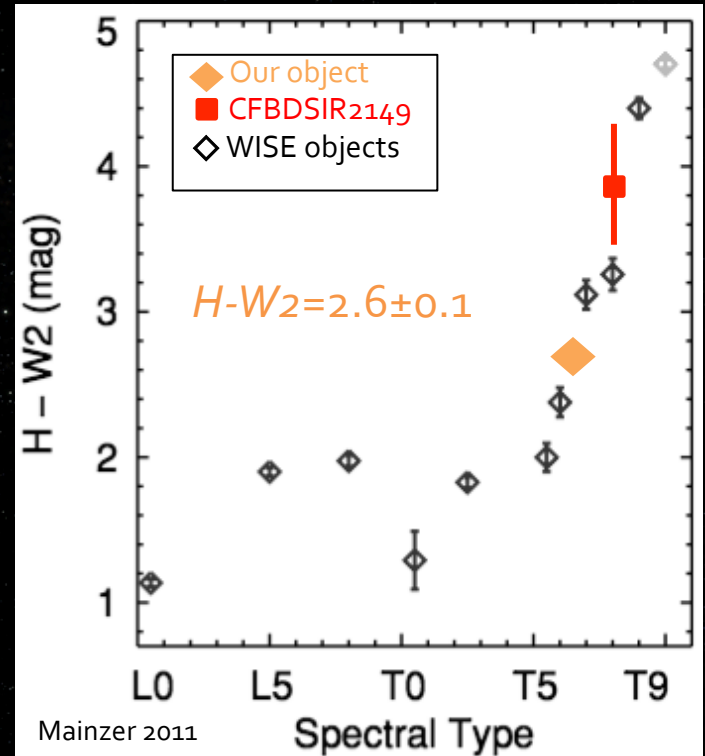
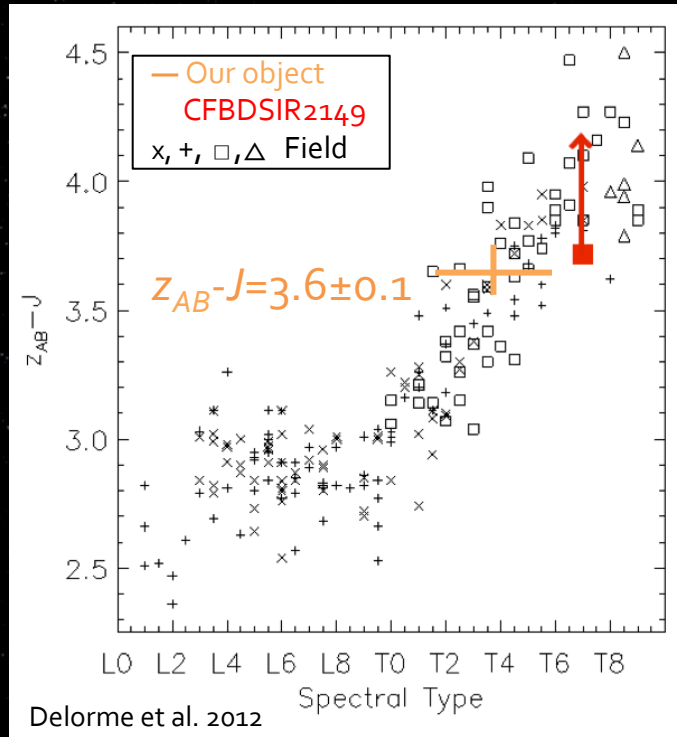
$i_{AB} - z_{AB}$	> 3.51
$z_{AB} - J_{MKO}$	3.64
$J_{MKO} - Ks_{MKO}$	0.76
W1-W2	0.8

a (with $d=48$ pc)	~ 2000 AU
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Common proper motion

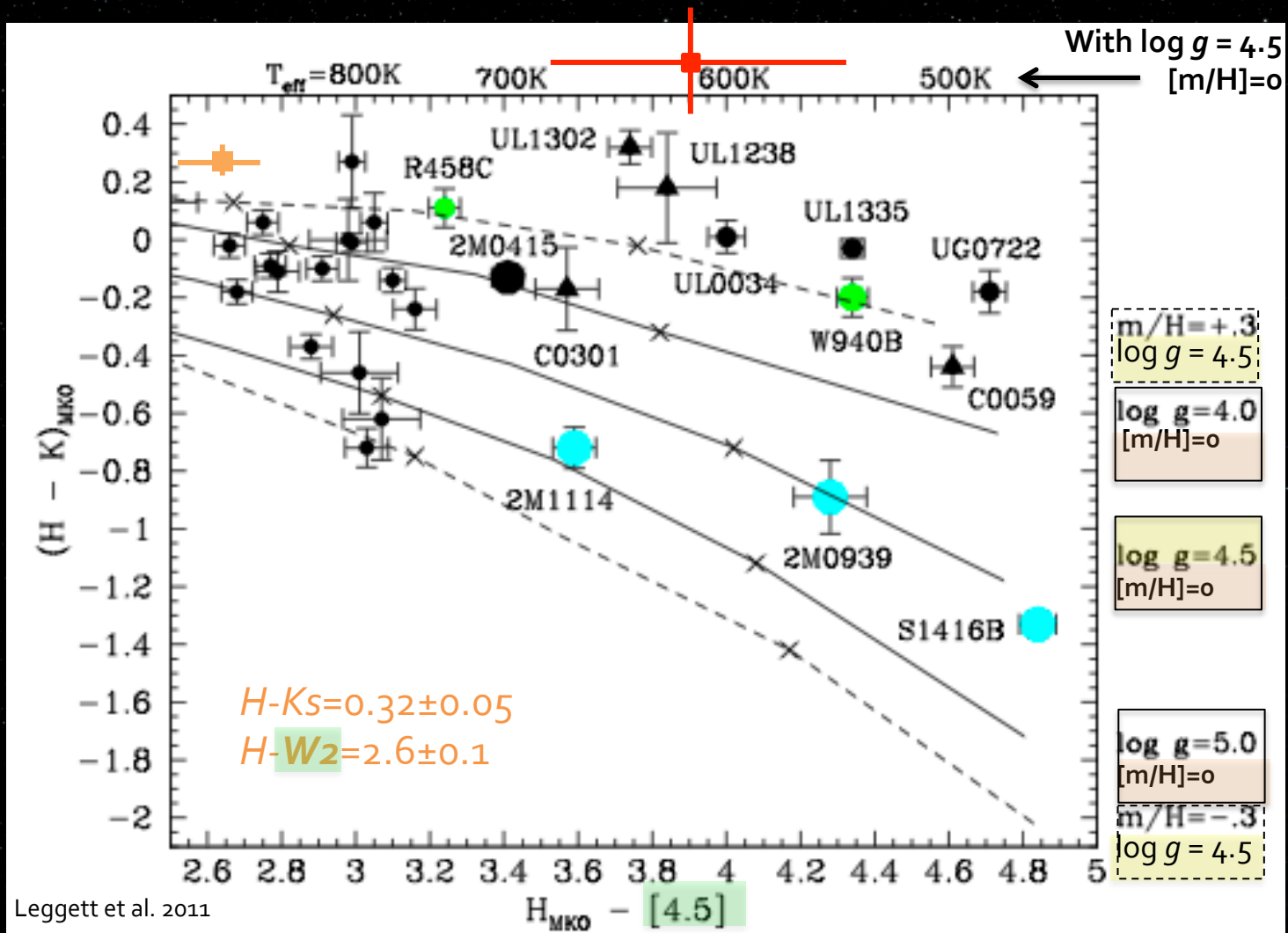


Photometric spectral type



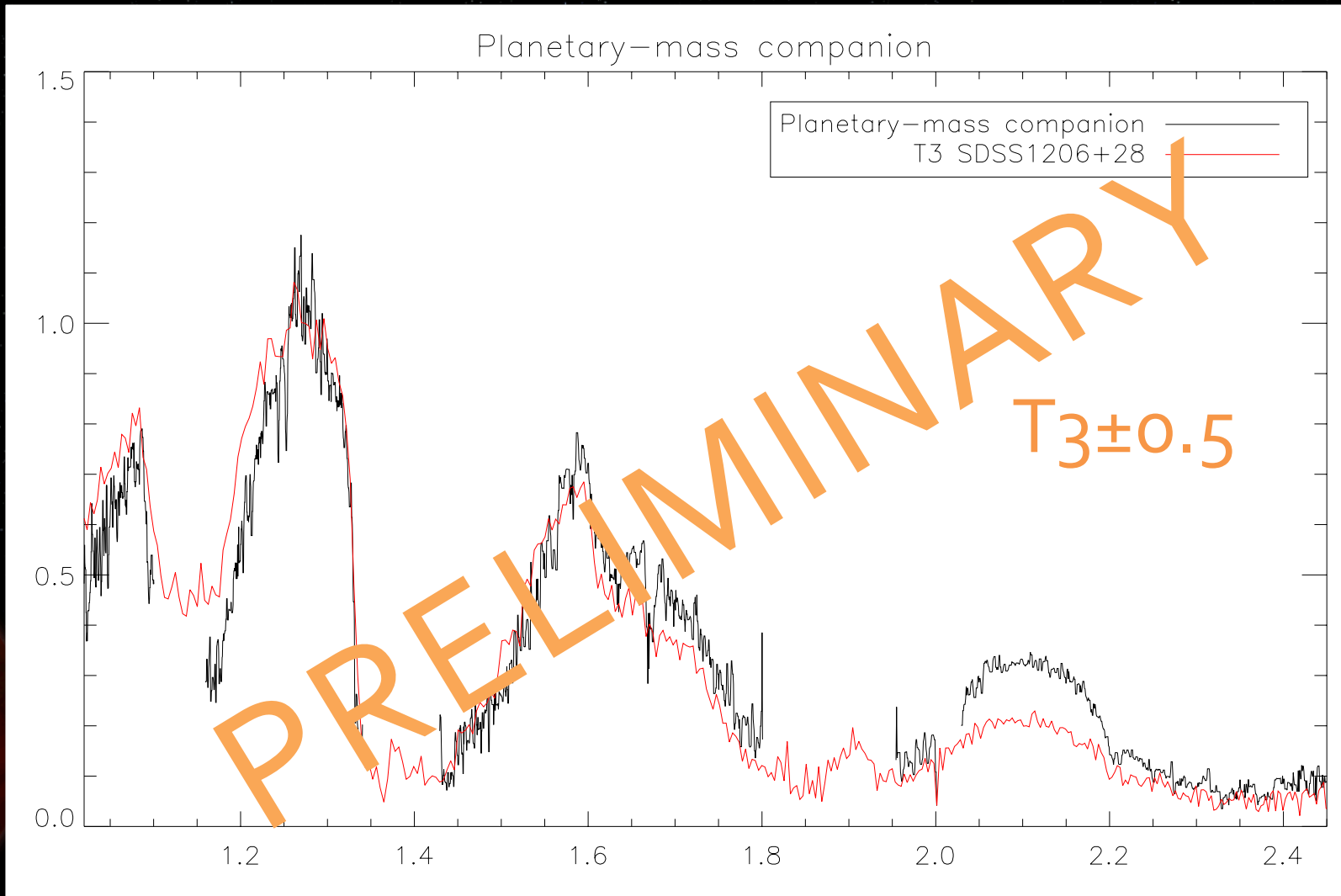
- From $z_{AB} - J$ and $H - W2 \rightarrow$ Sptype = T2-T6
- For comparison: **CFBDSIR2149** (Delorme et al. 2012, arXiv:1210.0305v1)
 - 4-7 M_{Jup} free-floater, AB Dor MG probable member
 - Sp. Type (spectr.): T7

Evidence of low $\log g$



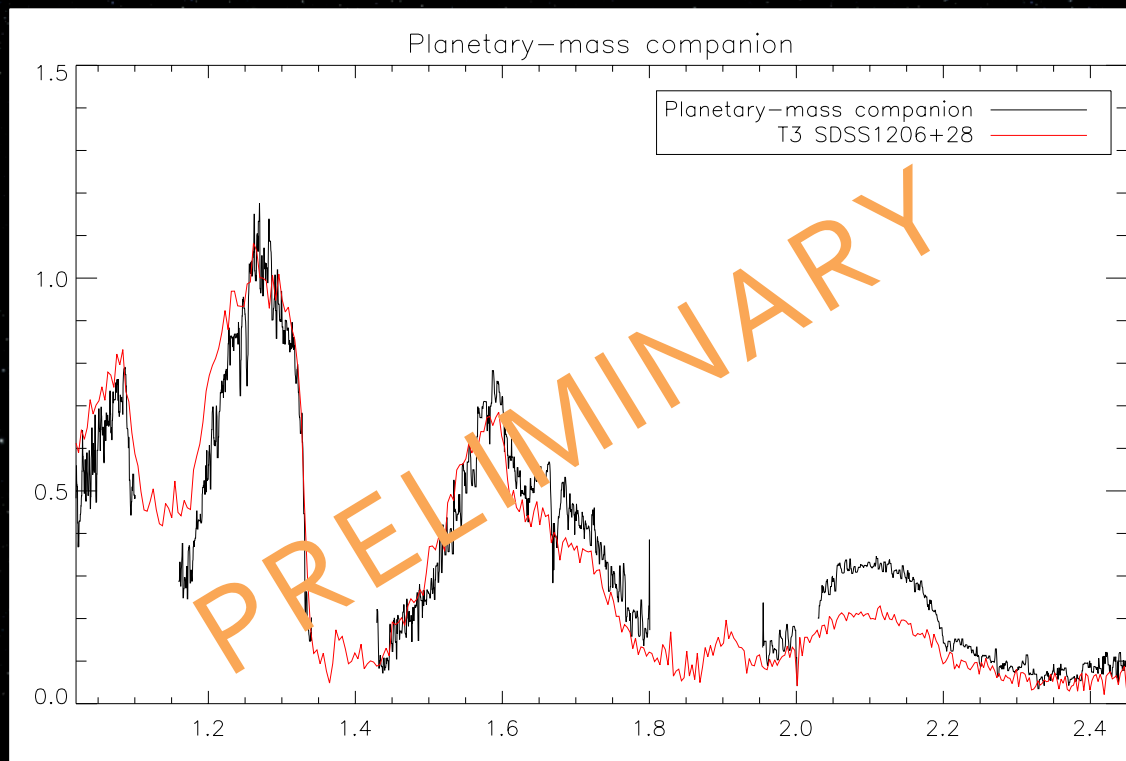
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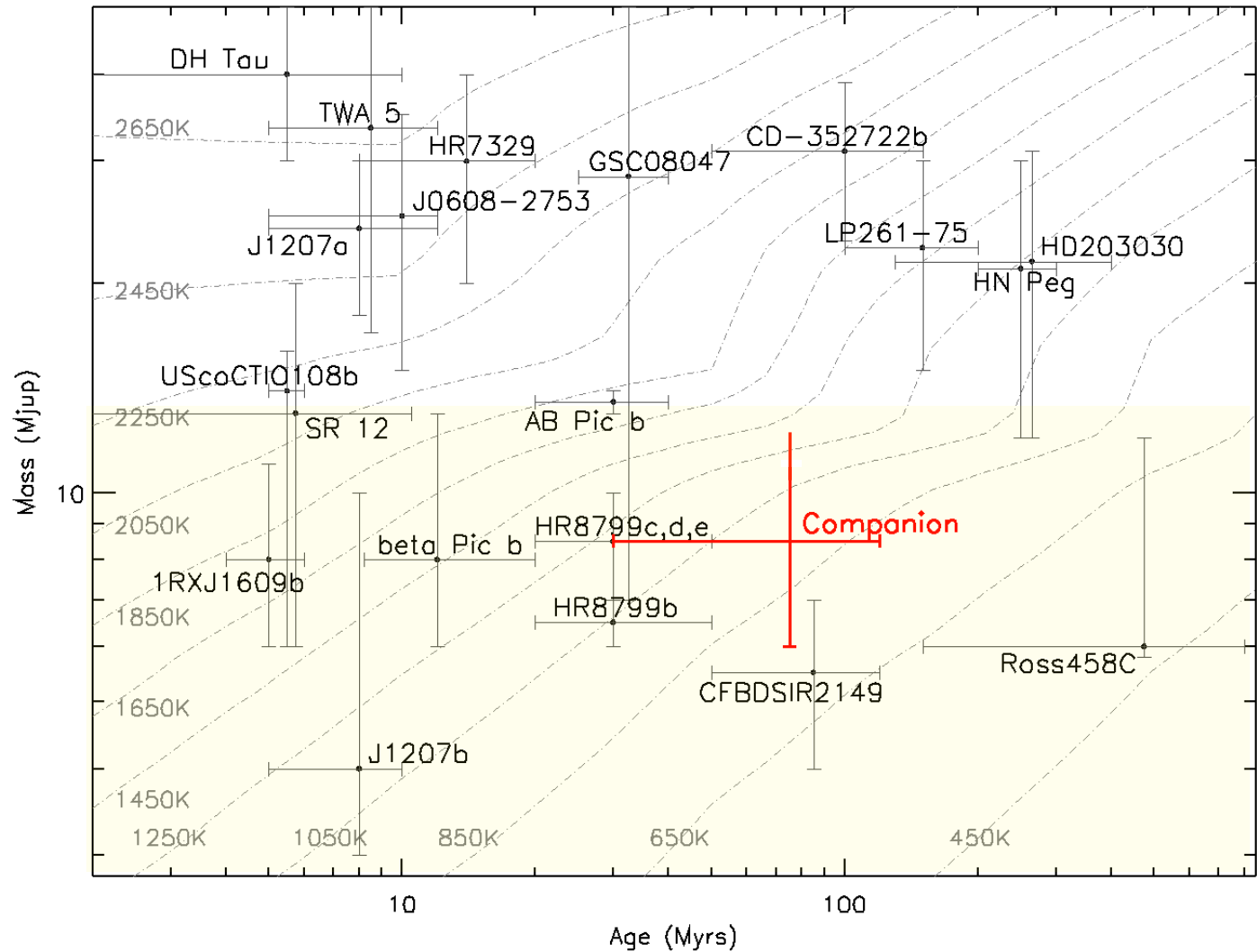


→ Sptype = ~~T2-T6~~ $T_{3 \pm 0.5}$ → $T(\text{Stephens2009}) = \text{900-1300K}$ → $\sim 1200\text{K}$

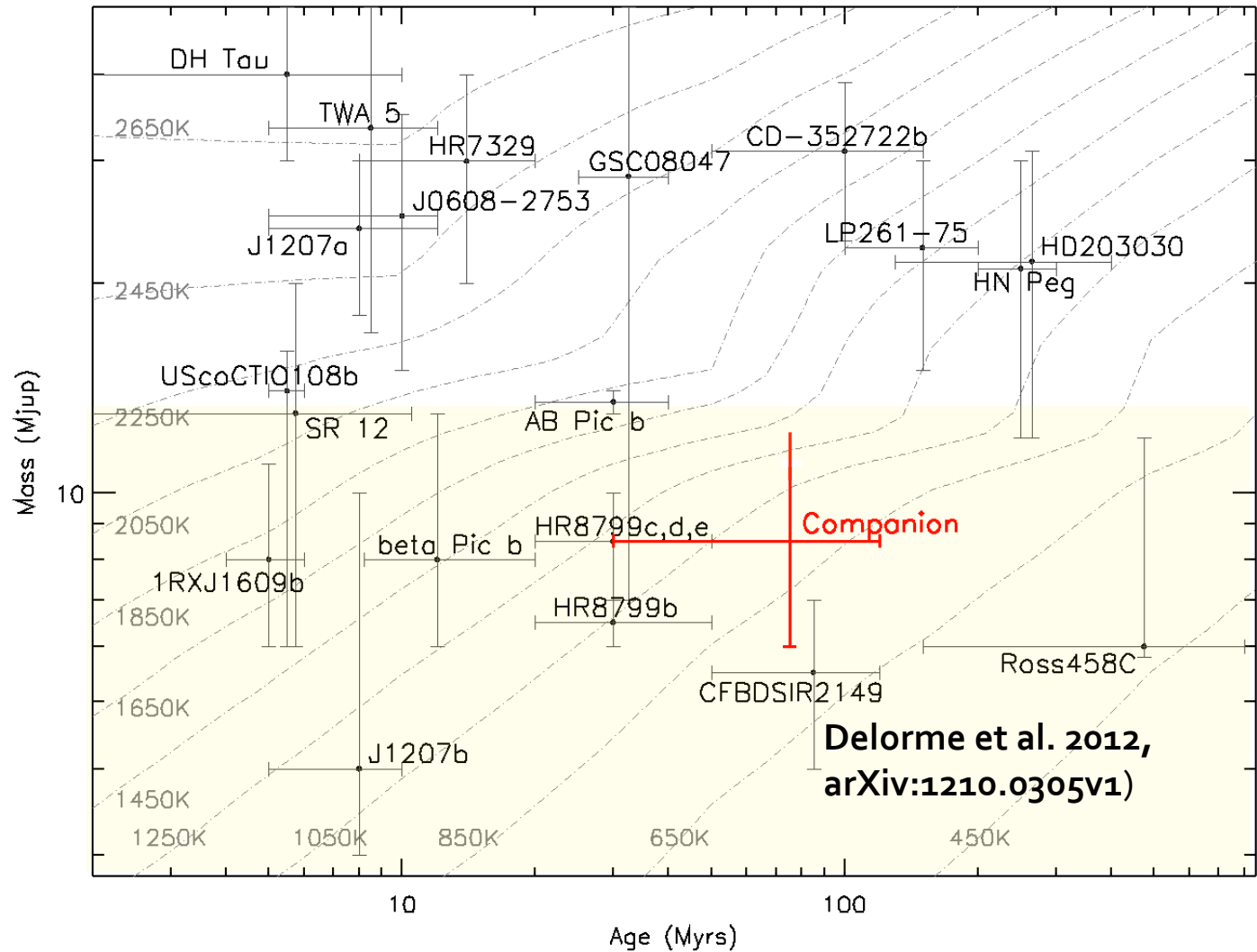
→ Age = 70_{-20}^{+50} Myr

→ $M(\text{BTSettl}) \sim 7-12 M_{\text{Jup}}$ (planetary-mass)

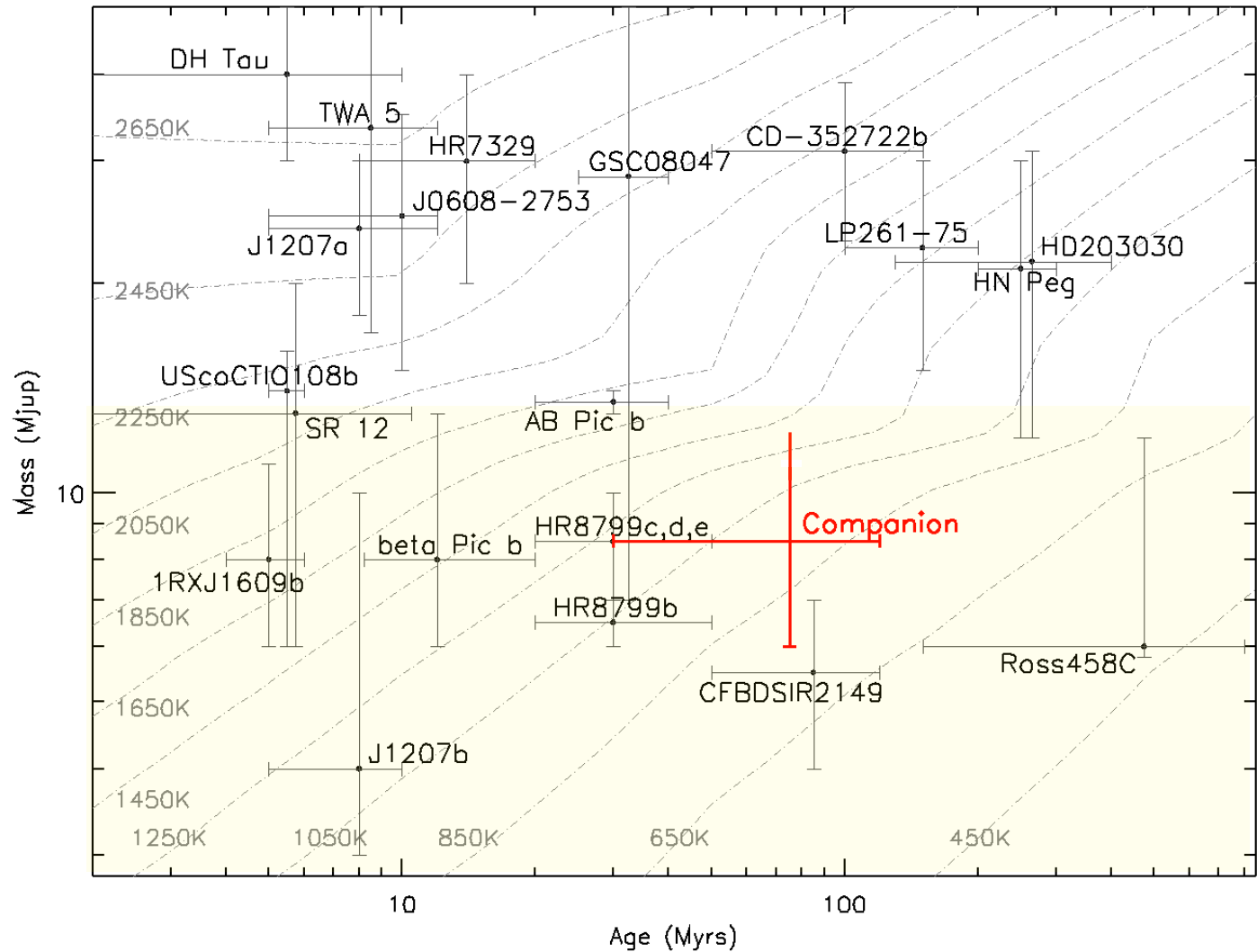
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- With GMOS *i* and *z* photometry, 1 companion was found (out of 90 stars):
 - **Young** (with constrained age) : 50-120Myr
 - **Planetary-mass** : $7-12M_{\text{Jup}}$
 - **Very far** from host : $\sim 2000\text{AU}$ \rightarrow proxy for close-in planets

Conclusion

- Direct imaging surveys can detect PM companions
- With GMOS *i* and *z* photometry, 1 companion was found (out of 90 stars):
 - **Young** (with constrained age) : 50-120Myr
 - **Planetary-mass** : 7-12M_{Jup}
 - **Very far** from host : ~2000AU → proxy for close-in planets
- Future work:
 - **NIR spectra analysis**
 - Other companions?
 - **Parrallaxe** of the system
 - Measure of the **metallicity** of the system
 - ...

All this (and more!) in a Naud et al. 2013 (in prep)

Thanks!

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