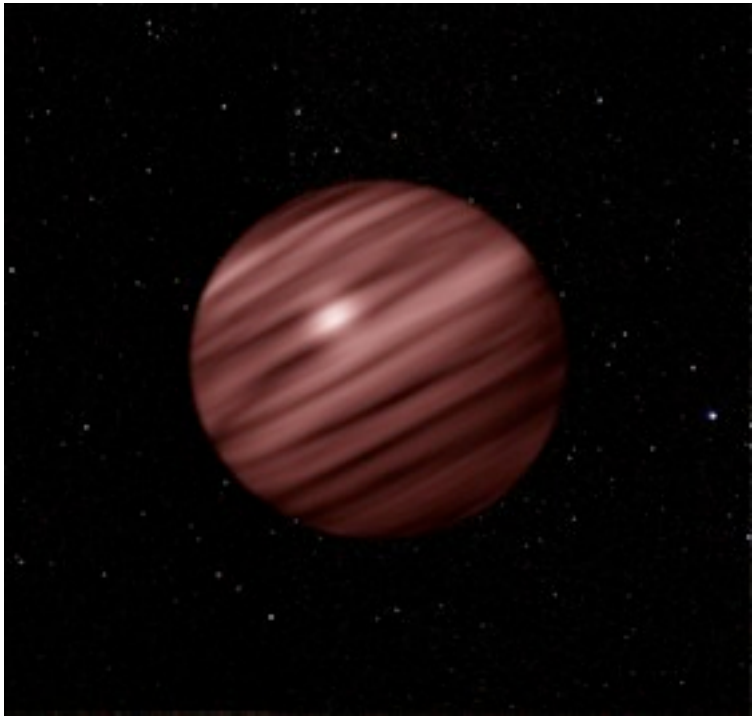
Last news from the Canada-France Brown Dwarfs Survey: looking for field brown dwarfs



C. Reylé (Besançon),
P. Delorme (St Andrews),
T. Forveille, X. Delfosse (Grenoble),
C. Willott(Toronto),
L. Albert (CFHT),
E. Artigau(Montréal)

Science Objectives

CFBDS: science objectives

=>Looks for brown dwarfs in a wide field far-red survey

=>Build a large sample to constrain field brown dwarfs space density and mass function

Young clusters: ~constrained

Field: Biased by low statistics and age-mass degeneracy

=>Find thick disc and halo, low-metallicity, brown dwarfs

=>Link stellar and planetary atmospheres: more and more complex chemistry!

Y dwarfs: the missing link between stars and planets

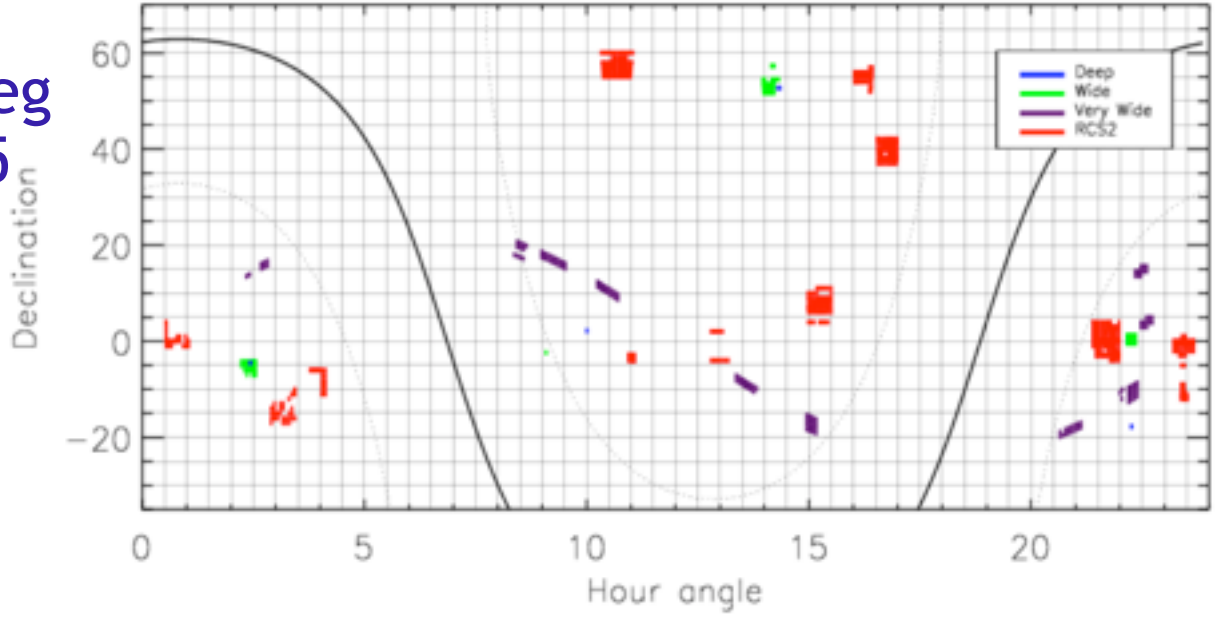
Put constraints on theoretical models: probe the temperature range between the coldest BDs (~525K) and Jupiter (100K).

The Survey

CFBDS: the survey

=> Survey in *i'* and *z'* filters, conducted by Megacam (1x1deg camera) at the Canada-France-Hawaii-telescope (3.6 m)

=> Covers about 780 sqdeg to typical limit of *z'*=22.5



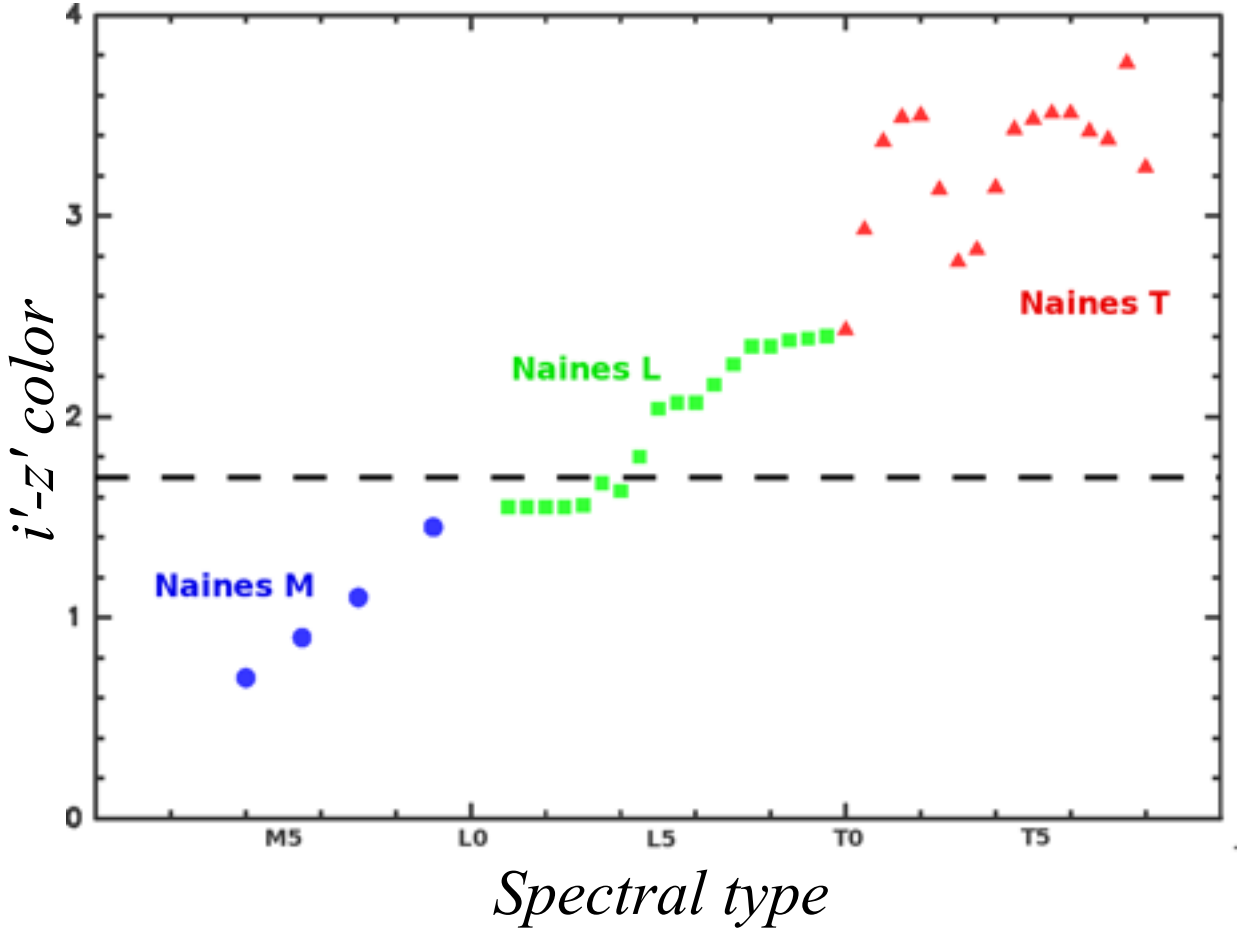
=> Over 50 000 000 sources analysed, hundreds being brown dwarfs

=> Reddest sources are followed-up with pointed J-band imaging to distinguish brown dwarfs from other astronomical sources

=> Spectra are obtained for the latest type dwarfs

CFBDS: the survey

candidate selection and analysis



Good *i'*-*z'* dynamics
L and T dwarfs *i'*-*z'*≥1.5
Our selection *i'*-*z'*≥1.7

Typical limit *z'*=22.5:

mid-L	215 pc
early-T	180 pc
late-T	50 pc

CFBDS: the survey
candidate selection and analysis

1. Sextractor+PSF fitting on *i'* and *z'* images
   ~50 000 sources per sqdeg
2. Catalogue matching and candidate selection
   ~1000 candidates per sqdeg
3. Filtering based on the χ^2 from the PSF-fitting
   10-50 candidates per sqdeg
4. Visual inspection, supernovae and asteroid rejection
   1-3 candidates per sqdeg => ~1400 in total

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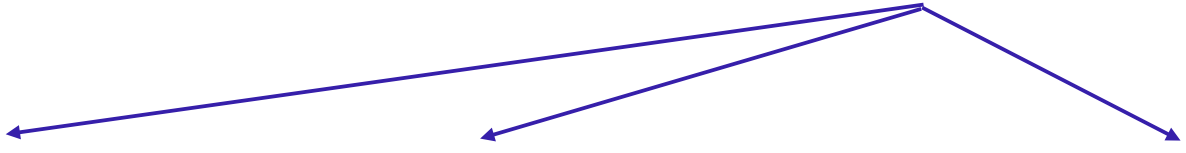


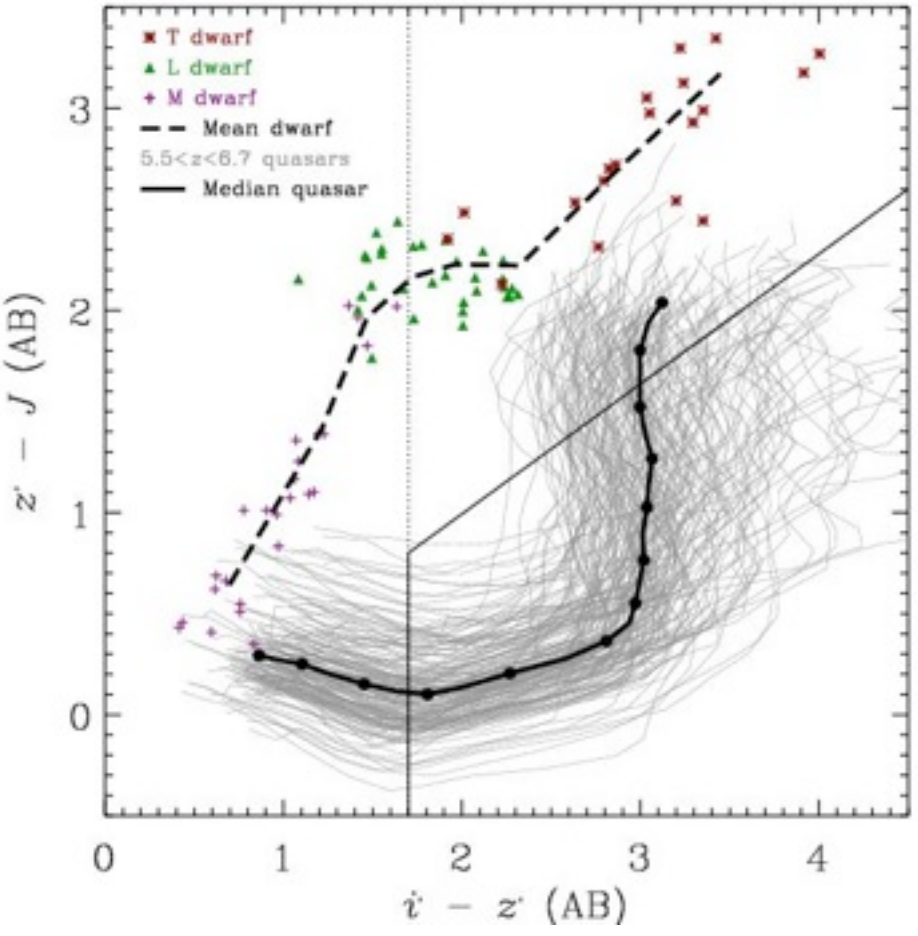
Brown dwarfs

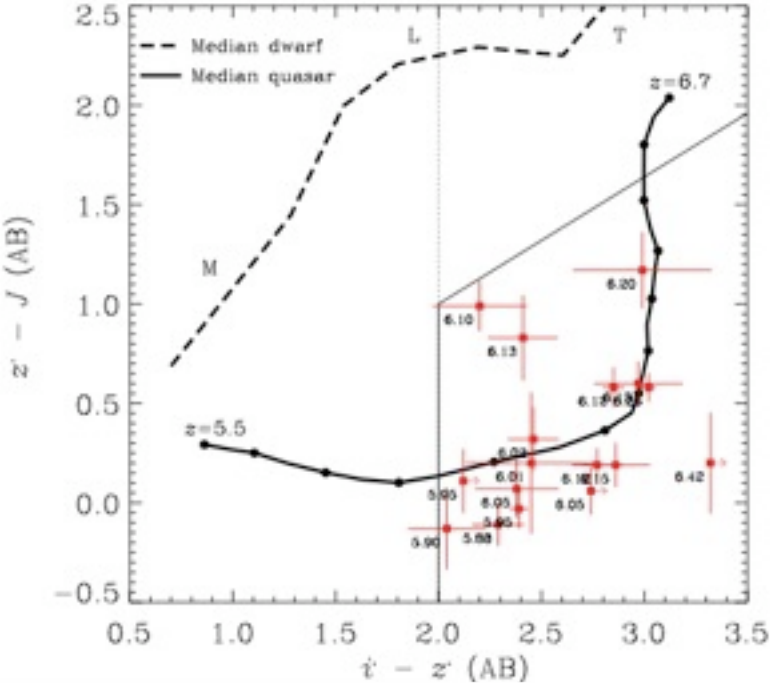
quasars redshift z>6

contaminants (M-dwarfs, false detections)

CFBDS: the survey

J-band follow-up





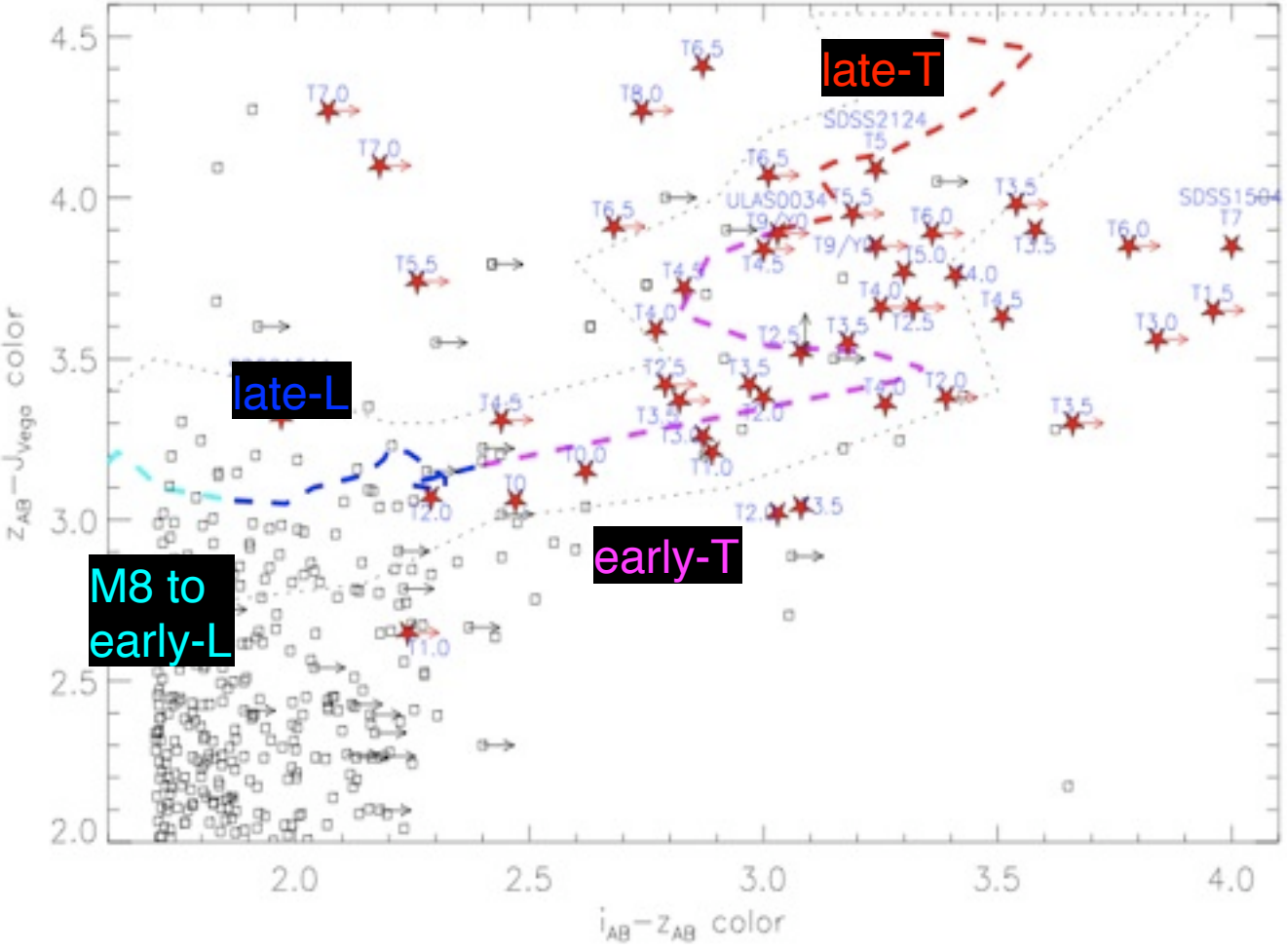
10 high-z quasars *(Willott et al., 2007, 2009)*:

QSO luminosity function

contribution to reionization

CFBDS: the survey

global sample



1060 candidates with J-band photometry

~300 L-dwarfs
~80 T-dwarfs

Spectroscopic follow-up for ½ of T-dwarfs *(Albert et al., in prep)*

The field brown dwarfs space density and luminosity function

Field BD space density

Complete sample of 102 late-L and T dwarfs with J-band follow-up over 444 sqdeg:

61 L5-T0 28 T0.5-T5 13 T5-T/Y

Space density ρ. Comparison with *Cruz et al. 2007, Metchev et al. 2008*

Spectral type	ρ(Metchev & Cruz) ρ(10^{-3}objects pc^{-3})	ρ(CFBDS)	expected number within 10 pc
L5-T0	$> 1.5 \pm 0.2$	$2.0^{+0.8}_{-0.7}$	
T0.5-T5.5	2.3 ± 0.9	$1.4^{+0.3}_{-0.2}$	6 ± 1
T6-T8	$4.7^{+3.1}_{-2.8}$	$5.3^{+3.1}_{-2.2}$	22^{+13}_{-9}
T8.5-T/Y	–	$8.3^{+9.0}_{-5.1}$	35^{+38}_{-21}

Reylé et al., submitted

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Reylé et al., submitted

Low-mass BD and old BD accumulate in this SpT range. At least 3 more T8+ in UKIDSS *(Burningham et al. 2008, 2009)*

ALL DETAILS IN THE POSTER BY P. DELORME

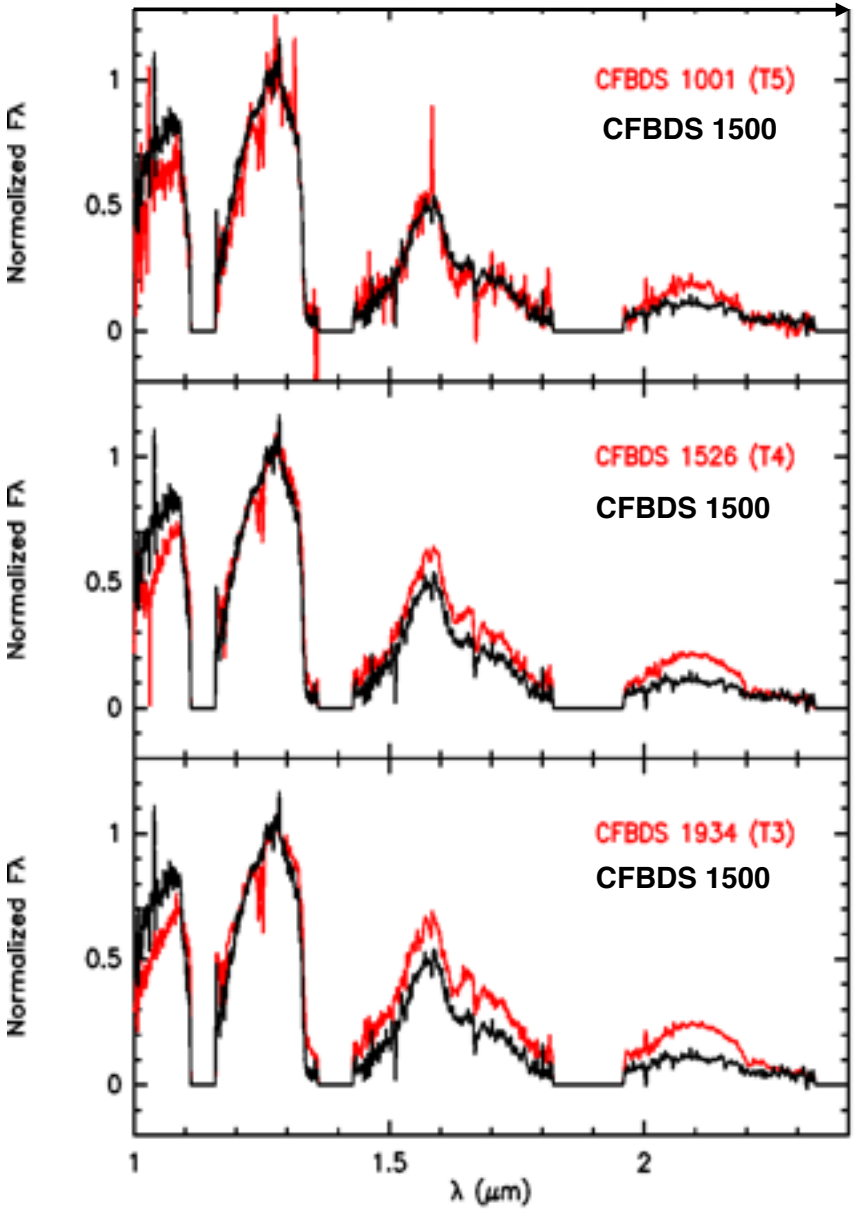
A mid-T subdwarf

A mid-T subdwarf

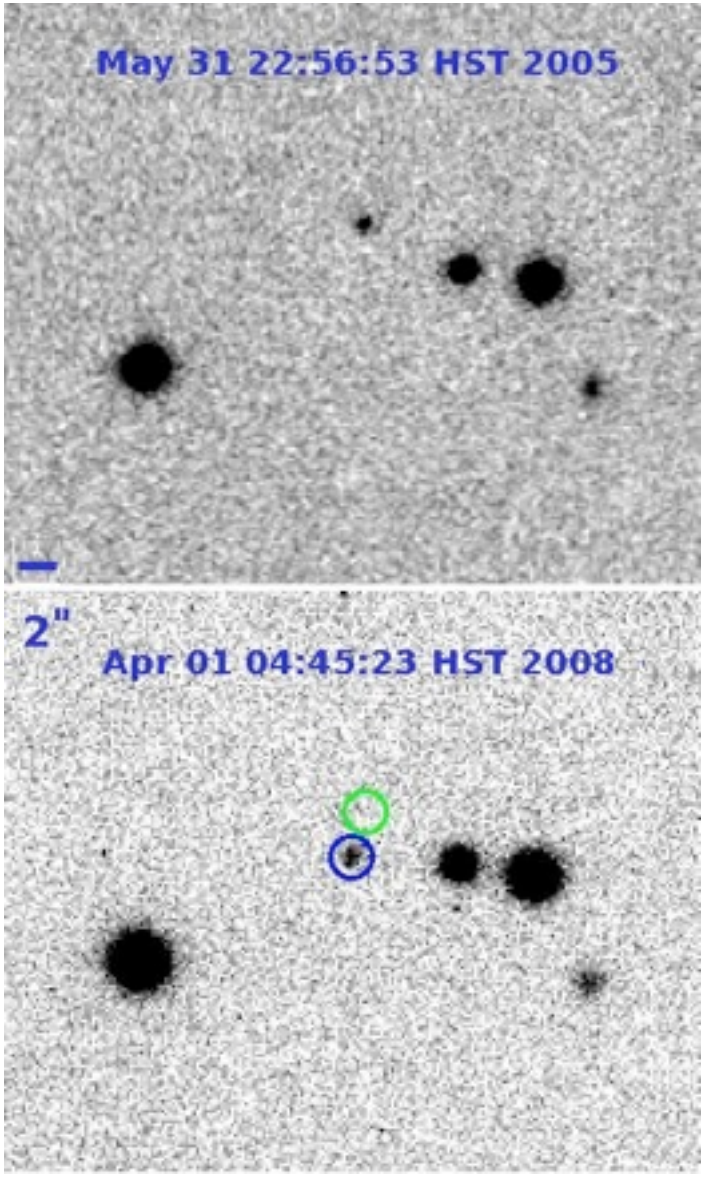
Very few metal-poor ultra-cool dwarfs currently known.
The latest: a late sdL *(Burgasser et al. 2003, 2007)*

The vast majority of 10 Gyr BD have cooled to T dwarf temperatures.
Only one low metallicity T6 ([M/H] =-0.2), probably belongs to the old thin disk *(Burgasser et al. 2002, 2006)*

CFBDS1500 T4.5
No 1.25 µm potassium doublet
=> [M/H] = -0.3 to -0.5



A mid-T subdwarf



CFBDS1500

High proper motion μ = 0.73 "/yr

d = 45±10 pc

=> v_t = 150 km/s

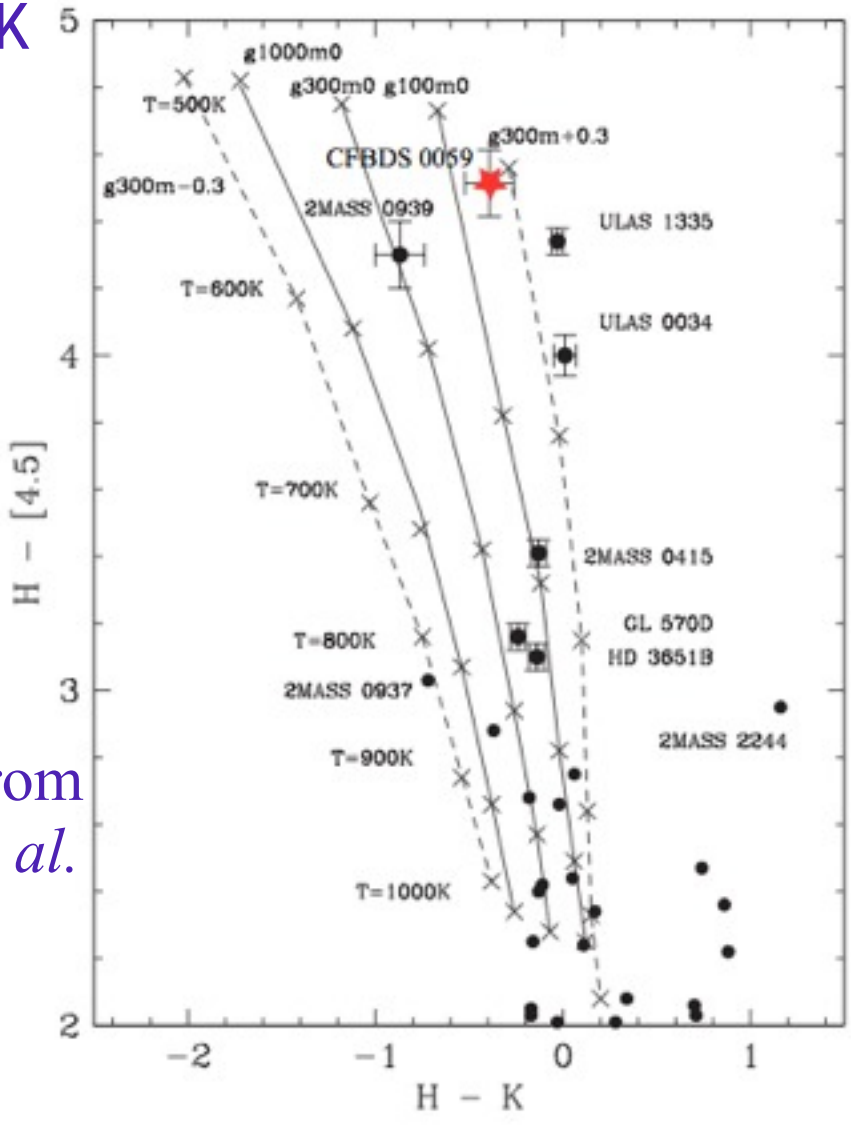
Implies a 80% probability that it belongs to the thick disc (from the Besançon stellar population model, *Robin et al. 2003*)

Delfosse et al., submitted

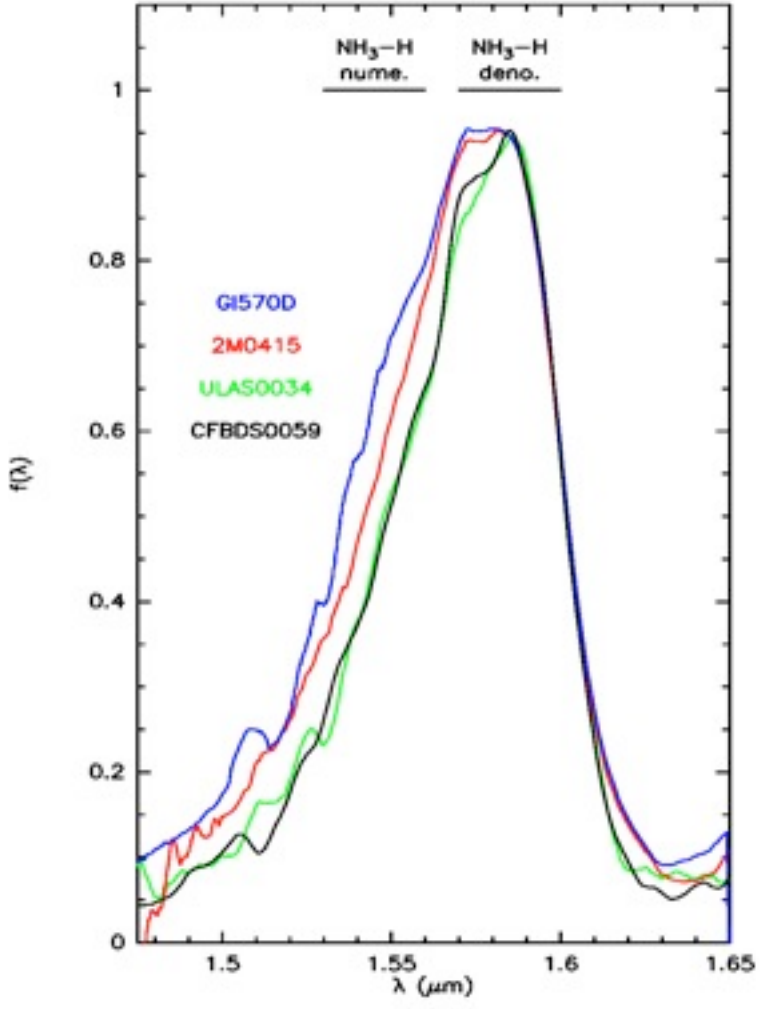
Ultracool brown dwarfs

Ultracool brown dwarfs

CFBDS0059 *Delorme et al., 2008* New mid-IR colours point to T=525 K



adapted from *Leggett et al. 2009*



Binaries

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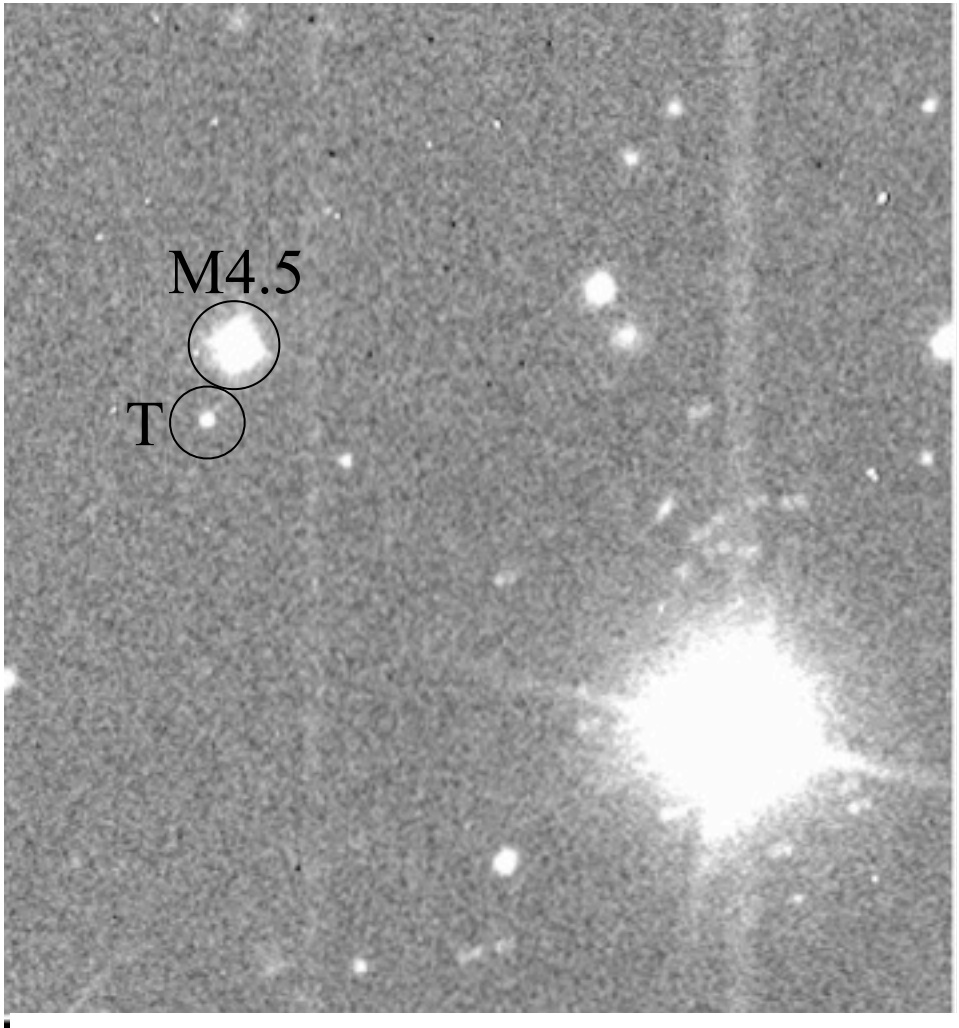

Only 8 MS+T resolved system confirmed

M4.5+early T, common proper motion

d=150 pc, vt=140 km/s
high tangential velocity=>probe atmospheric physics for high gravity and low metallicity

Separation ~1000 AU

Ongoing

Ongoing

CFBDS-W a survey with WIRCAM to detect T/Y dwarfs

180 sqdeg to J=20 on top of CFBDS fields => late T dwarfs not detected on the z' images in CFBDS

Today 66 sqdeg analysed:

- 76 T dwarfs candidates with z'-J>3.0
- 5 of them confirmed to be >T7
- 14 of them confirmed to be early and mid-T
- CFBDSIR1458: ultracool dwarf T/Y

Complete survey: ~15 >T7, 2-6 T/Y