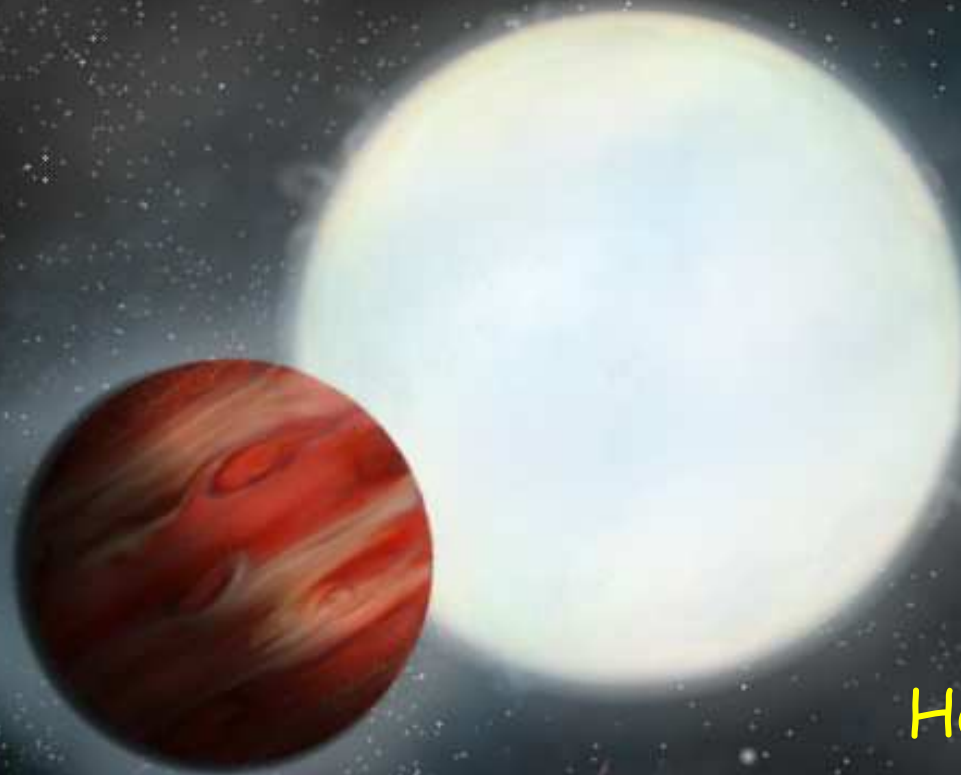


WTS1-b: the first planet detected in the WTS

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Hot Planet and Cool Stars
November 12th, 2012

JTP

Cappetta et al. 2012, MNRAS in press, astro-ph/1210.1217

Outline

- Observations
 - Photometry & Spectroscopy
- Candidate detection
 - J-band light curve
- Parent star characterization
 - SED analysis
 - Spectroscopic analysis
- Planet confirmation
 - Light curves fit
 - False positive EB test
 - High precision RV measures
- Discussion & conclusions

Observations

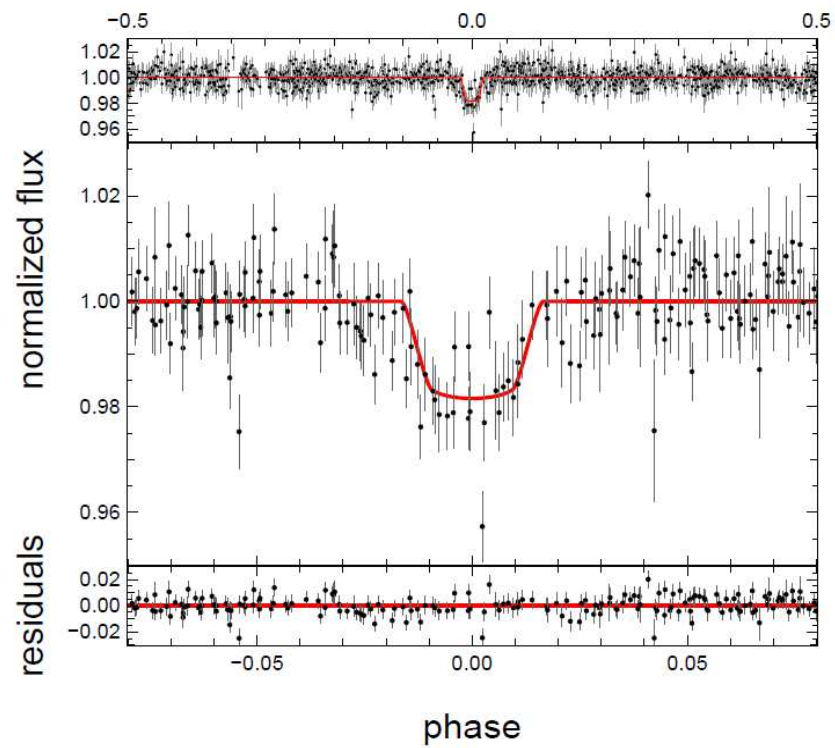
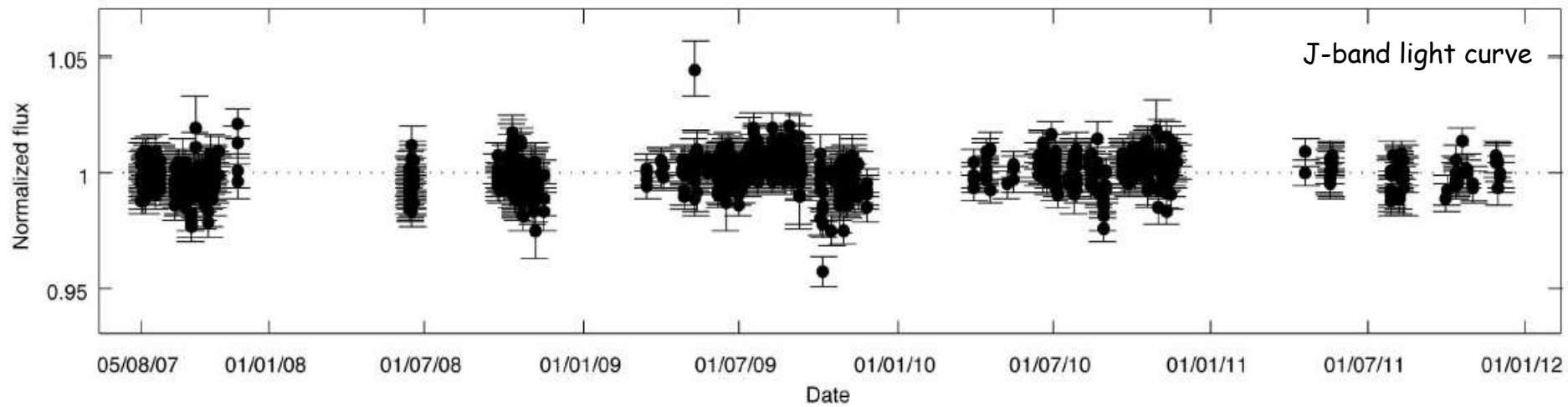
Photometry:

- UKIRT/WFCAM J-band light curve
- INT/WFC i'-band light curve
- SDSS, WFCAM, 2MASS, WISE, Bayfordbury

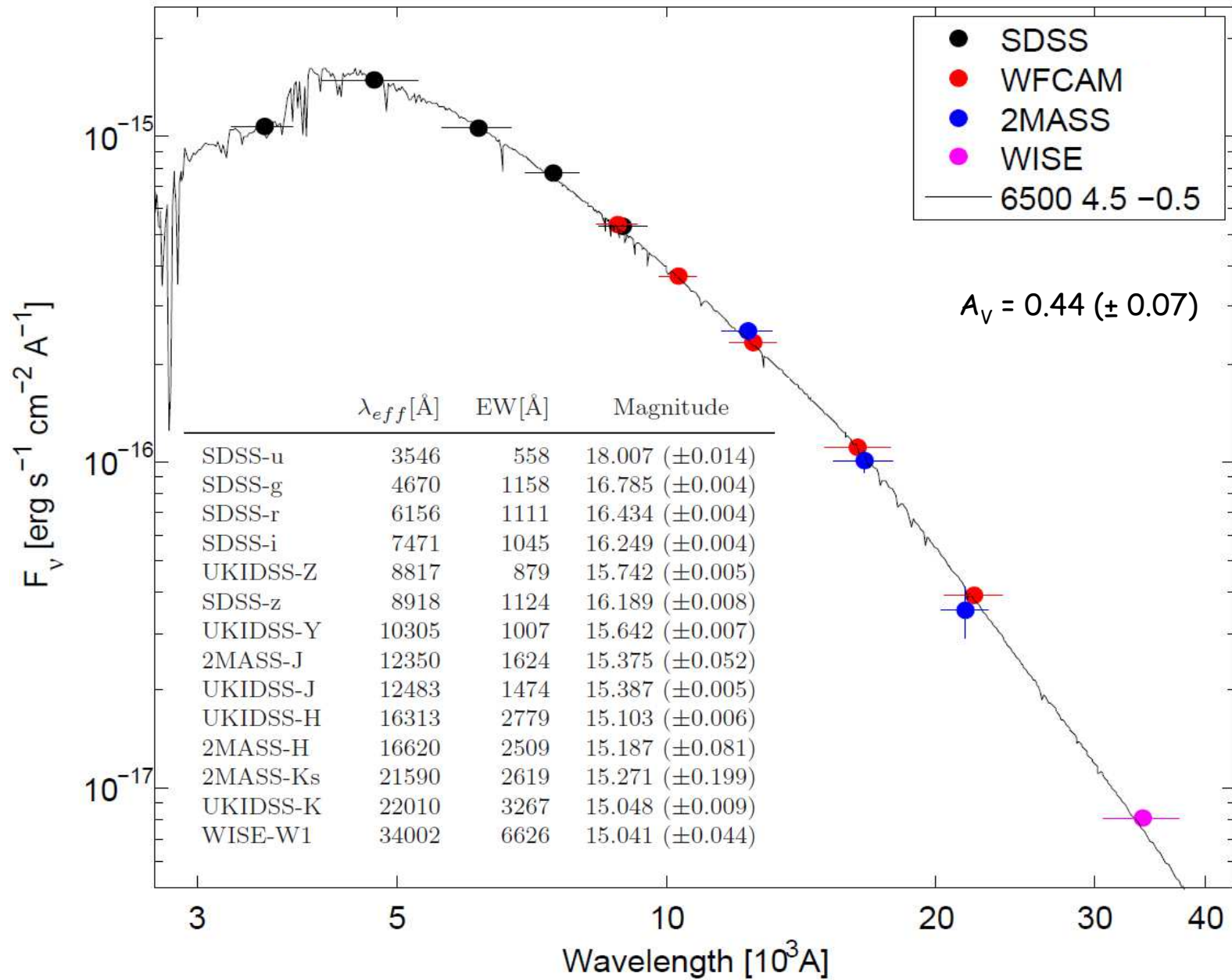
Spectroscopy:

- HET/HRS high resolution spectra (11 obs., $R=60000$, 4900-7000Å)
- WHT/ISIS int. resolution spectra (4 obs., $R=9000$, 8100-8900Å)
- WHT/ISIS low resolution spectra (1 obs., $R=1000$, 5000-9000Å)
- 2.2m Calar Alto/CAFOS low resolution spectra (1 obs., $R=1900$, 5850-9500Å)

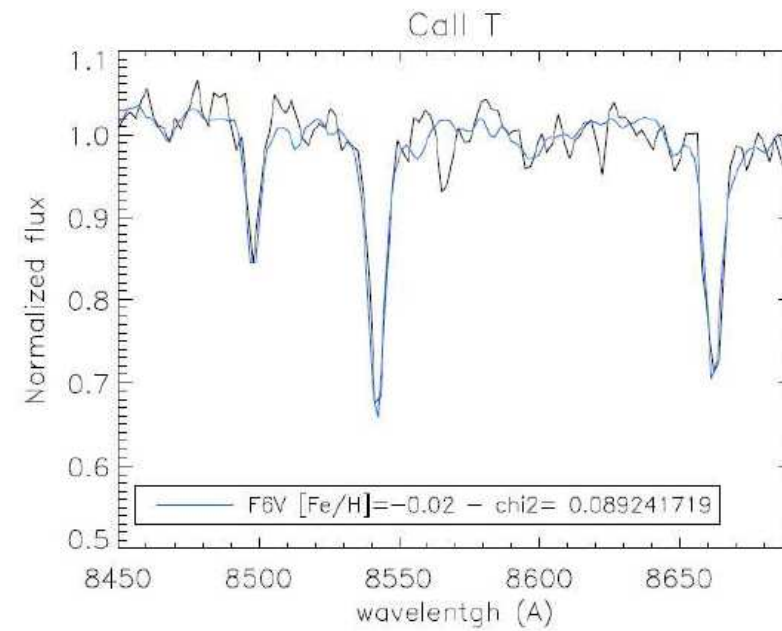
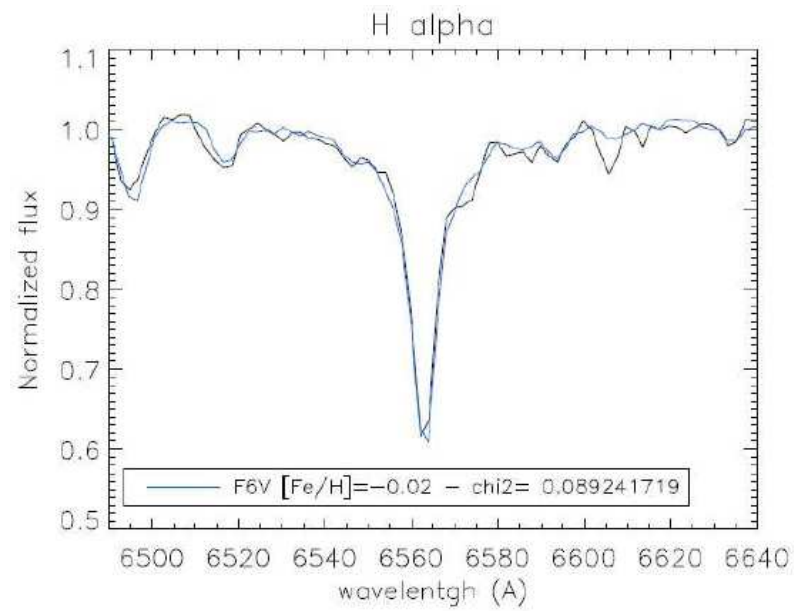
Candidate detection



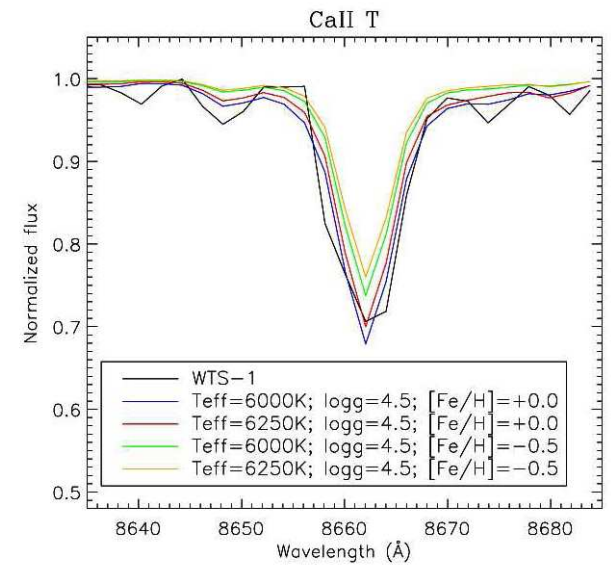
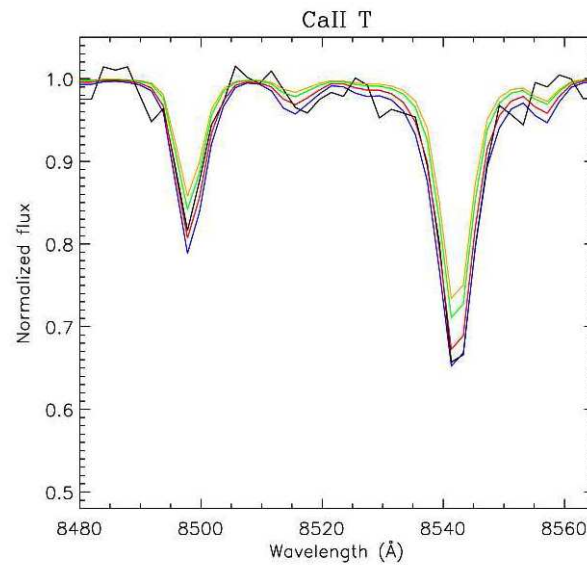
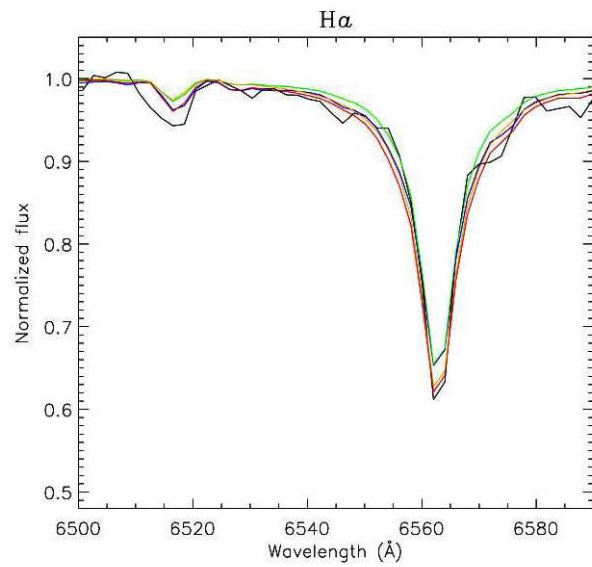
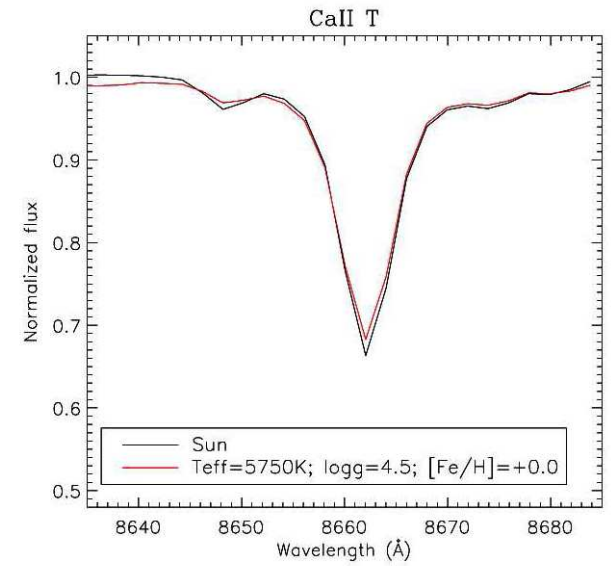
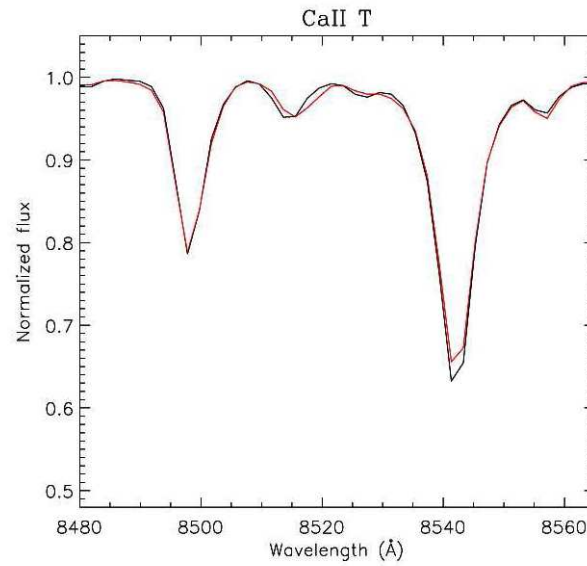
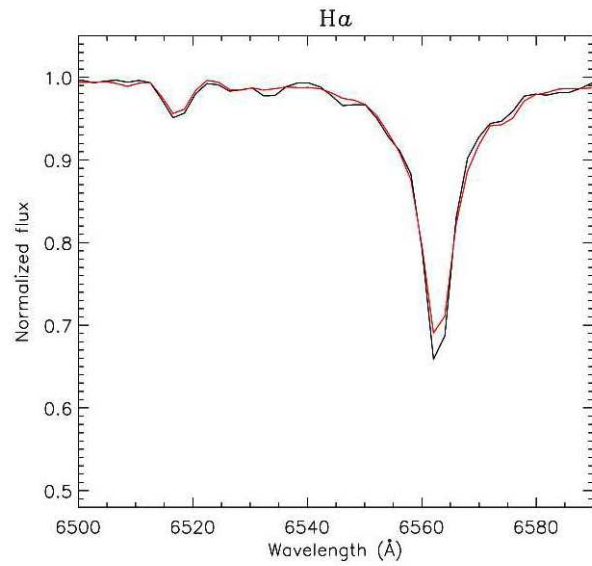
SED analysis



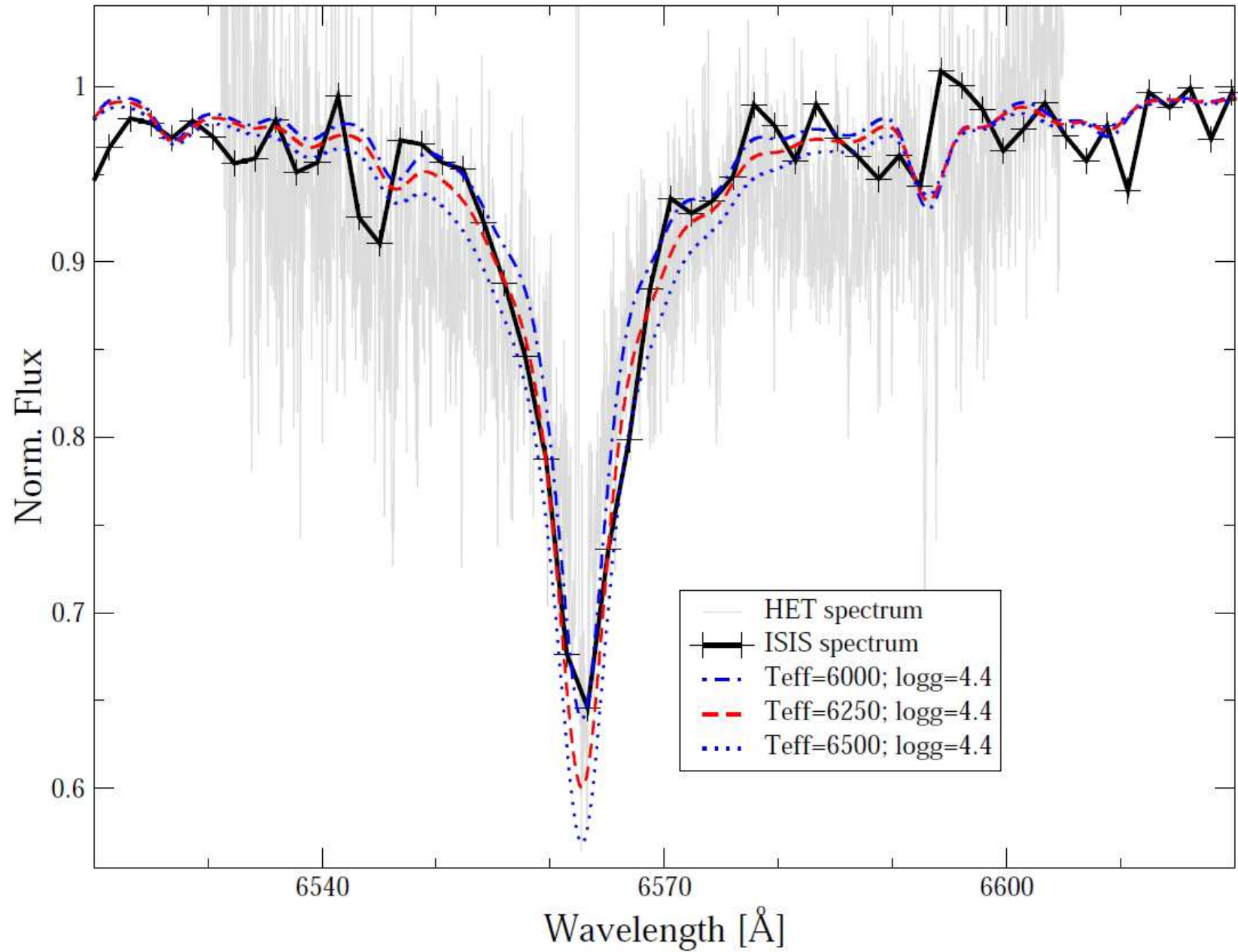
Spectroscopic analysis



Spectroscopic analysis



Spectroscopic analysis



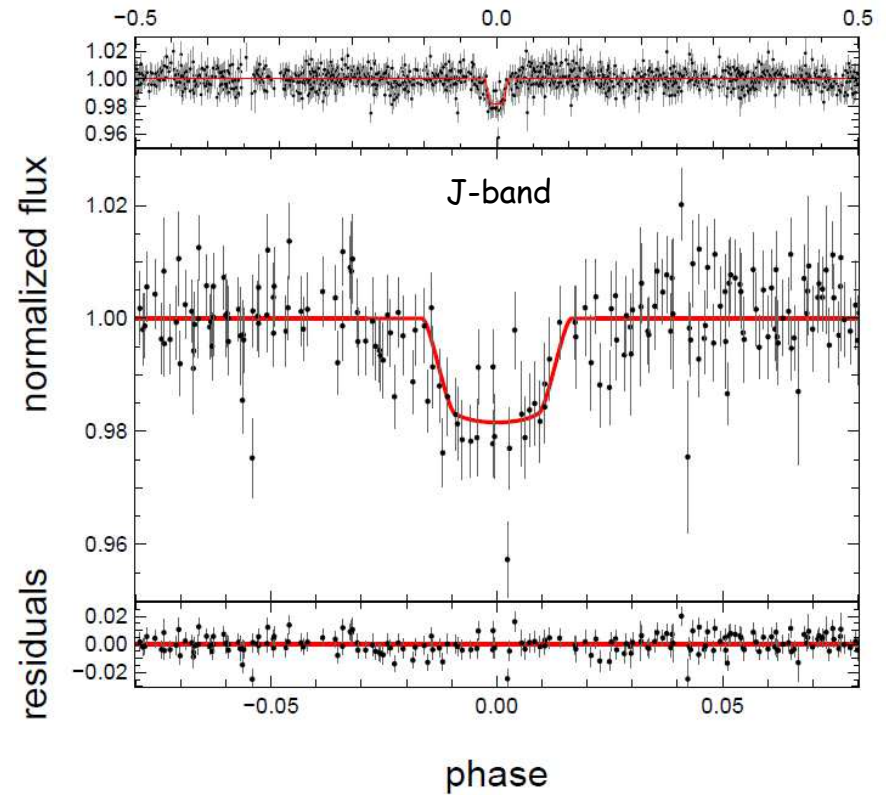
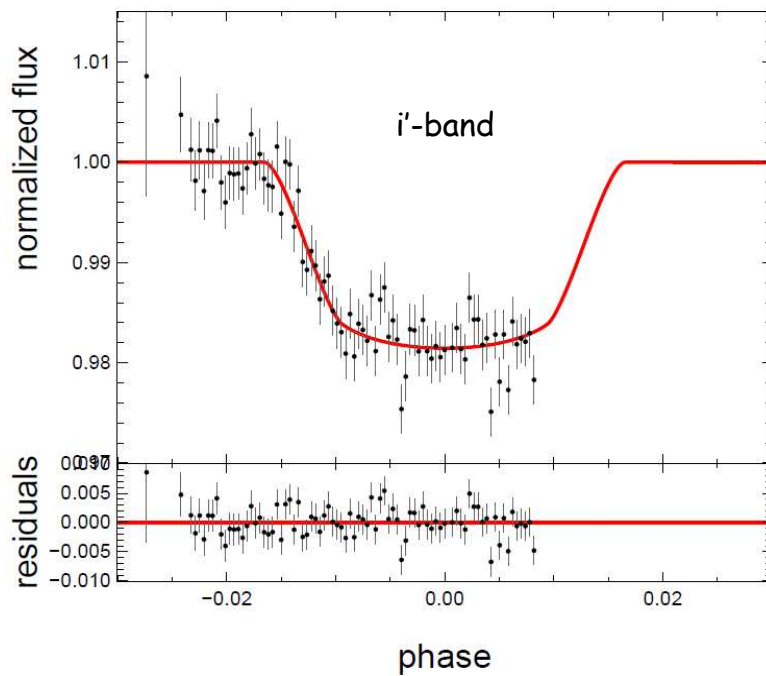
The parent star WTS1

Technique / Analysis	T_{eff}	Log(g)	[Fe/H]	
SED	6500 ± 250 K	4.5 ± 0.5	-0.5 ± 0.5	
Cafos VS Obs. Templ.	~ 6400 K	~ 4.4	~ 0.0	(F6V star ¹)
Cafos VS Synt. Templ.	6250 ± 250 K	4.5 ± 0.5	0.0 ± 0.5	
HET + ISIS	6000 ± 300 K	4.3 ± 0.3	-0.5 ± 0.3	
Overall	6250 ± 200 K	4.4 ± 0.1	[-0.5, 0.0]	(F6-8V star¹)

1) Gray 2008

Light curves fit

Parameter	Value
P_{orb}	$3.352059^{+1.2 \times 10^{-5}}_{-1.4 \times 10^{-5}}$ days
t_0	$2454318.7472^{+0.0043}_{-0.0036}$ HJD
R_p/R_s	$0.1328^{+0.0032}_{-0.0035}$
ρ_s	$0.79^{+0.31}_{-0.18} \rho_{sun}$
β_{impact}	$0.69^{+0.05}_{-0.09}$
inc	$85.5^{+1.0}_{-0.7}$ deg

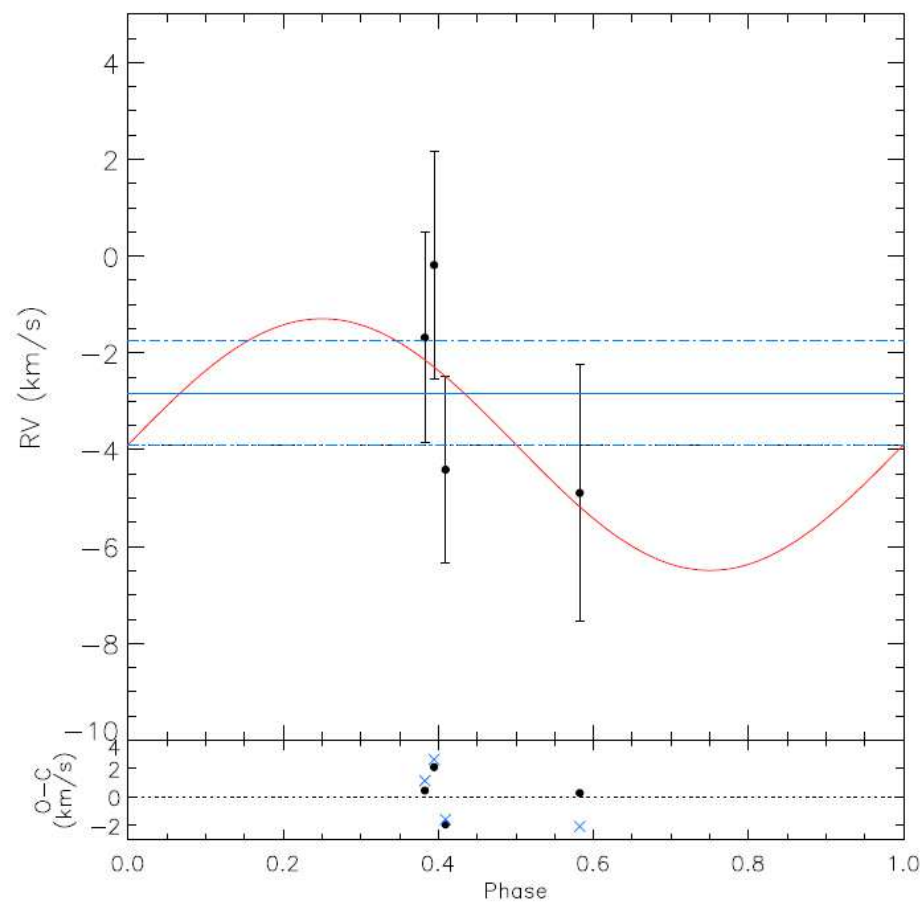
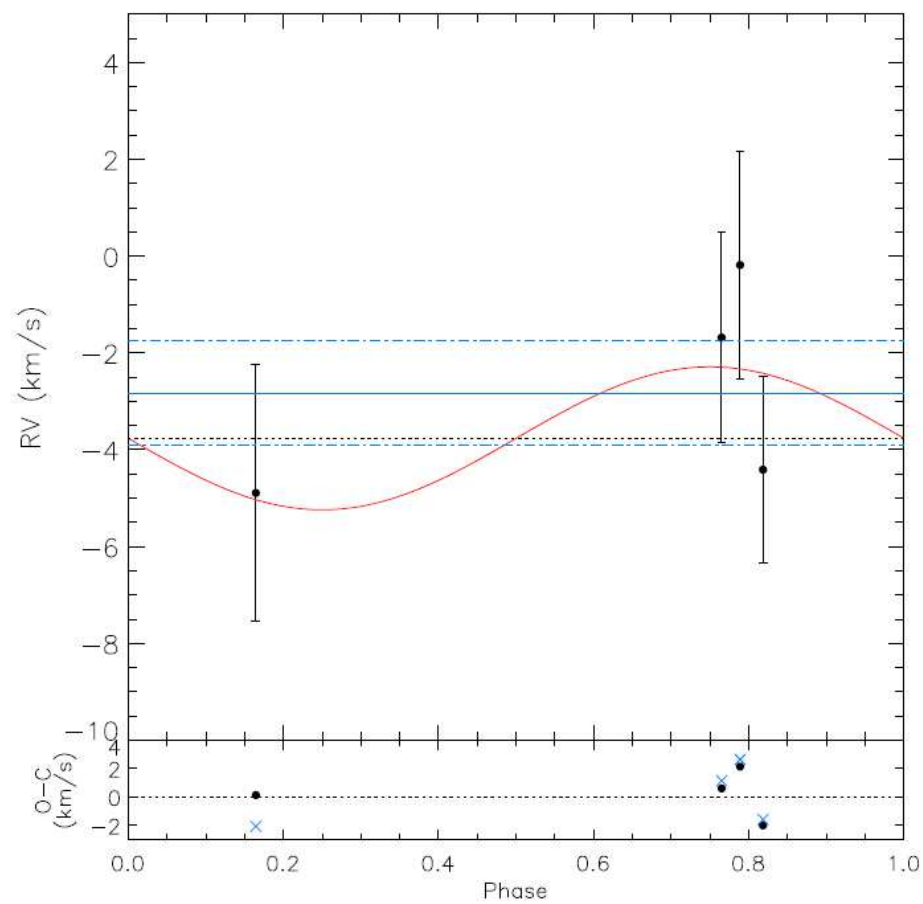


filter	γ_1	γ_2
J	0.14148	0.24832
i'	0.25674	0.26298

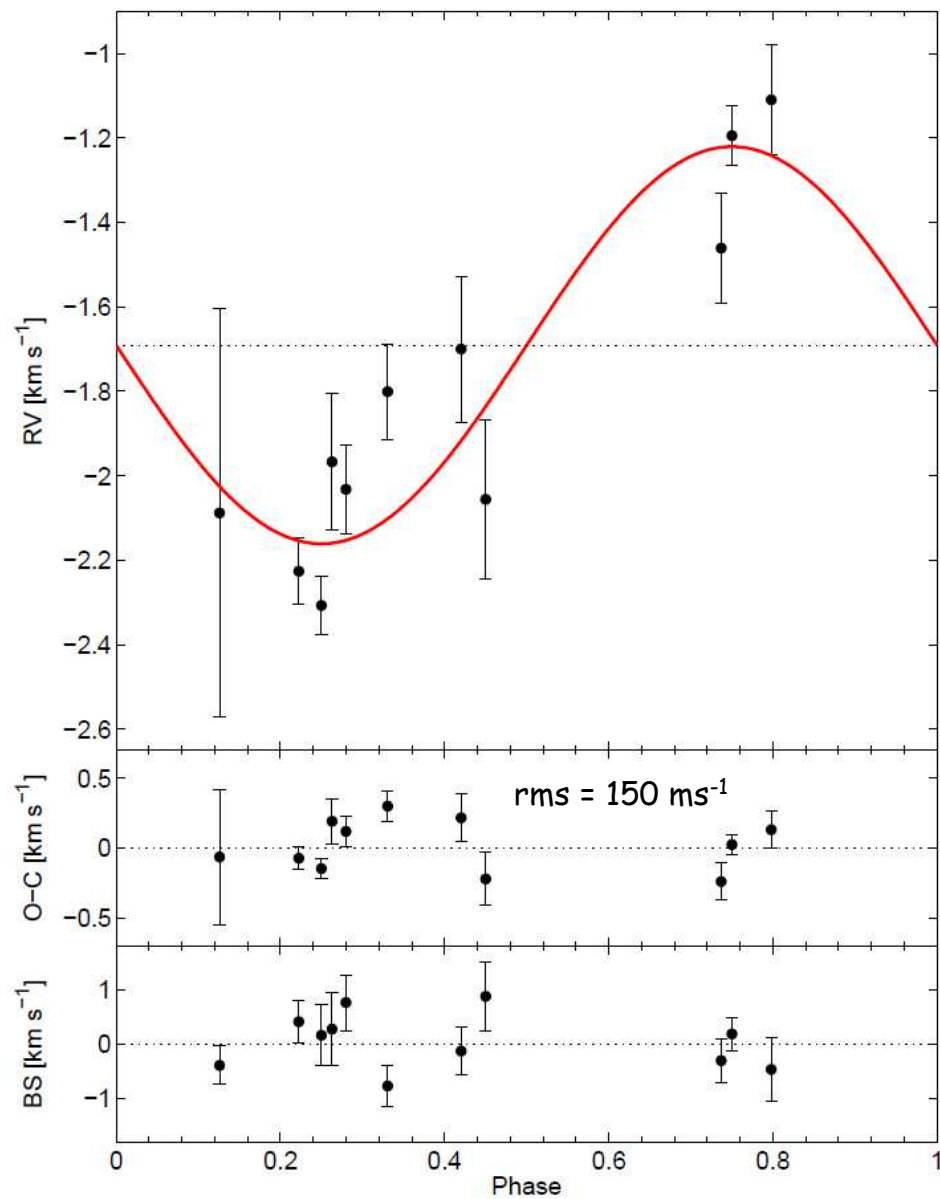
Claret & Bloemen, 2011
 $T_{eff}=6250K$, $\text{Log}(g)=4.4$, $[\text{Fe}/\text{H}]=0.0$

False-positive EB test

Model	Period (days)	K_* (km/s)	γ (km/s)	RMS (km/s)
Sinusoid	3.35205725	1.48 ± 1.61	-3.46 ± 1.51	1.92
Sinusoid	6.70411450	2.60 ± 2.55	-3.89 ± 1.50	1.88
Flat-line	—	—	-2.83 ± 1.08	1.94



Planet confirmation



$$RV = \gamma + K \sin(2\pi\phi)$$

$$K = -479 \pm 34 \text{ m/s}$$

$$\gamma = -1714 \pm 35 \text{ m/s}$$

$$\chi^2_{\nu} = 1.45$$

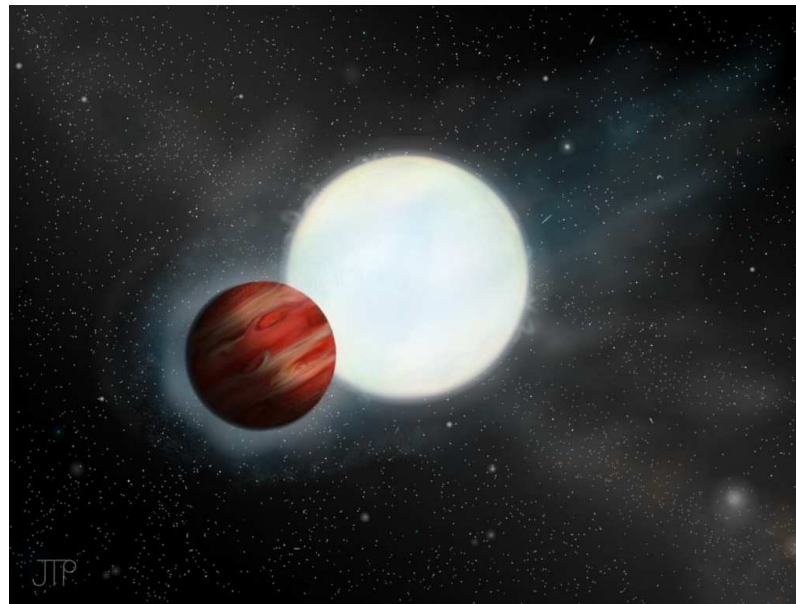
Properties of the WTS1 system

Parent star

Spectral type	F6-8 V
Mass	$1.2 \pm 0.1 M_{\text{Sun}}$
Radius	$1.15^{+0.10}_{-0.13} R_{\text{Sun}}$
T_{eff}	$6250 \pm 200 \text{ K}$
Log(g)	4.4 ± 0.1
[Fe/H]	[-0.5, 0.0]
$V \cdot \sin(i)$	$7 \pm 2 \text{ km} \cdot \text{s}^{-1}$
Age	> 300 Myr

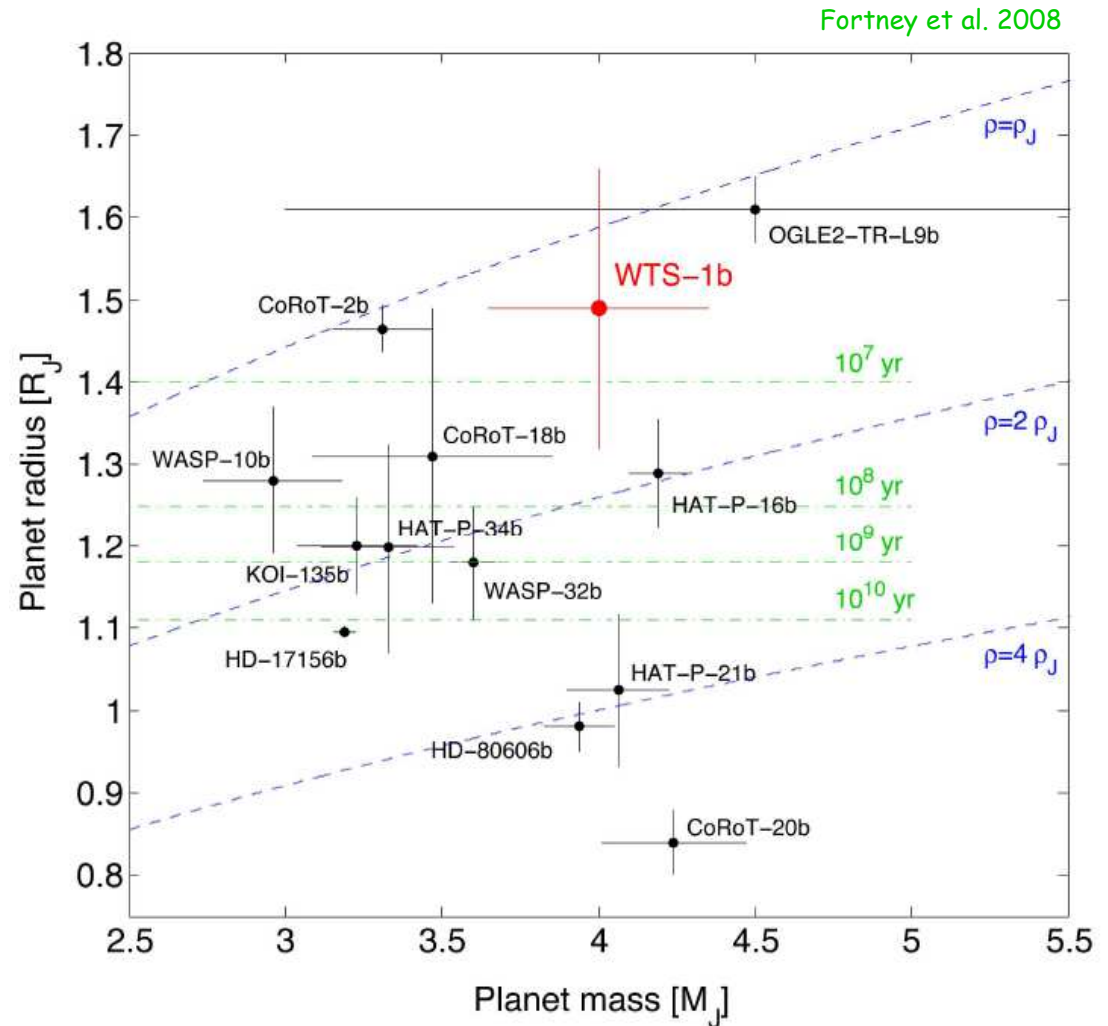
Planet

Mass	$4.01 \pm 0.35 M_{\text{Jup}}$
Radius	$1.49^{+0.16}_{-0.18} R_{\text{Jup}}$
Period	$3.352057^{+1.3e-5}_{-1.5e-5} \text{ days}$
a	$0.047 \pm \text{AU}$
t_0	$2\,454\,318^{+0.0045}_{-0.0039} \text{ HJD}$
Inclination	$85.5^{+1.0}_{-0.7} \text{ }^\circ$
β impact	$0.69^{+0.05}_{-0.09}$



Discussion

- One of the three largest planets in the mass range 3-5 M_{Jup} ;
- Too large for its age;
- Ohmic heating as possible explanation.



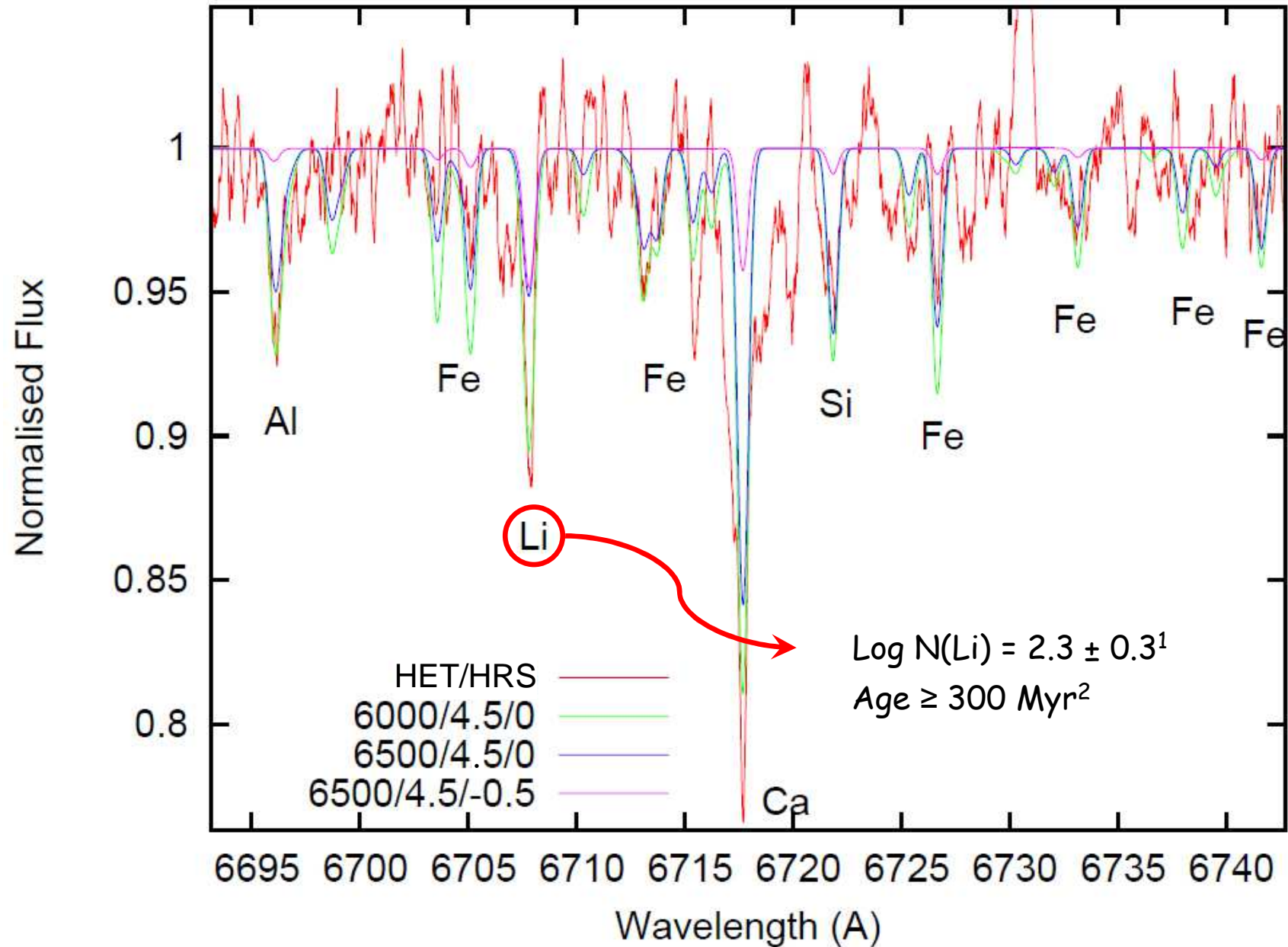
Conclusions

- WTS is able to find planets: WTS1-b
- Despite the focus on M-dwarfs, WTS1-b orbits an F star;
- WTS1-b is among the largest very hot Jupiters within the mass range 3-5 M_J .

Thanks for your time

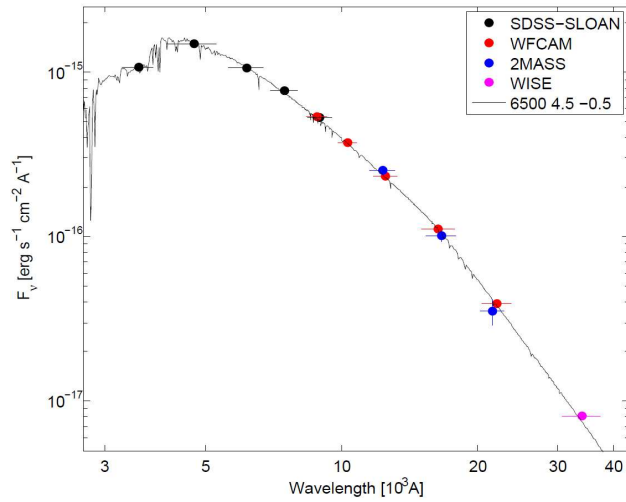


Spectroscopic analysis



1) Smith et al. 1998; Rosman & Taylor 1998 2) Sestito & Randlich 2003

The parent star: SED analysis



$$A_v = 0.44(\pm 0.07)$$



$$d = 3.2^{(+0.9}_{-0.4)} \text{ kpc}$$

Amôres & Lépine 2005
Spiral model

