Transmission spectroscopy with HORuS@GTC

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CSIC INTA

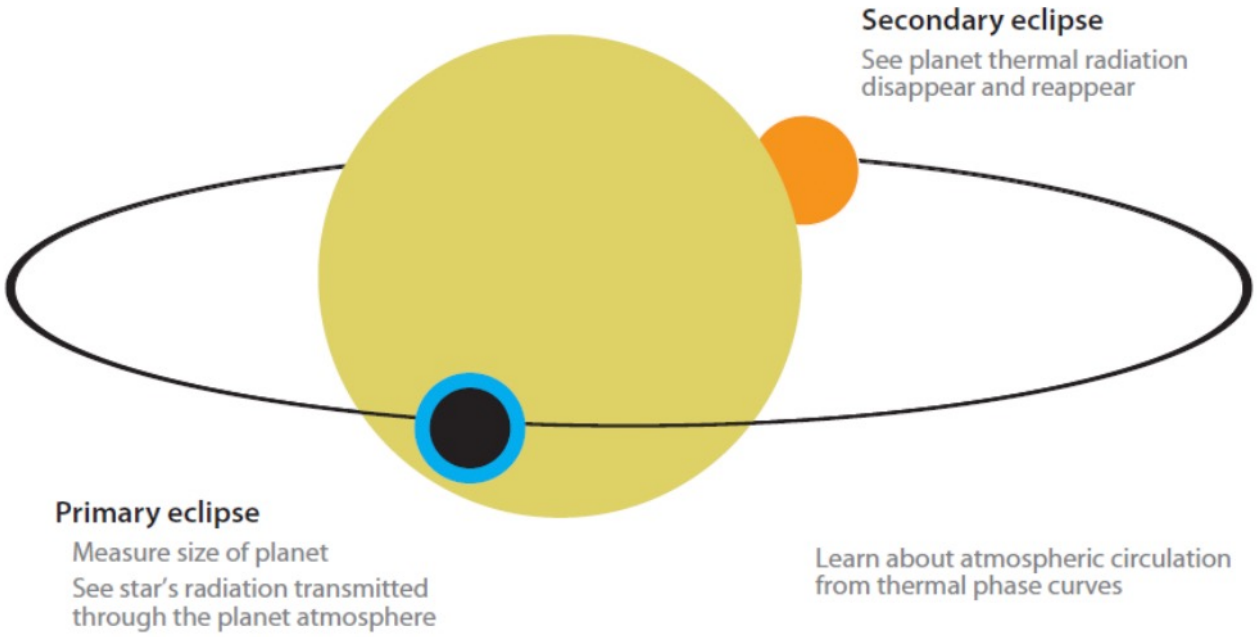
HORuS@GTC

- **H**igh **O**ptical **R**esolution **S**pectrograph
- *echelle* spectrograph at GTC
  - R ≈ 25,000
  - Wavelength coverage: 3800 – 6900 Å
  - http://www.gtc.iac.es/instruments/hors/horus.php

Transmission spectroscopy with HORuS

- 55 Cnc e (super-Earth):
  - M_p = 7.99 M_E
  - R_p = 1.88 R_E
  - T_{eq} = 1950 K
  - Orbits a G8V star with P = 0.74 d
  - Tabernero et al. (2020)

- KELT-7 b (hot Jupiter):
  - M_p = 1.28 M_{Jup}
  - R_p = 1.50 R_{Jup}
  - T_{eq} = 2015 K
  - Orbits an F2V star with P = 2.74 d
  - Tabernero et al. (2022b)



Seager & Demig (2010)

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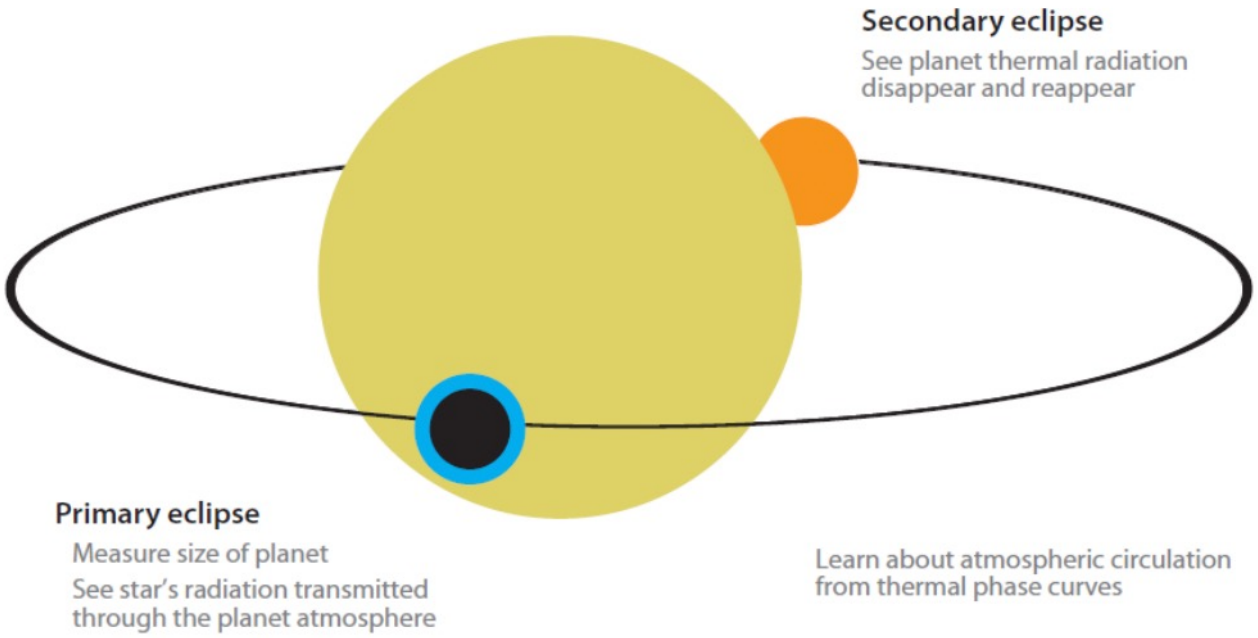

Seager & Demig (2010)

55 Cnc e

- Observations:
  - One epoch: December 2018
  - 4.2 h on target: 24 exposures
  - Part of the commisioning of the instrument

- Objetive:
  - Explore the capabilities of **HORuS** for transmission spectroscopy

- Publication in MNRAS: **Tabernero et al. (2020)**

Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

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Advance Access publication 2020 August 26

HORuS transmission spectroscopy of 55 Cnc e

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C. del Burgo,[4,5] R. García López,[3,4] R. Rebolo,[3,4] M. Abril-Abril,[6] R. Barreto,[3,4] J. Calvo Tovar,[3,4]
A. Díaz Torres,[3,4] P. Fernández Izquierdo,[3,4] M. F. Gómez-Reñasco,[3,4] F. Gracia-Témich,[3,4] E. Joven,[3,4]
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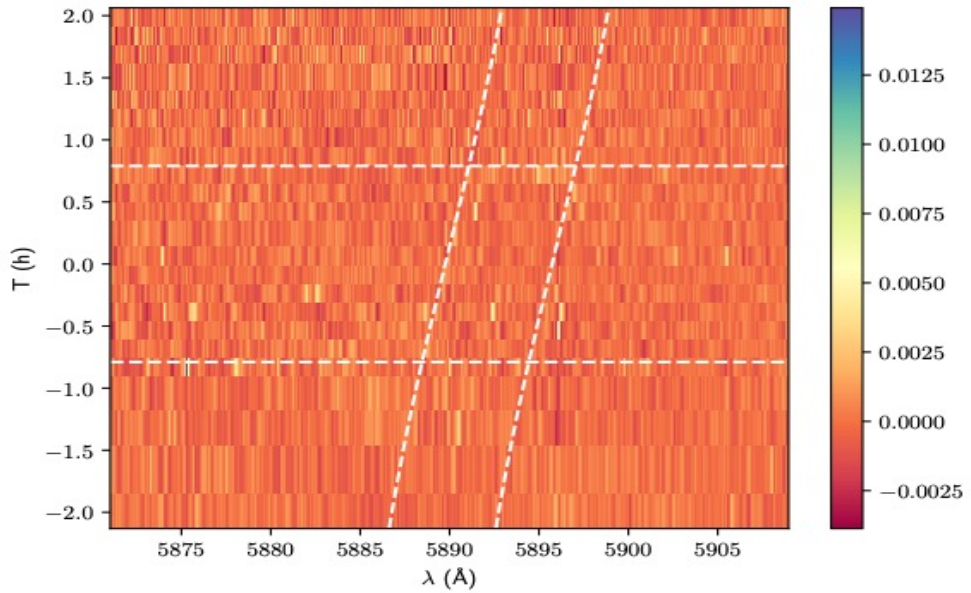

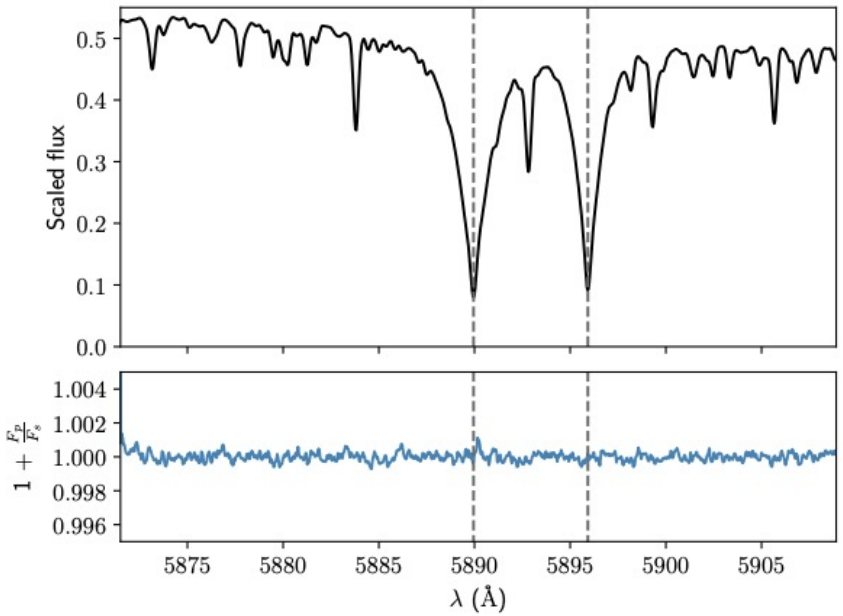

New upper limit to the presence of Na (< 0.034 %)

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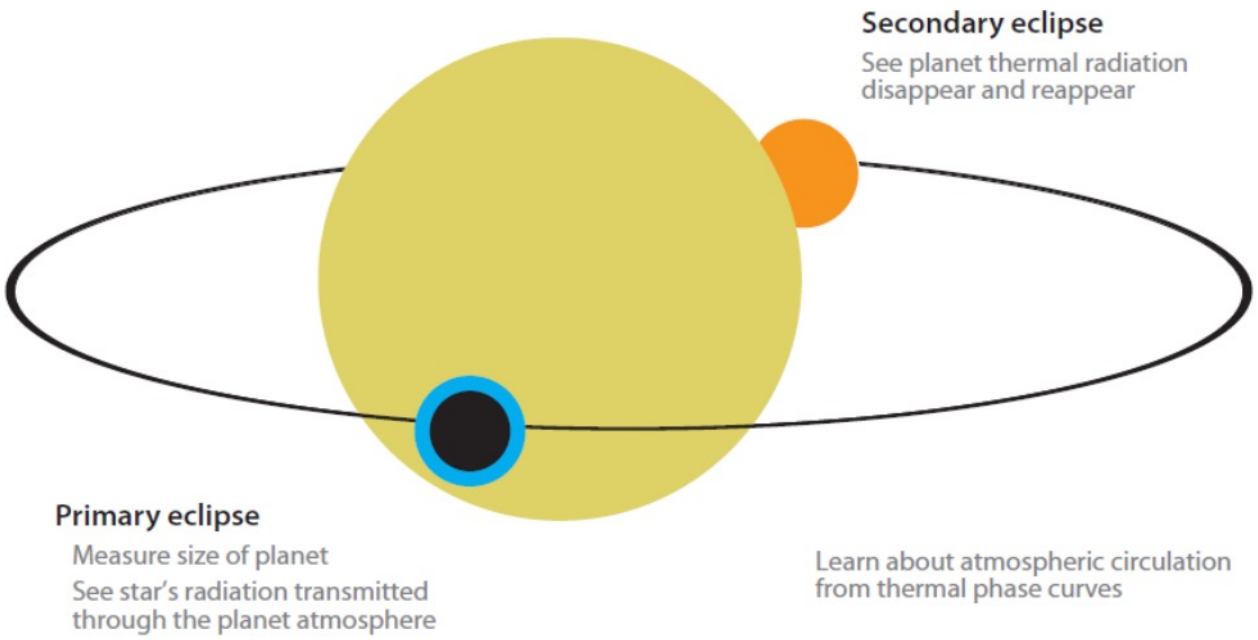

Seager & Demig (2010)

KELT-7b

- Observations:
  - Two epochs: November 2019, January 2020
  - ~7 h on target: ~70 exposures.
  - TESS and KELT LCs
  - Literature RVs
- Results:
  - Refine the parameters of this planetary system
  - Rossiter-McLaughlin + Doppler Shadow
  - Explore the presence of: H I, Li I, Na I, Mg I, and Ca II
  - Stellar activity during the transits
- Publication in MNRAS: **Tabernero et al. (2022b)**

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MNRAS **515,** 1247–1265 (2022) https://doi.org/10.1093/mnras/stac1759
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HORuS transmission spectroscopy and revised planetary parameters of KELT-7 b

H. M. Tabernero [1]★ M. R. Zapatero Osorio,[1] C. Allende Prieto,[2,3] E. González-Álvarez,[1] J. Sanz-Forcada,[4] A. López-Gallifa,[1,5] D. Montes [5] C. del Burgo,[6] J. I. González Hernández[2,3] and R. Rebolo[2,3]

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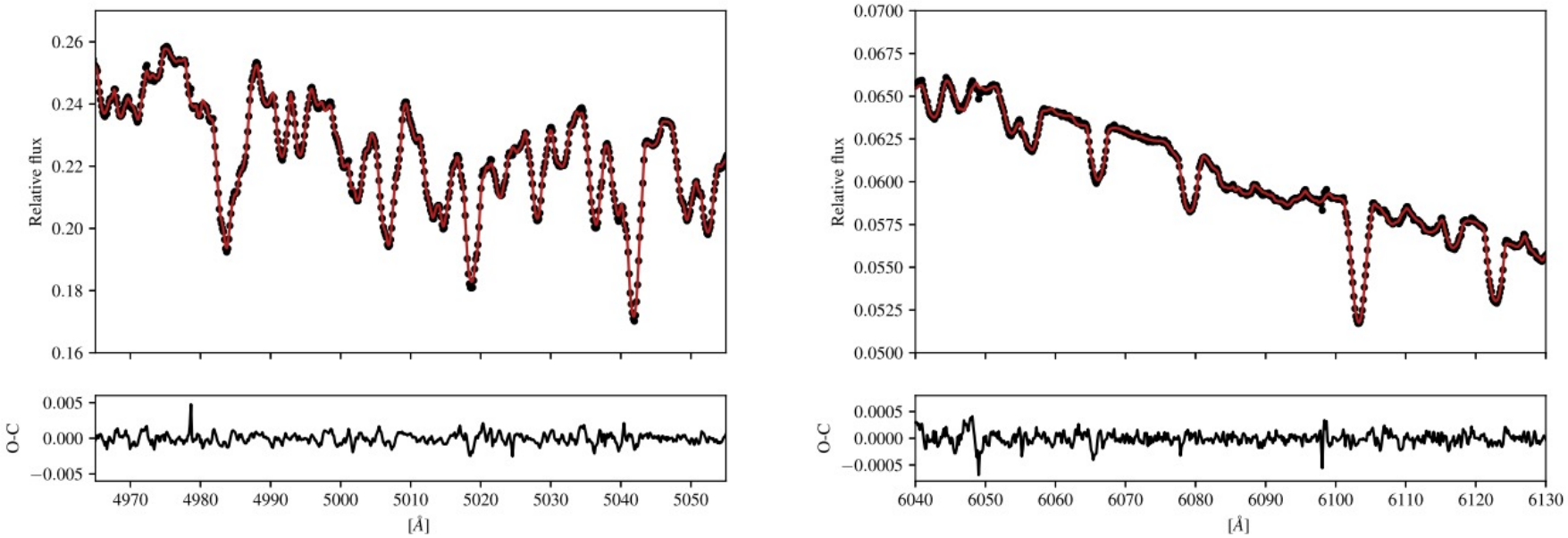
KELT-7b (system parameters I)



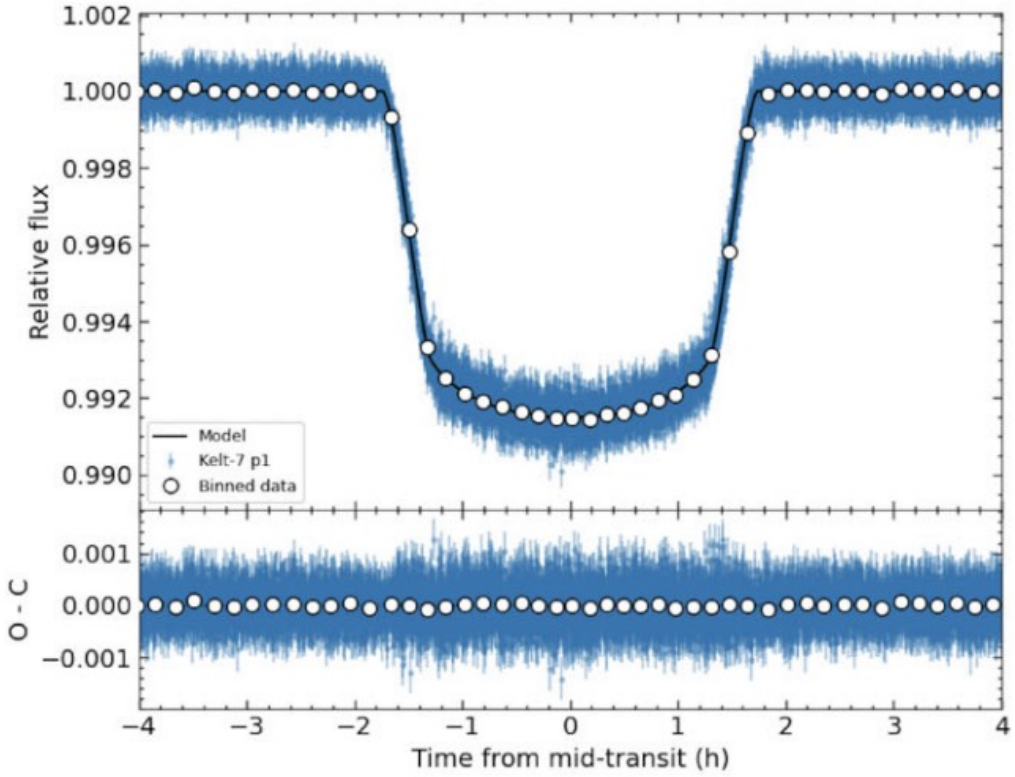
New stellar parameters of KELT-7 with StePArSyn (**Tabernero et al. 2022a**)

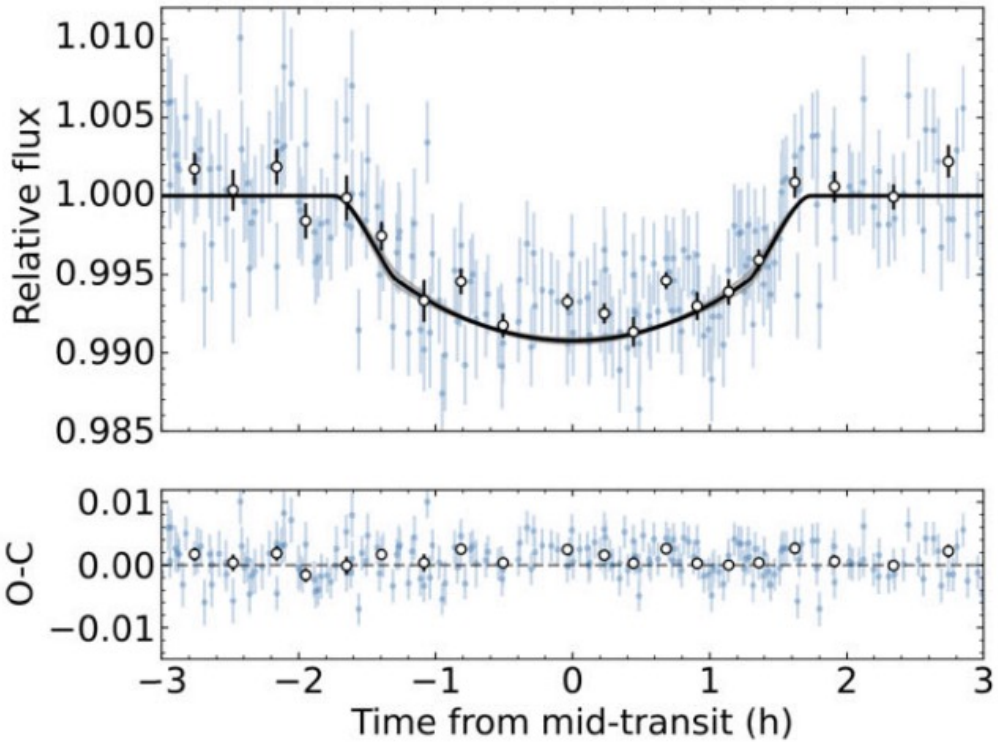
T_{eff} = 6699 ± 24 K, **log(g)** = 4.15 ± 0.09 dex, **[Fe/H]** = 0.24 ± 0.02 dex, and **vsini** = 71.4 ± 0.2 km/s

https://github.com/hmtabernero/SteParSyn/

Tabernero et al. (2022b)

KELT-7b (system parameters II)





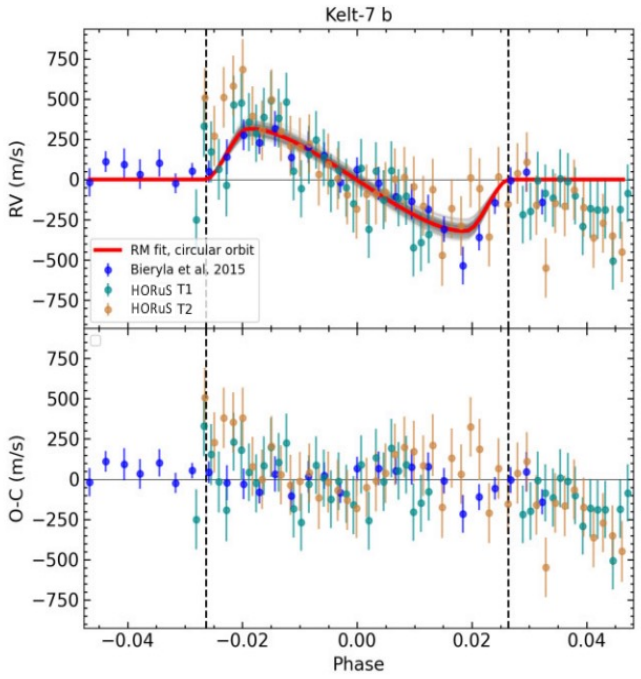
TESS

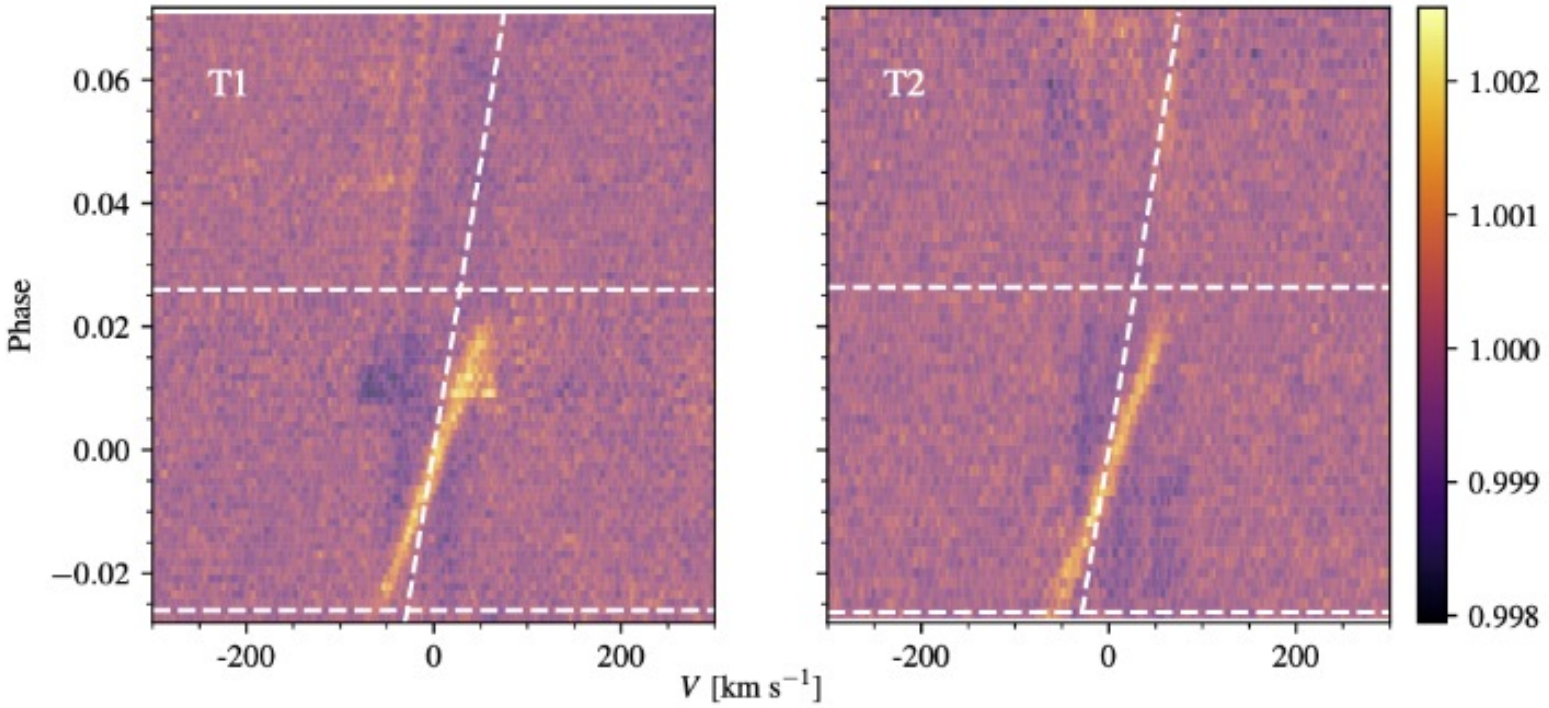
KELT

We revised the ephemeris using *juliet* (see Espinoza et al. 2019)

Tabernero et al. (2022b)

KELT-7b (R-M, Doppler shadow)





New value for the obliquity: λ = −10.55 ± 0.27 deg

Tabernero et al. (2022b)

KELT-7b (Transmission spectroscopy)

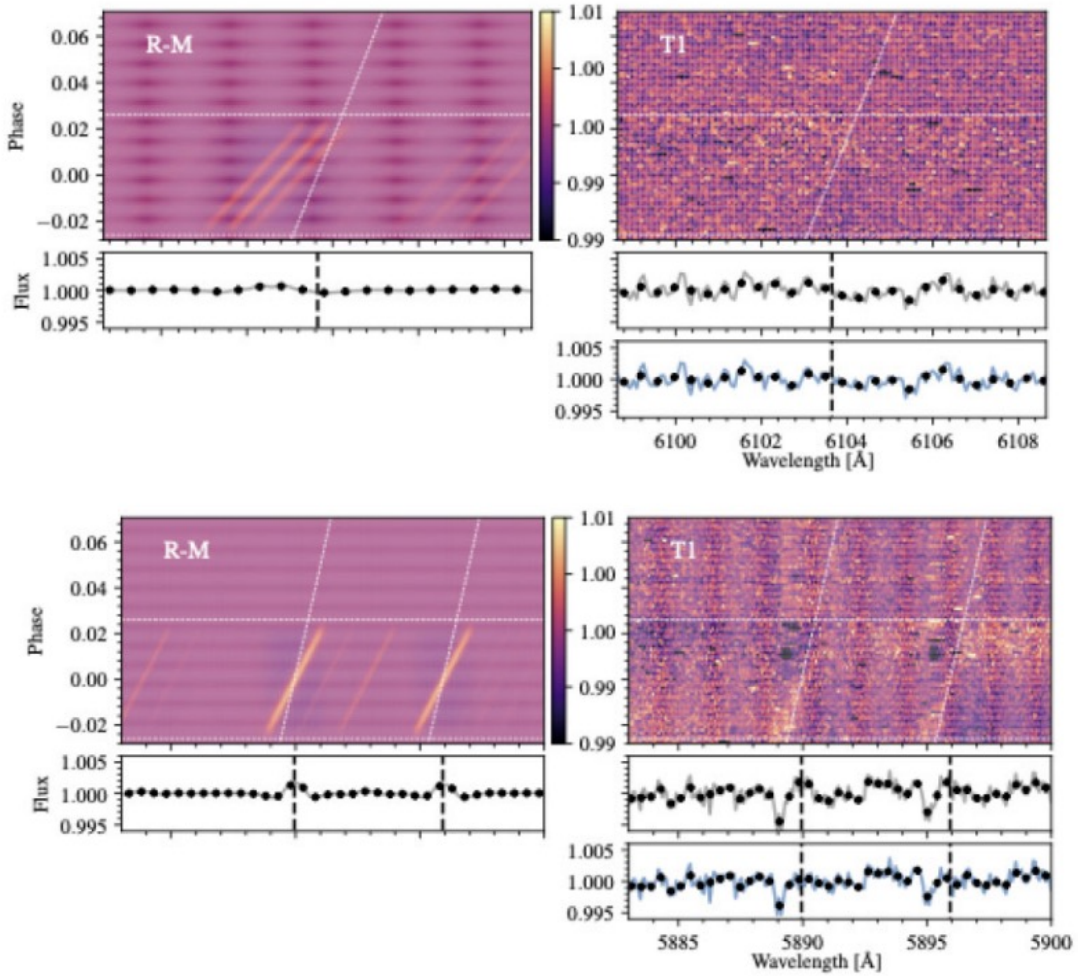
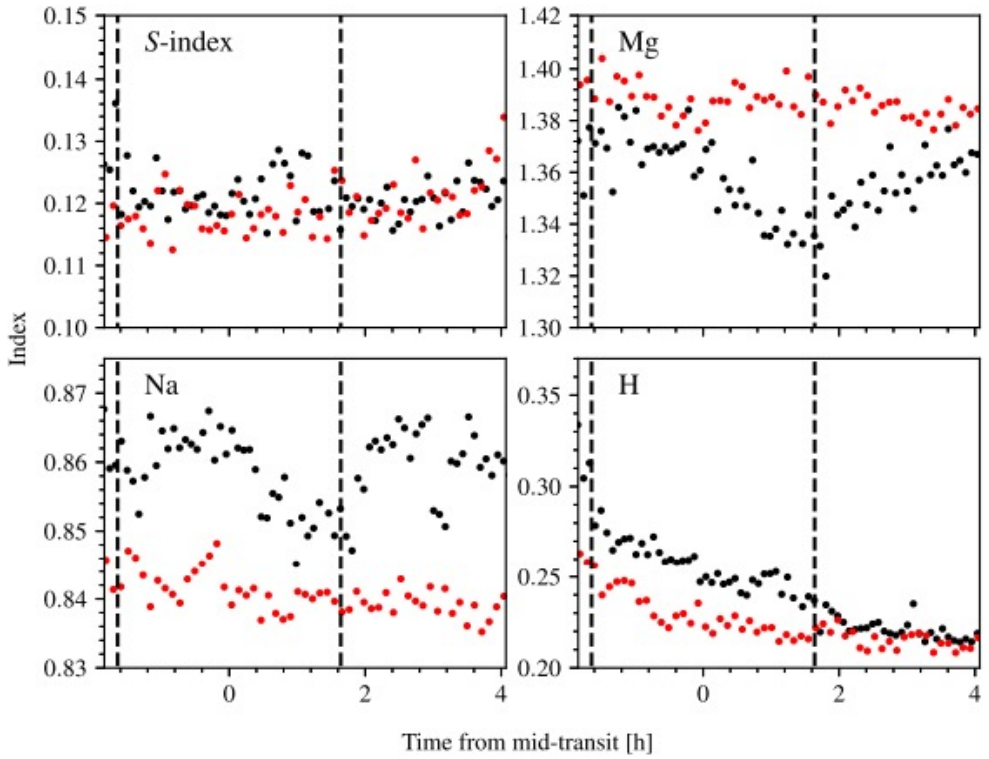


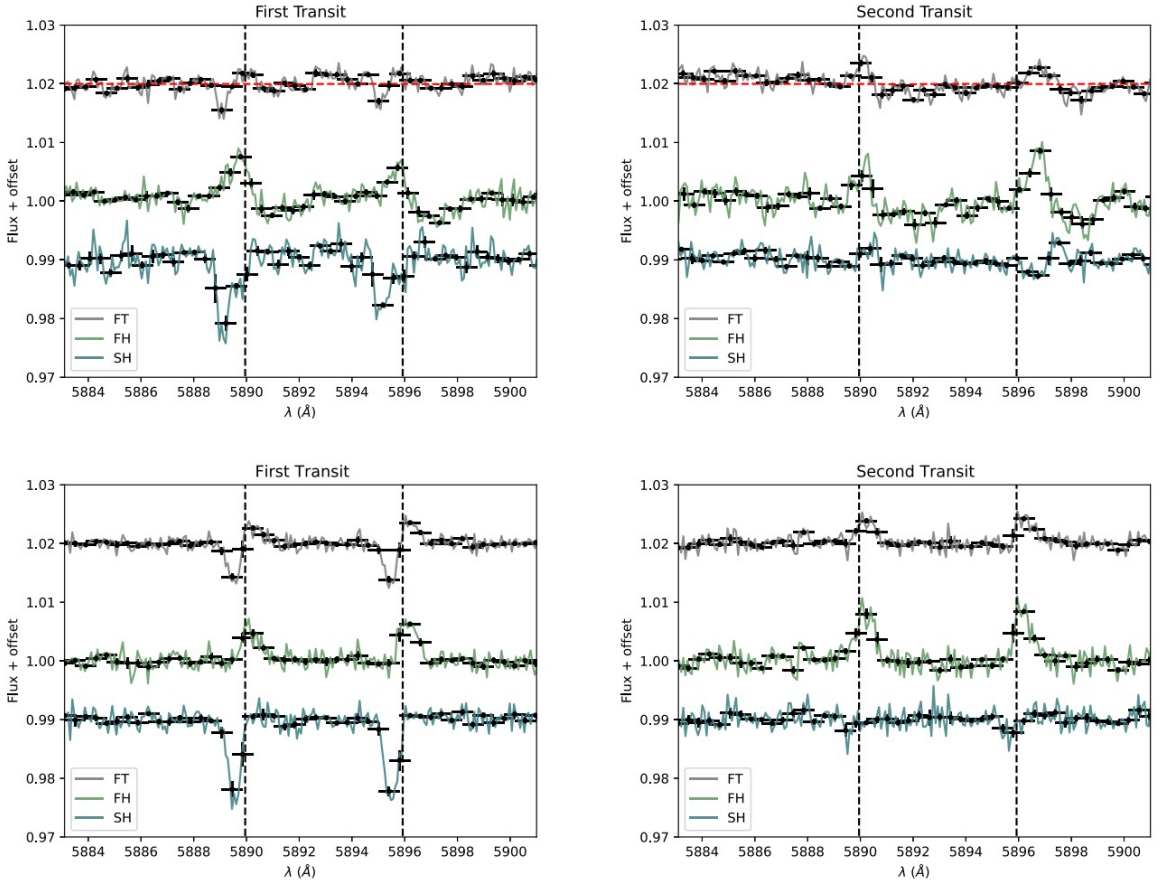
Table 2. Limits to the presence of the species studied in this work. The values provided here correspond to the average of the two transits.

Line(s)	*rms*			
	R-M + CLV (%)	Activity (%)	Observed limit (%)	Corrected limit (%)
Ca II H&K	0.089	0.081	0.530	0.516
Mg I b	0.073	0.054	0.150	0.119
Na I D	0.080	0.120	0.163	0.076
Li I	0.182	–	0.187	0.043
Hα	0.228	0.782	1.620	1.400

Tabernero et al. (2022b)

KELT-7b (Stellar activity)





Tabernero et al. (2022b)

Wrap-up

- Two planets analysed
- 55 Cnc e (**Tabernero et al. 2020**):
  - Explore the capabilities of **HORuS** for transmission spectroscopy (Na and H)

- KELT-7b (**Tabernero et al. 2022b**):
  - New KELT-7 system parameters
  - Rossiter-McLaughlin + Doppler Shadow
  - We searched for: H, Li, Na, Mg, and Ca
  - We modelled the stellar activity during the transits

THANK YOU!