Probing SPECULOOS-3b with PANIC: Toward a Northern Infrared Facility for SPECULOOS

Roberto Varas[1], Francisco José Pozuelos[1], Pedro Amado[1], Peter Pedersen[2], and Marina Centenera[1]

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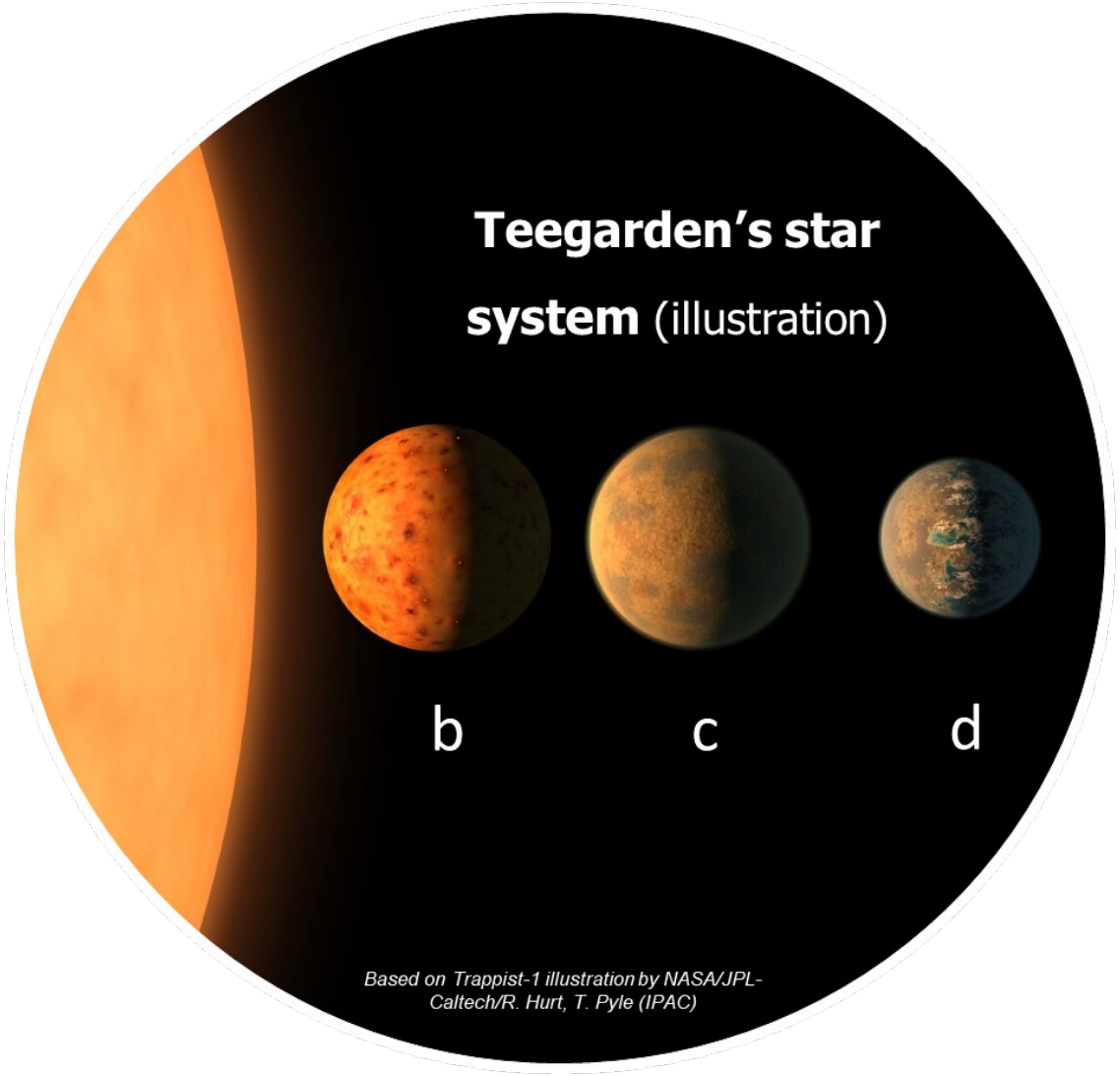
EXOPLANETS AROUND ULTRACOOL DWARFS

UCDs are M6.0 and later stars and sub-stellar objects (BDs)

They usually host small-rocky exoplanets and have a close Habitable Zone. On top of that, they have a relatively big planet-to-star radii ratio, which makes things easier for transits and atmosphere characterization

UCDs are indeed very cool objects for understanding exoplanets, planet formation (rocky planets, Jupiter-like planets, ...) and are specially interesting in the search for life



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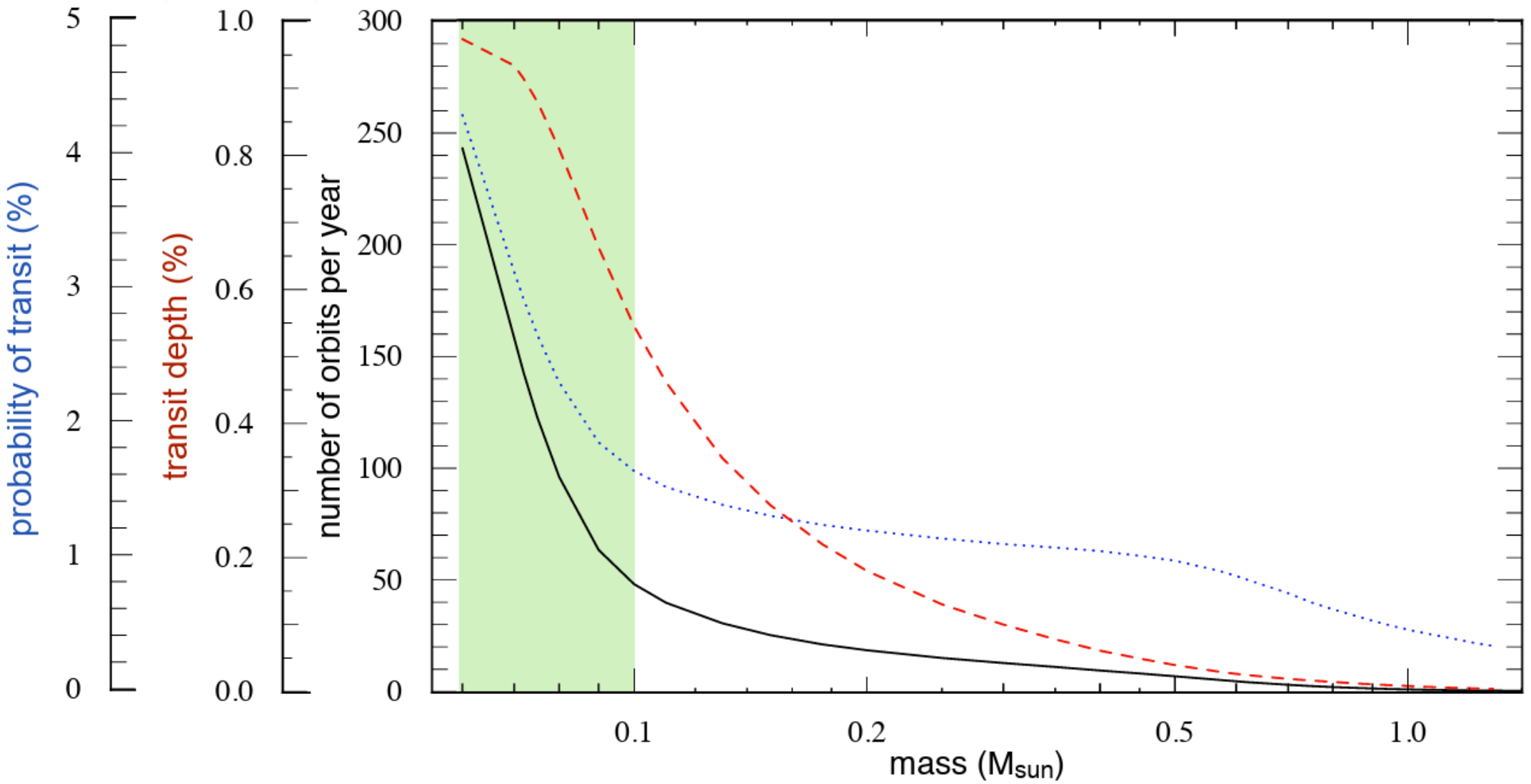
EXOPLANETS AROUND ULTRACOOL DWARFS



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EXOPLANETS AROUND ULTRACOOL DWARFS

Only four planetary systems have been detected: **SPECULOOS-3** and 2, Trappist-1, and Teegarden's star

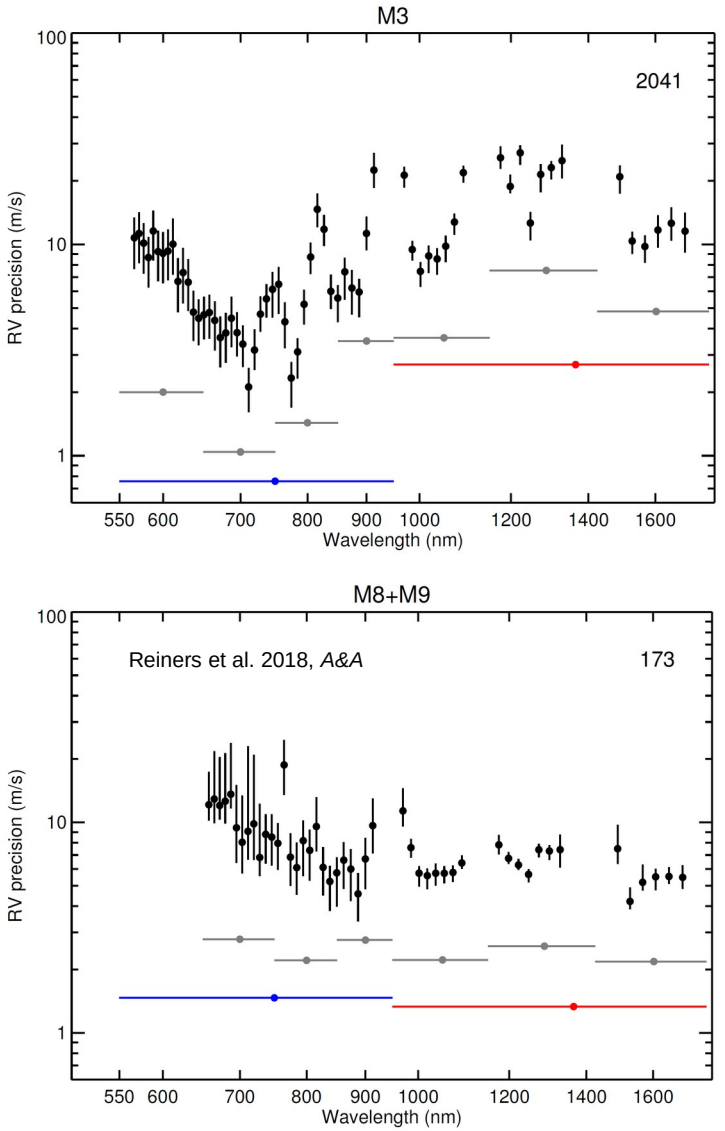
Faint stars: low signal to noise ratio

The flux peaks in **NIR**

Less spectral information in the NIR than in the VIS

Small planets, inducing small RV

Active and "fast" rotating stars



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SPECULOOS (Search for Planets EClipsing ULtra-cOOl Stars)

SPECULOOS-South (SSO)

Hosted by the European Southern Observatory (ESO) of Paranal in the Atacama Desert of Chile, SPECULOOS-South is composed of four robotic telescopes in operation since January 2019.

4 telescopes of 1m diameter and is equipped with an astronomical camera highly sensitive in the very-near-infrared' (up to ~0.9 microns).

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SPECULOOS-North (SNO)

SPECULOOS-North is the Northern counterpart of SPECULOOS-South. It is located at Teide Observatory in the island of Tenerife (Canaries) and National Astronomical Observatory of Mexico, in San Pedro Mártir (SAINT-EX)

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SPECULOOS (Search for Planets EClipsing ULtra-cOOl Stars)

SPECULOOS aims to find the most suitable terrestrial planets for detailed atmospheric characterisation by future giant observatories, such ELT and JWST.

The project was born in 2011 as a prototype on the TRAPPIST-South telescope in Chile. This prototype discovered TRAPPIST-1 *(= SPECULOOS-1)* composed of seven earth-like planets. In 2022, it discovered a planet around SPECULOOS-2 (Delrez et al. 2022), and in 2024 SPECULOOS-3 (Gillon et al. 2024).

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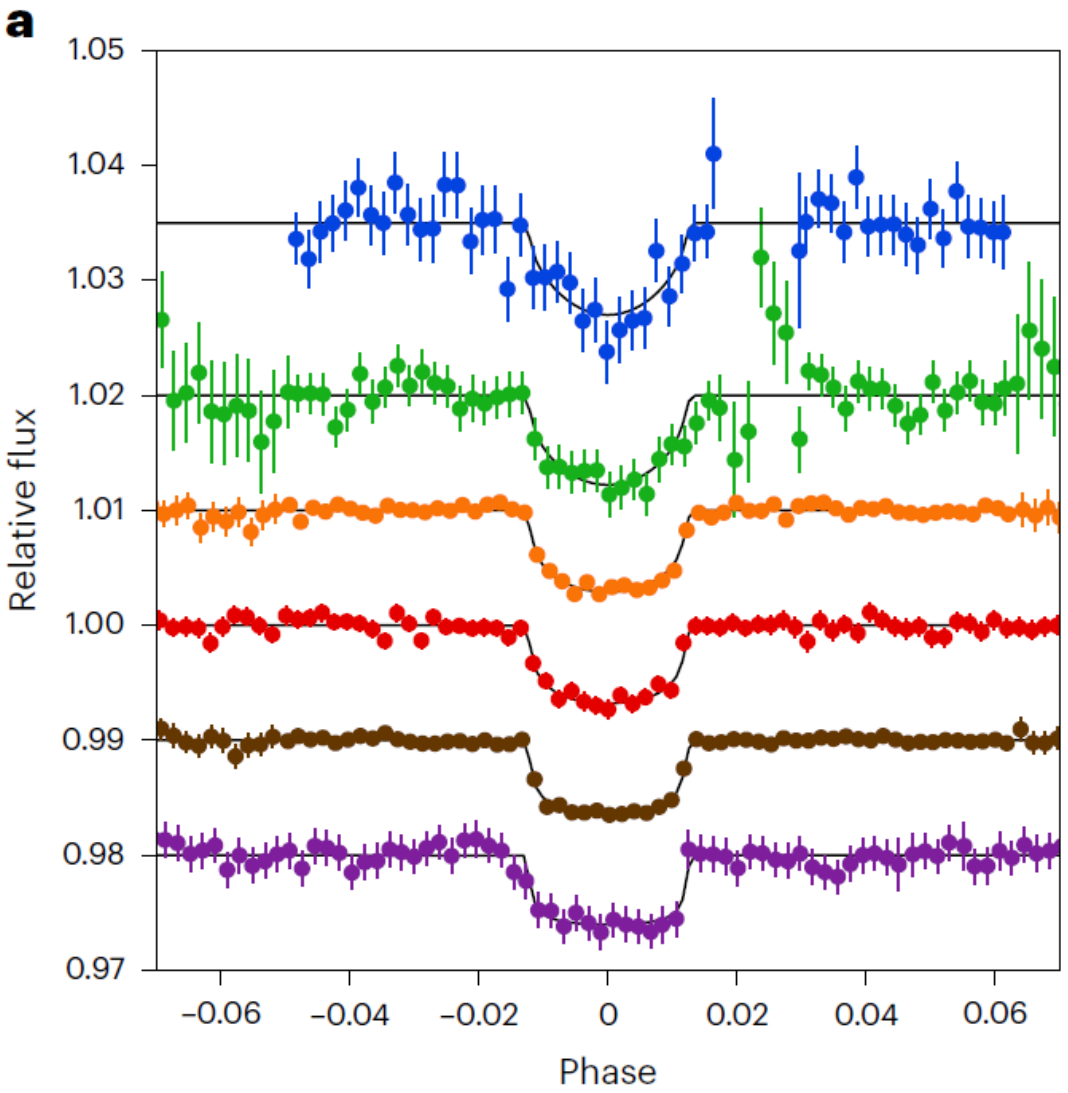
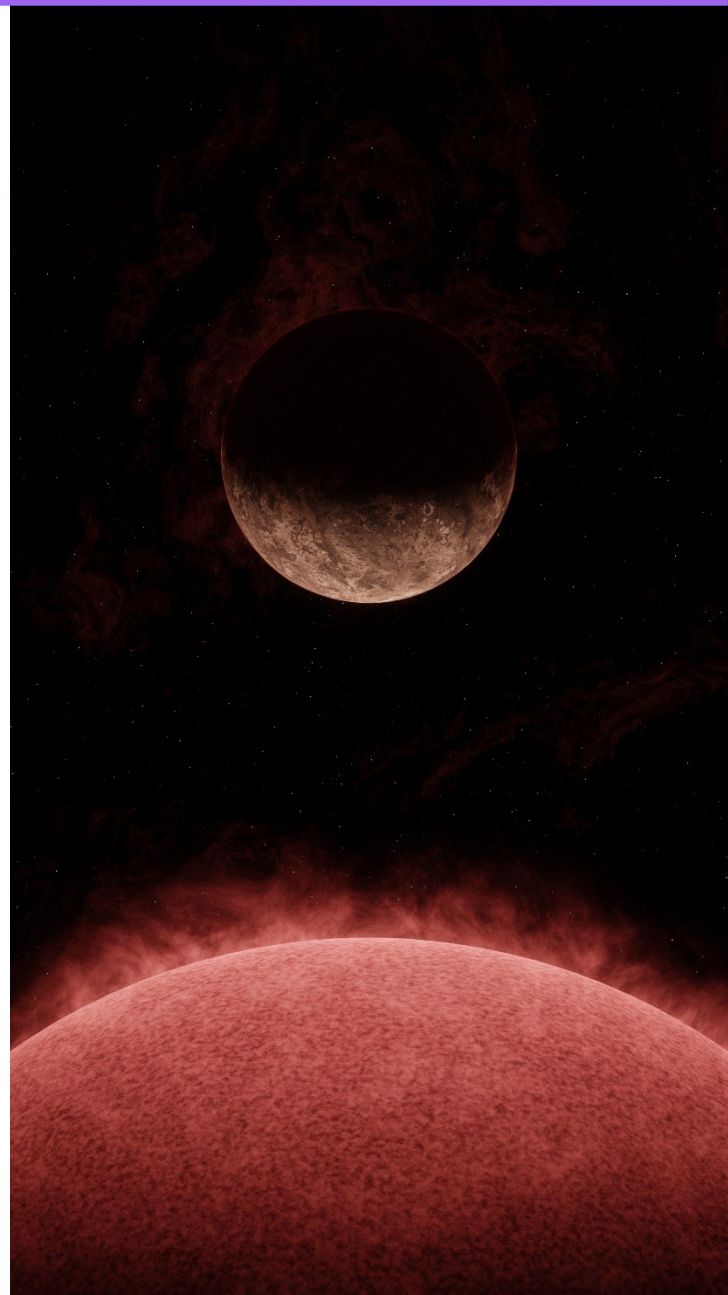
SPECULOOS-3b



SAINT-EX, SNO-Artemis, GTC/HiPERCAM, and UKIRT/WFCAM observations



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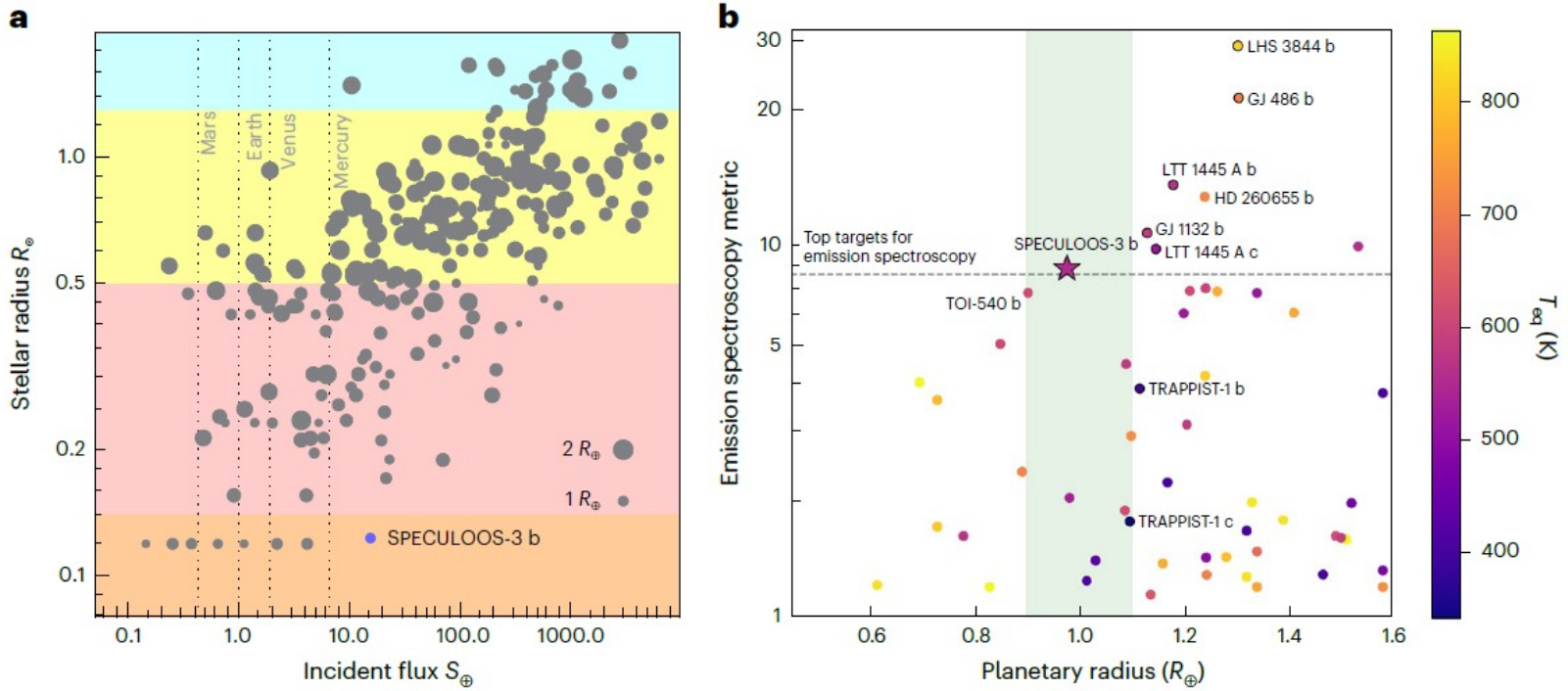
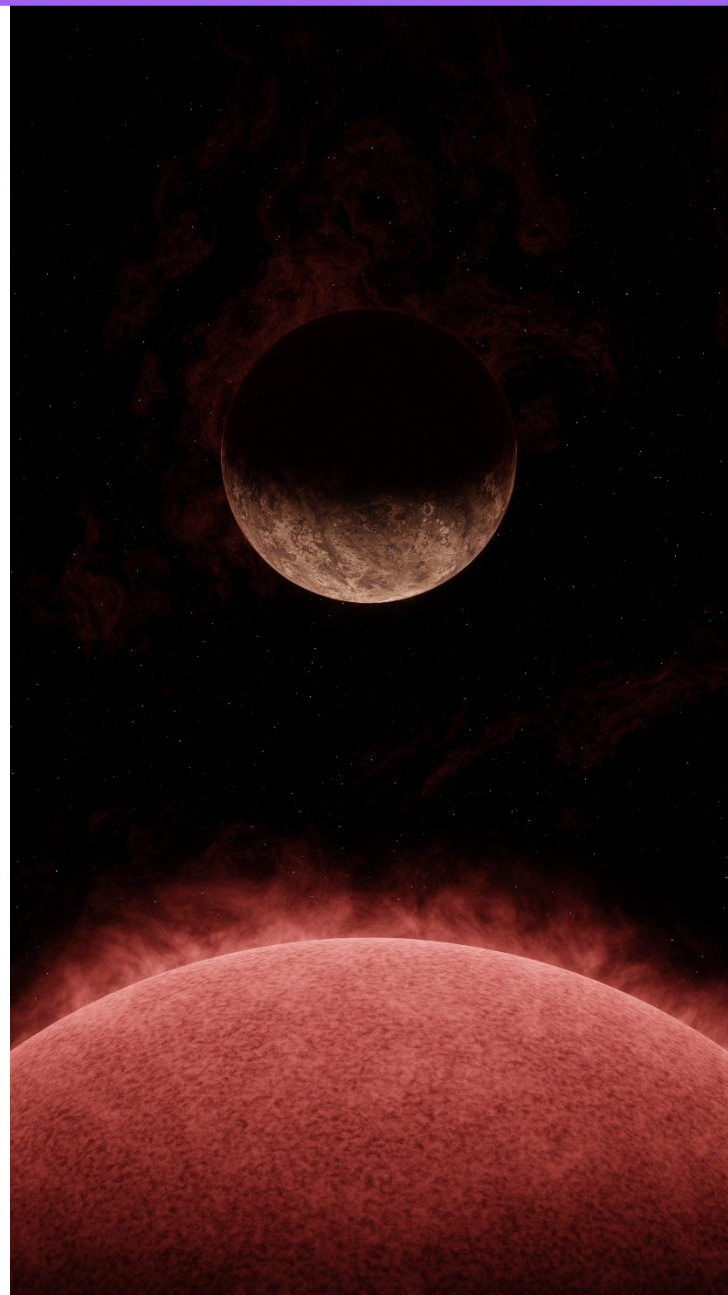
SPECULOOS-3b

Stellar Parameters: SPECULOOS-3[a,b]	
SpT	M6.5 V
$T_{\rm eff}$ (K)	2680 ± 60
$R_\star$ ($R_\odot$)	0.1342 ± 0.0062
$M_\star$ ($M_\odot$)	0.101 ± 0.002
$Z_{\rm mag}$	18.93± 0.02
$Y_{\rm mag}$	18.40± 0.04
$J_{\rm mag}$	11.50 ± 0.02
$H_{\rm mag}$	10.87 ± 0.02
$Ks_{\rm mag}$	10.54 ± 0.02

Planetary Parameters: SPECULOOS-3 b[a]	
$R_{\rm P}$ ($R_\oplus$)	0.977 ± 0.022
$P_{\rm orb}$ (days)	0.719 ± 5.7×10^{-7}
ΔF (ppm) [c]	5291 ± 116





JWST and spectroscopic campaigns

The targets JWST is prioritizing are late M-dwarfs with known exoplanets, because atmospheric characterisation is easier. Is the case of Trappist-1, with many hours of observations. SPECULOOS-3 is also going to be extensively observed.

Several spectroscopic campaigns have been monitoring SPECULOOS-3, such as CARMENES, and more will be done

Future infrastructures, such as ANDES-ELT, will be crucial to characterize these systems

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Probing SPECULOOS-3b with PANIC

With this proposal, we aim to evaluate the performance of the **PANIC** instrument for high-precision time-series photometry in the near-infrared, in order to assess its suitability **as a northern facility for the SPECULOOS project.**

The five filters (z, Y, J, H, Ks) will be tested to see the suitability of PANIC for this type of observations.

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[a] From [10].
[b] Magnitudes in Z and Y estimated from Pan-STARRS photometry.
[c] Transit depth.

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PANIC OBSERVATIONAL STRATEGY

Probing SPECULOOS-3b with PANIC: Toward a Northern Infrared Facility for SPECULOOS (25B-2.2-034)

Target: Speculoos-3 (M6.5)

RA=20:49:27.44

DEC=+33:36:50.96

17 Octubre: SPECULOOS-3b transit

ingress 20:13— midtransit 20:26— egrees 20:40

Start: 19:40; end: 21:10

filter: z

Exposure time: 60sec

18 Octubre: SPECULOOS-3 monitoring

Start: 20:00; end: 21:30

filter: Y

Exposure time: 60sec

19 Octubre: SPECULOOS-3b transit

ingress 23:59— midtransit 00:13— egrees 00:27

Start: 23:30; end: 01:00

filter: J

Exposure time: 60sec

20 Octubre: SPECULOOS-3 monitoring

Start: 20:00; end: 21:30

filter: H

Exposure time: 60sec

21 Octubre: SPECULOOS-3 monitoring

Start: 20:00; end: 21:30

filter: Ks

Exposure time: 60sec

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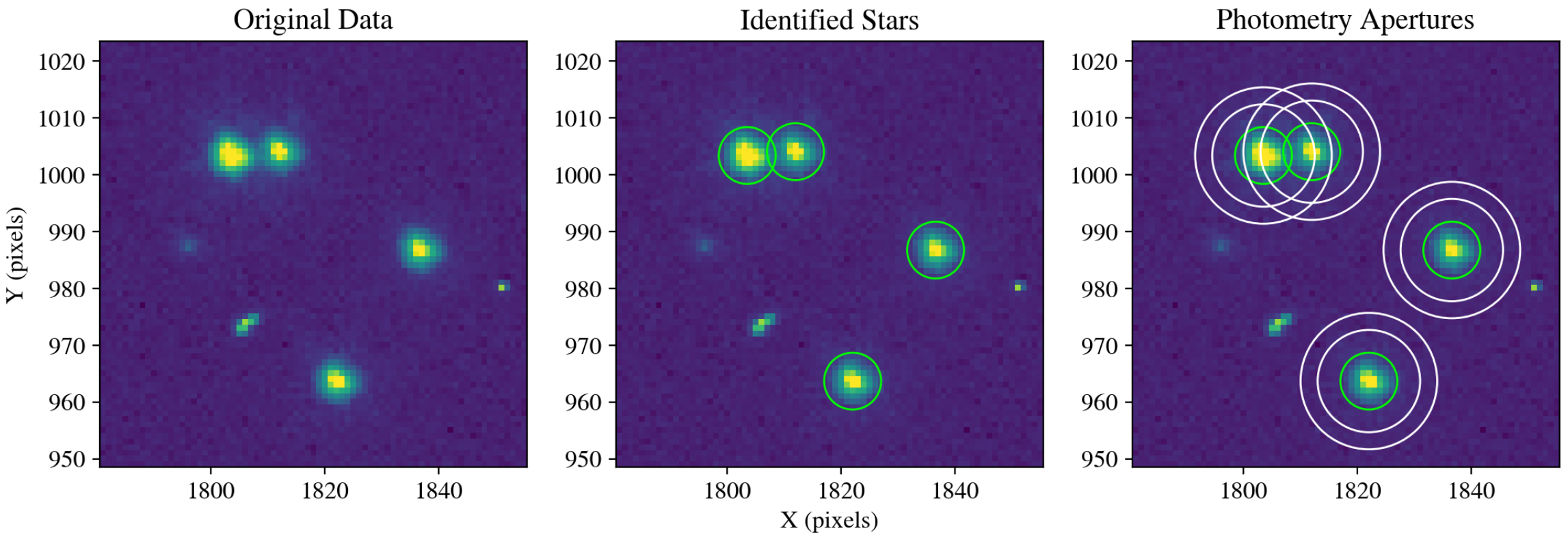
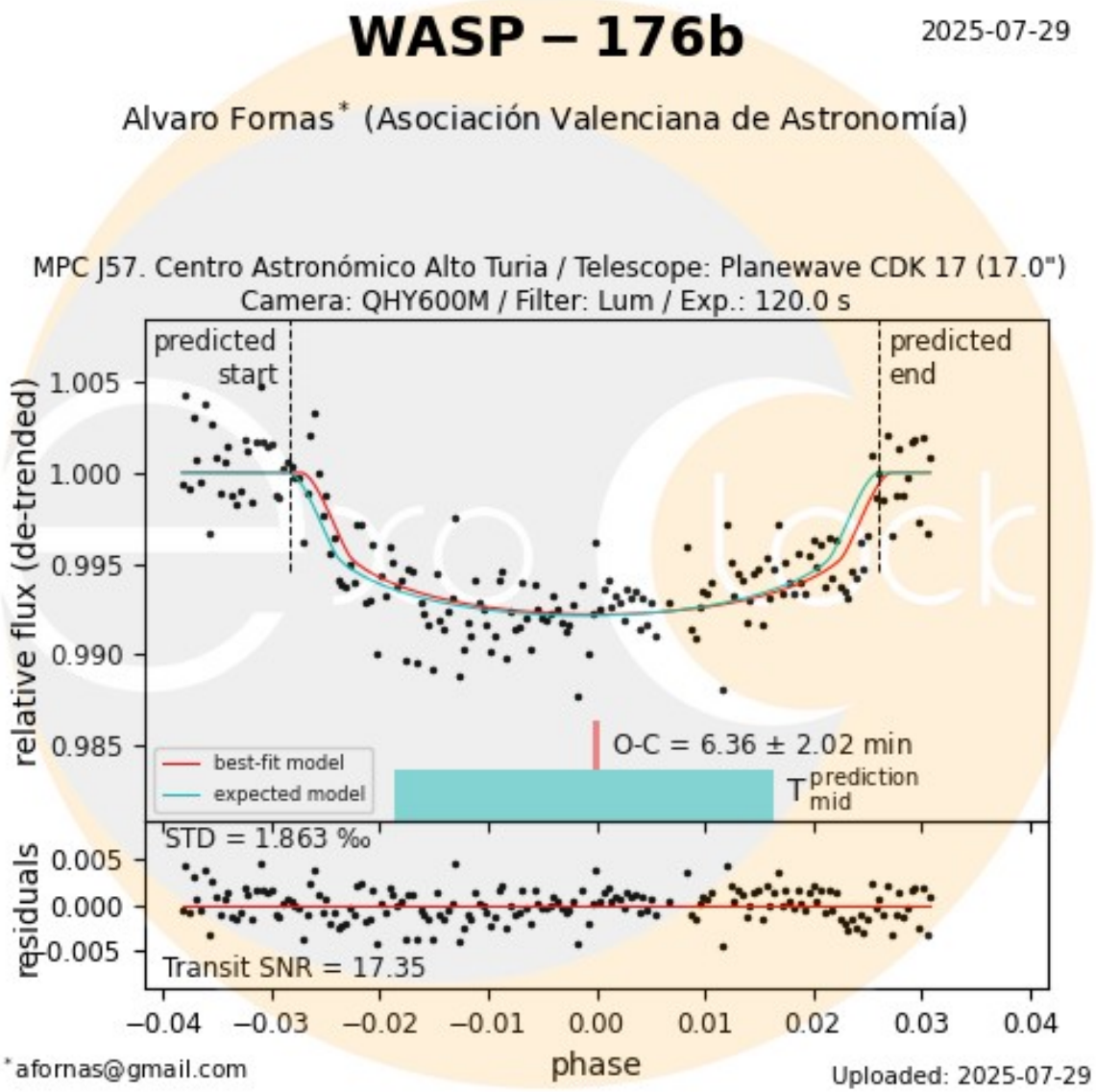
Differential photometry



Differential photometry



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Thanks for your attention!
Comments and questions please

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