

ATMOSPHERES OF SUB-NEPTUNES AT HIGH-RESOLUTION :

A first-hand Helium exploration with



DANY MOUNZER¹

Christophe Lovis¹

Romain Allart²

François Bouchy¹

René Doyon²

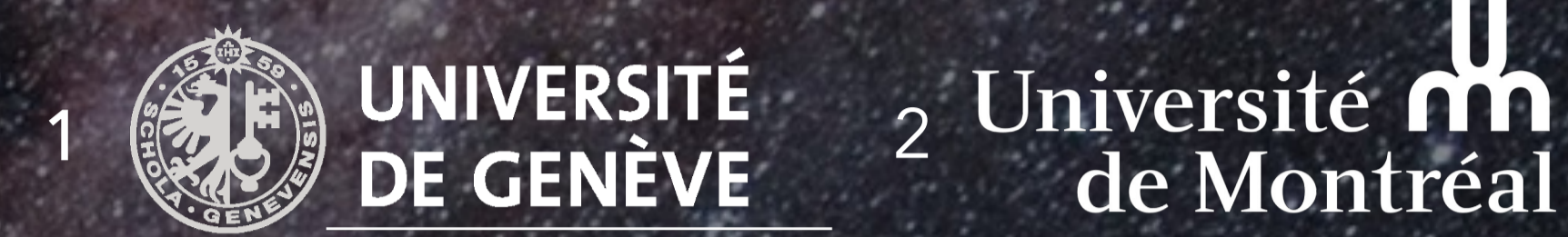
NIRPS Consortium



Hey ! Dany here.

I'm a PhD student in his last year at the University of Geneva, and I've been working on high-resolution transmission spectroscopy to analyze all types of exoplanet atmospheres, and a member of the ESPRESSO and NIRPS consortia.

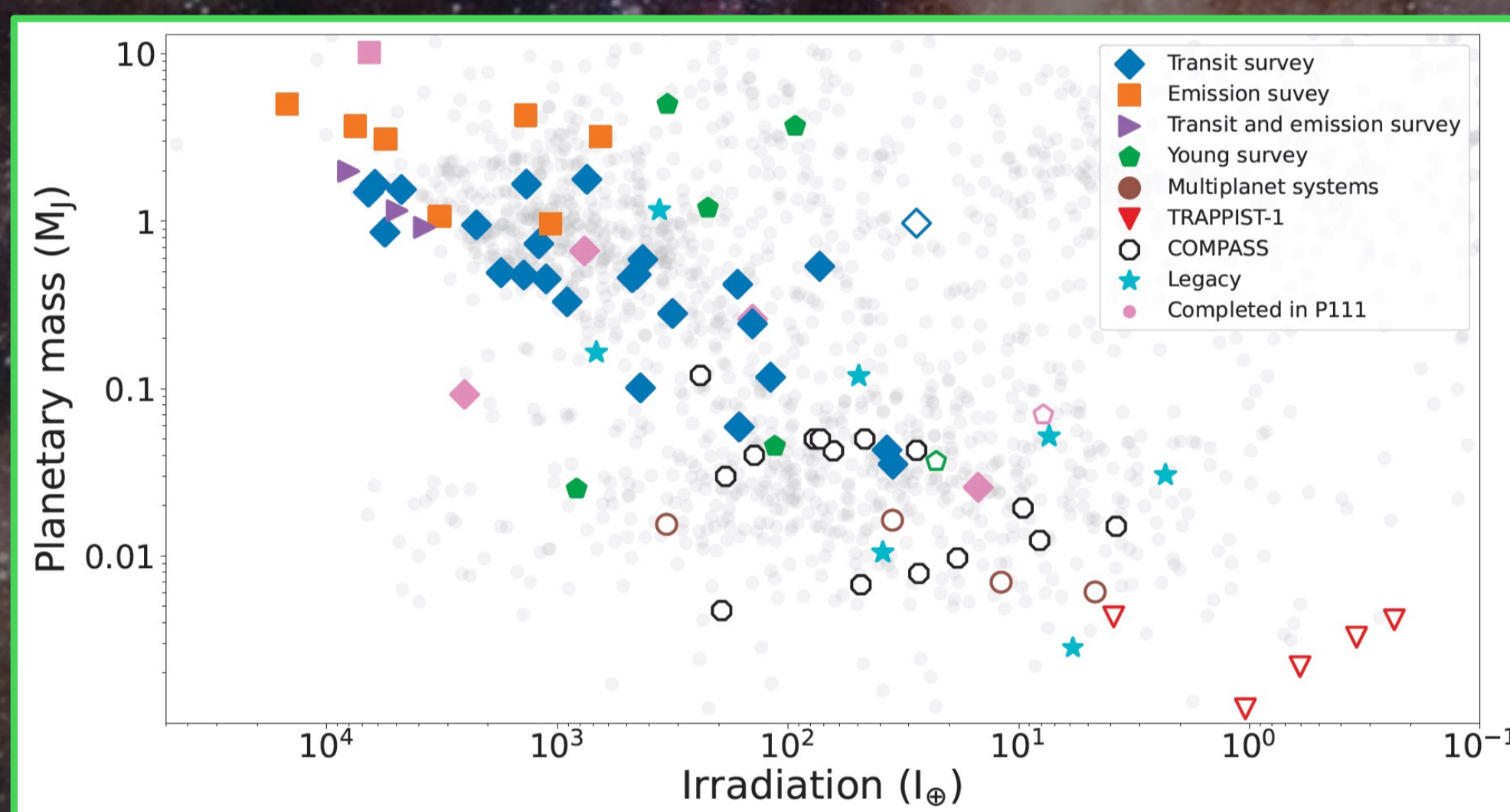
dany.mounzer@unige.ch



NIRPS

High-resolution spectrograph ($R \sim 80'000$) on the ESO 3.6m telescope in La Silla, Chile. The near-infrared twin (YJH bands) of HARPS, working simultaneously, started operating on April 1st 2023. The NIRPS¹ consortium has been awarded 725 nights for 5 years of Guaranteed Time Observations (GTO).

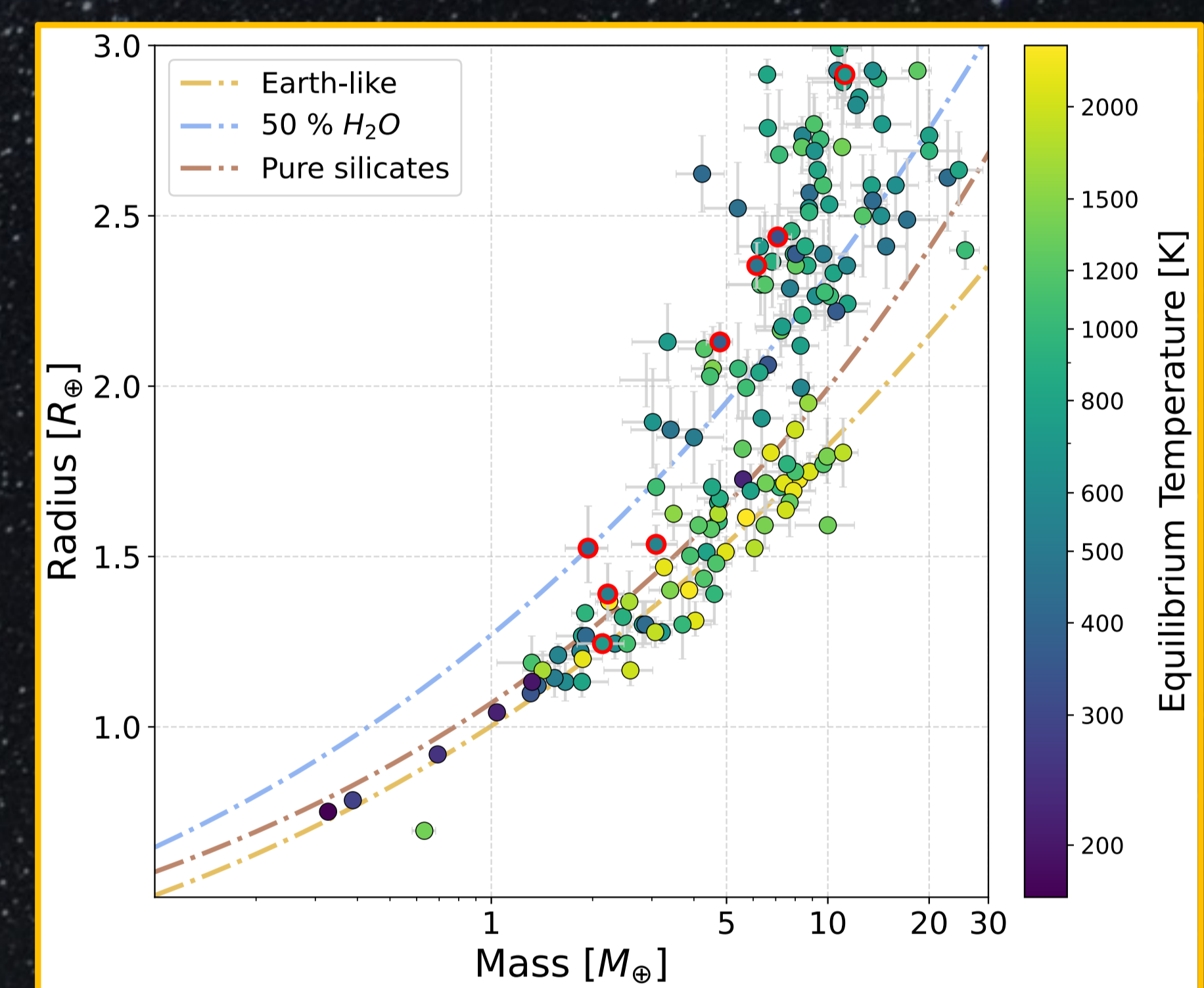
Around a third of this time is dedicated to the study of exoplanet atmospheres (Talk 986, Parallel 9C):



Sub-Neptunes

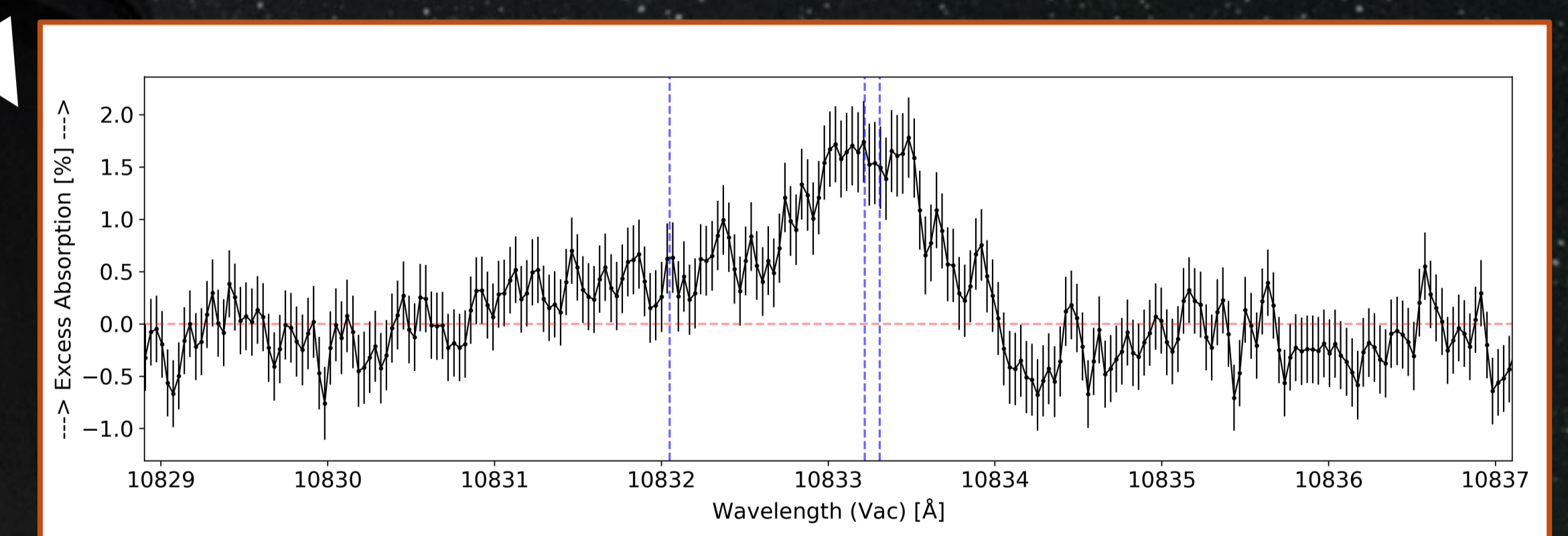
Until Exoplanets V, 32 transits of 14 sub-Neptunes ($< 3 R_{\text{Earth}}$) not named TRAPPIST-1 have been scheduled to understand their atmosphere and orbital architecture, and to do comparative analysis for multi-planetary systems, with many observations still coming.

Here, we focus on the transmission spectroscopy analysis around the Helium triplet for 9 of those (8 named, in red), spanning various masses, radii and temperatures:

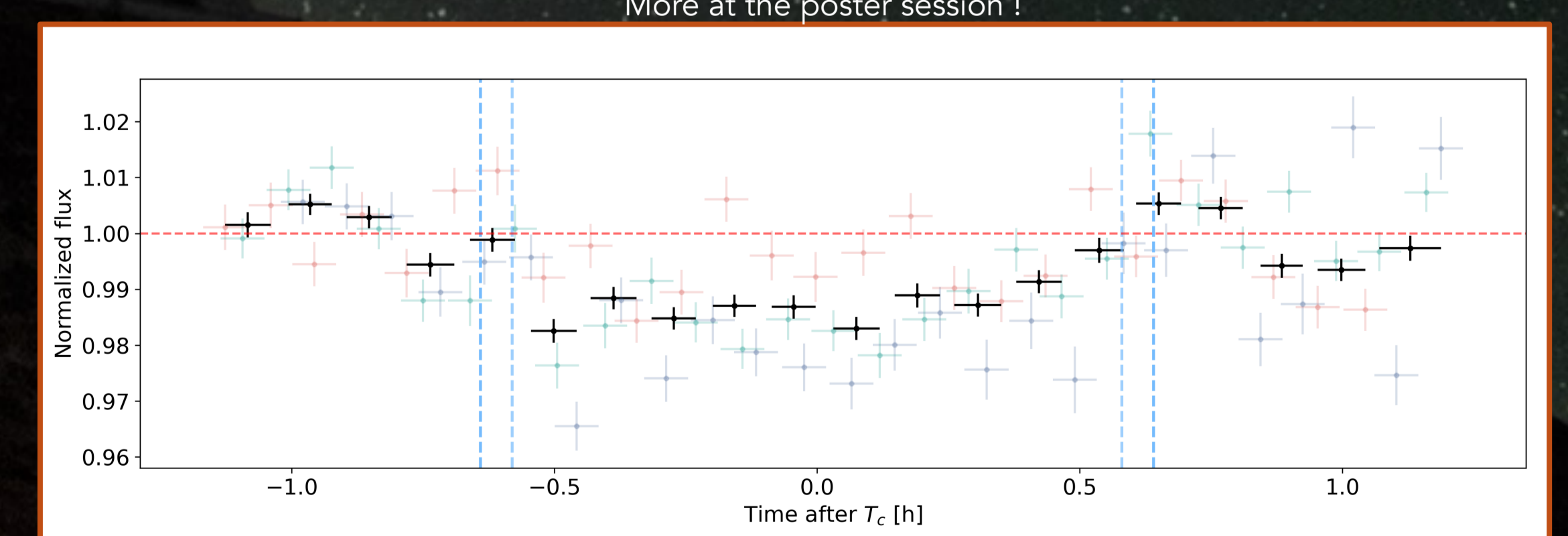


Planet	$R_p [R_{\oplus}]$	$M_p [M_{\oplus}]$	$T_{\text{eq}} [K]$	Sp.T.	J_{mag}	N_{tra}	S/N	Limit [%]
?	?	?	?	?	?	3	55	Detection ?
HD136352c	2.916	11.24	677	G4	4.308	1	300	< 0.265 %
LP791-18c	2.438	7.1	324	M6	11.559	6	12	< 5.806 %
HD260655b	1.24	2.14	709	M0	6.674	1	85	< 0.596 %
HD260655c	1.533	3.09	557	M0	6.674	1	85	< 0.712 %
L98-59c	1.34	2.42	517	M3	7.933	4	45	< 0.779 %
L98-59d	1.58	2.31	409	M3	7.933	2	50	< 1.636 %
TOI-270c	2.355	6.15	488	M3	9.099	2	45	< 1.129 %
TOI-270d	2.133	4.78	387	M3	9.099	1	35	< 2.102 %

Transmission spectrum and He light curve³



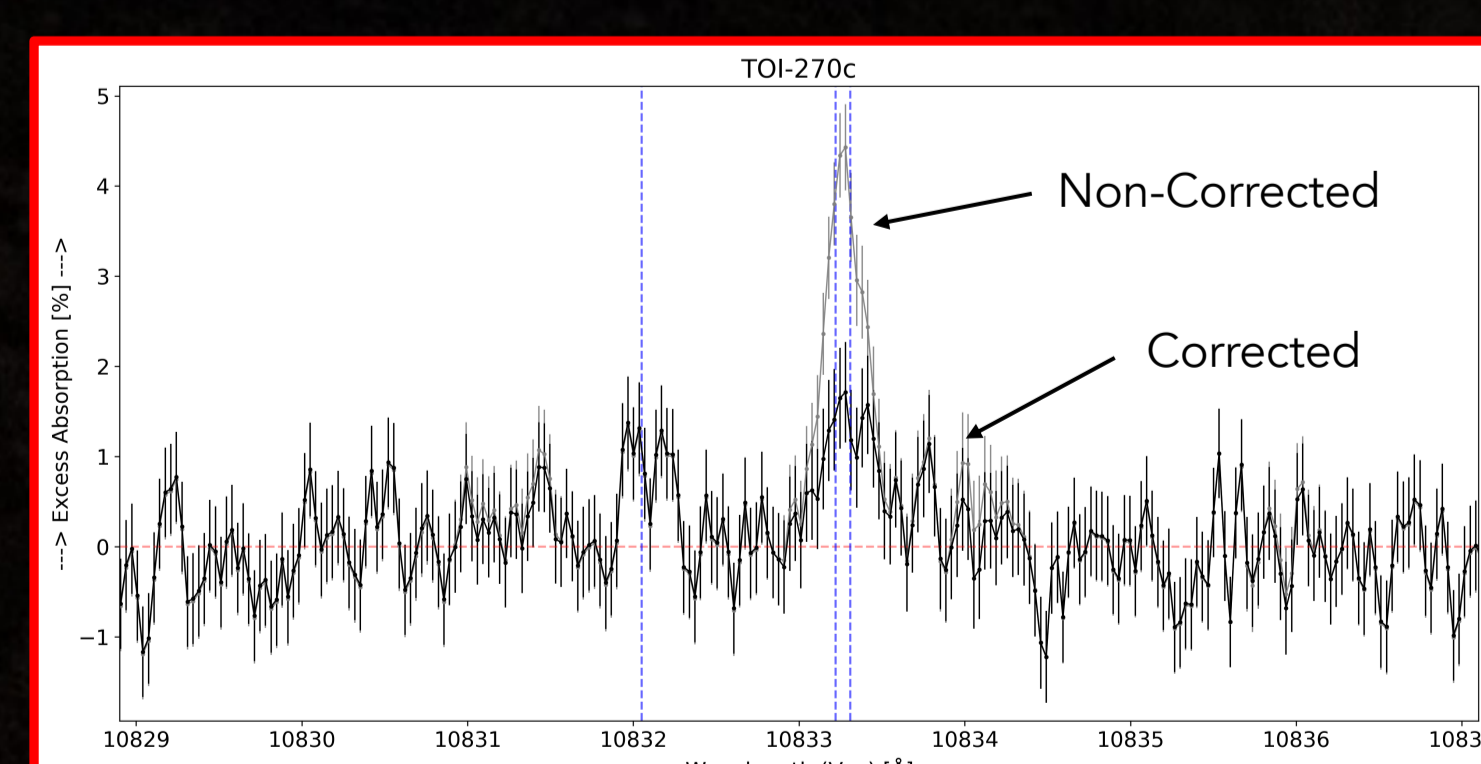
More at the poster session !



Take-Away

- NIRPS produces some of the most precise transmission spectra in the metastable Helium triplet ever produced
- A lot of its time is dedicated to exo-atmospheres, notably on temperate sub-Neptunes that will complement future JWST observations
- Increasingly better telluric correction is needed, especially for faint targets

Tellurics can fake a signature!



NIRPS @ ExoV:

Parallel Talk 986 - Romain Allart
Poster 435 - Alejandro Suarez
Poster 661 - Yann Carteret

Parallel Talk 1234 - Khaled Al Moulla
Poster 601 - Yolanda Frensch
Poster 871 - François Bouchy

Poster 616 - Léna Parc
Poster 1275 - Lucile Mignon

References:
[1] Bouchy, Doyon et al. 2017 « Near-InfraRed Planet Searcher to Join HARPS on the ESO 3.6-metre Telescope »
[2] Parc et al. 2024 « From Super-Earths to Sub-Neptunes: observational constraints and connections to theoretical models »
[3] Allart et al. 2023 « Homogeneous search for helium in the atmosphere of 11 gas giant exoplanets with SPIRou »

Molecules are next !