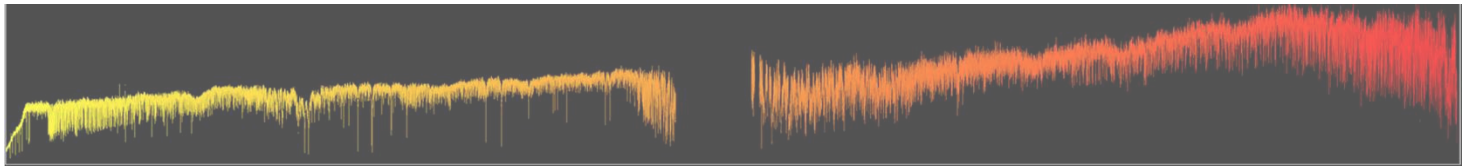
Cool giant planets with NIRPS

F. Bouchy, R. Doyon, L. Mignon, X. Delfosse, L. Parc, D. Ségransan, S. Udry and NIRPS consortium

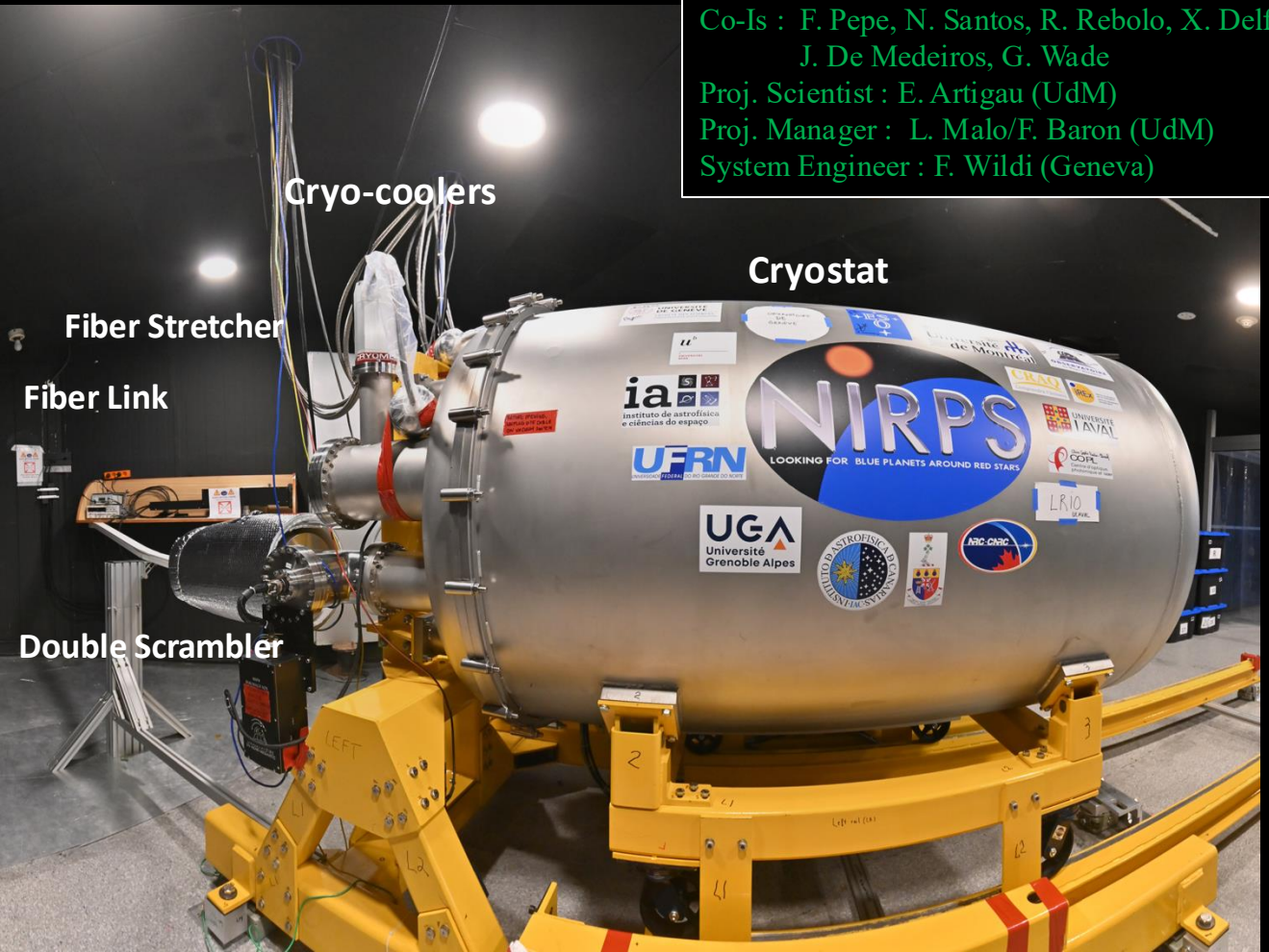


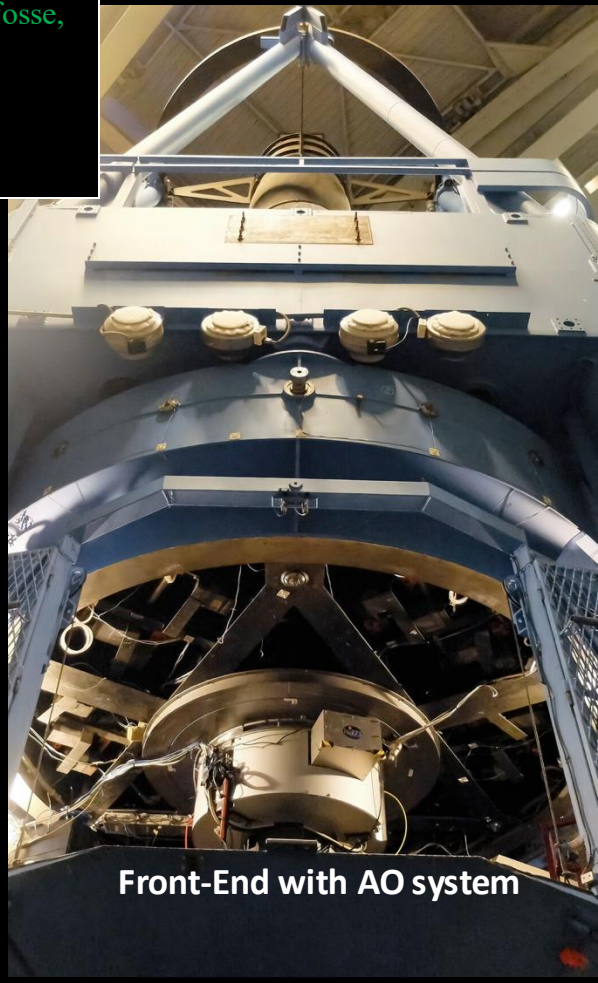
PlanetS National Centre of Competence in Research
UNIVERSITÉ DE GENÈVE FACULTÉ DES SCIENCES Département d'astronomie
ia instituto de astrofísica e ciências do espaço
Instituto de Astrofísica de Canarias
UNIVERSITÉ Grenoble Alpes
UFRN Universidade Federal do Rio Grande do Norte
OBSERVATOIRE DU MONT MÉGANTIC
Institut Trottier de recherche sur les exoplanètes
Trottier Institute for Research on Exoplanets
iREx Université de Montréal

NIRPS Room - Coudé Floor of 3.6m

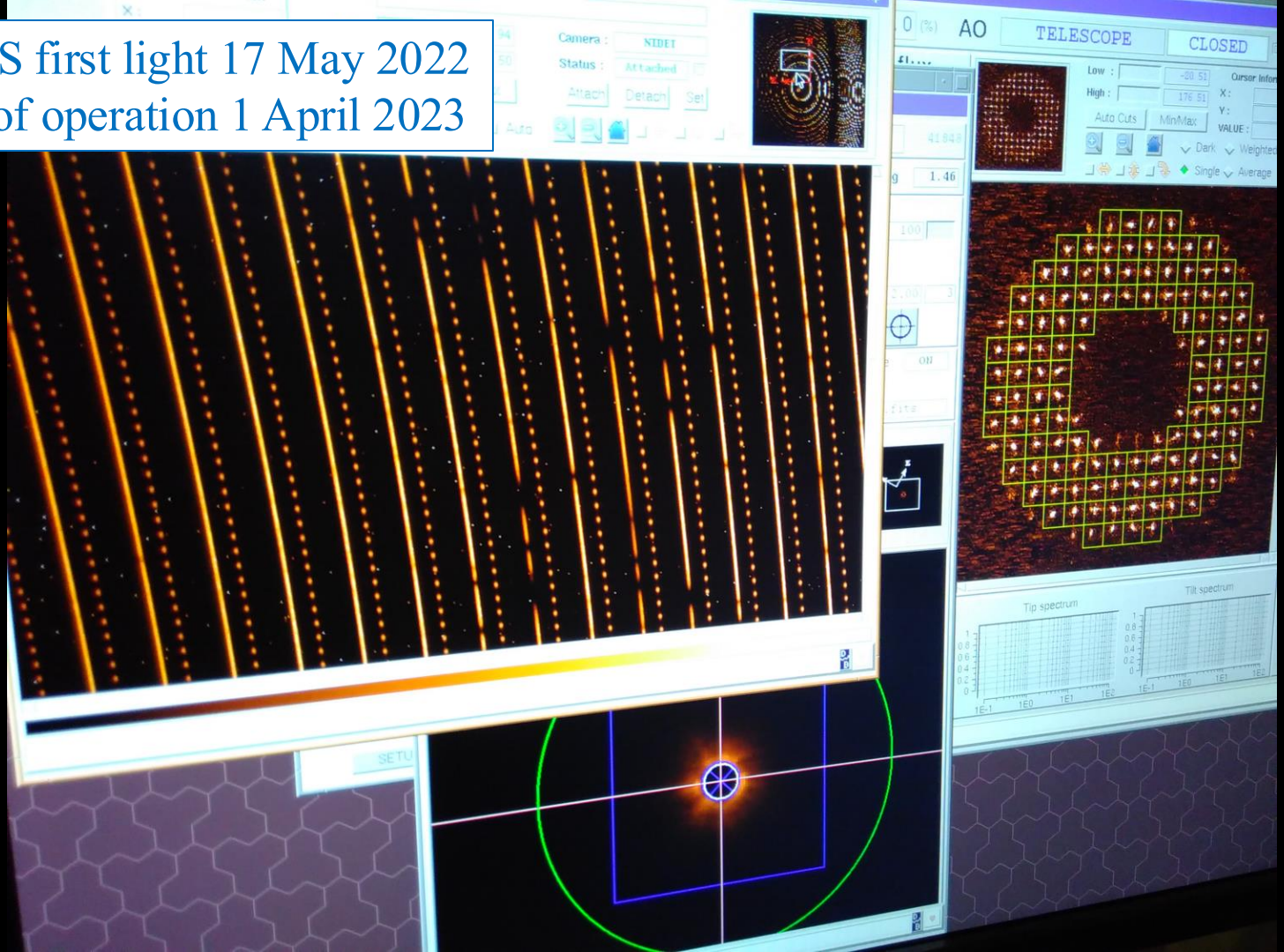
Co-PIs : R. Doyon (UdM) + F. Bouchy (Geneva)
Co-Is : F. Pepe, N. Santos, R. Rebolo, X. Delfosse, J. De Medeiros, G. Wade
Proj. Scientist : E. Artigau (UdM)
Proj. Manager : L. Malo/F. Baron (UdM)
System Engineer : F. Wildi (Geneva)

ESO 3.6m telescope

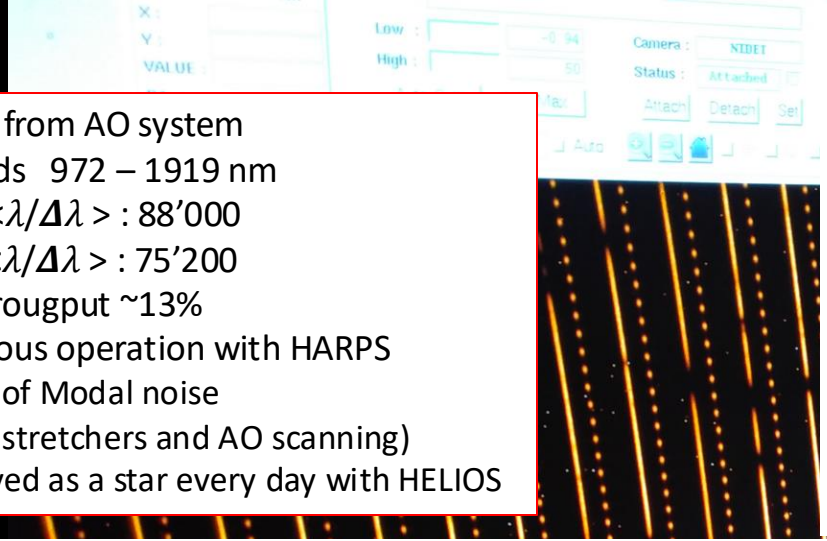


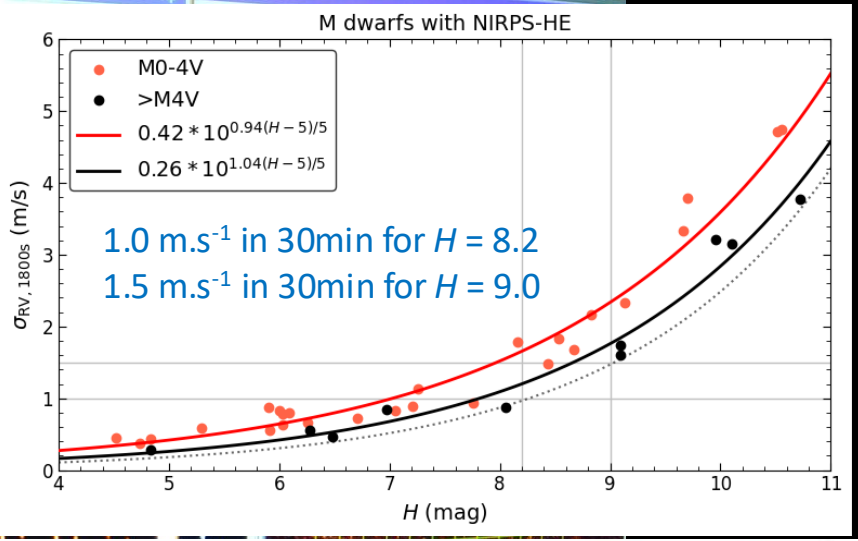


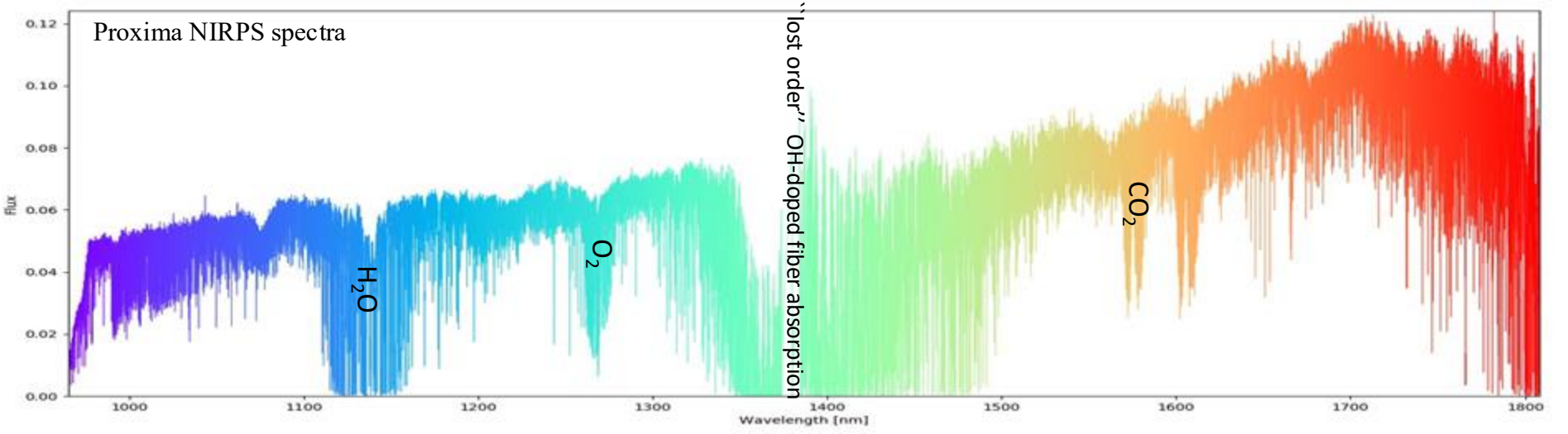
NIRPS first light 17 May 2022
Start of operation 1 April 2023



Fiber feed from AO system
Y, J, H bands 972 – 1919 nm
HA 0.4'' $<\lambda/\Delta\lambda>$: 88'000
HE 0.9'' $<\lambda/\Delta\lambda>$: 75'200
Overall througput ~13%
Simultaneous operation with HARPS
Mitigation of Modal noise
(fiber stretchers and AO scanning)
Sun observed as a star every day with HELIOS



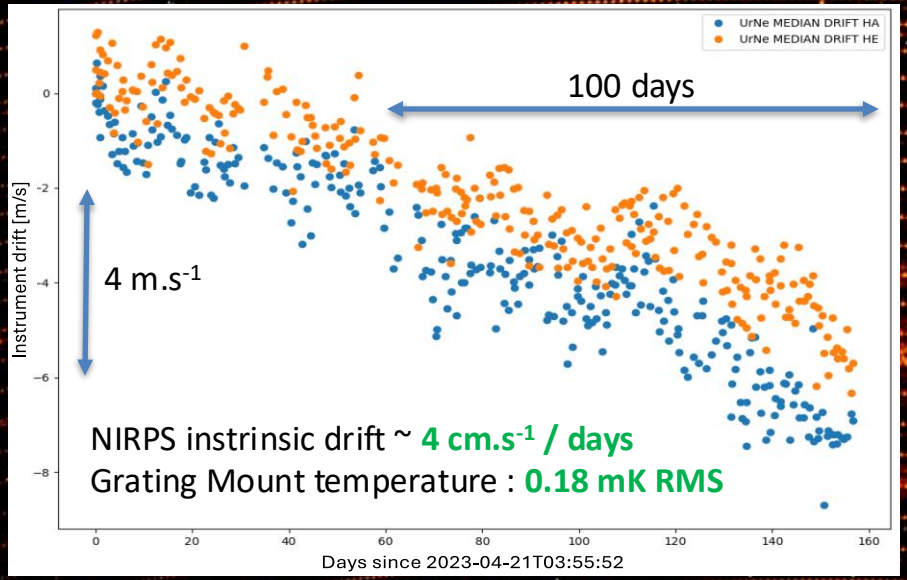


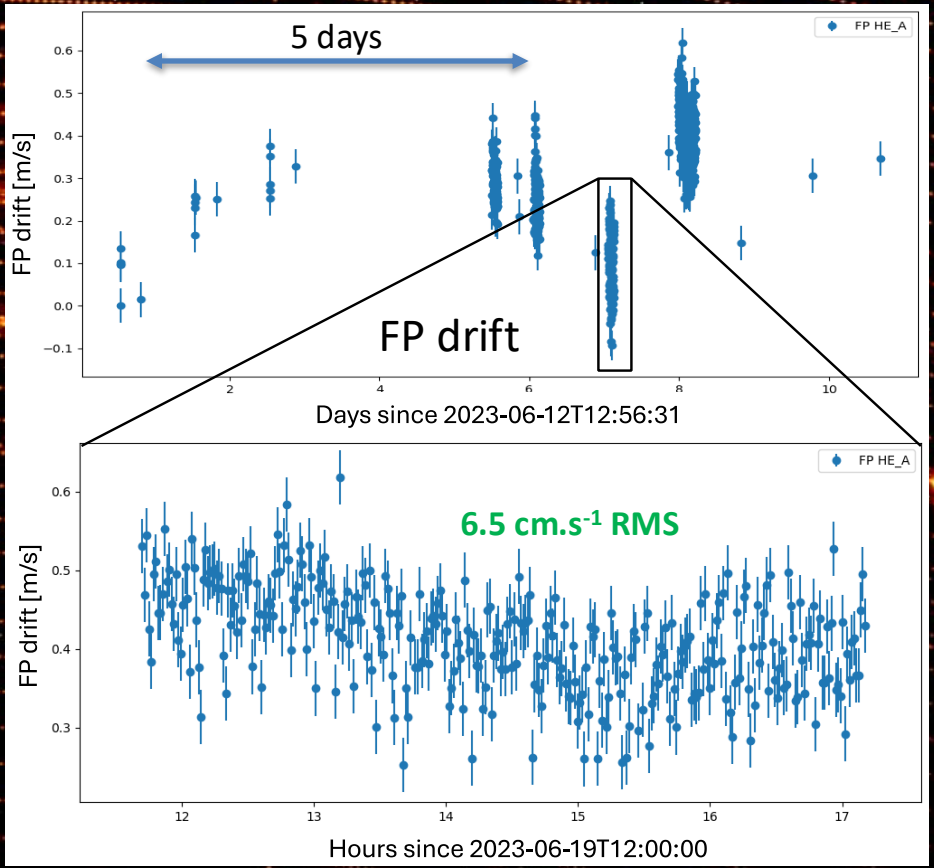


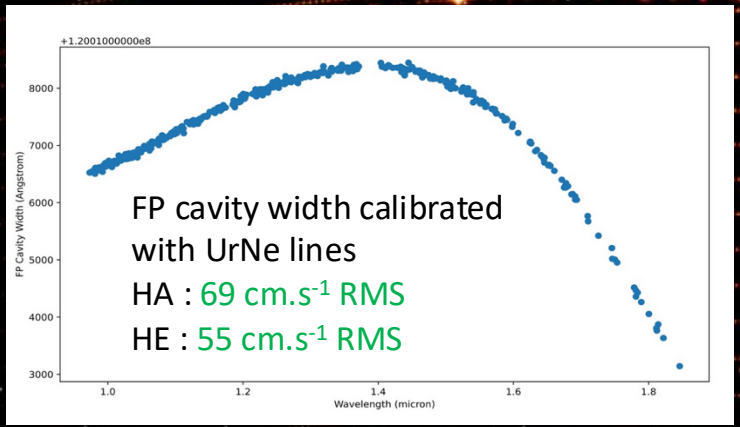
NIRPS joining HARPS at ESO 3.6 m

On-sky performance and science objectives

Bouchy, Doyon, Pepe et al. 2025, A&A, 700, A10



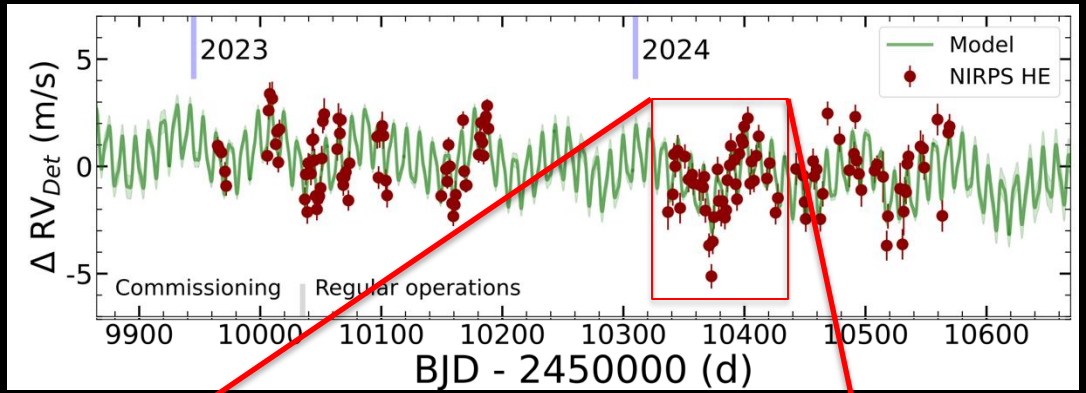


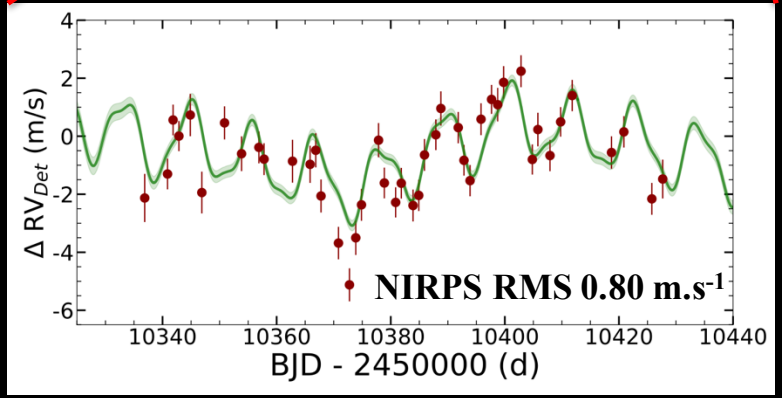


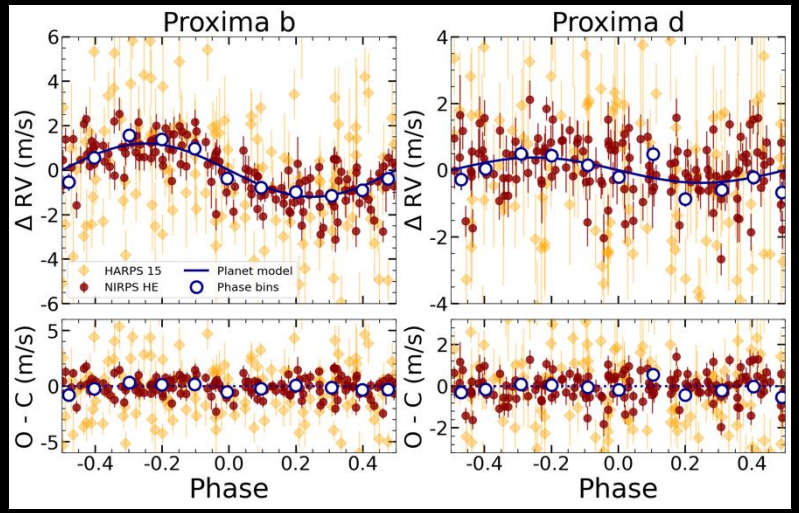
Diving into the planetary system of Proxima with NIRPS

Breaking the metre per second barrier in the infrared

Suarez Mascarenos, Artigau, Mignon, et al. 2025, A&A, 700, A11







Proxima

M5.5V H=4.8 V=11.1

d = 1.3 pc

P_b = 11.18 days

K_b = 1.15 ± 0.11 m.s^{-1} (NIRPS only)

K_b = 1.226 ± 0.062 m.s^{-1} (ALL)

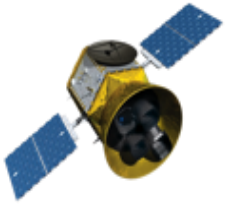
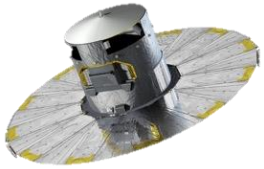
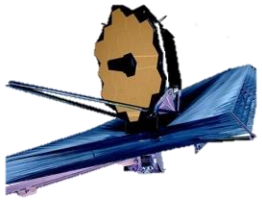
m_b.sin$i$ = 1.055 ± 0.055 $M_\oplus$

P_d = 5.123 days

K_d = 0.32 ± 0.14 m.s^{-1} (NIRPS only)

K_d = 0.392 ± 0.057 m.s^{-1} (ALL)

m_d sin$i$ = 0.260 ± 0.038 $M_\oplus$

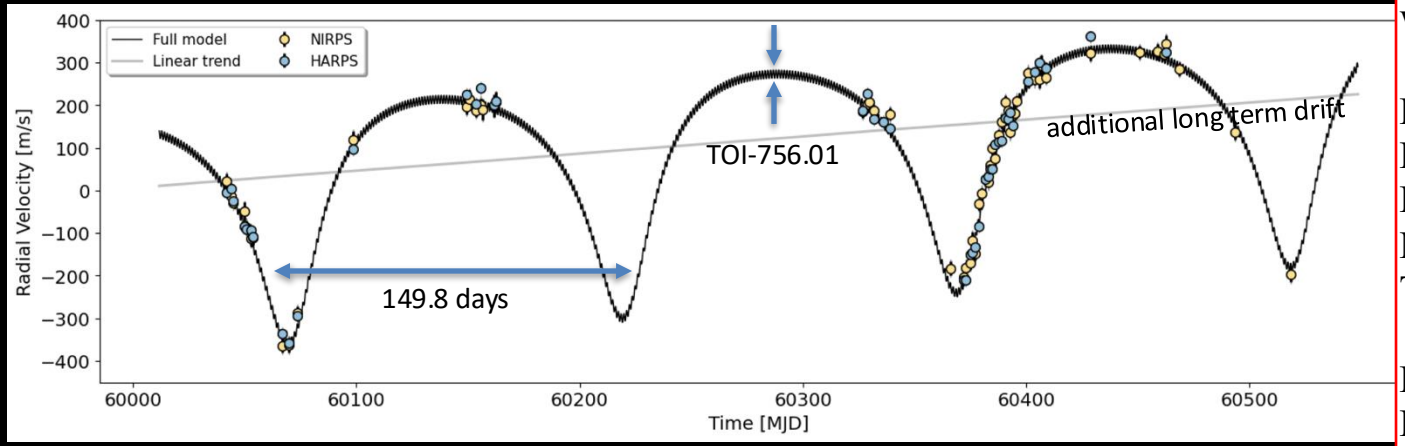

NIRPS-GTO science programs (725 nights over 5 years)

WP1: Blind radial-velocity search of exoplanets around low-mass stars (L. Mignon/X. Delfosse) **225 nights**
WP2: Mass characterization of exoplanets transiting M dwarfs (F. Bouchy/R. Doyon) **225 nights**
WP3: An in-depth look into exoplanets through high-resolution time-series spectroscopy (R. Allart) **225 nights**

Other Science 1: Improving metallicity determination of M dwarfs with FGK binaries
Other Science 2: Radial-velocity variations in cool giants: exoplanets or stellar activity?
Other Science 3: Stellar activity impact on radial-velocity variations in K stars
Other Science 4: Transiting S-type exoplanets
Other Science 5 : Atmospheric studies of Solar system objects

} **50 nights**

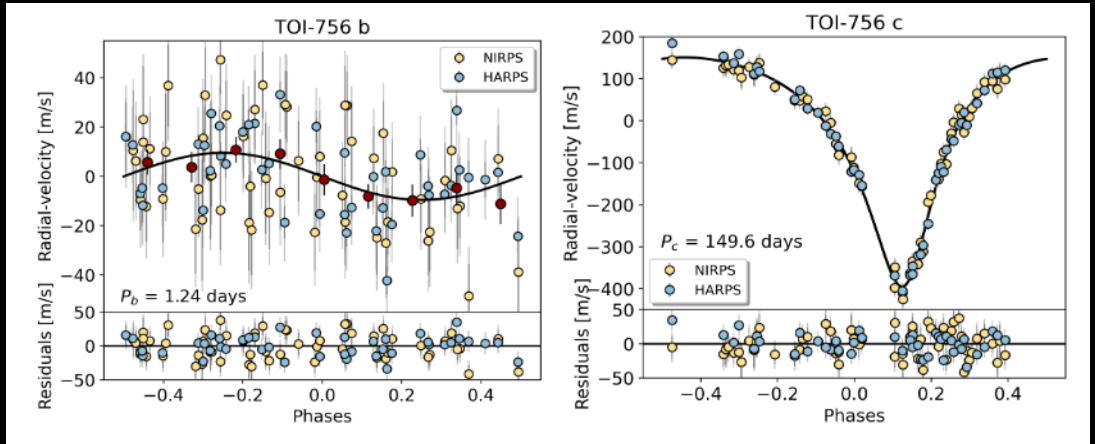
NIRPS and TESS reveal a peculiar system around the M dwarf TOI-756
A transiting sub-Neptune and a cold eccentric giant
Parc, Bouchy, Cook et al. 2025, A&A, in press



TOI-756
M1V H=10.5 V=14.6
+ co-moving stellar companion
WT 352 (M3/4V @ 955 AU)

$P_b = 1.24$ days
$K_b = 9.4 \pm 2.4$ m.s^{-1}
$R_b = 2.87 \pm 0.06\ R_\oplus$
$M_b = 10.1 \pm 1.7\ M_\oplus$
$Teq_b \sim 934$ K

$P_c = 149.6$ days
$K_c = 272 \pm 4$ m.s^{-1}
$M_c \sin i = 4.17 \pm 0.06\ M_{Jup}$
$e_c = 0.45 \pm 0.01$
$Teq_c \sim 194$ K



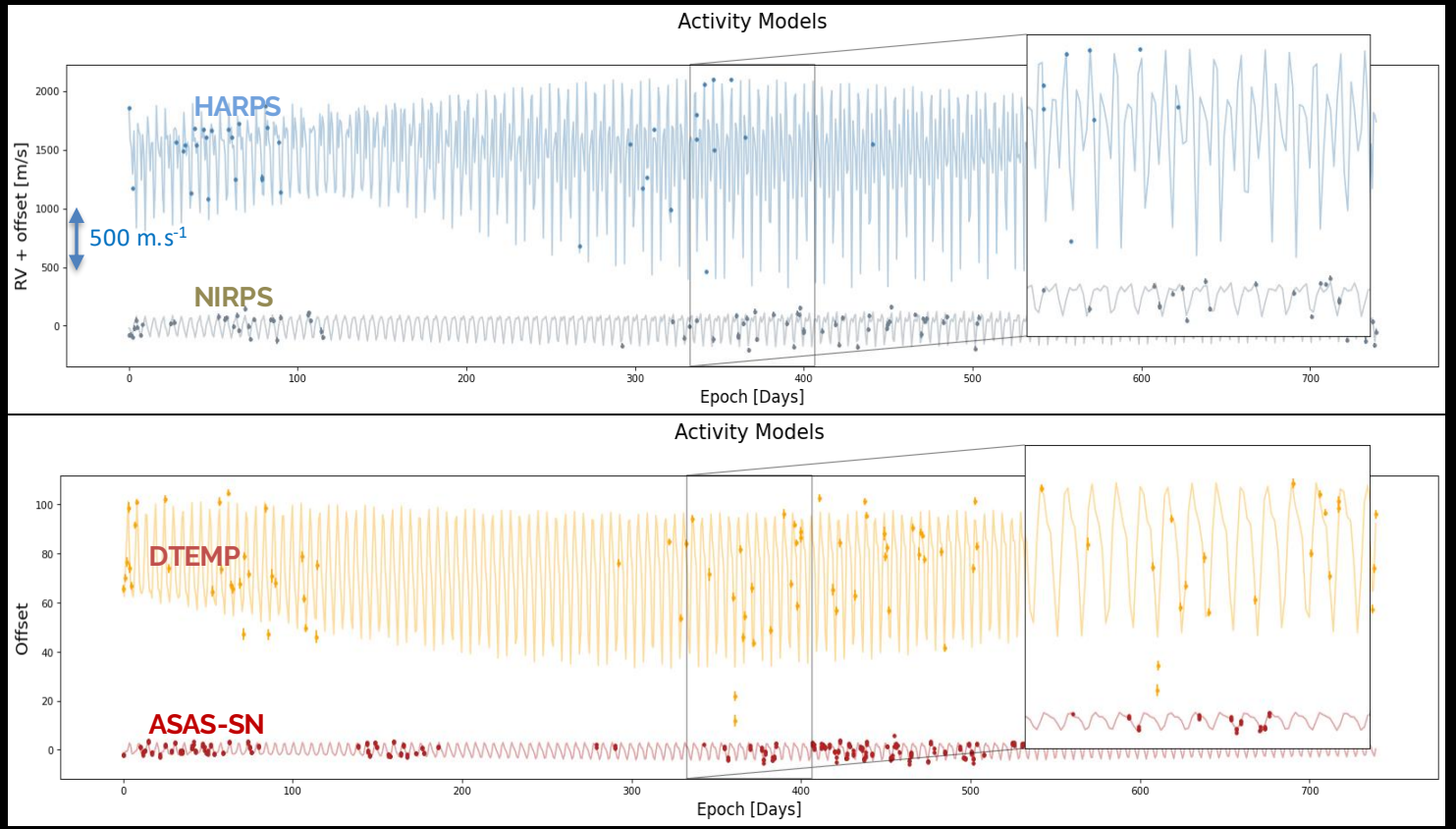
First confirmed system hosting both a transiting sub-Neptune and an outer giant planet around an M dwarf.

NIRPS Unveils a 17 Myr warm, Saturn-mass exoplanet

Moranta, Gagné, Mignon et al. in prep

PACAMARA-1

- M1 part of Beta Pic Moving Group
- **age ~17 Myr**
- 0.67 +/- 0.08 $M_\odot$
- 5.4 days rotation rate



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- M1 part of Beta Pic Moving Group
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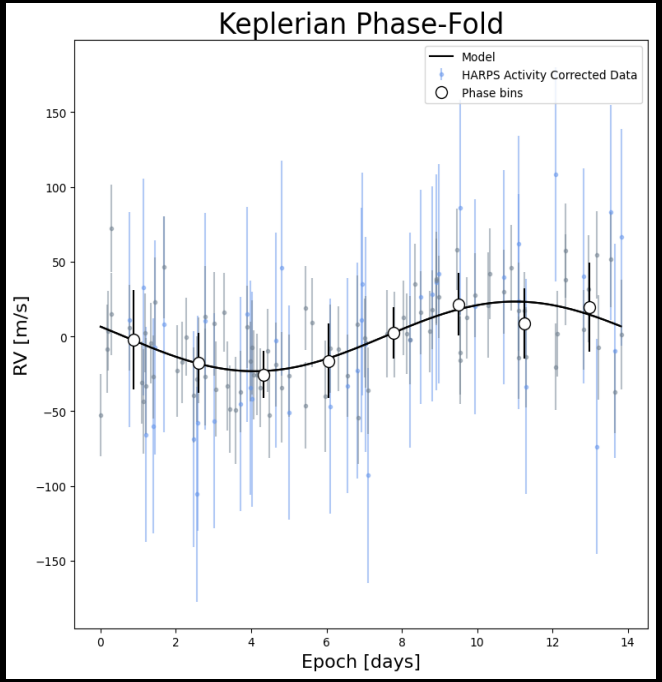
Gaussian Process
Quasi-Periodic Kernel

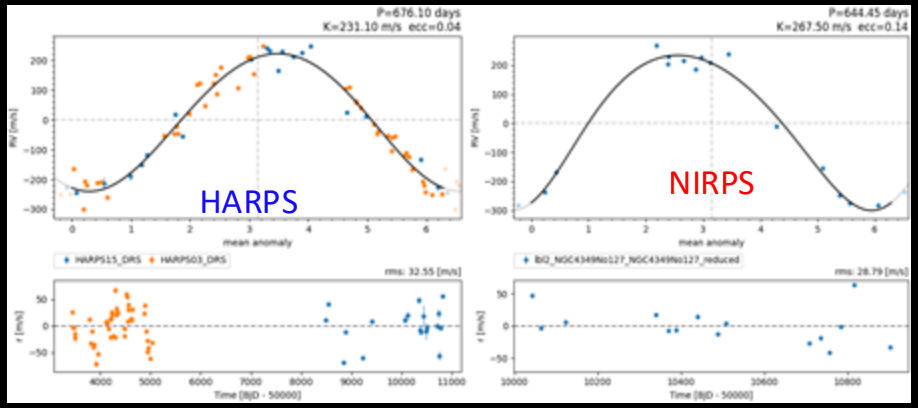
Jointly fitted with shared hyperparameters



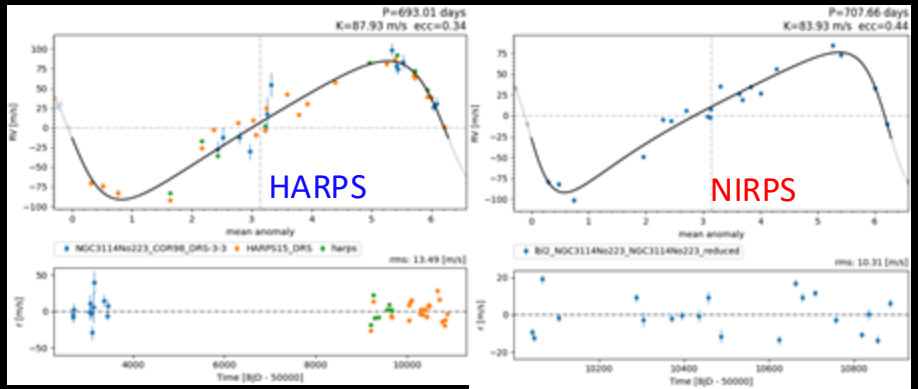
PACAMARA-1b
P = 13.9 days
K = 24.0 ± 5.5 $m.s^{-1}$
a = 0.1 AU
$m.sin i$ = 0.25 ± 0.06 M_{Jup}
Teq = 585 K

Other Science 2: Radial-velocity variations in cool giants: exoplanets or stellar activity? (Elisa Delga-Mena)

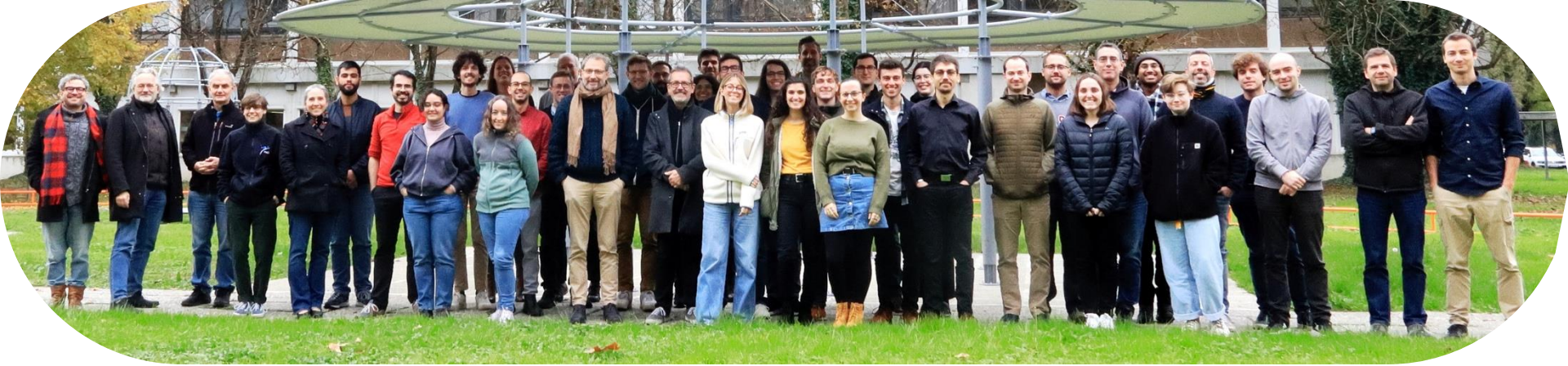
Monitoring of 18 evolved stars (~ 2 $M_{\odot}$) in open clusters showing long period and/or high amplitude RV variations



NGC4349No127
active star
larger amplitude nIR than optical
+ correlation with activitiy signals



NGC3114No223
planet candidate
similar amplitude nIR and optical



NIRPS science team members @ OHP conference

- François Bouchy
- Vincent Bourrier
- Jean-Baptiste Delisle
- David Ehrenreich
- Joao Faria
- Yolanda Frensch
- Lucile Mignon
- Christoph Mordasini
- Léna Parc
- Damien Ségransan
- Stéphane Udry

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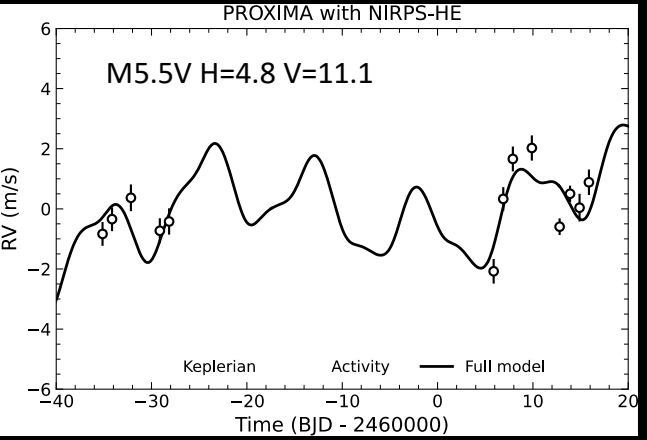
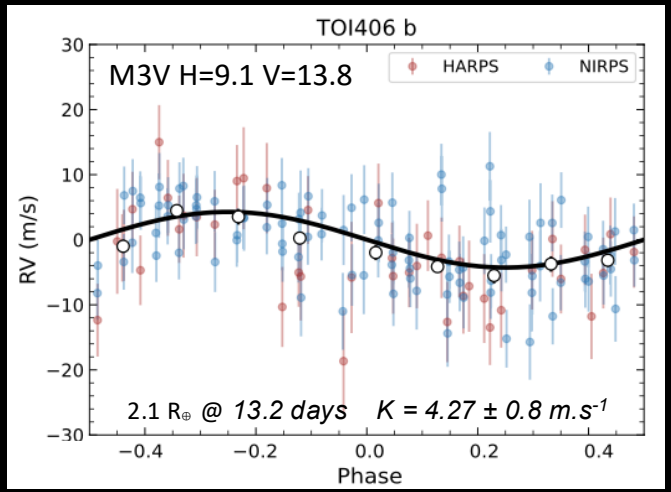
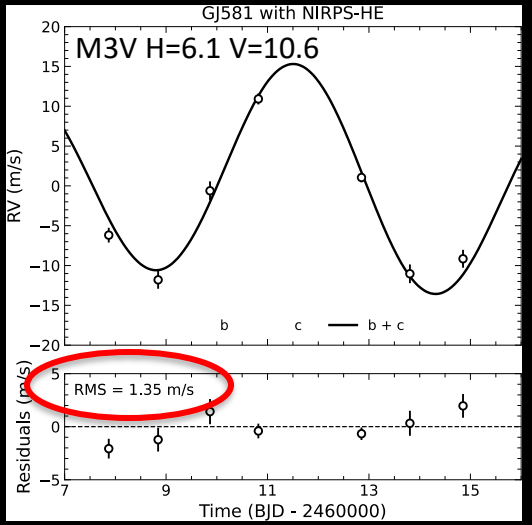
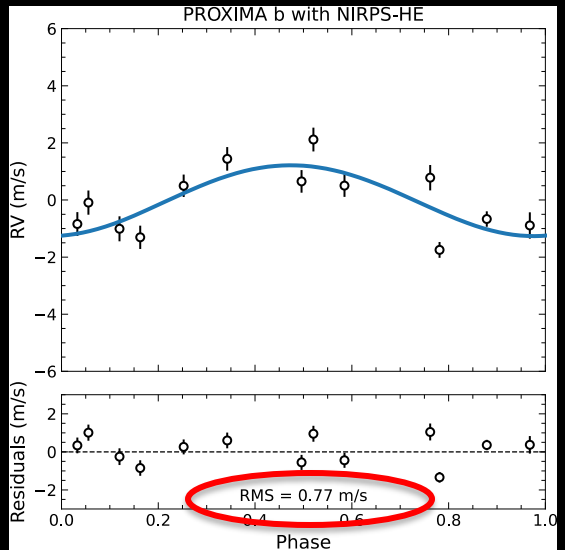
On-sky performance and science objectives

Bouchy, Doyon, Pepe et al. 2025, A&A, 700, A10

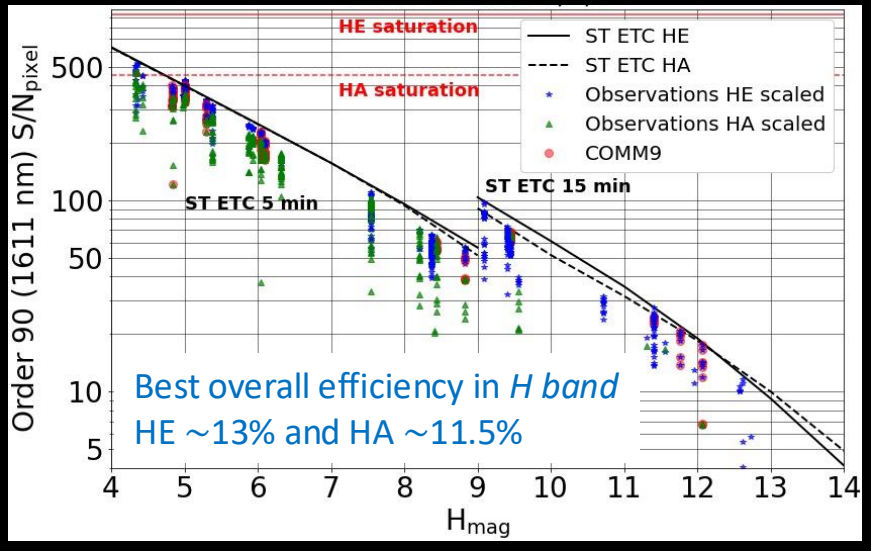


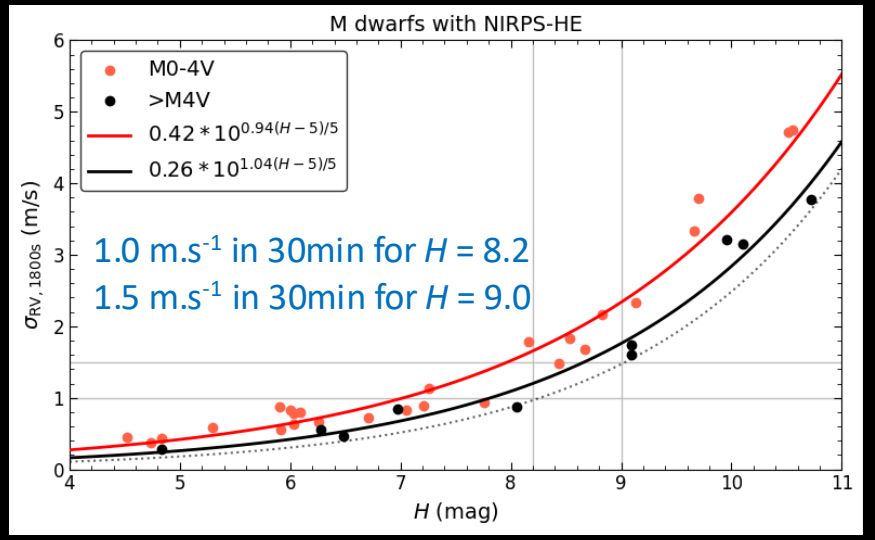


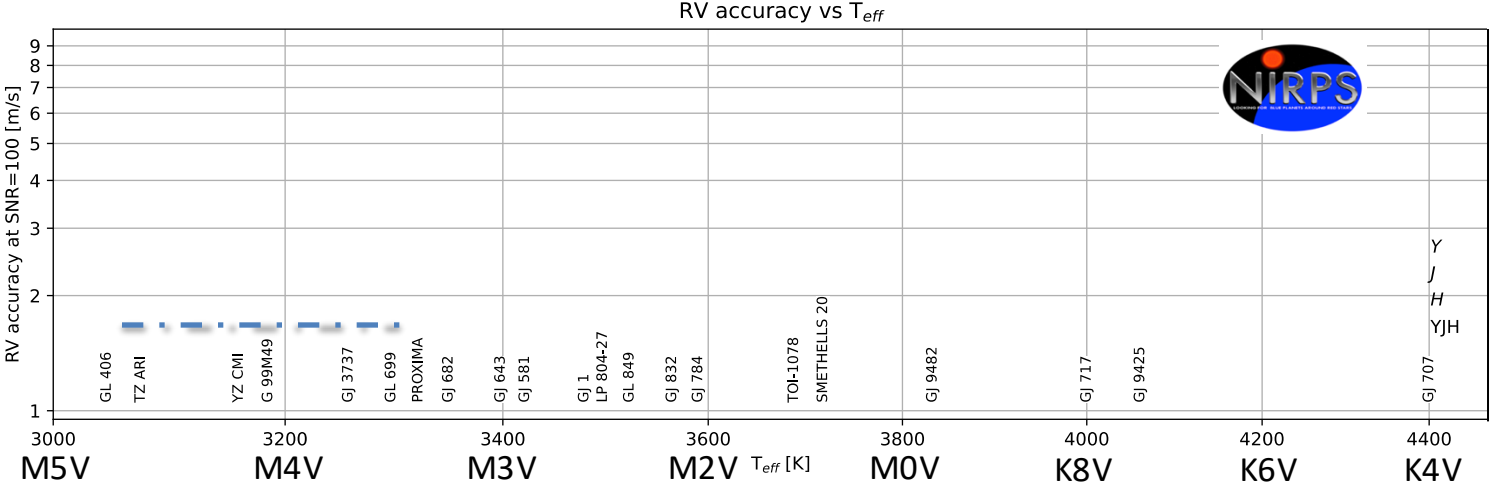




NIRPS σ_{RV} = 3.1 m.s^{-1} / HARPS σ_{RV} = 3.7 m.s^{-1}







SNR=100 (in H band)

Photon-noise predictions

Artigau+2018 3.1 m.s^{-1}

Figueira+2016 2.8 m.s^{-1}

Reiners+2020 4.2 m.s^{-1}

Measured on NIRPS

σ_{RV} ~1.7 m.s^{-1}

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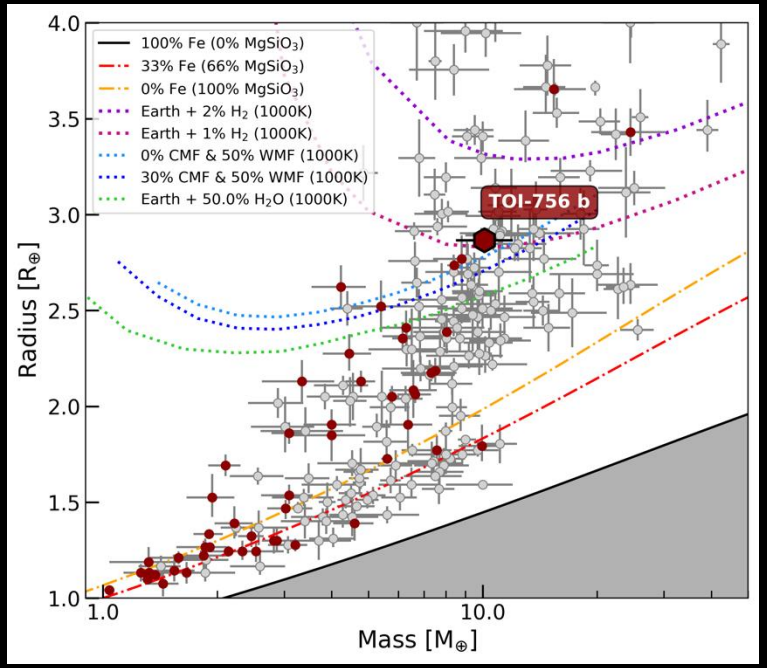
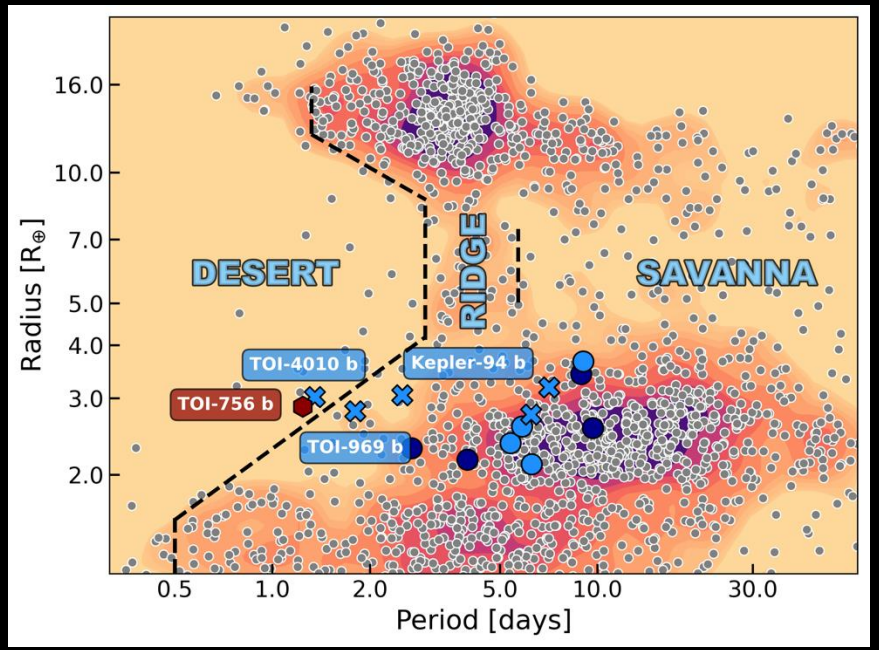
A transiting sub-Neptune and a cold eccentric giant
Parc, Bouchy, Cook et al. 2025, A&A, in press



``Miscible-envelope Sub-Neptunes" category
Pure H/He envelope or mixed supercritical H_2O and H/He



Sub-Neptunes + eccentric giant companion