Near Infra Red Planet Searcher

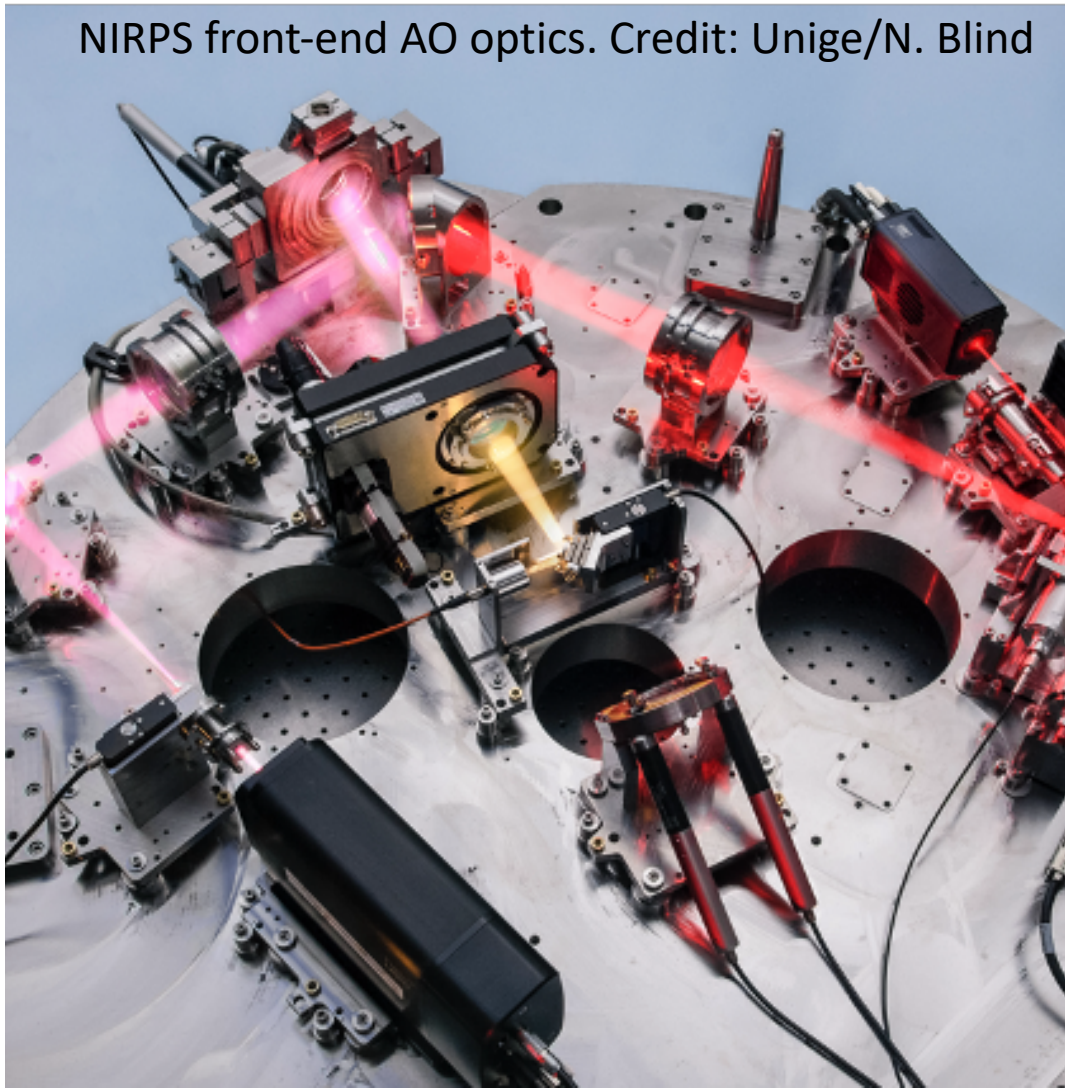
La Silla Paranal User Workshop P112 - 3 March 2023

Louise Dyregaard Nielsen, ESO fellow (Garching)

NIRPS in a nutshell

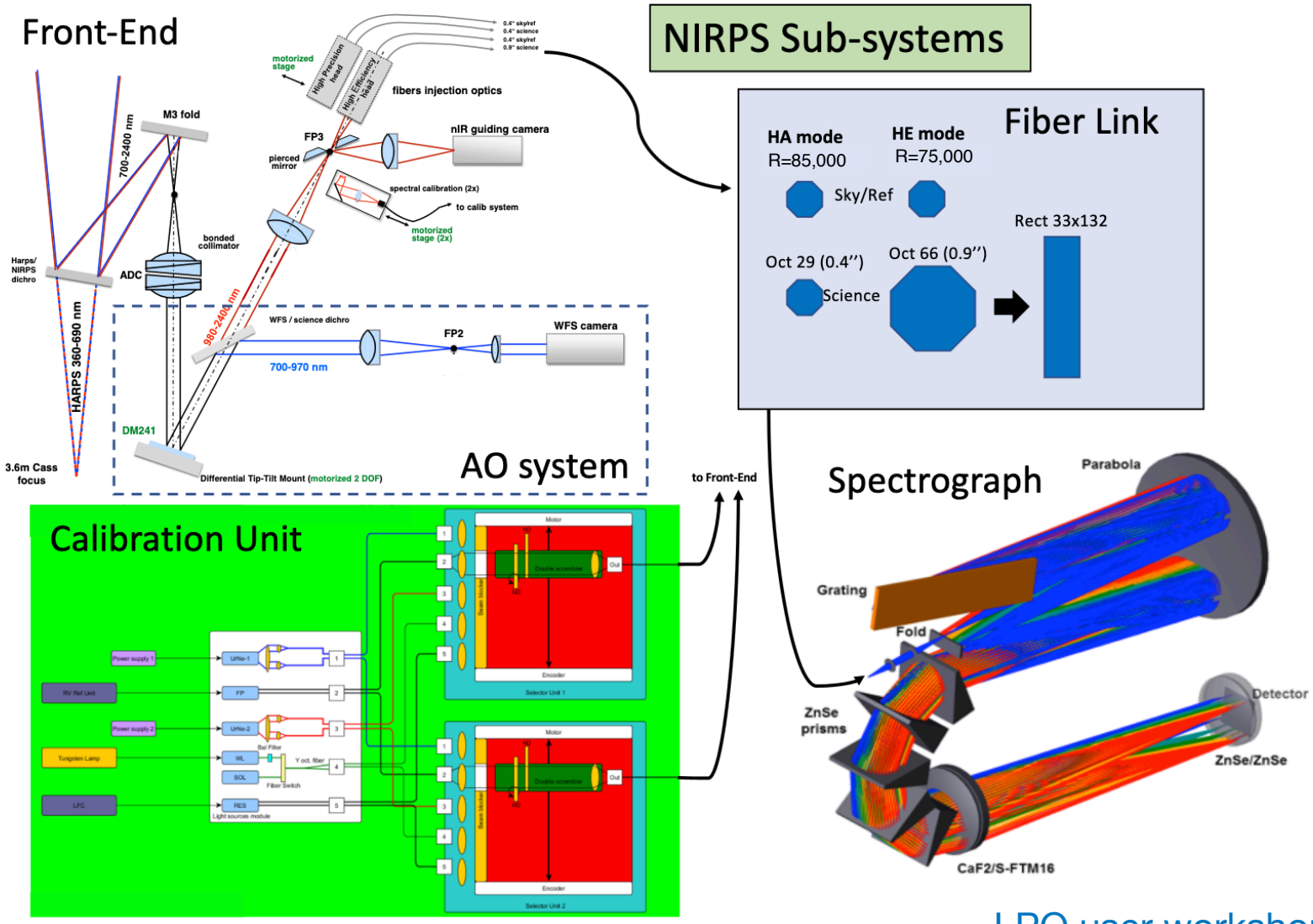
- On the ESO 3.6m, **GTO**=725n over 5 yrs
- AO-assisted, fibre-fed echelle spectrograph
- Y, J, H bands, 0.971 — 1.854 microns
- Two modes: R = 82,000 / 75,000
- Top-level requirement: high RV precision 1m/s
- Simultaneous operation w. HARPS
- Throughput >10%

NIRPS
LOOKING FOR BLUE PLANETS AROUND RED STARS



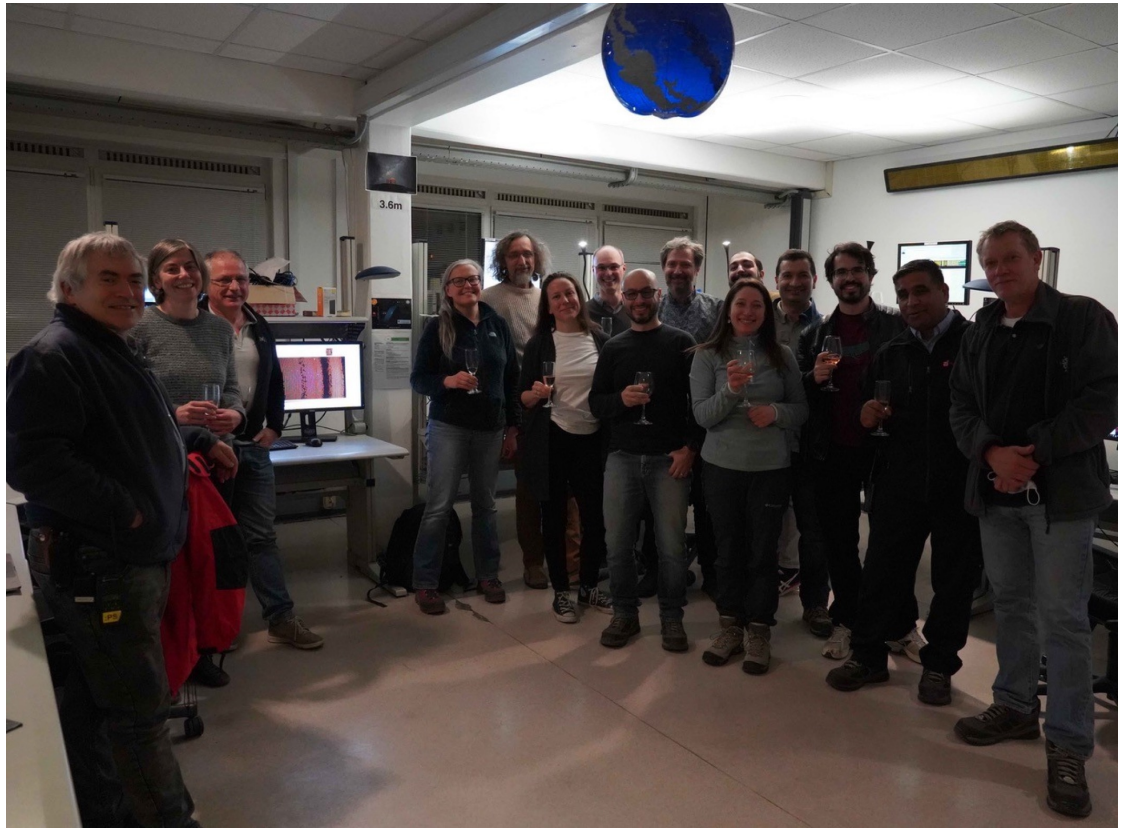
NIRPS front-end AO optics. Credit: Unige/N. Blind

NIRPS: front-end w. AO, calibration, fibre link and spectrograph

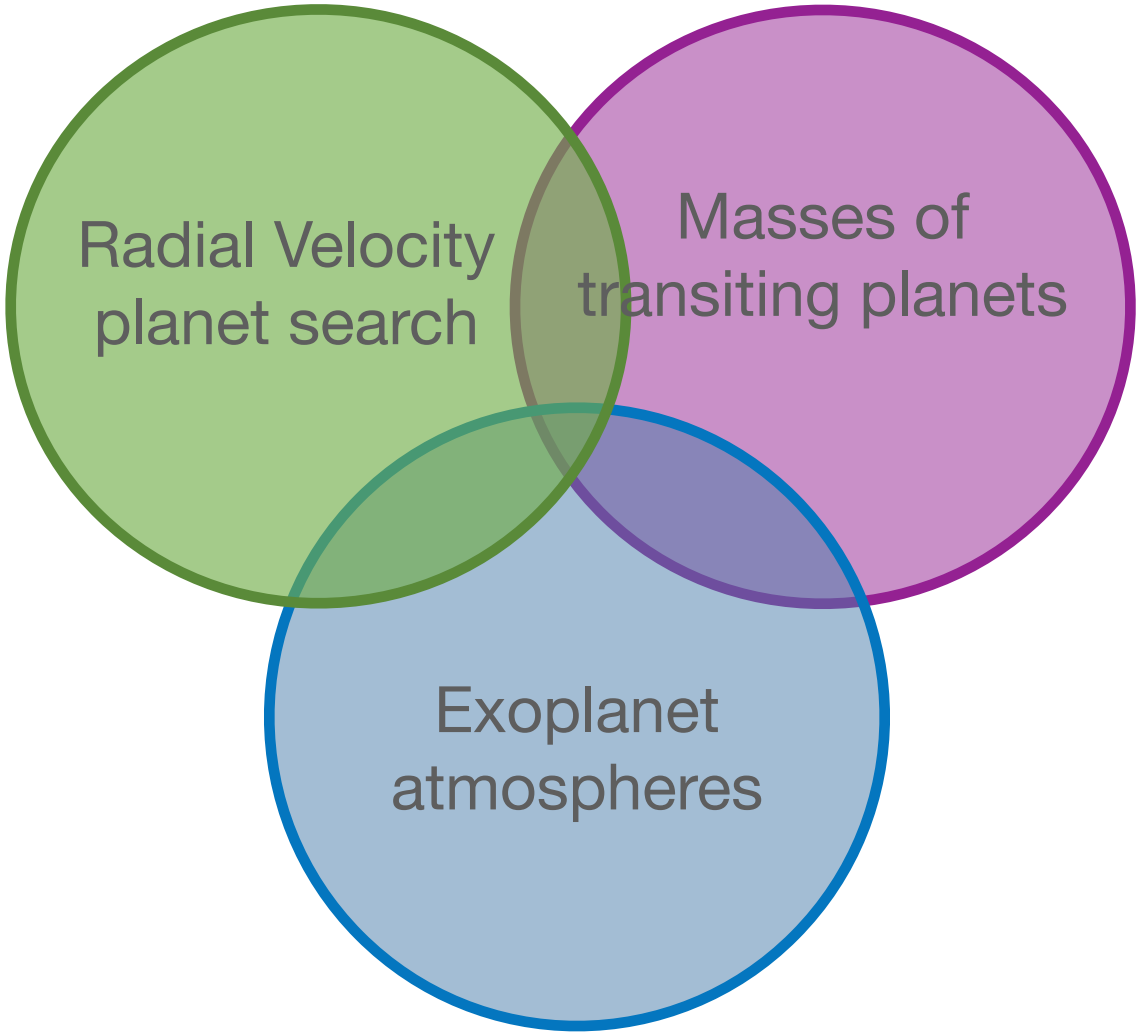


NIRPS timeline

- Jan 2016: Kickoff meeting @ Geneva
- Oct 2016: PDR @ Montreal
- May 2017: FDR @ Porto
- Jun 2017: MoU signed with ESO
- May 2019: PAE Fiber link Sep: Front-End
- … COVID …
- Oct 2021: PAE spectrograph
- Mar 2022: AIV in La Silla
- **Jun 2022: First light**
- **Aug 2022: offered to community for P111**
- **March 2023: final commissioning**
- Later: Laser Frequency Comb



NIRPS science



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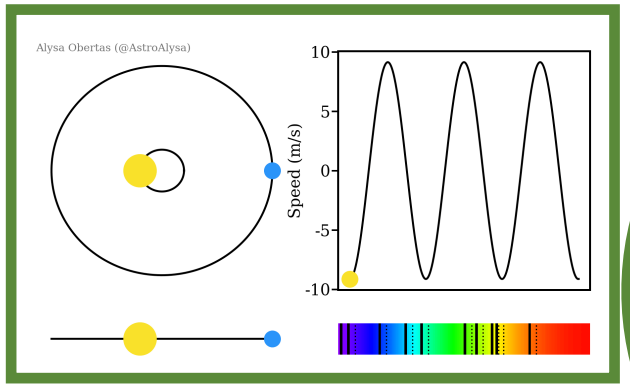
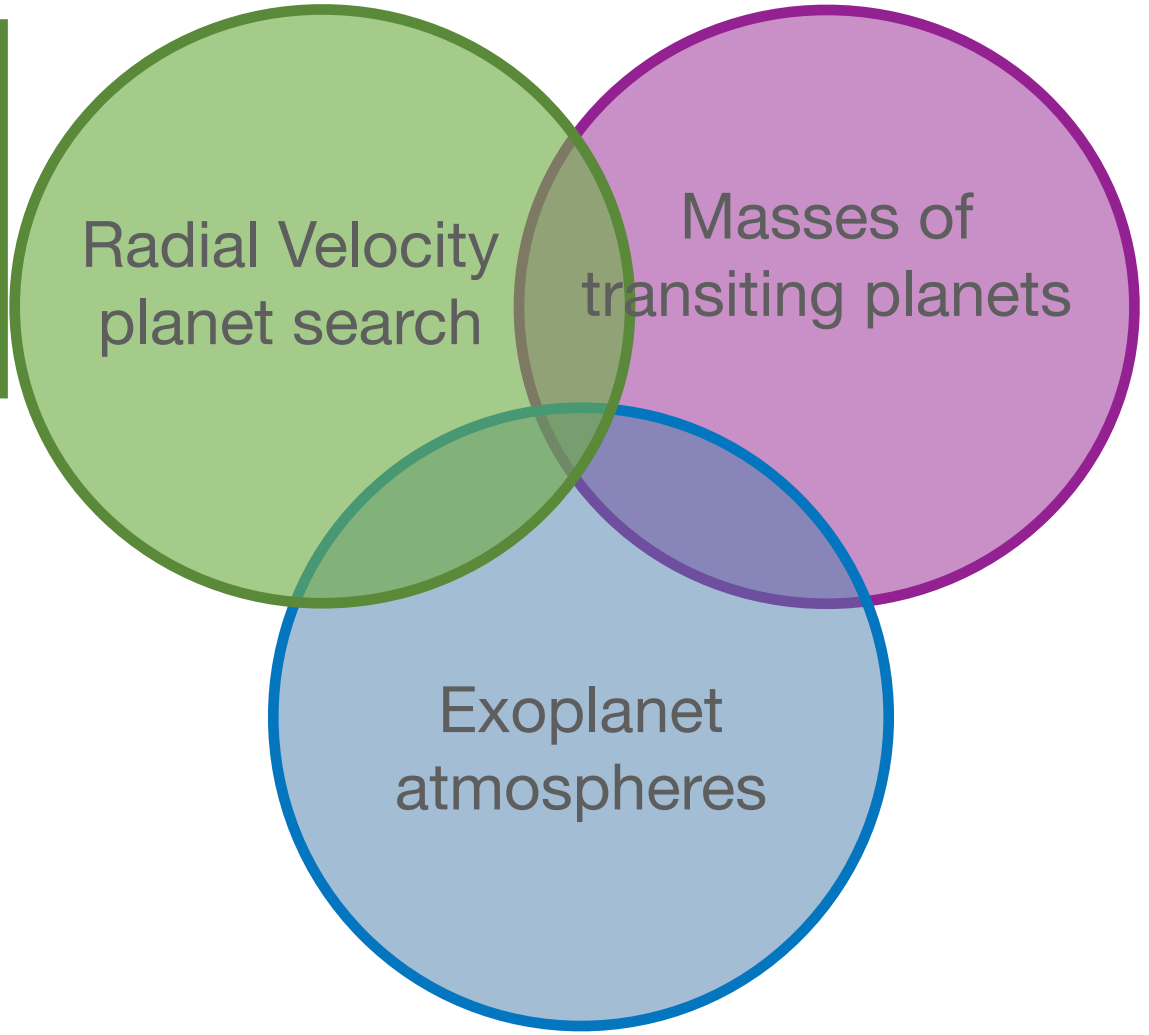
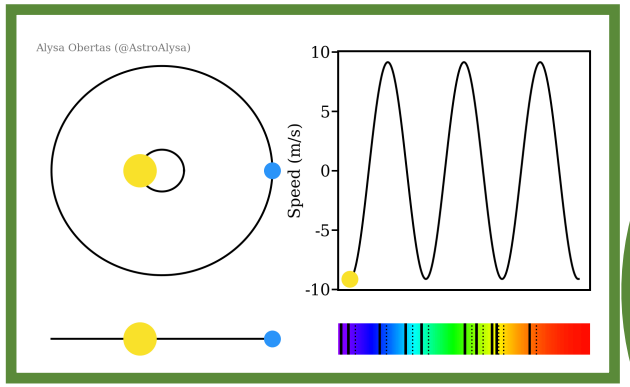
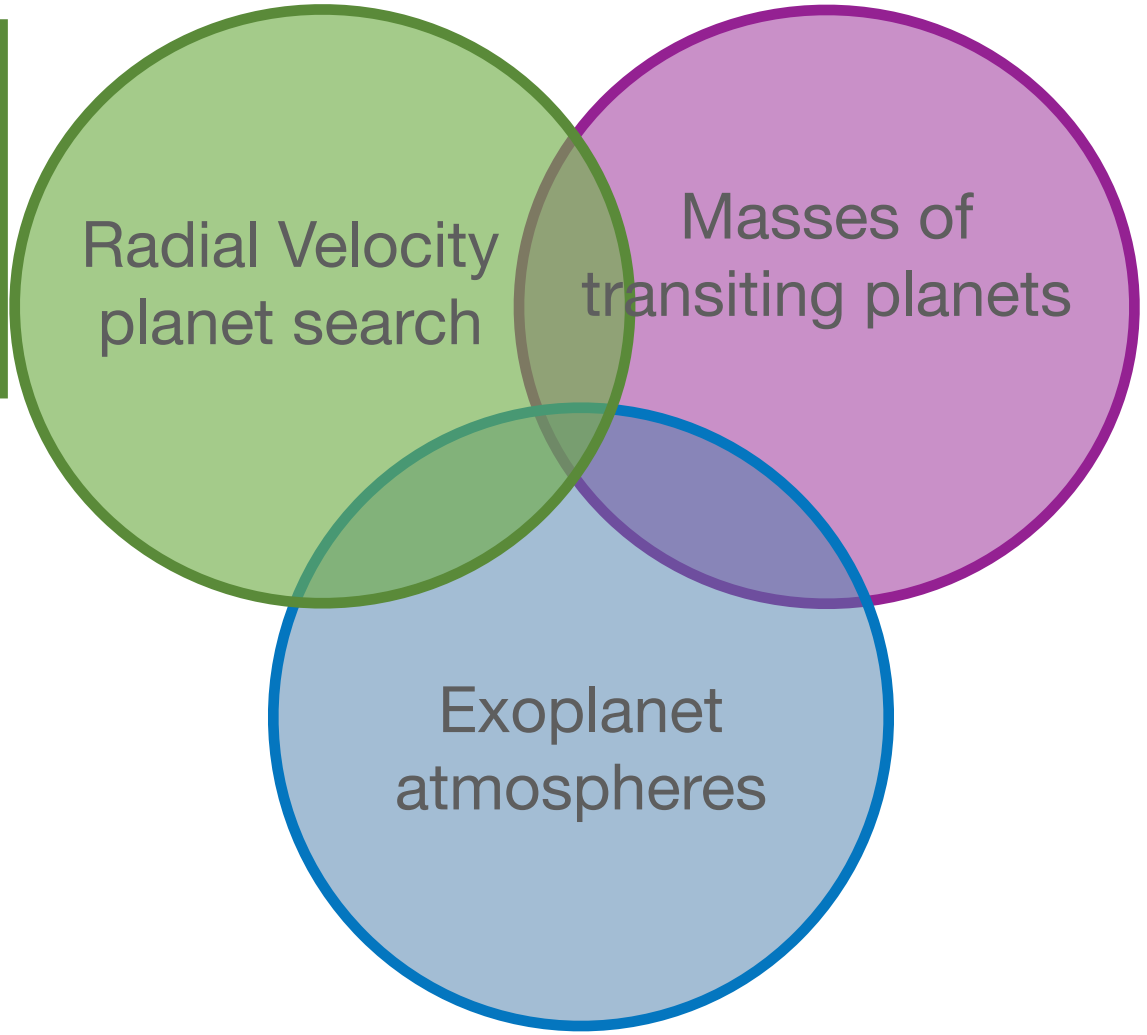
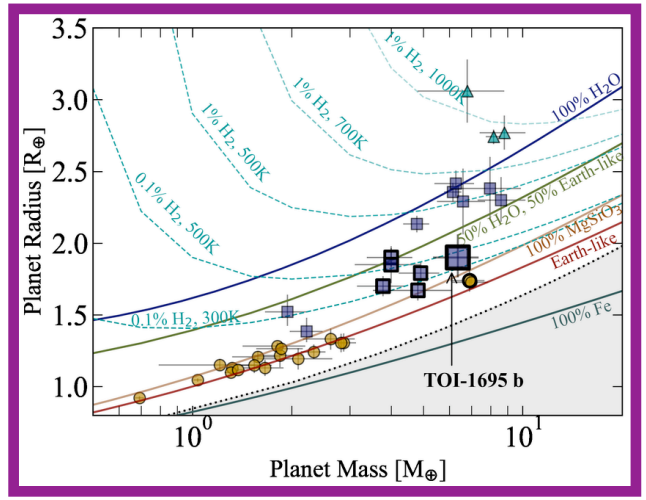




NIRPS science







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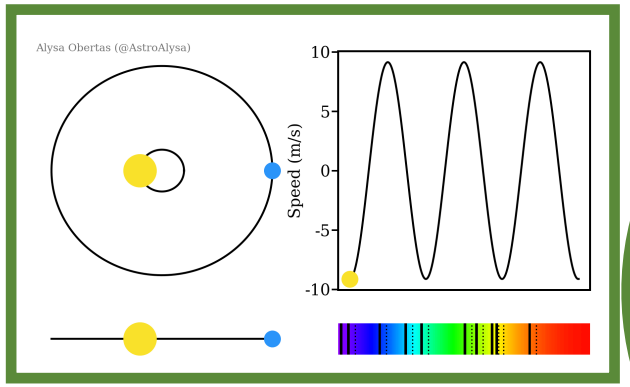
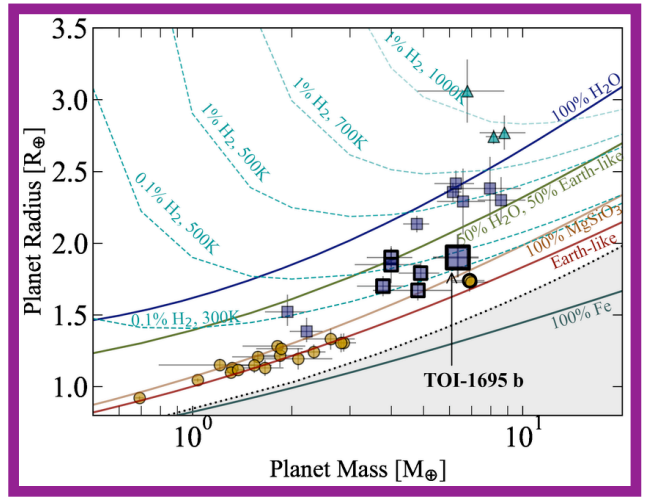
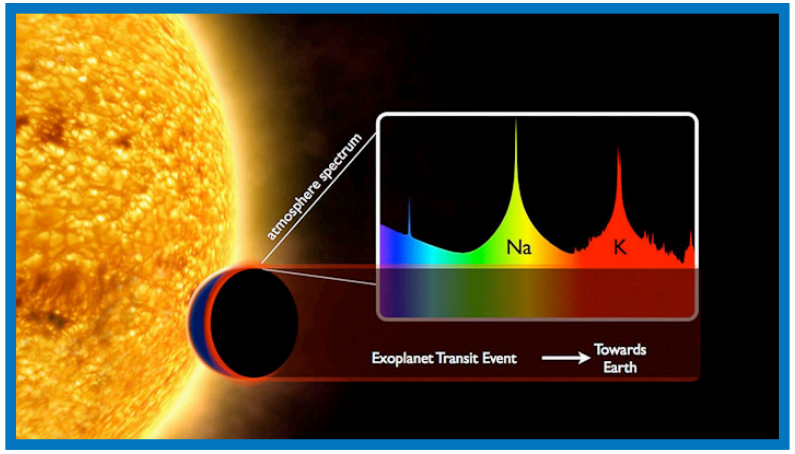


Radial Velocity planet search

Masses of transiting planets

Exoplanet atmospheres





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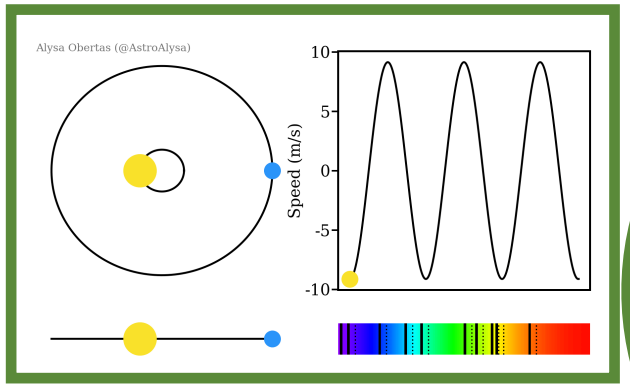

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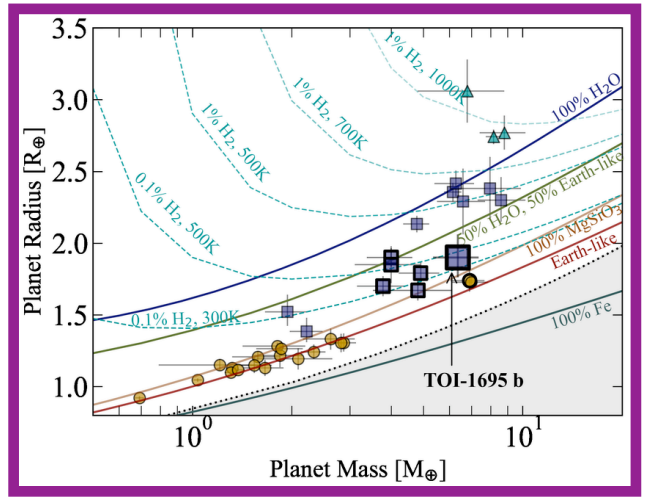
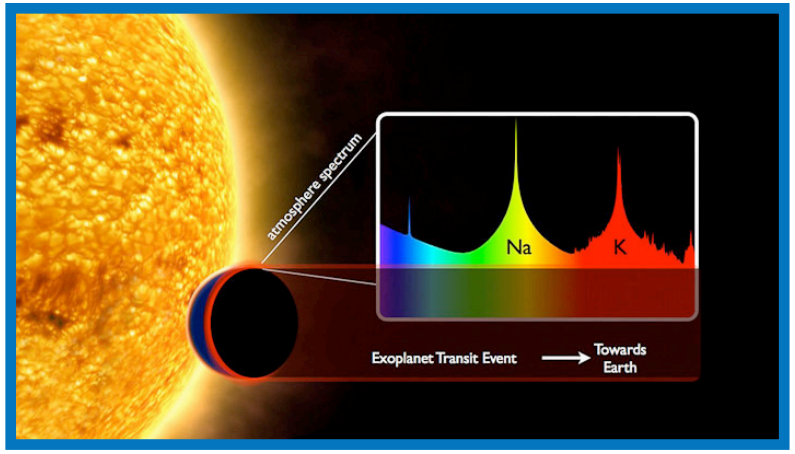


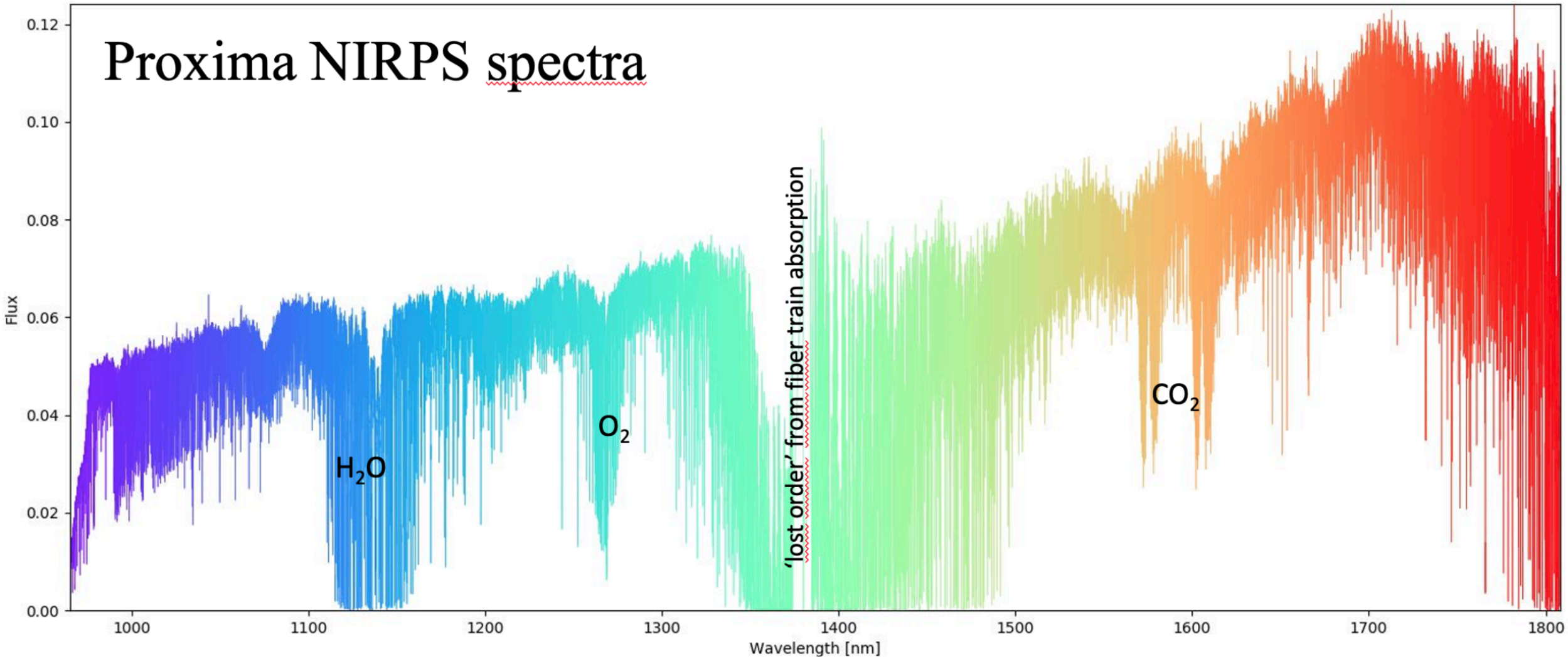
Exoplanet atmospheres



Stellar physics

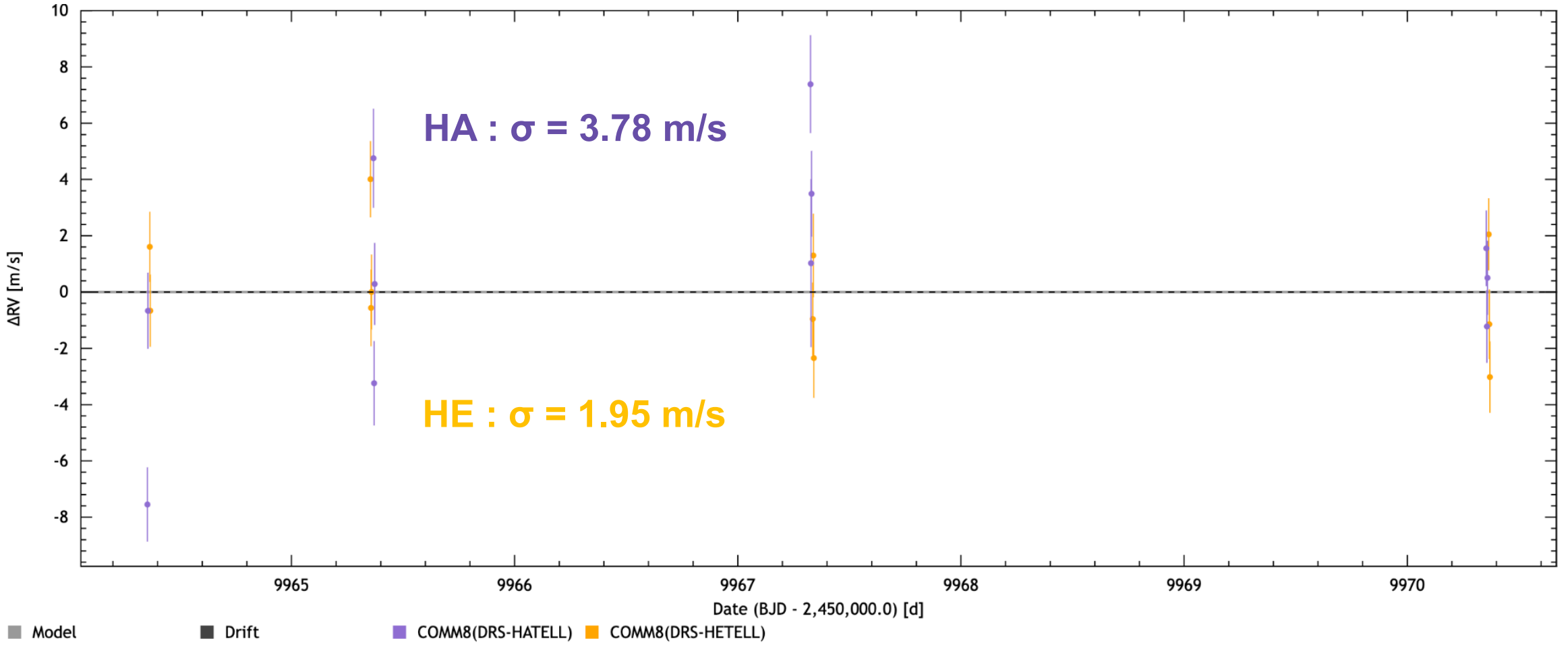
Your science??

NIRPS data and results



NIRPS data and results

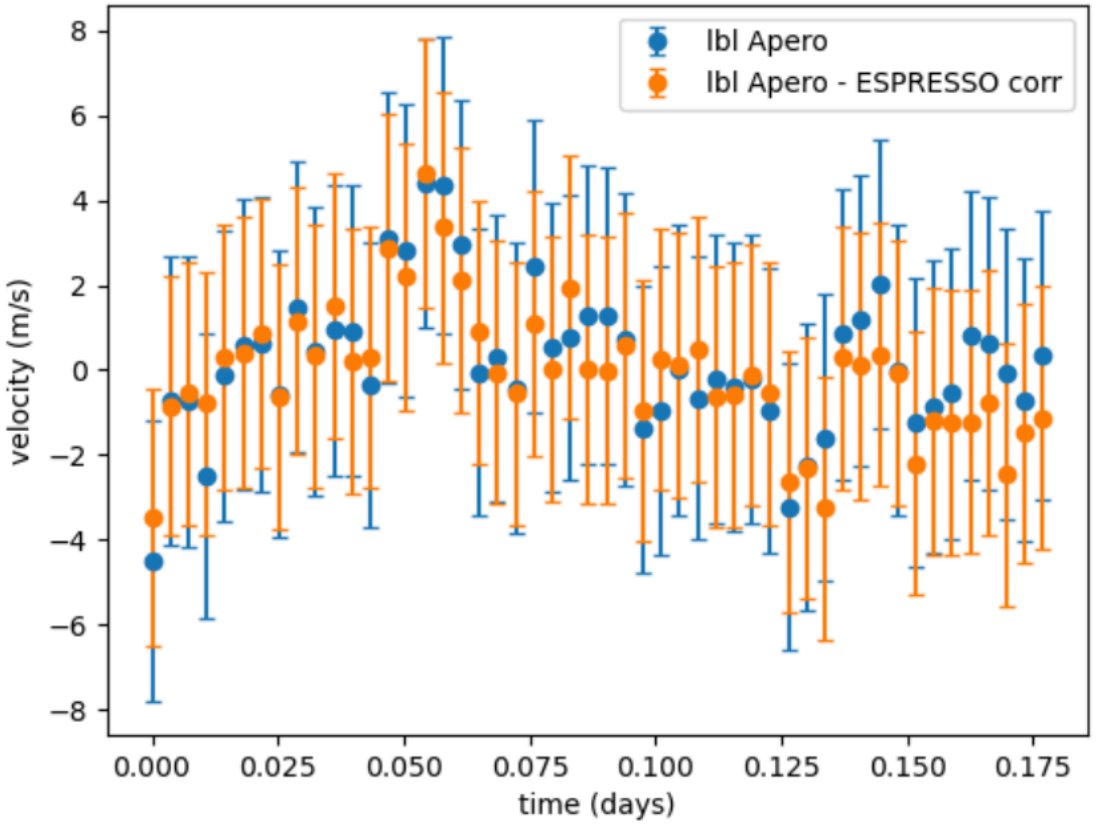
Preliminary results: **Proxima Cen**



Credit: Lucile Mignon & NIRPS Science team

NIRPS data and results

Preliminary results: **RV monitoring**



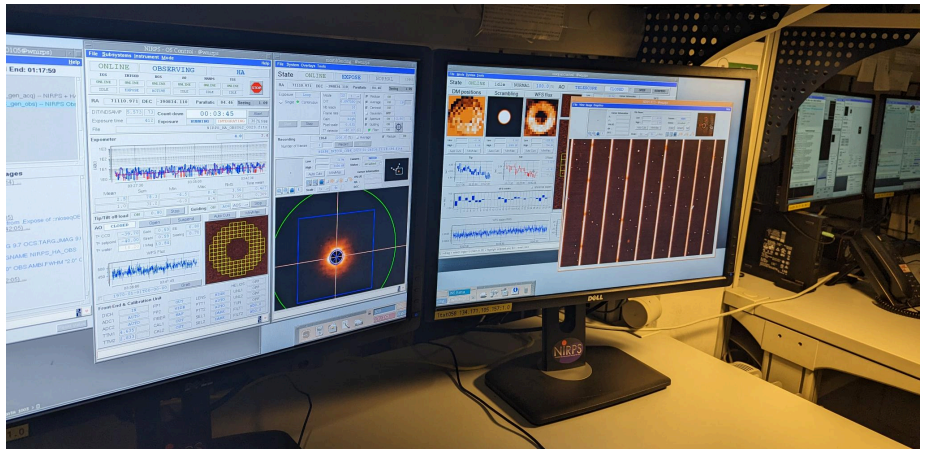
1.5 m/s RMS over hours

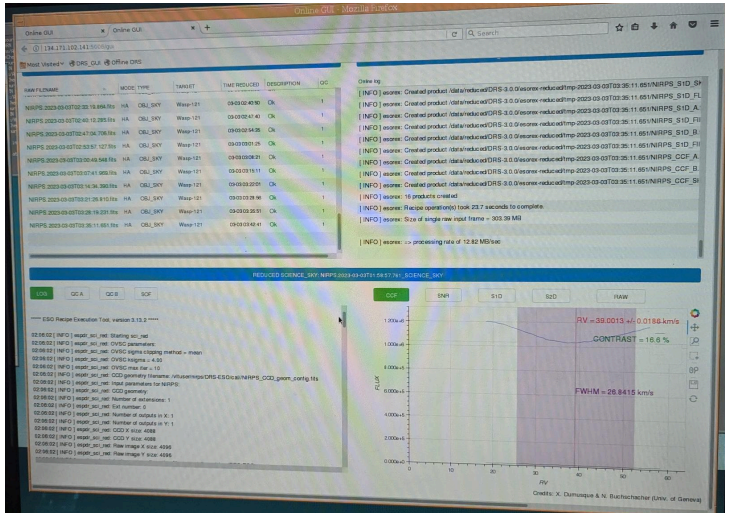
0.85 m/s point-to-point RMS

Credit: Charles Cadieux & NIRPS Science team

Observing with NIRPS

- **Data reduced at the telescope and archived in real-time**
- Pipeline based on ESPRESSO DRS
- Visitor mode or remote observing (DVM) with eavesdropping (LOEM)
- **Inexperienced observers** are encouraged to first observe in VM or use LOEM for training



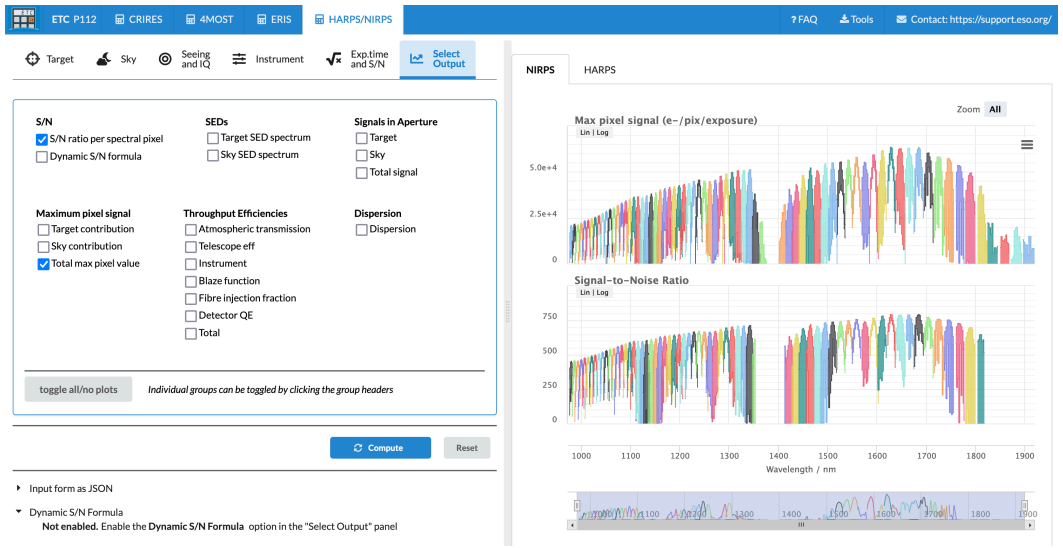


Useful tools and information

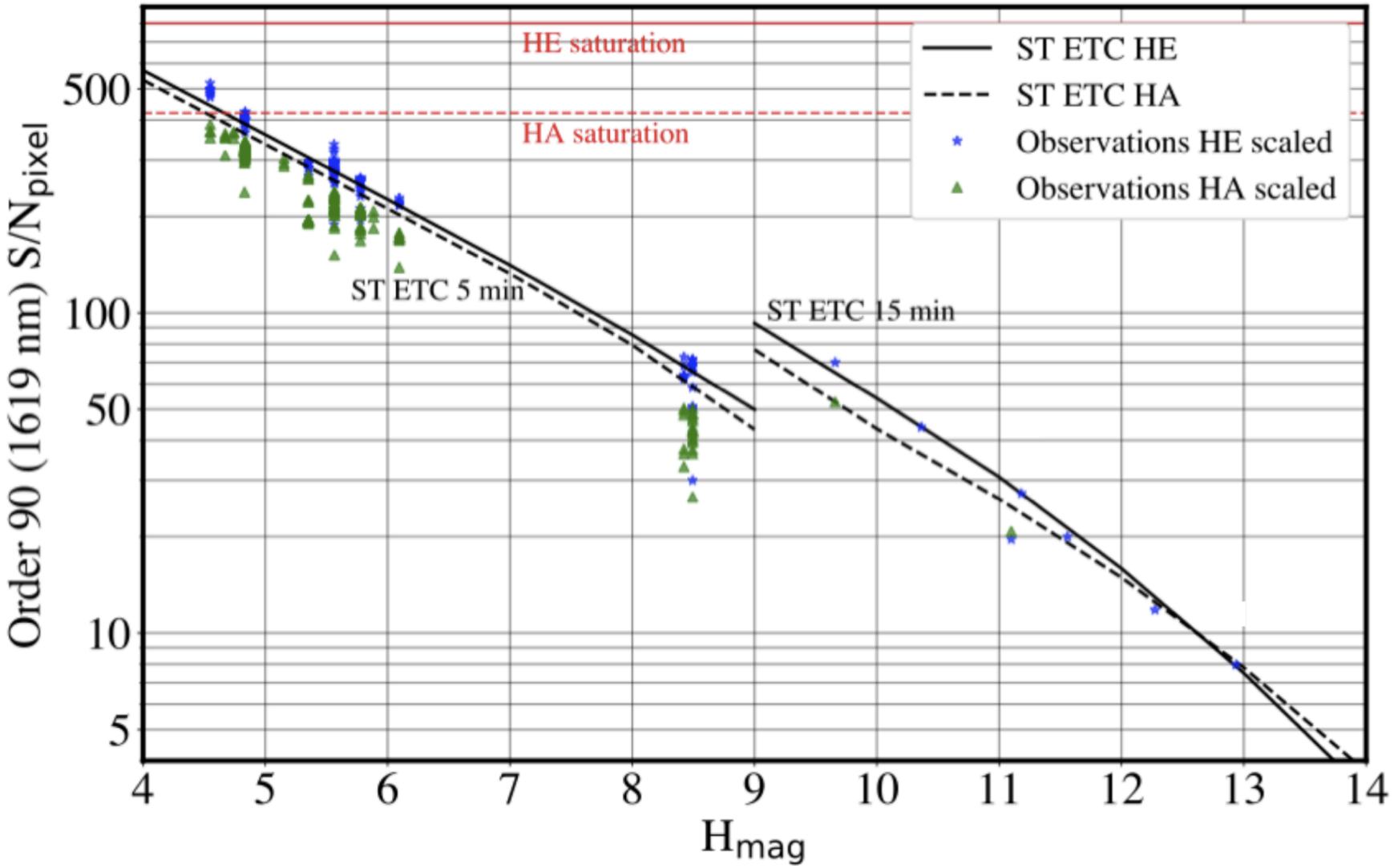
ESO pages:
https://www.eso.org/sci/facilities/lasilla/instruments/nirps.html
incl. user manual, pipeline instructions, etc.

Target blocked by GTO P112:
https://www.eso.org/sci/observing/teles-alloc/gto/112.html

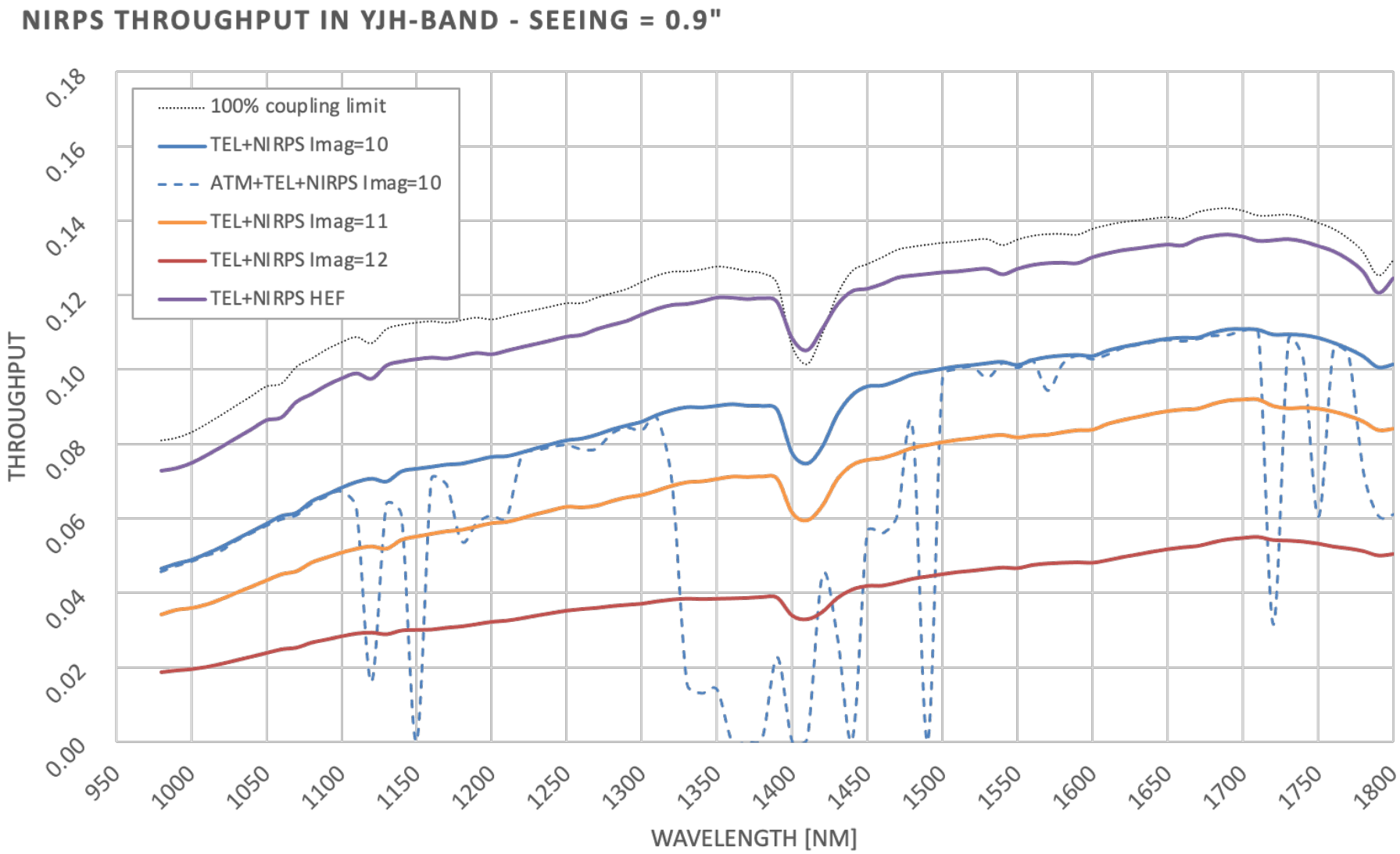
ESO ETC - HARPS + NIRPS
https://etc.eso.org/observing/etc/nirps



NIRPS SNR


HE saturation
HA saturation
ST ETC HE
ST ETC HA
Observations HE scaled
Observations HA scaled
ST ETC 5 min
ST ETC 15 min
Order 90 (1619 nm) S/N$_{pixel}$
500
100
50
10
5
4
5
6
7
8
9
10
11
12
13
14
H$_{mag}$

NIRPS Throughput



NIRPS in a nutshell

Subsystem	Parameters
HA mode	Spectral resolution $\lambda/\Delta\lambda$ = 82 000 (expected to be 100 000 with the upgraded grating) 0.4 arcsec object fibre, AO assisted feed 0.4 arcsec simultaneous reference fibre for sky or drift
HE mode	Spectral resolution $\lambda/\Delta\lambda$ = 75 000 (expected to be >80 000 with the upgraded grating) 0.9 arcsec double slicing in the pupil plane 0.4 arcsec simultaneous reference fibre for sky or drift
Environment	Vacuum : < 10^{-5} mbar Cryogenic: 80 K with 1 mK stability

Calibration Sources	Uranium-Neon Hollow-Cathode lamp Stabilized etalon Fabry-Perot Laser Frequency Comb expected in 2023
Detector	Hawaii 4RG, 4k x 4k, 15 μm pixels
Limiting Magnitudes	Bright End: H = -0.5 for HE / H = 0.2 for HA Faint End: I = 14.5
Stability	< 2 m/s intrinsic stability over one night Wavelength Calibration 0.75 m/s
Sampling	0.94 km/s per pixel, 3.9 pixels per FWHM
Operation	Simultaneous operation with HARPS without degrading HARPS performance

Spectral domain	0.971 – 1.854 μm (*YJH* photometric bandpasses)

Radial Velocity Precision

Spec Type	Teff›	V	H	HARPS σ_{RV}	NIRPS σ_{RV}
M1V	3700	11	7.1	2.2 m/s	1.3 m/s
M4V	3200	11	6.0	1.2 m/s	0.6 m/s
M6V	2800	11	4.1	0.9 m/s	0.2 m/s

Spec Type	Teff	V	H	HARPS σ_{RV}	NIRPS σ_{RV}
M1V	3700	12.9	9.0	5.3 m/s	3.0 m/s
M4V	3200	14.0	9.0	4.8 m/s	2.2 m/s
M6V	2800	15.9	9.0	8.6 m/s	1.8 m/s