



NIRPS Science Meeting

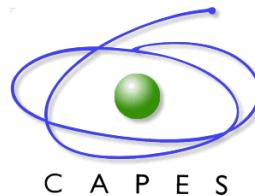
Montreal, September 27-29, 2018

ETC NIRPS

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Observatoire de Genève - UMIGE





Main Goal

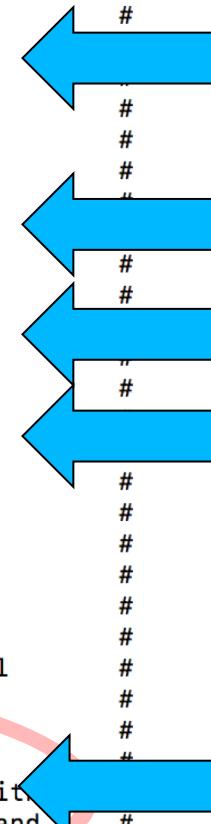
- Measure SNR and RV precision for NIRPS observations
- Based on work from *Robert Harris* (*Heidelberg University*)
ETC HARPS python code – Measure SNR and RV precision

**Tool that will be distributed with members of the
NIRPS Science Team**

How to use – Input parameters

NIRPS ETC – Version (May/2018)

```
#####
# INPUT parameters:
#
# 1 - Spectral Type Template
# IRTF Spectral Library.
# (http://irtfweb.ifa.hawaii.edu/~spex/IRTFSpectralLibrary/index.html):
# F0V/F5V/G0V/G5V/K0V/K3V/K7V/M0V/M1V/M2V/M3V/M4V/M5V
# M6V/M7V/M8V/M9V/L1V/L2V/L3V/L4V/L5V/L6V/L8V/T2V
#
# 2 - Observation mode:
# HA - High Accurate mode
# HE - High Efficiency mode (without AO)
#
# 3 - Seeing (in arcsec) @ 500nm:
# Range from 0.7 to 1.2
#
# 4 - Airmass:
# Range from 1.0 to 2.0
#
# 5 - Object magnitude (H band)
#
# 6 - Exposure time (in seconds)
#
# ATTENTION:
#   - This simulation is to derive the S/N at the central
#     wavelength of each order for the H4RG.
#   - The relation between S/N and RV precision is
#     calculate only for M stars.
#   - RV precision is based on Figueira et al. (2016), with
#     updated values from Jason et al., in preparation, and
#     Artigau et al. (2018).
#
#####
```



Spectral types
([IRTF Spectral Library](#))

HA and HE modes

Seeing – 0.7 – 1.2

Airmass – 1.0 – 2.0
([TAPAS models](#))

RV Precision

- Only for M stars
- Figueira et al. (2016), Artigau et al. (2018), and Jason et al., in preparation

Output Results

Spectral type (F0V/F5V/G0V/G5V/K0V/K3V/K7V/M0V/M1V/M2V/M3V/M4V/M5V/M6V/M7V/M8V/M9V/L1V/L2V/L3V/L4V/L5V/L6V/L8V/T2V): M5V

Observation Mode (HA/HE): HA

Seeing, in arcsec (range 0.7–1.2): 1.0

Airmass (range 1.0–2.0): 1.5

Object magnitude (H band): 9.0

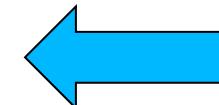
Exposure time (in sec): 300

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Y band: 980 – 1110 nm

J band: 1200 – 1330 nm

H band: 1510 – 1735 nm

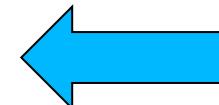


IR Bands

TEMPLATE STAR: M5V

H (mag): 9.0

Exposure time (seconds): 300.0



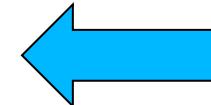
Input parameters

Observation Mode: HA

seeing (arcsec): 1.0

airmass: 1.5

Saturation limit (e-/pxl): 98280



Saturation limit

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Output Results

Table Spectral Format

order	central wave (beg-end) (um)	Eff.	object (e-/pxl)	snr (ph/pxl)	snr (ph/res elem)	sat (%)
#149	977.05 (973.79– 980.35)	0.018	3.81466e+02	19.2	33.8	0
#148	983.65 (980.35– 987.00)	0.020	4.29999e+02	20.6	36.2	0
#147	990.35 (987.00– 993.74)	0.021	3.95980e+02	19.7	34.8	0
#146	997.13 (993.74–1000.57)	0.021	4.19830e+02	20.3	35.8	0
#145	1004.01 (1000.57–1007.49)	0.021	4.42749e+02	20.9	36.7	0
#144	1010.98 (1007.49–1014.51)	0.021	4.73403e+02	21.6	38.0	0
#143	1018.05 (1014.51–1021.63)	0.022	4.85771e+02	21.9	38.5	0
#142	1025.22 (1021.63–1028.85)	0.023	5.04166e+02	22.3	39.2	0
#141	1032.49 (1028.85–1036.14)	0.023	5.26889e+02	22.8	40.1	0

SNR Estimations

SIGNAL TO NOISE RATIO:

Mean S/N: 28.5 (ph/pxl) | 50.2 (ph/res elem)
 Mean S/N (ph/pxl): Y= 23.7 | J= 33.1 | H= 41.9
 (ph/res elem): Y= 41.7 | J= 58.3 | H= 73.9

S/N in H (1625 nm): 36.0 (ph/pxl) | 63.3 (ph/res elem)

Output Results

RV Precisions Estimations

RADIAL VELOCITY PRECISION:

$v\sin i = 1.0$ km/s:

RV precision (m/s) for YJH bands (min): 1.4 2.7 10.9

RV precision (m/s) for YJH bands (max): 1.9 6.2 20.4

Total RV precision (m/s) (min): 1.2

Total RV precision (m/s) (max): 1.8

$v\sin i = 5.0$ km/s:

RV precision (m/s) for YJH bands (min): 3.2 6.2 19.1

RV precision (m/s) for YJH bands (max): 3.8 14.5 36.3

Total RV precision (m/s) (min): 2.8

Total RV precision (m/s) (max): 3.6

$v\sin i = 10.0$ km/s:

RV precision (m/s) for YJH bands (min): 6.0 12.5 36.2

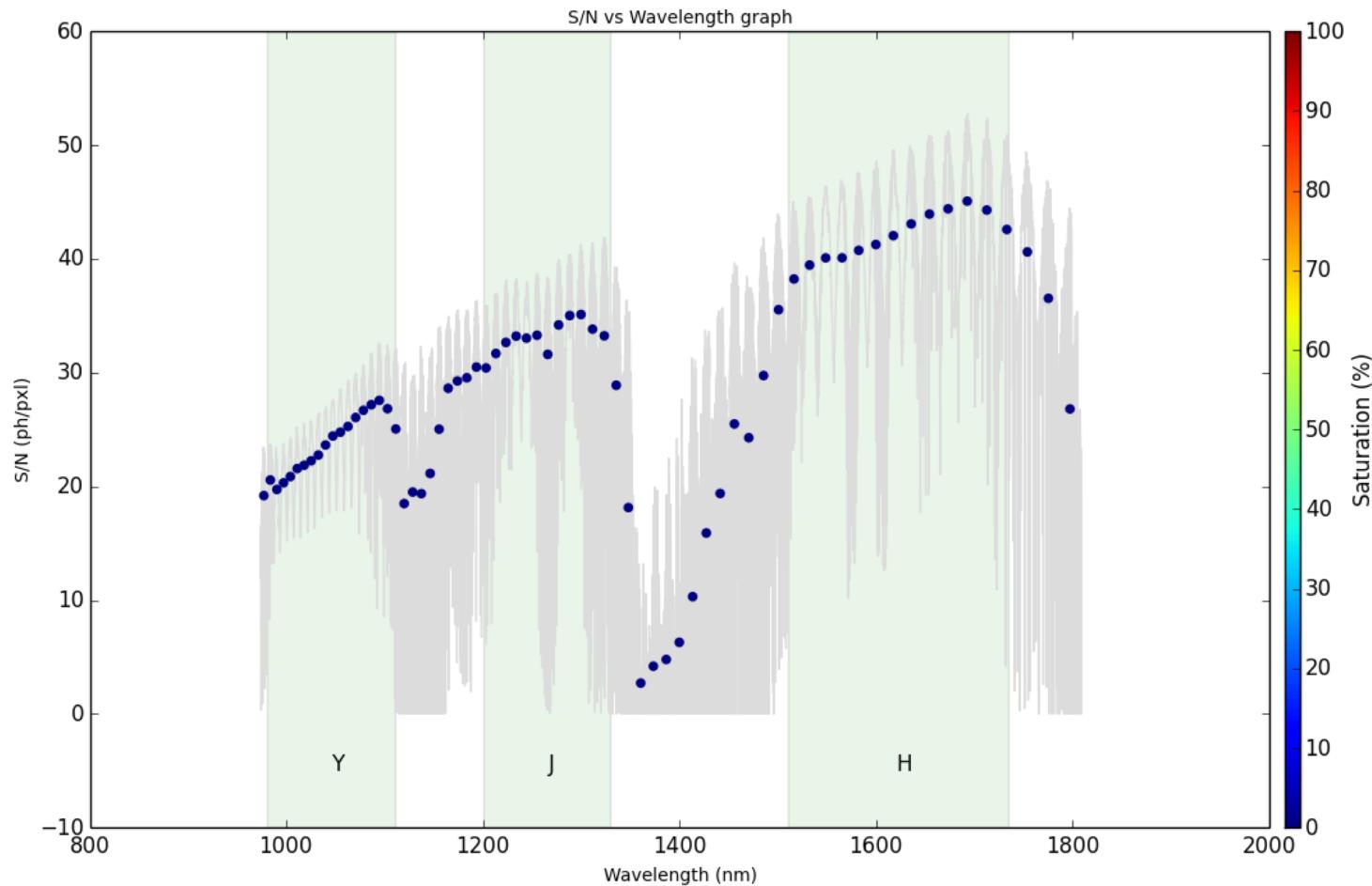
RV precision (m/s) for YJH bands (max): 7.1 29.5 67.6

Total RV precision (m/s) (min): 5.3

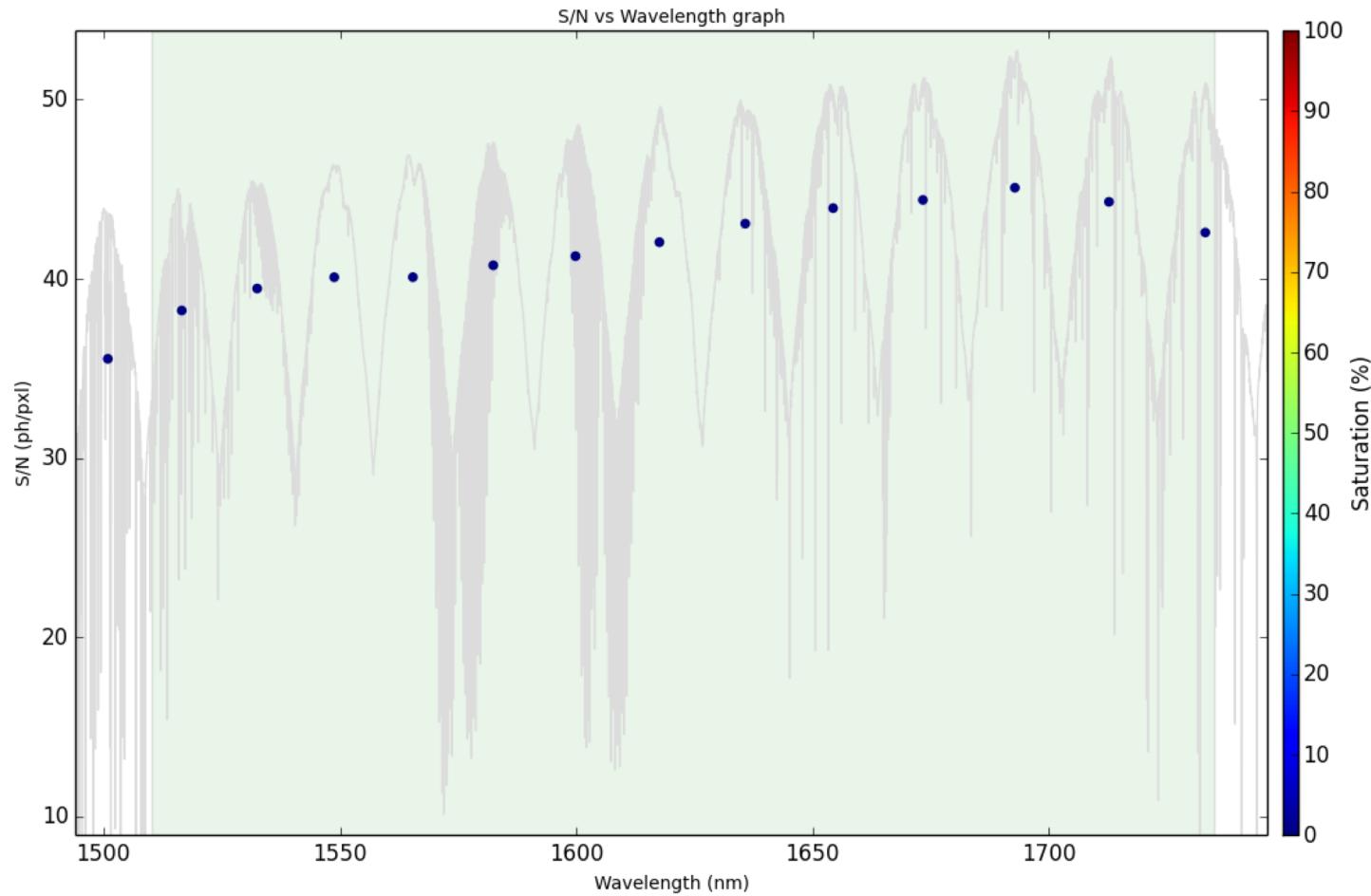
Total RV precision (m/s) (max): 6.9

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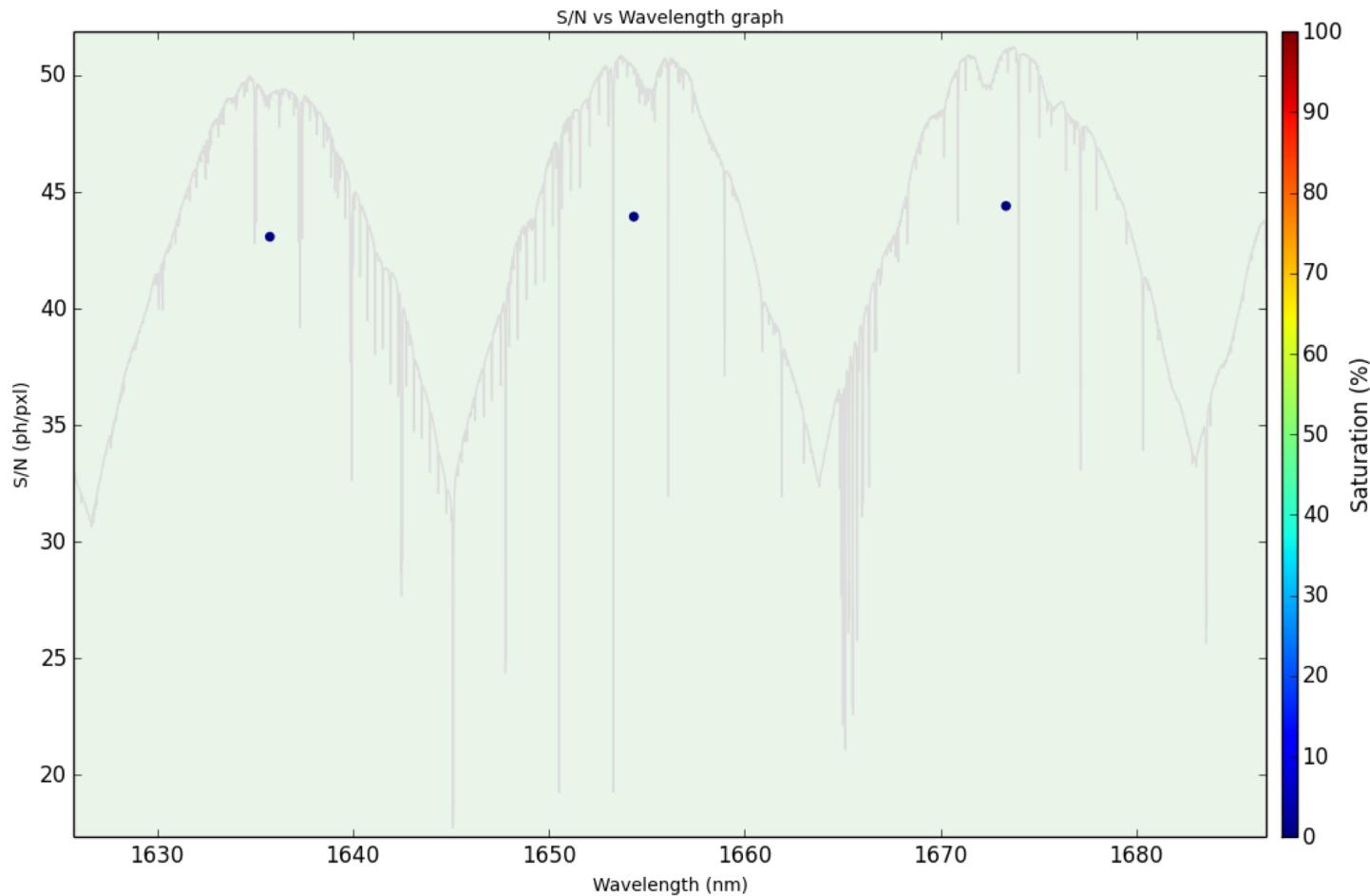
Output Results



Output Results



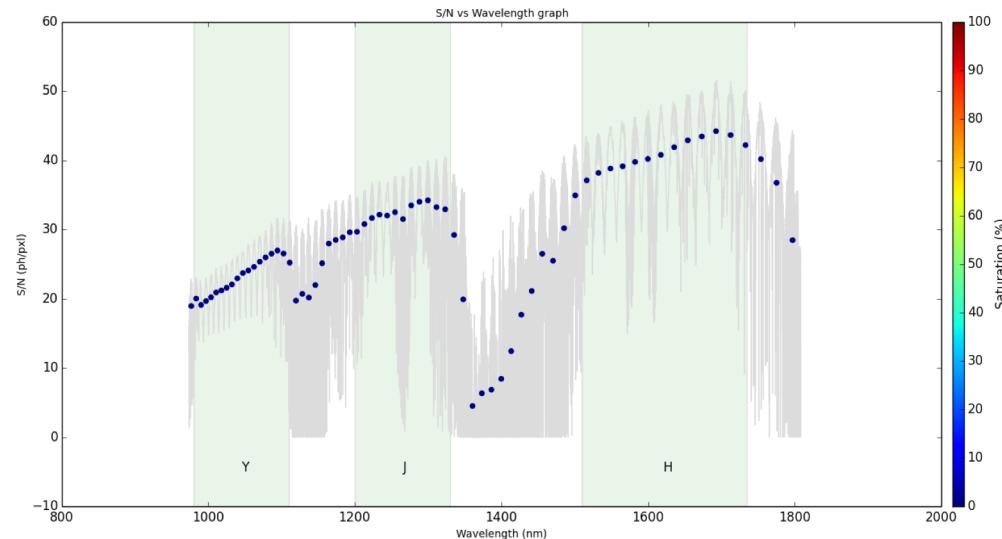
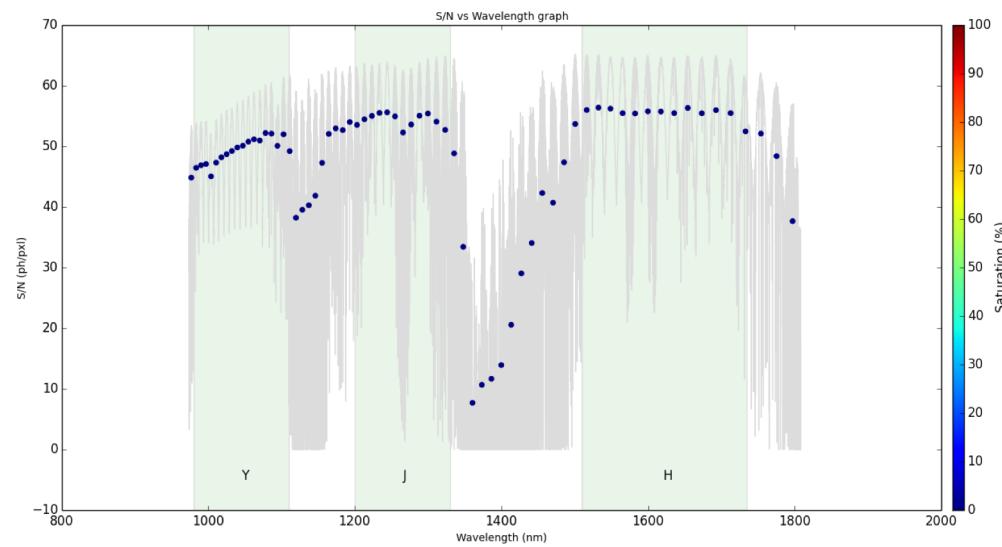
Output Results



Examples

INPUT parameters:

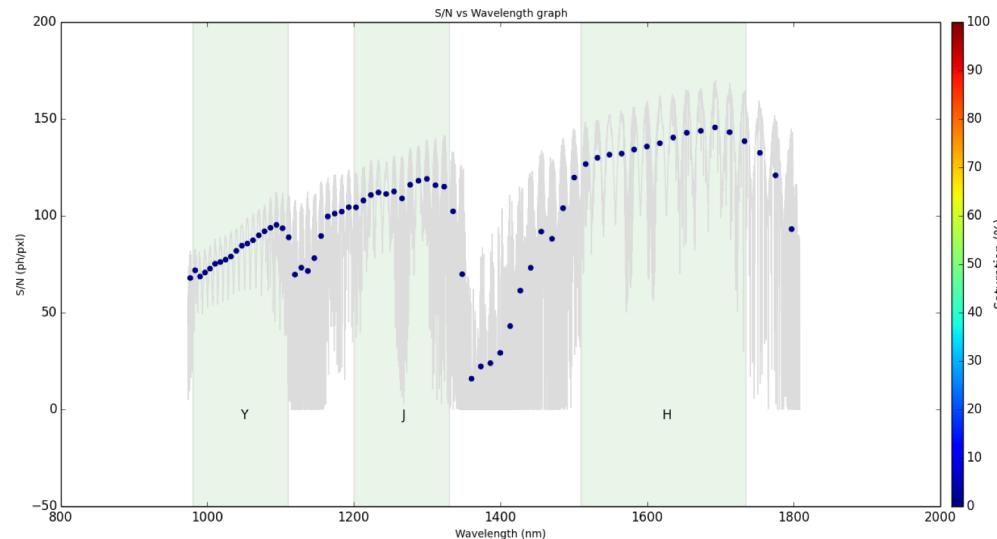
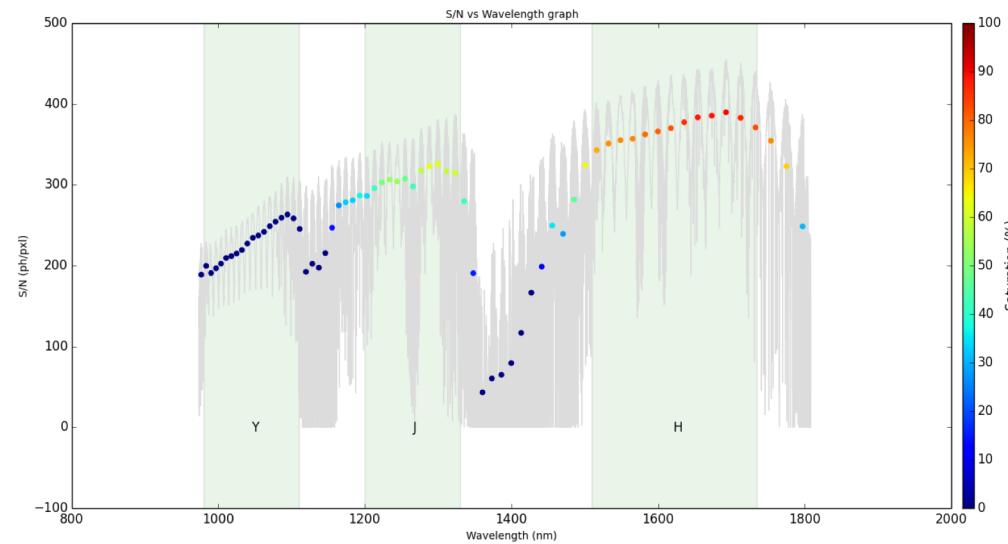
- Spectral Type: **F0V / M5V**
- Observation mode: **HA**
- Seeing: **0.9"**
- Object magnitude (**I**): **10**
- Exposure time: **900s**



Examples

INPUT parameters:

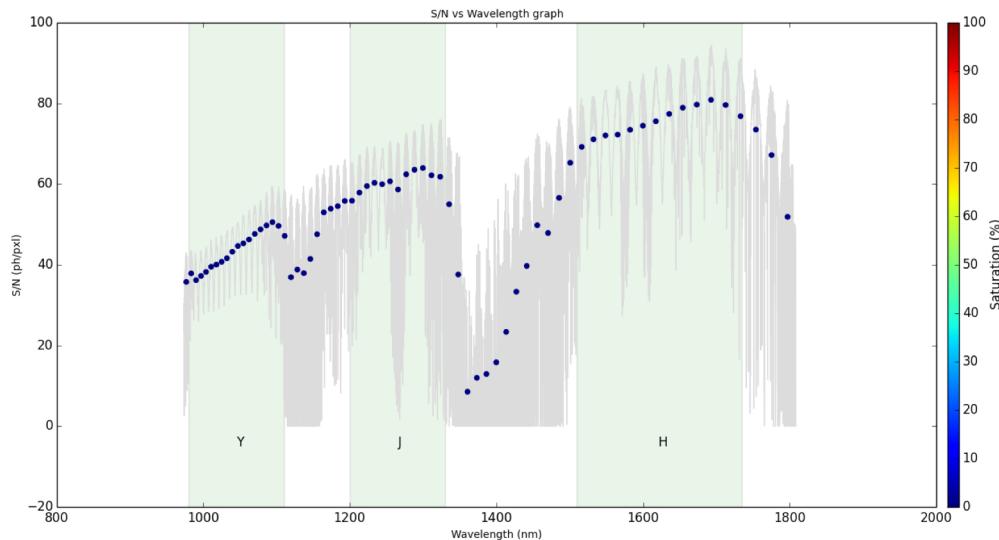
- Spectral Type: **M5V**
- Observation mode: **HA**
- Seeing: **0.9"**
- Object magnitude (I): **6/8**
- Exposure time: **900s**



Examples

INPUT parameters:

- Spectral Type: **M5V**
- Observation mode: **HA/HE**
- Seeing: **0.9"**
- Object magnitude (**I**): **9**
- Exposure time: **900s**



HA

SIGNAL TO NOISE RATIO:

Mean S/N: 52.9 (ph/pxl) | 93.2 (ph/res elem)
 Mean S/N (ph/pxl): Y= 43.4 | J= 60.6 | H= 75.5
 (ph/res elem): Y= 76.4 | J=106.6 | H=132.9

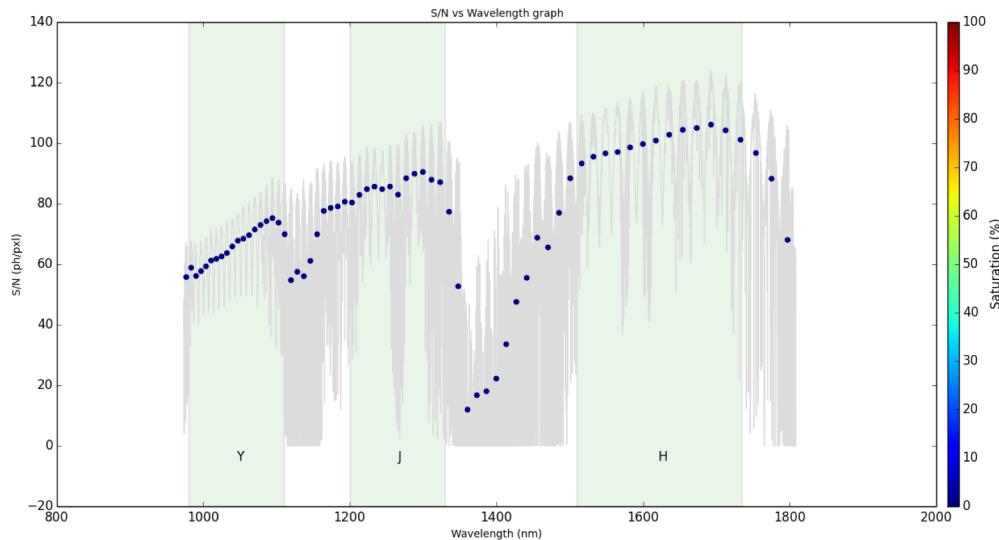
S/N in H (1625 nm): 64.5 (ph/pxl) | 113.6 (ph/res elem)

HE

SIGNAL TO NOISE RATIO:

Mean S/N: 74.8 (ph/pxl) | 151.4 (ph/res elem)
 Mean S/N (ph/pxl): Y= 65.9 | J= 85.9 | H=100.4
 (ph/res elem): Y=133.5 | J=173.9 | H=203.3

S/N in H (1625 nm): 85.9 (ph/pxl) | 173.9 (ph/res elem)



Conclusions

- ✓ Implement last results from labs (AO / H4RG)
- ✓ Adaptation of ETC for NSTS
- ✓ ESO documentation