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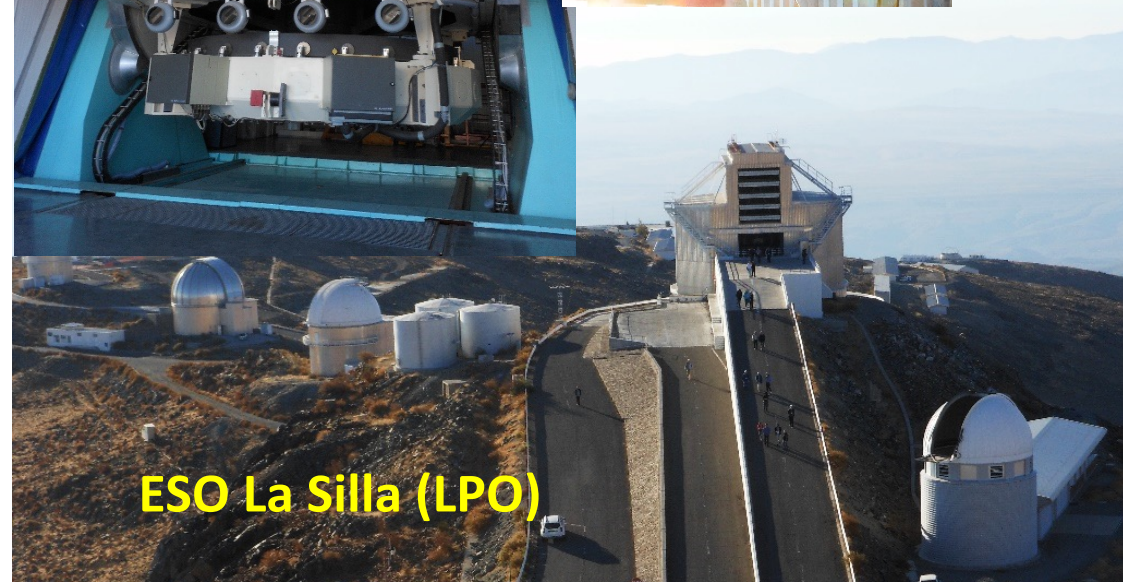
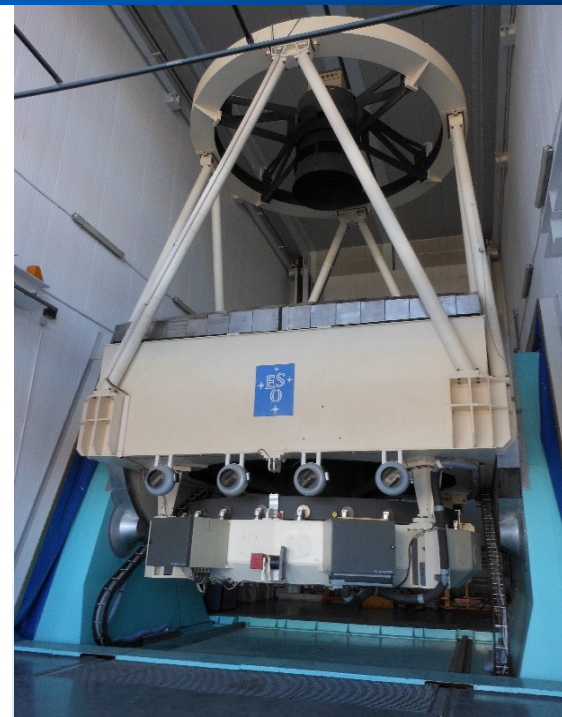


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Son Of X-Shooter

- ❑ Single-object wide band spectrograph from U to H band @ESO-NTT 350-2000 nm
- ❑ 'Similar' to X-Shooter @VLT
- ❑ Two arms (VIS + NIR) with partial overlap around 800 nm to cross-calibrate spectra
- ❑ $R \sim 4,500$ (3,500-6,000)
- ❑ Acquisition camera to perform photometry ugrizY-V (3.5'x3.5')



ESO La Silla (LPO)



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Consortium

Institutes from 6 Countries

- ❑ Istituto Nazionale di AstroFisica (INAF), Italy
- ❑ Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot, Israel
- ❑ Universidad Andres Bello & Instituto Milenio de Astrofísica (MAS), Santiago, Chile
- ❑ FINCA - Finnish Centre for Astronomy with ESO & Turku University, Turku, Finland
- ❑ Queen's University Belfast, UK
- ❑ Tel Aviv University, Israel
- ❑ Niels Bohr and Aarhus University, Copenhagen, Denmark





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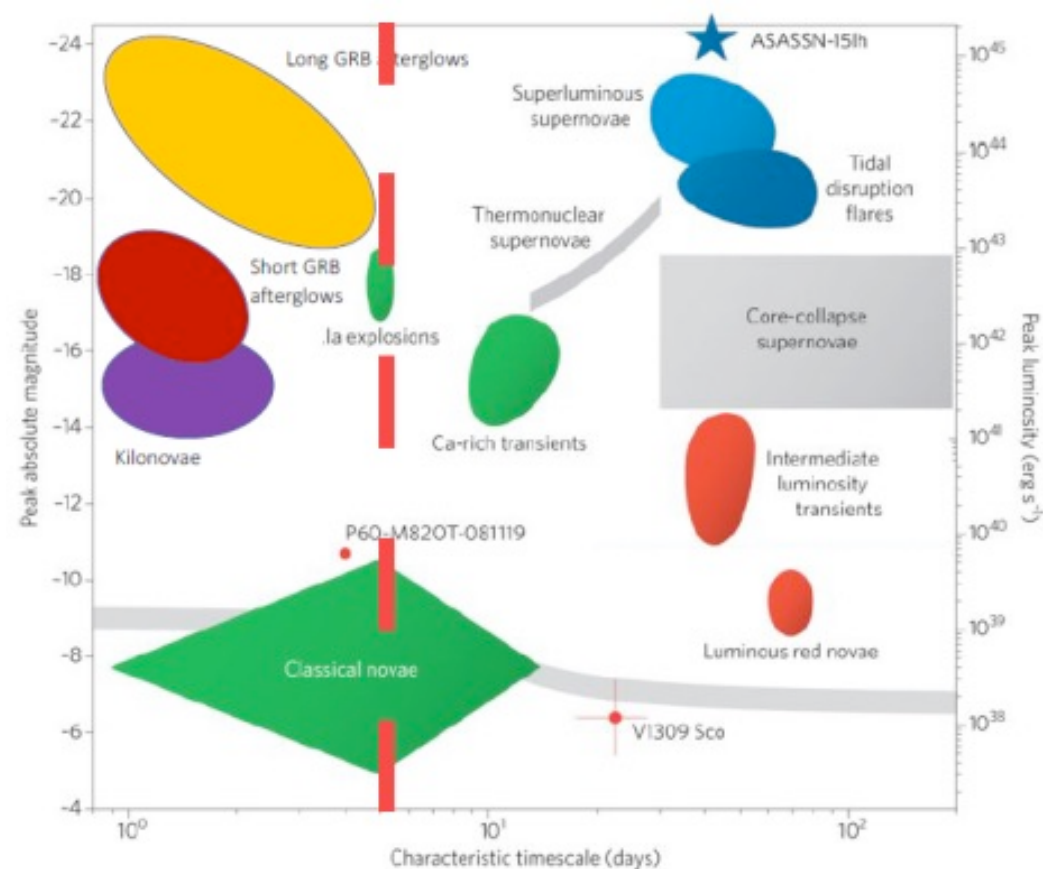


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Spectroscopic follow up of transients

- ☐ Classification of transients
- ☐ Supernovae (all flavours)
- ☐ Gravitational Wave events
- ☐ Neutrino events
- ☐ Blazars and AGN
- ☐ Nuclear transients and Tidal Disruption Events
- ☐ GRB and FRB
- ☐ Transient X-ray binaries, magnetars, ultra-luminous X-ray sources (NS & BH)
- ☐ Asteroids and Comets
- ☐ Young Stellar Objects, stellar variability, exoplanets
- ☐ The Unknown





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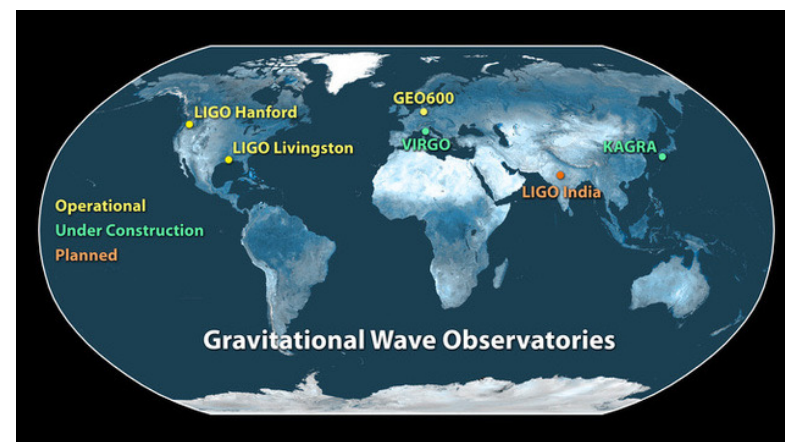


Sinergies

SOXS will have 180 n/yr (for ≥ 5 yr)
 $\sim 3,000$ -4,000 spectra/yr

A spectroscopic machine for the transient sky

- ☐ New deeper survey: Vera Rubin, PanSTARRS, DES, ZTF, ...
- ☐ Space optical missions: Gaia, EUCLID, ...
- ☐ Space high-energy missions: Swift, Fermi, SVOM, ...
- ☐ Radio new facilities: MeerKAT, SKA, ...
- ☐ VHE: CTA
- ☐ Messengers: aLIGO-Virgo, KM3Net, ANTARES, ...





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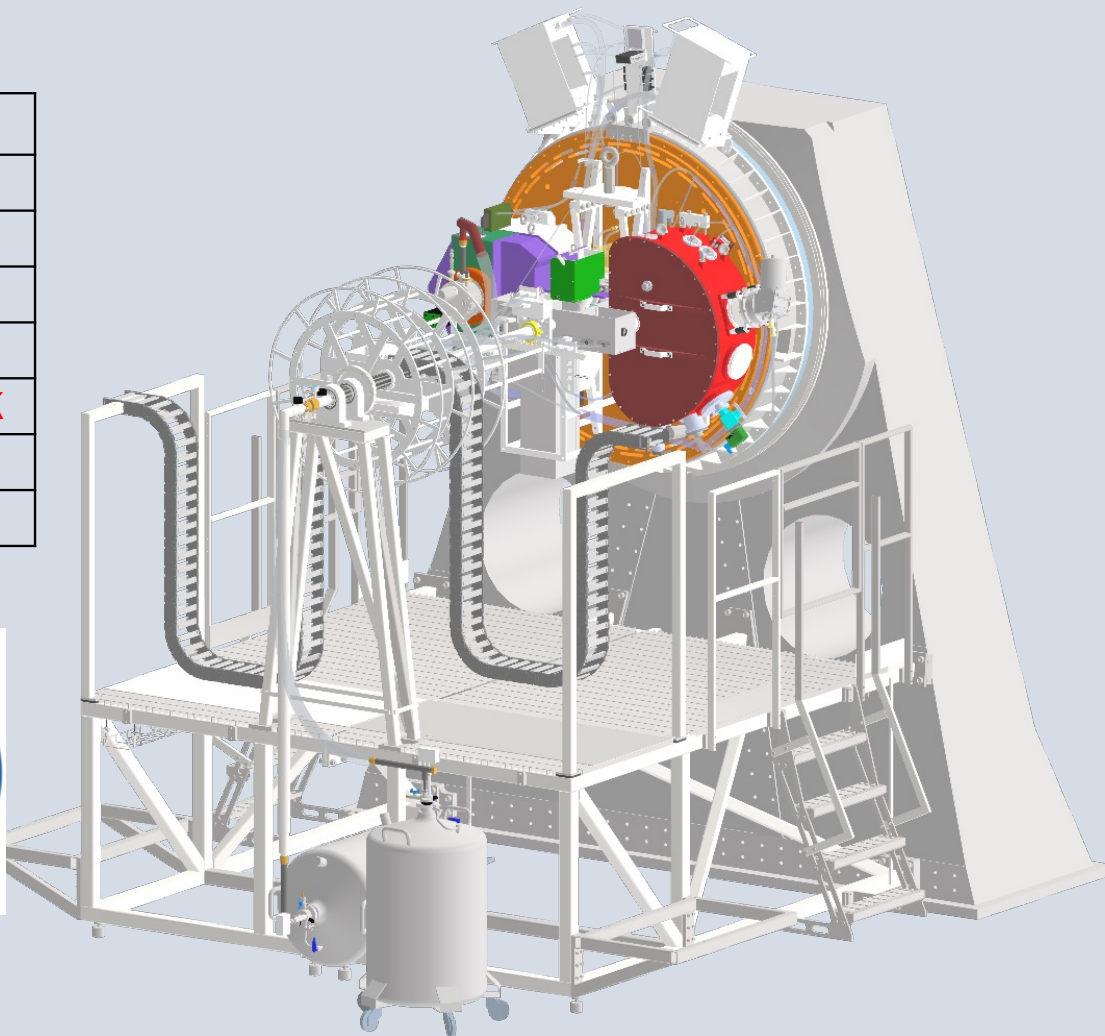


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	UV-VIS	NIR
Spectral range	350-850 nm	800-2000 nm
Resolution (1" slit)	>3600 (≈4500 avg)	5000
Slit widths	0.5 - 1 - 1.5 - 5 arcsec	0.5 - 1 - 1.5 - 5 arcsec
Slit height	12 arcsec	12 arcsec
Detector	e2V CCD44-82 2Kx4K	Teledyne H2RG 2Kx2K
Pixel Size	15 μm	18 μm
Detector Scale	0.28"/pixel	0.25"/pixel

	Camera
Spectral range	360-970 nm
Detector	Andor iKon M-934 1Kx1K
Field of View	3.5'x3.5'
Pixel Size	13 μm
Detector Scale	0.205"/pixel





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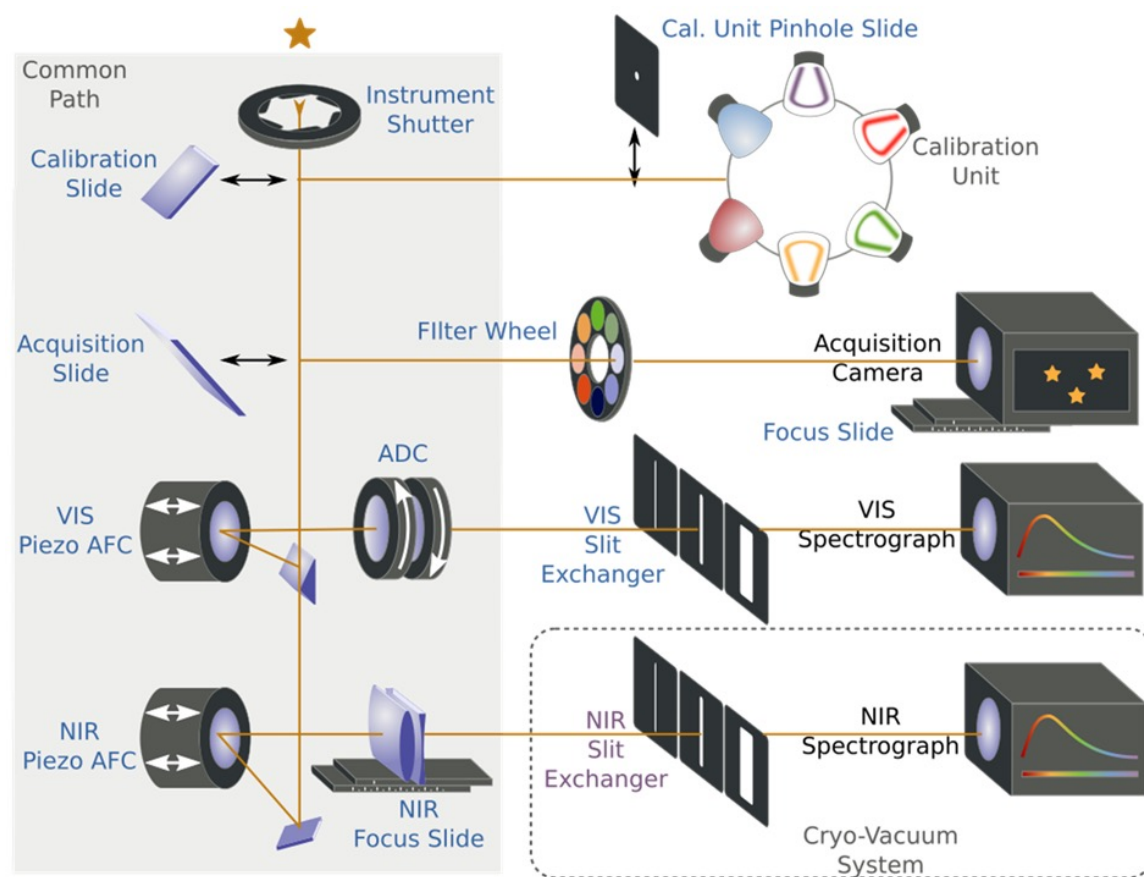
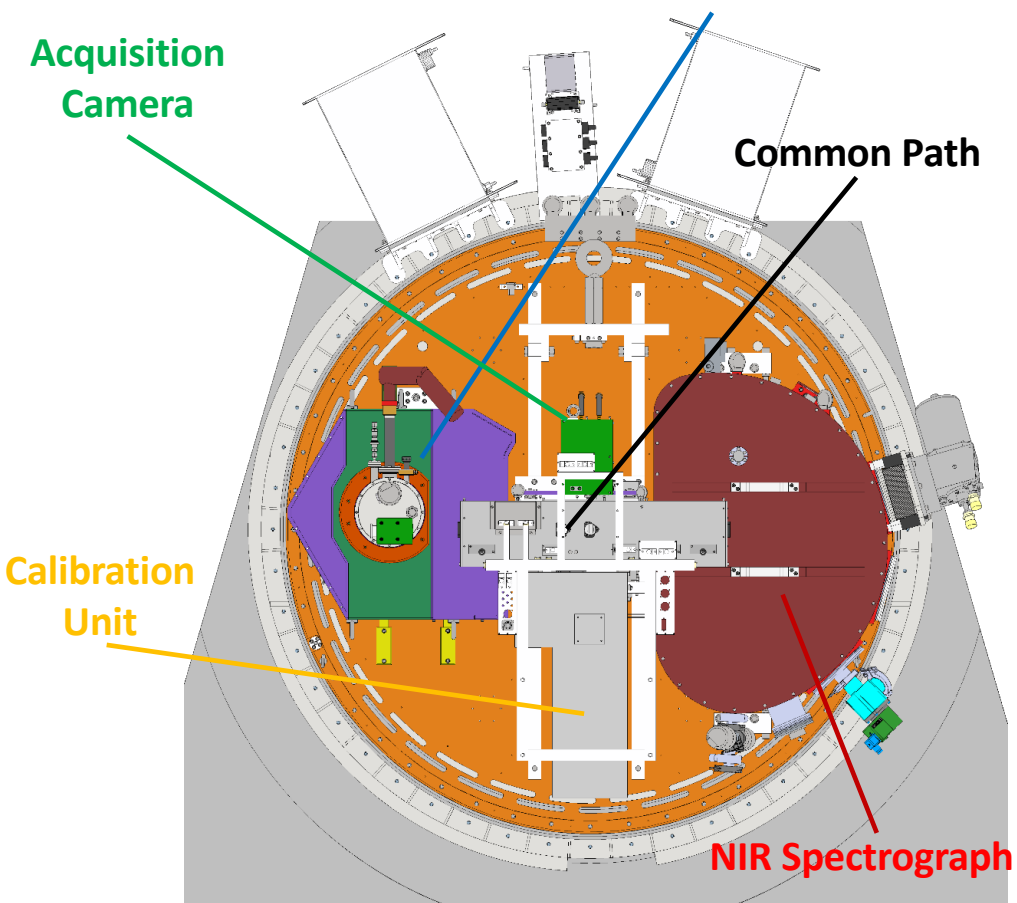
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UV-VIS Spectrograph





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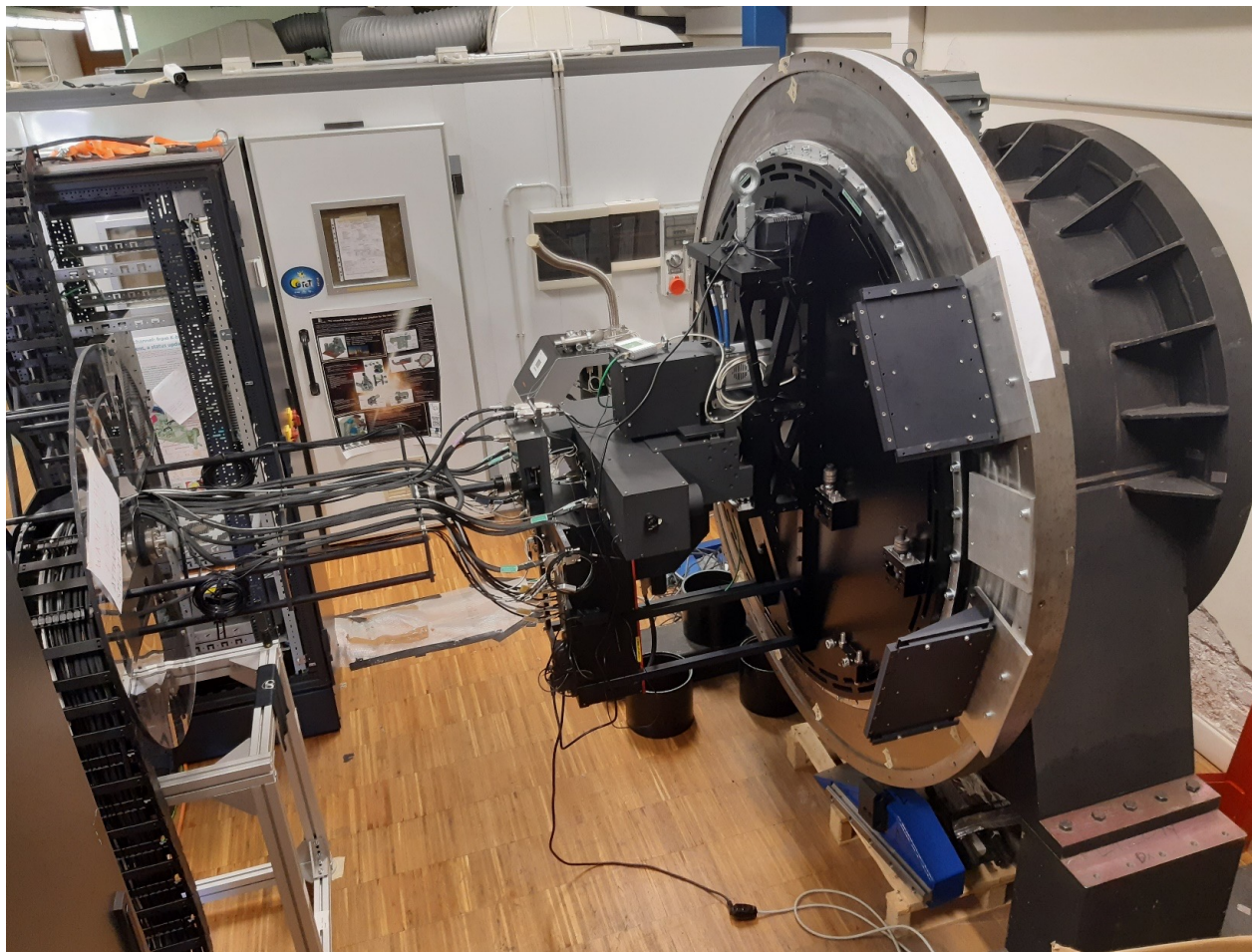
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AIT @INAF Padova





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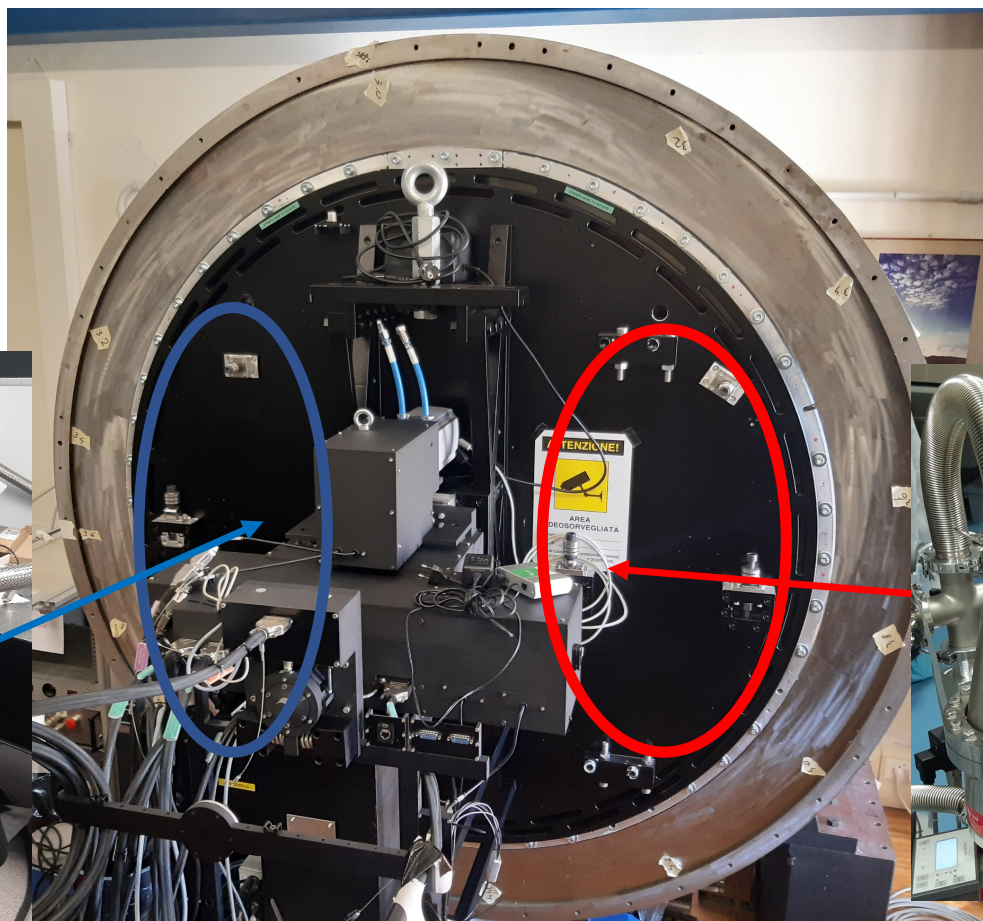
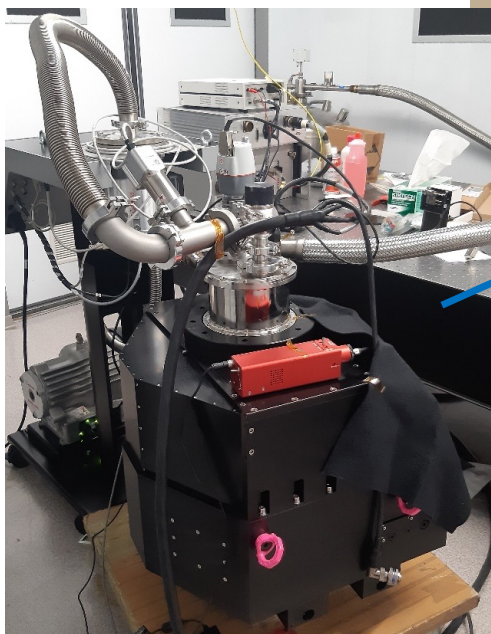
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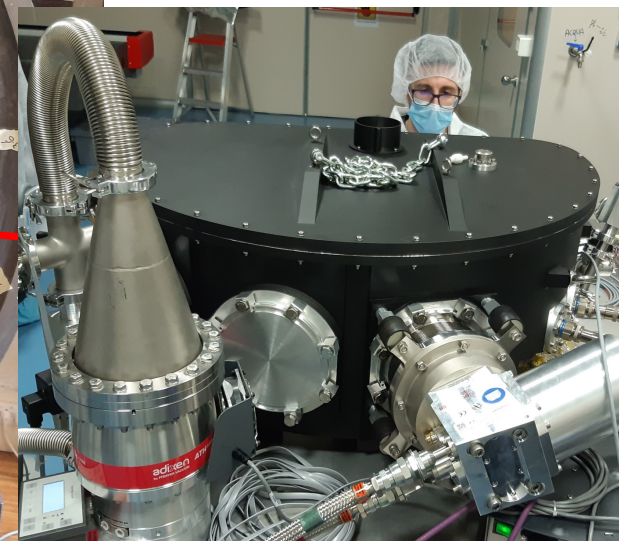
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UV-VIS Spectrograph
@INAF Padova



NIR Spectrograph
AIT Phase @INAF Merate





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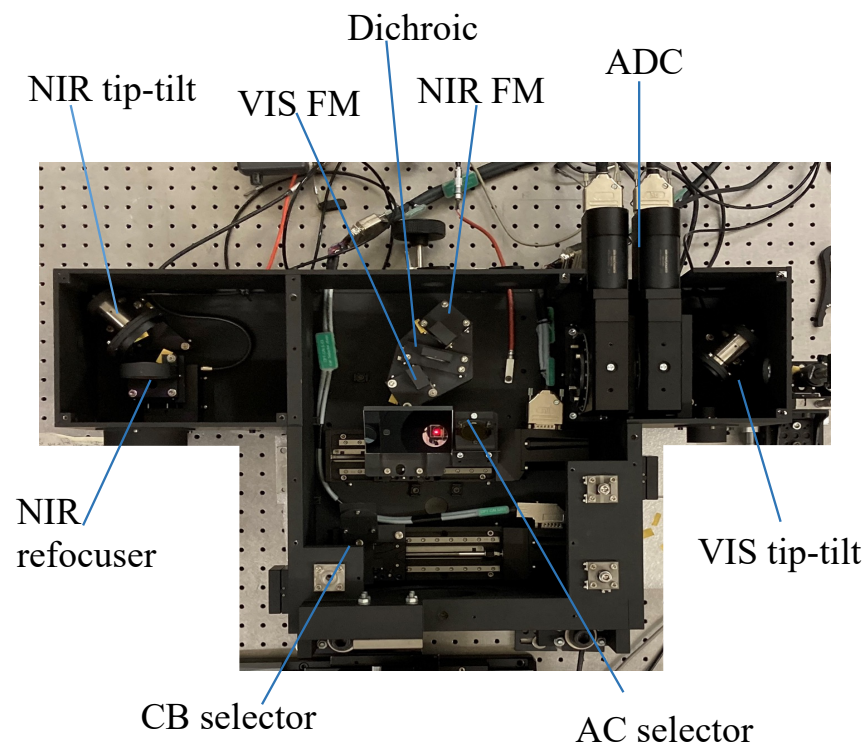
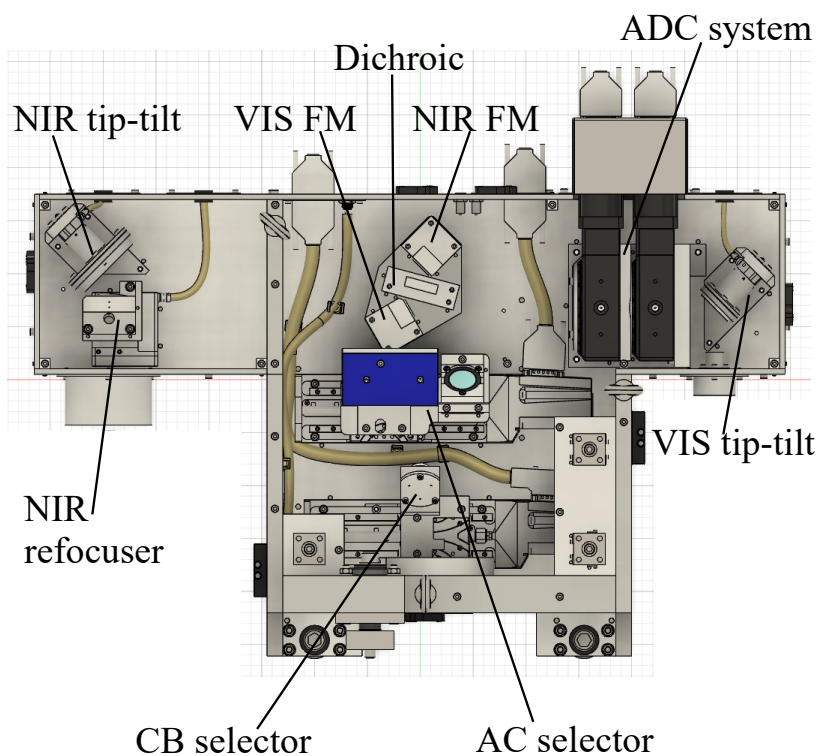
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Common Path



Archer Optx
Optical Precision. Optimal Outcome.

OPTIMAX

ASAHI SPECTRA USA

PECCHIOLI RESEARCH
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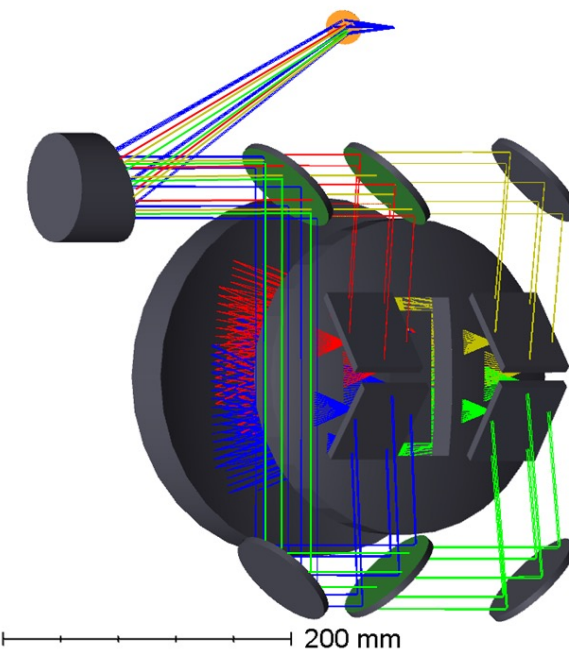
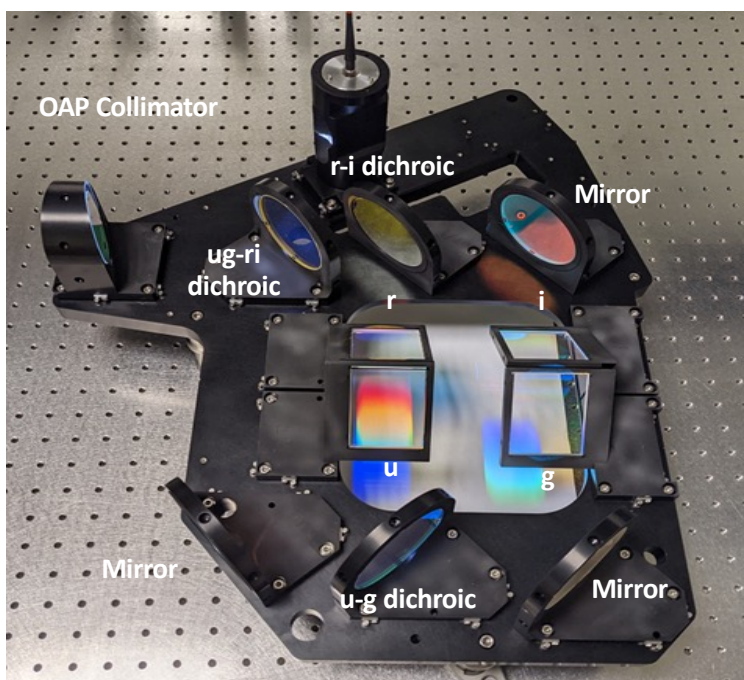
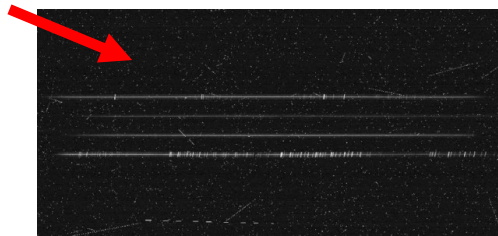


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UV-VIS: Multi-Imaging Transient Spectrograph

- ❑ Collimated beam is divided to 4 bands using 3 dichroics.
- ❑ Each band has its own optimized disperser
- ❑ Single camera
- ❑ 1st order dispersion, $\mathcal{R} \sim 4500$ at α_{Lit} .
- ❑ 4 bands quasi-orders are imaged onto a single 4kx2k CCD.



Quasi-Order	Wavelength Range [nm]
<i>u</i>	350 – 439.5
<i>g</i>	427 – 547
<i>r</i>	527 – 680
<i>i</i>	664 – 850

Winlight System ASAHI SPECTRA USA
Fraunhofer IOF



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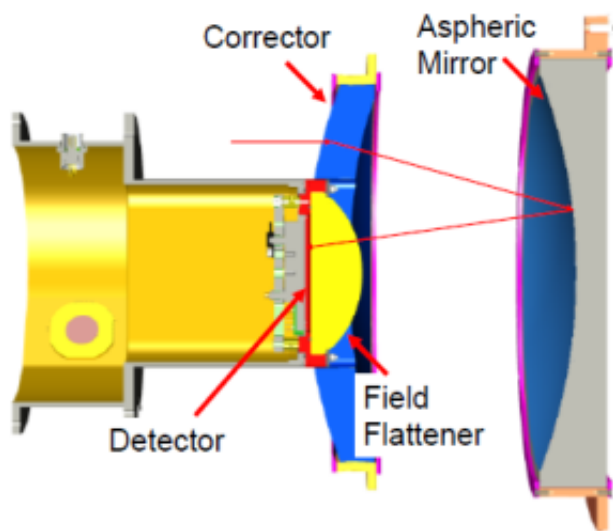


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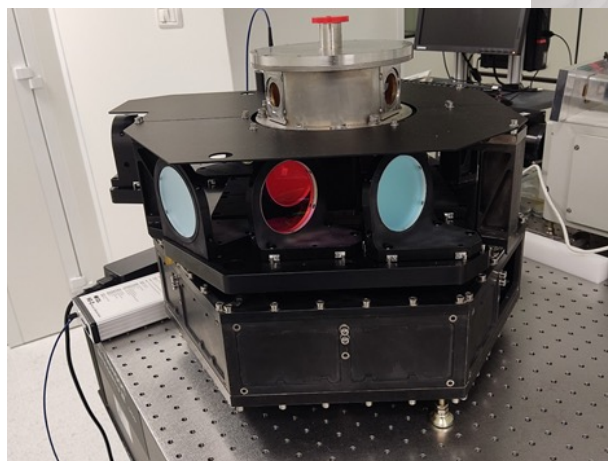


UV-VIS Camera

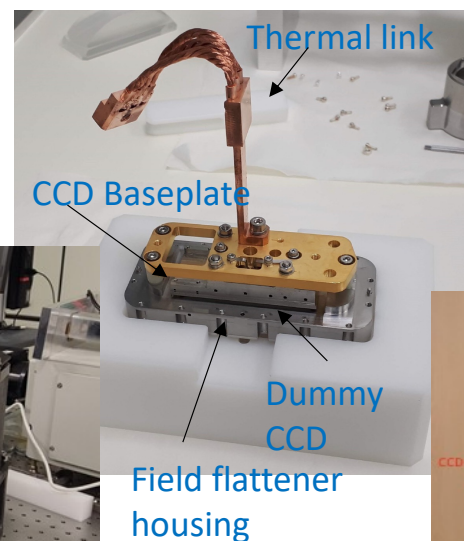
- ❑ Three element catadioptric camera: all aspheric
- ❑ Used as 4 off axis F/3.1 cameras.
- ❑ CaF₂ corrector + Fused Silica Field Flatteners
- ❑ Low CTE=>Athermal camera



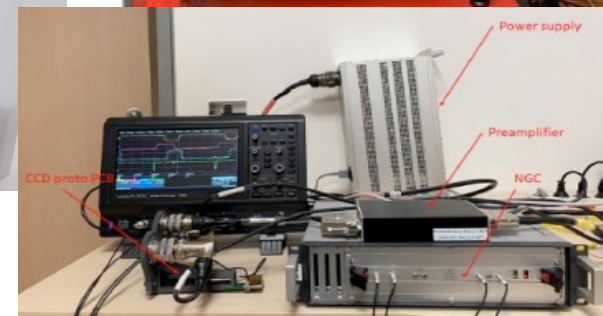
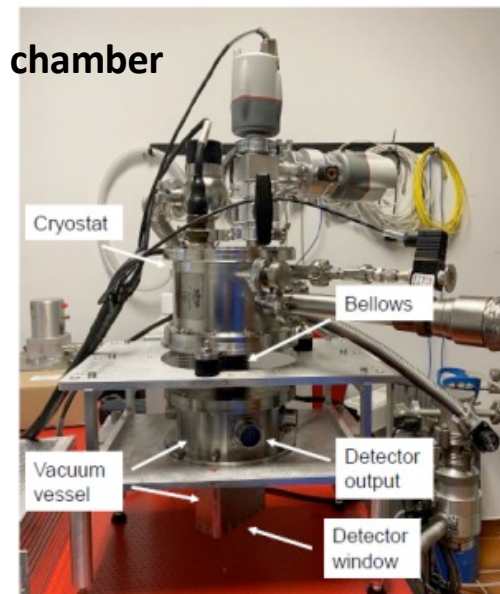
Feed + Camera



CCD Invar Baseplate gold plated



CCD vacuum chamber



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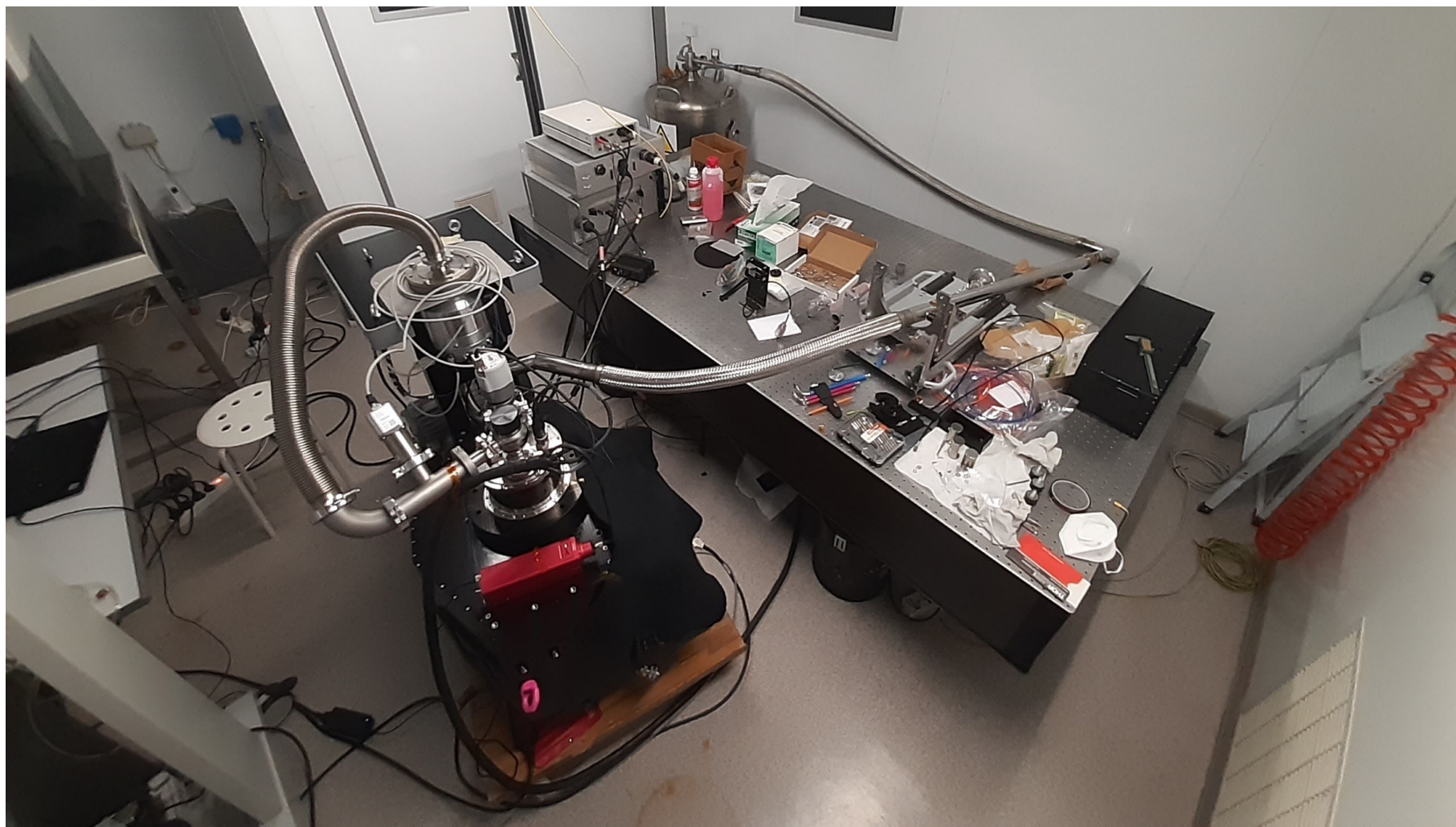
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NIR Spectrograph

4C Design

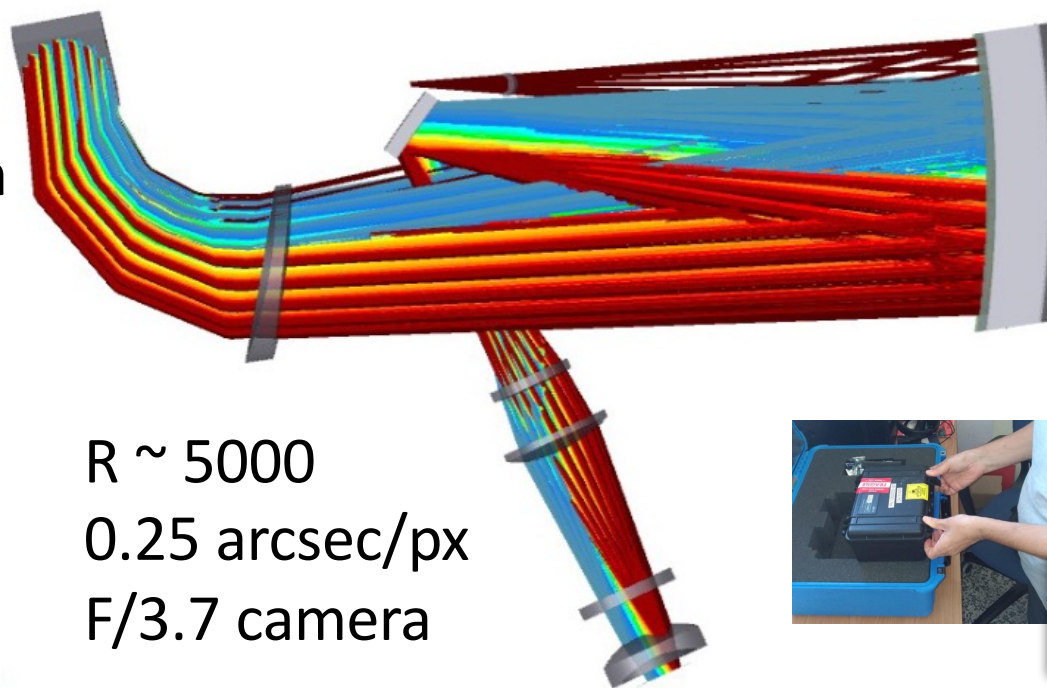
Spectrograph with
Collimator

Compensation of
Camera

Chromatism

Echelle

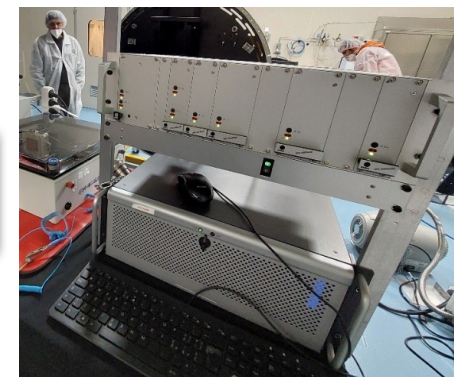
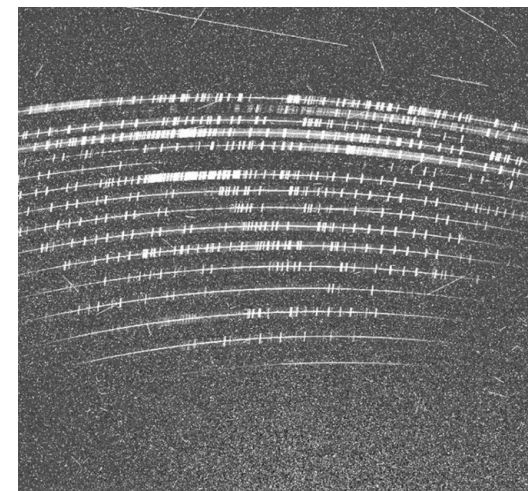
Cross-Dispersed



$R \sim 5000$

0.25 arcsec/px

F/3.7 camera



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ESO NGC Controller





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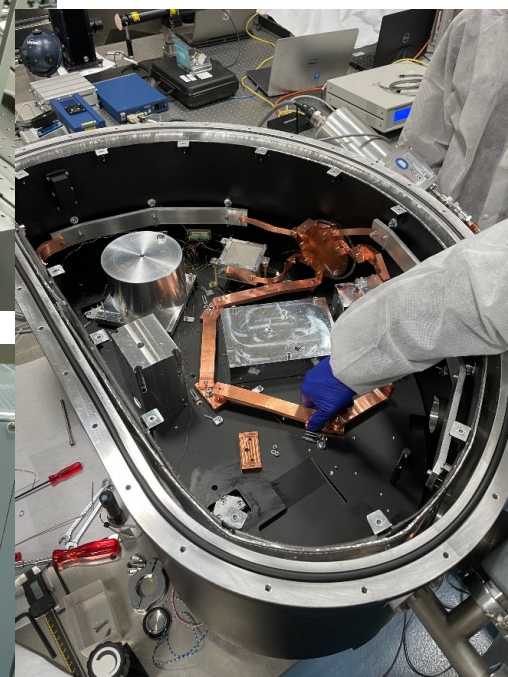
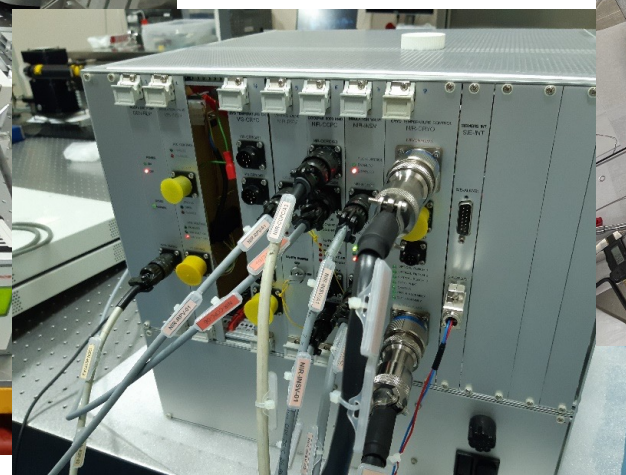
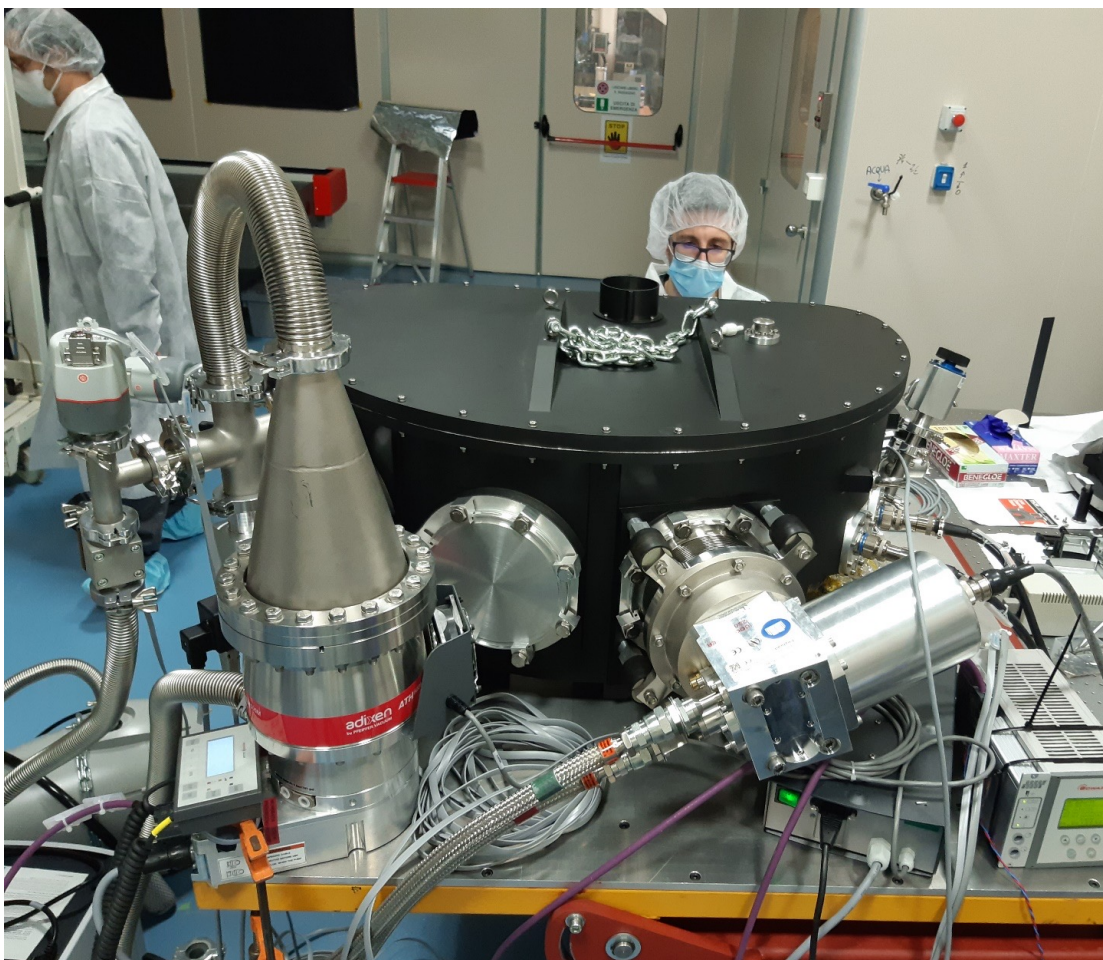
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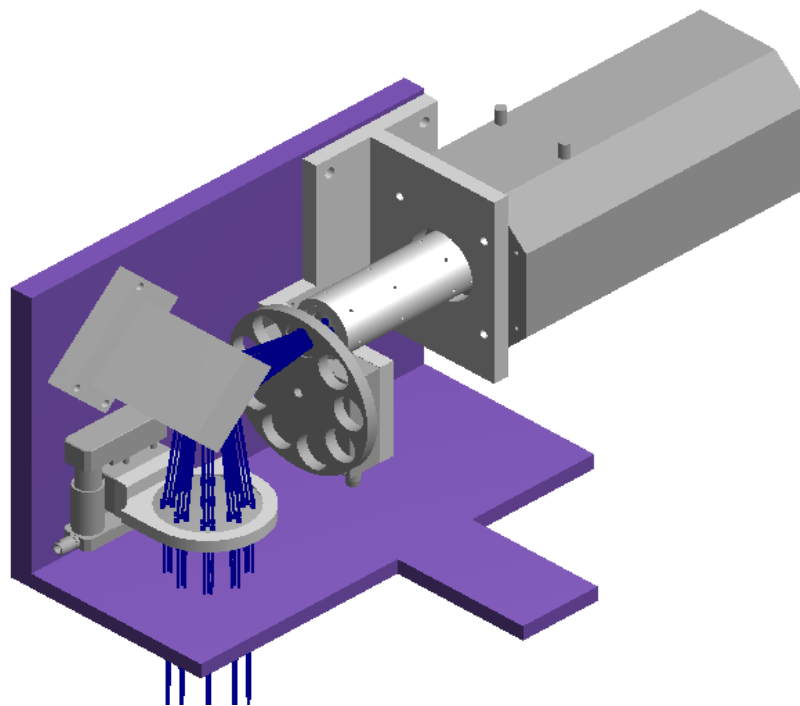
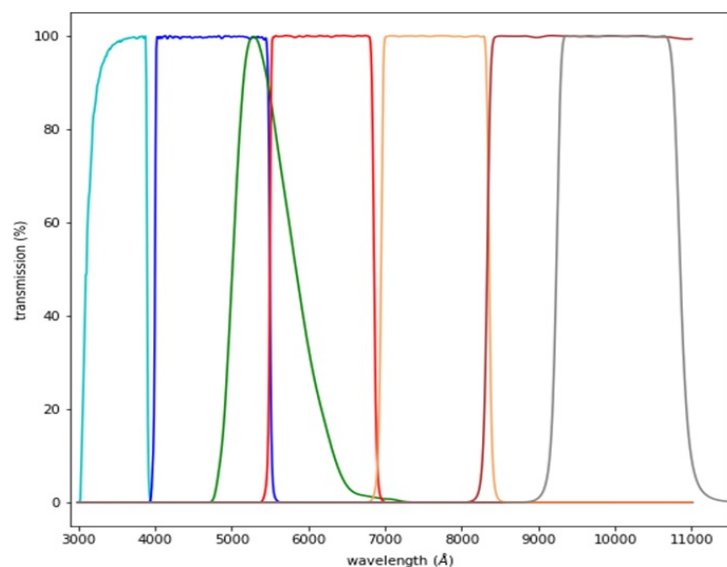


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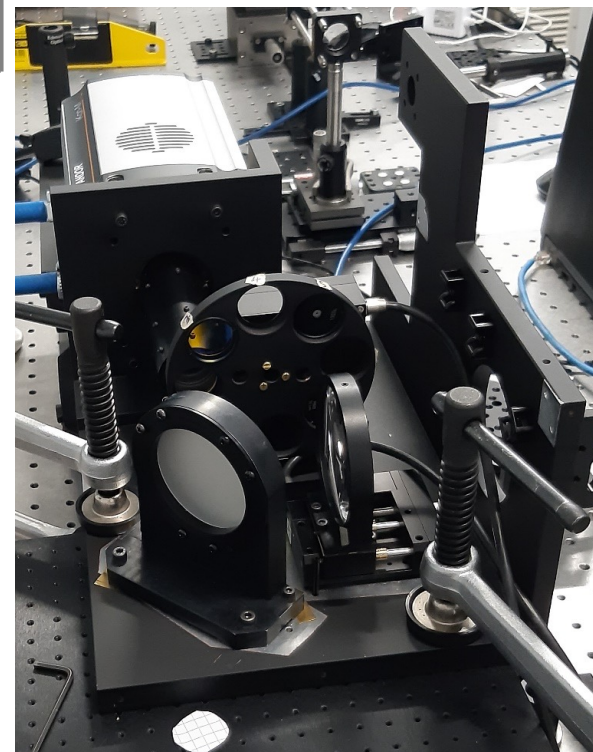


A&G Camera

- ☐ Target Acquisition
- ☐ Secondary guiding
- ☐ Photometry



FoV: 3.5'x3.5'
Filters: ugrizY + V



ASAHI SPECTRA USA

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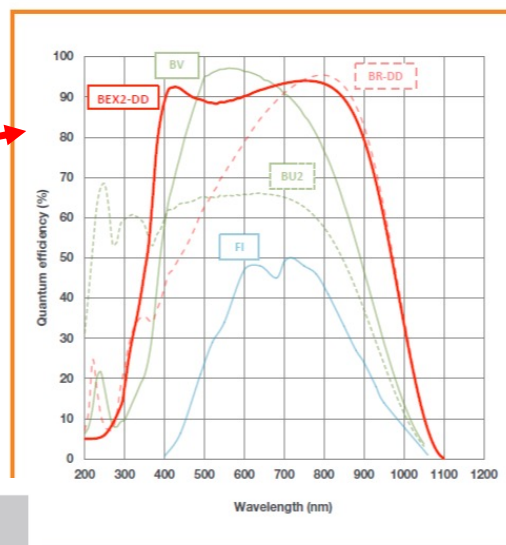


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A&G Camera

BEX2-DD => High
QE in a broad
wavelength range



Active pixels	1024 x 1024
Sensor size	13.3 x 13.3 mm
Pixel size (W x H)	13 μm x 13 μm
Active area pixel well depth	100,000 e ⁻ (130,000 e ⁻ for BR-DD and BEX2-DD models)
Pixel readout rates (MHz)	5, 3, 1, 0.05
Read noise	2.9 e ⁻
Maximum cooling	-100°C
Frame rate	4.4 fps (full frame)

Andor iKon M934
1024x1024
13μm/px 0.205 "/px



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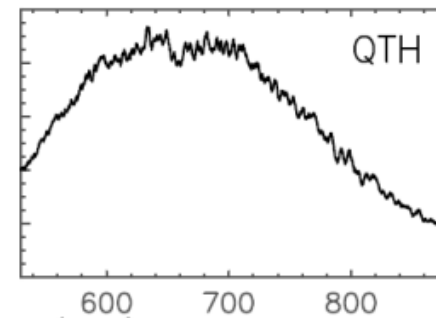
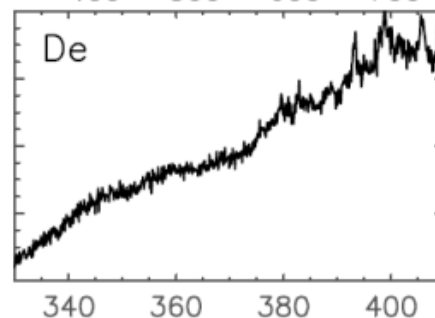
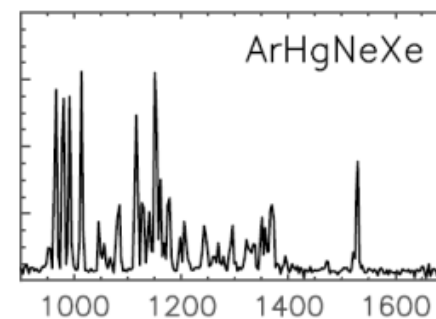
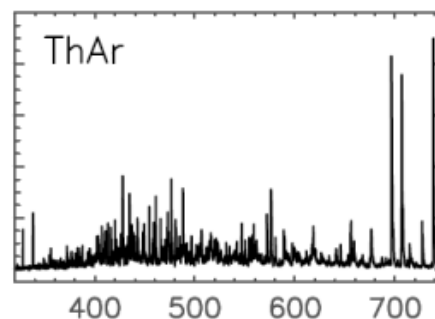
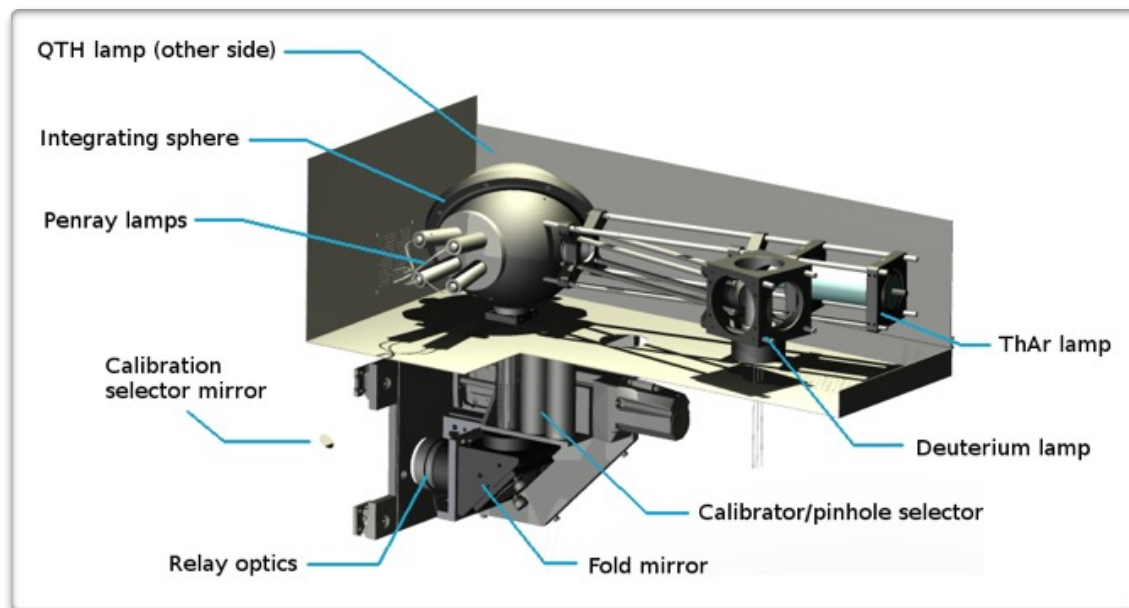
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Calibration Unit





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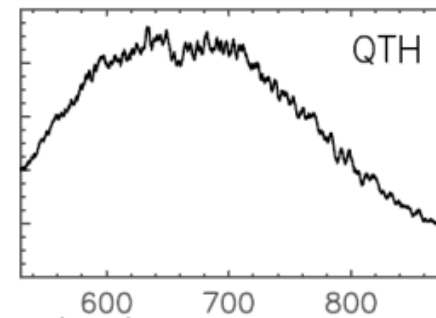
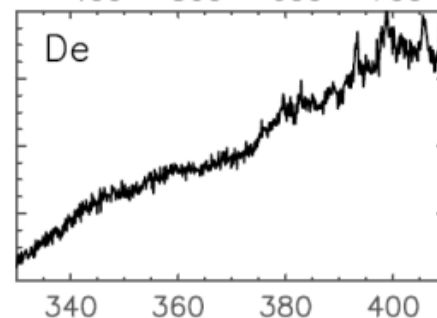
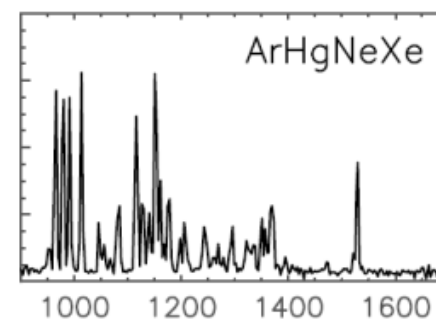
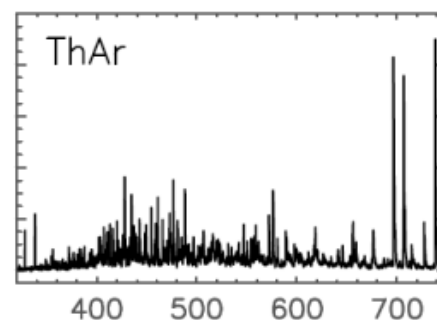
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Calibration Unit





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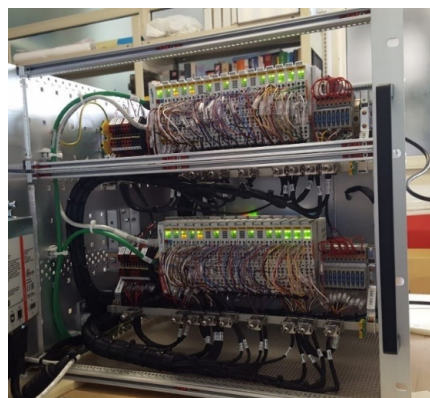
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Electronics





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Instrument Software

SOXS OS Control - @wsxs

File Options Engineering Telescope Instrument Help

SOXS OS Control

Ins Mode: Undefined

State: **LOADED**

Substate: idle

Disk Space: 121 GB of 153 free

INS_DISK/insroot/SOXS/INS_ROOT

Update

Bytes Percent

Alarm Panel

TCS

State: **ONLINE** Tracking: **ENABLED**

Substate: **IDLE** RA: 104.89044

Access: **IGNORE** DEC: -795221.276

OS ICS NIR VIS ACQ TECH

State: **ONLINE** **LOADED** **ONLINE** **ONLINE** **ONLINE** **ONLINE**

Substate: idle idle idle idle idle idle

NIR - Near Infrared Spectrograph

Exp. status: Undefined Exp. time: 6 (s) Remaining: 0 (s) End

Instr. mode: Simul. Filename: sxSelfTestNgcIR_2.fits Abort

VIS - Visible Spectrograph

Exp. status: Undefined Exp. time: 1 (s) Remaining: 0 (s) End

Instr. mode: Simul. Filename: sxSelfTestNgcOPT_2.fits Abort

ACQ - Acquisition Camera

Exp. status: Undefined Exp. time: 1 (s) Remaining: 0 (s) End

Instr. mode: Undefined Filename: fTestAcq_2022-05-18T18:28:35.863.fits Abort

TECH - Technical Camera

Exp. status: Undefined Exp. time: 0.05 (s) Remaining: 0 (s) End

Instr. mode: Undefined Filename: fTestTech_2022-05-18T18:29:52.026.fits Abort

SOXS Status - @wsxs

File Std. Options Help

SOXS Status

Ins Mode: Undefined

State: **LOADED**

Substate: idle

TCS

State: **ONLINE** Tracking: **ENABLED**

Substate: **IDLE** RA: 104.89044

Access: **IGNORE** DEC: -795221.276

Shutter and calibration slides

INSH: **LOADED** HW: CLOSED

CALS: **LOADED** HW: FAIL 122

CUPS: **LOADED** HW: FAIL 16

Calibration Lamps

QTH: **LOADED** HW: OFF

DEUT: **LOADED** HW: OFF

NEON: **LOADED** HW: OFF

ARGO: **LOADED** HW: OFF

XENO: **LOADED** HW: OFF

MERC: **LOADED** HW: OFF

THAR: **LOADED** HW: OFF

Sensors

CVTS P: 2.49

CVTS T: 2.49

CPTS T: 350.00

CRAC: **ONLINE**

CRNF: **ONLINE**

CRMS: **ONLINE**

CRSW: **ONLINE**

NIR - Near Infrared Spectrograph

NIR: **ONLINE** LCU-SIM idle

Exposure: inactive DIT: 5.00

Remaining: 0 NDIT: 1

AFC2: **LOADED** HW: X 0 Y 0

NFOC: **LOADED** HW: FAIL 99899

NISE: **STANDBY** SIM 0

VIS - Visible Spectrograph

VIS: **ONLINE** HW-SIM idle

Exposure: 1 DIT: 0.00

Remaining: 0 NDIT: F

AFC1: **LOADED** HW: X 0 Y 0

ADC1: **LOADED** HW: ERROR

ADC2: **STANDBY** SIM STANDING

WISE: **STANDBY** SIM 2

TECH: **ONLINE** SIM IDLE

ACQ - Acquisition Camera

ACQ: **ONLINE** SIM IDLE

ACQS: **LOADED** HW: FAIL 106

ACFW: **LOADED** HW: 571151

AFOC: **LOADED** HW: FAIL 54671

SOXS

File Std. Options Help

INSH: **CLOSED**

CALS: **FAIL**

ACQS: **FAIL**

AFC1: **LOADED** X:0.0 Y:0.0

AFC2: **LOADED** X:0.0 Y:0.0

ADC1: **OFF** - 0

NFOC: **LOADED** -0.9989958

THAR: **LOADED**

MERC: **LOADED**

XENO: **LOADED**

ARGO: **LOADED**

NEON: **LOADED**

QTH: **LOADED**

DEUT: **LOADED**

CUPS: **FAIL**

ACFW: **LOADED**

ACQ: **LOADED**

AFOC: **LOADED** -0.5467146

WISE: **LOADED**

TECH: **LOADED**

VIS: **LOADED**

NISE: **LOADED**

NIR: **LOADED**



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Operations

ETC

Pipeline

Scheduler

Quality Control

Remote Monitoring

Help desk

5 years

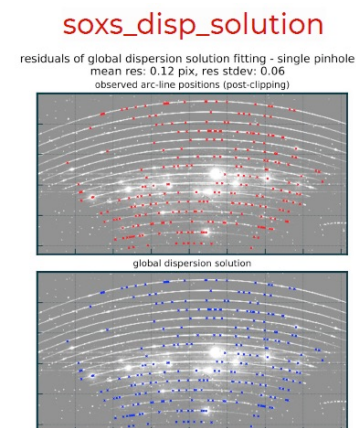
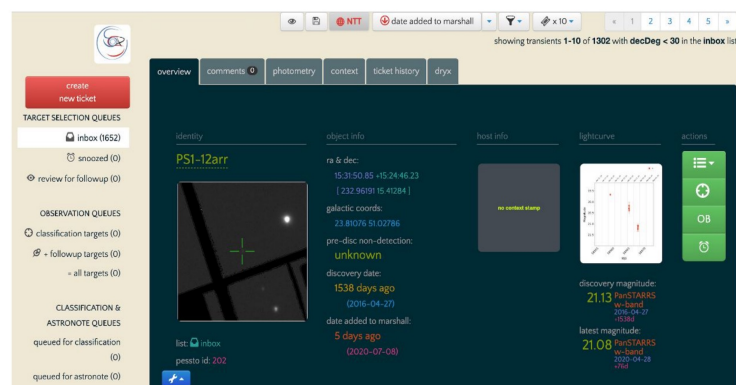
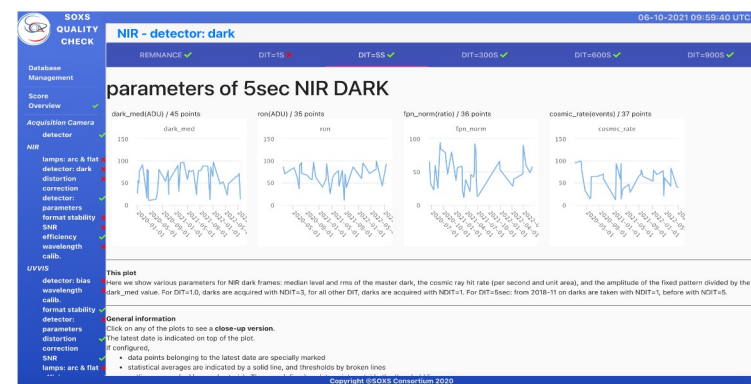
SOXS SCHEDULER

Switch to VES
New OB
New Urgent OB
Refresh
Show Logs

List of OBS

ID	OB Type	Target Name	Ra	Dec	Magnitude	Exp. Time	Actions
1	Undefined	PKS 1553+132rs	08h40m00s	+10d00m00s	17.5	3	[Icons]
4	Classification	AT2018hj	17h57m49.68s	+15d18m28.44s	16.4	2070	[Icons]
5	Proposal ESO	AT2018hm	09h25m17.68s	+09d45m00.072s	17.3	752	[Icons]
6	Classification	AT2018hv	19h08m06s	-15d22m09.12s	16.6	2994	[Icons]
7	Follow up	AT2018hx	09h44m34.56s	-09d28m05.52s	16.4	2070	[Icons]
8	Follow up	SN2018hy	02h26m47.304s	-09d04m02.316s	16.1	1570	[Icons]
10	Follow up	AT2018huc	04h49m54.48s	-41d56m18.24s	17.4	824	[Icons]
11	Undefined	SN2018huk	09h45m08.16s	-79d23m47.44s	17	570	[Icons]
12	Classification	SN2018hul	23h24m56.64s	+09d25m52.68s	17.8	1192	[Icons]

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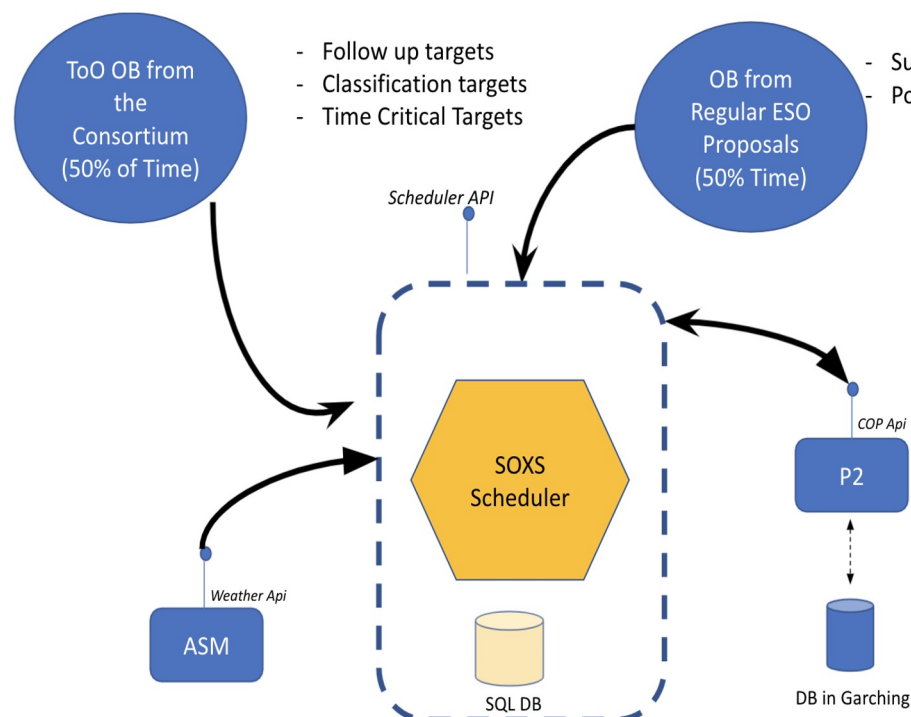
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Scheduler

- ❑ Schedule is updated daily
- ❑ Telescope operator on site

- ❑ P2 system, vOT interface with ESO
- ❑ Web based app



Marshall

Feeders:

- ❑ ZTF, ATLAS, PanStarrs, LSST-Lasair, etc.
- ❑ TNS, Atel, GCN, etc.

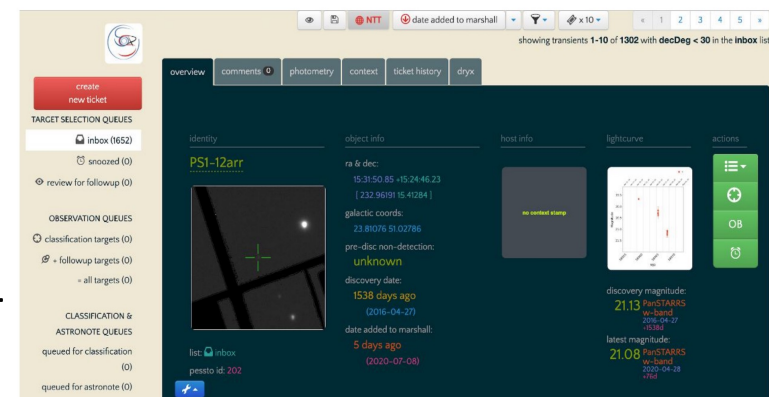
SOXS SCHEDULER

Switch to VES
New OB
New Urgent OB
Refresh
Show Logs

List of OBs

AID	OB Type	Target Name	Ra.	Dec.	Magnitude	Exp. Time	Actions
1	Undefined	PKS 1553+112bis	08h40m00s	+10d00m00s	11.5	3	[Actions]
4	Classification	AT2018hj	17h51m49.68s	+15d18m28.44s	10.4	2070	[Actions]
5	Proposal ESO	AT2018th	07h25m17.88s	+09d39m00.07s	17.3	752	[Actions]
6	Classification	AT2018th	19h08m00s	-15d23m08.12s	18.8	2994	[Actions]
7	Follow up	AT2018th	07h44m34.56s	+06d28m05.52s	10.4	2070	[Actions]
8	Follow up	SN2018th	02h26m47.304s	-09d04m02.316s	16.1	1570	[Actions]
10	Follow up	AT2018th	04h49m54.48s	-41d56m18.24s	17.4	824	[Actions]
11	Undefined	SN2018th	05h45m08.16s	-79d23m47.4s	17	570	[Actions]
12	Classification	SN2018th	23h24m56.64s	+09d25m52.68s	17.8	1192	[Actions]

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