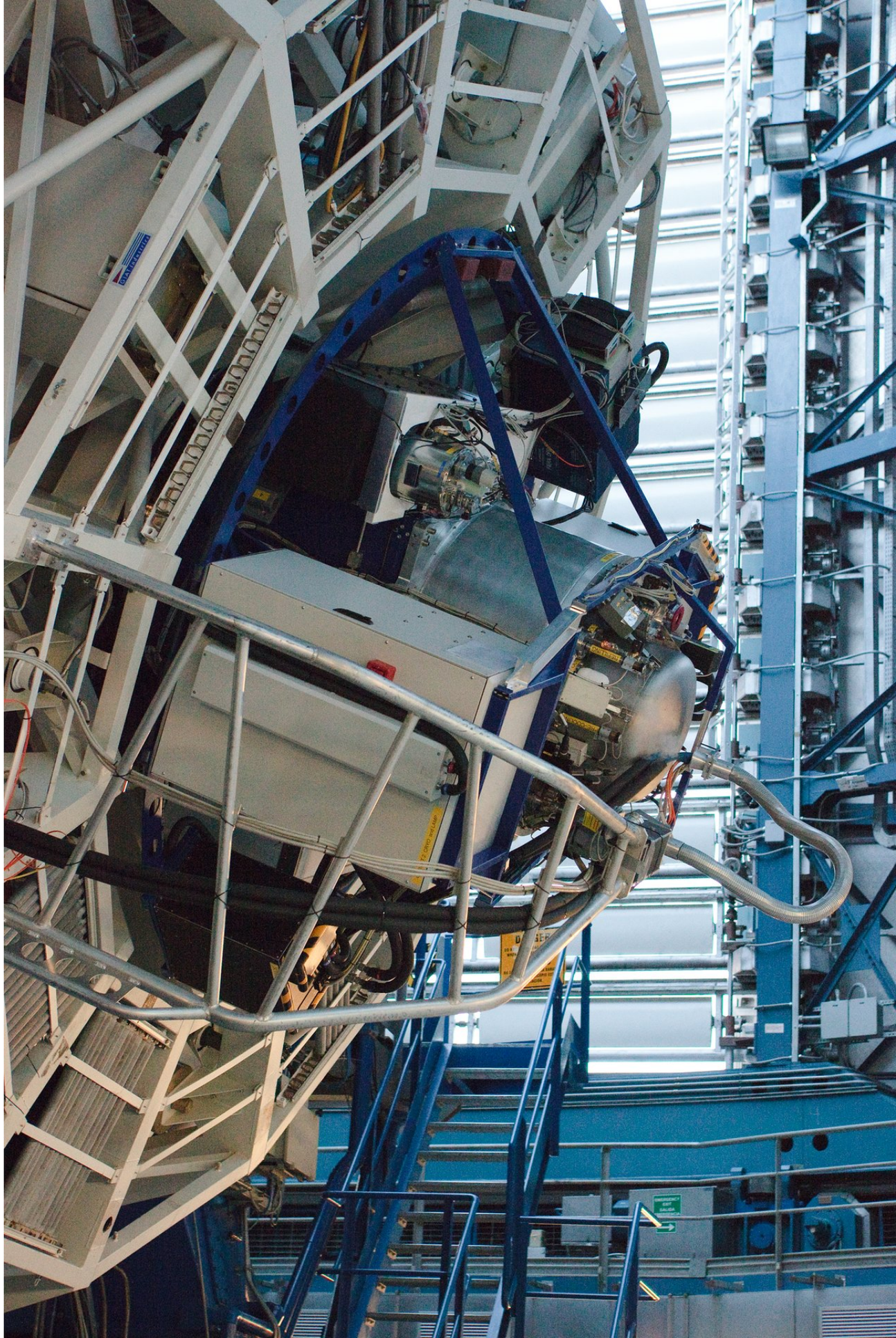
X-shooter: the first of the VLT second generation instruments

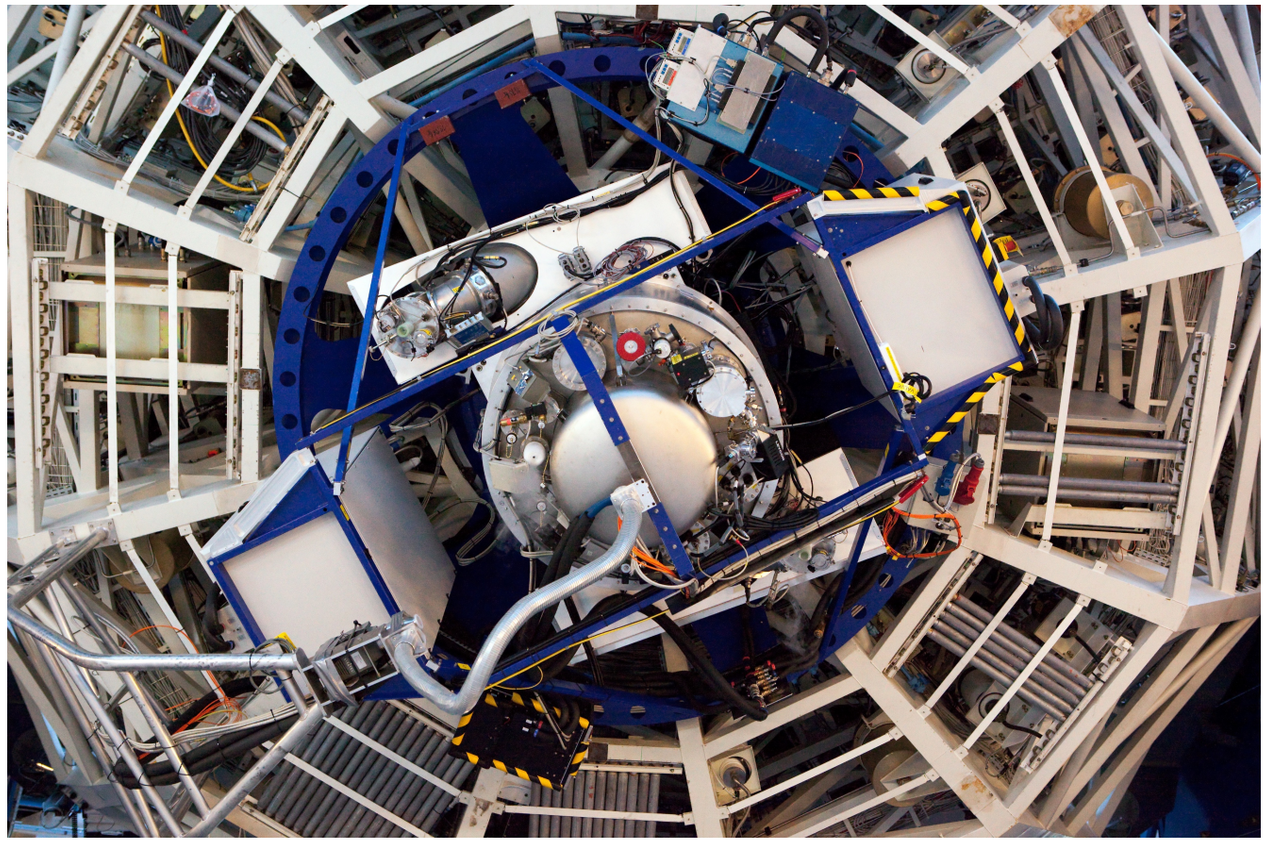
Andrea Mehner
(ESO Chile)

2017 ESO Calibration Workshop:
the second generation VLT instruments and friends

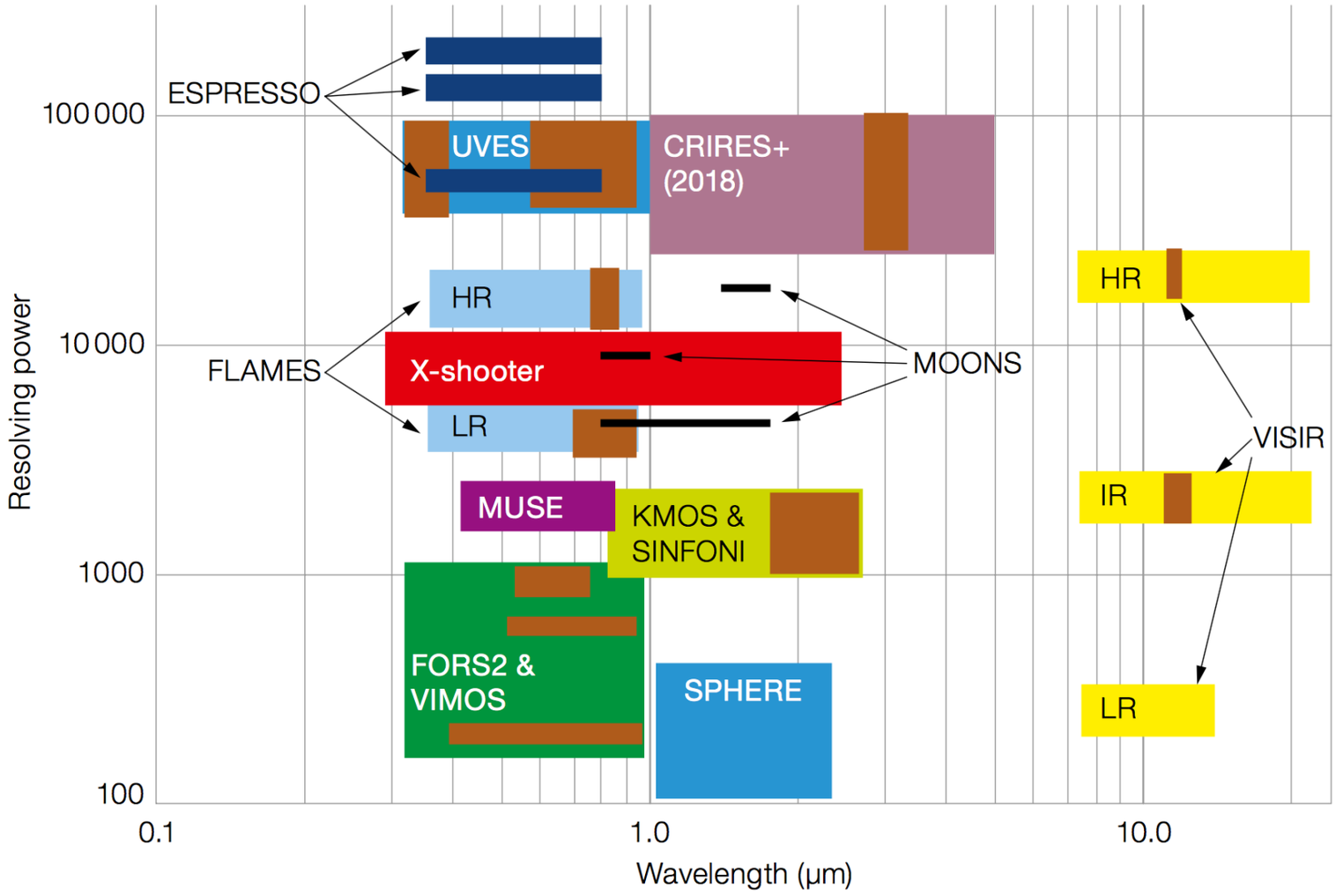


Outline

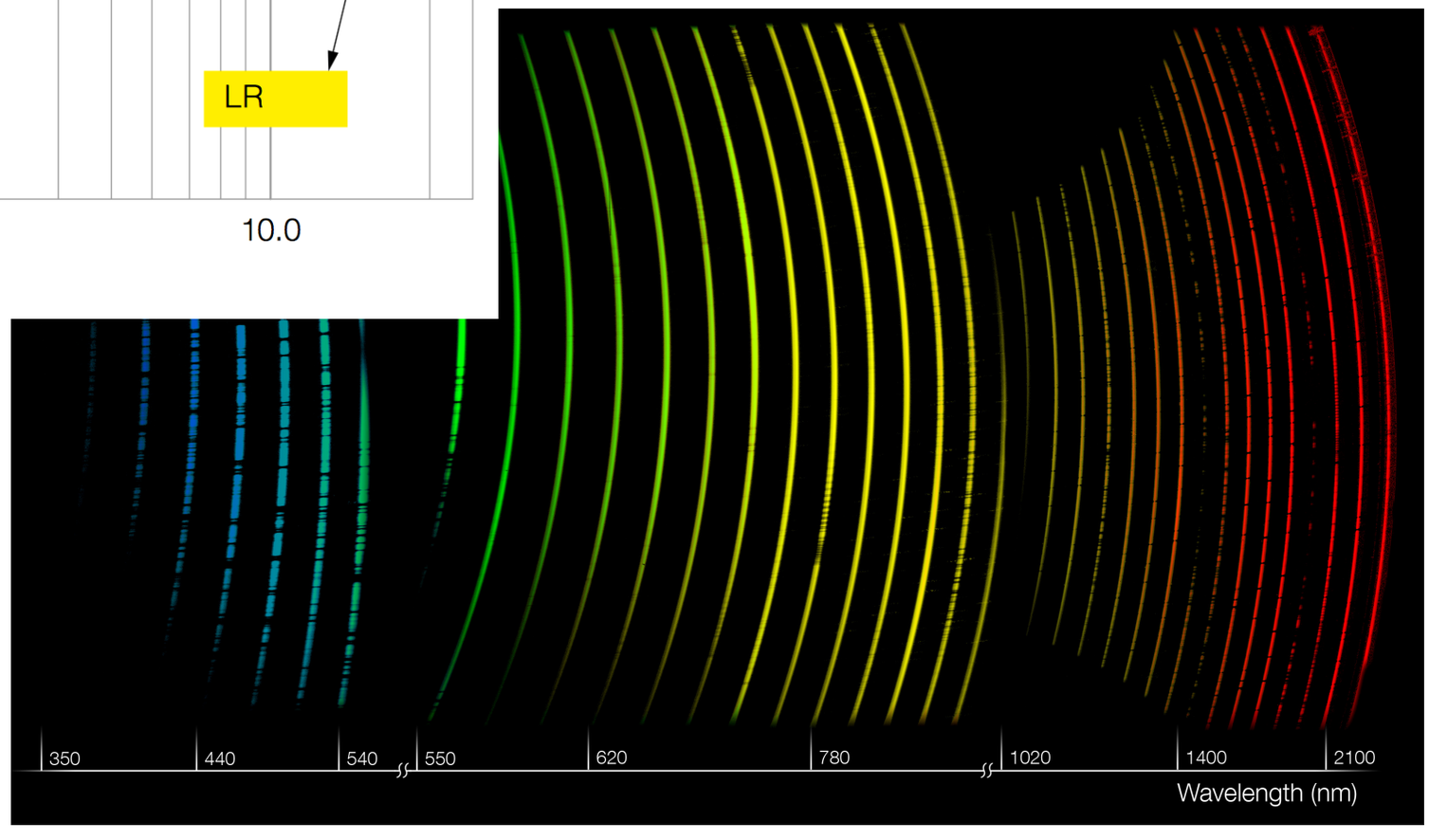
- X-shooter overview
- calibration plan (data analysis + instrument health)
- selection of raw/reduced data quality concerns



Why X-shooter?

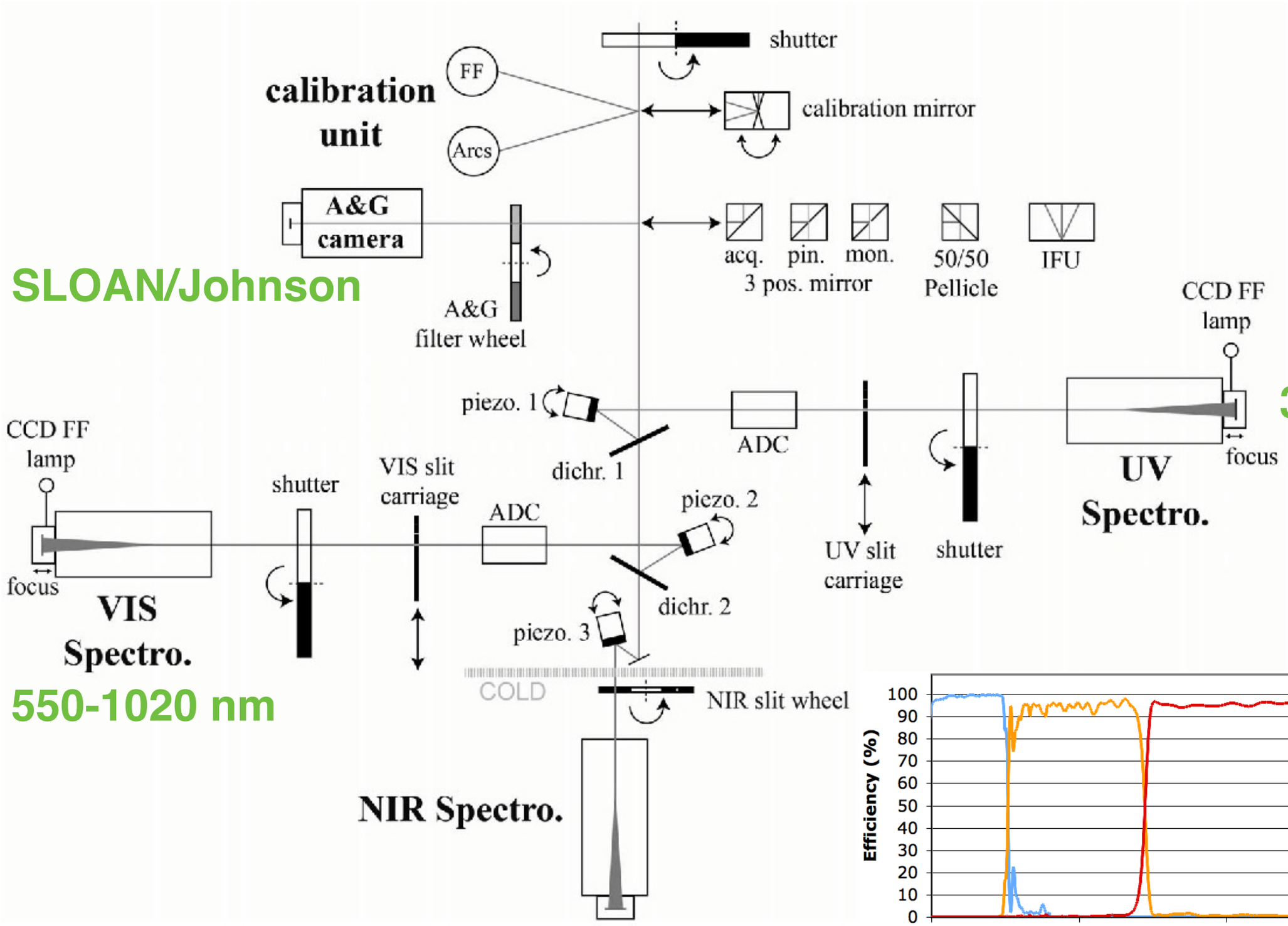


- simultaneous coverage from UV to near-IR (300-2400 nm)
- medium resolution
- high sensitivity



de Zeeuw (2016)

Layout: 4 arms

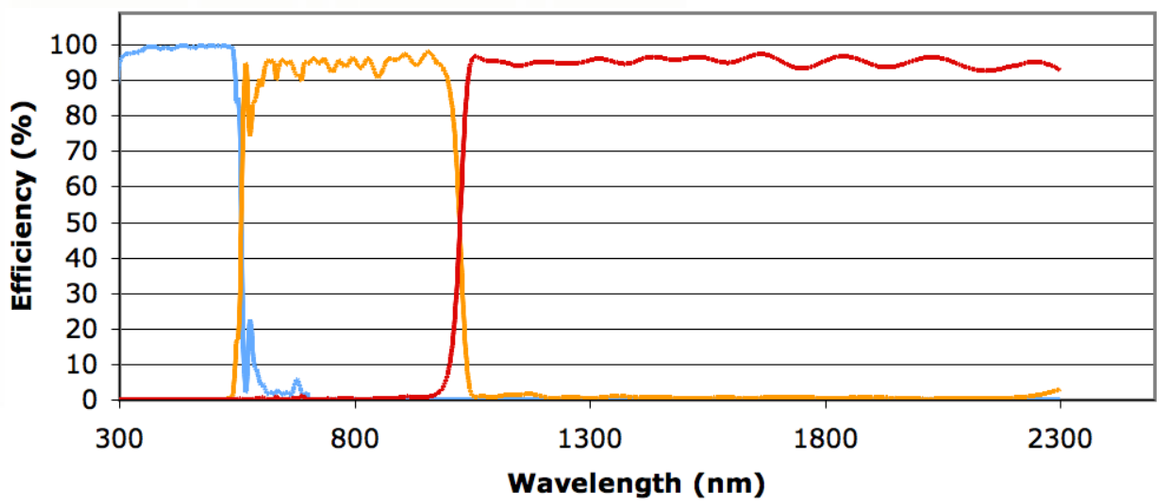


SLOAN/Johnson

300-500 nm

550-1020 nm

1020-2480 nm



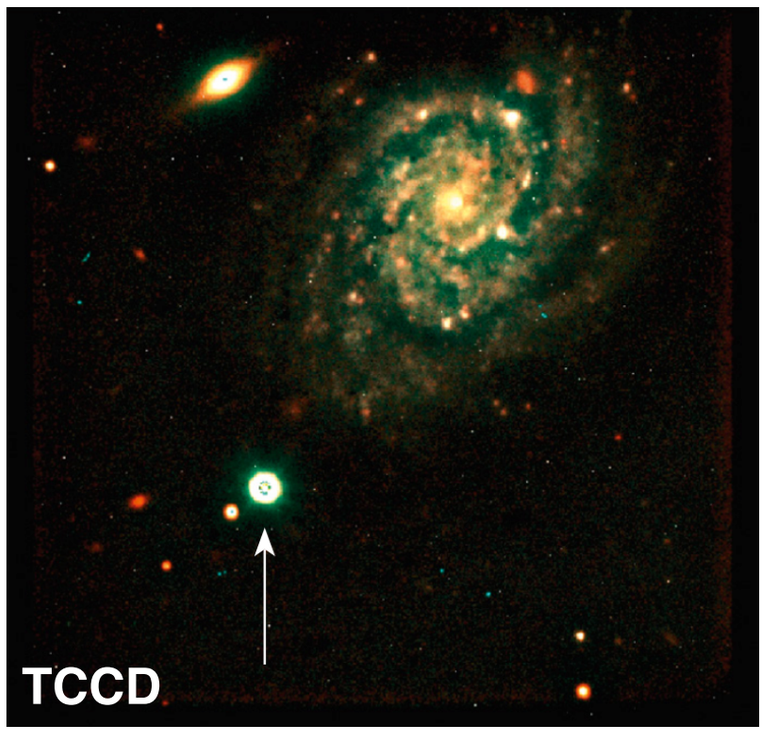
Instrument/observing modes

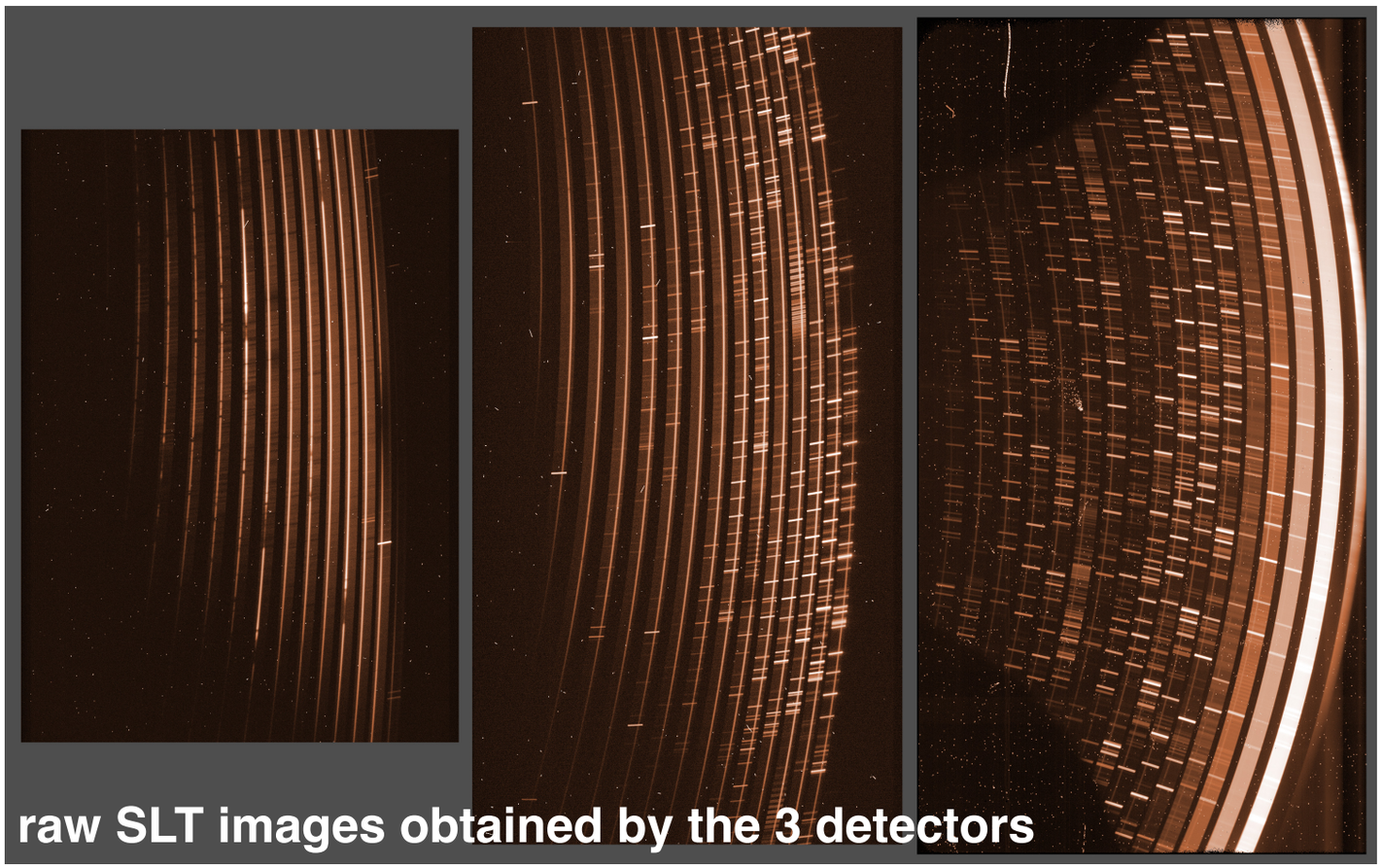
Instrument modes

- SLT (0.4”-5”)
- IFU (4”x1.8”)
- (IMG with TCCD)

Various observing modes

- stare
- nodding
- generic offset/fixed offset
- mapping
- synchronised





Nighttime calibration plan

Spectrophotometric standard stars

- instrument response
- relative flux calibration

future: replaced by tools like molecfit (night time used for calib plan 14% -> 5%)

Telluric standard stars

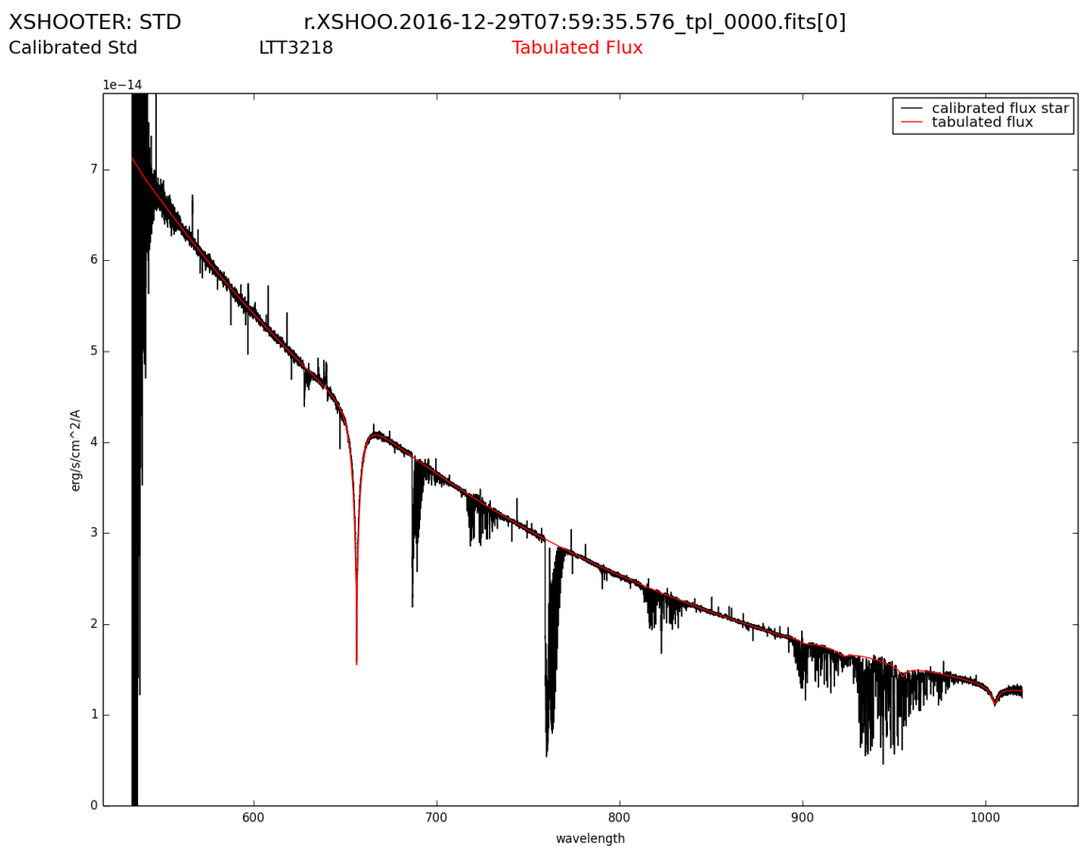
- telluric absorption lines

Optional (user provided, rare)

- radial velocity standards
- attached wave calibration

Efficiency monitoring

- monitor instrument health



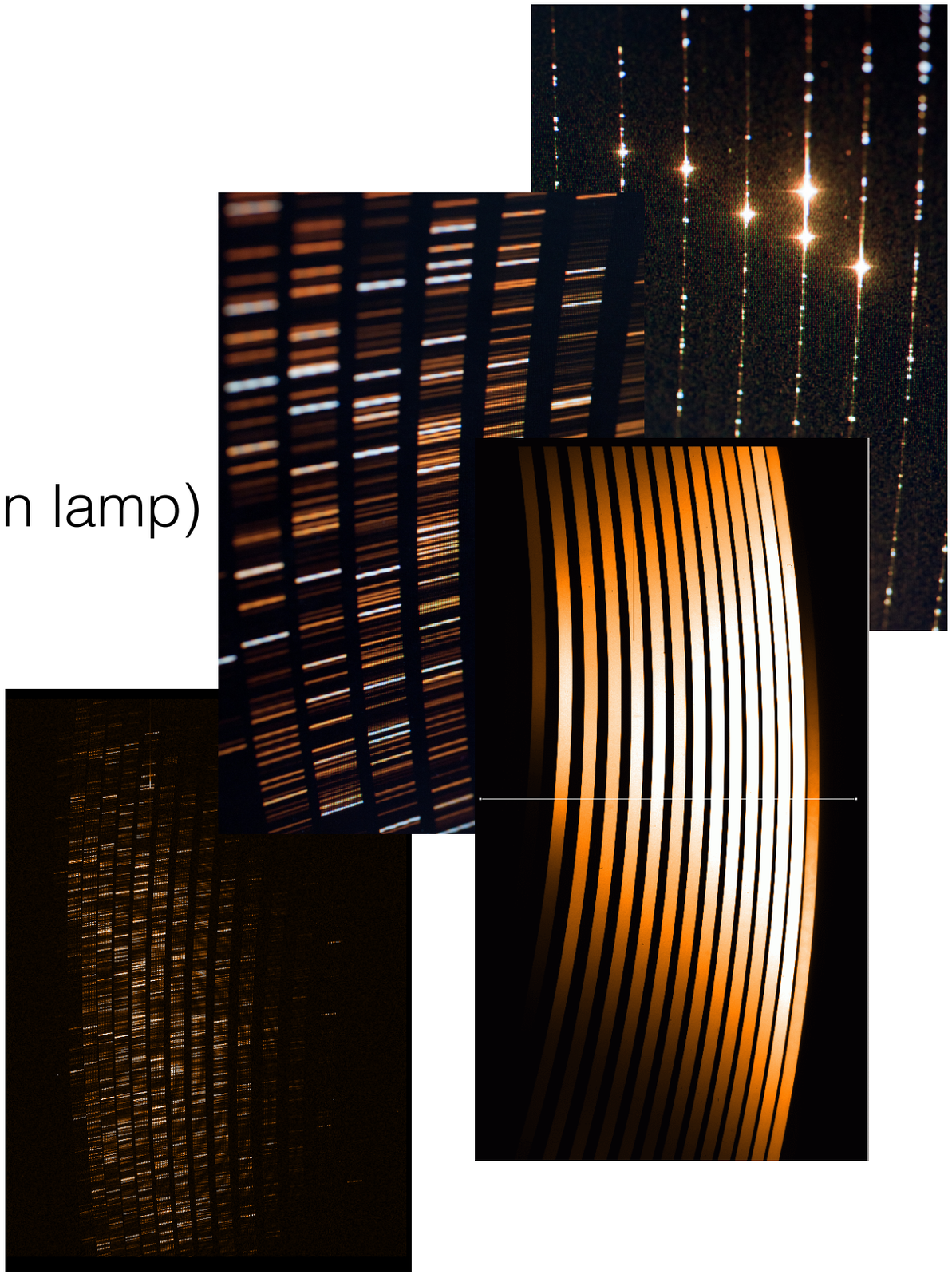
Daytime calibration plan

Data analysis

- bias
- dark
- flat
- fmtchk (single pinhole + ThAr)
- orderdef (single pinhole + halogen lamp)
- wave (multiple pinhole + ThAr)

Instrument health

- dark
- arc
- linearity
- ADCs+IFU
- reference acquisition position



Issues

X-shooter data quality concerns

Raw data

instrument: (1) mechanical failure of ADCs
(2) moving acquisition reference
(3) humidity effects
(4) readout noise in VIS arm

catalogue: (5) unsuitable telluric standard stars

Reduced data

pipeline: (6) IFU
(7) sky subtraction

CalSelector/reflex workflow/phase3: (8) bad UVB response

X-shooter data quality concerns

Raw data

instrument: (1) mechanical failure of ADCs
(2) moving acquisition reference
(3) humidity effects

better quality criteria, better data flow monitoring
-> detect data quality issues
-> best possible data (products)

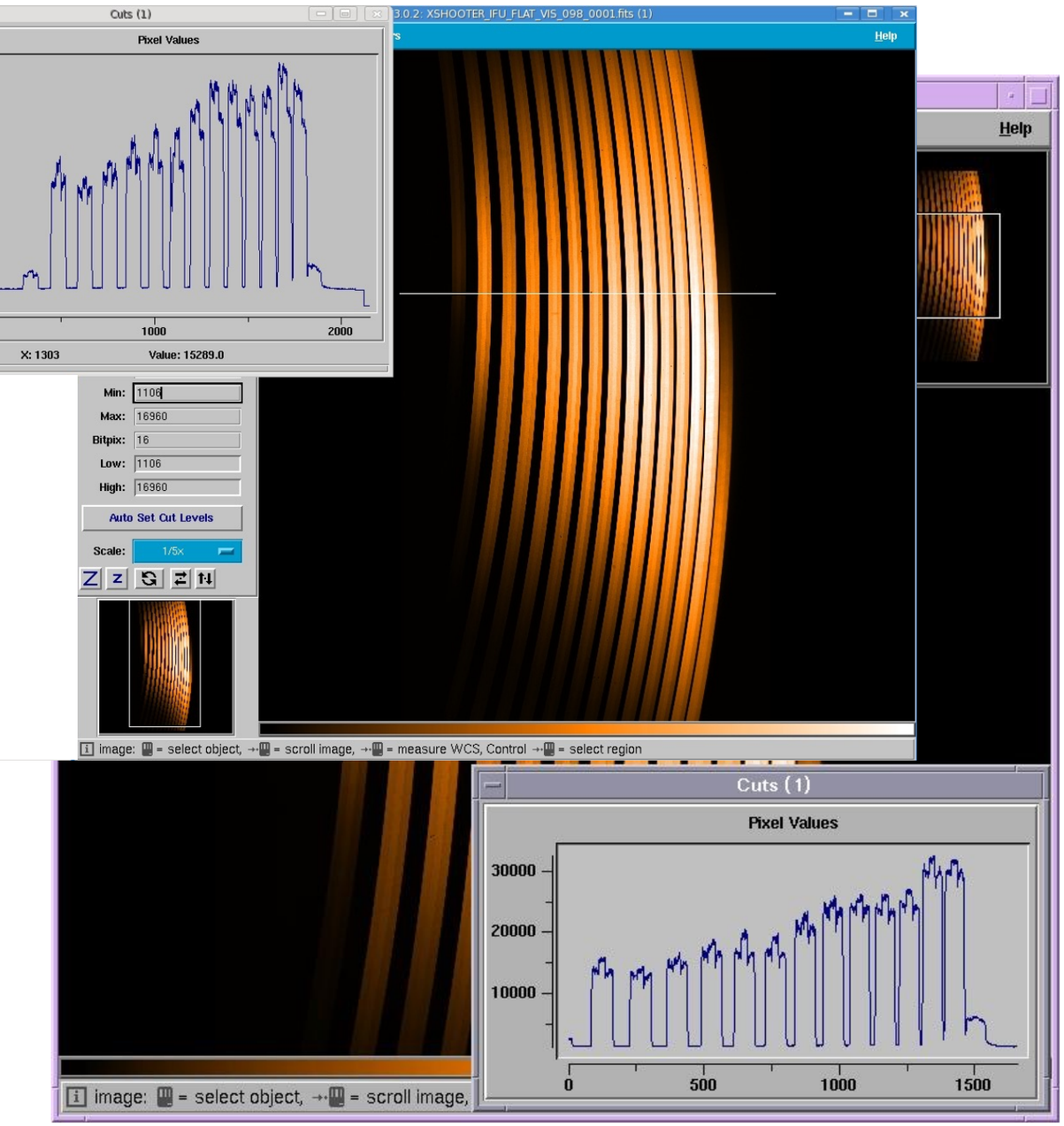
Reduced data

pipeline: (6) IFU
(7) sky subtraction

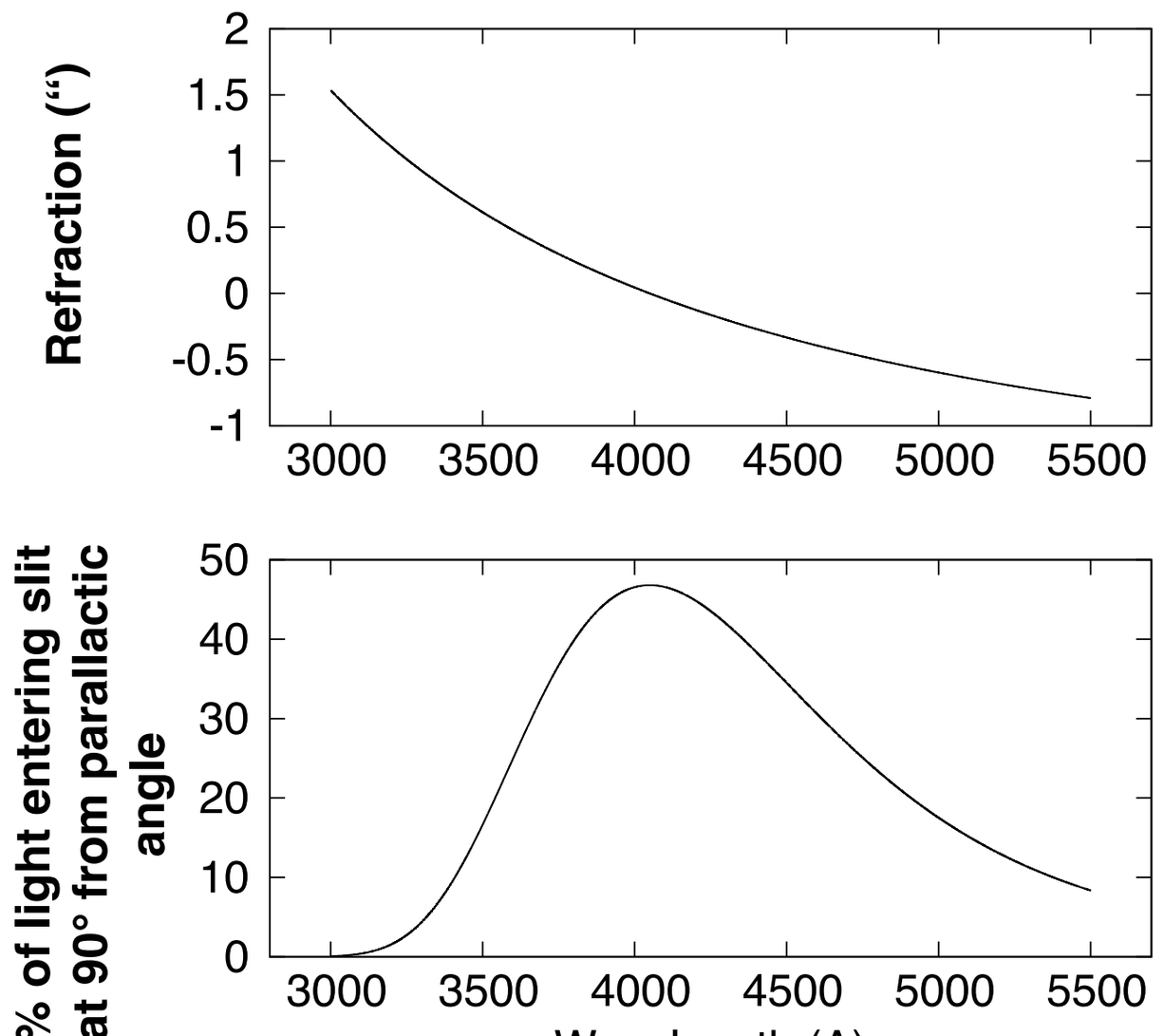
CalSelector/reflex workflow/phase3: (8) bad UVB response

(1/8) Mechanical failure of ADCs

- material wear in low temperatures, ADCs disabled in 2012
- installation of **new ADC drives** in May 2017



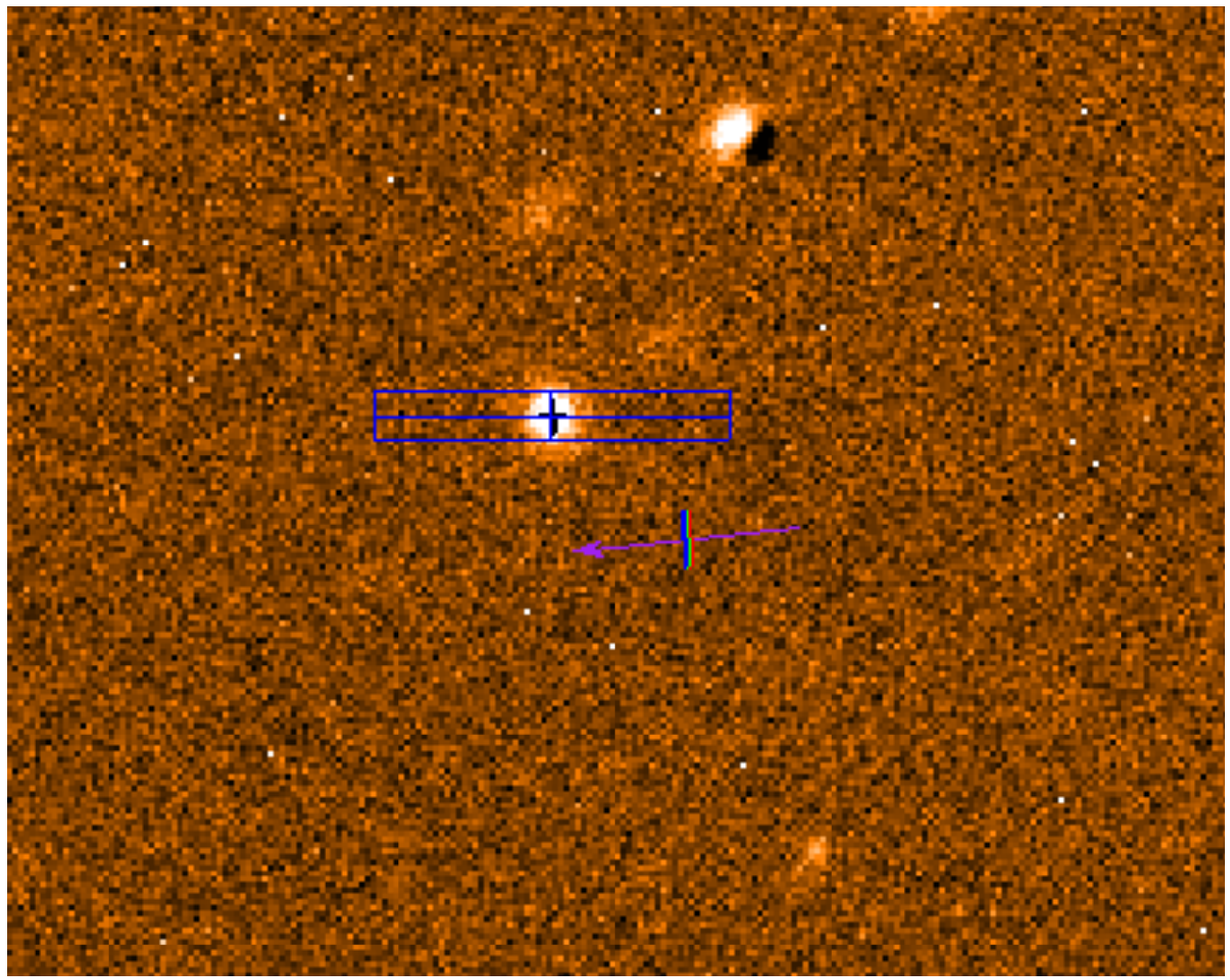
UVB, 0.5” slit, airmass 1.3, seeing 0.8”



(2/8) Moving acquisition reference

- X-shooter acquisition is performed “blindly”
- imperfect target centering due to moving function, incorrect software update
- -> loss of flux, wavelength shift

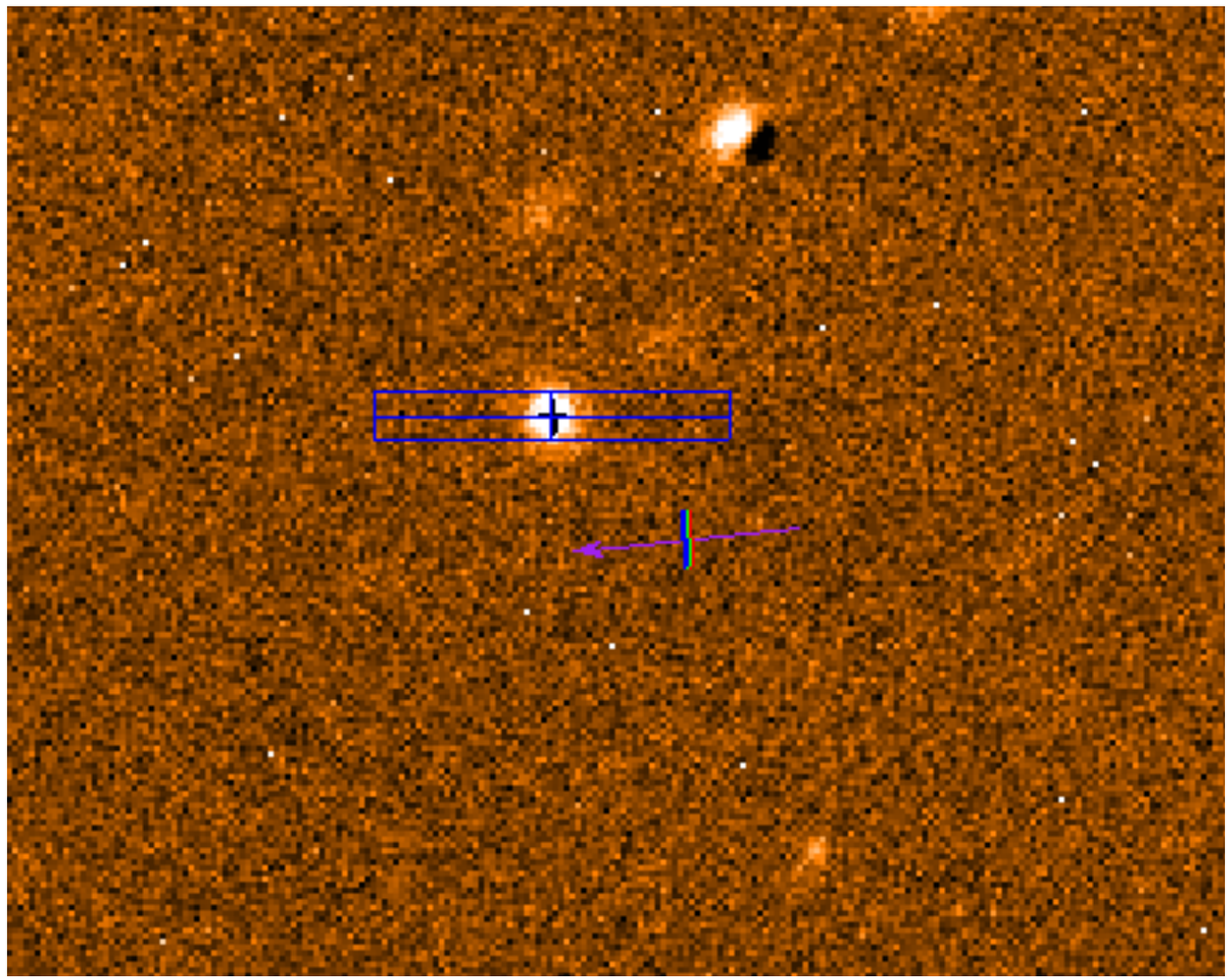
- **check of reference position** every day



(2/8) Moving acquisition reference

- X-shooter acquisition is performed “blindly”
- imperfect target centering due to moving function, incorrect software update
- -> loss of flux, wavelength shift

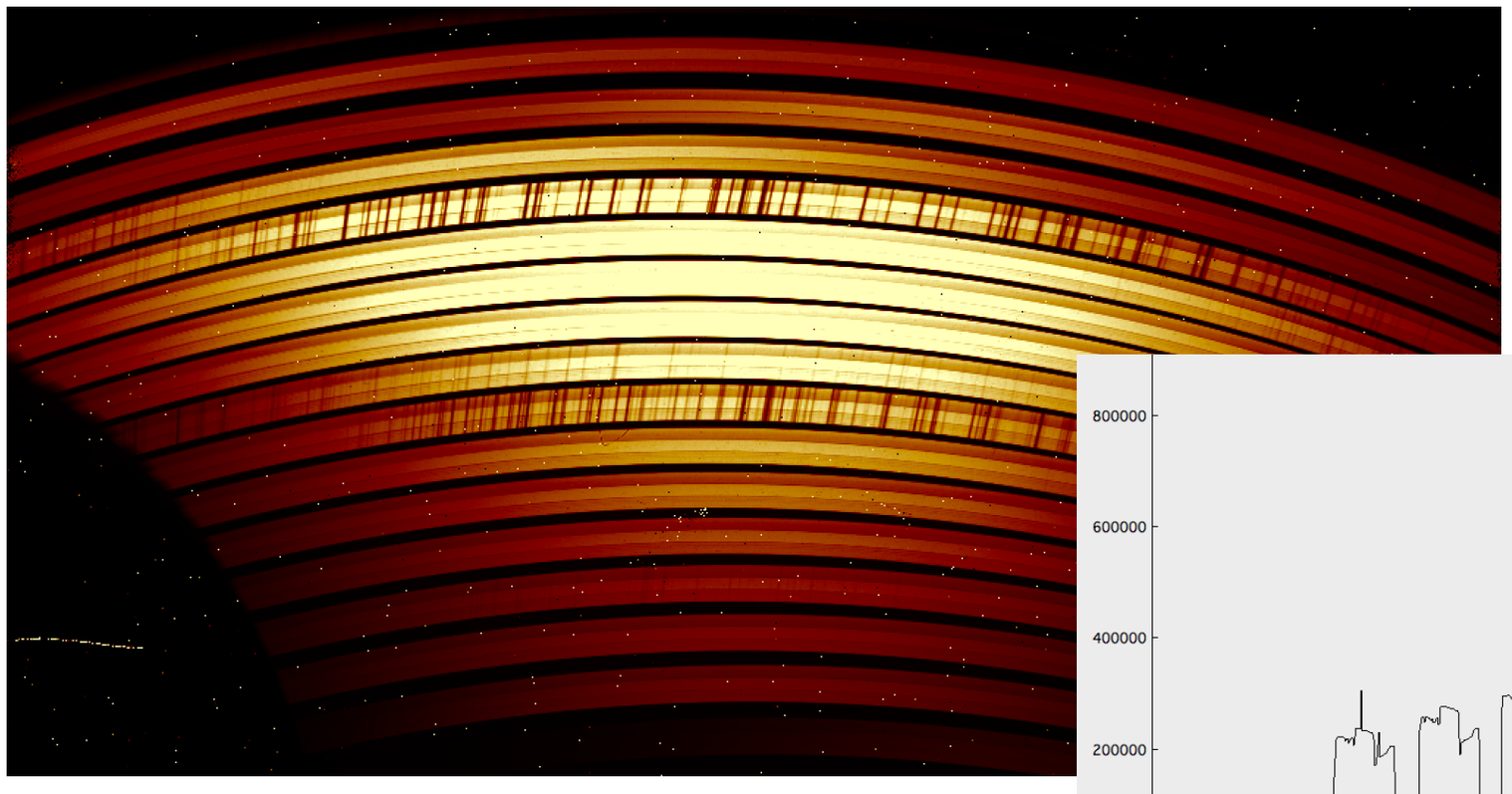
- **check of reference position** every day

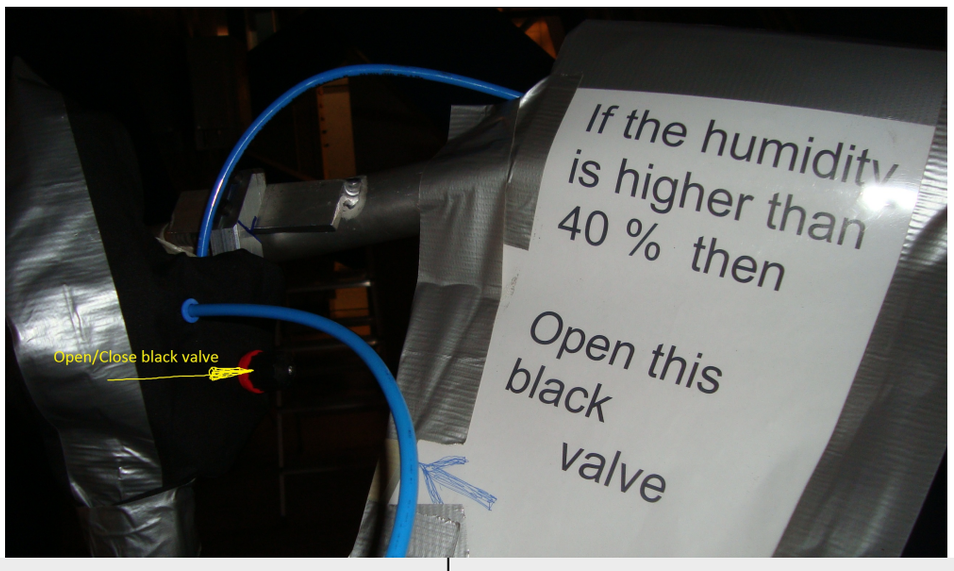


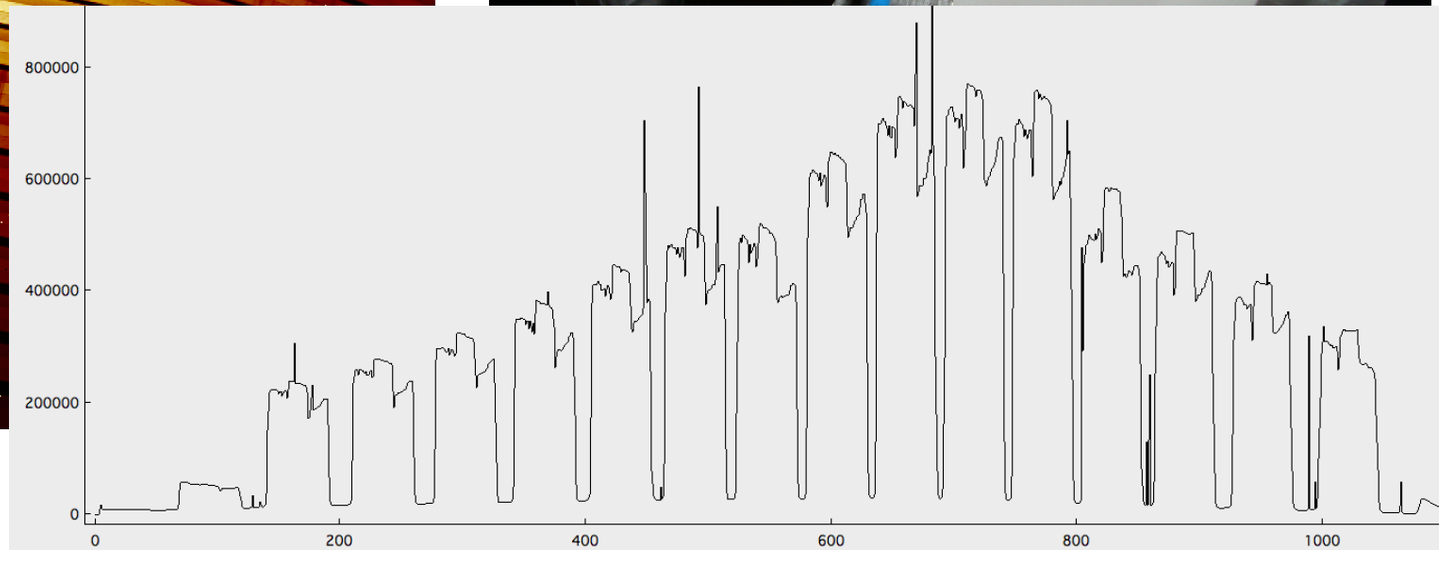
monitor moving functions and functions that perform “blind” operations!

(3/8) Humidity effects

- condensation occurs on the NIR entrance window
- coating on dichroics soak up water
- affecting all three arms for up to two weeks
- manual **airflow system** installed in 2015
- **correlate selected quality parameters with weather parameters**

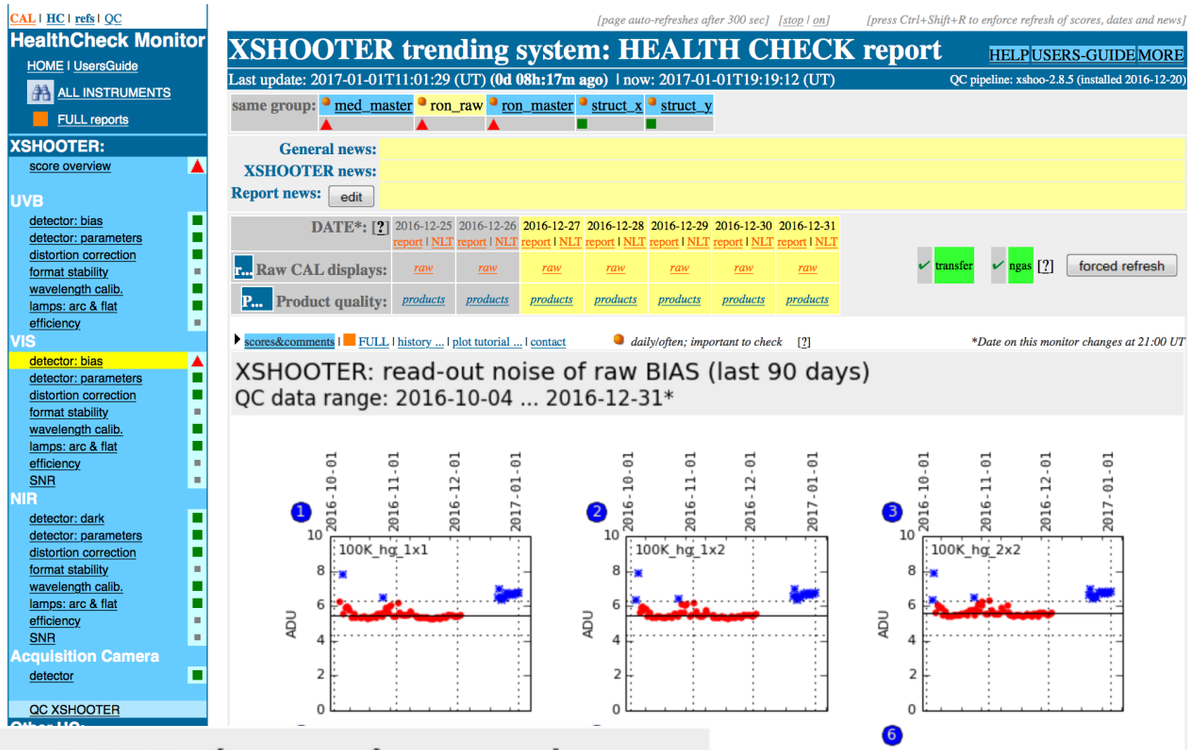




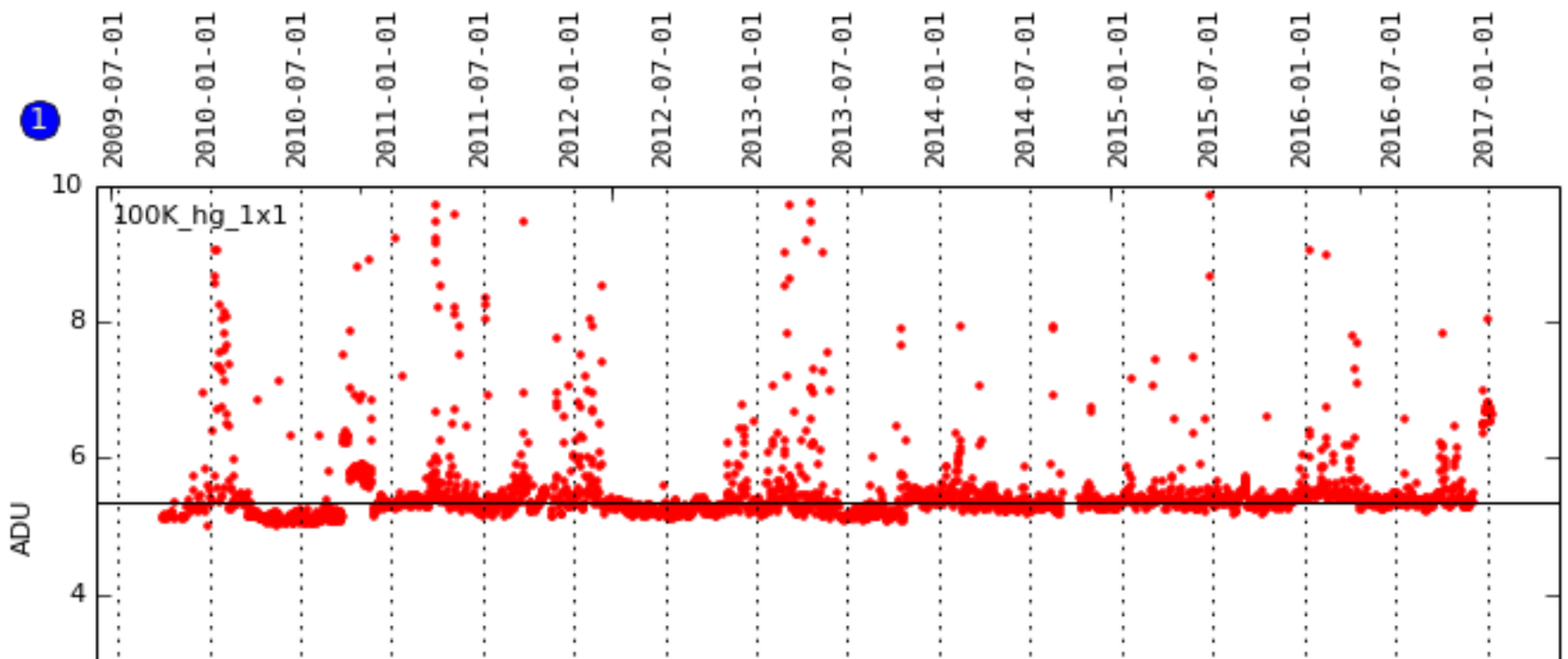


(4/8) High readout noise in VIS arm

- likely due to cabling and grounding
- concern for faint targets
- **no solution** found
- **provide users with easier access to relevant health parameters?**

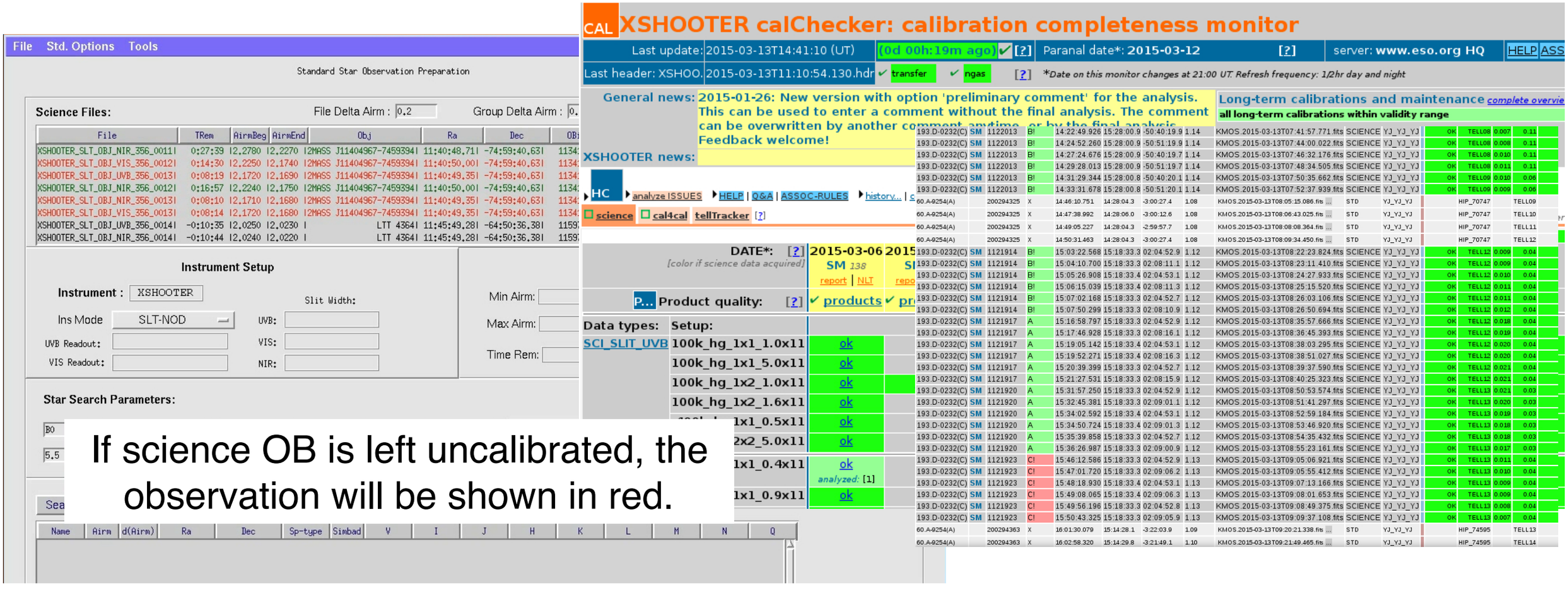


XSHOOTER: read-out noise of raw BIAS (FULL range, 2658 days, close-up)
QC data range: 2009-10-01 ... 2017-01-08*



(5/8) Unsuitable telluric standard stars

- 2009-2015: 1079 B-type telluric standard stars observed (Simbad database)
- 19% of those are: Be stars, binaries, SGs, LPV, strange line profiles
- **clean catalogue + molecfit**
- **investigate earlier, especially with ELT!**



(6/8) Pipeline: IFU

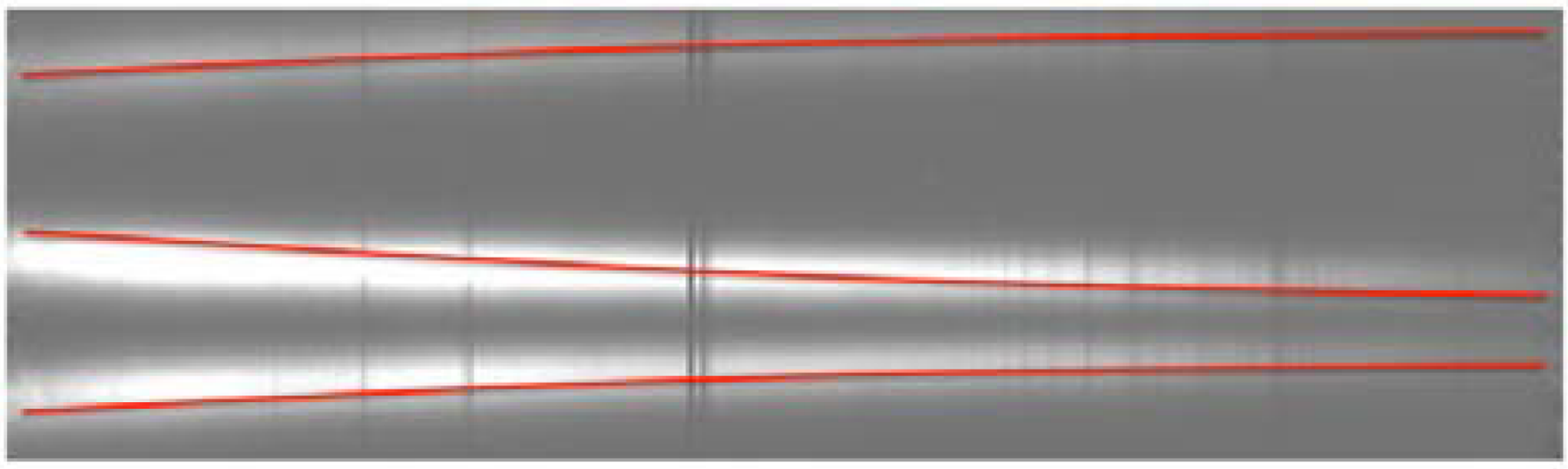
no science-ready IFU products

- 2012-2016: 334 hours for 35 programs
- only 15% of programs published (8 papers)

no operational costs, but:

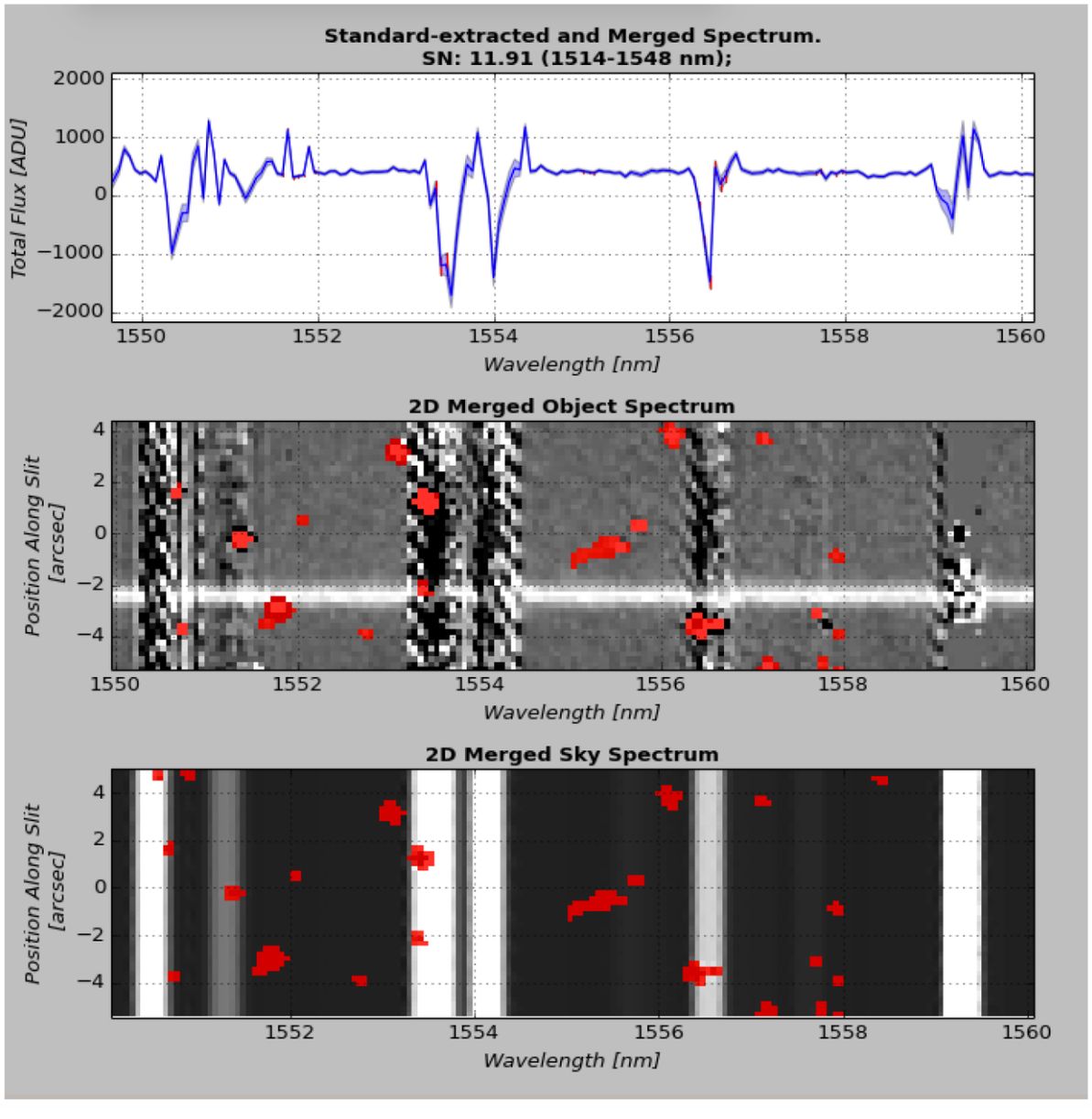
- frustrated users, very few proposals
- not scientifically competitive (MUSE+SINFONI+ERIS)

- **decommission or pipeline project to either improve or downgrade to a simple image slicer mode?**
- **science-ready pipeline products!**



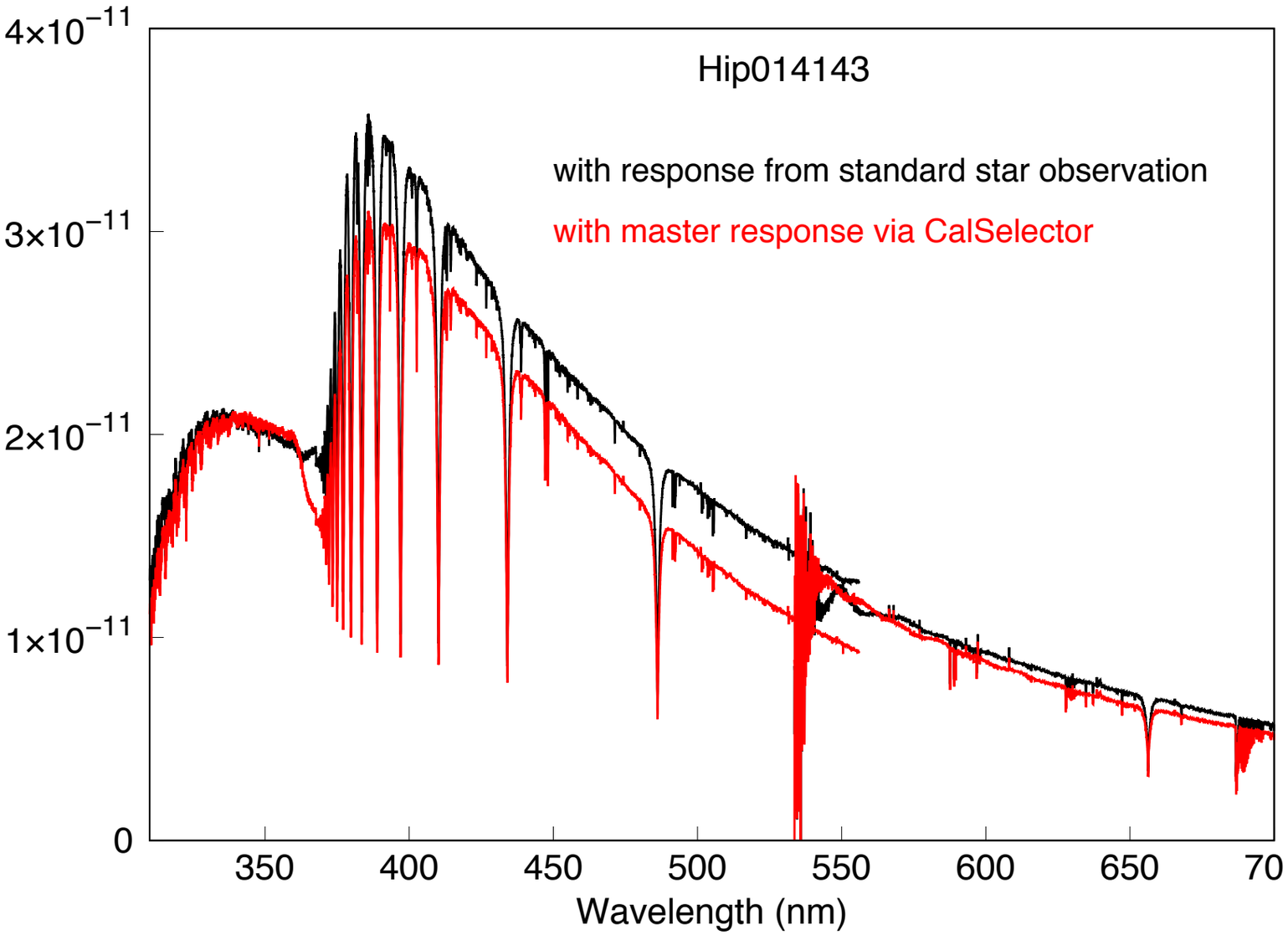
(7/8) Pipeline: sky subtraction

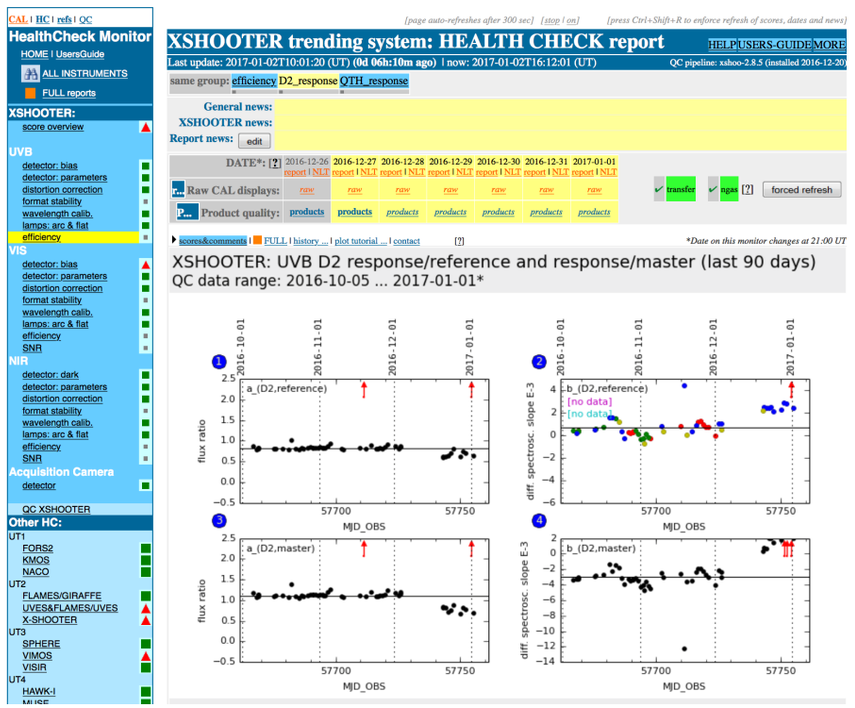
- optimal extraction needed (SDP project… since 5 years)
- solution to come in 2017 from **CRIRES+ consortium**?



(8/8) Master calibrations: response

- artefact at the Balmer jump, different flux level
- due to two (variable) flat field lamps in the UVB
- **health check**
- **validity, no default usage of master calibrations?**





Conclusions

ESO's goal: provide the community with the best possible (raw/reduced) data

- **define:** better requirements and quality criteria and parameters from the start of operations, based on instrument specifics (and limitations regarding resources)

- **monitor:** the entire data flow and quality parameters to
    1. identify instrumental problems
    2. improve data (products) delivered to the community