Ground-based Instrument Control Software: SOXS and co.

Davide Ricci INAF-OAPD

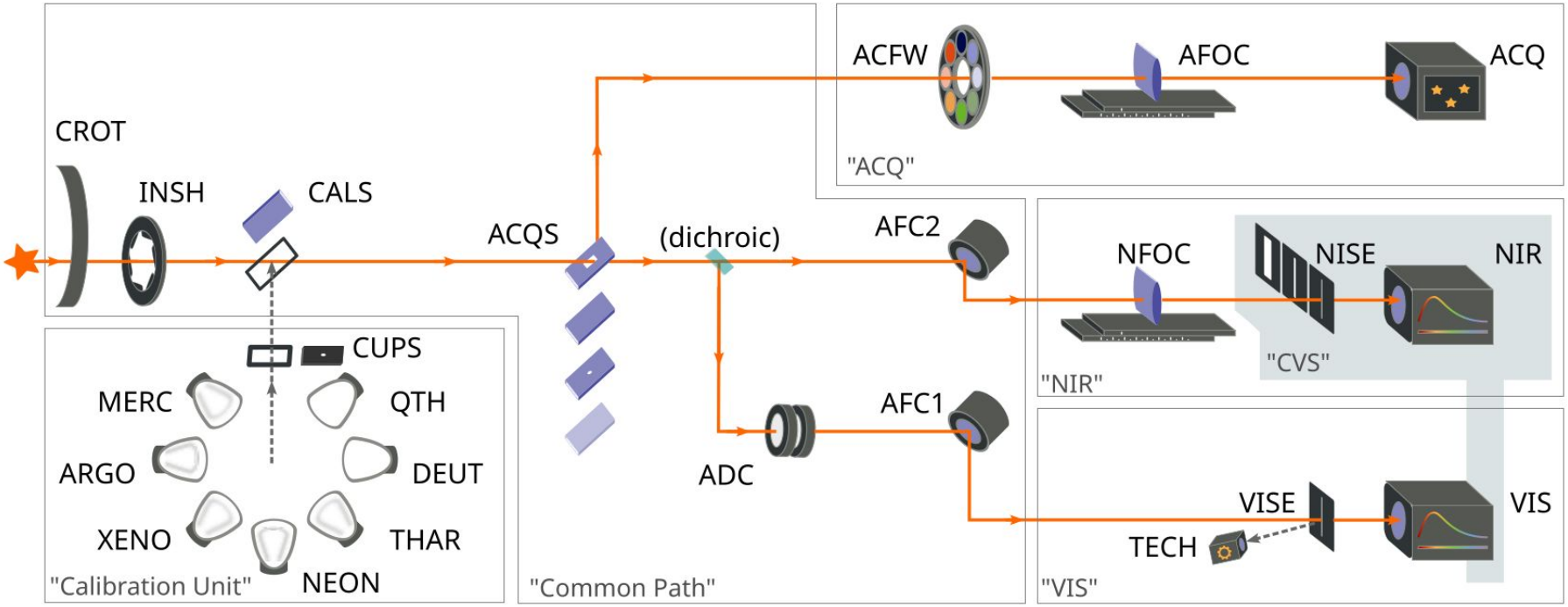
USC-C General Assembly

Trieste 9-13/03/2026

The OAPD Instrument Control Software team:
A. Baruffolo, B. Salasnich, D. Ricci, E. Costa, F. Laudisio, S. Lampitelli, A. Lorenzetto, C. Di Prospero, D. Diretto

foto: S. Savarese

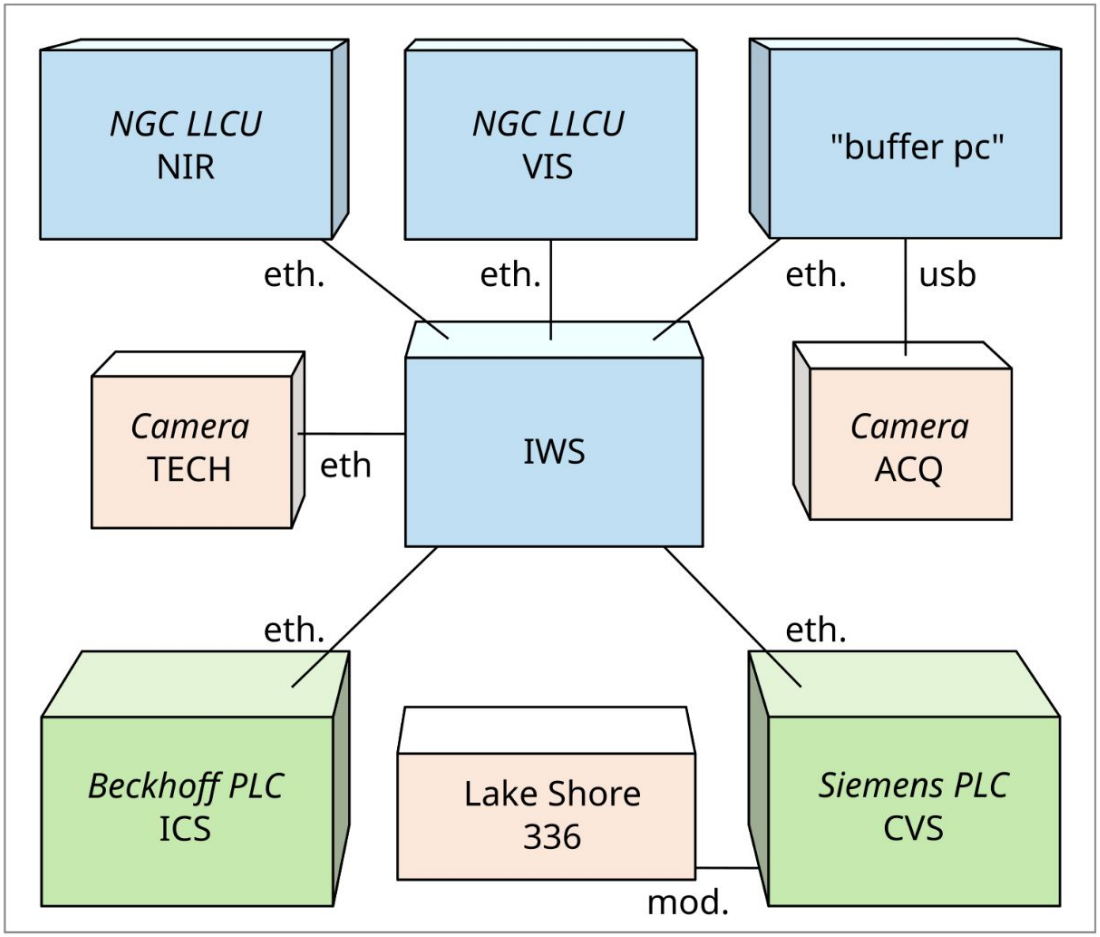
SOXS schematic view

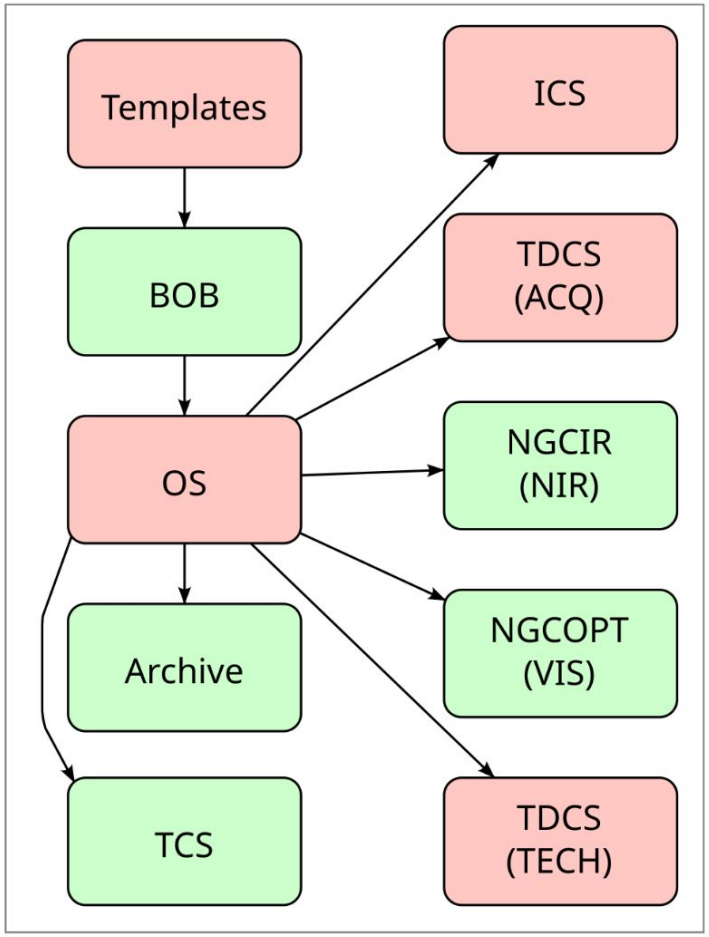


- Implemented using VLT2024
- Interfacing with NTT (VLT2010)
- Custom Python scheduler
- Custom Python pipeline `soxpipe` https://github.com/thespacedoctor/soxspipe

- Special devices:
  - NISE
  - AFC
  - CROT
- “Special detector”:
  - Acquisition Camera

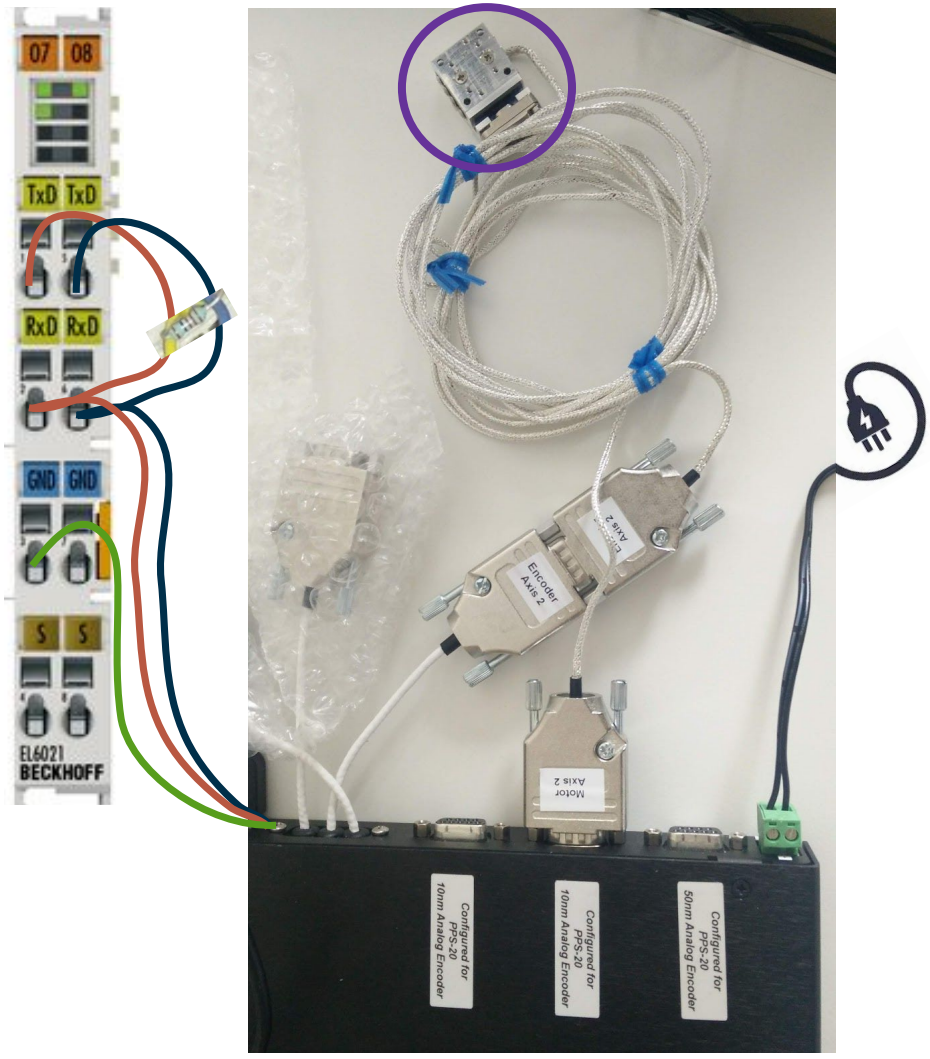
Network architecture and Software architecture



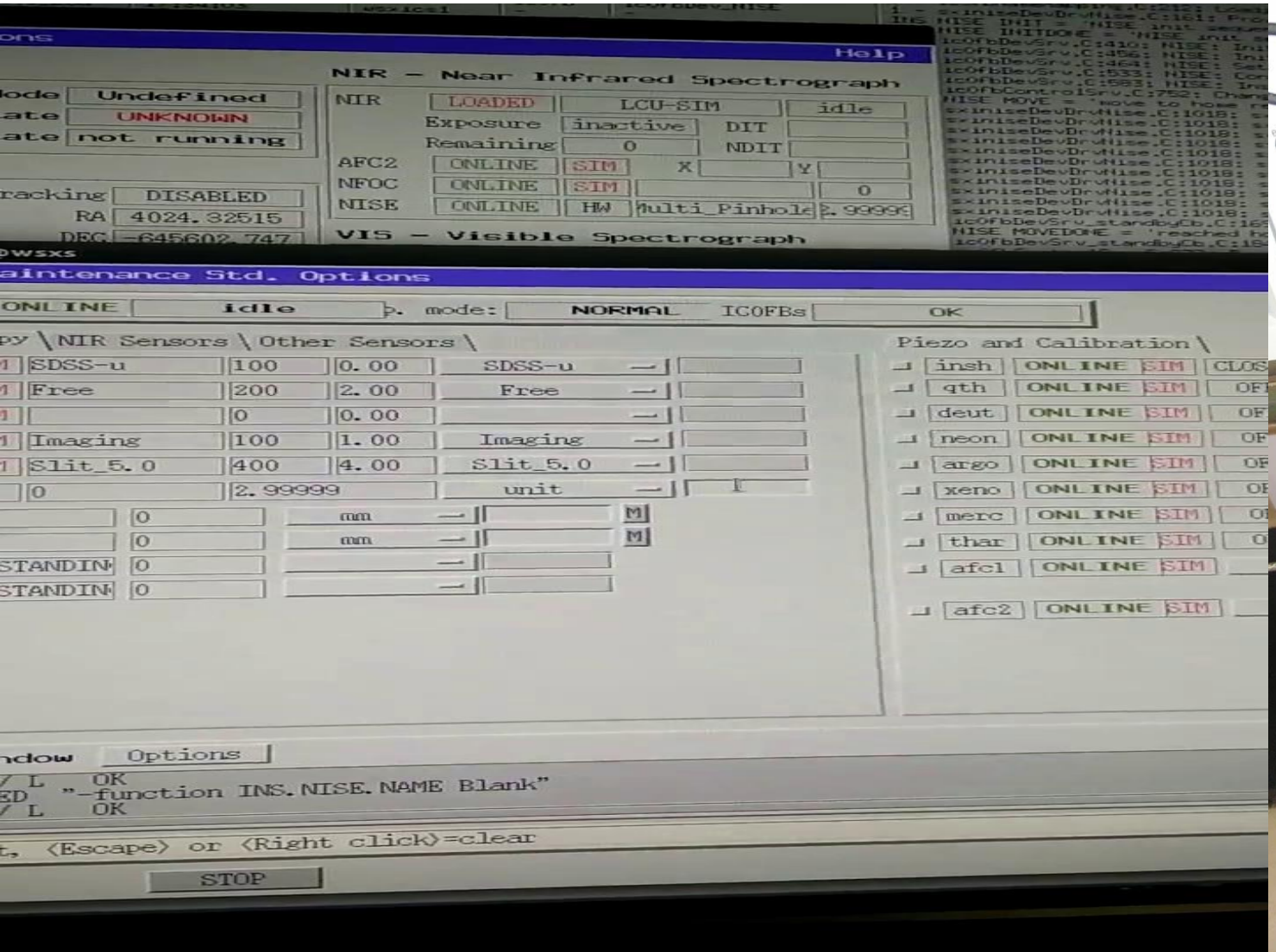


NISE: Near Infrared Slit Exchanger

- PPS-20 piezo device
- **Initially** Micronix controller MMC-103
  - PLC module EL6023 (Serial interface RS485)
- **Then** Micronix controller MMC-110
  - PLC module **EL6001** (Serial interface **RS232**)
- Special Device sxinise INS module developed and tested.
- Function Block in “NISE TwinCAT Solution”



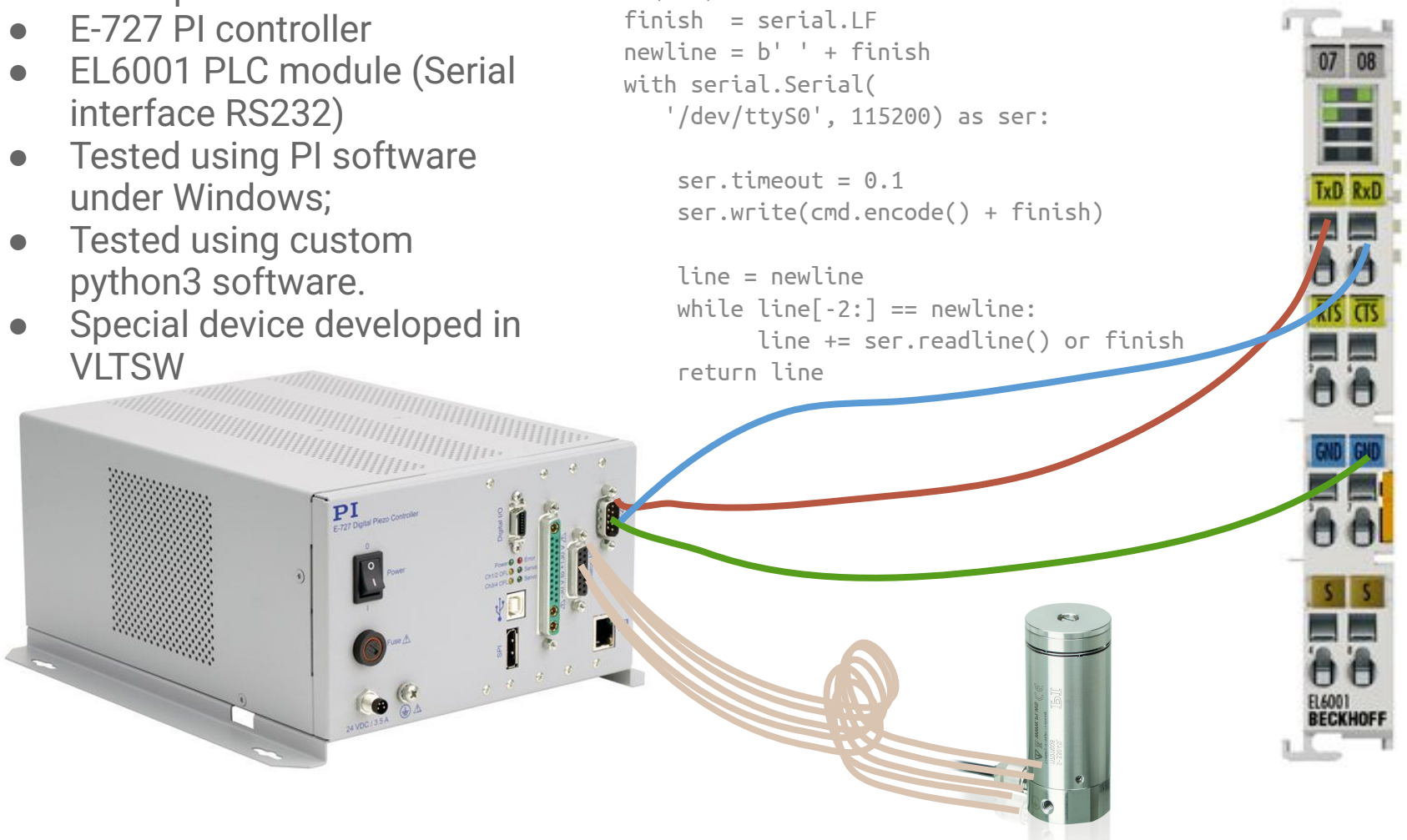
controller →[RS232] → PLC → [opcua]→IWS



AFC: Active Flexure Compensator

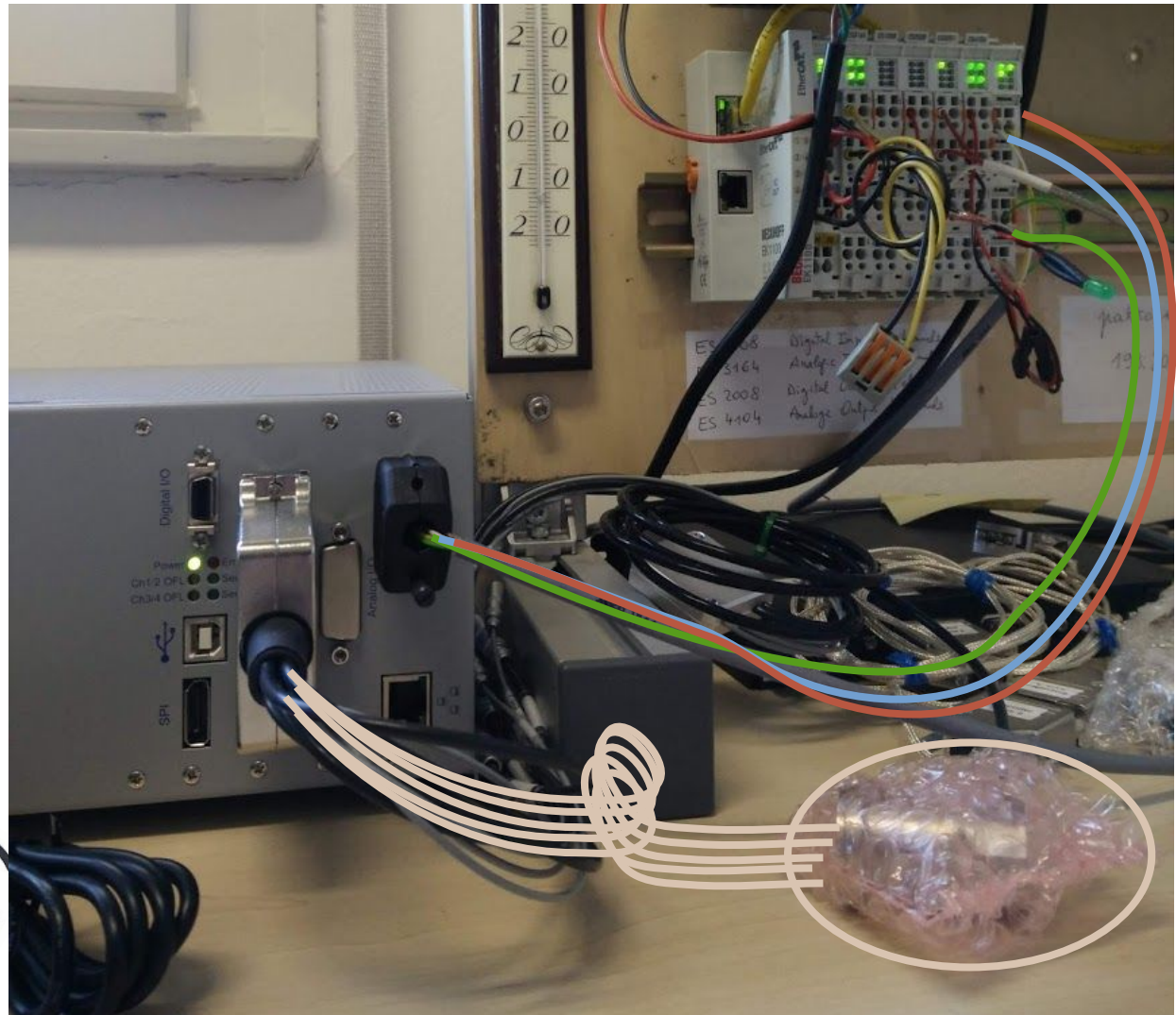
- S-330 piezo device
- E-727 PI controller
- EL6001 PLC module (Serial interface RS232)
- Tested using PI software under Windows;
- Tested using custom python3 software.
- Special device developed in VLTSW

```
import serial
def send(cmd):
      finish  = serial.LF
      newline = b' ' + finish
      with serial.Serial(
         '/dev/ttyS0', 115200) as ser:

          ser.timeout = 0.1
          ser.write(cmd.encode() + finish)

          line = newline
          while line[-2:] == newline:
                line += ser.readline() or finish
          return line
```



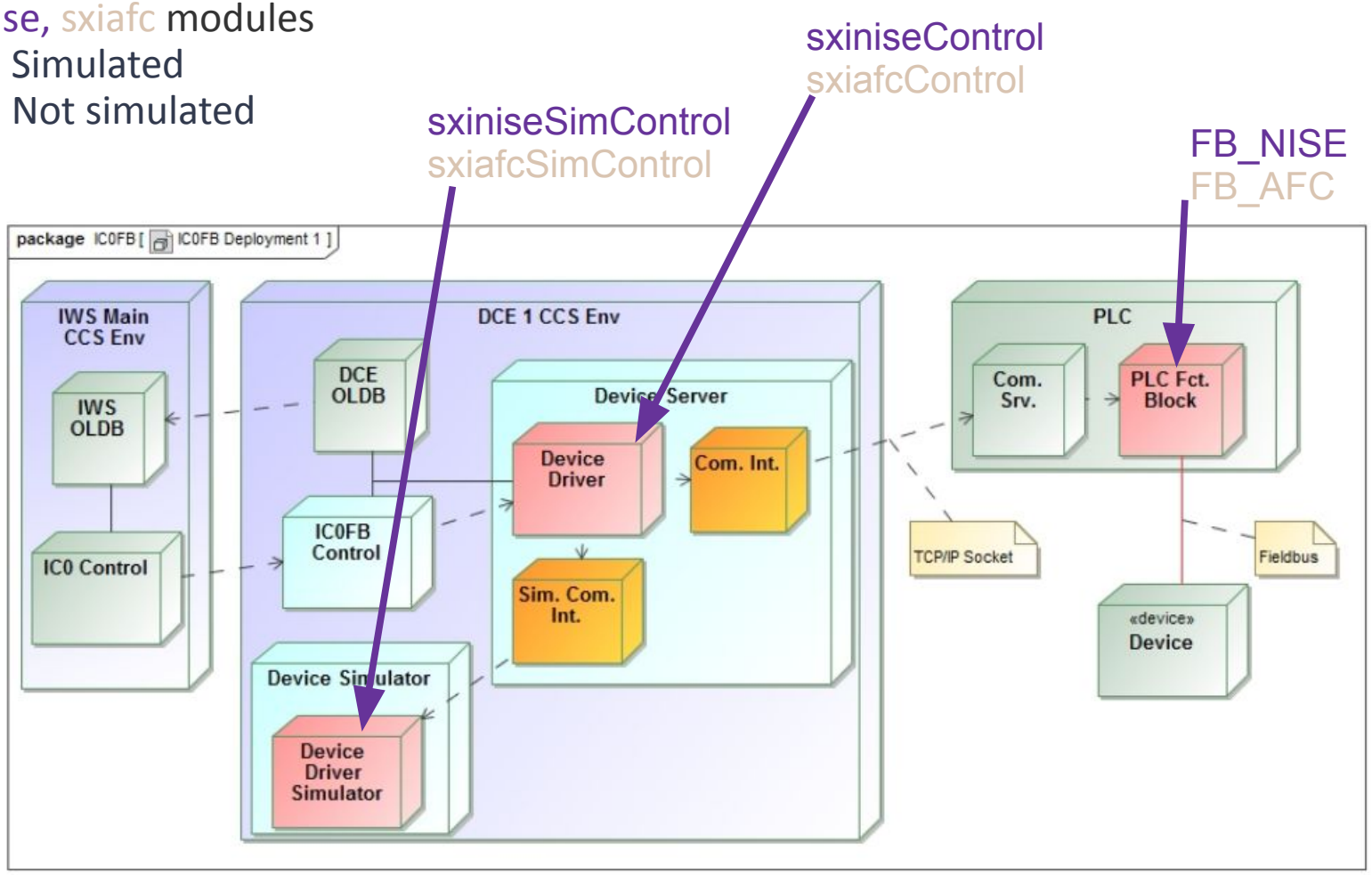
AFC: Active Flexure Compensator

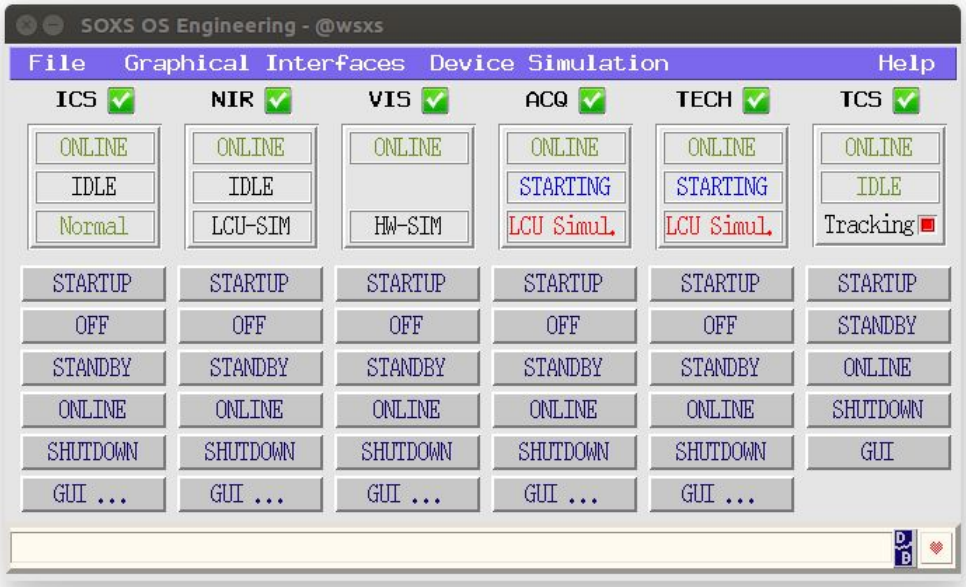
- As for NISE, tested in PLC test bench
- Function Block FB_AFC developed at PLC level (TwinCAT)
- Special Device sxiafc INS developed at IWS level.
- AUTO mode based on Lookup table

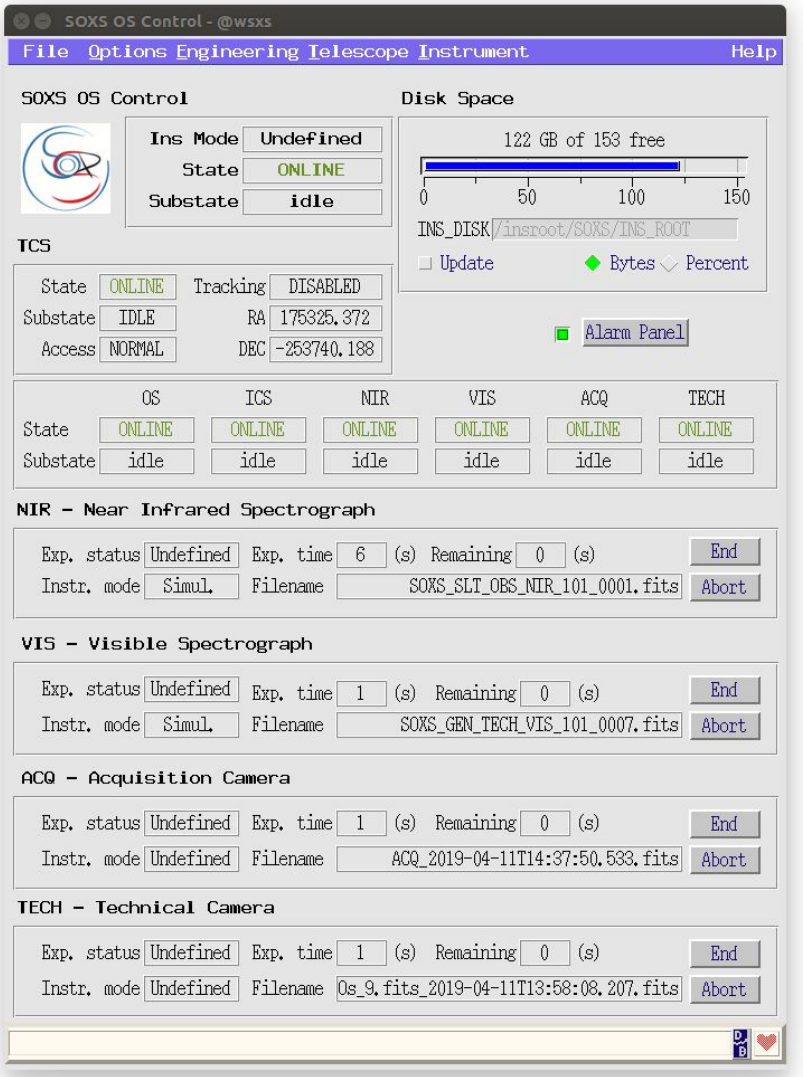


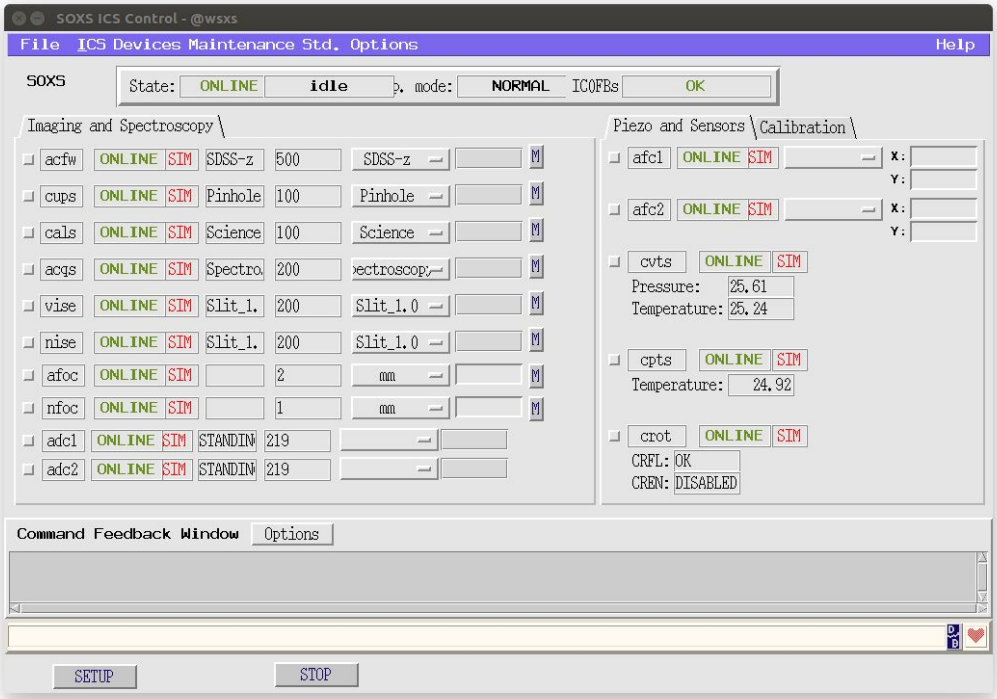
Special devices deployment

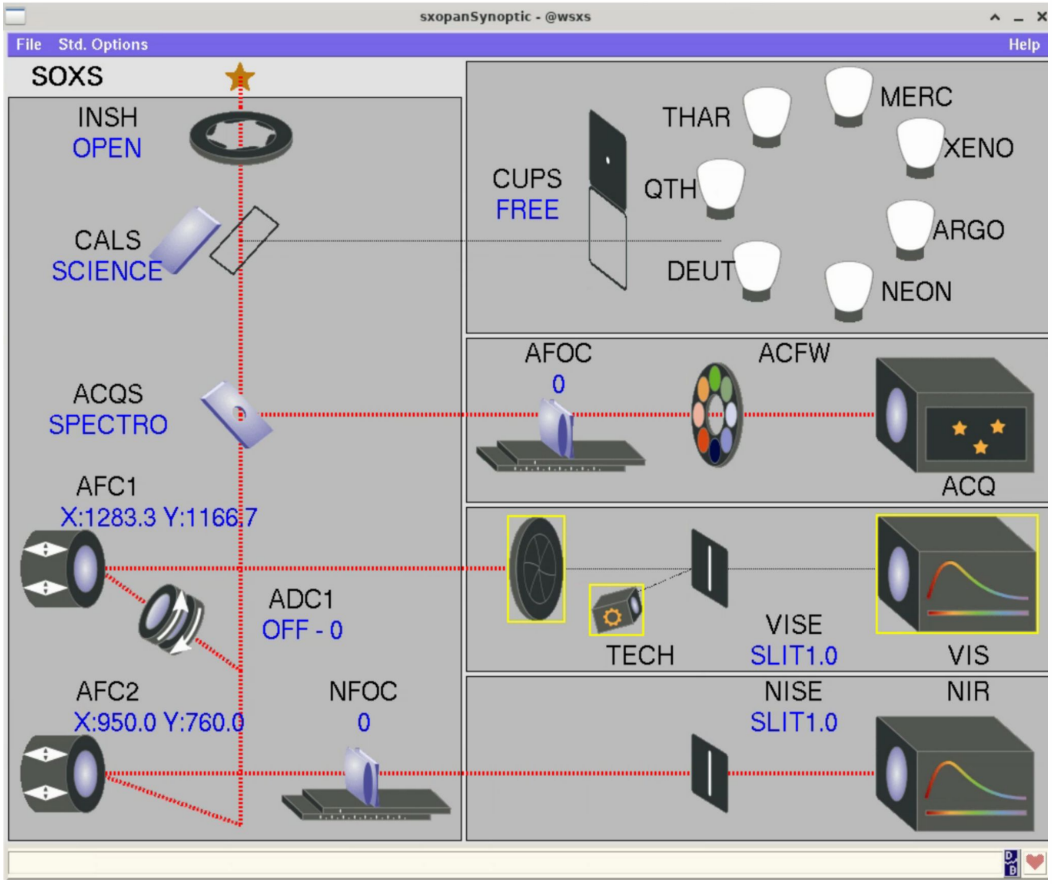
- sxinise, sxiafc modules
  - Simulated
  - Not simulated

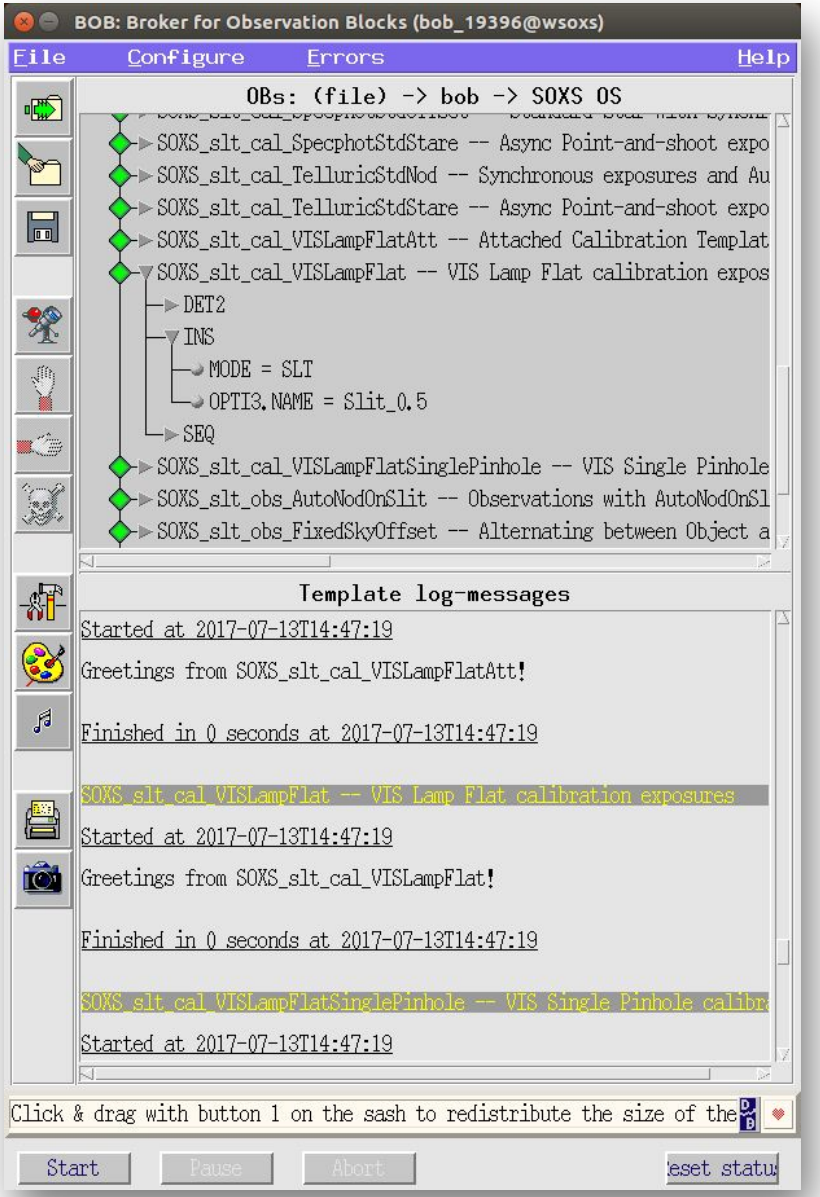



SOXS OS Engineering - @wsxs
File Graphical Interfaces Device Simulation Help
ICS NIR VIS ACQ TECH TCS
ONLINE ONLINE ONLINE ONLINE ONLINE ONLINE
IDLE IDLE STARTING STARTING IDLE
Normal LCU-SIM HW-SIM LCU Simul. LCU Simul. Tracking
STARTUP OFF STANDBY ONLINE SHUTDOWN GUI ...


SOXS OS Control - @wsxs
File Options Engineering Telescope Instrument Help
SOXS OS Control
Ins Mode Undefined
State ONLINE
Substate idle
Disk Space
122 GB of 153 free
0 50 100 150
INS_DISK /insroot/SOXS/INS_ROOT
Update Bytes Percent
TCS
State ONLINE Tracking DISABLED
Substate IDLE RA 175325.372
Access NORMAL DEC -253740.188
Alarm Panel
OS ICS NIR VIS ACQ TECH
State ONLINE ONLINE 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 SOXS_SLT_OBS_NIR_101_0001.fits Abort
VIS - Visible Spectrograph
Exp. status Undefined Exp. time 1 (s) Remaining 0 (s) End
Instr. mode Simul. Filename SOXS_GEN_TECH_VIS_101_0007.fits Abort
ACQ - Acquisition Camera
Exp. status Undefined Exp. time 1 (s) Remaining 0 (s) End
Instr. mode Undefined Filename ACQ_2019-04-11T14:37:50.533.fits Abort
TECH - Technical Camera
Exp. status Undefined Exp. time 1 (s) Remaining 0 (s) End
Instr. mode Undefined Filename Os_9.fits_2019-04-11T13:58:08.207.fits Abort

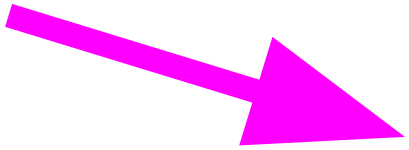

SOXS ICS Control - @wsxs
File ICS Devices Maintenance Std. Options Help
SOXS
State: ONLINE idle mode: NORMAL ICOFBs OK
Imaging and Spectroscopy
Piezo and Sensors Calibration
acfw cups cals acqs vise nise afoc nfoc adc1 adc2
afc1 afc2 cvts cpts crot
Pressure: 25.61
Temperature: 25.24
Temperature: 24.92
CRFL: OK
CREN: DISABLED
Command Feedback Window Options
SETUP STOP


sxopanSynoptic - @wsxs
File
Std. Options
Help
SOXS
INSH
OPEN
CALS
SCIENCE
ACQS
SPECTRO
AFC1
X:1283.3 Y:1166.7
ADC1
OFF - 0
AFC2
X:950.0 Y:760.0
NFOC
0
CUPS
FREE
THAR
MERC
XENO
QTH
ARGO
DEUT
NEON
AFOC
0
ACFW
ACQ
TECH
VISE
SLIT1.0
VIS
NISE
SLIT1.0
NIR


BOB: Broker for Observation Blocks (bob_19396@wsoxs)
File
Configure
Errors
Help
OBs: (file) -> bob -> SOXS OS
SOXS_slt_cal_SpecphotStdStare -- Async Point-and-shoot expo
SOXS_slt_cal_TelluricStdNod -- Synchronous exposures and Au
SOXS_slt_cal_TelluricStdStare -- Async Point-and-shoot expo
SOXS_slt_cal_VISLampFlatAtt -- Attached Calibration Templat
SOXS_slt_cal_VISLampFlat -- VIS Lamp Flat calibration expos
DET2
INS
MODE = SLT
OPTI3.NAME = Slit_0.5
SEQ
SOXS_slt_cal_VISLampFlatSinglePinhole -- VIS Single Pinhole
SOXS_slt_obs_AutoNodOnSlit -- Observations with AutoNodOnSl
SOXS_slt_obs_FixedSkyOffset -- Alternating between Object a
Template log-messages
Started at 2017-07-13T14:47:19
Greetings from SOXS_slt_cal_VISLampFlatAtt!
Finished in 0 seconds at 2017-07-13T14:47:19
SOXS_slt_cal_VISLampFlat -- VIS Lamp Flat calibration exposures
Started at 2017-07-13T14:47:19
Greetings from SOXS_slt_cal_VISLampFlat!
Finished in 0 seconds at 2017-07-13T14:47:19
SOXS_slt_cal_VISLampFlatSinglePinhole -- VIS Single Pinhole calibr
Started at 2017-07-13T14:47:19
Click & drag with button 1 on the sash to redistribute the size of the
Start
Pause
Abort
eset statu

SOXS INS Publications

- 2024SPIE13101E..2GR **The SOXS instrument control software approaching the PAE**
- 2020SPIE11452E..2QR **Development status of the SOXS instrument control software**
- 2018SPIE10707E..1GR **Architecture of the SOXS instrument control software**
- (In total, ~50 SOXS publications)
- **JATIS** referred paper **submitted!**



The SOXS spectrograph Instrument Control Software

Davide Ricci[*,a], Bernardo Salasnich[a], Andrea Baruffolo[a], Jani Achrén[l], Matteo Aliverti[b], José A. Araiza-Durán[v], Iair Arcavi[n], Laura Asquini[b], Federico Battaini[a], Sagi Ben-Ami[g], Alex Bichkovsky[g], Anna Brucalassi[v], Rachel Bruch[g], Lorenzo Cabona[b], Sergio Campana[b], Giulio Capasso[c], Enrico Cappellaro[a], Riccardo Claudi[a], Mirko Colapietro[c], Rosario Cosentino[e], Francesco D'Alessio[f], Paolo D'Avanzo[b], Sergio D'Orsi[c], Massimo Della Valle[c], Rosario Di Benedetto[k], Simone Di Filippo[a], Avishay Gal-Yam[g], Matteo Genoni[b], Marcos Hernandez Díaz[e], Ofir Hershko[g], Jari Kotilainen[j,q], Hanindyo Kuncarayakti[j,q], Marco Landoni[b], Gianluca Li Causi[r], Laurent Marty[c], Seppo Mattila[q], Matteo Munari[k], Luca Oggioni[b], Hector Pérez Ventura[e], Giorgio Pariani[b], Giuliano Pignata[m], Kalyan Radhakrishnan[a], Stephen Smartt[s], Michael Rappaport[s], Marco Riva[b], Adam Rubin[h], Salvatore Savarese[c], Pietro Schipani[c], Salvatore Scuderi[w,k], Maximilian Stritzinger[u], Fabrizio Vitali[f], David Young[s], Ricardo Zanmar Sanchez[k], Gerard Zins[h]

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OAPD projects

MORFEO ICSS **@ELT,** towards Final Design Review
Multiconjugate adaptive Optics Relay For ELT Observations

MORFEO RTC **@ELT,** passing Final Design Review

MAVIS @VLT, towards Final Design Review
MAVIS - MCAO-Assisted Visible Imager and Spectrograph

SOXS @NTT, towards Preliminary Acceptance in Chile
Son Of X-Shooter

ERIS @VLT, currently in operation!
Enhanced Resolution Imager (SPIFFIER) and Spectrograph (NIX), with AO.

SHARK-NIR @LBT, currently in early science phase!
Extreme-AO for High Contrast Imaging in the NIR

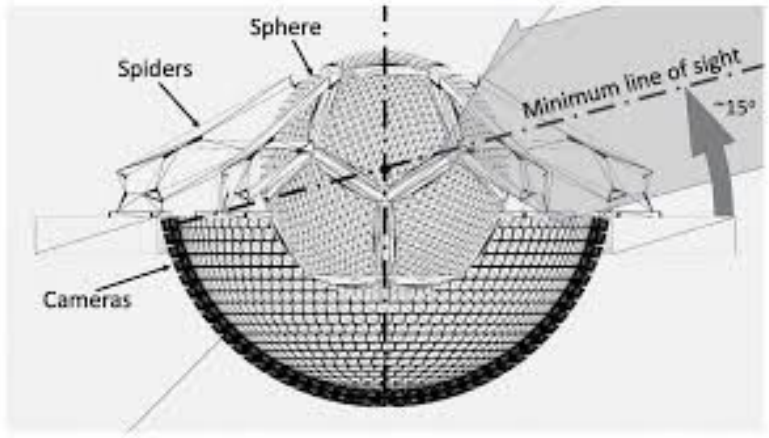
not dependent on ESO frameworks

OAPD new projects… and future projects?

Ekarus - Adaptive optics at Asiago Ekar site using Papyrus (ex OHP)
https://ui.adsabs.harvard.edu/abs/2023aoel.conf E..13F/abstract

LBCMOS - Upgrading LBC @ LBT with a CMOS
https://spie.org/AS/conferencedetails/astronomy-ground-based-instrumentation#3100633

MezzoCielo - A whole sky 1m telescope close to the Einstein Telescope site
https://ui.adsabs.harvard.edu/#abs/2024SPIE13094E..33R/abstract



HRMOS - High-Res Multi-Object Spectrograph, will be proposed for VLT2030 roadmap
https://ui.adsabs.harvard.edu/abs/2023arXiv231208270M/abstract

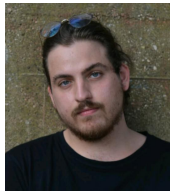
SOXS Control Software team @ OAPD

SPHERE's first light team:
Andrea Baruffolo,
Bernardo Salasnich


Joined for SOXS, SHARK (LBT), MAVIS:
Davide Ricci,
Elia Costa


Joined for MORFEO ICSS, SHARK (LBT):
Fulvio Laudisio,
Alessandro Lorenzetto


Joined for MORFEO ICSS and RTC:
Salvatore Lampitelli,
Chiara Di Prospero,
Daphne Diretto


Software Quality Assurance:
Andrea Balestra,
Rosanna Sordo


↑ also involved in **Model-Based System Eng.** (MORFEO, MAVIS, CUBES, ANDES+PLATO)

IT support:
Amedeo Petrella,
Danilo Selvestrel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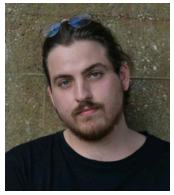


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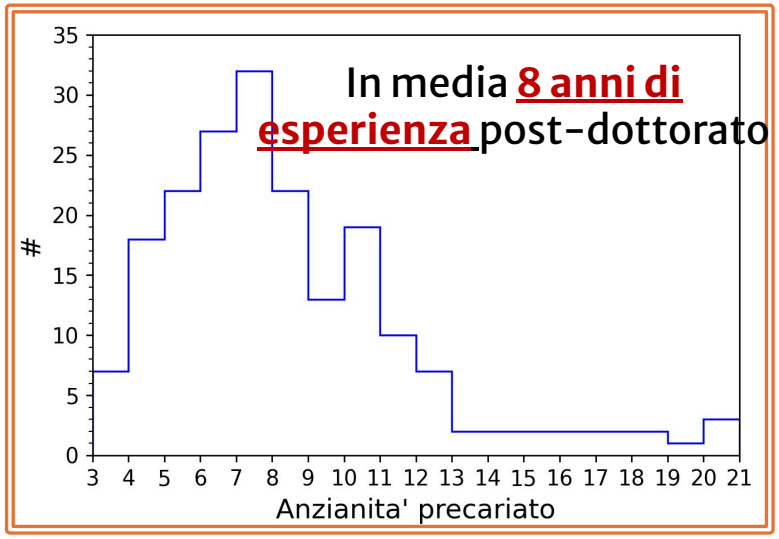
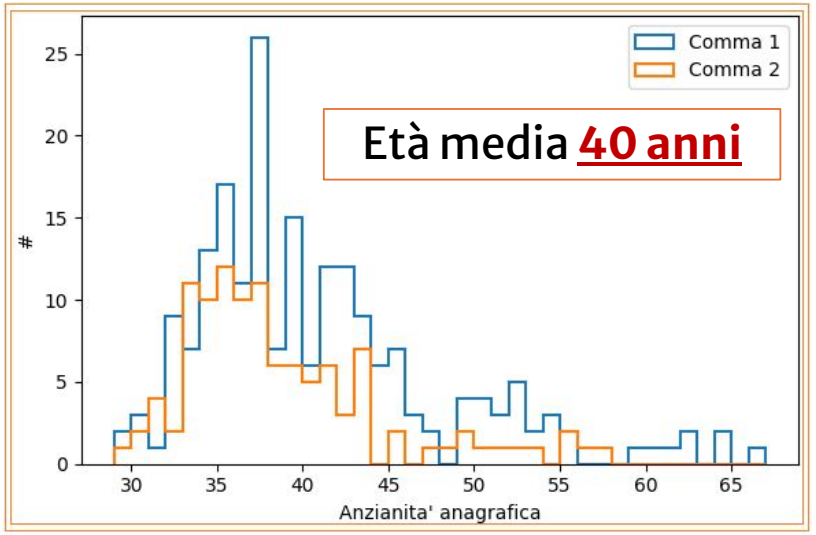
IT support:
Amedeo Petrella,
Danilo Selvestrel


La situazione del personale precario in INAF è INSOSTENIBILE!

1.200 Tempo Indeterminato Vs **650** precari: più di 1 precario ogni 2 persone di ruolo



Plot di un campione rappresentativo dei precari INAF al 31/12/2024



Dei 650, **287** possono essere stabilizzati:
173 tramite chiamata diretta (comma 1)
114 tramite concorsi riservati (comma 2)

Entro l'anno, l'attuale situazione determinerà l'esodo di > 100 lavoratori altamente qualificati e il MUR se ne lava le mani

È **URGENTE** che INAF **PROCEDA ORA** con le **STABILIZZAZIONI TRAMITE MADIA:** unica soluzione per questa emergenza

Molti colleghi (972) hanno già firmato, per sostenerci e aggiungere il nome alla lista del QR,
contattaci a retestabilizzandi1.inaf@gmail.com