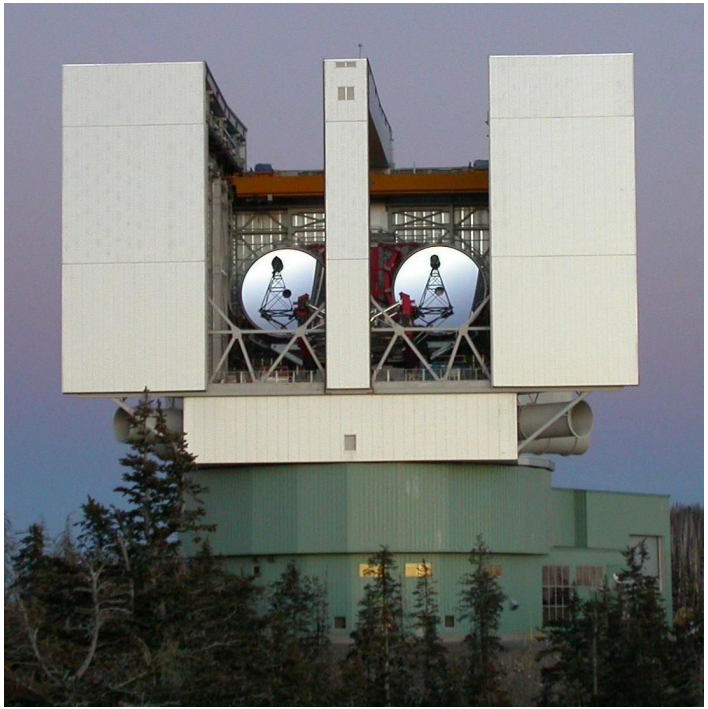
A common interface for small and giant telescopes

Davide Ricci, Lorenzo Cabona, Andrea Damonte
6° ChiantiTopics, 2024-02-28

“Small **telescopes** in the giant era”

- Astelco Alt-Az **80cm**, two Nasmyth foci: SBIG STX-16081 **CCD**, and ocular
- *“Commissioning and improvements of the instrumentation and launch of the scientific exploitation of OARPAF”*, ***2021JATIS...7b5003R***
  - https://doi.org/10.1117/1.JATIS.7.2.025003

- **2x 8.2m**, several focal station. **SHARK-NIR** on gregorian left
- *Improvements to SHINS, the SHARK-NIR instrument software, during the AIT phase,* ***2022SPIE12189E..20R***
  - https://doi.org/10.1117/12.2629469



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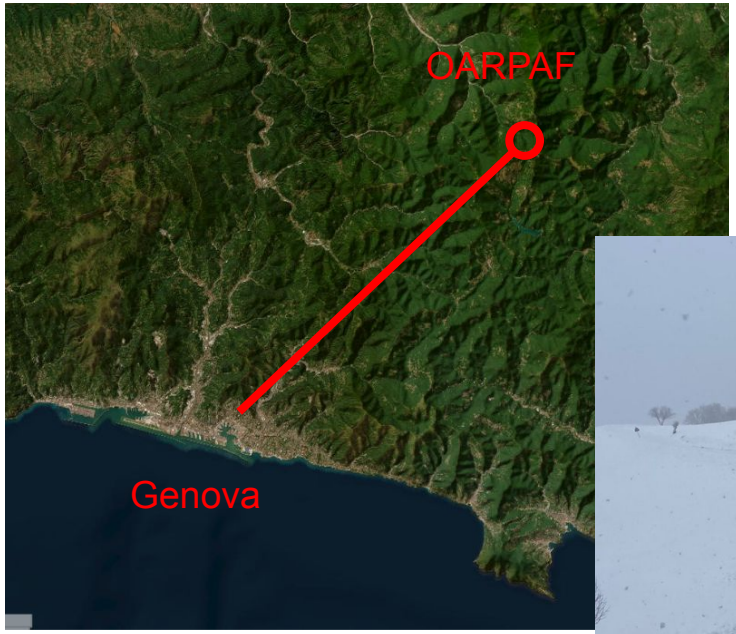

YESTERDAY

- **2x 8.2m**, several focal station. **SHARK-NIR** on gregorian left
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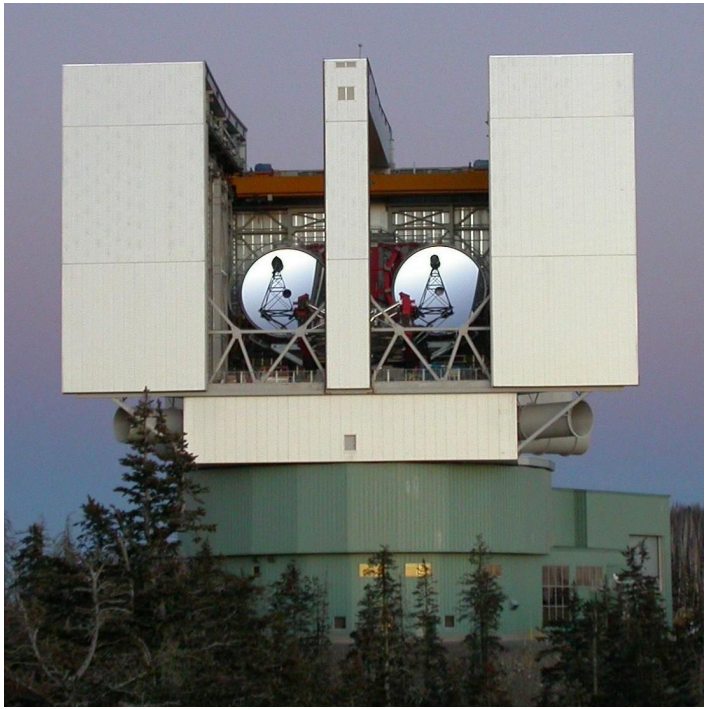
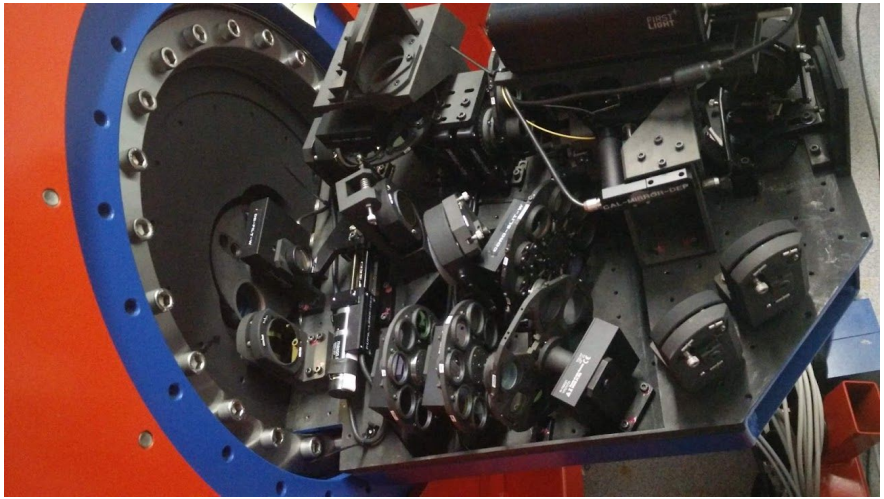


“Small **instruments** in the giant era”

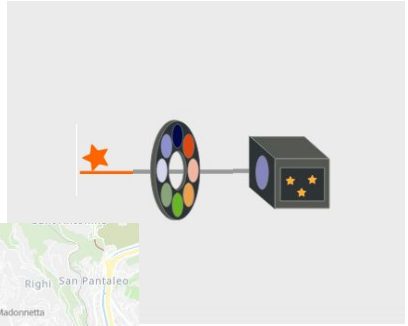
- **OARPAF observatory (Imaging and photometry)**
  - Astelco Telescope
  - Gambato + OmegaLab Dome and Lights
  - SBIG STX-16081 CCD camera with filters
  - (ip camera…)

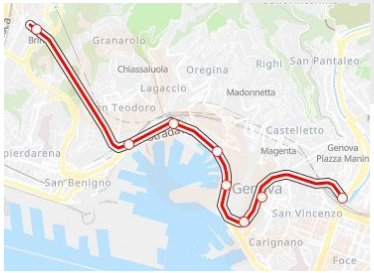
- **SHARK-NIR (coronagraphy, direct imaging, LSS spectroscopy)**
  - (interface with LBT telescope)
  - **5** Deployers + shutter
  - **7** Wheels
  - Atmospheric Dispersion Correctors
  - Derotator
  - **3** Calibration Lamps
  - NIR scientific camera
  - Real Time Computer:
    - Technical camera
    - Deformable Mirror



“Small **synoptic views** in the giant era”

- **OARPAF observatory (Imaging and photometry)**
  - Astelco Telescope
  - Gambato + OmegaLab Dome and Lights
  - SBIG STX-16081 CCD camera with filters
  - (ip camera…)





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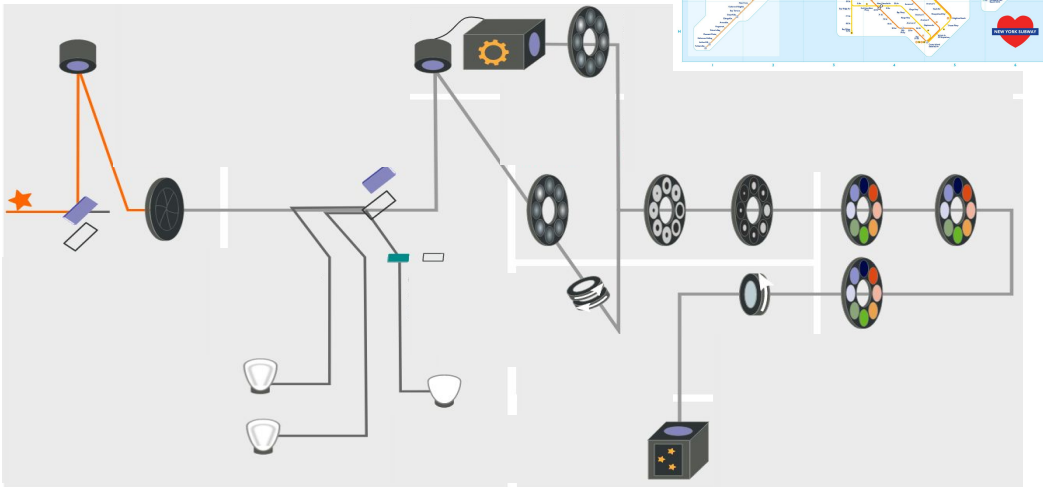
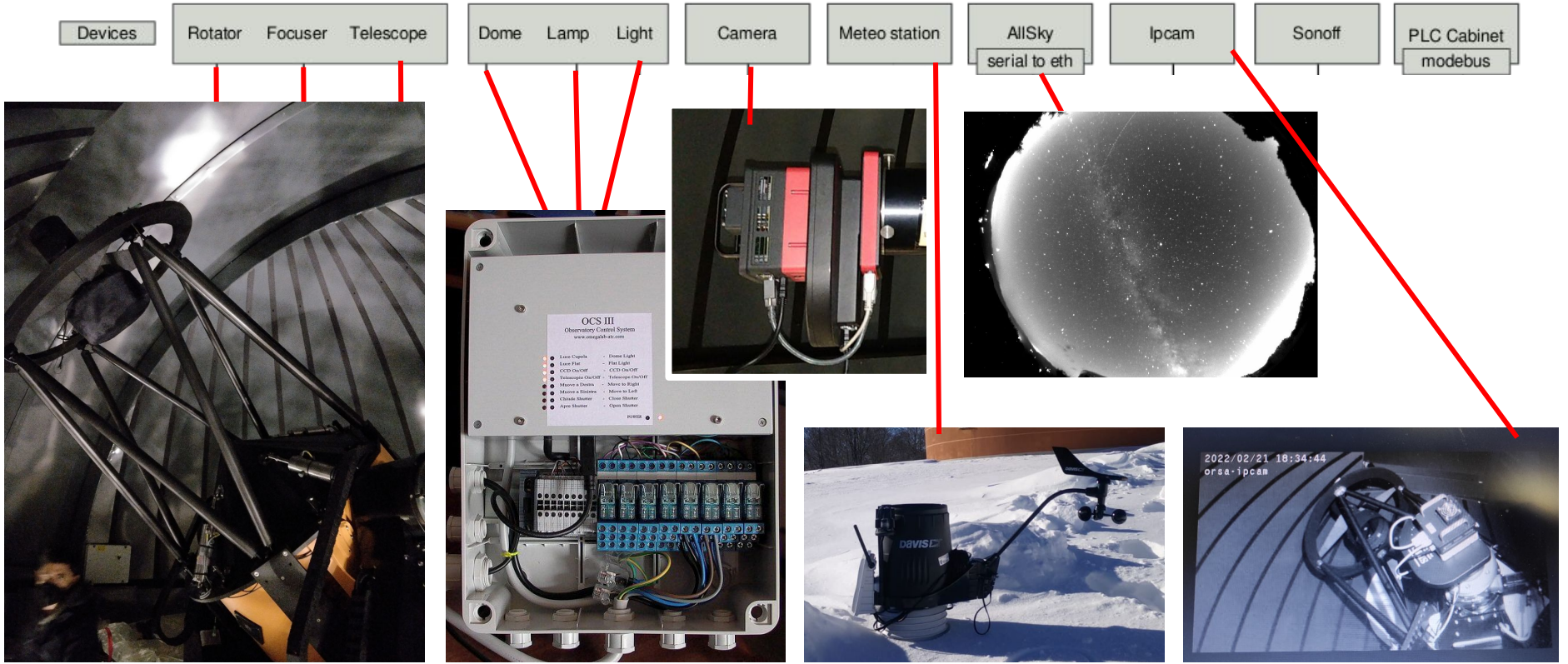
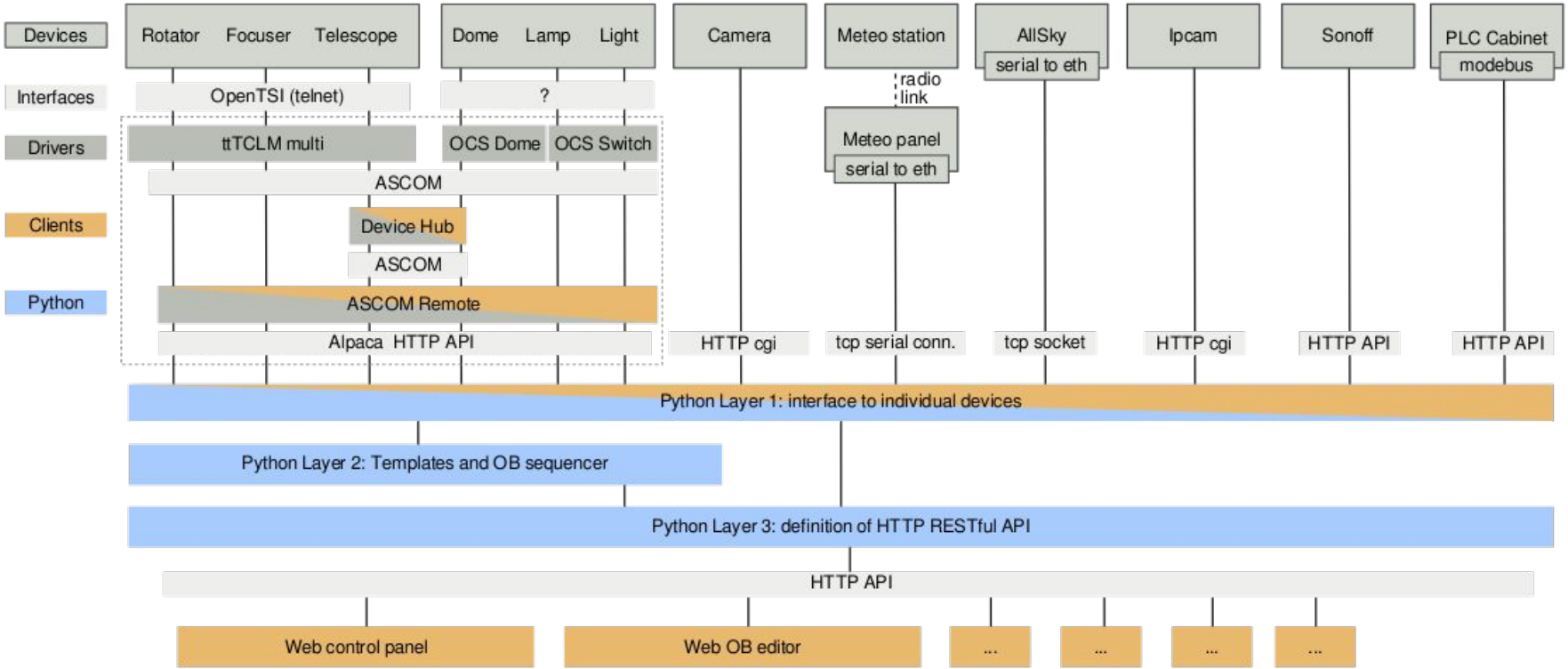


OARPAF control software stack

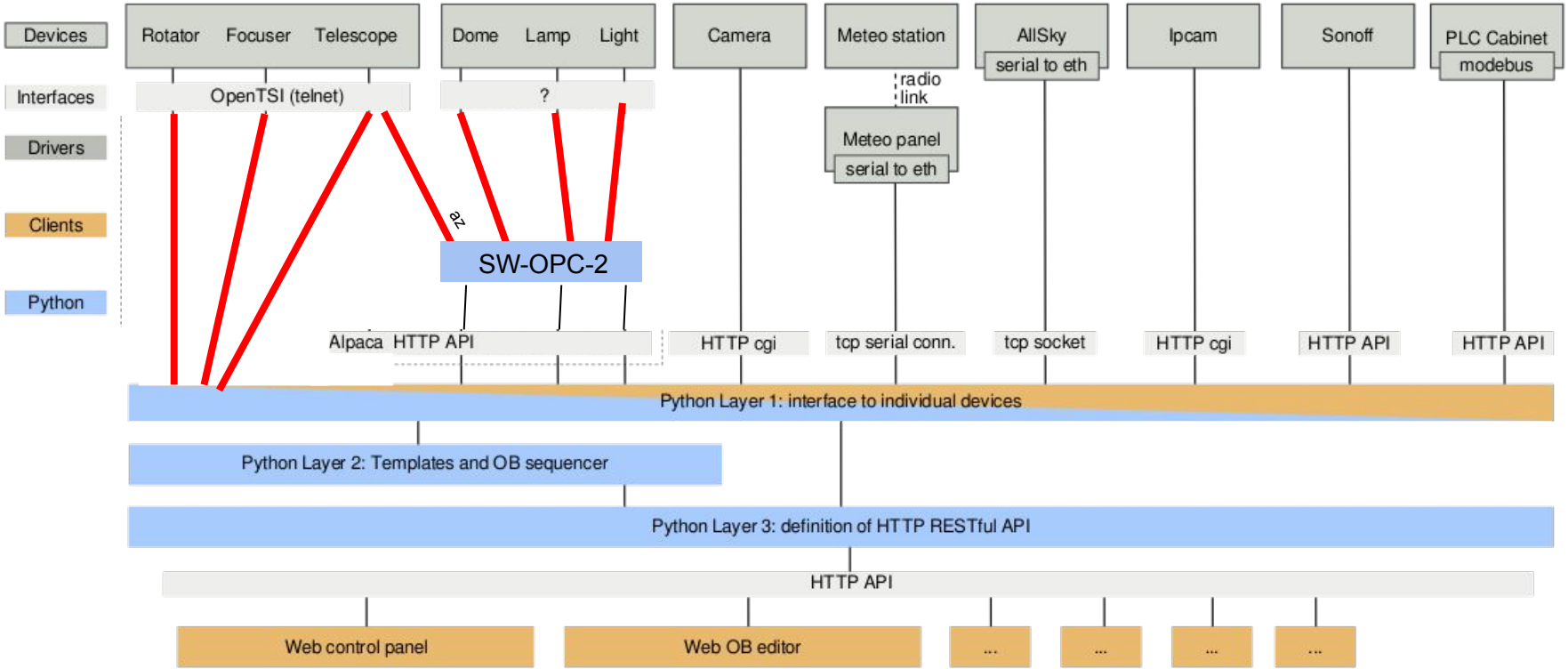
- *“Toward the remotization and robotization of the OARPAF Telescope”,*
  - Proc. SPIE 12186



2022: stack involving a windows pc (ascom remote = web server Alpaca)



2024: **improvements** thanks to the @Luca Fini "Alpaca" driver 4 Chianti



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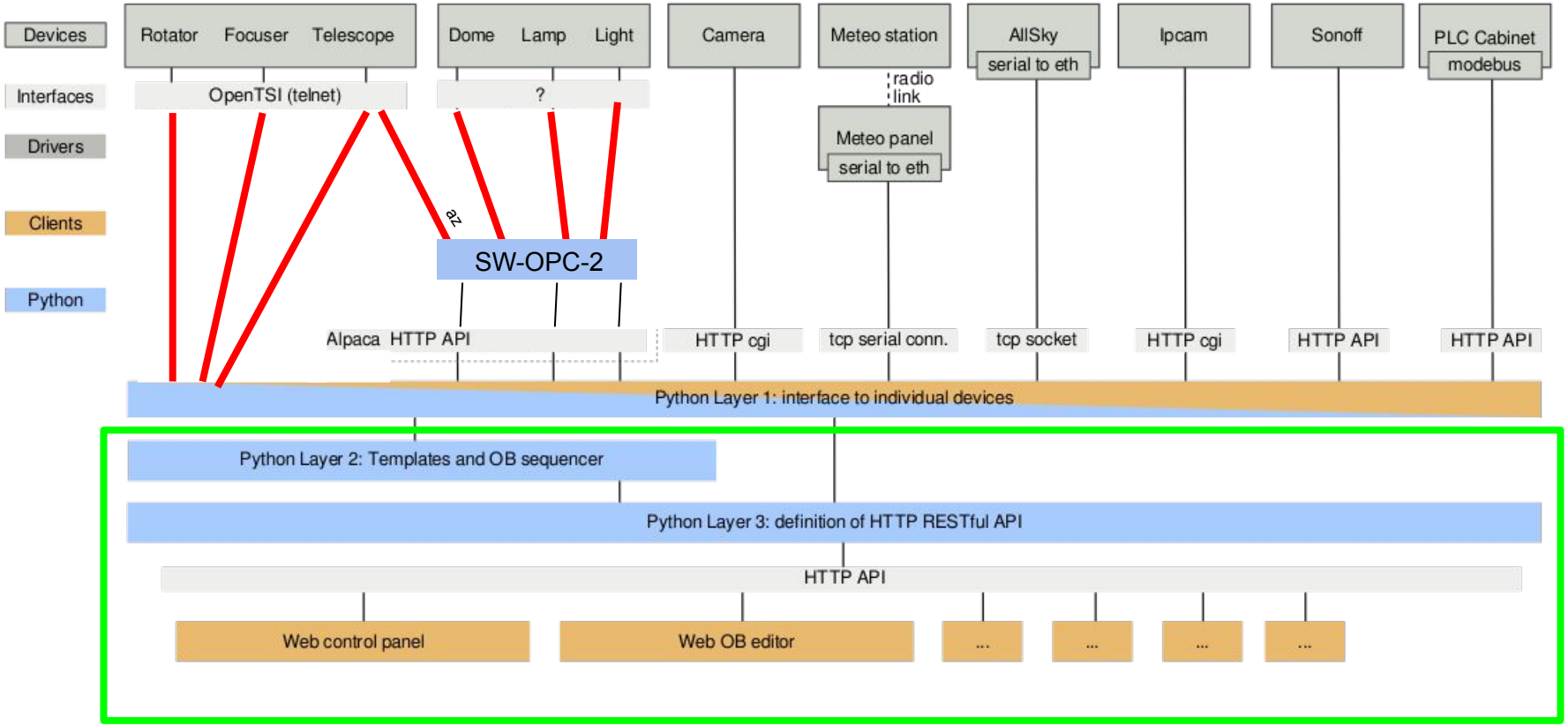
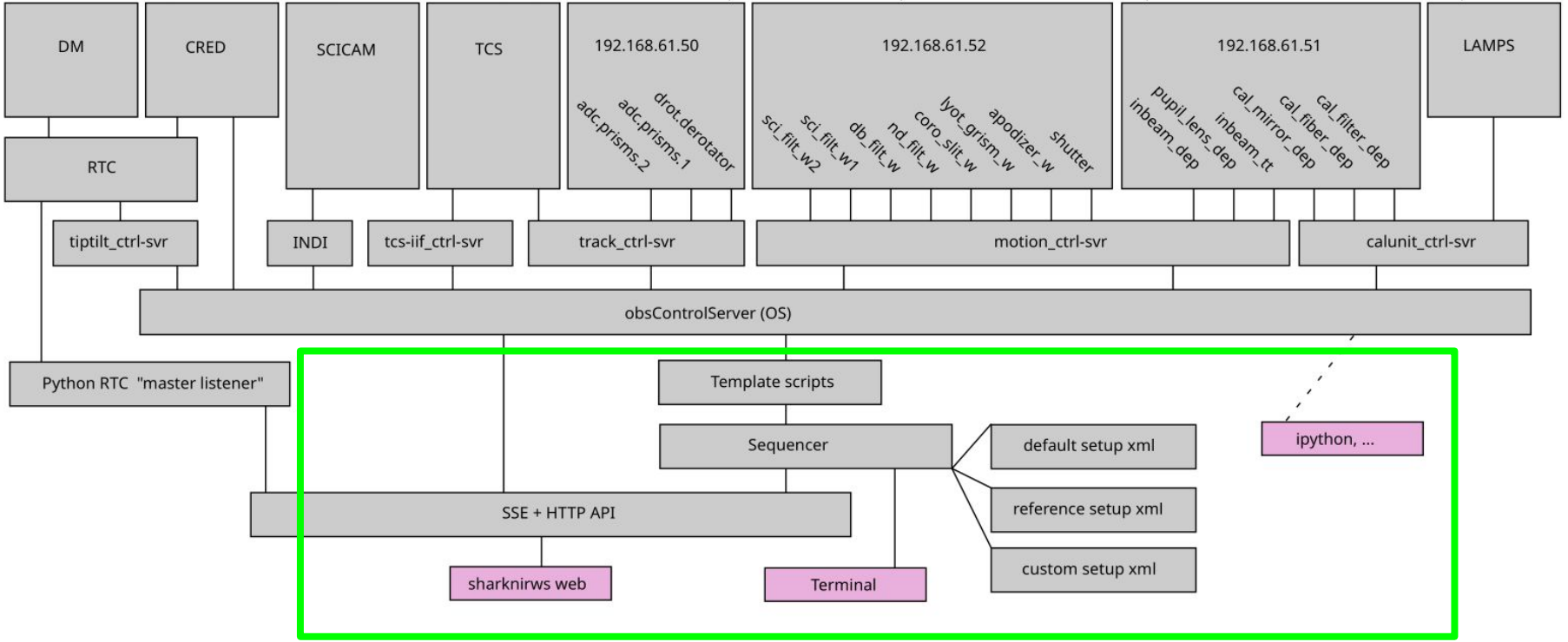


SHARK-NIR: low level OS over C++ TwiceAsNice libraries from MPIA



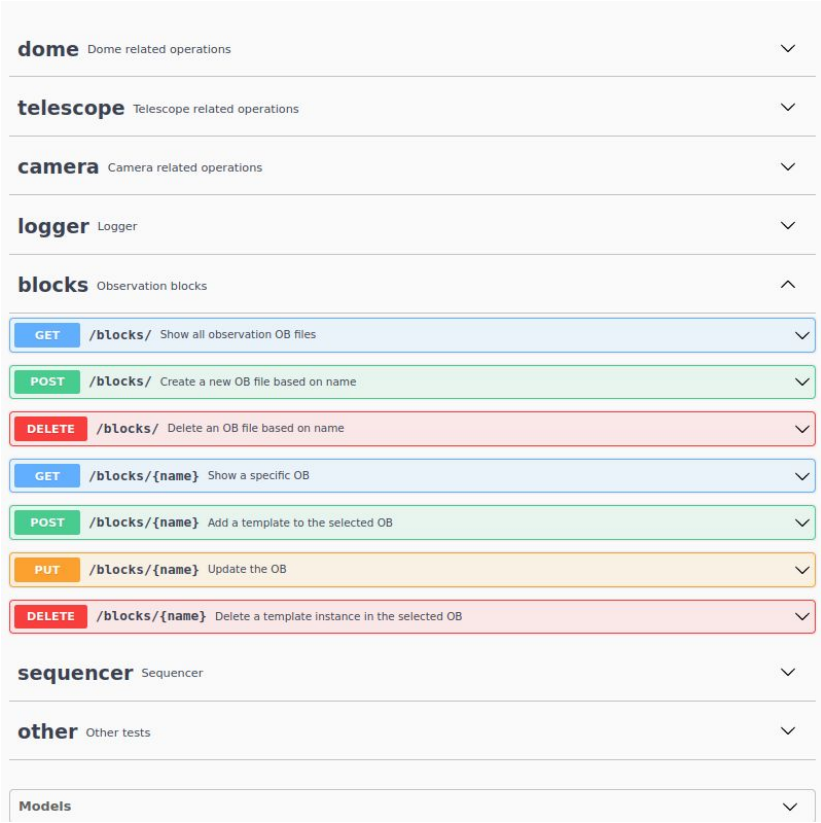
Small **REST APIs** in the modern web era

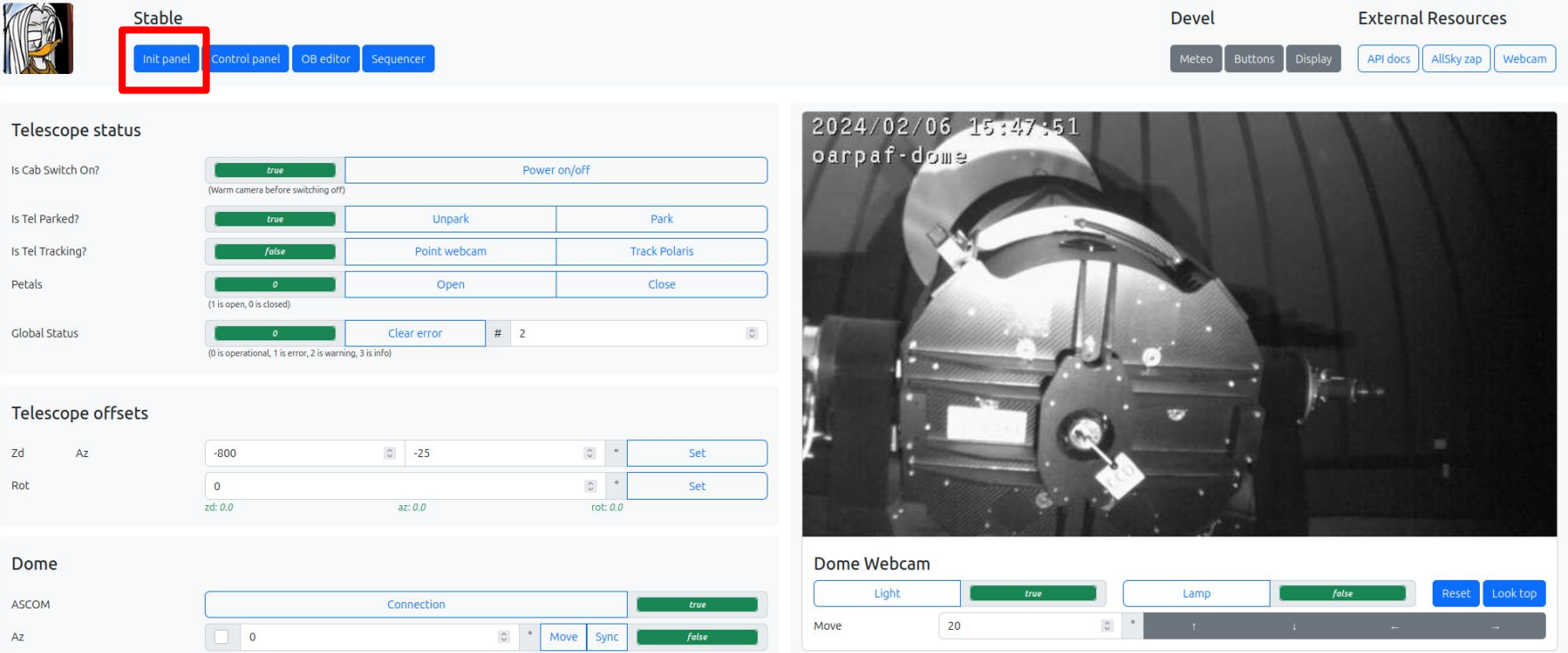
- A “standard” of this decade
  - `GET` a **resource** or the state of an action
  - `PUT` (update) it
  - `POST` (create) a new one or start an action
  - `DELETE` it or stop an action

- Valid for both:
  - Atomic operations on devices
  - Build and launch OBs

- flask-restx → Swagger auto-documented
- Anyone can build its own client
  - ...such as its own **web interface**

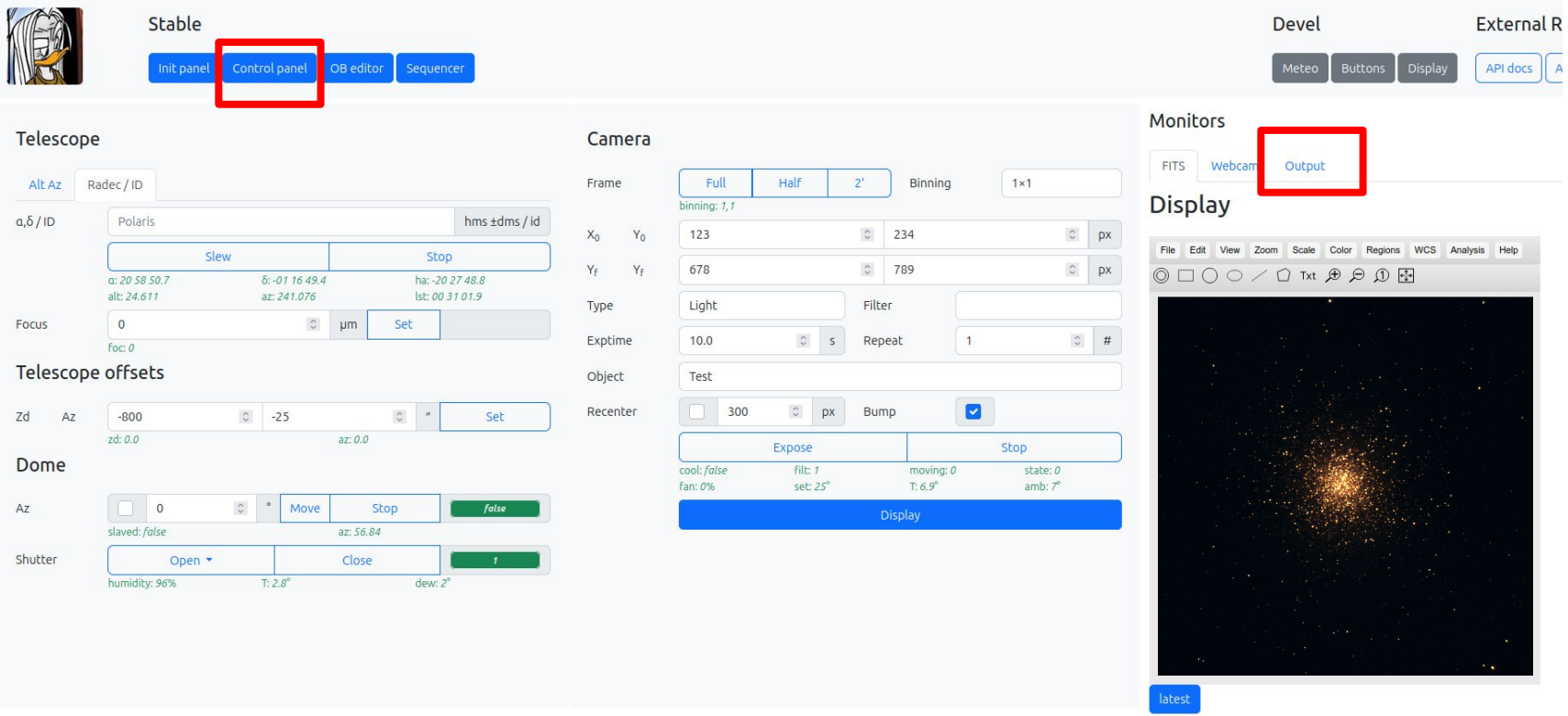
- Next big step: easy to implement automatic **TESTS**
  - `curl -X GET blabla > blabla.json`
  - `diff blabla.json blabla.ref.json`





- Server-side bulk GET to send a “**global status**” over **Server-Sent Events** (SSE) every 1.0s
- Client-side PUT/POST/DELETE to trigger APIs using buttons
- Better method?
  - websocket?
    TARANTA-SKA-style?
    - → Mini-grant
  - Let’s discuss!

@Matteo Canzari suggested graphQL?



- Displaying FITS files in a web page: always a pain. js9 is the “less painful”…
- **output** → focus or offset correction plot
- NO database for simplicity, but maybe in the future?

Small **OB editor** and **sequencer** in the ESO P2 and BOB era

Ob list

Load OB: m92 | or | Create new: insert name | Create

m92

1 acquisition

radec: [17.28, 43.13]

Delete Template instance

2 observation

objname: M92 test b
binning: 2
filter: V
exptime: 3
repeat: 3
frametype: Light
xystart: [500, 500]
xyend: [1250, 1250]

Delete Template instance

Ob controls

Add template: -- Select a template --

Update this OB! | Delete this OB!

- bias
- fillheader
- flat
- acquisition
- box
- observation
- testlamp
- focus
- lampsoff

Same for SHARK-NIR!

@Lina Tomasella
no DB/scheduler
up to now

Ob sequencer

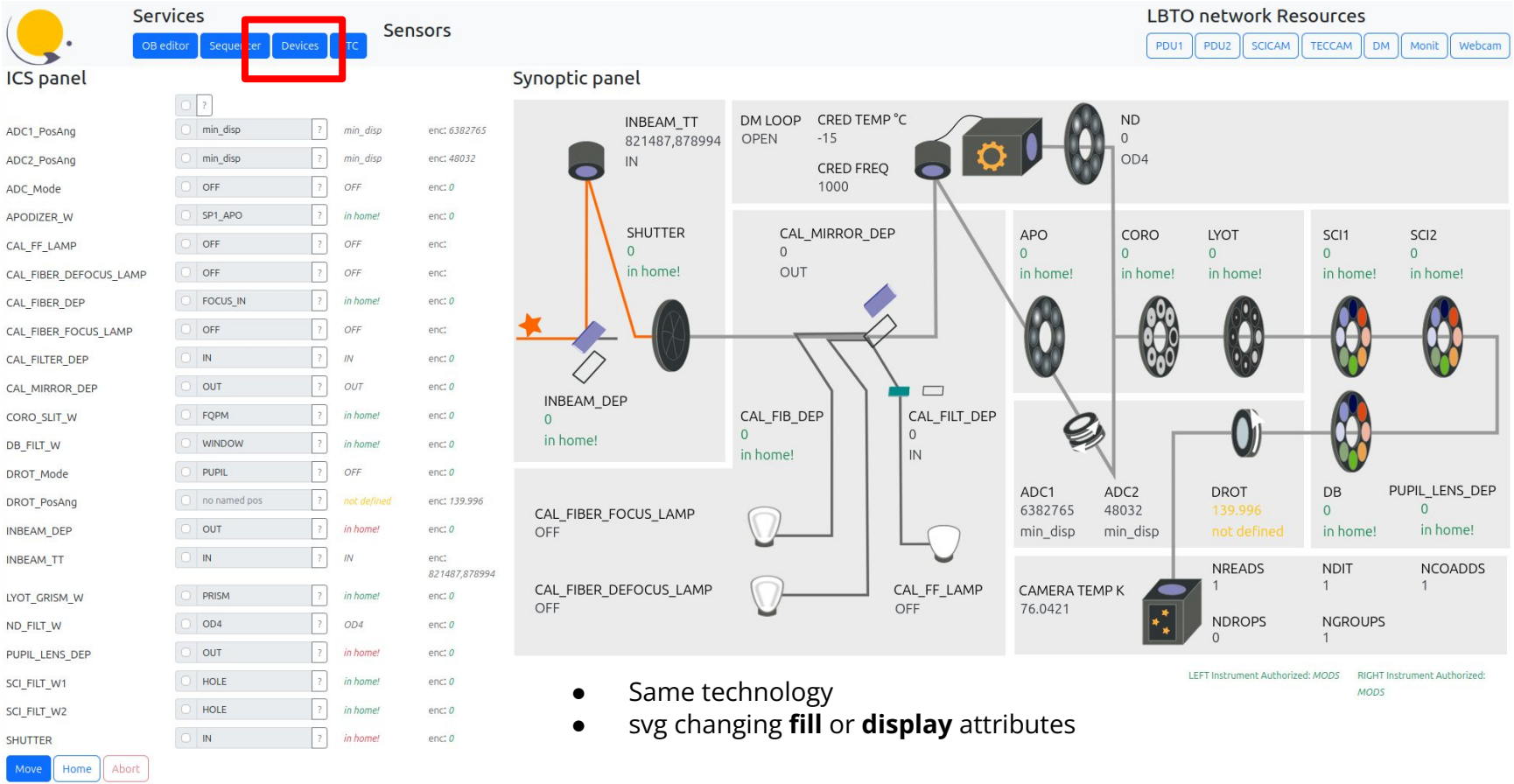
Load OB: -- Select a saved OB --

Start | Stop

Sequencer log

```
2022-06-20 11:00:08 DEBUG   | Total elapsed time: 0.21s (sequencer execute:66)
2022-06-20 11:10:51 INFO    | Loading the ob from file ob/make_bias.json (sequencer load_file:20)
2022-06-20 11:10:51 INFO    | There are 1 templates in the ob (sequencer execute:37)
2022-06-20 11:10:51 INFO    | ---------------------------------------- (sequencer execute:42)
2022-06-20 11:10:51 INFO    | Running template bias (basetemplate run:28)
2022-06-20 11:10:51 DEBUG   | Params: (basetemplate run:33)
2022-06-20 11:10:51 DEBUG   |    binning  1      (basetemplate run:35)
2022-06-20 11:10:51 DEBUG   |     repeat  3      (basetemplate run:35)
2022-06-20 11:10:51 INFO    | Running content bias (basetemplate run:37)
2022-06-20 11:10:51 INFO    | Running template observation (basetemplate run:28)
2022-06-20 11:10:51 DEBUG   | Params: (basetemplate run:33)
2022-06-20 11:10:51 DEBUG   |    binning  1      (basetemplate run:35)
2022-06-20 11:10:51 DEBUG   |     repeat  3      (basetemplate run:35)
2022-06-20 11:10:51 DEBUG   |    objname  Bias frame (basetemplate run:35)
2022-06-20 11:10:51 DEBUG   |    exptime  0      (basetemplate run:35)
2022-06-20 11:10:51 DEBUG   |     filter  U      (basetemplate run:35)
2022-06-20 11:10:51 DEBUG   |  frametype  Bias   (basetemplate run:35)
2022-06-20 11:10:51 INFO    | Running content observation (basetemplate run:37)
2022-06-20 11:10:51 INFO    | Running template templates.lampsoff (basetemplate run:28)
2022-06-20 11:10:51 WARNING | Params are empty: {} (basetemplate run:31)
2022-06-20 11:10:51 INFO    | Running content templates.lampsoff (basetemplate run:37)
2022-06-20 11:10:51 INFO    | Luce Flat found to be Off (lampsoff content:24)
2022-06-20 11:10:51 INFO    | Luce Flat is now Off (lampsoff content:28)
2022-06-20 11:10:51 INFO    | Luce Cupola found to be Off (lampsoff content:24)
2022-06-20 11:10:51 INFO    | Luce Cupola is now Off (lampsoff content:28)
2022-06-20 11:10:51 INFO    | Template templates.lampsoff ended (basetemplate run:40)
```

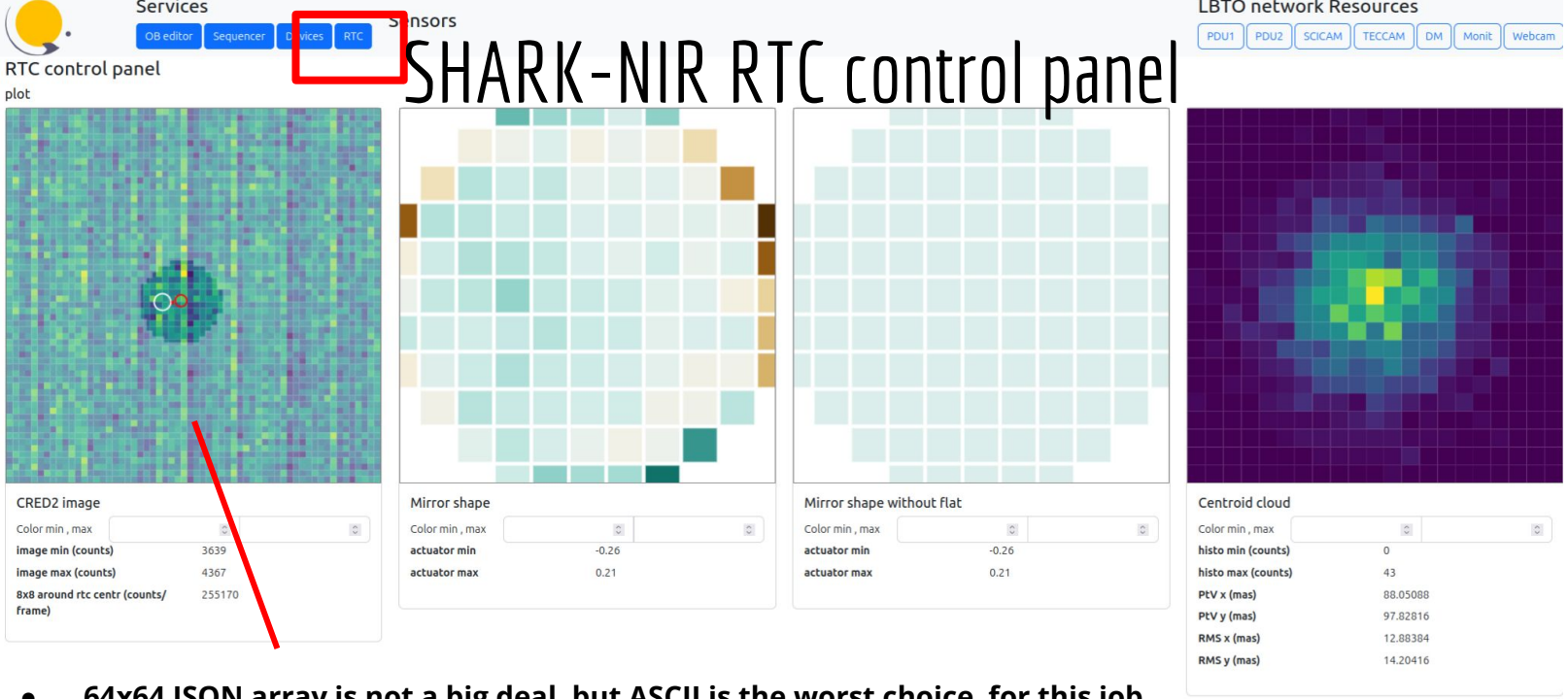
SHARK-NIR motors engineering panel with synoptic view



- Same technology
- svg changing **fill** or **display** attributes

SHARK-NIR RTC control panel

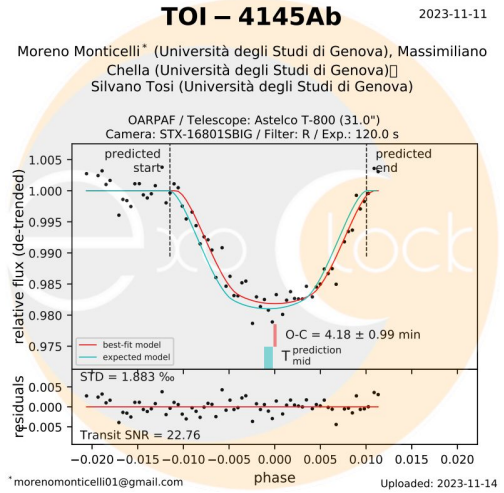
@David Darson:
Present: CRED,
Future: SWIR?

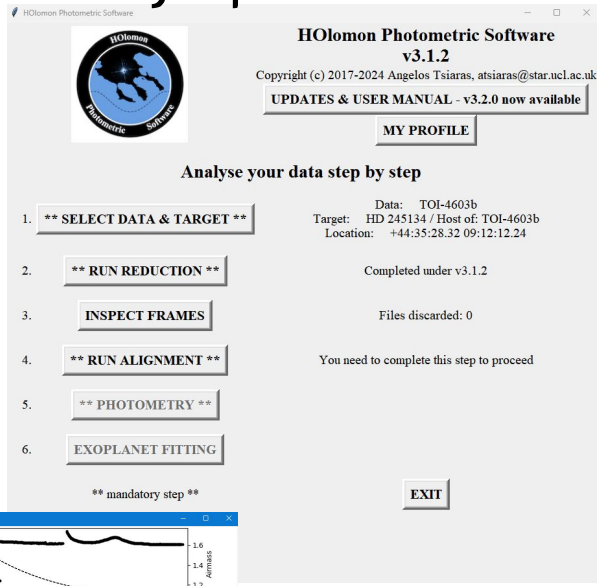


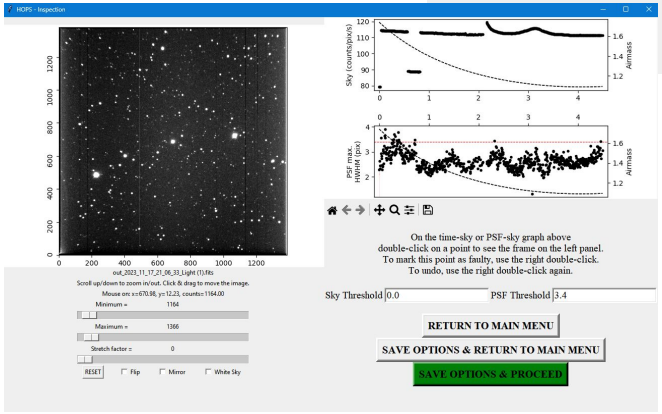
- **64x64 JSON array is not a big deal, but ASCII is the worst choice for this job**

OARPAF **local** observations by students of University of Genoa

- Observational Astronomy **PhD** class XXXVII and XXXVIII cycle:
  - https://www.difi.unige.it/en/phd/cycles/37
  - https://www.difi.unige.it/en/phd/cycles/38
- **Master degree in Physics**
  - Observations in the framework of the I**ntroduction to Astrophysics and Cosmology** class
  - https://corsi.unige.it/off.f/2023/ins/67344





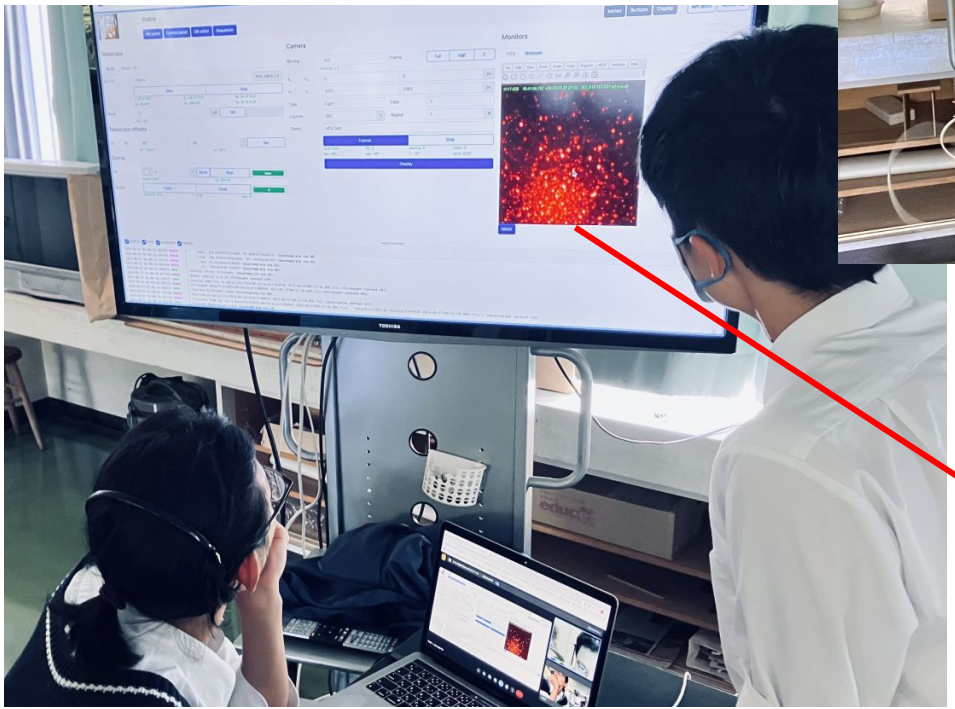


Exoclock

@Anastasia Kokori's HOPS

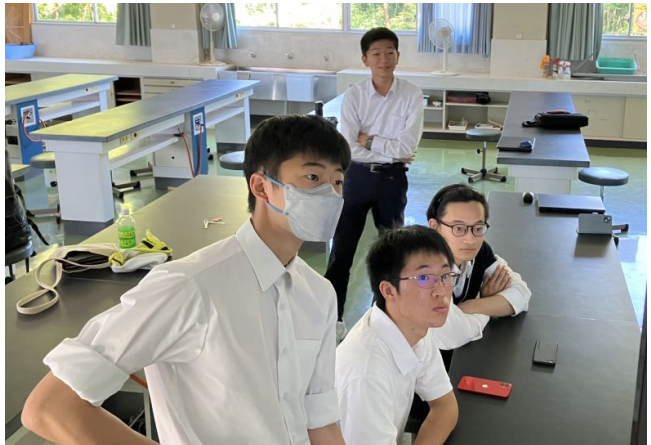
OARPAF **remote** observation from Kōryō High School, Japan!

2023-06-20:
08:00 Hokuto = 23:00 UTC = 01:00 Genova
12:00 Hokuto = 03:00 UTC = 05:00 Genova → Sunrise



M13

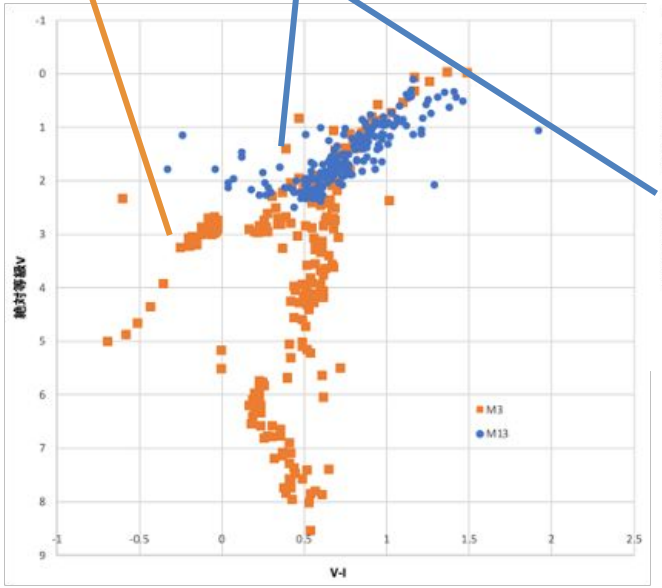
3x180 V
3x180 I
flat
bias



Small **proposals** in the giant era

M3 data : from literature

M13: OARPAF
(ds9 “ring” on ~200 stars!)



OARPAF Proposal

Osservation of M11,M13

Yusei Kato[1] and Kanji Ito[1]

[1] Koryo High School, 2003 Nagasakakamijho Nagasakacho, Hokuto-city, , Yamanashi 408-0021, Japan,

June 16, 2023

Open clusters are relatively young clusters of stars, while globular clusters are older clusters of stars. Due to this difference, the distribution of Color-Magnitude Diagram (CMD) is different. The purpose of this observation is to compare the distribution of CMD and to improve our understanding of the stars that make up the open clusters and globular clusters.

Contents

1 Scientific Facts

1.1 M11

M11 is a open cluster in the constellation Scutum. It looks more like a globular cluster than a open cluster. It is classified as the densest of the open clusters, and the distance between stars at the center of the cluster is less than one light year. The cluster is composed of Type I stars, and since it is a group of newly born stars, pale, hot O-type stars and B-type stars are prominent. Therefore, it is expected that there are many main-sequence stars and few red-giant stars are seen.

1.2 M13

M13 is a globular cluster in the constellation Hercules, containing 500,000 stars. It contains many Type II stars and is estimated to be more than 10 billion years old, making it a very old object. Because of its extremely high density, close interactions and collisions between stars are thought to occur from time to time. Blue straggler, which are located near the main-sequence, are sometimes seen, and their temperature is high enough to be equivalent to F- or A-type stars. Therefore, there are many red-giant stars that are far from the main-sequence, but sometimes we can see stars that are distributed at the position of blue main-sequence stars when we draw the CMD.

2 Objective

The purpose of this observation is to determine the magnitudes of the stars in the globular cluster M13 and the open cluster M11, to make CMD of each cluster, and to compare the globular and open clusters.

3 Proposed Runs

Observation dates may be postponed due to weather, humidity, or equipment conditions. We use V and I filters to observe star clusters.

We intend to make at least three observations with exposure times of 180 seconds each per filter.

Run	Instrument	Time	Month	Seeing
A	SBIG STX-16801	3h	June	2"

4 Justification of Runs

4.1 Instrument

The SBIG STX-16801 camera is a dedicated tool for high performance photometry at OARPAF observatories. Its excellent cooling performance allows the CCD to be cooled sufficiently to reduce noise. Therefore, it is possible to accurately determine the magnitude of stars with this tool.

4.2 Months of Observation

M11 is located in the constellation of Scutum and M13 is in the constellation of Hercules. Both can be seen in the summer night sky.

4.3 Observation Time

At least, 20 minutes would be needed to prepare for the observation and 40 minutes each to observe the object. Three hours is also reasonable, taking into account the time needed to make a re-observation.Therefore we want three hours per observation.

4.4 Seeing

The seeing at the OARPAF site is 2.0", with an average seeing of 2.5" on summer nights. The humidity is high during the summer months, so the average seeing may be lower during the observation.

5 Targets

M11 is a dense cluster, so its visual diameter is relatively small. Therefore, we believe that many stars can be observed even at high magnitude.

M13 is one of the largest globular clusters in the northern sky and has very good visibility. The relatively high magnitude allows us to observe even the stars of cluster's center.

For these reasons, we considered these two clusters to be easy to observe and suitable for observing.

Under the facts about these objects and at this observation site, the motion on the sky is as shown below.

Name	M11	M13
Type	open cluster	Globular Cluster
αJ2000	18 51.1	16 41 41.6
δJ2000	-06 16	+36 27 40.7
Magnitude	6.3	6.4

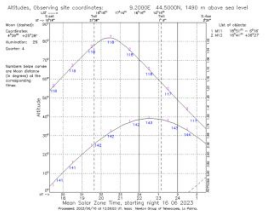


Figure 1: M11 and M13 observability

6 Telescope Justification

The OARPAF telescope has sufficient performance to study the magnitudes of M11 and M13. The success of previous observations of TXS 0506+056, which is at about 15th magnitude, suggests that our observations will have a high probability of success.

References

[1] Sadanori Okamura Astronomy Dictionary, NIPPON HYORON SHA CO., LTD.(2012).

[2] German Lanzavecchia and Albert Rescia, OARPAF Proposal-Observation of TXS 0506+056,

[3] Le Catalogue de Messier, AstroArts, https://www.astroarts.co.jp/alacarte/messier/index-j.shtml,2023/06/14 2023/06/14

- **2nd place at** 44th Yamanashi Prefecture High School Arts and Culture Festival Natural Science Division *“Student Natural Science Research Presentation Competition”*
- ~50 groups, for a total of 200 high school students.

Small **summary** in the giant era

- REST APIs can be a valuable resource to build comprehensive control tools for both **small** telescopes and instruments for **giant** telescopes;
- Small telescopes:
  - **test bench** for hardware and software solutions in the giant world;
- Web technologies are standard
  - and maybe it's simpler to find developers/collaborators
  - +... fundraising?

Priceless for training and engagement:

- Understand the control software stack.
  - They can be involved in further implementations; this lead to:
- Understand how to control single devices while manually operating the telescope for **their projects**; this leads to:
- Understand the automated template operations,
  - that is also **the way giant telescopes work.**
- Modern astrophysics is its technology too → **INAF**
  - Get involved in instrument control software development


INAF
ISTITUTO NAZIONALE DI ASTROFISICA


DEERE
544H