



INAF

ISTITUTO NAZIONALE
DI ASTROFISICA



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ON BEHALF OF THE SOXS CONSORTIUM

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ESO Munich - 01 July 2025

THE SOXS OPERATION MODEL

OUTLINE

- ▶ The envisioned observing night
- ▶ Architecture and targets
 - ★ What are targets / Pre-approval
 - ★ Marshall Urgent
 - ★ ESO OBs
- ▶ The scheduler:
 - ★ Science Team interface
 - ★ Scheduling algorithm
 - ★ Automated night management

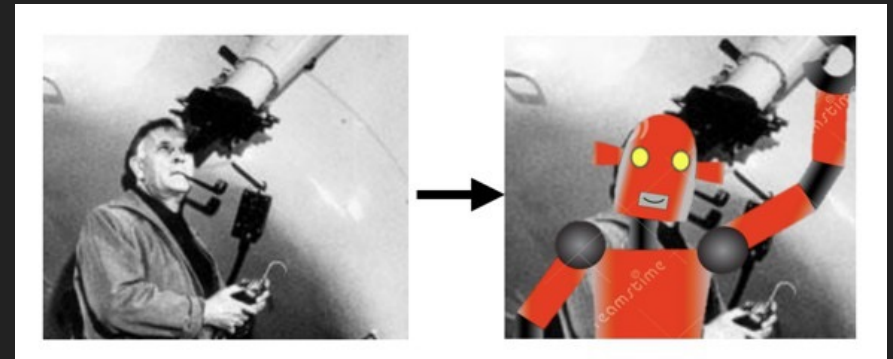
WARNING

- A lot of work in progress (testing, prioritisation of the targets, robustness of the code...)
- This is a new model for operation, tuning will be required.
- Comments welcome !



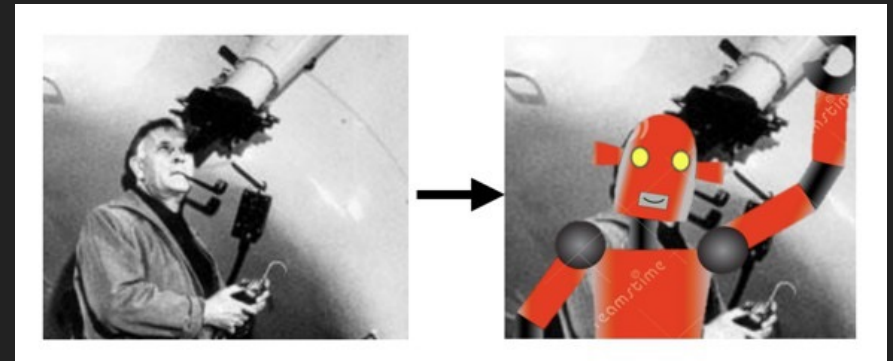
GENERAL CONCEPT – WHAT WE NEED TO DO

- ▶ Full automation of the scheduling process
- ▶ Providing a schedule of observable targets
- ▶ Optimization of the observation quality and time at the telescope
- ▶ Reliable automated decisions for management of unforeseen events
- ▶ Operation tracking
- ▶ Flexibility



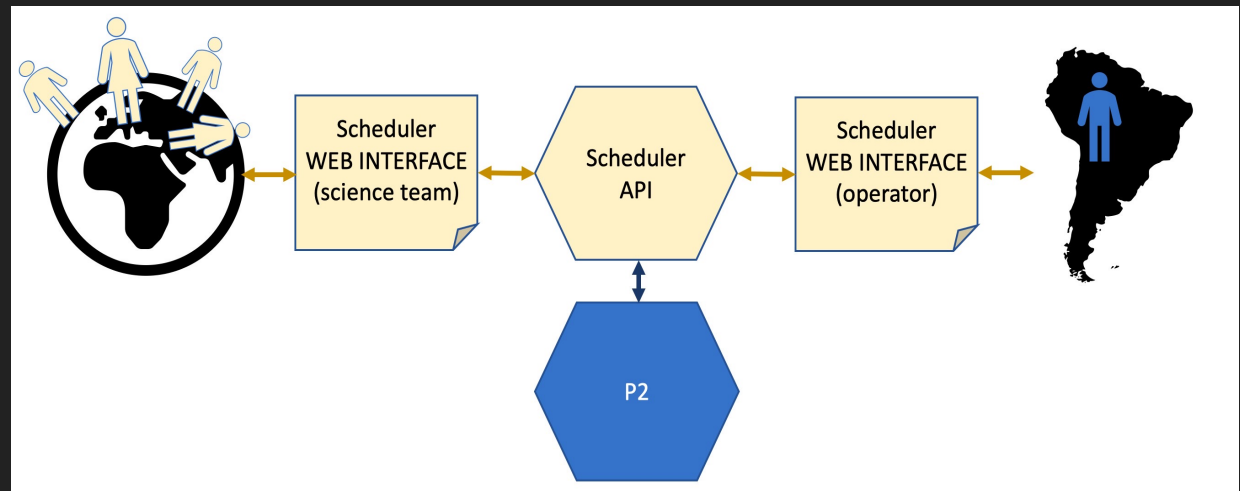
GENERAL CONCEPT

- ▶ 50 % of the time for the **GTO** (transients, time domain Astrophysics). **ToO**
- ▶ 50 % of the time for the **ESO proposals** (any kind of sources, even ToO).
- ▶ Observing time shared within the same conditions (e.g. weather).



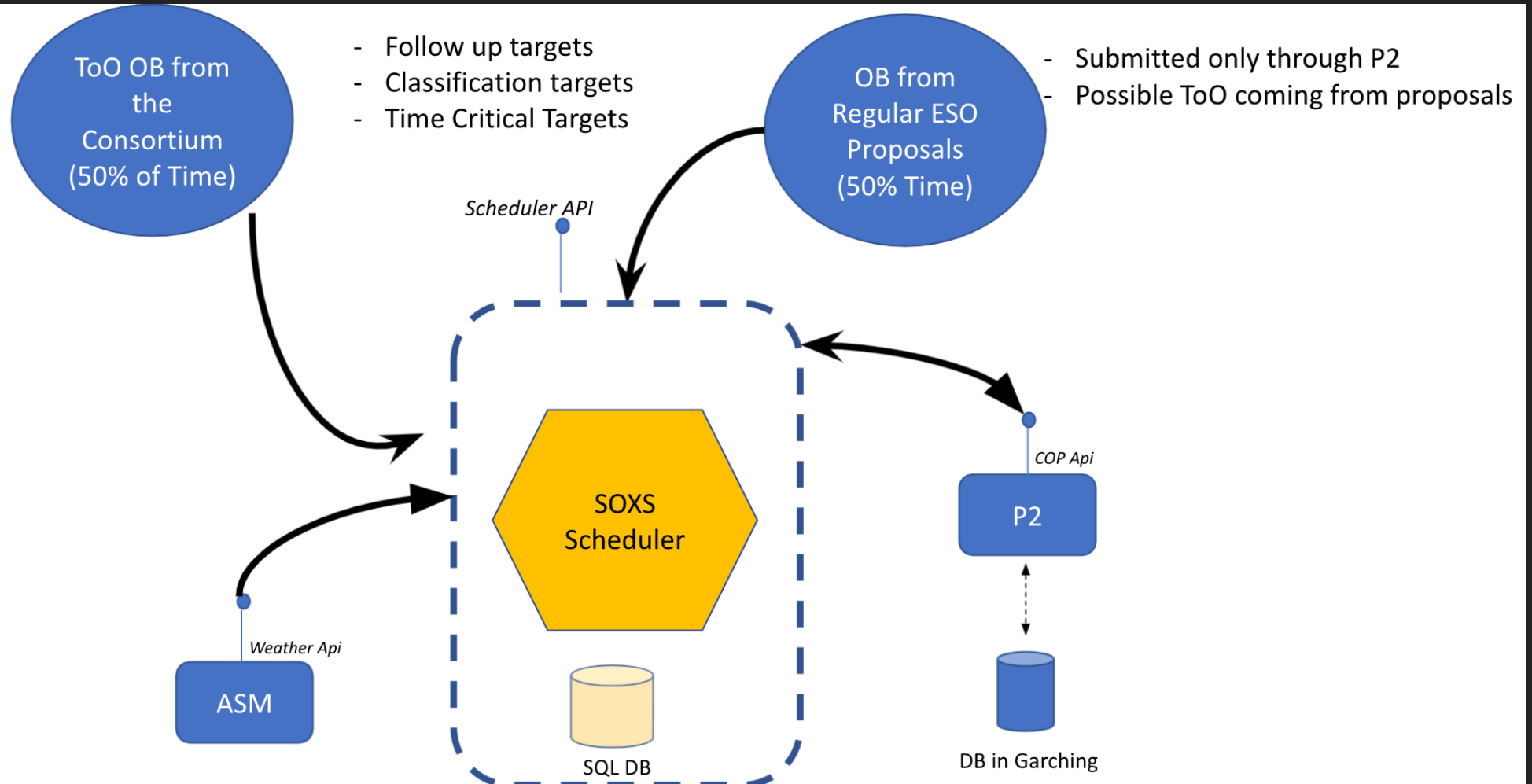
OBSERVING NIGHT

- ▶ We work on ToOs and regular ESO proposals, with schedule decided daily
- ▶ **No astronomer on the mountain**, the scheduler will do all the work of selecting targets, respond on weather changes, urgent targets, etc.
- ▶ The Science Team will gather online during the European afternoon to approve the proposed schedule

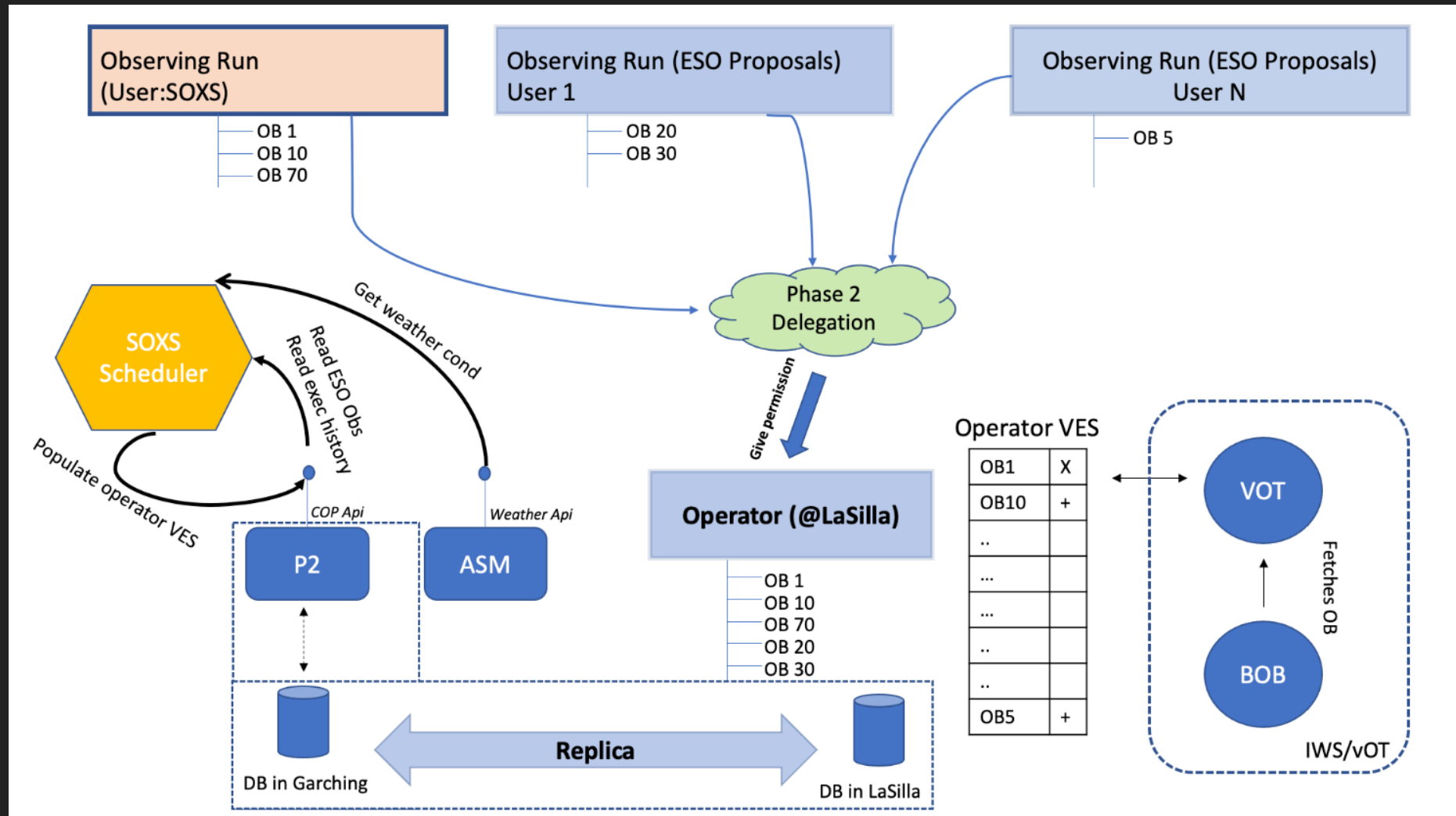


ARCHITECTURAL OVERVIEW

Architectural Overview



Architectural Overview

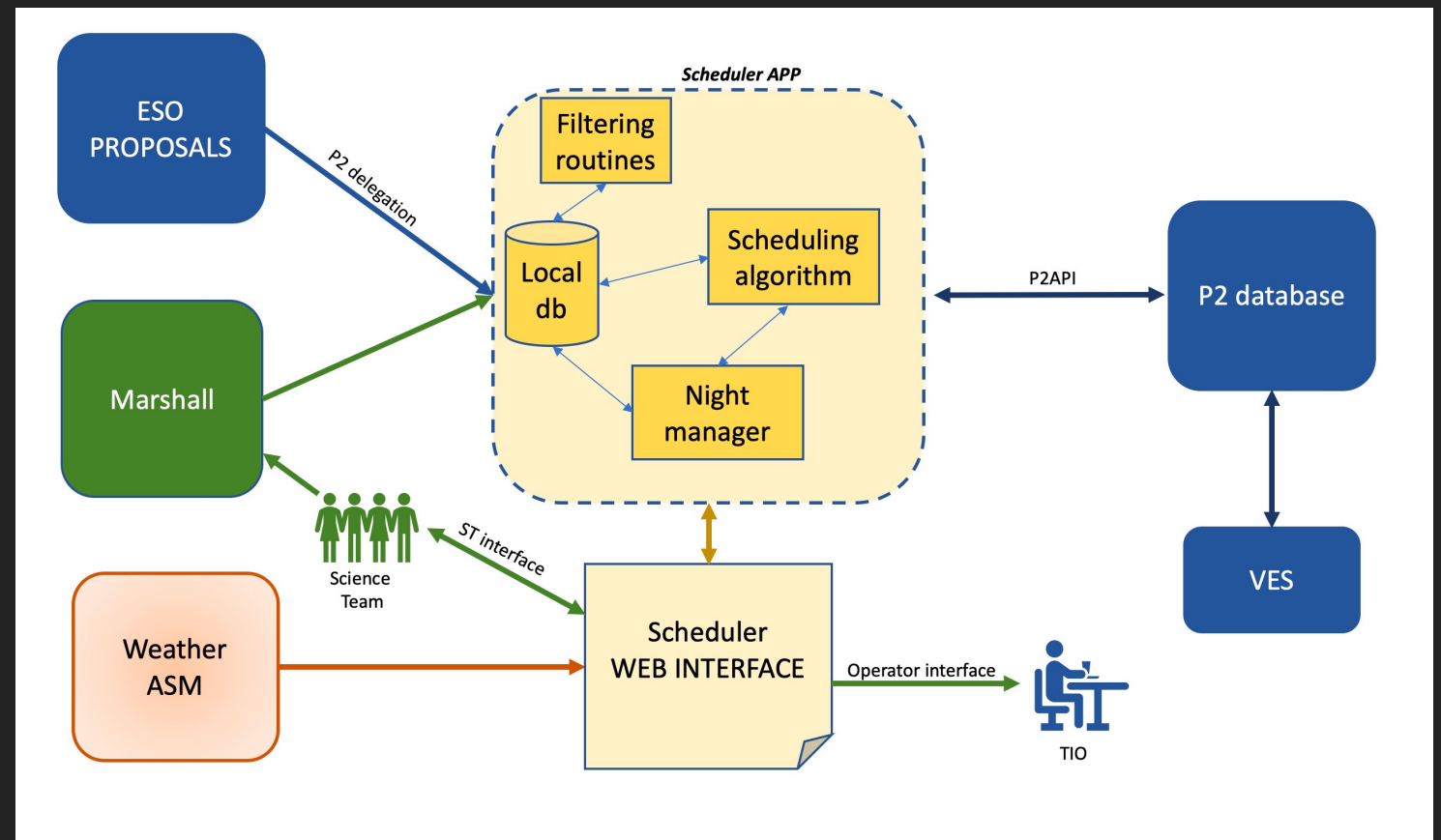


WHAT ARE OUR TARGETS ?

- ▶ For the GTO, we will refer to three categories of targets: Classification, follow-up, urgent
- ▶ All of these will fall within our (well defined) science cases
- ▶ To request a follow-up observation, PIs will need to submit a mini-proposal to our Scientific Committee
- ▶ Swift procedure with clean guidelines
- ▶ For the regular ESO proposals, we will refer generic to OBs.

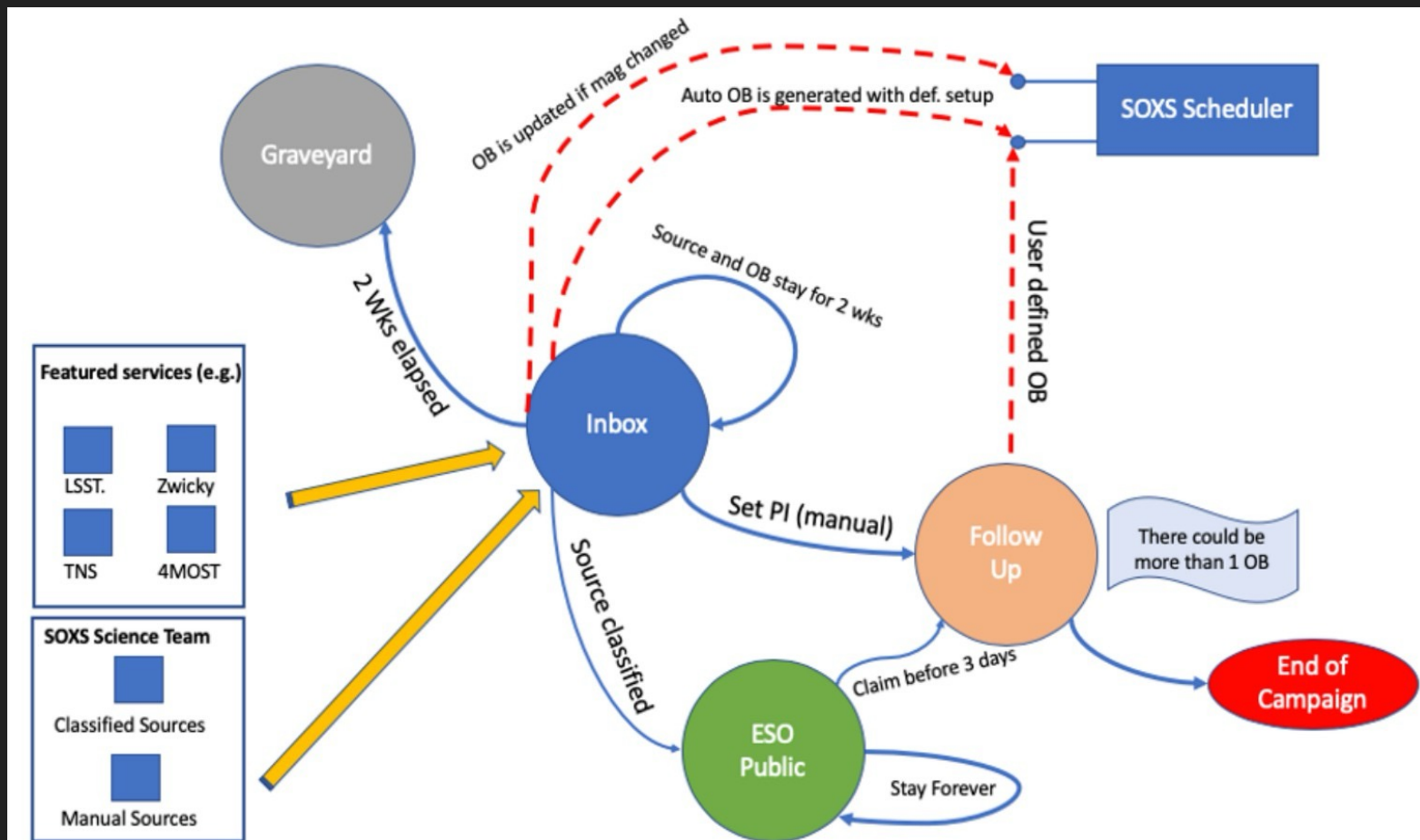
THE SCHEDULER

- ▶ Fed by Marshall and ESO p2DB
- ▶ Several routines distribute the workload
- ▶ Synched to P2 with automatically



GTO SOURCE WORKFLOW USE CASE SCENARIO

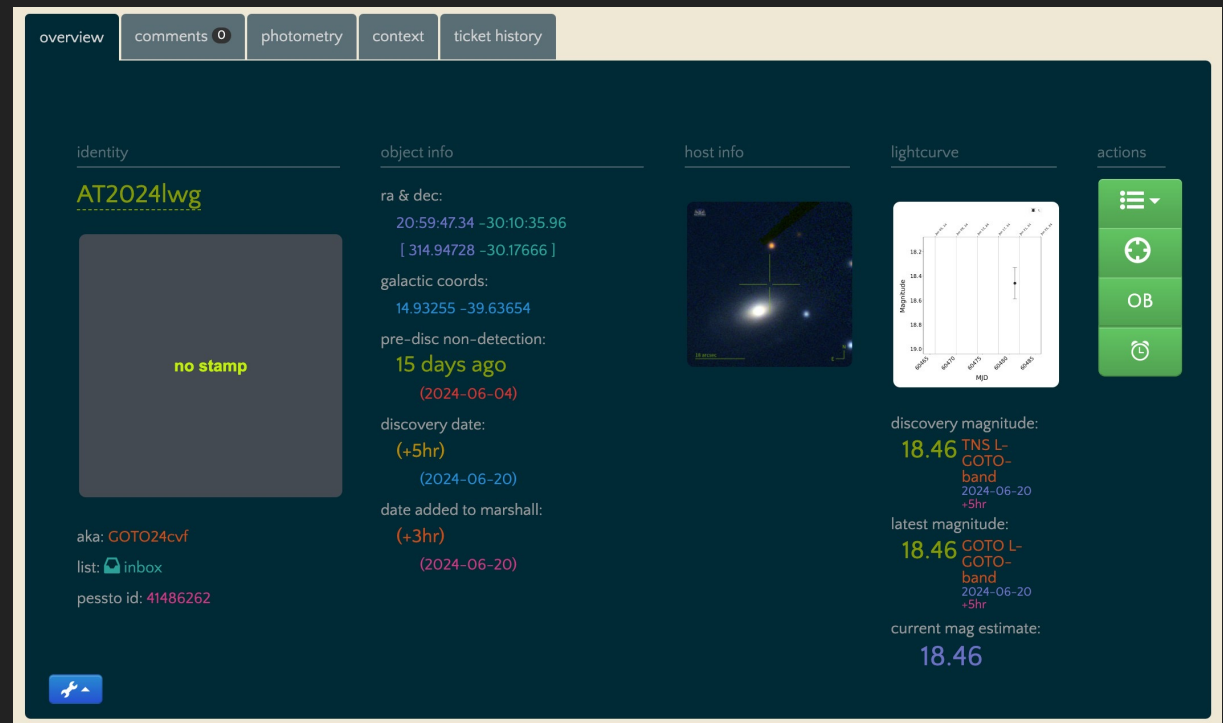
GTO SOURCE WORKFLOW



HOW TO GET YOUR CLASSIFICATION AND FOLLOW UP TARGETS

MARSHALL

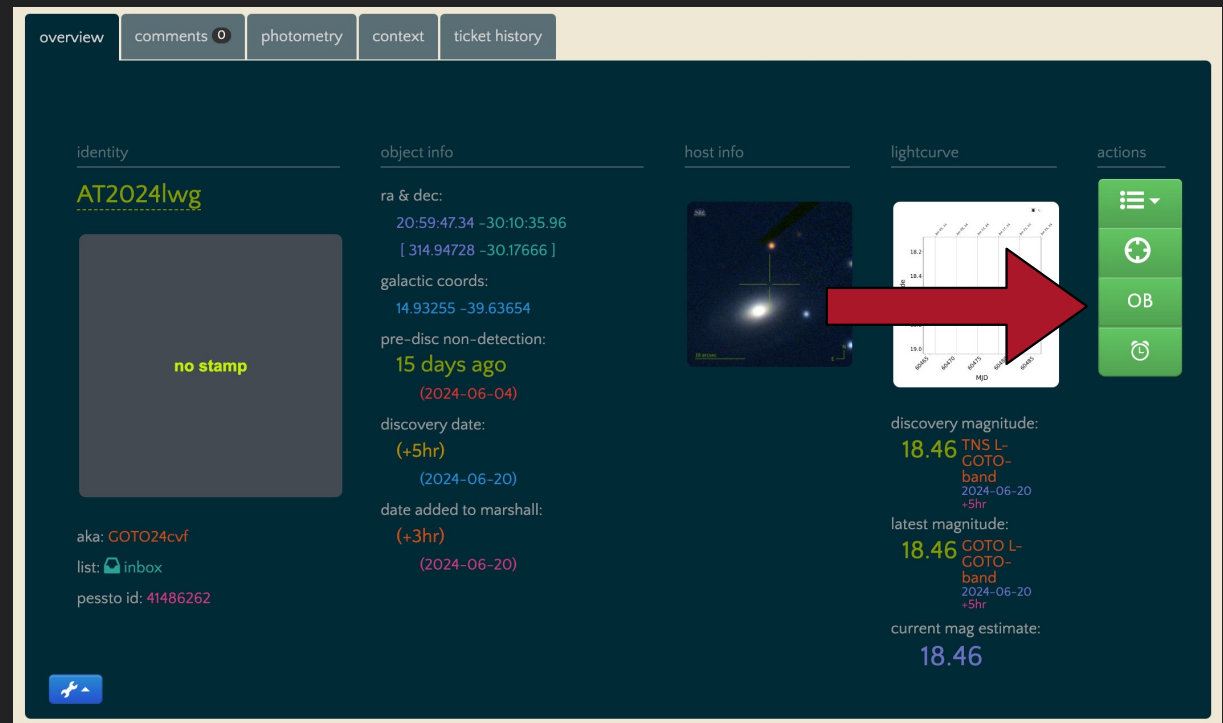
- ▶ The Marshall aggregates all of the info from new/old transients
- ▶ Sends Classification OBs/ Updates automatically to the scheduler



HOW TO GET YOUR FOLLOW UP

MARSHALL

- ▶ The follow up requests will be created from the SOXS Marshall
- ▶ Will either create them ex-novo, or claiming a classification target/a known source
- ▶ These will be sent to the Scheduler DB (our own)



THE SOXS SCHEDULER

THE SCHEDULER

SCIENCE TEAM INTERFACE

Night Management

Night Report

GTO Progress

Weather Forecast

Average Conditions

Search OB

Full OB list

New OB

New Urgent OB

Show Logs

Changelog v0.195

Opened Night: 23-06-2024

24-06-2024 09:43:30 UTC

The Manager

Air Temp.(2m)[°C] NotAvailable
Seeing[""] NotAvailable

Wind Speed(10m)[m/s] NotAvailable

Wind Dir.(10m)[deg] NotAvailable
Dew Temp.(2m)[°C] NotAvailable

Rel. Hum.(2m)[%] NotAvailable

Bar. Press.(2m)[hPa] NotAvailable

SCHEDULE

OBSERVABLE OB

FOLLOWUP ESO & URGENT OB

Schedule

CloseNight

ID	Scheduled	Target	Type	Obs. Start	Obs. End	Actions
7716		AT2022odq	CLASSIFICATION	2024-06-23 23:18:21.586	2024-06-23 23:28:21.586	
58565		Follow_up_5	FOLLOW UP	2024-06-23 23:23:21.308	2024-06-23 23:33:21.308	
8973		ATLAS23jqc	ESO OB	2024-06-23 23:28:21.570	2024-06-23 23:33:21.570	
8973		ATLAS23jqc	ESO OB	2024-06-23 23:38:21.308	2024-06-23 23:43:21.308	
7354		SN2022ewg	CLASSIFICATION	2024-06-23 23:43:21.307	2024-06-23 23:58:21.307	
63771		ESO_OB24	ESO OB	2024-06-23 23:58:21.308	2024-06-24 00:33:21.308	
46753		ESO_OB24	ESO OB	2024-06-24 00:28:21.308	2024-06-24 01:03:21.308	
		ESO_OB24	ESO OB	2024-06-24	2024-06-24	

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MANY USER-FRIENDLY TOOLS

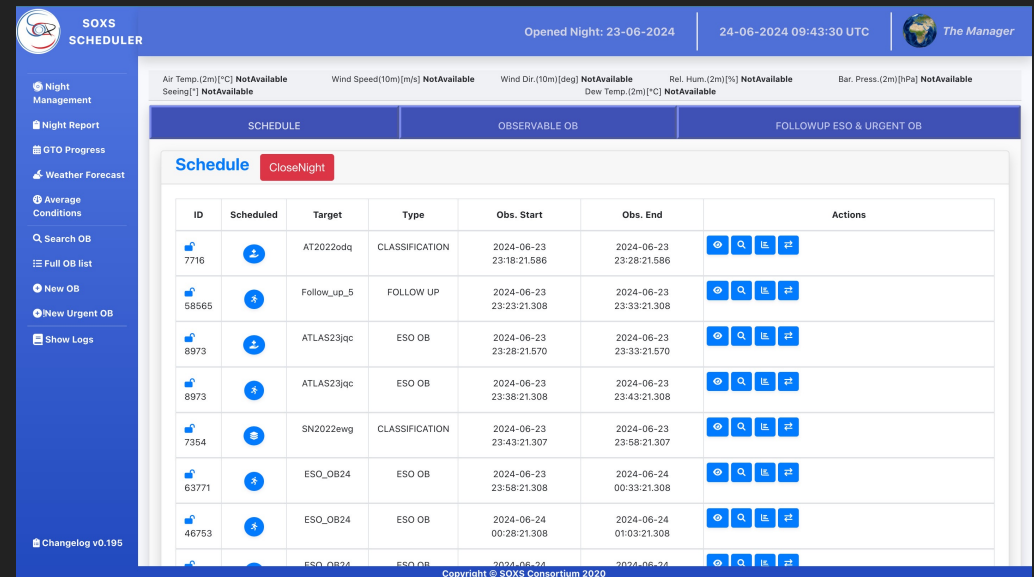
The scheduler interface has many tool to aid the science team during their operations, mainly to:

- ▶ Modify the proposed schedule
- ▶ View the OB specifics
- ▶ View the Guaranteed Time of Observation status
- ▶ View weather forecasts

THE SCHEDULER

SCHEDULING

- ▶ “Static” schedule
- ▶ 2 algorithms
- ▶ Follow up OBs with Priority Scheduler from Astroplan
- ▶ Classification targets with GGF
- ▶ Still TBD, we may open up other possibilities



The screenshot displays the SOXS SCHEDULER web interface. At the top, it shows the current night status: "Opened Night: 23-06-2024" and "24-06-2024 09:43:30 UTC". A sidebar on the left contains navigation links: Night Management, Night Report, GTO Progress, Weather Forecast, Average Conditions, Search OB, Full OB list, New OB, New Urgent OB, and Show Logs. The main content area is titled "Schedule" and features a "CloseNight" button. Below this is a table with the following columns: ID, Scheduled, Target, Type, Obs. Start, Obs. End, and Actions. The table lists several observations, including classification targets and follow-up observations.

ID	Scheduled	Target	Type	Obs. Start	Obs. End	Actions
7716		AT2022odq	CLASSIFICATION	2024-06-23 23:18:21.586	2024-06-23 23:28:21.586	
58565		Follow_up_5	FOLLOW UP	2024-06-23 23:23:21.308	2024-06-23 23:33:21.308	
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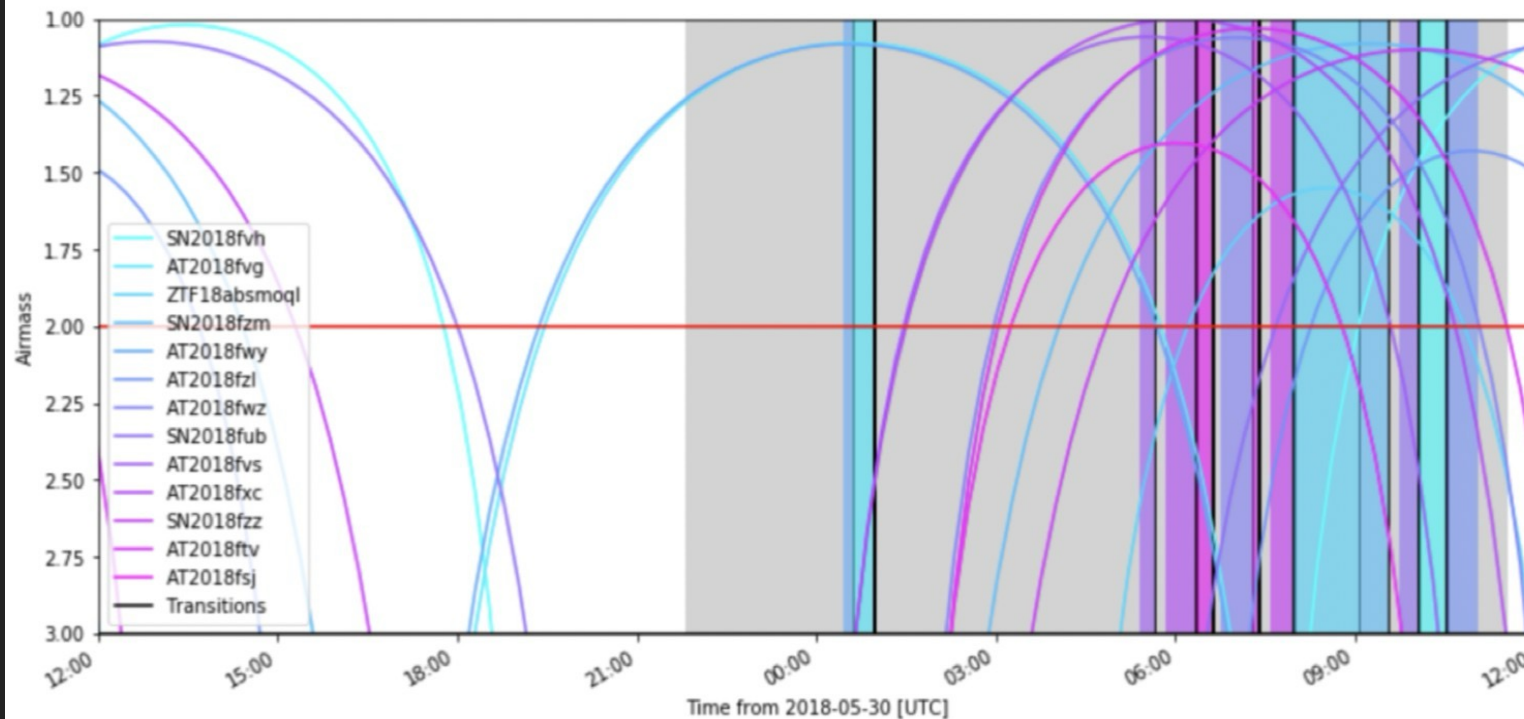
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SCHEDULING ALGORITHMS

PRIORITY SCHEDULER

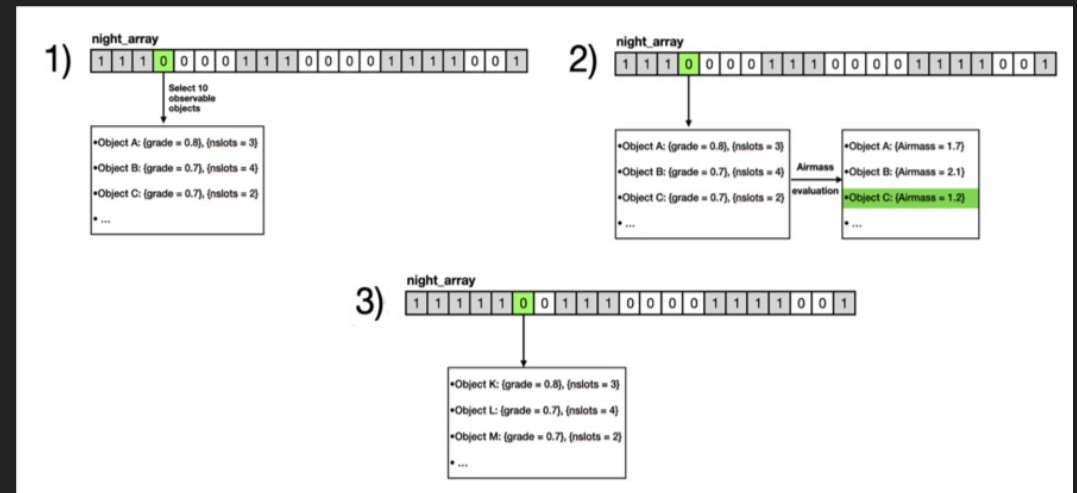
- Sorts and schedules by priority
- Optimizes constraints with 1 minute time-grid

Airmass vs time for a schedule



GRADED GAP FILLER

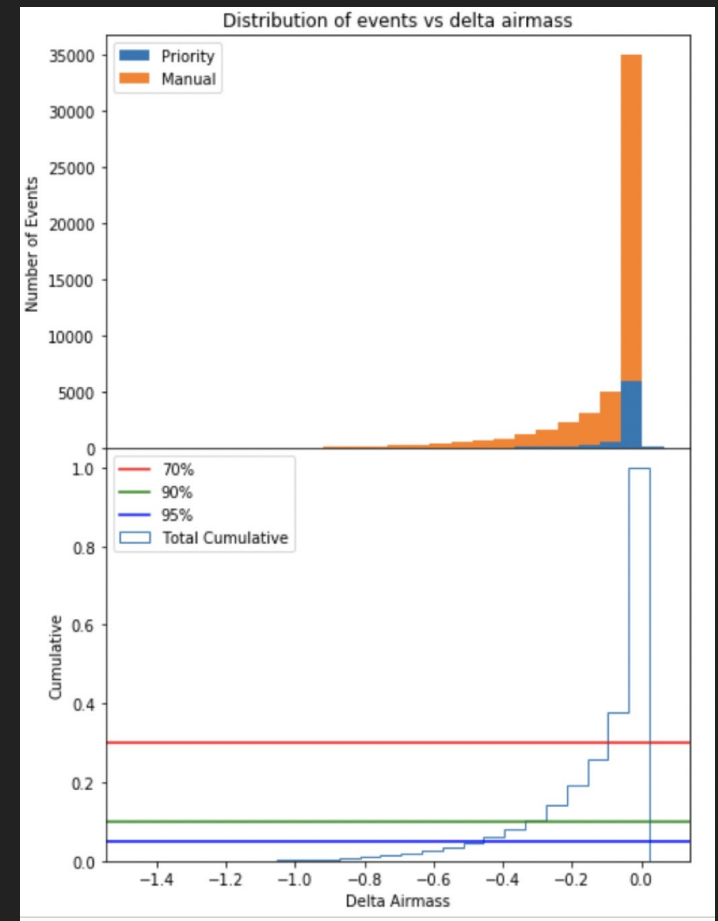
- ▶ During filtering, every OB is associated with a “grade” (based on current ESO probabilities on airmass, FLI, etc.)
- ▶ The algorithm is greedy, finds a hole in the schedule and wants to fill it
- ▶ Chooses 10 targets with highest grade, checks their constraints for that hole
- ▶ Winner gets scheduled



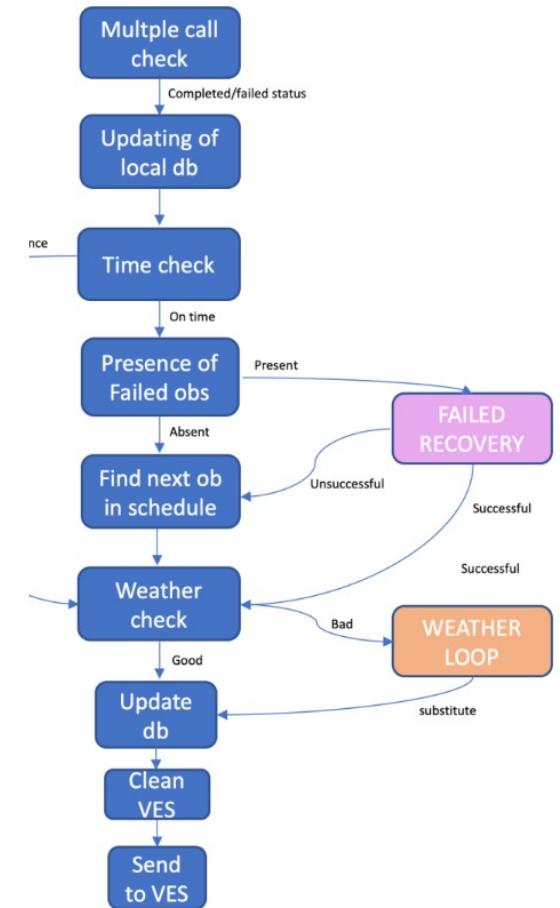
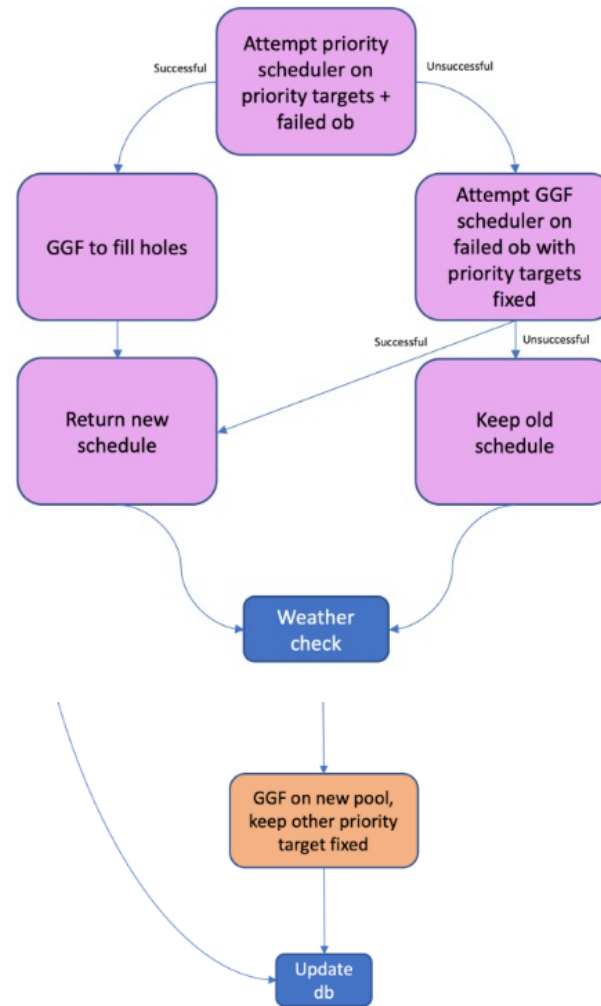
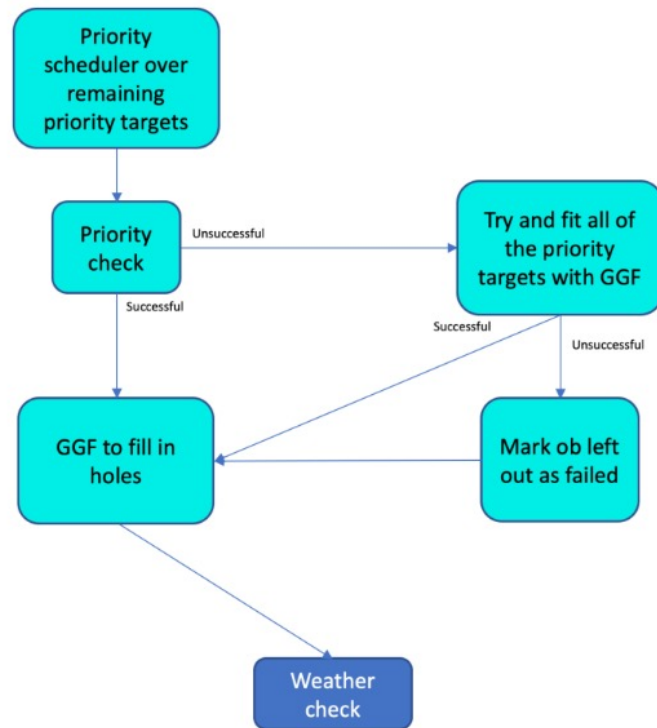
CAN WE TRUST THOSE ALGORITHMS ?

Can we trust those algorithm?


- ▶ Our first Monte Carlo simulations, with the 2018 ePESSTO data
- ▶ 40 different nights simulated, with 100 schedules per night
- ▶ 90% of events are scheduled at airmass less than 0.3 from their best \rightarrow deg



NIGHT MANAGEMENT



THE OPERATOR INTERFACE




SOXS
SCHEDULER

Show Logs

Changelog v0.194

Opened Night: 13-09-2023

02-10-2023 14:24:17 UTC

The Operator 1

Air Temp.(2m)[°C] 10.8
Seeing[""] NotAvailable

Wind Speed(10m)[m/s] 19.2

Wind Dir.(10m)[deg] 39

Rel. Hum.(2m)[%] 31
Dew Temp.(2m)[°C] -3

Bar. Press.(2m)[hPa] 766.5

Visitor Execution Sequence

NEXT OB

Currently in VES

ID	Type	Target	Ra	Dec	Obs. Start	Obs. End	Status	Max. Seeing	Actions
7574	CLASSIFICATION	AT2022nyr	16h16m28.32s	-65d38m33s			P	0.8	<div>RETRY</div>

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REAL CASE USE AND TEST

- System tested successfully **end-to-end** in La Silla Sept 2024
- Another run should happen during the next September with the idea to improve the stability of the system and the code.
- **Plus:** The scheduler logic for SOXS operation is completely decoupled by design. Improvements, change of the logic and ways to manage the OBs can be performed completely from Europe

Thanks!