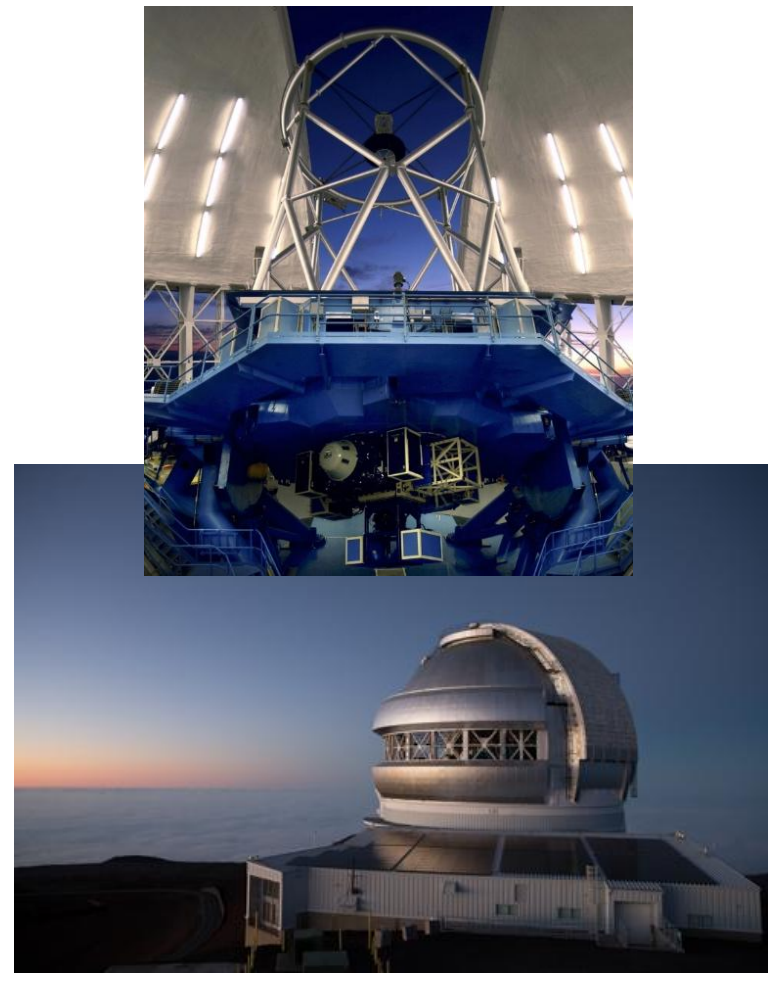


## The International Gemini Observatory

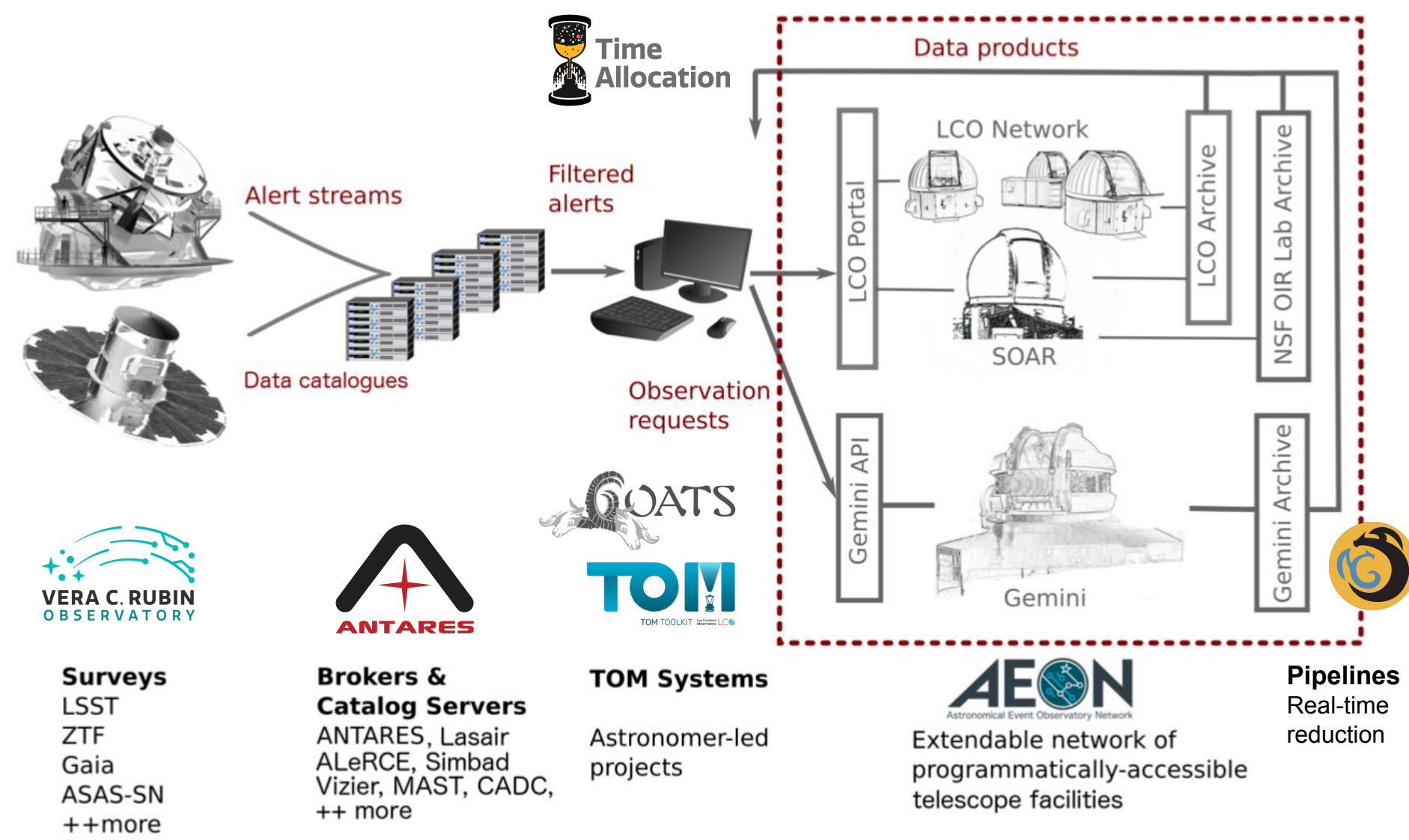
- Twin 8-m telescopes
  - Hawaii and Chile (full sky, 6 hours of longitudinal difference)
  - 5 full international participants (US, CA, BR, KR, AR), 2 hosts (HI, CL), exchange (JP)
- Complementary optical/NIR instrumentation
  - Facility and visitor
  - Facility instruments have common interfaces to the observatory system
- Operates mostly in queue
  - Staff observers
  - Match observation constraints to current conditions



## Time Domain Follow-Up

Gemini does a substantial amount of time-domain astronomy due to the flexible queue observing mode. Thus it is an important resource for characterizing new and rare objects found in surveys such as the Zwicky Transient Facility (ZTF) and the Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST).

Gemini works within AEON (Astronomical Event Observatory Network) along with Las Cumbres Observatory and SOAR. These facilities provide programmatic access to queue observing and data archives. These capabilities are being expanded to the Blanco 4-m at CTIO and others.



Time Domain Ecosystem:

- Facilities/Surveys generate events
- Brokers catalog and classify events
- Science teams use Target Observation Managers (TOMs) to prioritize and submit observation requests
- Observatories take, reduce, and distribute data via archives

## Gemini Program Platform

Current proposal and observation preparation tools (PIT, OT) are more than 20 years old and have fundamental limitations.

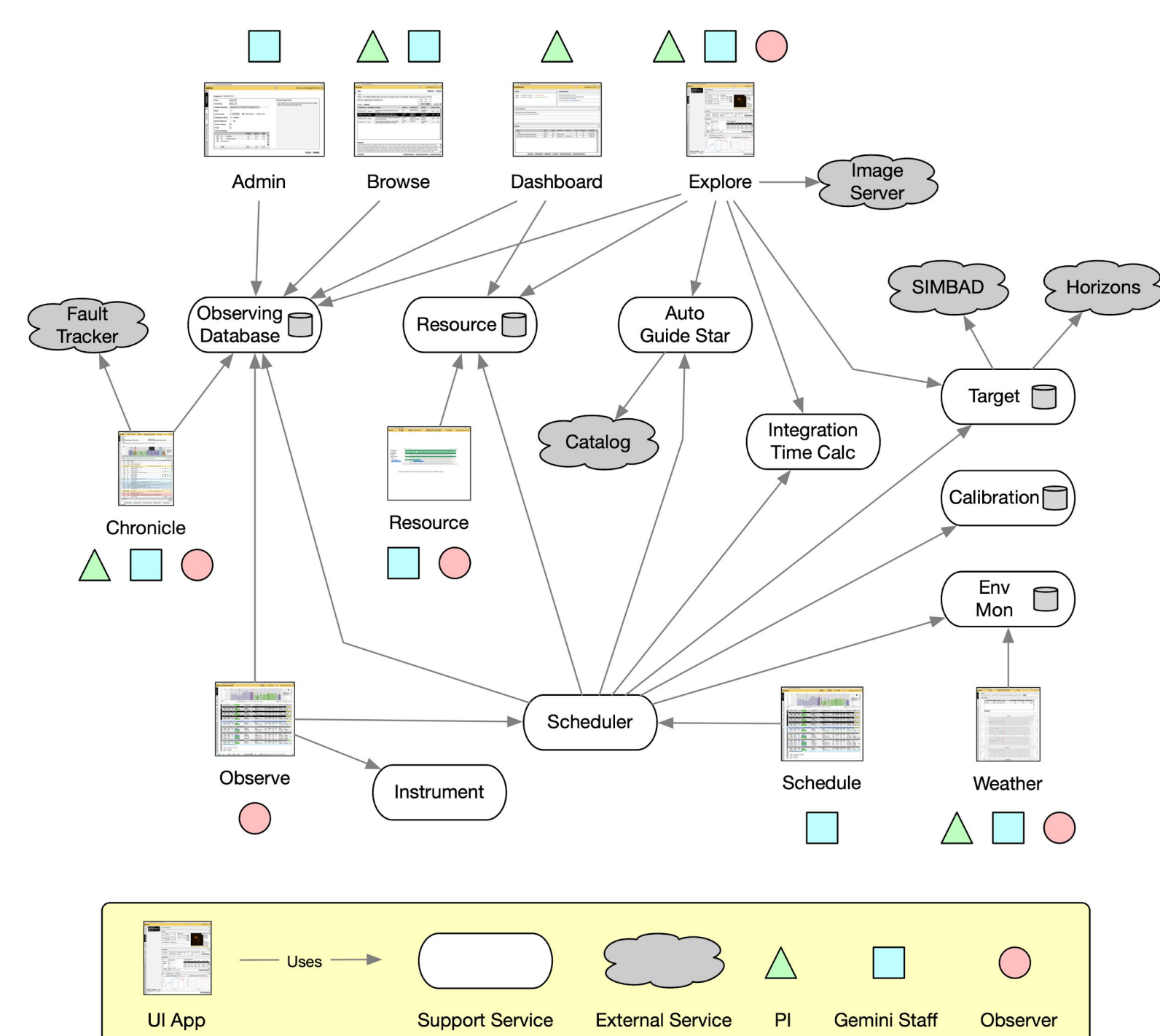
The Gemini Program Platform (GPP) is the core of a new observatory control system with the following goals:

- **Improve usability** - make proposal and Phase 2 preparation much easier
- **Improve efficiency** - improve flexibility and reduce user/staff workload via automation
- **Support Time Domain Astronomy (TDA)** - provide the software framework for the GEMMA scheduler and APIs (e.g. AEON)
- **Support new instruments/systems** - e.g. SCORPIO and GNAO/GIRMOS
- **Avoid obsolescence** - make the code maintainable and scalable

GPP consists of several web applications connecting to a single database and services in the cloud:

- Explore: proposal and observation preparation
- Dashboard: program management
- Browse: basic search
- Chronicle: logging and time accounting
- Weather: current and historical conditions

Most capabilities will also be available programmatically via APIs.



## Explore

The Explore web application is the new combined Phase 1&2 tool. Observing sequences are generated automatically based on science requirements. If no customization is needed then observations can be executed as soon as they are approved.

In addition to the new features indicated in the figure at the right, GPP will:

- Provide user authentication via ORCID
- Undo/redo of changes
- Allow uploading lists of targets and automatically generate observations that give the desired S/N.
- Allow cadences by providing timing constraints between observations (e.g. observe between 3 and 5 nights after the previous observation).
- Allow logical groupings of observations:
  - AND: observe all together
  - OR: observe n of m
- Generate associated baseline calibrations automatically with the instrument configuration linked to the science observation

GPP early early night testing and science use is expected by the end of 2024.

GPP is expected to enter operations by 2026.

Visibility plot with sky brightness and moon

Physical on-target conditions constraints

Enter science requirements to see a list of instruments/modes that meet those constraints

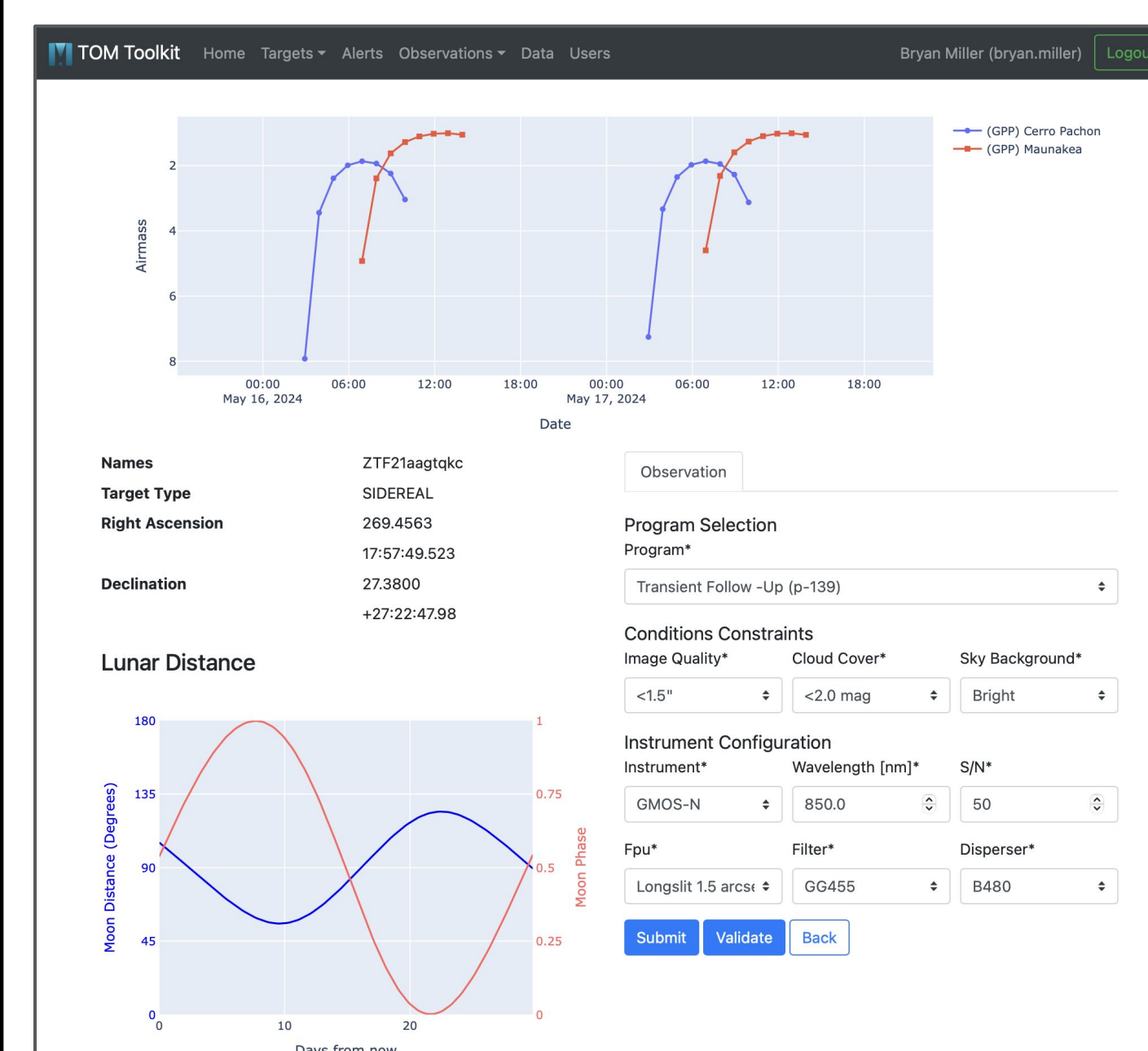
Embedded Integration Time Calculator to get exposure time to reach S/N



## API Driven ToO Triggering with a TOM

Most actions that can be performed with the Explore UI can be done programmatically via APIs.

For example, observations can be requested using a Target Observation Manager (TOM) via a GPP plugin for the TOM Toolkit (<https://tom-toolkit.readthedocs.io>).

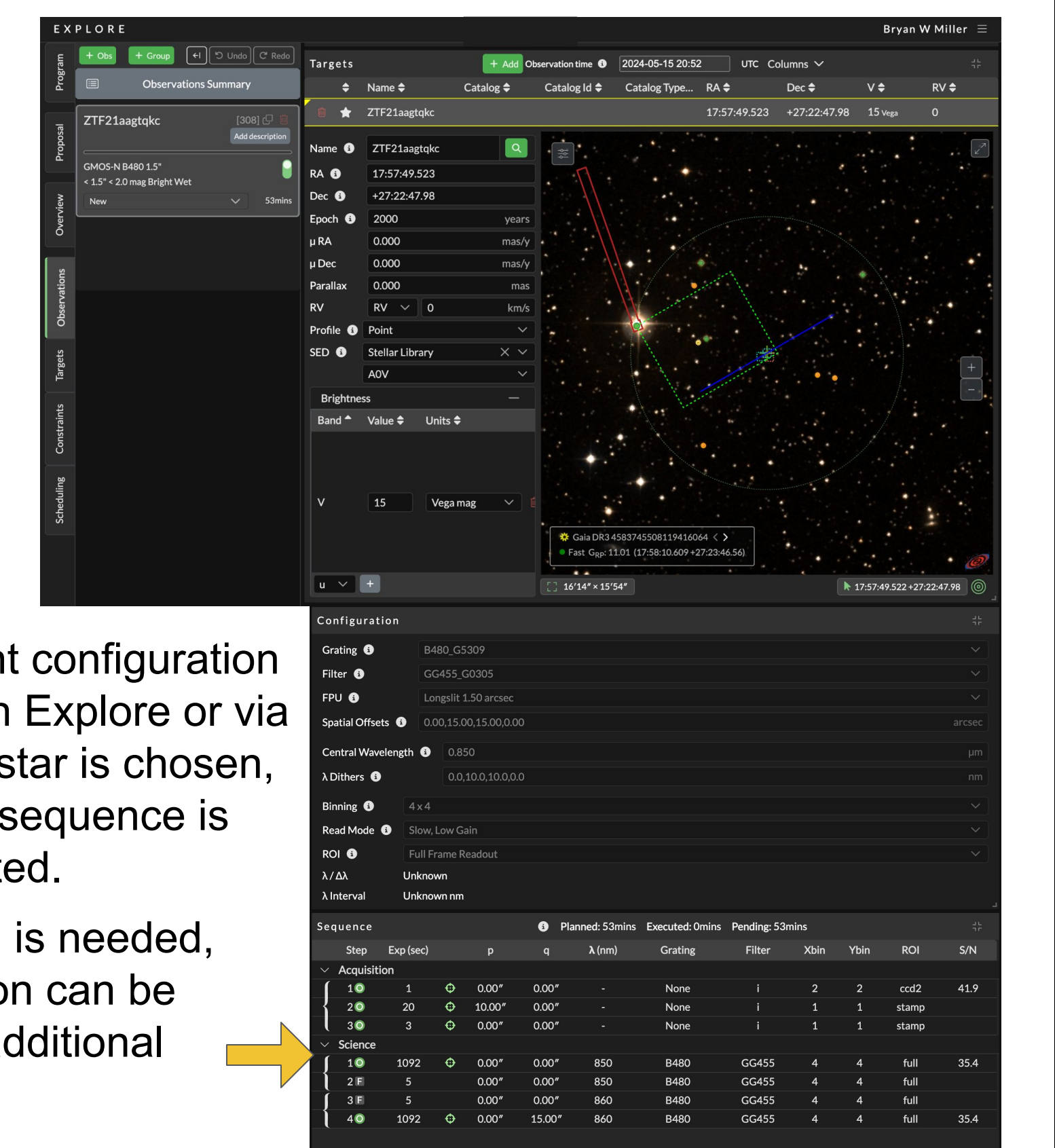


GMOS-N observation defined in a TOM. A TOM allow enables automated workflows



Once an instrument configuration is selected either in Explore or via the API, the guide star is chosen, and the observing sequence is automatically created.

If no customization is needed, then the observation can be executed without additional human checking.



## Dynamic Scheduler

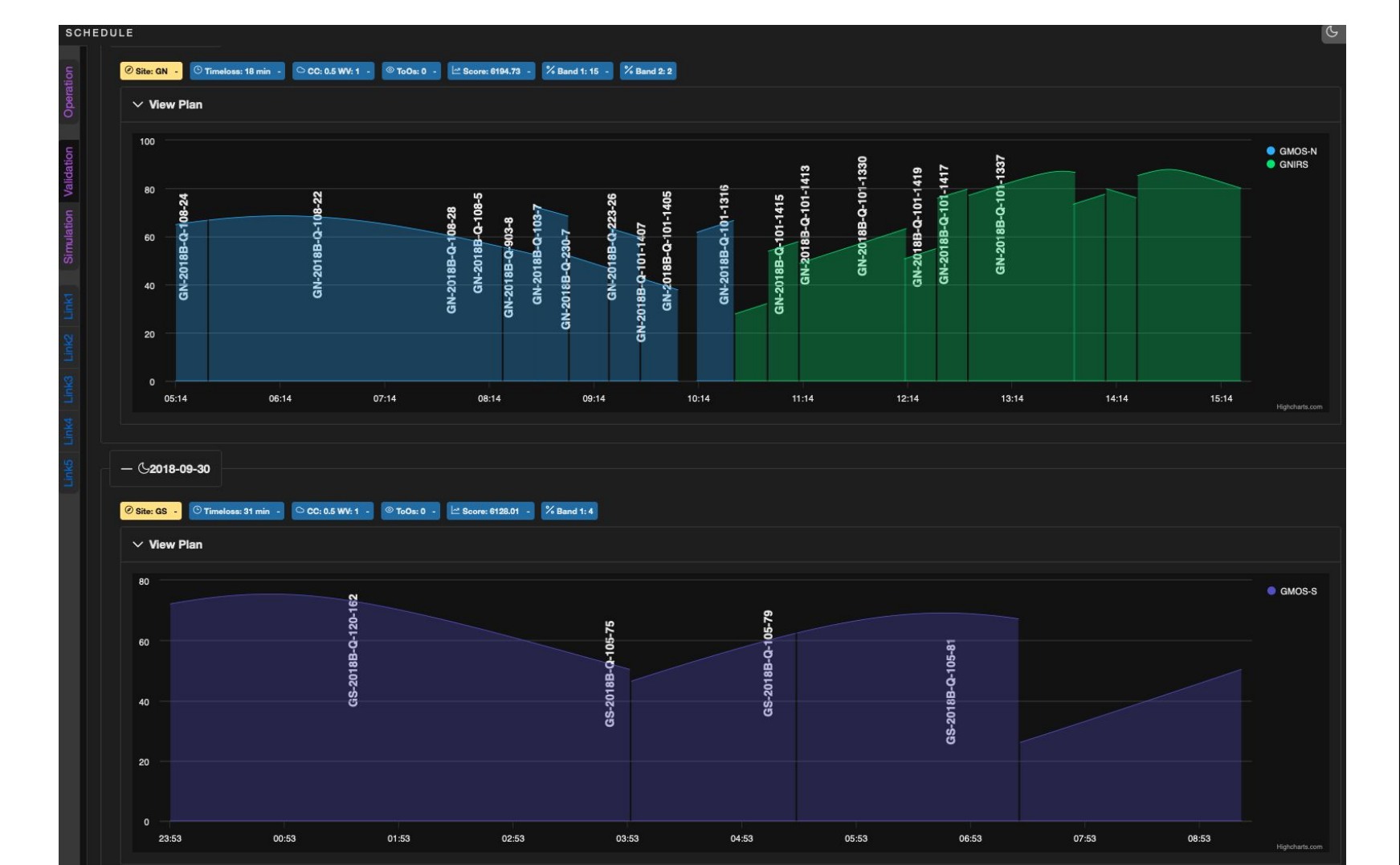
Gemini is implementing real-time scheduling as part of the NSF-funded GEMMA (Gemini in the Era of Multi-Messenger Astronomy) project.

Goals:

- Automatically update observing plans as events occur (e.g. ToOs, weather changes, faults), which will:
  - Reduce the effort of human queue coordinators who currently prepare multiple queue schedules for a range of possible weather conditions.
  - Give real-time advice to the nighttime observer to ensure that we are always executing the best observation for the current conditions.
- Maintain or improve Gemini's program completion statistics

It will create plans for Gemini North and South together as a mini network (see figure at right).

The scheduler is currently in development in parallel with GPP.



Observing plans created together for GN and GS in the Schedule application.

