AEON+

Overview

LCO

SOAR TELESCOPE

W. M. KECK OBSERVATORY

SKYNET ROBOTIC TELESCOPE NETWORK

GEMINI OBSERVATORY
Exploring the Universe, Sharing its Wonders

CFH

NSF | NOIRLab

NRAO National Radio Astronomy Observatory

NSF

Supported by the National Science Foundation under Grant No. 2432266. Image credit: LCO

AEON+ Goals

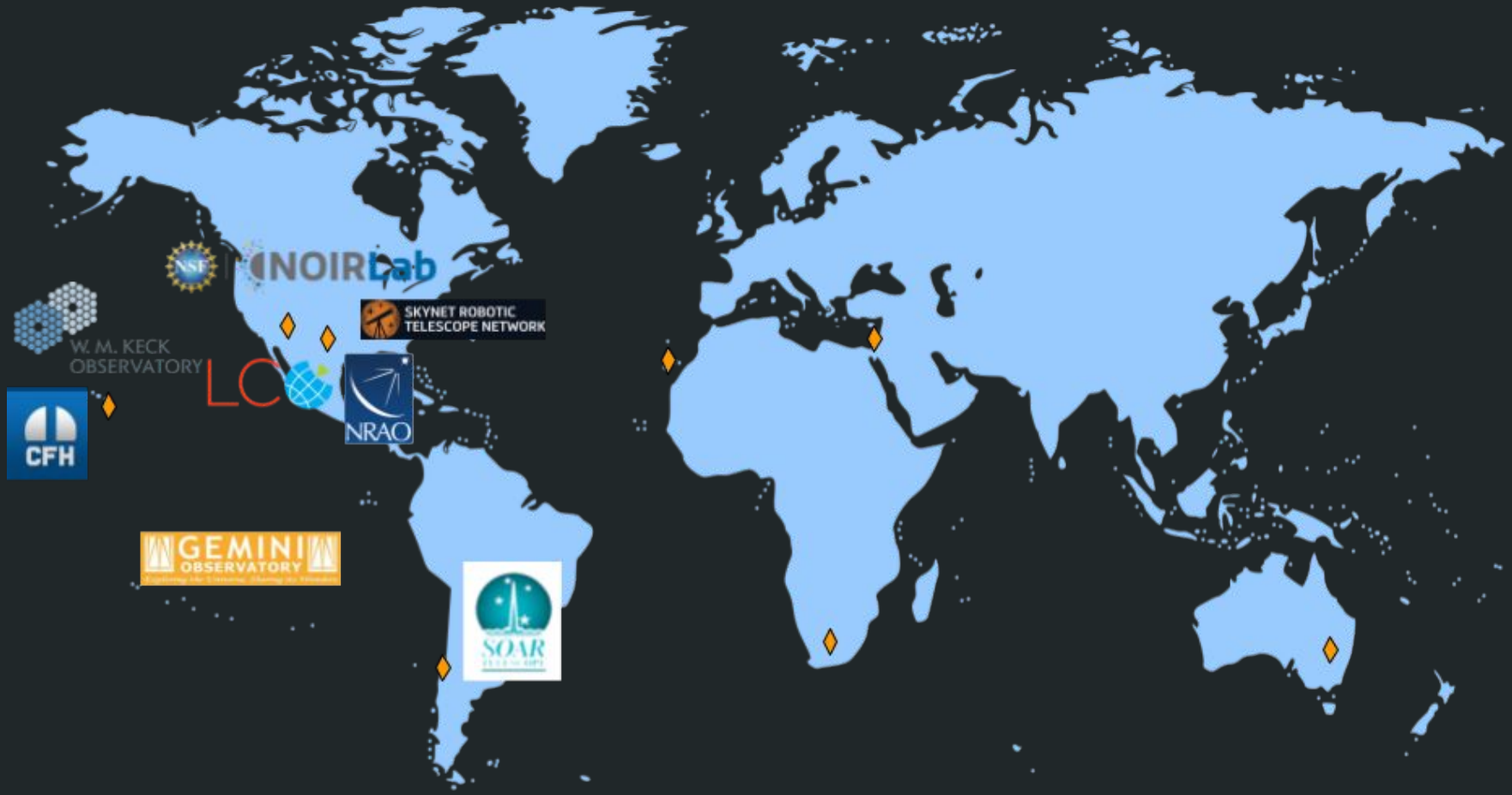
https://aeonplus.github.io/

Optimize telescope operations and astronomer experience for time domain observations *across all wavelengths*

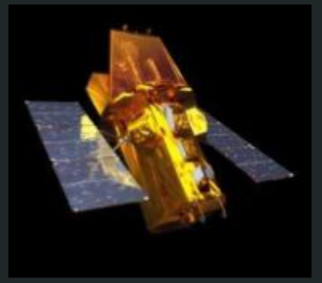
- Enable follow-up of discovery alerts
- Minimize workload and disruption from ToOs
- Maximize flexible and responsive modes of observations at different timescales
- Software tools for convenient workflow

Street et al., 2020, SPIE, 11449, 25

AEON+ Astronomical Events Observatories Network



AEON+ Compatible Facilities



Neil Gehrels Swift Space Telescope

Liverpool Telescope 2m

SAAO Intelligent Observatory telescopes

Work in progress:
Blanco 4m
Rubin In Kind Telescopes

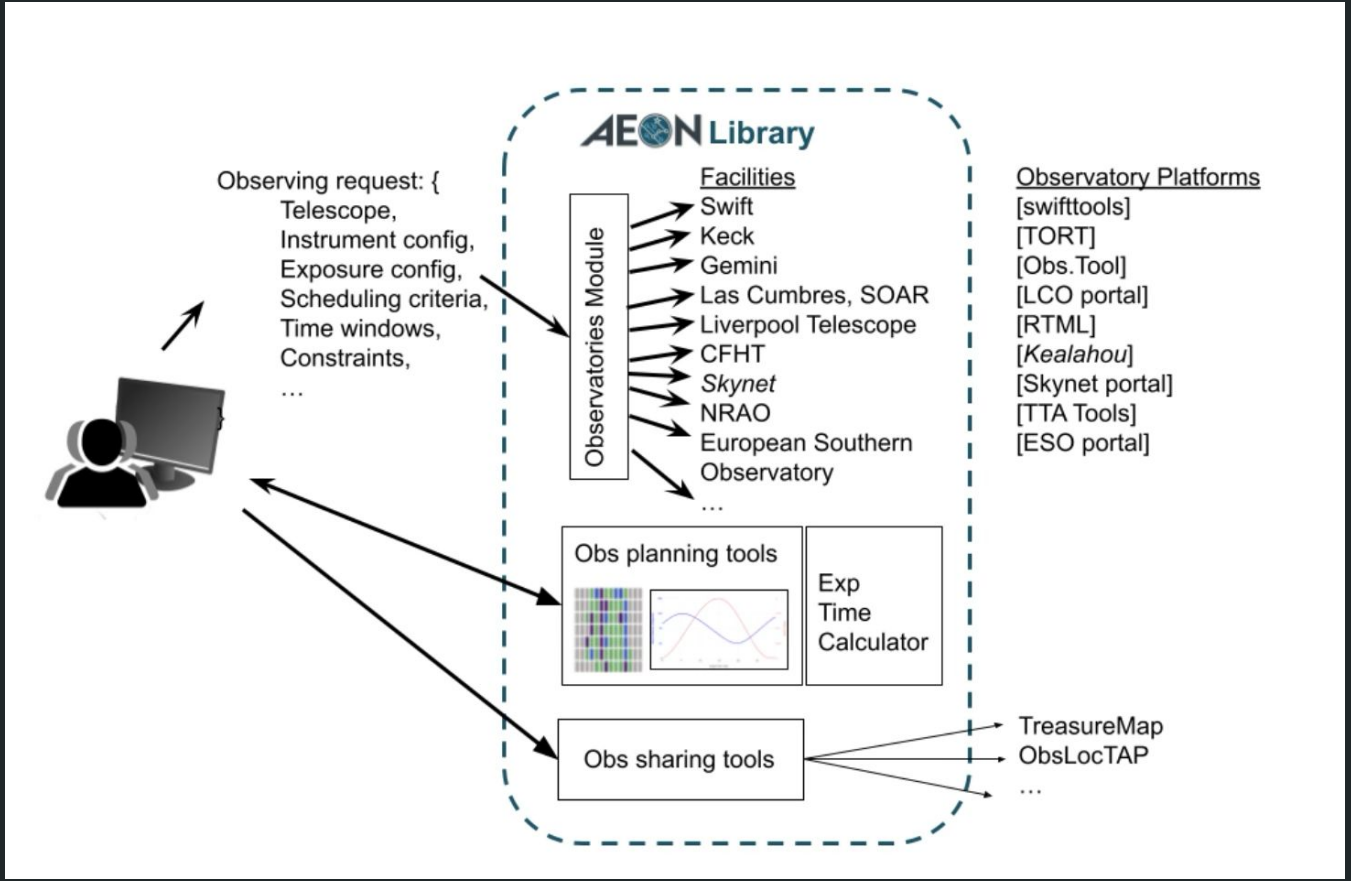
Image credits: Liverpool Telescope, NASA, SAAO, ESO

AEON+ : Extending AEON for multiwavelength follow-up

New NSF-supported program to expand the AEON Network

- New telescopes to be AEON compatible:
  - Canada-France-Hawaii Telescope 3.6m
  - Keck 10m
  - SkyNet Telescope Network (optical and radio facilities)
  - US National Radio Astronomical Observatory facilities
- CFHT software development for APIs and rapid ToO
- AEON+ standalone-library for observatory interfaces

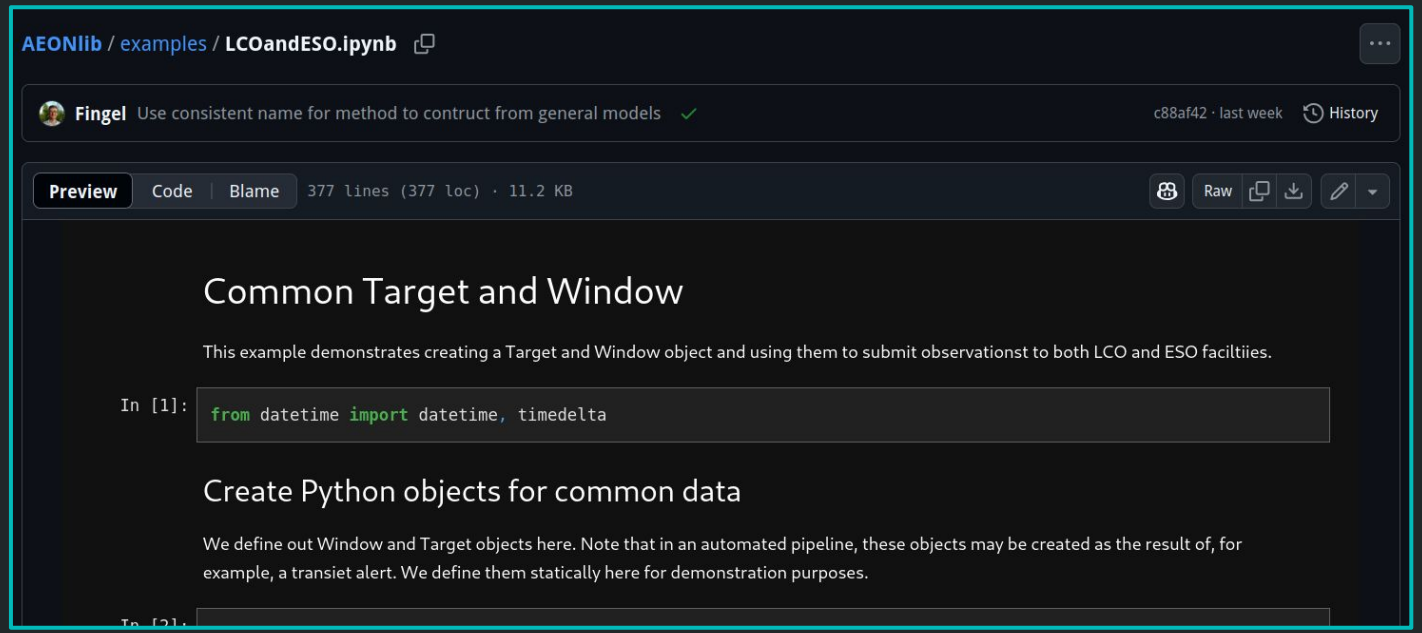
AEON+: Providing a uniform interface across telescopes



AEONlib: example Jupyter notebook: LCO and ESO submission

Demonstrates using common Target and Window data for submission to LCO and ESO.

This is early-stage development.



Autocompletion from pydantic

```
180
181
182
183
184
185
186
187
188
189
190
191
192
193
194
195
196
197  Lco1M0ScicamSinistroConfig(
198      exposure_count=1,
199      optical_elements=ElementConfig(),
200      exposure_time=20,
201  )
202
```

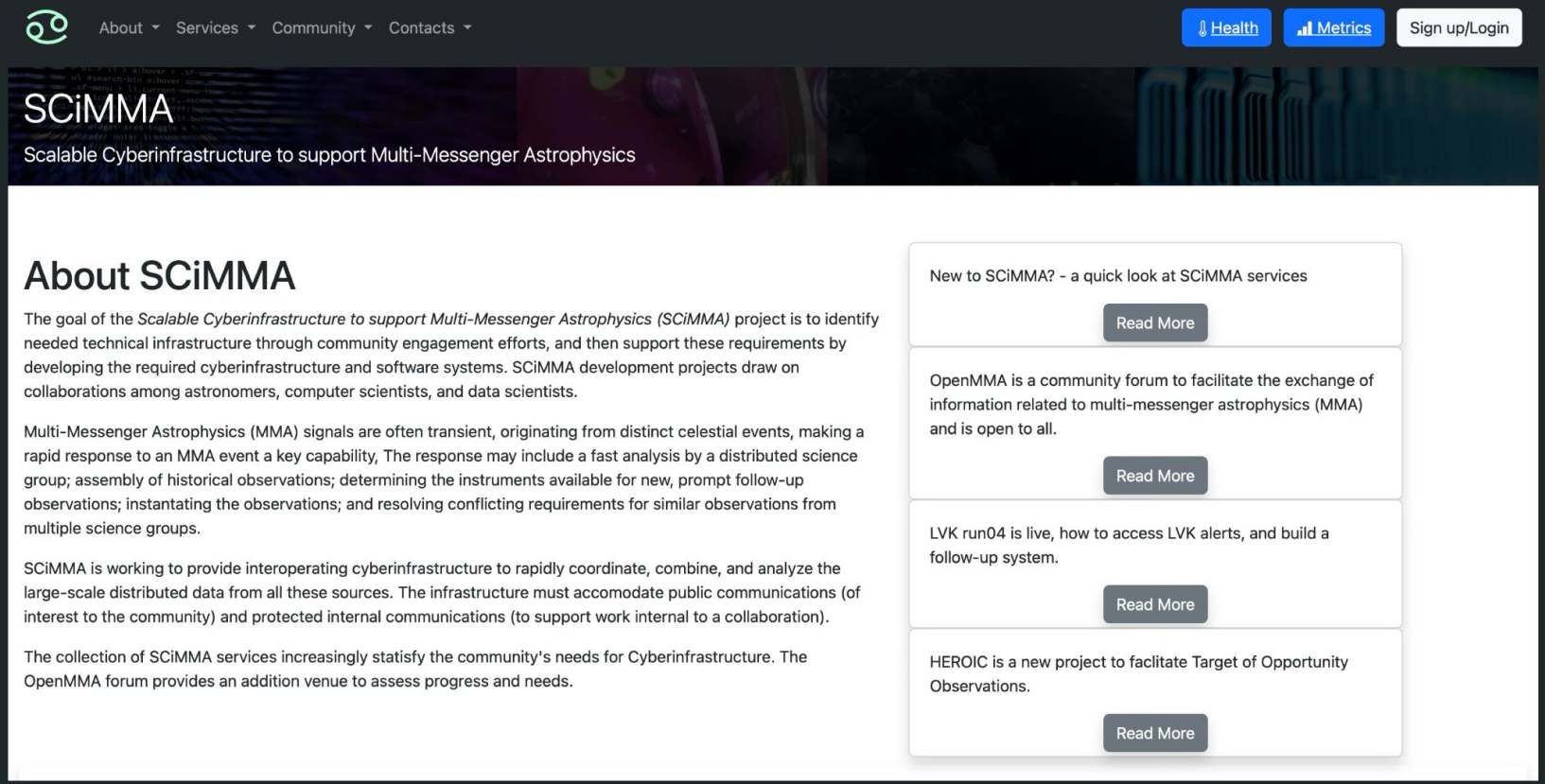
Validation

Accidentally setting exposure count to -3:

```
pydantic_core._pydantic_core.ValidationError: 1 validation error for Lco1M0ScicamSinistroConfig
exposure_count
  Input should be greater than 0 [type=greater_than, input_value=-3, input_type=int]
    For further information visit https://errors.pydantic.dev/2.11/v/greater_than
```

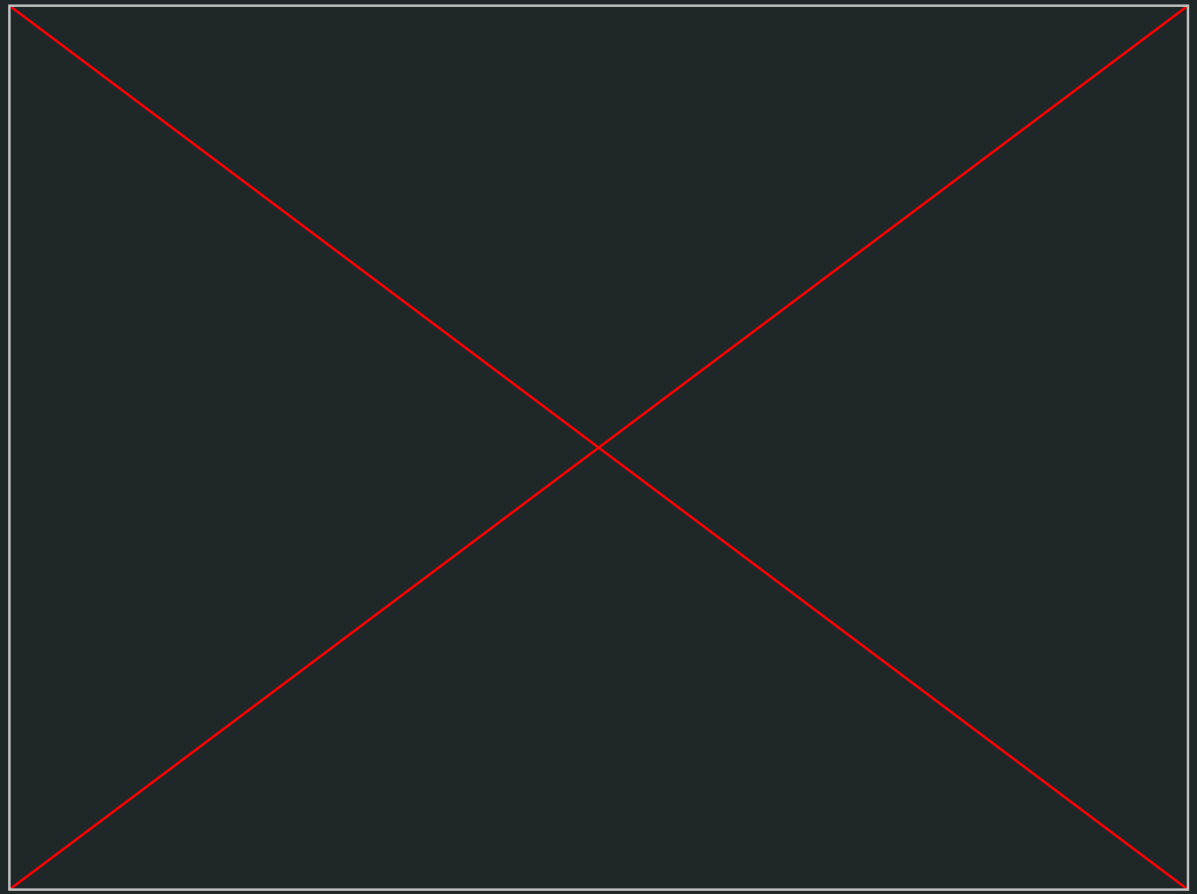
Client side logic prevents submitting invalid data to remote services which might contain their own bugs, or that have unexpected behavior when provided with unexpected values.

SCIMMA: Scalable Cyber Infrastructure for Multi-Messenger Astronomy



scimma.org

HEROIC



Where to find more information about AEON+ and AEONlib

- https://noirlab.edu/public/projects/aeon/
- https://lco.global/aeon/

- Project webpage
  - https://aeonplus.github.io/

- GitHub Organization
  - https://github.com/AEONplus
    - project board, AEONlib repo, etc.

Extra Slides

Keck Telescopes

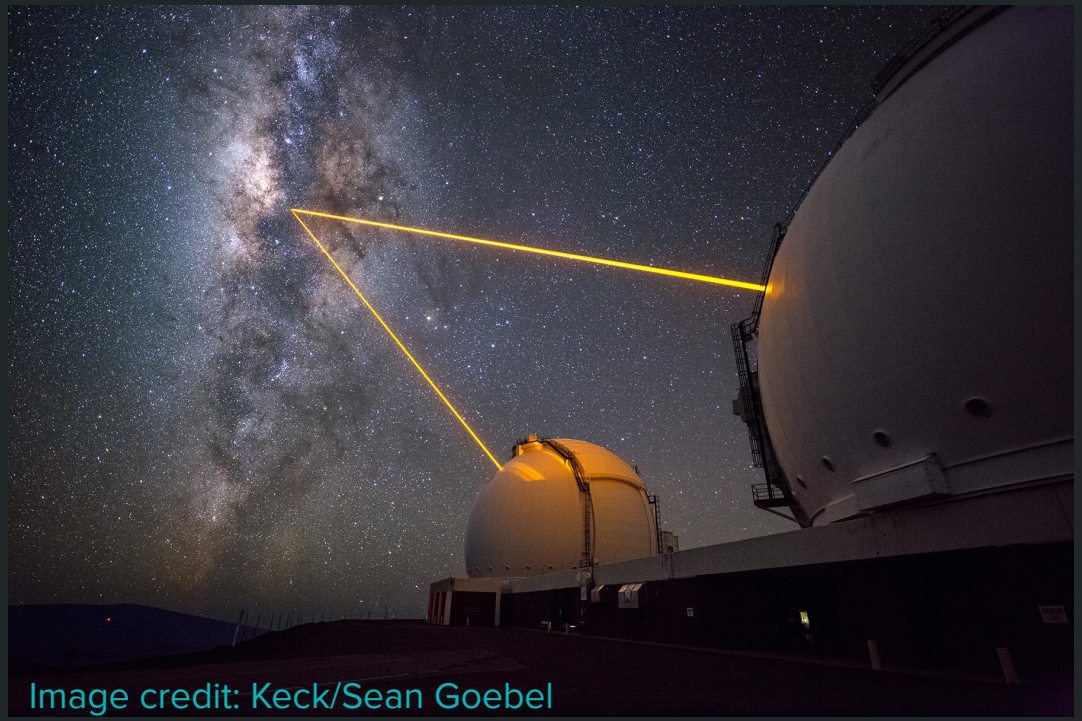


Image credit: Keck/Sean Goebel

Keck twin 10m telescopes

Optical/NIR instrumentation

Mauna Kea, Hawai'i

Recently announced API for observation submission

AEONlib module under dev

Skynet Telescope Network

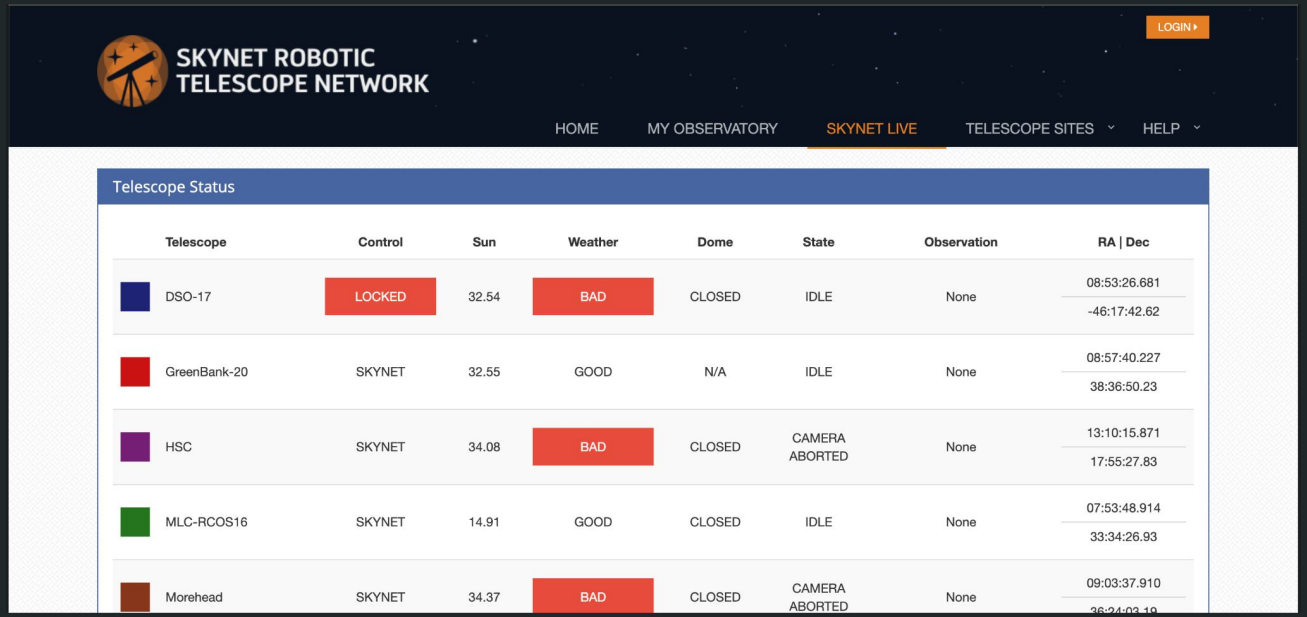


Image credit: UNC/Skynet

Network of 20 observatories coordinated from UNC

Optical telescopes + single-dish radio facilities

Programmatic interface

National Radio Astronomy Observatory

Operates all major US radio facilities, including

- ALMA,
- ngVLA
- Greenbank and more

Developing API for observation requests

Image credit: NRAO

Canada-France-Hawai'i Telescope

3.6m telescope, optical+NIR instrumentation

Mauna Kea, Hawai'i

100% queue-scheduled

Developing *Kealahou* API for obs submission

Developing rapid (<12hr) ToO capability

Image credit: CFHT/Cuillandre

Kealahou

Aloha, Rachel Street!

Current Account Information

Username	**rstreet**
First Name	**Rachel**
Last Name	**Street**
Email	**rstreet@lco.global**
Institute	**Las Cumbres Observatory**
Country	**USA**

Information incorrect? Update it!

K1 Kealahou Phase 1 Tool

K1, the Kealahou Phase 1 Tool

K1 has been developed to provide observing proposal submission and review for all five CFHT instruments: ESPaDOnS, MegaCam, SITELLE, SPIRou, and WIRCam.

K1 is used for proposal submission and review by NRC (Canada), CNRS (France), ASIAA, and NAOC, as well as

K2 Kealahou Phase 2 Tool

K2, the Kealahou Phase 2 Tool

K2 has been developed for preparing Queued Service Observations (QSO) for ESPaDOnS, MegaCam, and SPIRou. SITELLE and WIRCam use the Legacy PH2 Tool.

K2 Tutorials

Kealahou system

Currently supports observation requests for ESPaDOnS and SPIRou

Adding support for MegaCam

AEON+ will enable Kealahou access by external observers

Kealahou rToO

Target of Opportunity requests currently require 12hr+ notice

AEON+ includes the development of a rapid ToO process which will enable ToO requests to override science operations in progress, reducing this notice period to minutes.

AEON+ Tasks for CFHT

- Activity 1: Expand and secure the APIs necessary for users to retrieve a list of available templates and submit target and observation timing information to Kealahou.
- Activity 2: Implement the Rapid Target of Opportunity (rToO) capability for Kealahou.
- Activity 3: Document and publish the API definition.
- Activity 4: Develop AEONlib module for observation requests

AEON+ Workshops and Visiting Developer Program

- Annual workshops for observatory operators to encourage sharing of experience and tools

- Enable visits to LCO HQ for observatory and community developers