Next Generation TDA at Gemini: AEON, TOMs, GPP

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NSF’s NOIRLab
Due to queue, Gemini has always done a substantial amount of time-domain astronomy (TDA).

ToOs make up about 20-25% of the time charged in Band 1

- Max ToO rates are ~1-2/night
- The process is rather manual and not as efficient or capable as it could be

In the era of time-domain surveys (e.g. ZTF, Rubin/LSST) and MMA we must be prepared for a higher rate of ToOs.

Improvements are underway to attain Gemini’s strategic goal of being the premiere ToO follow-up facility while continuing to enable the breadth of PI research pursued by the Gemini community.
Surveys
LSST
ZTF
Gaia
ASAS-SN
++ more

Brokers & Catalog Servers
ANTARES, Lasair
ALeRCE, Simbad
Vizier, MAST, CADC,
++ more

TOM Systems
Astronomer-led projects

Data products
LCO Network
SOAR
NSF OIR Lab Archive
LCO Archive
 Gemini API
 Gemini Archive
 Gemini

AEON
Astronomical Event Observatory Network
Extendable network of
programmatically-accessible
telescope facilities
Instrumentation for TDA and Follow-up

Most facility instruments can be used for ToOs. Workhorse optical/NIR instruments will be the most useful for follow-up.

**Gemini North**
- Optical: GMOS-N, GNIRS, IGRINS2
- Near-IR: NIRI, GPI2
- AO: ALTAIR, NGS & LGS

**Gemini South**
- Optical: GMOS-S, SCORPIO*, GHOST
- Near-IR: FLAMINGOS-2, SCORPIO*, GSAOI
- AO: GeMS (MCAO), LGS (5)

Mid 2020s facility instrumentation
Target/Observation Managers (TOMs) match targets with telescopes, coordinate observations, and manage data.

In use by SNe, exoplanet, NEO, AGN, and microlensing teams. Useful for non-TDA projects, e.g. lots of targets, large teams. LCOgt has developed a toolkit: https://tom-toolkit.readthedocs.io/en/stable/
The Astronomical Event Observatory Network (AEON) is a collaboration between NOIRLab and Las Cumbres Observatory to develop and promote a network of programmatically accessible, dynamically scheduled telescopes.

1. Develop interfaces (APIs)
2. Use SOAR as pathfinder facility, running with LCOgt scheduler, queue on dedicated nights
3. Encourage data pipelining and archiving efforts
4. Incorporate Gemini, implement APIs and an automated queue scheduler
5. Investigate new TAC processes to enable the best use of the network
6. Be ready to incorporate other facilities (Rubin in-kind contributions, Blanco, etc)

https://noirlab.edu/public/projects/aeon/
https://lco.global/aeon/
The AEON working group and Gemini Board have been discussing TAC processes for making the best use of the network

Aims:

- Make it as easy as possible to apply for multiple facilities and minimize multiple jeopardy
- Meet participant requirements for proposal evaluations

Adopted concept:

- Gemini proposals evaluated by the NTACs
- Proposals for facilities allocated by NOIRLab evaluated by the NOIRLab/CSDC TAC process (e.g. Rubin in-kind, SOAR, LCOgt)

Now working on implementation details and software requirements.
Gemini currently works within AEON via a plugin for the TOM Toolkit and existing APIs

TOM (Target Observation Manager)
- The plugin provides an interface for requesting Gemini observations
- Also allows automatic triggers

The ODB API allows programmatic submission of observation requests (ToOs) - but is limited
- https://github.com/bryanmiller/gsselect

The Gemini Observatory Archive APIs allow the downloading of raw data
- https://archive.gemini.edu/help/api.html
- https://github.com/bryanmiller/pygoa_gemini
Gemini triggering is being incorporated into the toolkit.
Gemini will better support AEON via the Gemini Program Platform (GPP) and GEMMA

GPP - core of a new OCS

- Easier to use - replaces PIT, OT
- Web apps + APIs + database
- GN/GS observations in the same program
- Promotes automation
- Constraints needed for the scheduler
- Makes code more maintainable

For more information:

https://www.gemini.edu/observing/operations-development
https://www.youtube.com/watch?v=QNb-FCzGftE
https://noirlab.edu/public/products/mirro/mirror002/
GPP is now under construction, it has come a long way since the last Gemini Science Meeting...

2018

Have a Phase “0” tool for discovery of the appropriate instrument/mode for a project

- Near-IR spec, R~2000 ⇒ F2, GNIRS
- Optical spec, R > 20000 ⇒ GHOST, GRACES
- Imaging, FWHM < 0.1” ⇒ GSAOI, NIRI

2021

- [Configuration Table]

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Physical conditions on target (e.g. FWHM)

Build around the ITCs

Calculate overheads, execution probability
Physical conditions on target (e.g. FWHM)
We anticipate community testing to start in early 2022

We will organize a testing group/advisory committee by the end of the year.

We are planning demonstrations at the January AAS meeting.

Early testing will include:

● Filling in questionnaires on features and usability
● Mock use sessions
● Interviews
● Quantitative use tests (timed activities with old/new systems)

Let us know if you are interested in participating.
In late 2022 we are planning an early science/testing phase (XT)

XT1
- A special call for GMOS imaging/longslit
- ~5% of telescope time (~100hr/tel) for a reasonable evaluation, scheduler testing

XT2
- Testing as new instruments/modes are implemented
- Convert existing programs, give PIs a time bonus as motivation

Full operations is currently expected in 2024.
Gemini is implementing real-time scheduling and data reduction as part of the NSF-funded GEMMA (Gemini in the Era of Multi-Messenger Astronomy) project.

Scheduler - in prototyping and design stage

- Updates plans in real-time (weather, ToOs, etc)
- Schedule Gemini North and South together
- More capable APIs

Real-time data reduction

- DRAGONS pipeline (see talks by K. Labrie, Wed/Thurs)
- GMOS imaging/longslit initially
- Quick look reduction for QA in use
- Science quality reduction for 2022
- Archive updates

https://www.gemini.edu/gemma/
https://github.com/GeminiDRSoftware/DRAGONS
Summary

Gemini is aiming to be the premier 8-m class member of a follow-up network that will consist of:

- Brokers (alert filters)
- TOMs (target/resource matching)
- Dynamic scheduling and execution
- Telescopes from 1m aperture and up with workhorse instruments
- Real-time data reduction pipelines

Gemini is constructing a new observing system to support follow-up and to make using Gemini easier for everyone.

Community involvement will be vital.

https://www.gemini.edu/observing/operations-development

Discovering Our Universe Together