Gemini Observatory
Strategic Planning &
Wide-Field Astronomy

John Blakeslee
October 10, 2018
Perimeter Institute, Waterloo
Gemini Observatory:
Operating twin 8.1 m telescopes on Mauna Kea and Cerro Pachón, providing access to the entire sky

Dr. Jennifer Lotz Appointed Gemini Observatory Director

WHAT IS GEMINI?
GEMINI OBSERVATIONS

PROPOSAL MODES:

• **REGULAR PROGRAMS** 70% of all observing; call twice a year, deadlines ~Sept 30 and ~Mar 30.

• **LARGE AND LONG PROGRAMS** Proposals accepted annually; programs start in the B semester. Run 2 to 6 semesters; up to 20% of available observing time at each telescope. 20 programs accepted to date (7 on-going).

• **FAST TURNAROUND** 10% of time at each telescope. Proposals accepted monthly. If you apply, you are asked to peer review the other proposals.

• **POOR WEATHER PROPOSALS** Can be submitted at any time. Executed if nothing else is observable.

• **DIRECTOR’s DISCRETIONARY** 5% of time at each telescope. Proposals accepted anytime, and open to everyone.

OBSERVING (done from the Base Facilities in Hilo and La Serena):

• **QUEUE** Carried out for the PI by the Observatory staff. Observing conditions are best matched to the program. PIs can “eavesdrop” during the observations.

• **CLASSICAL** Carried out by PIs (extremely rare; 1 night min).

• **PRIORITY VISITOR OBSERVING MODE** PIs are at the base facility for any length of time, and can interrupt the queue to run their own program (Band 1 Programs only).
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Subaru-Gemini Time Exchange

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Introduction

This document presents a Strategic Vision for the Gemini Observatory, focusing on its role beyond 2021. At this time the infrared-optimized James Webb Space Telescope (JWST) will have been gathering data for over two years, the Large Synoptic Survey Telescope (LSST) will be near the end of its science commissioning phase and will soon be embarking on its ten-year all-sky survey. Construction of the Giant Magellan Telescope GMT), the Thirty Meter Telescope (TMT), and the European Extremely Large Telescope (E-ELT) will be well underway, hearkening in a transition from the present ‘8m era’ into one where the dominant ground-based telescopes will
Gemini in the Era of Multi-Messenger Astronomy:
High Image Quality & Rapid Response
aka “The $26M Project” (or $33M CAD)

• New Multi-Conjugate Adaptive Optics at Gemini-North (GNAO), incorporating a deformable secondary
  + New Real-Time Computer for AO system at Gemini-South.

• Operations improvements and data pipeline development to optimize rapid follow-up of transient sources

• Education & public outreach programs on the general theme of “Multi-Messenger Astronomy”

• All funds must be spent by 30 Sep 2024 (5 years after FY19).
4x multiplexing advantage over similar instruments.

GIRMOS Architecture
PI: Suresh Sivanandam, U. Toronto

Spectrographs
Object Selector

MOAO System

Deformable Mirror

IFS

Gemini GeMS Focal Plane

Open-loop AO

2 arcminute

CFI Funding

$18M budget
Gemini Follow Up of Light from Gravitational Wave Event

http://www.gemini.edu/node/12719

- GW170817: the first Gravitational Wave signal detection from a neutron-neutron star merger, and the first with an identified electromagnetic counterpart

- Gemini observed the kilonova explosion using GMOS and FLAMINGOS-2 during a 30-day follow-up campaign by 2 Rapid ToO & 4 DDT Programs

- Gemini F2 data “collectively the longest-running, and finest, infrared imaging and spectroscopy of this object available.” (Edo Berger, press release)

- Gemini data helped enable triggering of HST and Chandra observation as part of a coordinated program (PI Eleonora Troja)
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Gemini/FLAMINGOS-2 data

Chornock et al. 2017

GW170817

+4.5 d

Kasen et al. 2017
red kilonova model
M = 0.04 M☉
v = 0.1 c
Xlanthanide = 10⁻²
Gemini is a key resource for OIR follow up of LSST.
Synergy in Plan: LSST follow-up

“Beyond 2021, Gemini should exploit its geographical location & agile operational model in order to be the premier facility for the follow-up investigation of targets identified by the LSST.”

- Ongoing work on a Transient Follow-up System (“AEON”) involving Gemini, Las Cumbres Observatory, and NOAO facilities (+ CFHT?) linked to a transient event broker, initially for ZTF, LIGO, etc.

- Effort at Gemini closely linked to the ongoing OCS upgrade project, undertaken to modernize Gemini’s proposal, scheduling, and operations software.

- We are developing a plan for how the Transient Follow-up Network will work in practice, but full partnership will have access to all; we need your involvement (ToO advisory group forming)!
LSST followup will span a range of timescales.

High priority, rapid response TOOs

• rare triggers: minutes-hours response time
• GRBs, GW EM counterparts, nearby young SNe
• other unusual transients…

Routine but time-sensitive followup

• common events or longer evolution timescales
• CVs, SNe, TDEs, odd variable stars, comets, asteroids…
• New observing & operating modes can improve efficiency

Static science

• large samples, no time variation
• well-matched to multi-object spectroscopy
• Ultra/Hyper-MP stars, distant galaxies, quasars…
• Simultaneous 8-band photometry or spectroscopy over 3.3’ field
• Rapid identification, and characterization of transients
• High-time resolution follow-up, from minutes to years
• Also a panchromatic workhorse instrument for static sources

PI: Massimo Roberto, STScI
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See Alexander van der Horst’s talk from July 2018 – Science & Evolution of Gemini Observatory Meeting Website
Gemini South is well-placed for rapid LSST follow up.

But proximity also has its limitations...
Gemini North provides longitudinal baseline. Gemini sites have greater E-W than N-S separation; provides six additional hours of observations for follow-up.
Gemini is partnering with the Las Cumbres Observatory Network to maximize the efficiency of follow up in Time Domain Era.
A new discovery “ecosystem” needed to identify alerts of interest & obtain rapid follow-up observations.
The proposed AEON solution is a follow-up system that dynamically turns alerts into requested data.

Surveys = LSST, ZTF, etc
Brokers = ANTARES, possibly others.

Time domain infrastructure workshop
(https://www.noao.edu/meetings/lsst-tds/)

We’re also working hard on robust data pipelines

Credit: Bryan Miller
AEON = NOAO/SOAR/Las Cumbres/Gemini collaboration to enable dynamic scheduling of targets from TOMs on SOAR, Gemini,… others welcome.

Also, Gemini is now assembling a focus group of ToO users to advise us on the overall strategies for rapid follow-up in the LSST/TDA Era.

Please talk to me if you’re interested!

Goal: Gemini/AEON ready for rapid response by 2022