

Gemini Observatory 2021-2030 Strategic Plan Update

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Science & Evolution of Gemini

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Beyond 2021: A Strategic Vision for the Gemini Observatory

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“The bravest are surely those who have the clearest vision of what is before them, glory and danger alike, and yet notwithstanding, go out to meet it.” – Thucydides

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

Elements of the Strategic Vision

The community survey provides strong evidence for an overall cohesion in the Gemini community. The following elements of a post-2021 strategic vision reflect a synthesis of the input provided by the various stakeholders:

- 1. *Independent evolution of the telescopes.*** The 'two telescopes, one observatory' model may remain desirable post-2021, but it should not be an axiomatic. There is a strong sense amongst stakeholders that the additional degrees of freedom that would develop from allowing the telescopes to take on independent identities could enhance the overall science impact of the Observatory, and such models should be actively explored.
- 2. *Specialization of one or both telescopes.*** It is widely accepted by most stakeholders that as 30m-class telescopes come on-line, 8m-class facilities may be able to enhance their relevance by appropriate specialization.
- 3. *Preservation of Principal Investigator science.*** Notwithstanding the previous point, for a large fraction of the community Gemini is likely to remain their main visible/near-IR facility. Specialization must recognize this basic fact and provide balanced access to PI-mode instrumentation for a significant fraction of the available observing time.
- 4. *Synergy with other facilities.*** There is broad support in the community for enhancing scientific impact in post-2021 Gemini by operating in a mode that is closely synergistic with other observatories.

The degree of emphasis placed on the elements above differs from Partner to Partner, but that these central elements are held in common by all Partners was of paramount importance in developing the coherent vision for the Observatory that we turn to next.

Now we need to make a Plan...

“The future ain’t what it used to be.” – Yogi Berra (1925–2015)

The Gemini Board of Directors has instructed the Observatory to develop a **Strategic Plan** to implement the broad principles advanced in the Board’s *Strategic Vision*.

In addition to exploring “**independent evolution**” of the telescopes, involving possible **specialization** to maximize **synergies** with other major facilities, the *Strategic Vision* also emphasizes **building on existing strengths** of Gemini.

Focus Areas of the Strategic Plan

1. Preserving Gemini PI Science in the 2020s
2. Evolution of “Two Telescopes, One Observatory model”
3. Optimizing Gemini operations, especially for rapid follow-up of high priority transient sources
4. Enhancing Gemini’s Adaptive Optics Capabilities
5. Gemini User Support in the 2020s
6. Future of the Visiting Instrument Program

Taking them one-by-one....

1. PI-Driven Science in the 2020's

- **Semesterly proposals:** backbone of the current queue schedules; allows efficient planning.
- **Fast Turnaround programs:** popular and add flexibility.
- **Large & Long Programs (LLPs)** – adjust time fraction based on demand; distinguish **LPs** from multi-semester programs (**MPs**).
- **Director's Discretionary Time (DDT)** – proven effective for time-critical events; 14% of pub's in 2017, majority of press releases
- **Integration of Gemini into Transient Follow-up System**
 - Automatic triggering of brokered transients
 - Follow-up of LSST transients will be “PI-driven”
 - Developing plan for how system will work in practice

2. Evolution of the Two Telescopes Model

- From the *Strategic Vision*:
“Additional degrees of freedom that would develop from allowing the telescopes to take on independent identities could enhance overall science impact of the Observatory; such models should be actively explored.”
- Primary areas of scientific focus for the two telescopes may be expected to vary for geographical and instrumentation reasons.
- More flexible North/South time accounting may be scientifically desirable, possibly varying by semester based on partner demand.
- Some potential partners may only want to participate in one of the telescopes; could consider growing the partnership in this way.
- However, for the sake of operational efficiency, ease of maintenance, and redundancy (e.g., ‘Oumuamua follow-up), telescope hardware and operations software should remain as consistent as possible.

And what about specialization?

SCORPIO

8-channel imager and spectrograph capable of multi-band imaging, long slit broad-band spectroscopy and high-time-resolution (Gemini-South)

Simultaneous Spectral Coverage: 0.40-2.35 μm (imaging)

0.37 - 2.35 μm (spectroscopy)

Spectral Resolution: $R=4,000$

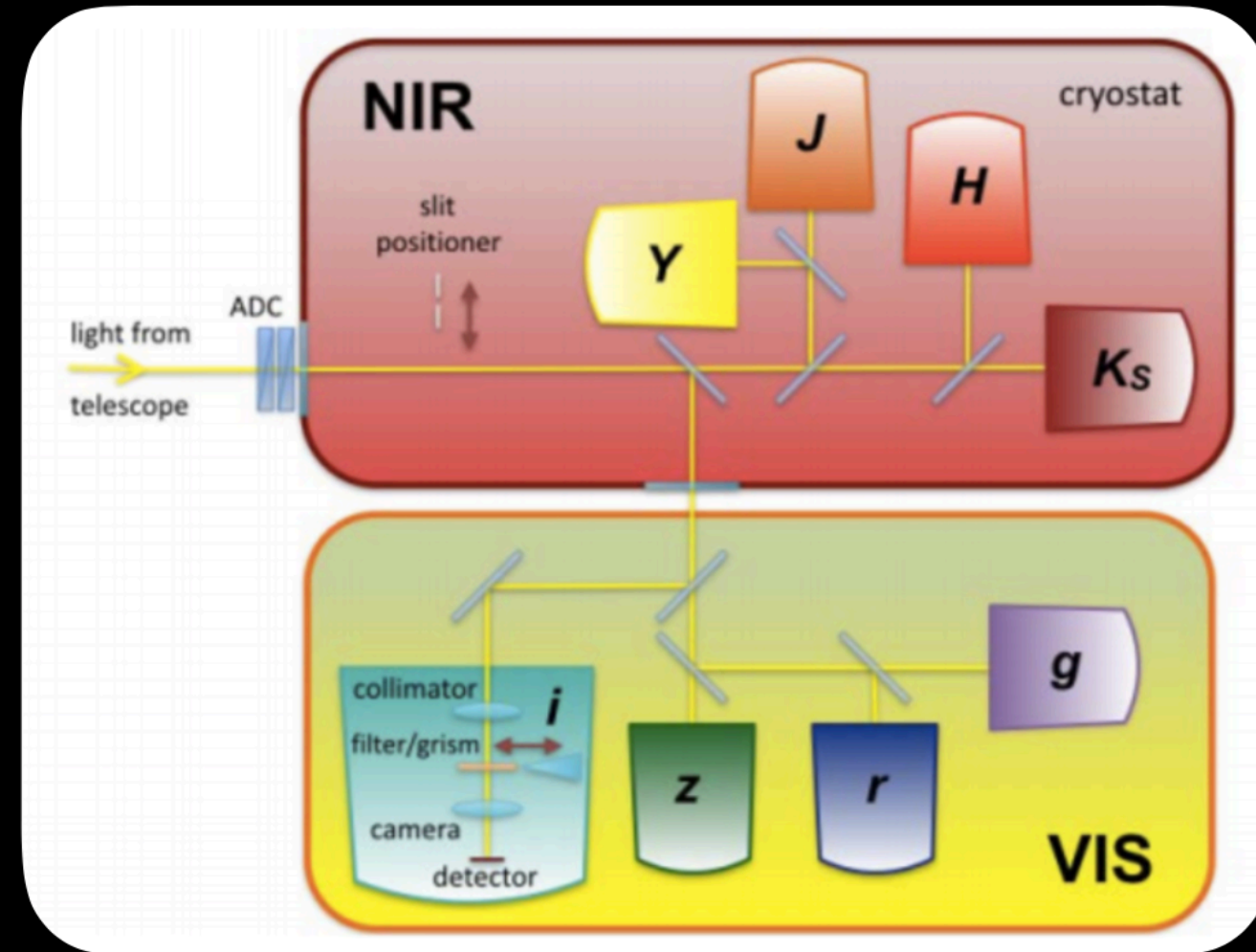
Time Resolution: 50ms

FOV: 3' X 3' (square)

$D= 4.24'$ (circular)

Plate Scale: 0.18 " /pixel

Science: Transient/variable events (fast radio bursts, gravitational wave sources, gamma-ray bursts, Supernovae, tidal disruption events), X-ray binaries, Neutron Stars, White Dwarfs, Transiting Extrasolar Planet, Trans-Neptunian Objects, Asteroseismology, eclipsing binary systems, AGNs, Galaxy clusters



Contract Signed on March 3, 2017

CoDR passed on August 3, 2017

Preliminary Design Kickoff on October 16, 2017

Expected Commissioning on March 2022



Cerro Pachón – Future site of the LSST



LSST

Large Synoptic Survey Telescope



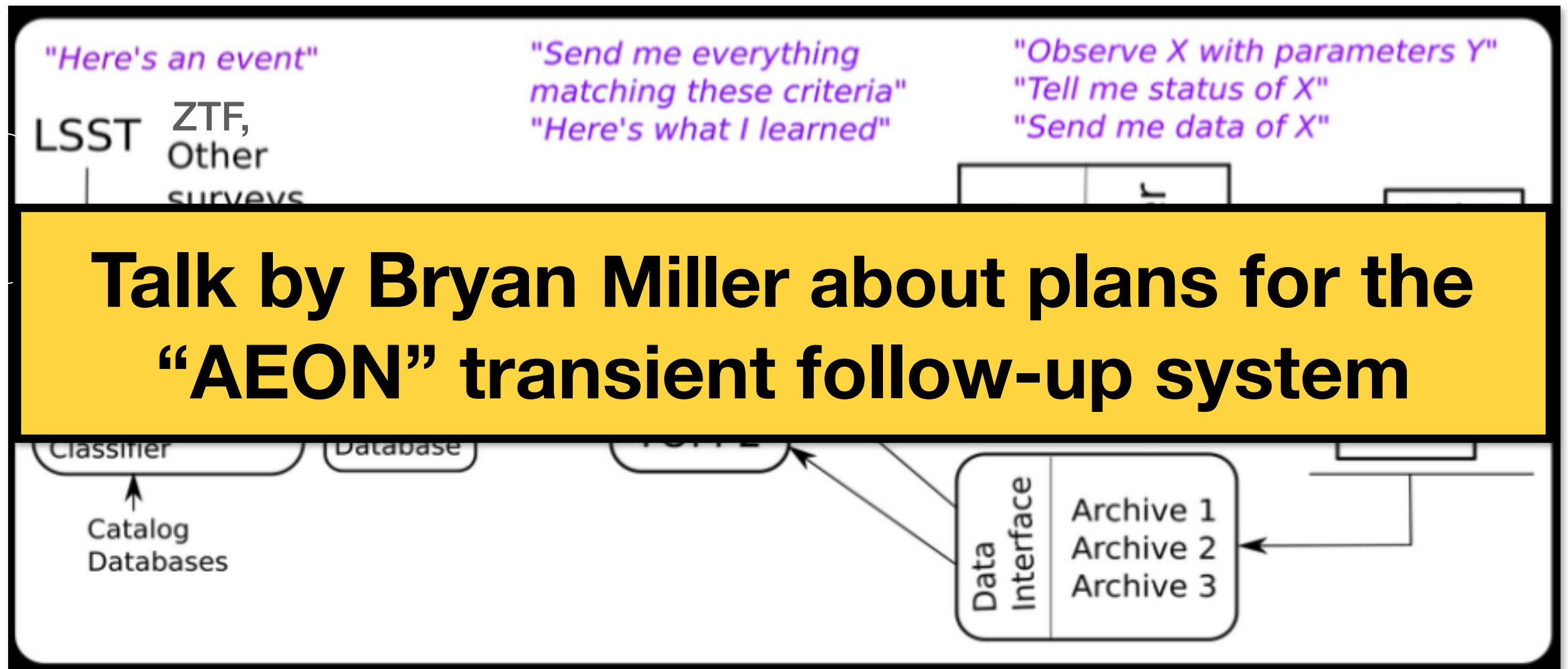
3. Synergy: “Premier Facility for LSST follow-up”

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

- Began formal discussions with NOAO and Las Cumbres Observatory about design and implementation of a Transient Follow-up System (AEON), linked to the ANTARES event broker, initially for ZTF transients.
- Project Scientists appointed at Gemini, Las Cumbres, and NOAO; regular team meetings to ensure coordination.
- We have also created a new internal project, “Integrating Gemini into the LSST follow-up System,” which encompasses all the internal effort; closely related to the ongoing OCS upgrade project.
- Developing plan for how the Transient Follow-up Network can work in practice, given real-life complications of time exchange, etc.

Sketch for a Transient Follow-up Network

“Time-Domain Astronomy Project”



Credit: Rachel Street, LCO

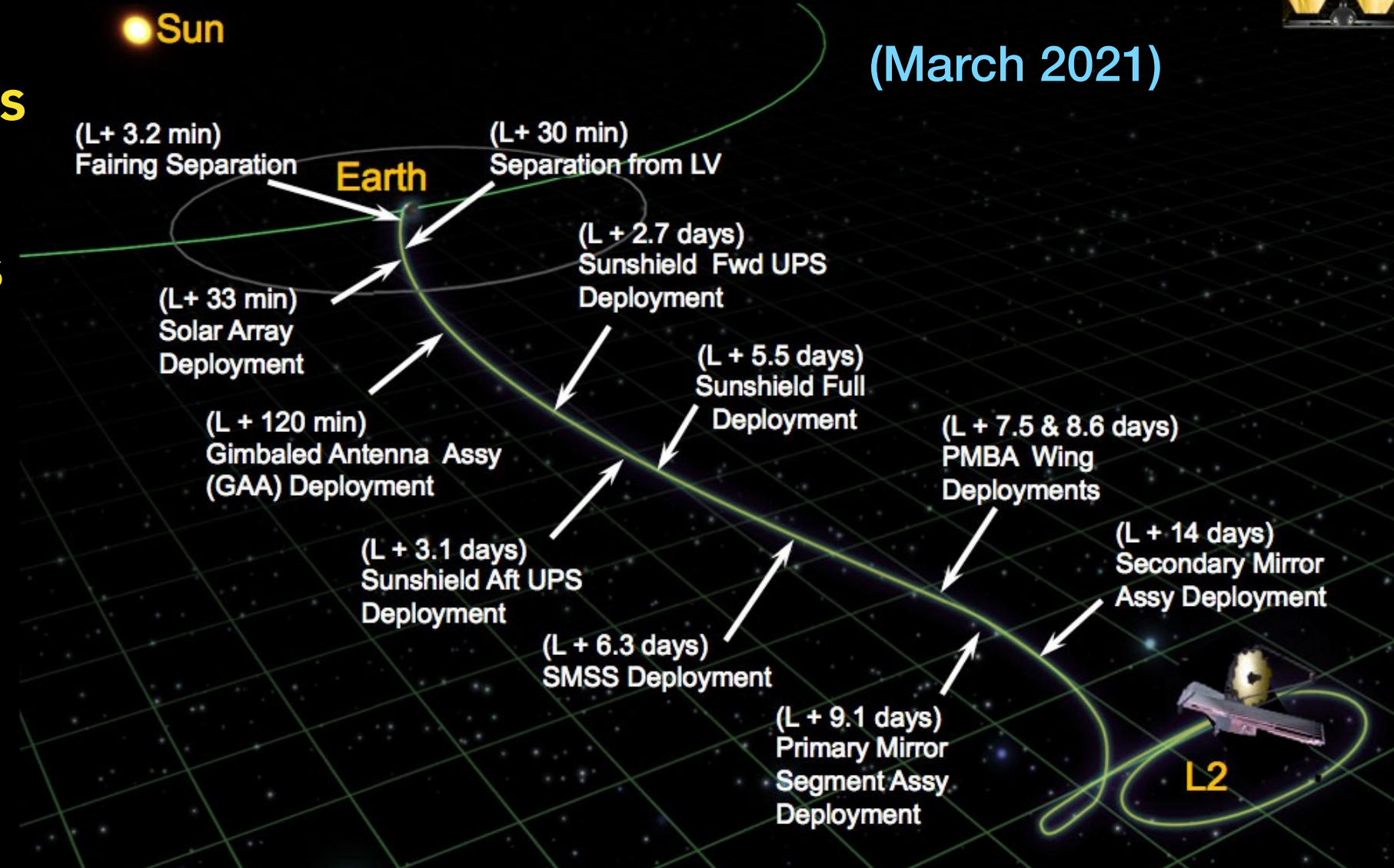


Strategic Plan

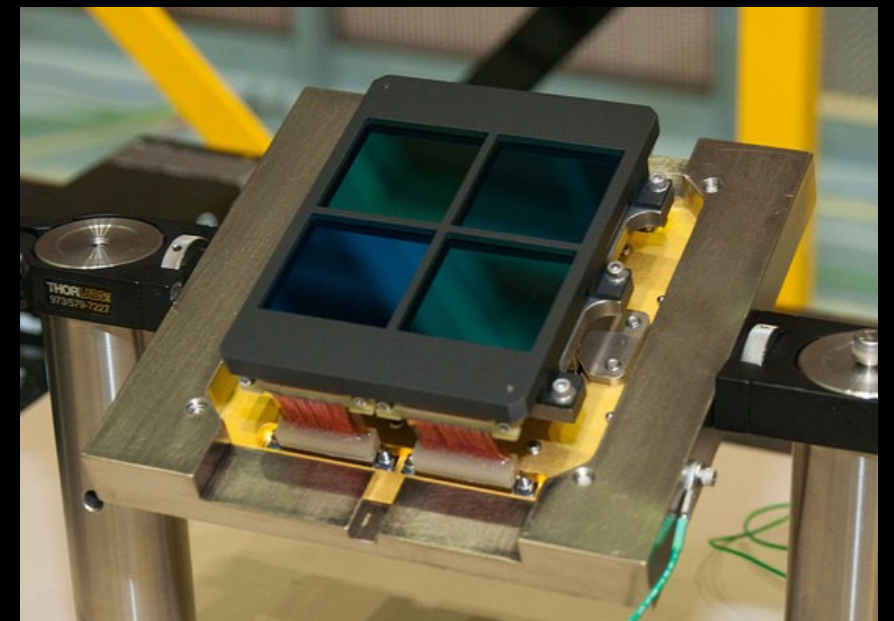
Building on strengths
to synergize with
other major facilities
in the 2020's...



JWST Launch/Deployment Timeline



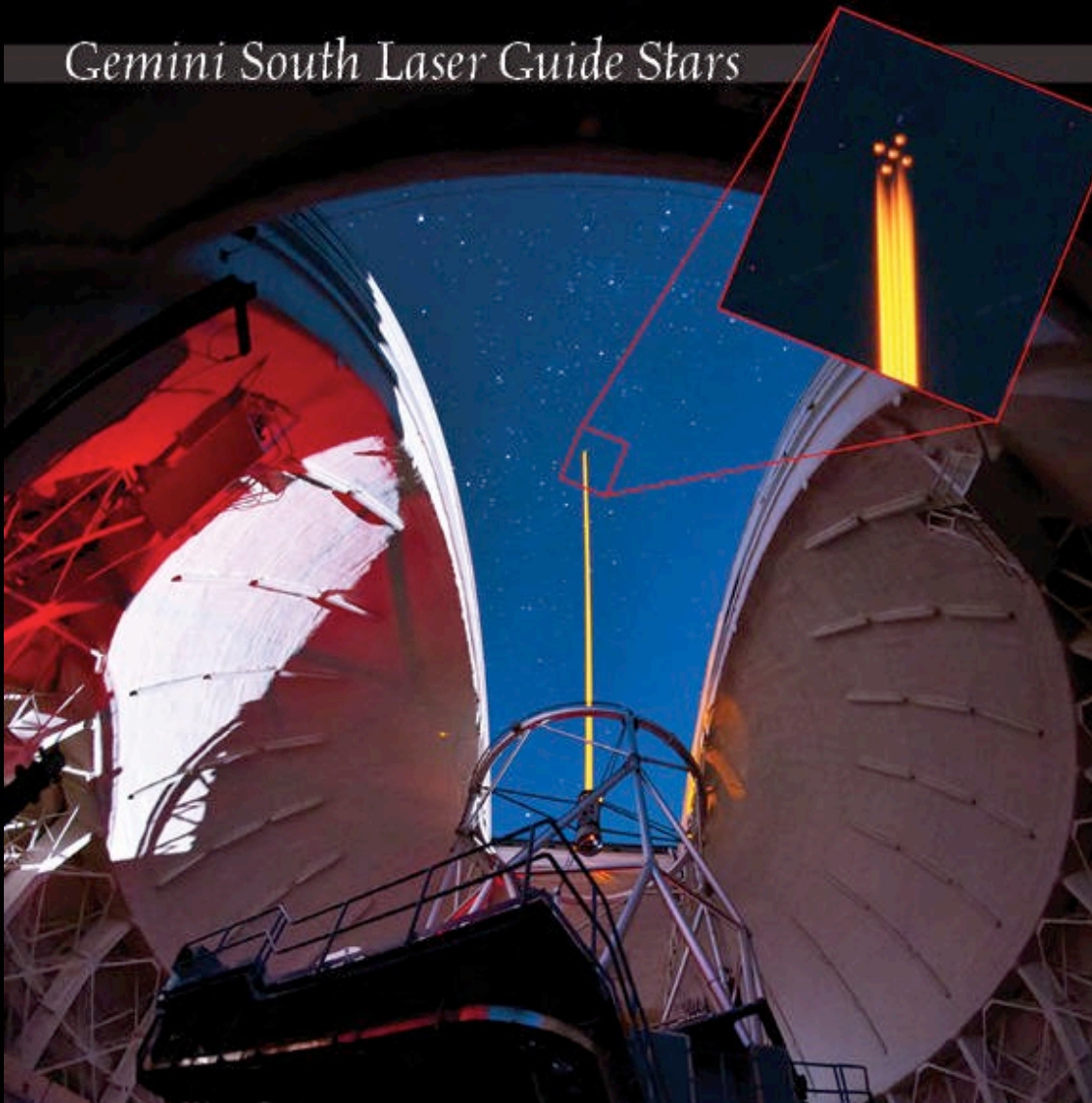
JWST NIRCам H2RG
(0.6–2.5 μm) detectors
mounted in focal plan
Module A.



GeMS/GSAOI

Gemini Multi-Conjugate
AO System (GeMS) delivers
images with FWHM $< 0.09''$
over the $1.4'$ field of the
Gemini South AO Imager.

Gemini South Laser Guide Stars



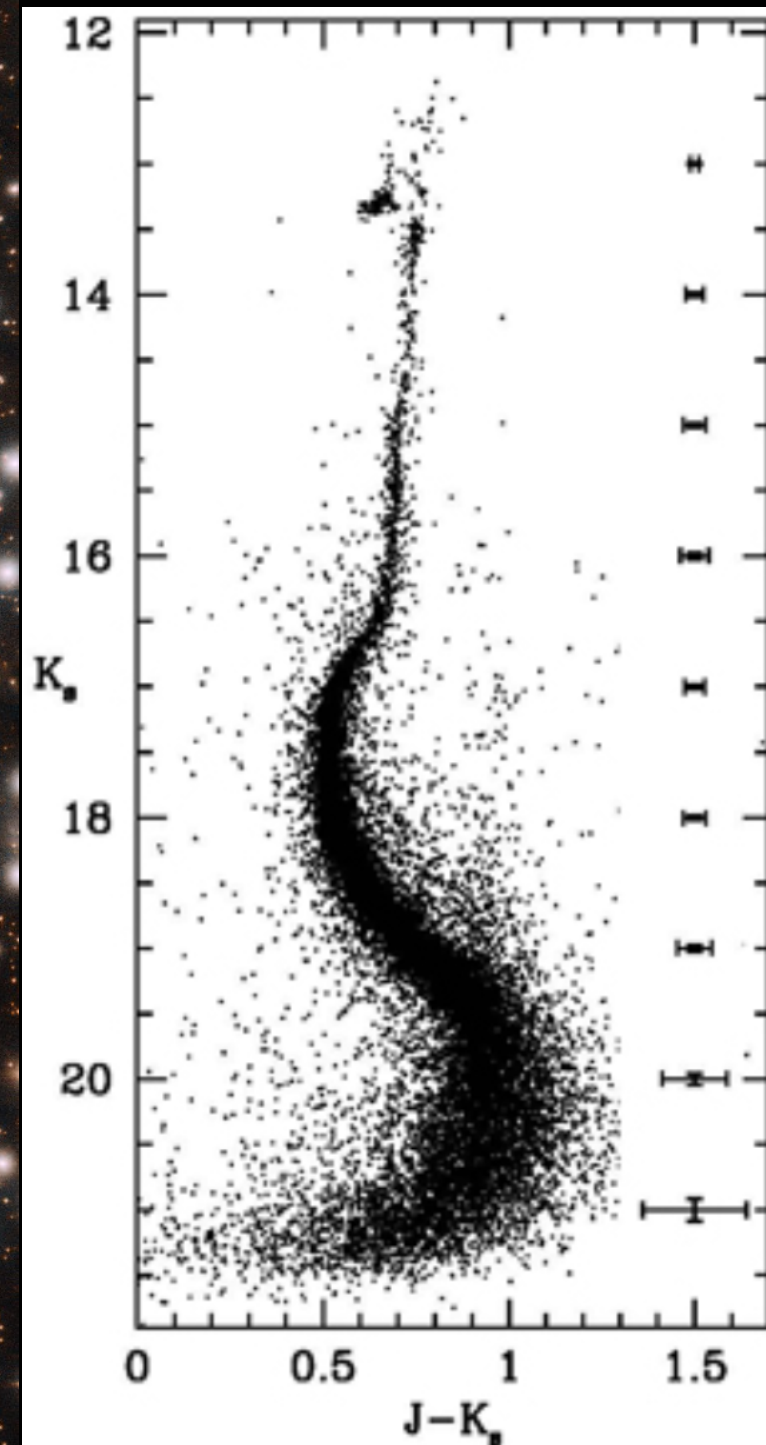
Bullets Rip Through Orion Nebula



Gemini Observatory
Legacy Image

Gemini Observatory/AURA/J. Bally (University of Colorado)
(Background Images: Space Telescope Science Institute/NASA)

Globular Cluster NGC 6624



4. Enhancing AO Capabilities at Gemini North

- Gemini telescopes were designed for optimal image quality, but the ALTAIR Adaptive Optics system at Gemini North, the better of the two sites, has become outdated.
- Gemini's AO team has investigated several possible options for revamping Gemini North's AO capabilities in the 2020s.
- GeMS Relocation Study: GeMS could be moved to the North, with an upgraded RTC, for a cost of about \$10M over 3 years.
- Considerable recent effort in conceptual design and costing for a new GeMS system, plus a deformable secondary mirror to act as DM0 and allow the possibility of full GLAO in the future.
- Will also be useful for visiting instruments such as GIRMOS.

5. Gemini User Support in the 2020s

- Gemini has a unique User Support Model involving the National Gemini Offices, Science Operations Groups (North and South), and the Science User Support Department (SUSD).
- Some uncertainties associated with possible restructuring under NCOA, but the plan is to maintain Gemini's SUSD.
- For the Strategic Plan, the main effort related to User Support is the development of flexible, automated, science-quality data reduction pipelines, written in Python, enabling real-time processing of triggered follow-up observations.
 - See *Kathleen Labrie's DRAGONS poster!*

6. Future of the Visiting Instrument Program

“Beyond 2021, Gemini should be viewed as the premiere hosting facility for visitor instruments whose scope and ambition may be comparable to that of ‘facility-class’ instruments.”

- The Plan on this point is to continue the popular VIP, with more emphasis on ambitious ‘facility-class’ instruments that will deliver new, high-demand capabilities to Gemini users (e.g., IGRINS, GIRMOS, MAROON-X, BATMAN).
- The details of “facilitization” of high-demand visiting instruments still being worked out, but a draft document “Converting Visiting Instruments to Facility Instruments” includes a proposed process with an example use case.

Summary

1. Preserve & enhance Gemini PI Science in the 2020s
2. Some evolution of “Two Telescopes, One Observatory”
3. Integration of Gemini into a time-domain network (AEON) for optimized follow-up of high-priority transients
4. Revitalize Gemini North’s Adaptive Optics system
5. General-purpose Python-based data reduction pipelines
6. A strong VIP, focusing more on facility-class instruments

Overall: a more capable, efficient, science-driven Gemini.