



NSF's NOIRLab Townhall

240th Meeting of the AAS
Pasadena, CA
June 13, 2022



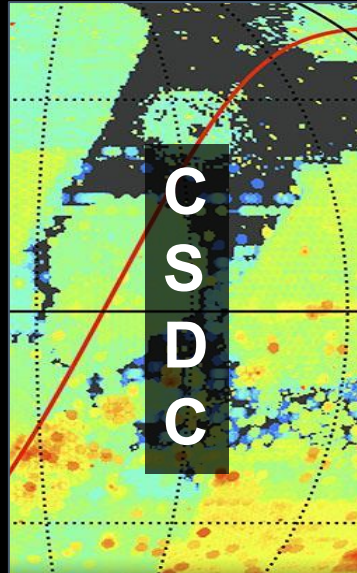
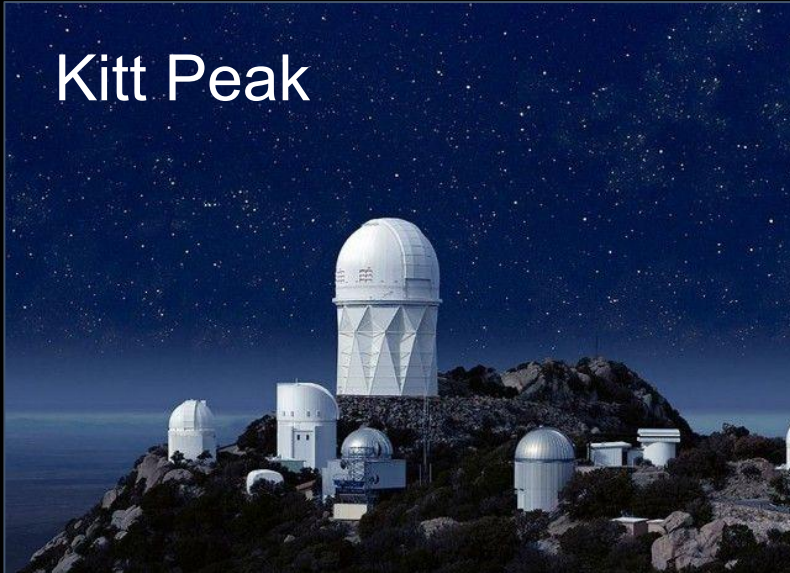
Program



- Astro2020 and NSF's NOIRLab
Patrick McCarthy
- New Capabilities and Next Generation User Support
Janice Lee
- Rubin Observatory Status and Transition to Operations
Bob Blum
- Towards Sustainable Observatory Operations
Bob Blum for Inger Jorgensen
- Q&A

NSF's NOIRLab

Kitt Peak



Gemini

With our international partners



Cerro Tololo

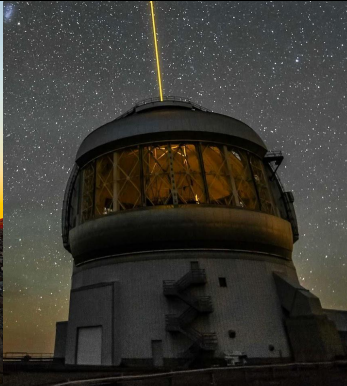


Rubin Observatory Operations

An NSF-DOE Partnership



A diverse Tool Kit



Rubin

Gemini S

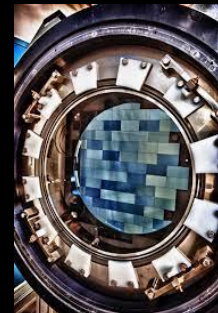
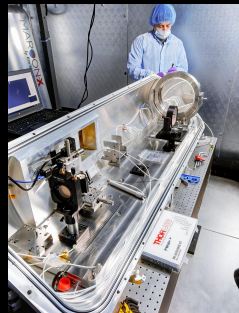
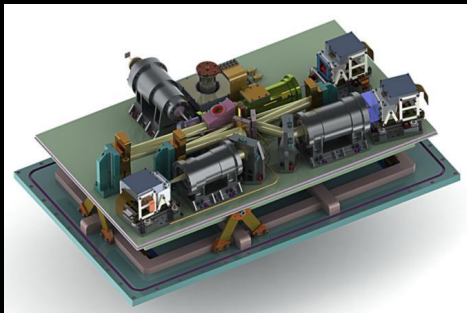
Gemini N

Blanco

SOAR

Mayall

WIYN



NEWFIRM
NOAO
@Blanco

IGRINS
KASI/UT Austin
@Gemini S.

MAROON-X
U. Chicago
@Gemini N.

DECam
FermiLab
@Blanco

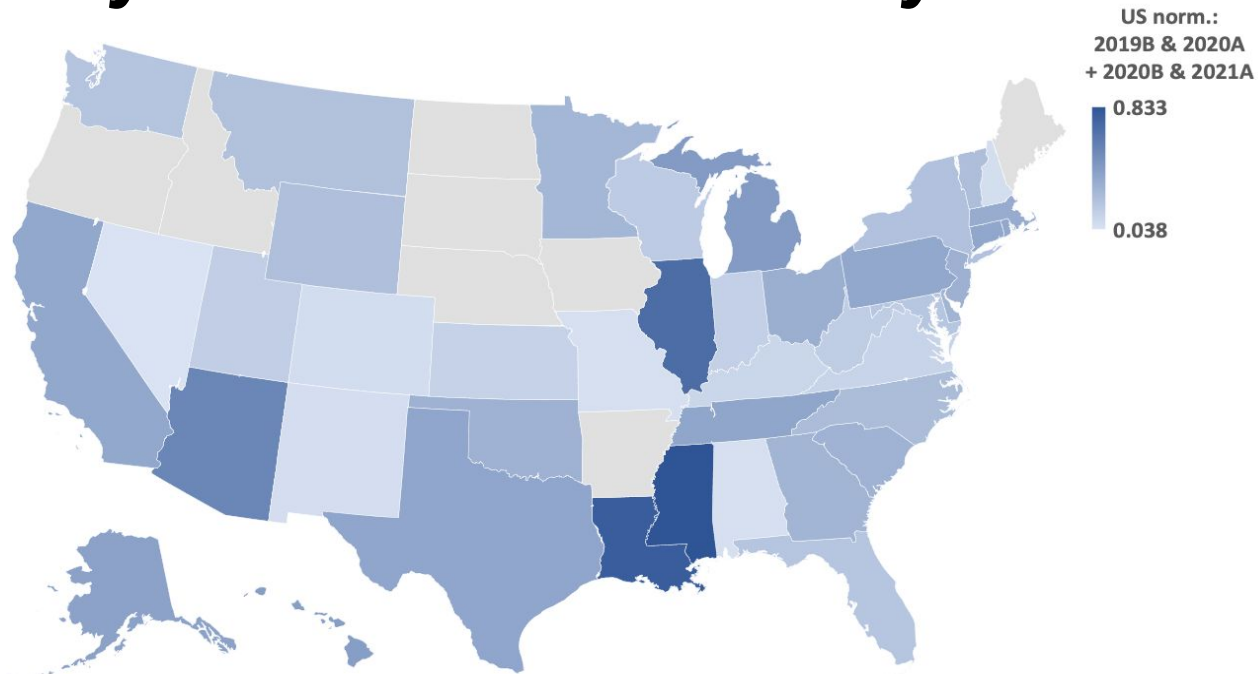
DESI
LBNL
@Mayall

NEID
Penn State/NASA
@WIYN



NSF's NOIRLab

By the Numbers.... today



Distribution of US users – 2019 through 2021
Normalized by AAS membership

Powered by Bing
© GeoNames, Microsoft, TomTom

2000 nights/yr of 4m and 8m telescope time

1200 proposals per year

700+ refereed publications in FY2021

500+ investigators/yr – US and international

31 instruments available

17 tenant telescopes on Kitt Peak and CTIO

> 37 billion distinct objects in data archive

> 7 Petabytes of data

> 2/3 of the sky with > 30 min exposure time



Key Themes from the Decadal Report

Invest in diversity, training, fellowships

Prize Fellowship, REU program, Interns

Collect demographic data – and outcomes

TAC demographic data, dual anonymous, success rates

Framework to address satellite constellations

IAU Centre and SatHub

More remote observing, less travel

Sustainability Program

Pipelines for Science Ready Data

CSDC+, DRAGONS

Community Astronomy model

Engaging Indigenous peoples



NOIRLab's Role in The OIR System*

Leadership of the
US ELT Program

Execution of Rubin's LSST...
providing open access to the data

Coordination of facilities & systems
for *Time Domain Astronomy*

Operation of unique capabilities
e.g., *DECam, NEID, GNAO, GEMS, DESI...*

Leadership in
community-based discussions for
the future

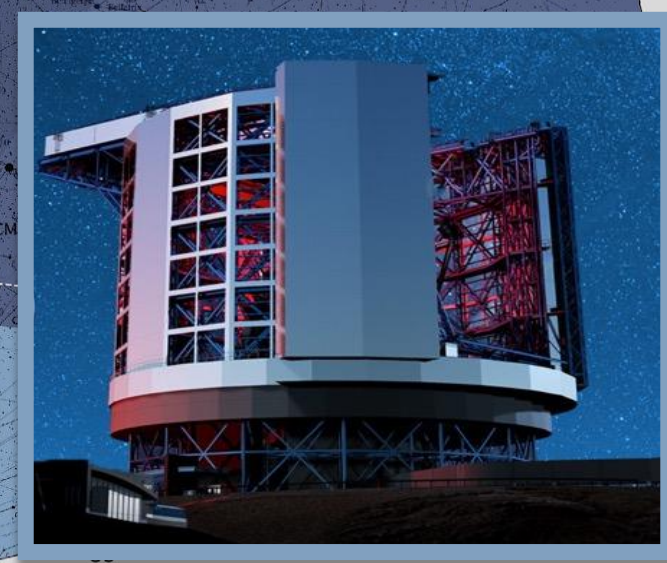
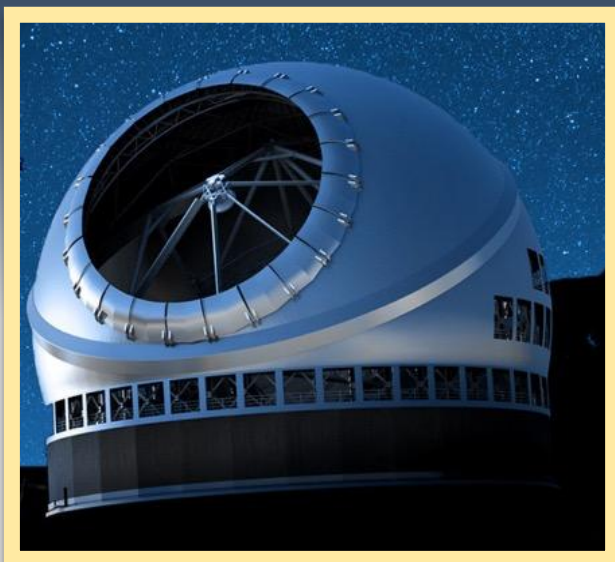
Contributing to a healthy R&D program of *Technology Development...coordination* of US excellence in the design and construction of instrumentation



Pathways to Discovery Report

*“Because of the powerful potential that large (20 – 40 m) telescopes with diffraction-limited adaptive optics have for astronomy, and because of the readiness of the projects, the survey’s priority for a frontier ground-based observatory is a significant U.S. investment in the Giant Magellan Telescope (GMT) and Thirty Meter Telescope (TMT) projects, ideally as components of a coordinated **U.S. Extremely Large Telescope Program (ELT) program.**”*

The US ELT System



US ELTP Open House
Tuesday 5:30 – 7:00
Ballroom D

Satellite Constellations

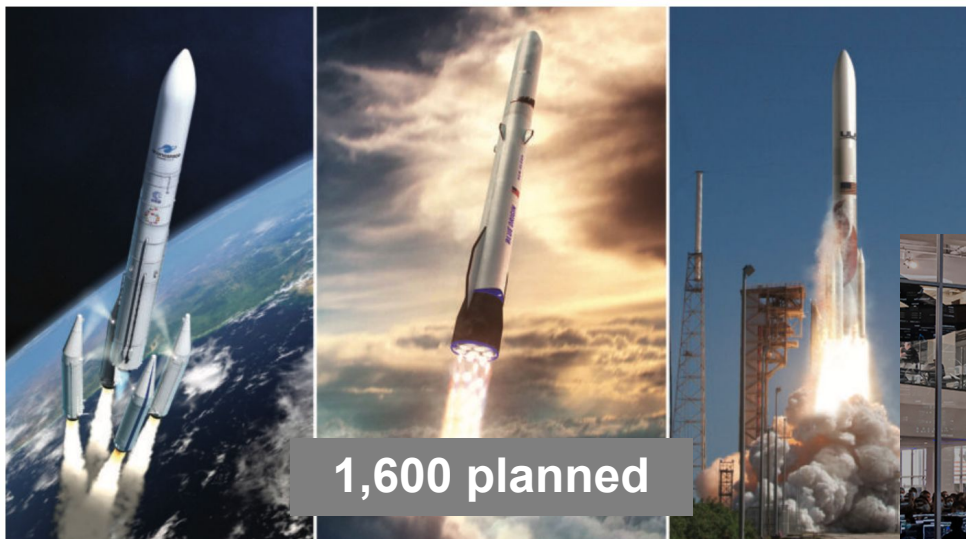
Launches / OneWeb / Press releases - 21 Mar 2022

OneWeb to resume satellite launches through agreement SpaceX

Agreement to resume its launch program with **650 planned** constellation for global grade secure connectivity around the world.

Amazon signs multibillion-dollar Project Kuiper launch contracts

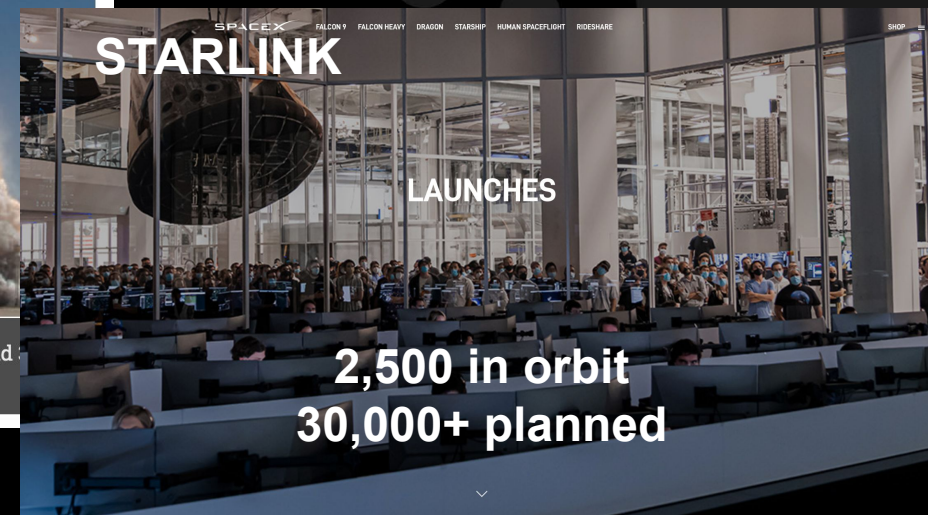
by Jeff Foust — April 5, 2022



1,600 planned

Amazon's 83-launch deal includes 18 Ariane 6 launches, 12 to 27 New Glenn launches and United Launch Alliance Vulcan Centaur. Credit: Arianespace/Blue Origin/ULA

Screenshot



155
TOTAL LAUNCHES

Screenshot

117
TOTAL LANDINGS

94
REFLOWN ROCKETS



IAU Center for Protection of Dark and Quiet Skies

- Working with industry to mitigate impacts
- “Sat Hub” – software tools to predict passes and remove streaks
- “Policy Hub” – provide information to policy makers
- Communications – provide information to astronomers and public
 - new website launched (www.iau.cps.org)
- Satellites and Laser Guide Stars
 - NOIRLab and NSF in discussions with the Laser Clearing House and satellite companies



New Capabilities & Next Generation User Support

*Janice C. Lee, Chief Scientist
Gemini Observatory/NSF's NOIRLab*

Wide-Field IR Imaging in Chile



NEWFIRM Leaving Kitt Peak...
...bound for Tololo

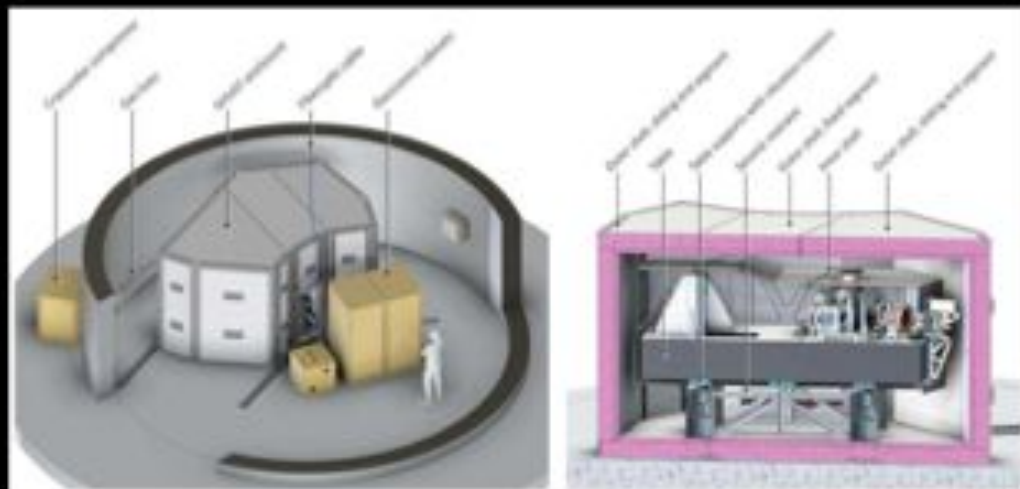


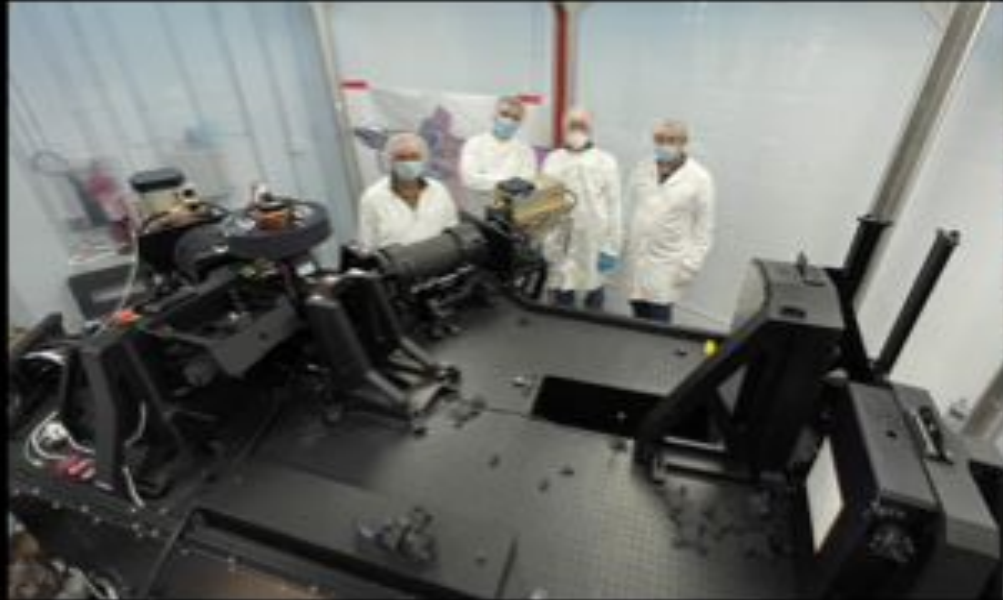
NEWFIRM at the Blanco

NEWFIRM Wide-Field IR
Imaging for Time Domain and
Multi-Messenger Astronomy
on the Blanco 4m

ISPI IR imager moving to
SOAR with new detector

- The first week of April brought the first team members from Canada, Australia and Hilo to work with the GS engineering team on unpacking and assembly.
- 14 external team members will work in person along the different integration and verification stages that follow, until the planned on-sky commissioning in June.





GHOST bench integrated and inner enclosure assembled.



GHOST Cassegrain acquisition unit showing the mini-IFU arms.

- ❖ Team resumed I&T in March, with 14 team members traveling from HAA, AAO and GN, to work at CP in the period April-June.

SCORPIO Update



SCORPIO grating cells at FRACTAL.



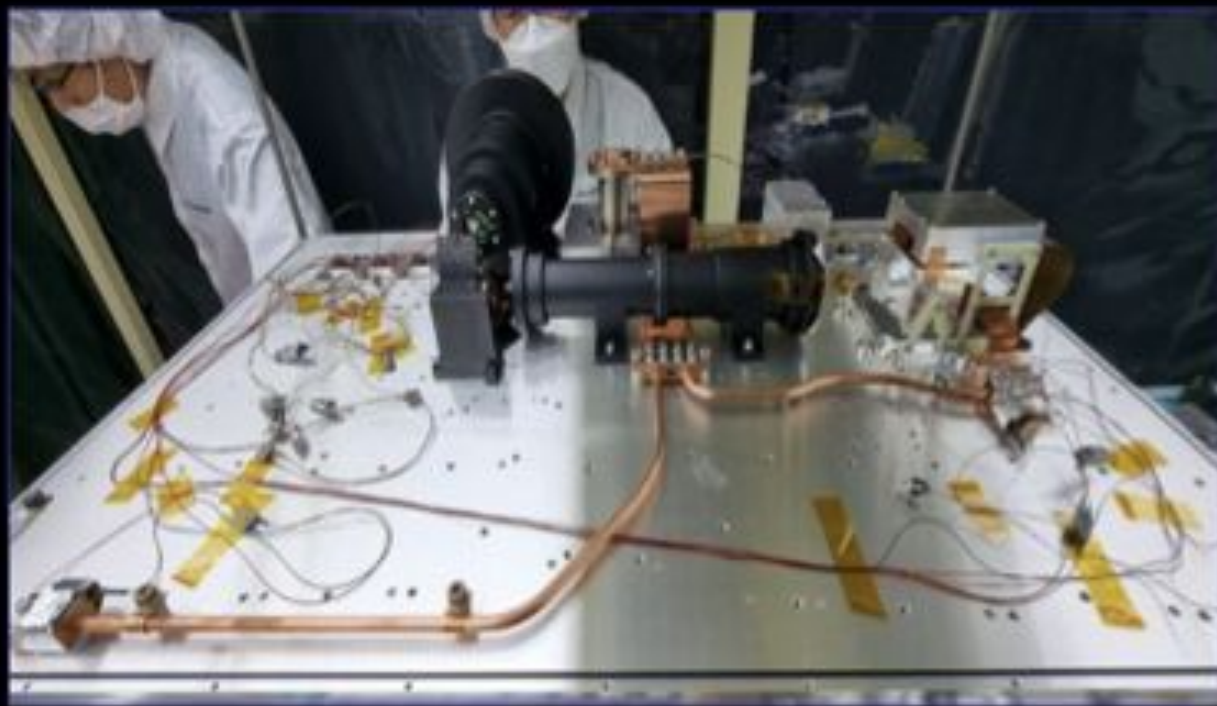
Cryostat shield at Dynavac

- ❖ With the exception of the cryostat, the delivery of which has been delayed due to the radiation shield redesign effort, all other vendor parts have now been delivered. This includes all optical components.

IGRINS-2 Update



IGRINS-2 3D model. On the top the H & K arms, on the bottom the IO and SVC.



IGRINS-2 bench with fully assembled IO and the SVC, including the detector assembly and the cryogenic components.

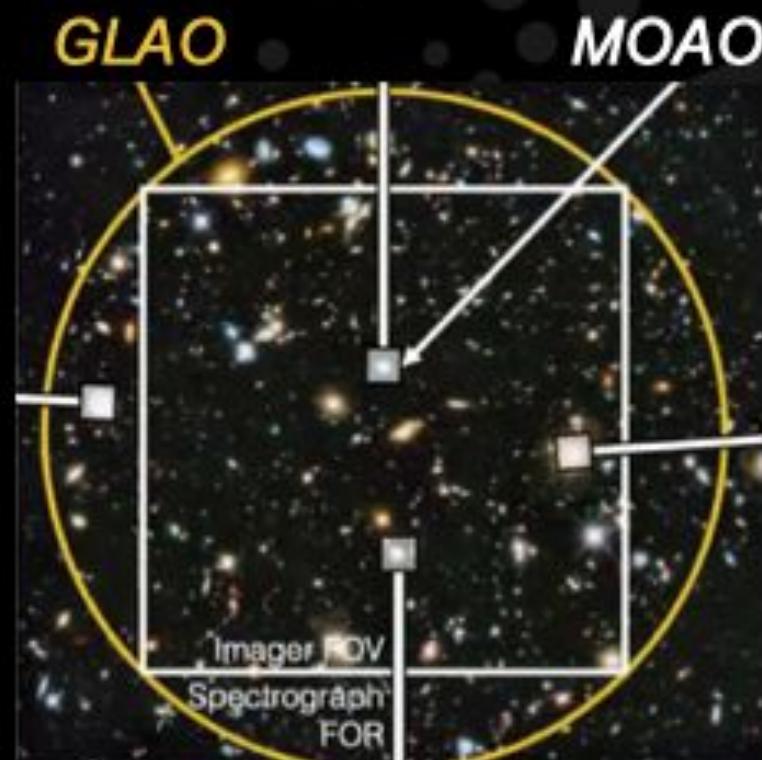


SVC detector assembly.

❖ Progressing as planned into the assembly and integration phase.

GIRMOS update

- ❖ The project had a successful Preliminary Design Review (PDR) in May, with a Review Committee report expected at the end of the month.
- ❖ The design phase has significant involvement of Gemini, with the expectation of becoming resident or facility instrument in the long term.
- ❖ The next milestone for GIRMOS is the completion of the CD phase, expected for December 2023.
- ❖ GIRMOS is forecasted to arrive at Gemini North in April 2026, with the final ATR coupled with GNAO's schedule.



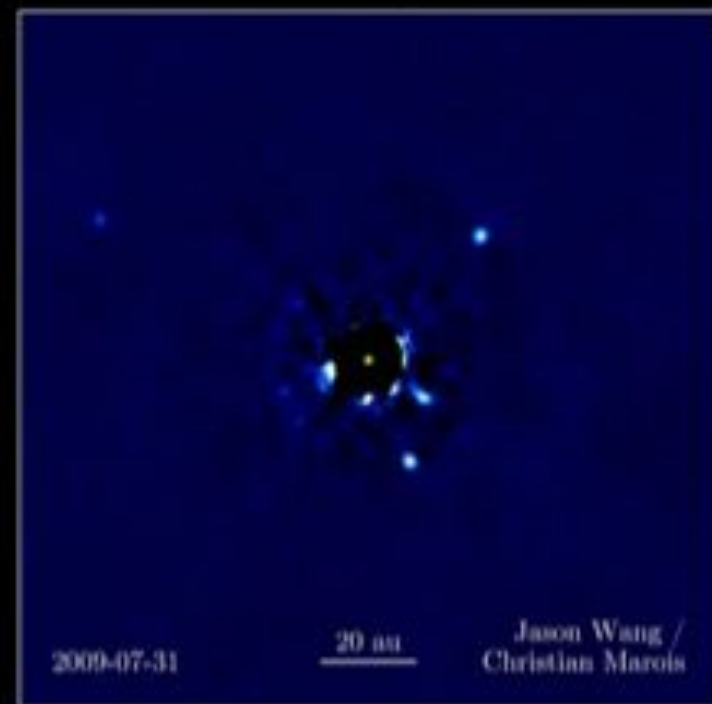
GIRMOS imager FOV, and the 4 MOAO IFU arms FOR.

GNIRS IFUs update



*Assembled LR IFU.
F2 & F3 fore-optics
(left) and S1 slicer
(right).*

- ❖ Until March 2022 the team had limited access to their facilities due to various social distancing measures in place but nonetheless, they finished up manufacturing the low-resolution IFU.
- ❖ Pre-shipping tests were completed in April and the LR-IFU is on its way to Hilo, arriving May 23rd.
- ❖ The HR-IFU completion is planned for early June.
- ❖ On sky commissioning of both IFUs is still expected to start in July. If the HR-IFU has further delays will be installed later in the year.



upgrade to Gemini Planet Imager by Notre Dame, UC San Diego to improve contrast ratio, sensitivity; move to GN by 2024 funded by NSF, Heising-Simons

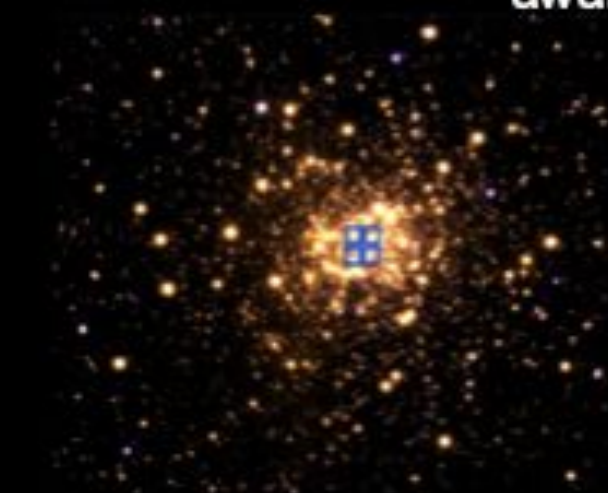


GNAO + GIRMOS

new GNAO facility:
part of NSF "Gemini in
Era of Multi-Messenger"
award" to Gemini Obs.



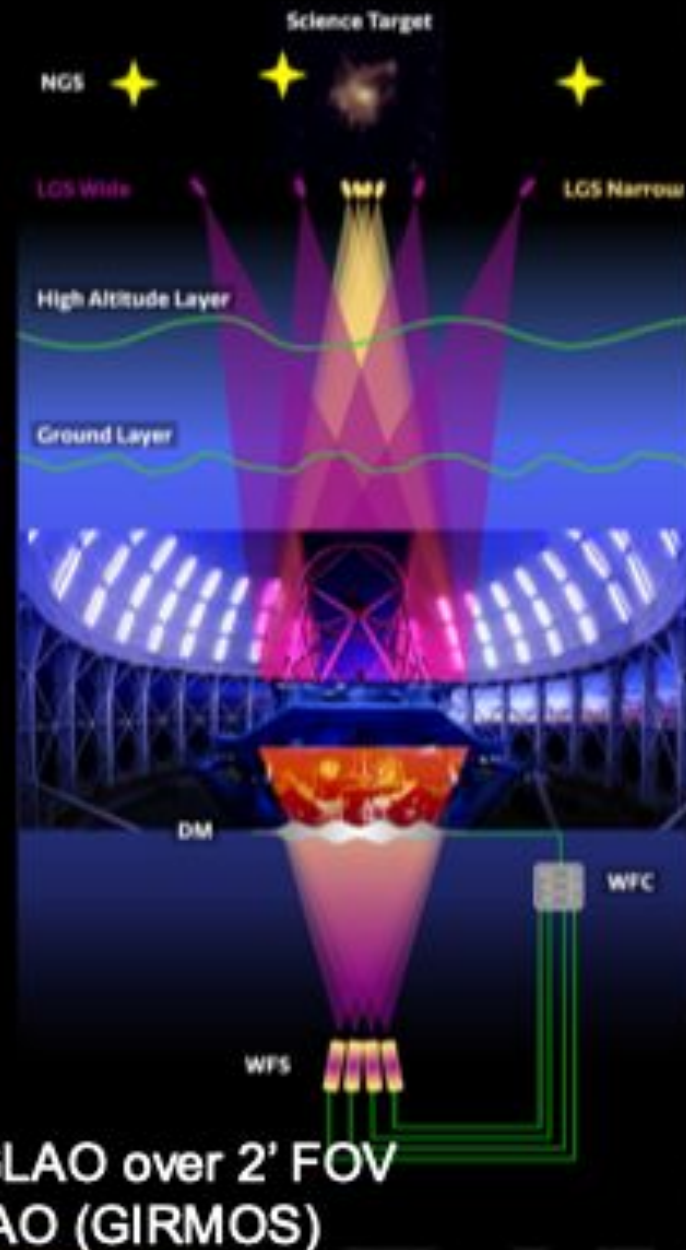
Multiple Objects
Pick-off System



Single Object
Tiled Super-IFU

GIRMOS:

PI: S. Sivanandam; funded by Canadian Innovation Fund

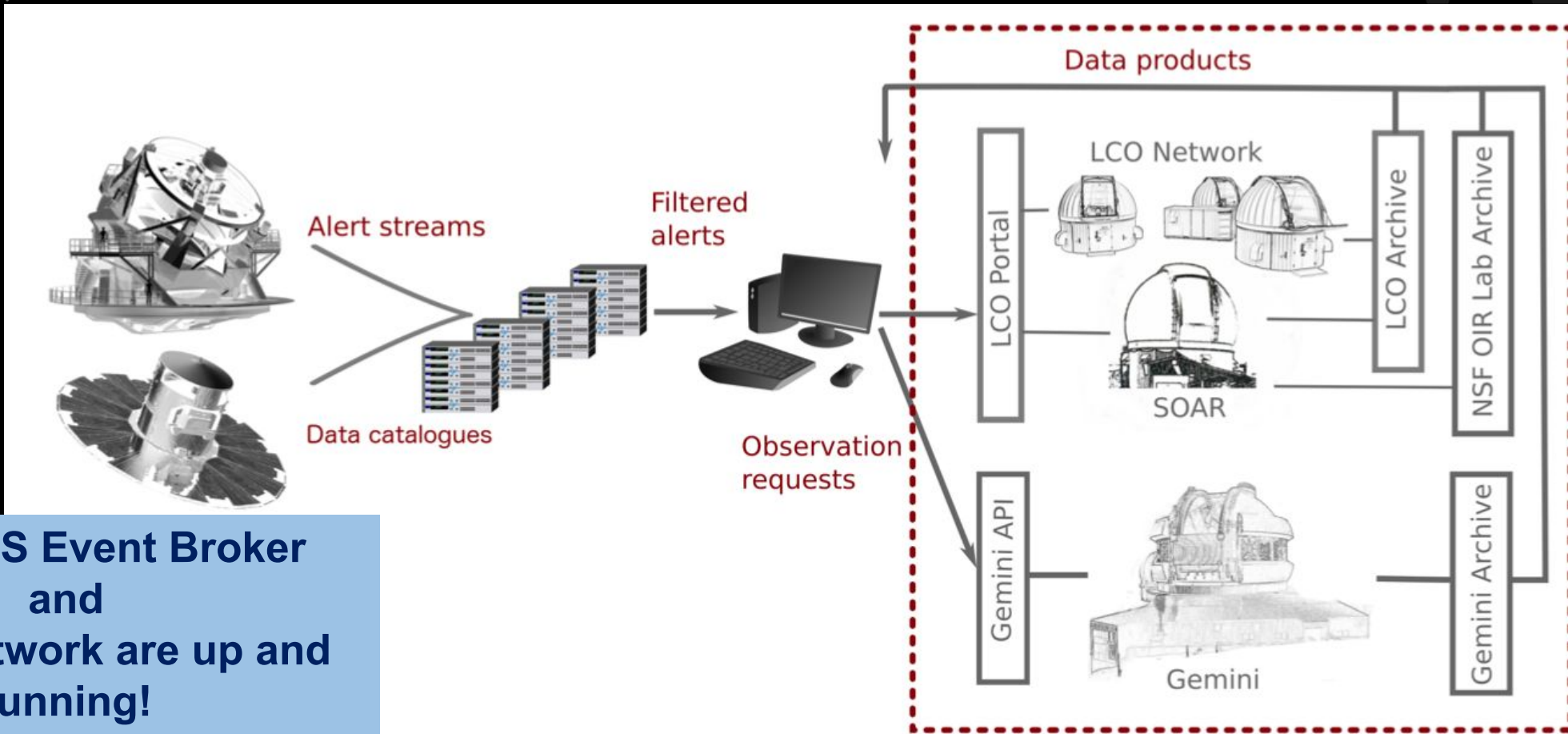


GNAO:

LTAO, GLAO over 2' FOV
+ MOAO (GIRMOS)



Astronomical Event Observatory Network



**ANTARES Event Broker
and
AEON Network are up and
running!**

Surveys

- LSST
- ZTF
- Gaia
- ASAS-SN
- ++more

Brokers & Catalog Servers

- ANTARES, Lasair
- ALeRCE, Simbad
- Vizier, MAST, CADC,
- ++ more

TOM Systems

- Astronomer-led projects

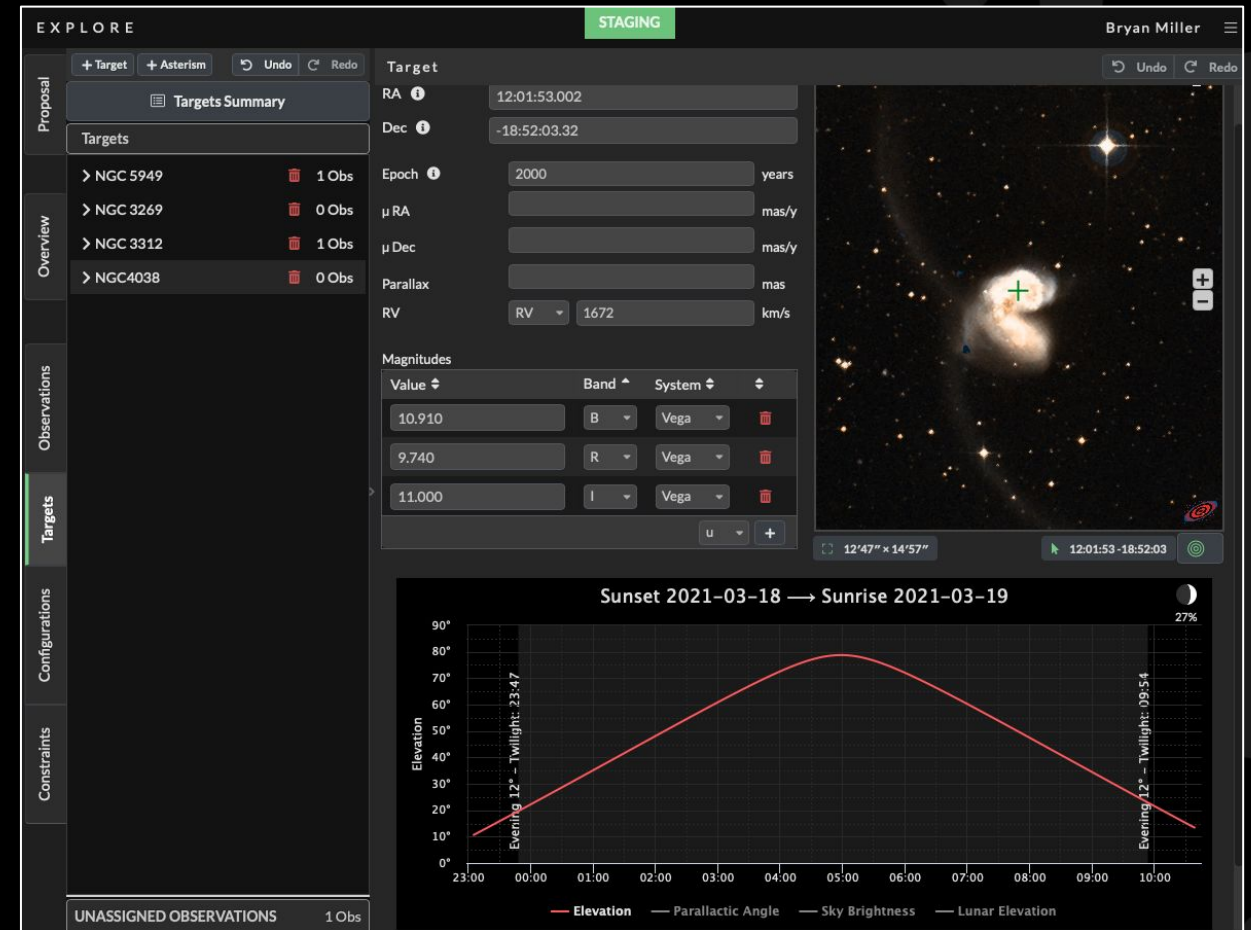


Extendable network of programmatically-accessible telescope facilities

Software Upgrades to support TDA

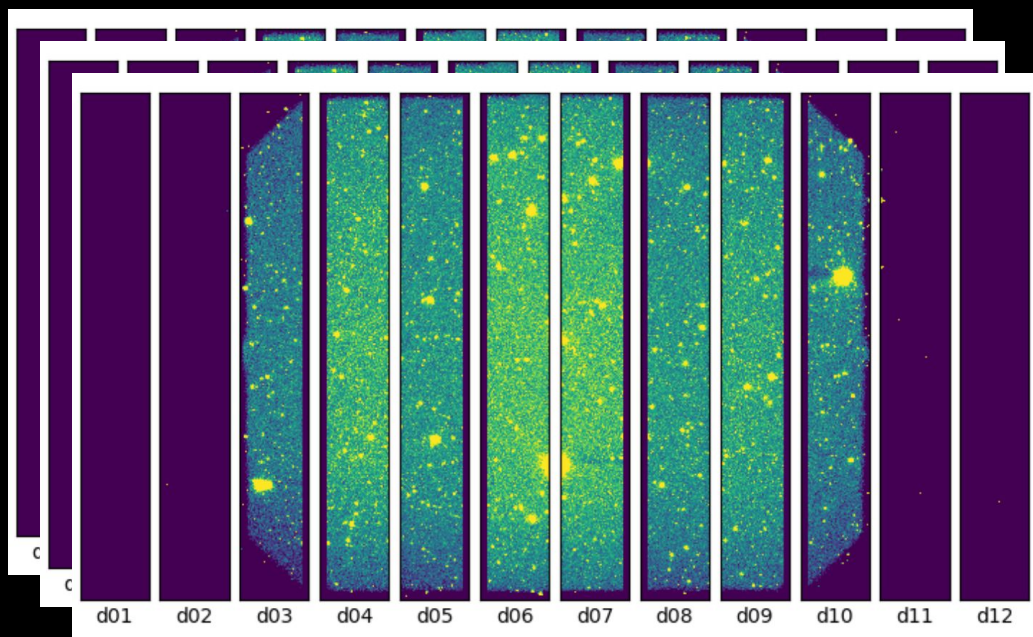
GPP - CORE OF NEW OCS

- Web apps + APIs + new database
- Easier to use - replaces PIT, OT
- GN/GS observations in the same science program
- Promotes automation
- Provides constraints for the automated scheduler
- GPP v1 completion 2024





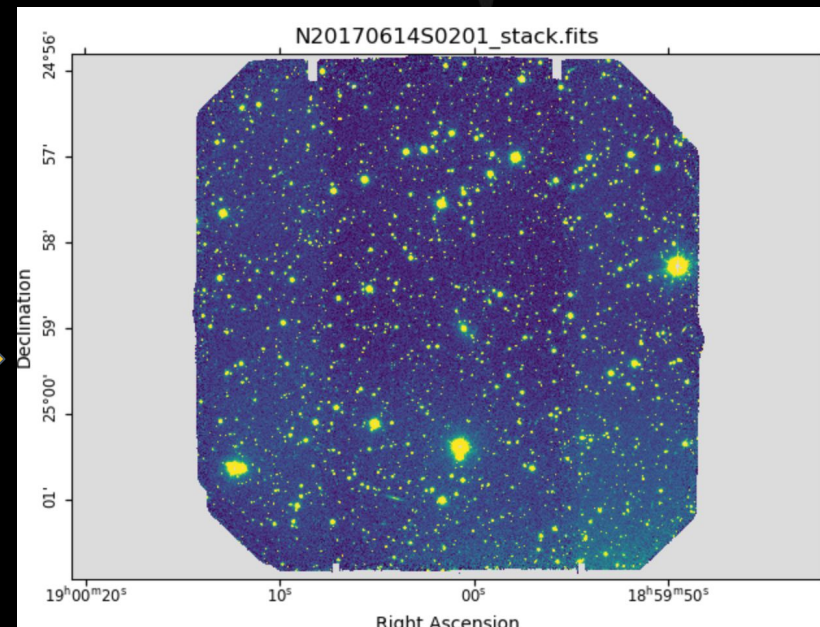
Data Reduction for TDA - DRAGONS



GMOS 12-amplifier data files (a dither set)



DRAGONS ToO
quick-look pipeline



Stacked image (instrument signatures removed) with catalog-based WCS

CURRENT DRAGONS CAPABILITIES

- All imaging modes
- Quick-look reduction for GMOS long-slit spectroscopy
- Automation of DR for ToOs (FY2022)

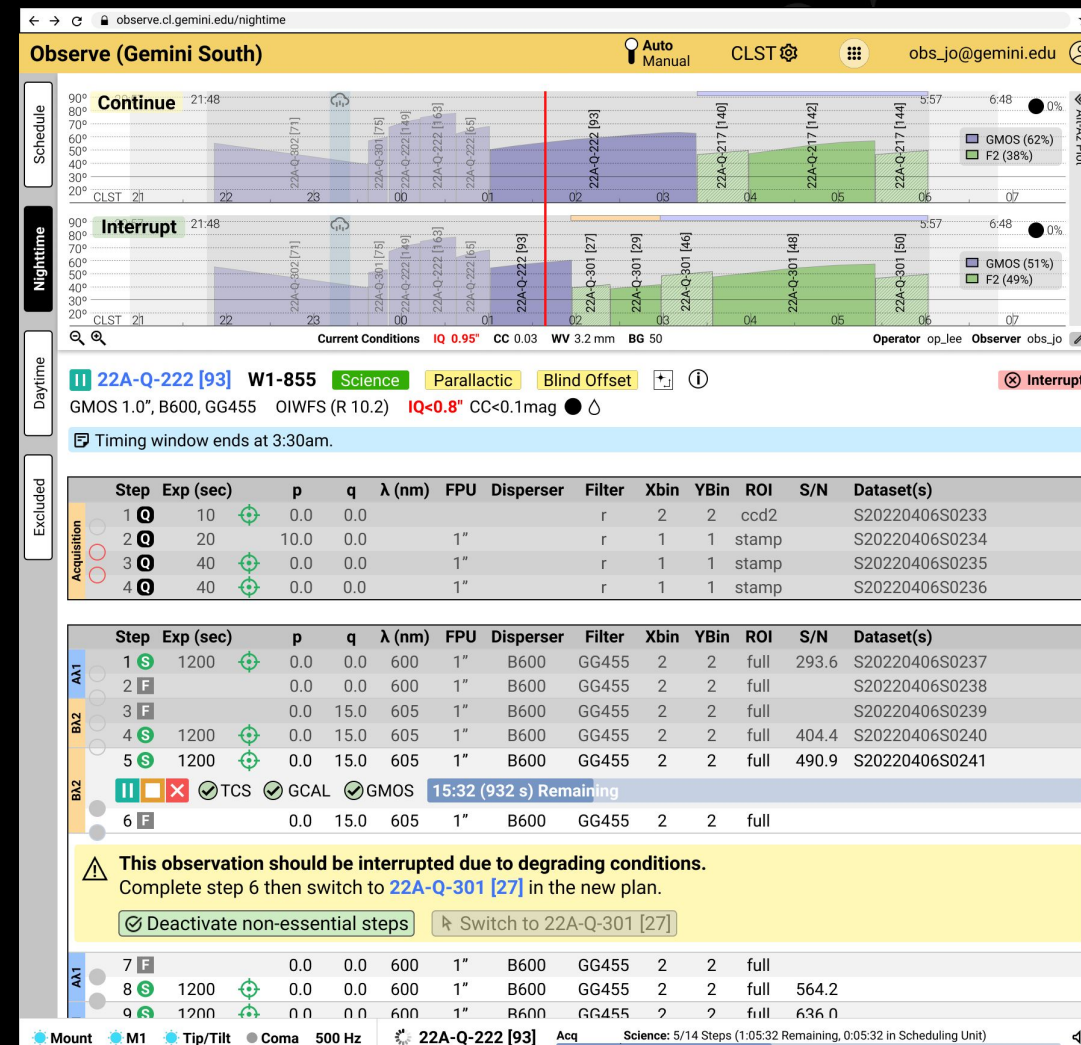
5-YEAR PLAN ADDITIONS for TDA

- NIR longslit reduction
- SCORPIO reduction

Automated Scheduling

GREEDY MAX ALGORITHM

- Schedules both Gemini telescopes together
- Optimises the current night
- Recalculates on the fly as conditions change and/or targets of opportunity come in
- Mockup to right shows the scheduler reacting to a change in observing conditions by presenting the observer with a new night plan





Rubin Observatory

*Bob Blum, Director for Operations
Rubin Observatory/NSF's NOIRLab*

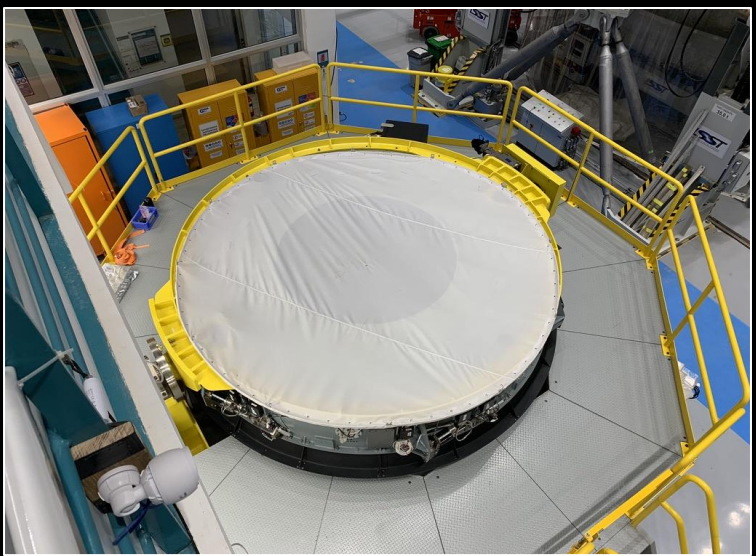
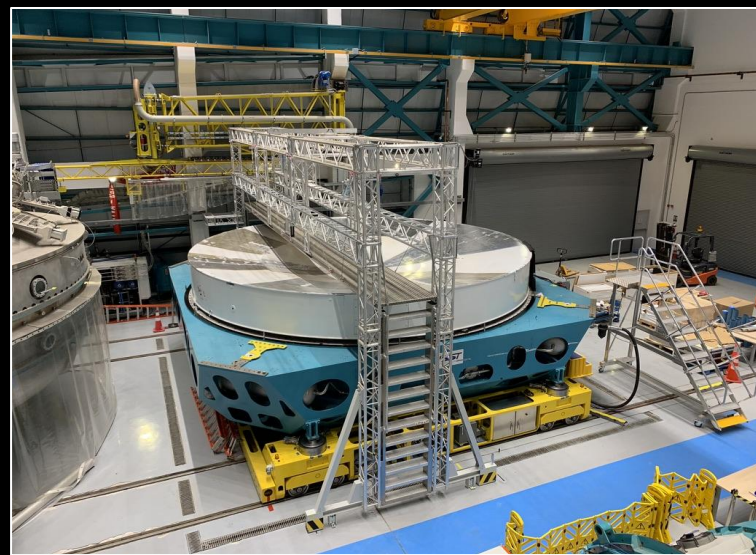


Rubin Observatory Status



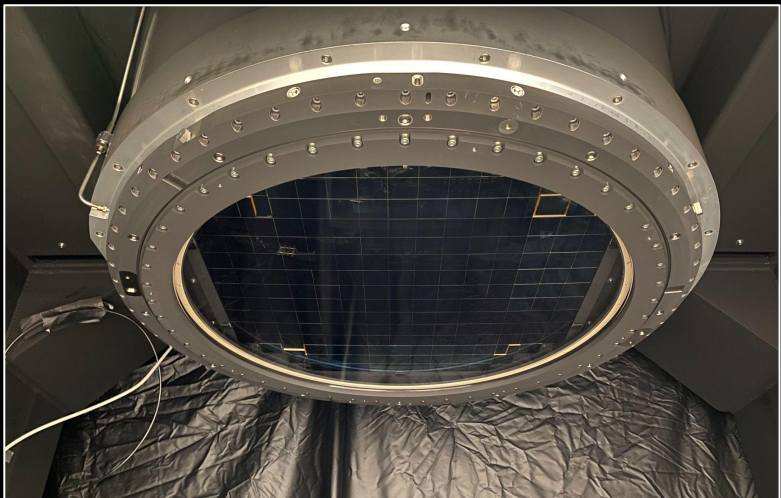
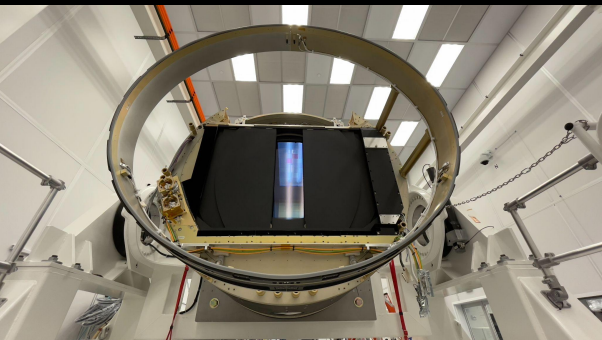
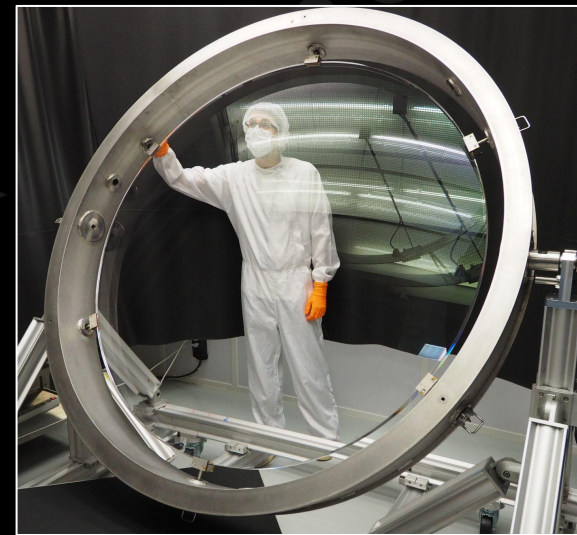
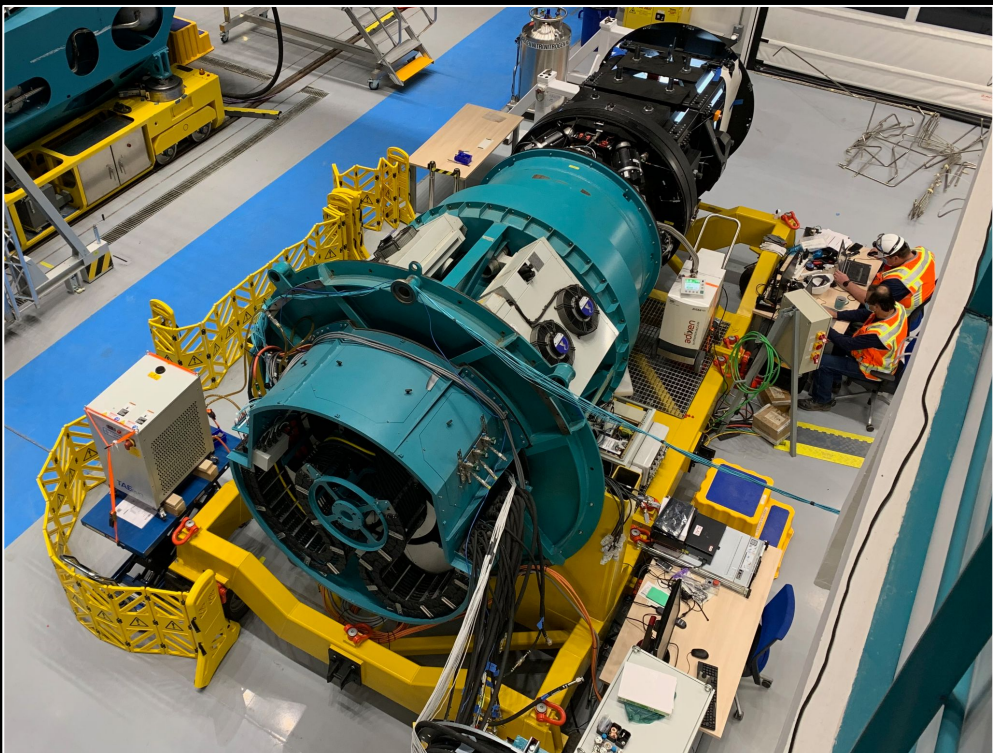


Rubin Observatory Status





Rubin Observatory Status





Rubin Observatory Status

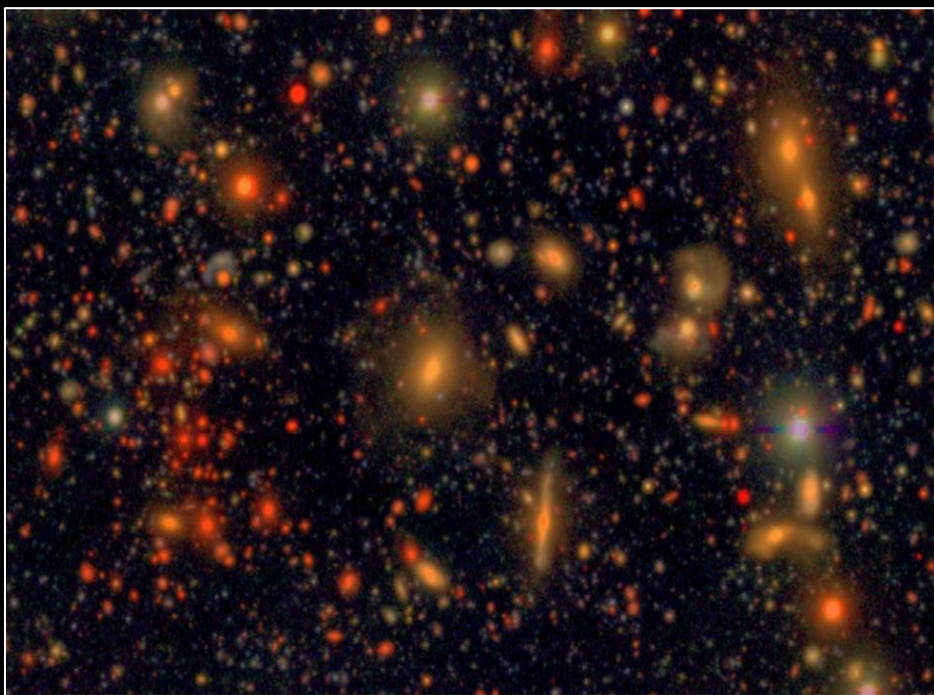




Transition to Operations: Building the Rubin User Experience

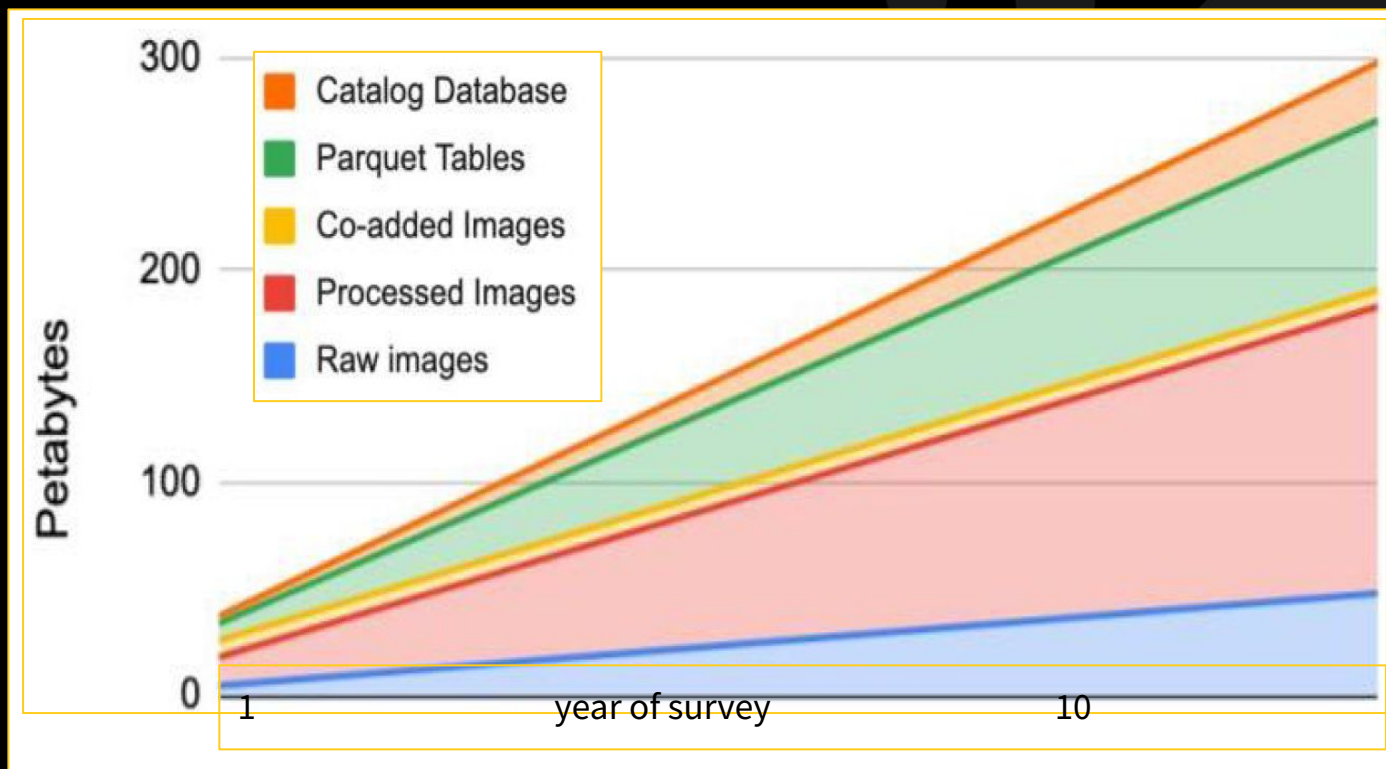


The final LSST 10-year sky map will be like having ~3 million of these, tiled over the entire southern sky.



Ivezić et al. 2019

The Rubin Observatory's total data holdings will start at ~40 PB and grow to ~300 PB over the 10-year LSST.



O'Mullane et al. 2021 (RTN-003.lsst.io)



Transition to Operations: Building the Rubin User Experience



Goal: Democratize science by removing barriers to participation in the Legacy Survey of Space and Time (LSST).

- abundant, discoverable documentation of the end-to-end system
- clear entry points and tutorials from beginner through advanced levels
- asynchronous, distributed, friendly support
- a stable software environment with compute resources
- prioritize research inclusion and seed expertise across the community
- enable anyone to become power user and push the cutting edge with LSST



Transition to Operations: Data Previews



VERA C. RUBIN OBSERVATORY Portal Notebooks APIs Documentation Support Community melissagraham ▾

Rubin Science Platform

Portal

Discover data in the browser

Learn more about the portal.

Notebooks

Process and analyze LSST data with Jupyter notebooks in the cloud

Learn more about notebooks.

APIs

Learn how to programatically access data with Virtual Observatory interfaces

Learn more about APIs.




Transition to Operations: User Support



VERA C. RUBIN OBSERVATORY | **Community forum** 🔍 ☰ 👤 1

Welcome to the Vera C. Rubin Observatory LSST Community forum ^ Collapse


This Community Forum is the main portal for community engagement and crowd-sourced support for science with the Rubin Observatory data products and services. Everyone is welcome to browse, ask questions, share knowledge, and discuss topics related to Rubin Observatory and the Legacy Survey of Space and Time (LSST).



Getting started

Forum user resources:


- New here? [Welcome!](#)
- Read the forum's [user guide](#).
- Review our [Community Guidelines](#).
- Read [forum how-to](#) topics.
- Forum Q&A: [Meta category](#).
- Run the [interactive forum tutorial](#).
- Review the [Terms of Service](#).



Join the conversations

Discuss and ask questions about:

- [Rubin Science Platform](#)
- [Rubin data products](#)
- [LSST Science Pipelines](#)
- [Survey strategy](#) and cadence optimization
- [Alerts and brokers](#) for time-domain astronomy









Links

Additional Rubin Observatory resources on the web:

- [Rubin Observatory: For Scientists](#)
- [LSST Science Collaborations](#)
- [Survey Cadence Optimization](#)
- [LSST Science Pipelines](#)
- [Rubin Observatory technical documentation](#)

With *thousands of users*, knowledge bottlenecks are a risk to science. Support must be accessible and timely. A crowd-source model is the only sustainable option.

all categories ▾ | all tags ▾ | **Categories** | Latest | Top | Bookmarks | Unread (33) | My Posts | ⚙️ | + New Topic

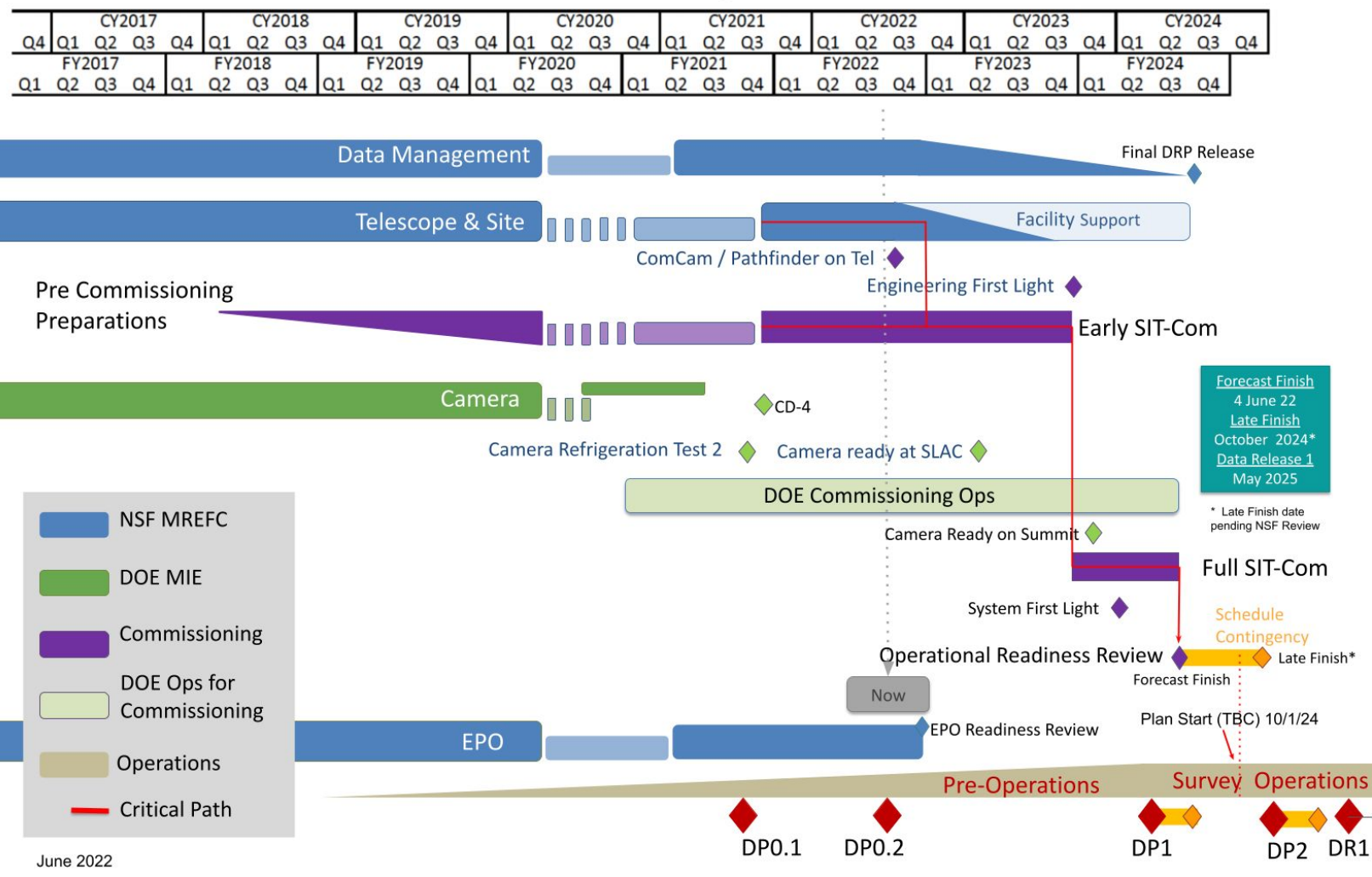
Category	Topics	Latest
News News and announcements from Rubin Observatory.	133 3 unread 1 new	 Image Difference Task using DECam images [gen3] 2 Support decam, imagedifference, coadd 10m
Support Community support venue for using the LSST software, services and data.	522 13 unread	 Suggest a science breakout session for the Rubin PCW 2022 3 Project and Community Workshop 2022 1h
Science Public discussions about LSST science.	357 7 unread	 Rubin Seeing Band Distribution Data Q&A 2h
Science Collaborations Science discussions for members of LSST Science Collaborations.	89 1 unread	 Survey Simulations v2.1 (April 2022) Survey Strategy opsim, run-release, maf 4h
		 Rubin Observatory News Digest May 17 2022 News 0 22h
		 <input checked="" type="checkbox"/> How to predict magnitudes from spectra Data Preview 0 smwlv, photometry 1 1d



Transition to Operations



Rubin Observatory Schedule





Towards Sustainable Operations

at

NSF's NOIRLab

Towards Sustainable Operations

Pathways to Discovery recommendation on addressing climate change:

... increase the use of remote observing, hybrid conferences, and remote conferences, to decrease travel impact on carbon emissions and climate change

As a federally funded facility (FFRDC) NOIRLab has an opportunity and an obligation to lead by example to share this change with the community and the public

NOIRLab has a *self-funded* plan to reduce our carbon footprint by 30% and proposals to *reduce our footprint by 50%* and make one or more of our *telescopes carbon-neutral*



nature
astronomy

ARTICLES

<https://doi.org/10.1038/s41550-022-01612-3>

 Check for updates

Estimate of the carbon footprint of astronomical research infrastructures

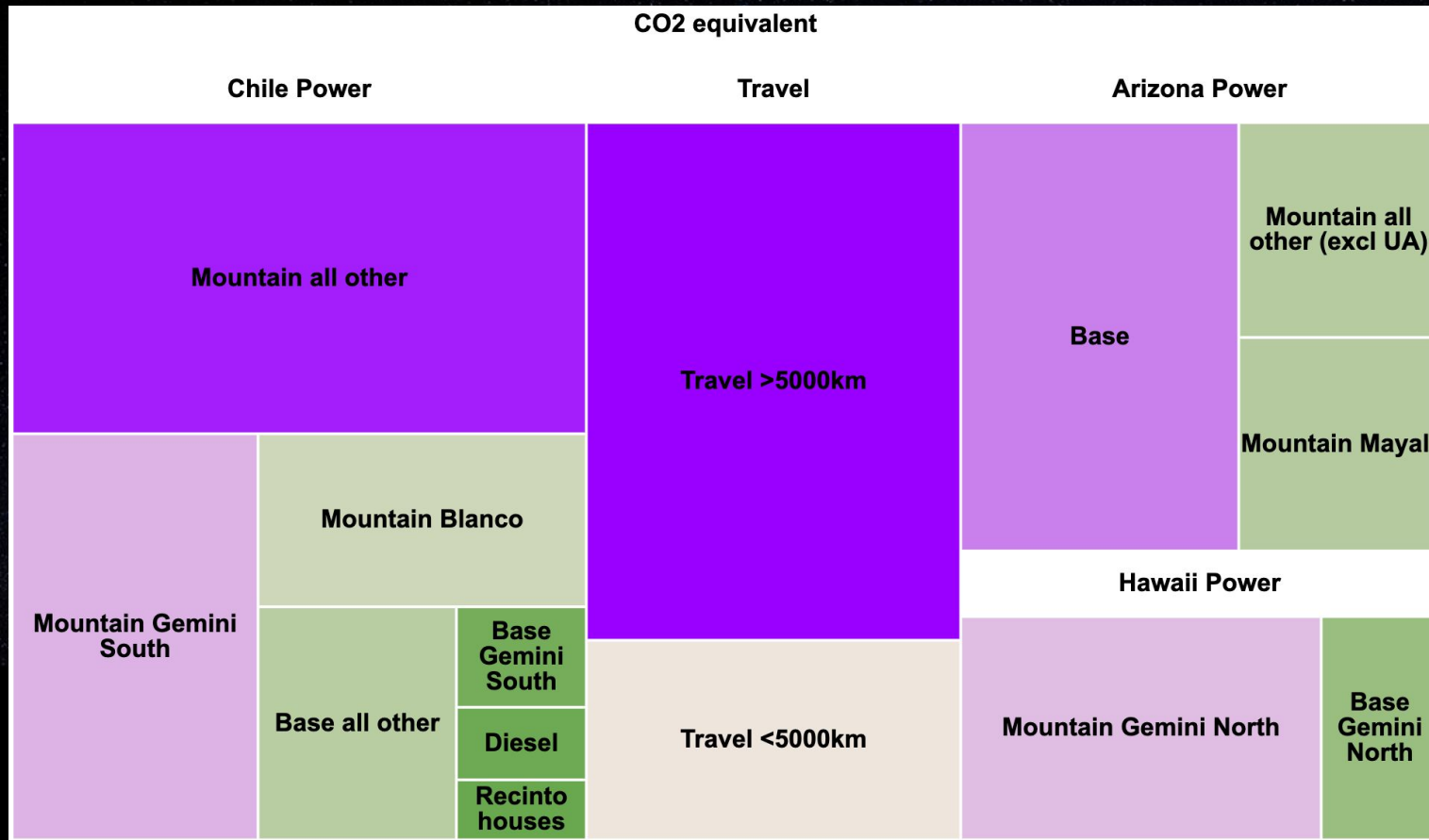
Jürgen Knödlseder  , Sylvie Brau-Nogué, Mickael Coriat, Philippe Garnier, Annie Hughes , Pierrick Martin and Luigi Tibaldo 



NOIRLab Carbon footprint



Pre-Pandemic (FY2019) baseline: 8700 tons CO₂ equivalent



Areas of rectangles are proportional to the carbon footprint in each area



Gemini PV Systems



Gemini South:
207 kW system
Production ~1000 kWh/day
~ 20% of usage.
Online July 16, 2016



Gemini North:
100 kW system
Production ~650 kWh/day
~12% of usage.
Online September 2015





Moving ahead



- We have an initial assessment of NOIRLab's carbon footprint. We will track this going forward. Does not yet include Rubin and we don't include impact of community using NOIRLab facilities or contractor/vendor impact.
- We have a program designed to halve travel by 2027, make energy efficiency improvements in our buildings, and add PV power generation expansions. We have a specific proposal to make one Gemini telescope carbon neutral.
- Our baseline program is funded within our current budget through savings on travel. It would result in a 30% reduction in carbon emissions. Plans for further changes could get us to 50%.



Related Events



- NOIRLab Open House Wednesday 7:30 PM Sheraton Piazza Ballroom
- US ELT Open House Tuesday 5:30 PM Ballroom B
- “A Bold Future for Astrophysics” Wednesday 9:00AM Sheraton Piazza Ballroom

● ***NOIRLab is Hiring!***

Come see us at our booth in the exhibit hall



A special thank you to our Partners

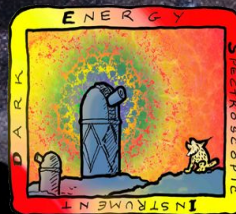


U.S. DEPARTMENT OF
ENERGY

Office of
Science



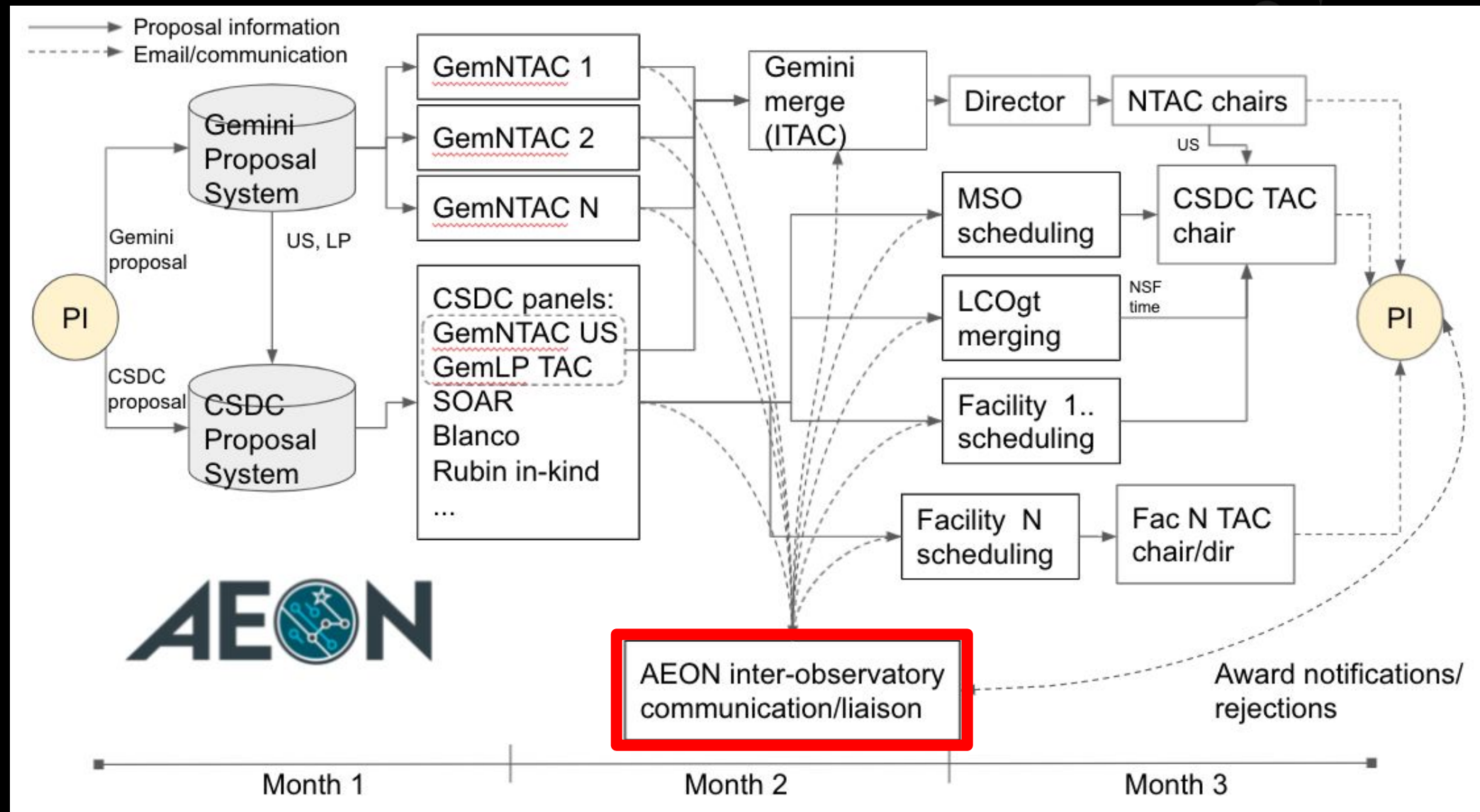
Ministerio de Ciencia,
Tecnología e Innovación
Argentina







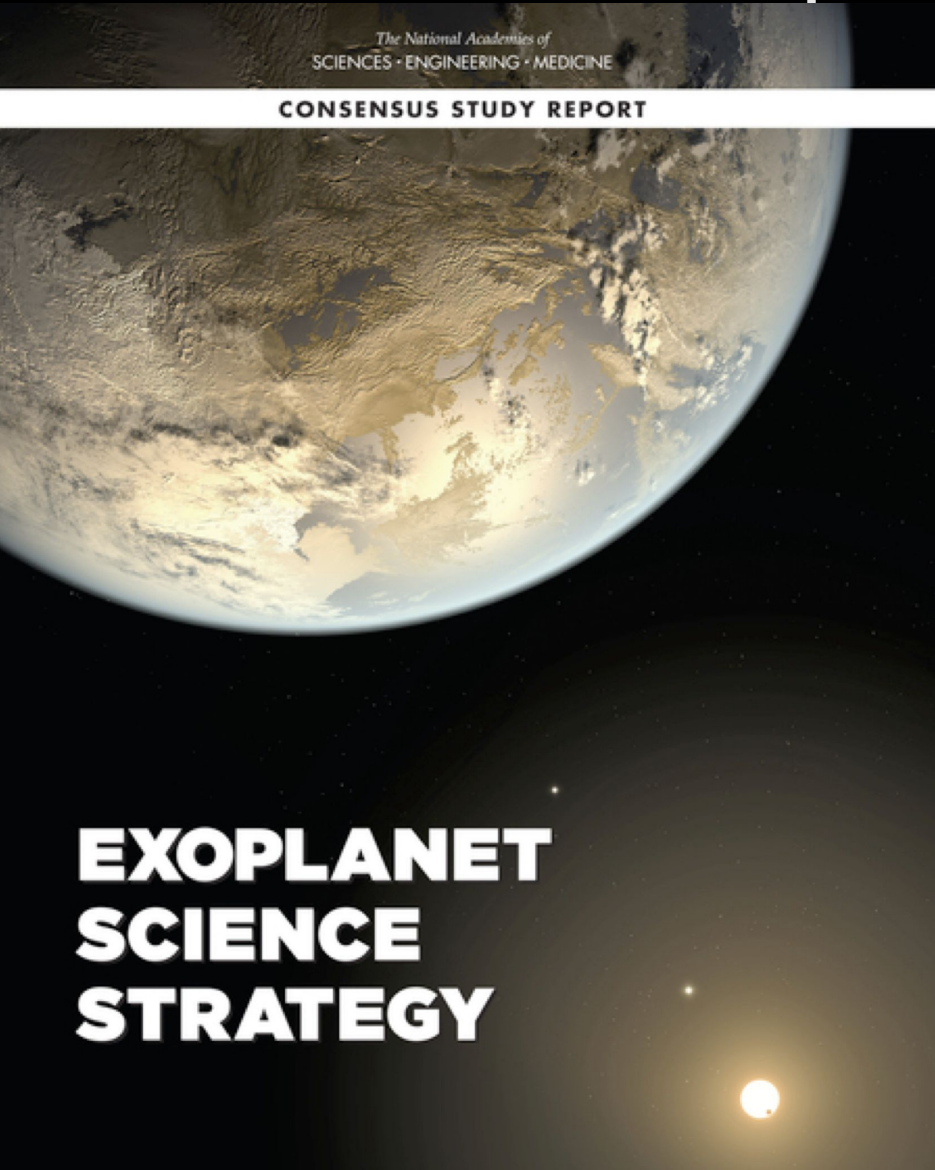
AEON Proposal Cycle



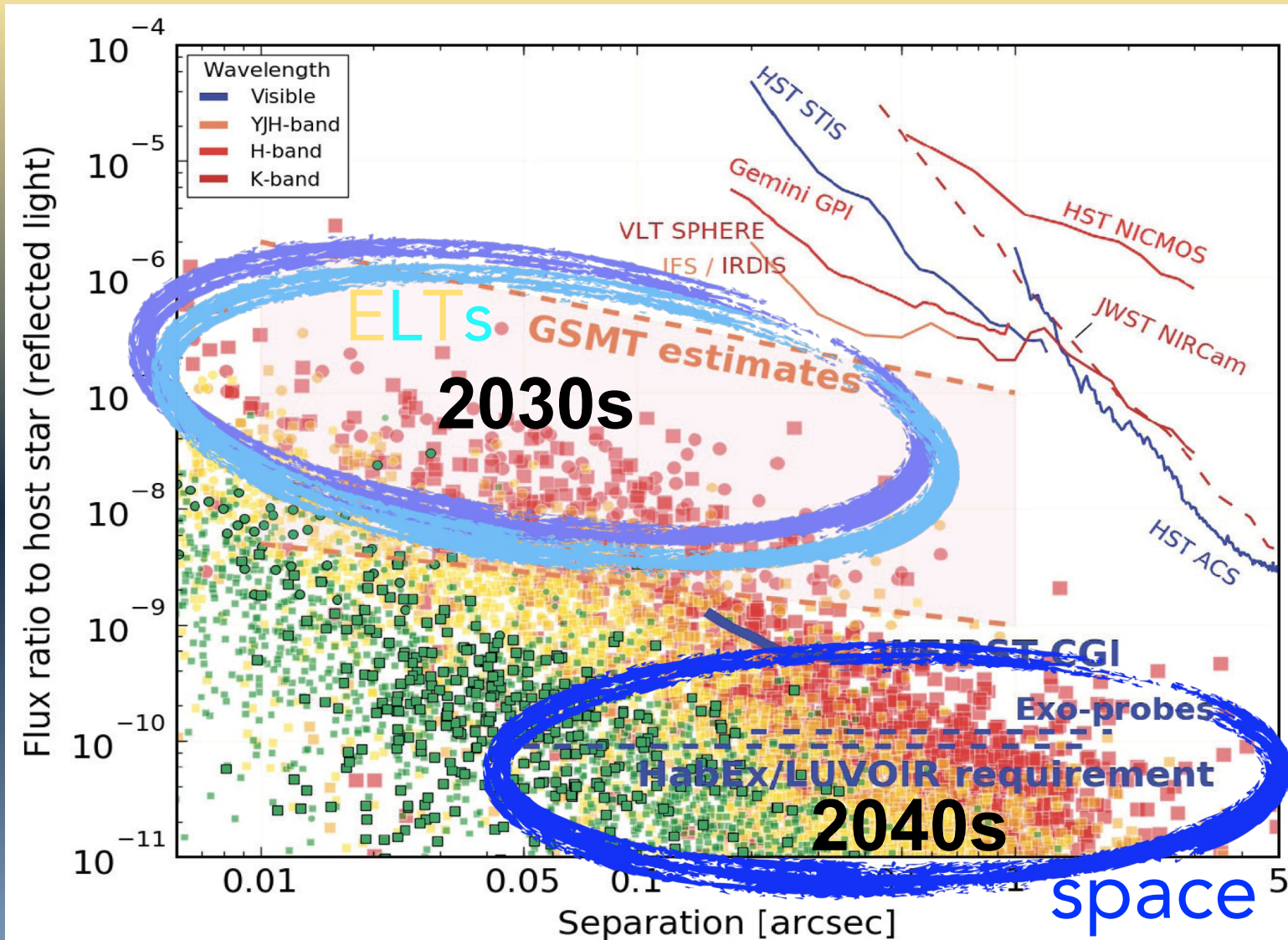
Exoplanet Imaging

The National Academies of
SCIENCES · ENGINEERING · MEDICINE

CONSENSUS STUDY REPORT

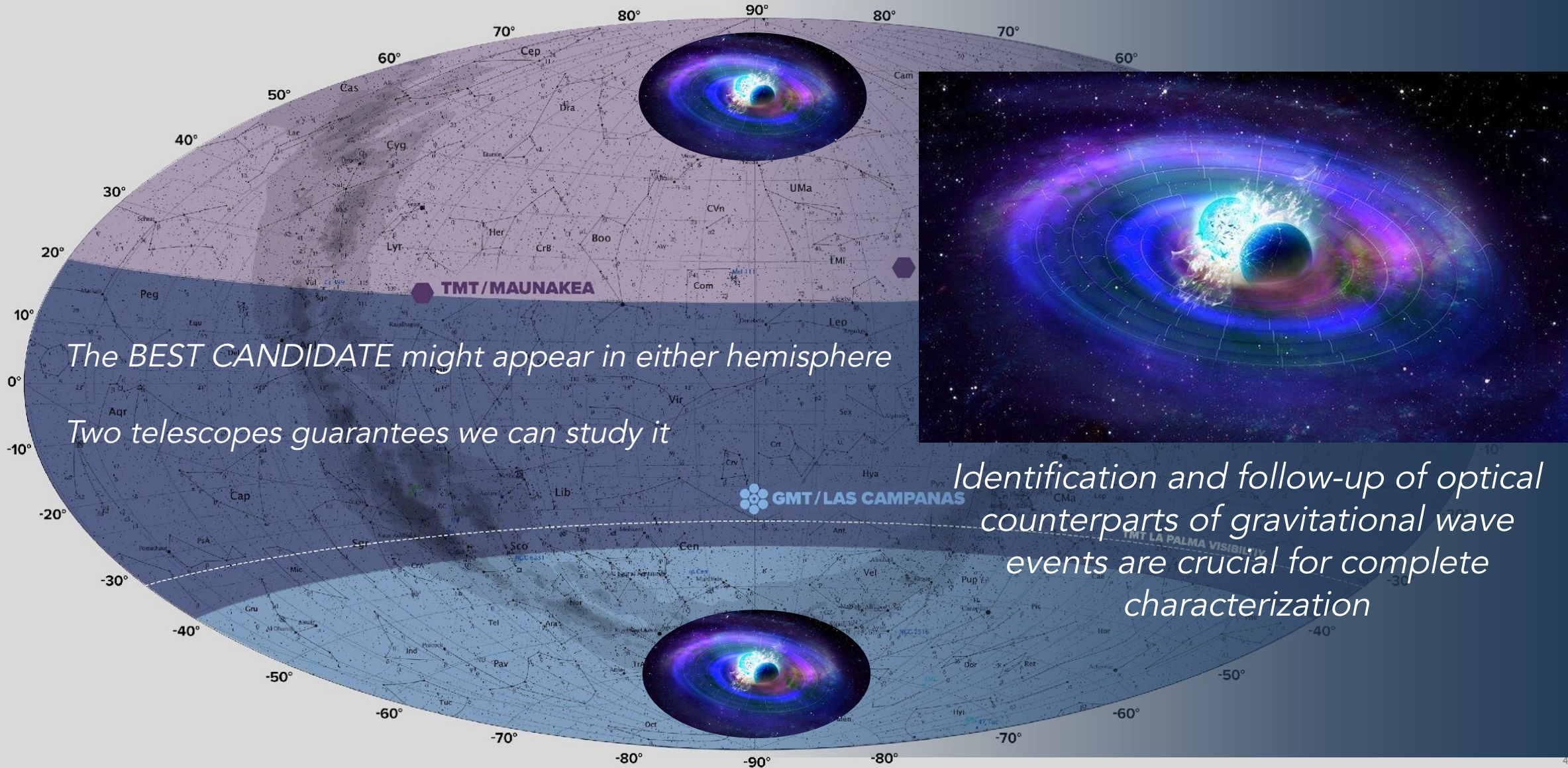


**EXOPLANET
SCIENCE
STRATEGY**





Sky Coverage – gravitational waves





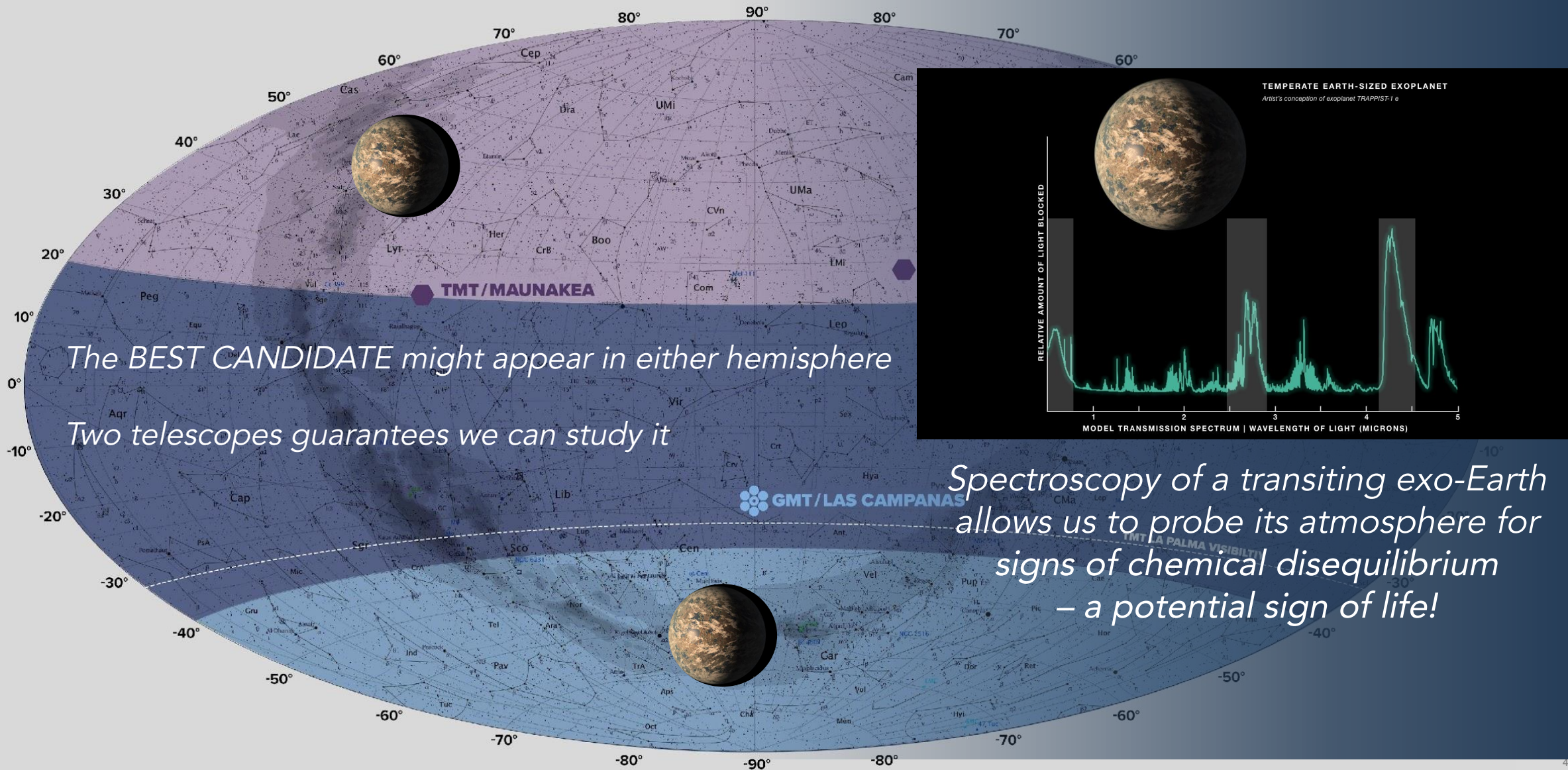
NOIRLab's Role in The OIR System*

- Leadership of the US ELT Program
- Execution of Rubin's LSST...
 - providing open access to the data
- Coordination of facilities & systems for *Time Domain Astronomy*
- Operation of unique capabilities
 - e.g., *DECam, NEID, Gemini Instruments*
- Leadership in *community-based discussions* for the future
- Contributing to a healthy R&D program of *Technology Development in coordination with university groups*

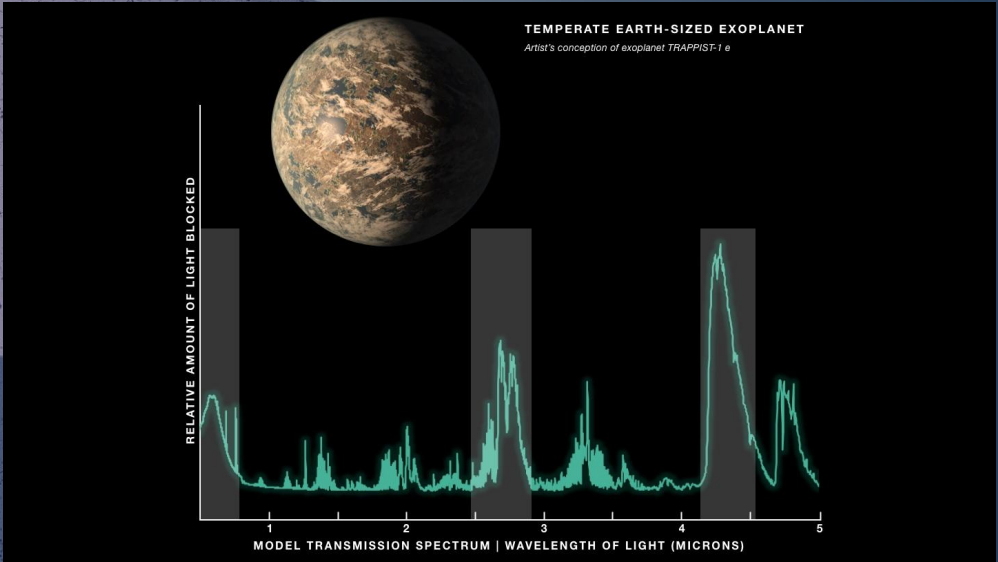
*From Pathways, Table K-3



Full Sky Coverage - exoplanets



The BEST CANDIDATE might appear in either hemisphere
Two telescopes guarantees we can study it



Spectroscopy of a transiting exo-Earth allows us to probe its atmosphere for signs of chemical disequilibrium – a potential sign of life!



Exoplanet Atmospheres

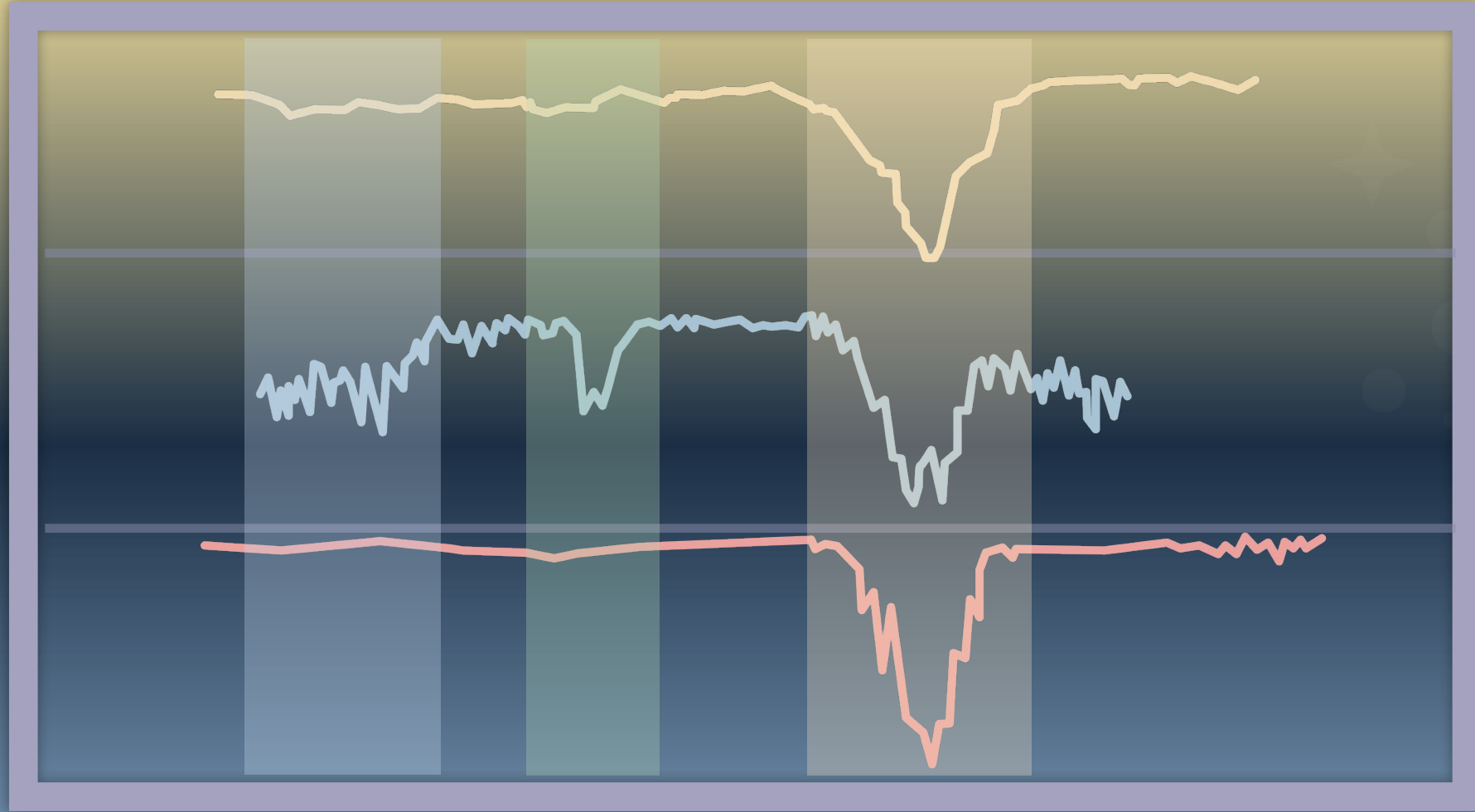


Water

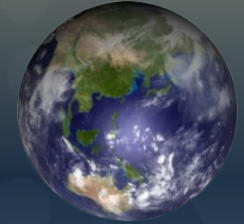
Ozone

Carbon Dioxide

Brightness



Infrared Wavelengths



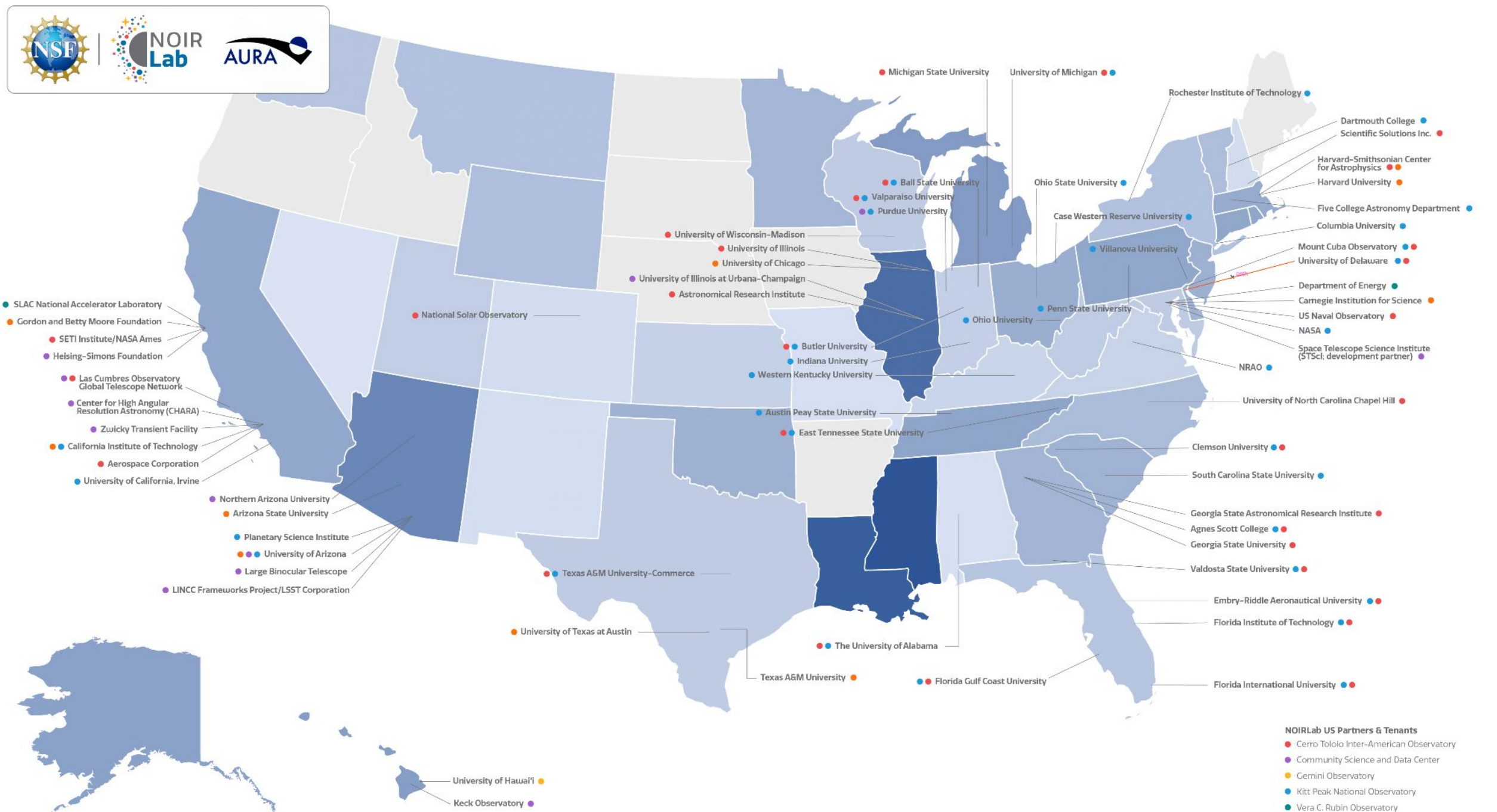
The US ELT System

Full sky coverage - discoveries anywhere on the sky

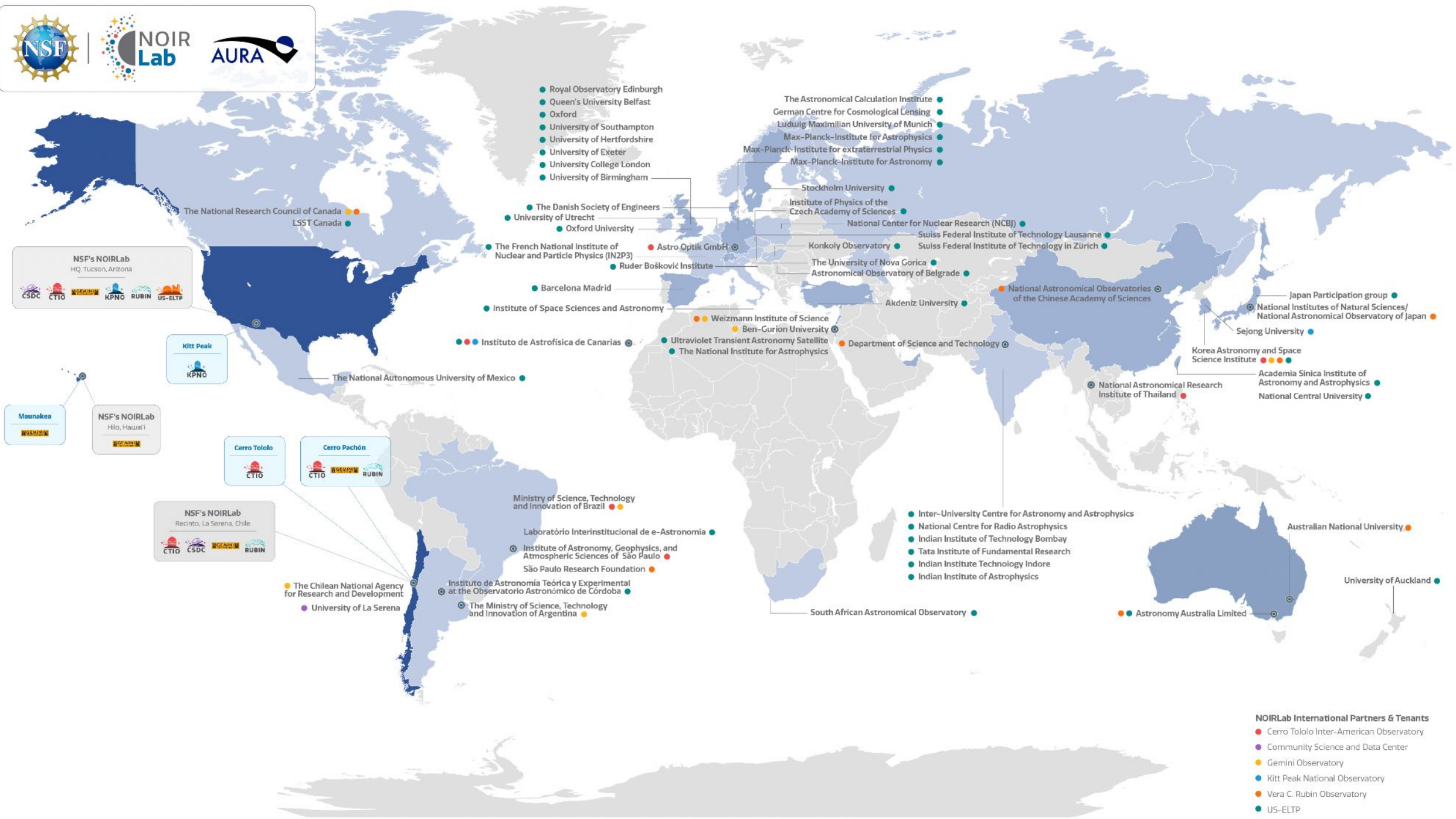
Longitudinal separation for time-critical science

Synergy with other space- and ground-based facilities

~50% sky overlap → more time on sky



- NOIRLab US Partners & Tenants**
- Cerro Tololo Inter-American Observatory
 - Community Science and Data Center
 - Gemini Observatory
 - Kitt Peak National Observatory
 - Vera C. Rubin Observatory
 - US-ELTP



- Royal Observatory Edinburgh
- Queen's University Belfast
- Oxford
- University of Southampton
- University of Hertfordshire
- University of Exeter
- University College London
- University of Birmingham

- The Astronomical Calculation Institute
- German Centre for Cosmological Lensing
- Ludwig Maximilian University of Munich
- Max-Planck-Institute for Astrophysics
- Max-Planck-Institute for extraterrestrial Physics
- Max-Planck-Institute for Astronomy

- Stockholm University
- Institute of Physics of the Czech Academy of Sciences
- National Center for Nuclear Research (NCBJ)
- Konkoly Observatory
- The University of Nova Gorica
- Astronomical Observatory of Belgrade

- Swiss Federal Institute of Technology Lausanne
- Swiss Federal Institute of Technology in Zürich

- National Astronomical Observatories of the Chinese Academy of Sciences

- Japan Participation group
- National Institutes of Natural Sciences/ National Astronomical Observatory of Japan
- Sejong University
- Korea Astronomy and Space Science Institute
- Academia Sinica Institute of Astronomy and Astrophysics
- National Central University

- National Astronomical Research Institute of Thailand

- Inter-University Centre for Astronomy and Astrophysics
- National Centre for Radio Astrophysics
- Indian Institute of Technology Bombay
- Tata Institute of Fundamental Research
- Indian Institute Technology Indore
- Indian Institute of Astrophysics

- Australian National University
- University of Auckland

NSF's NOIRLab
HQ, Tucson, Arizona

Kitt Peak
KPNO

Maunakea
KECK

NSF's NOIRLab
Hilo, Hawaii

Cerro Tololo
CTIO

Cerro Pachón
CTIO GEMINI RUBIN

NSF's NOIRLab
Recinto, La Serena, Chile

- The Chilean National Agency for Research and Development
- University of La Serena

- Ministry of Science, Technology and Innovation of Brazil

- Laboratório Interinstitucional de e-Astronomia

- Institute of Astronomy, Geophysics, and Atmospheric Sciences of São Paulo
- São Paulo Research Foundation

- Instituto de Astronomía Teórica y Experimental at the Observatorio Astronómico de Córdoba

- The Ministry of Science, Technology and Innovation of Argentina

- South African Astronomical Observatory

- Astronomy Australia Limited

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