



# NSF's National Optical-Infrared Astronomy Research Laboratory (NOIRLab)

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AAAC Update  
September 22, 2020





# NSF's National Optical-Infrared Astronomy Research Laboratory

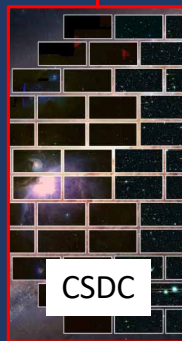
## Formerly NOAO

Cerro Tololo  
Inter-American  
Observatory

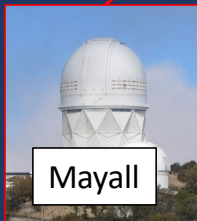


CSDC

Community  
Science & Data  
Center



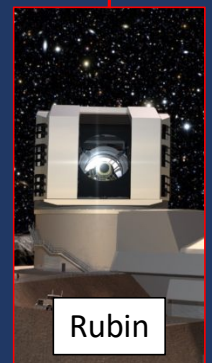
Kitt Peak  
National  
Observatory



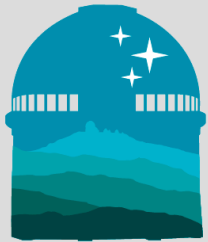
International  
**Gemini**  
Observatory



Vera C.  
Rubin  
Observatory  
Operations



# NSF's National Optical-Infrared Astronomy Research Laboratory



## CERRO TOLOLO

From the first observations in 1965, Cerro Tololo, located in Chile, has served as the principal platform for U.S. astronomical investigation of the southern skies.



## COMMUNITY SCIENCE & DATA CENTER

Programs within the Community Science and Data Center support and enable a broad range of astronomical community science activities across the US ground-based optical and infrared system.



## KITT PEAK

Founded in 1958, Kitt Peak National Observatory is home to one of the largest arrays of optical and radio telescopes in the world.



## GEMINI OBSERVATORY

The Gemini Observatory consists of twin 8.1-meter diameter optical/infrared telescopes located on two of the best observing sites on the planet.



## RUBIN OBSERVATORY

Vera C. Rubin Observatory, currently under construction on Cerro Pachón in Chile, is an 8-meter-class telescope coupled to a 3.2-gigapixel camera – the world's largest digital camera ever fabricated for optical astronomy.

Five main programs, each with its own identity

# NSF's NOIRLab



Integration of NSF's night-time OIR facilities recommended by:

- Astro2010 Decadal Survey
- NSF's 2012 Portfolio review
- NRC's 2015 report on Optimizing the U.S. ground-based OIR system

*Launched on October 1, 2019*

All of the NOIRLab facilities were (and continue to be) managed by AURA



# NSF's NOIRLab

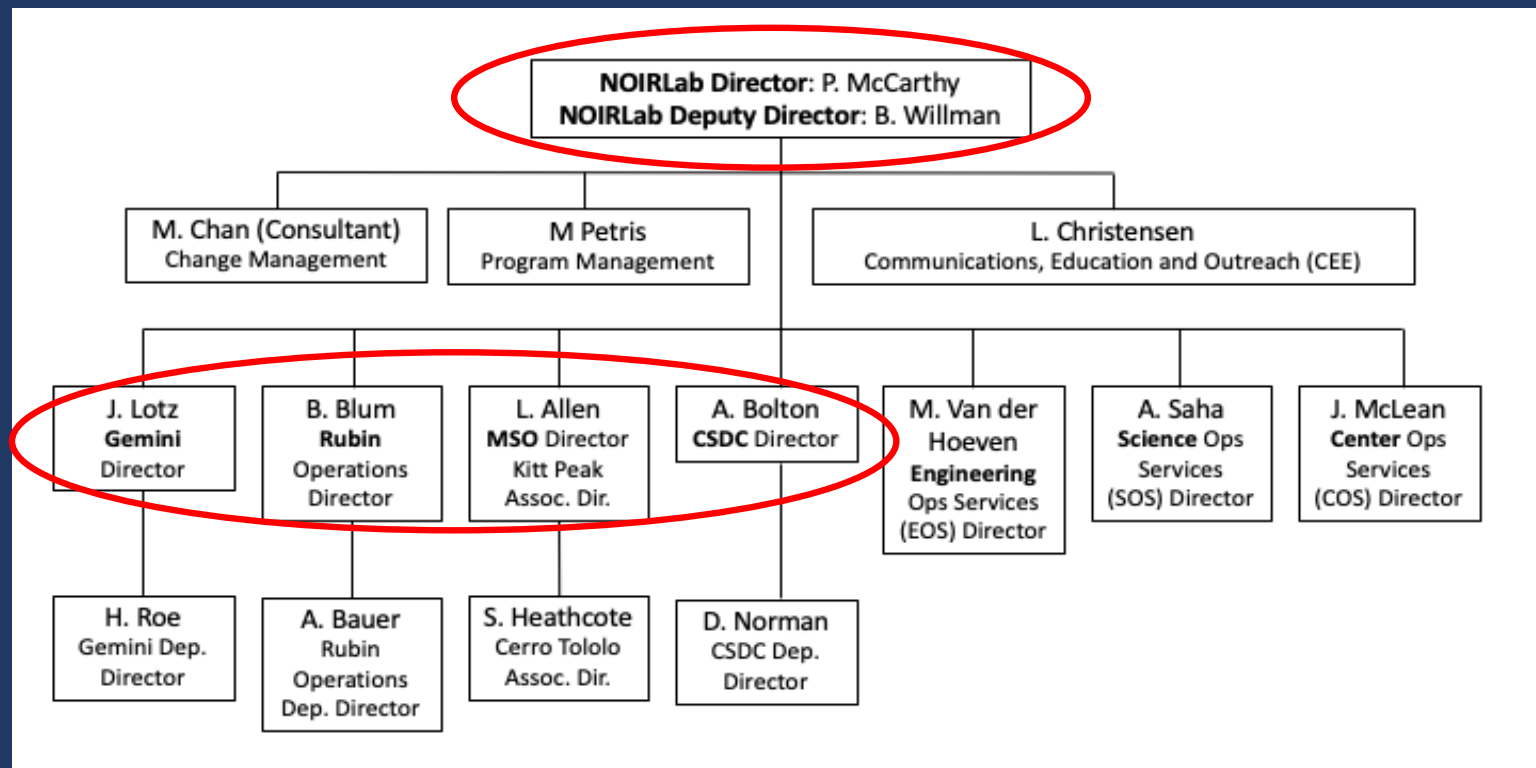


NSF's NOIRLab is a strategic priority for AST. It is a means of:

- optimizing scientific synergies
- consolidating services
- promoting efficient operations
- strengthening U.S. leadership in Optical-Infrared astronomy

Managed by the NOIRLab “Directorate” – NOIRLab Director and Deputy Director

# NOIRLab Org Chart

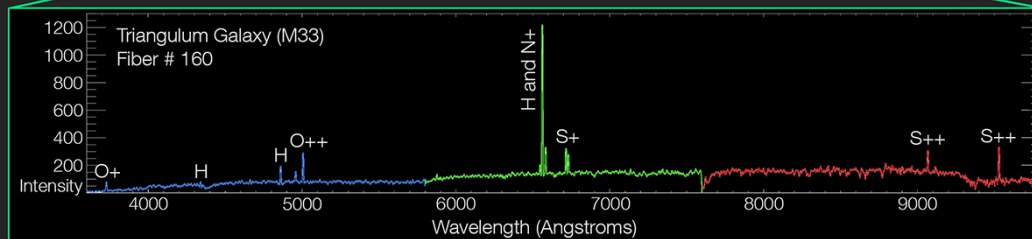
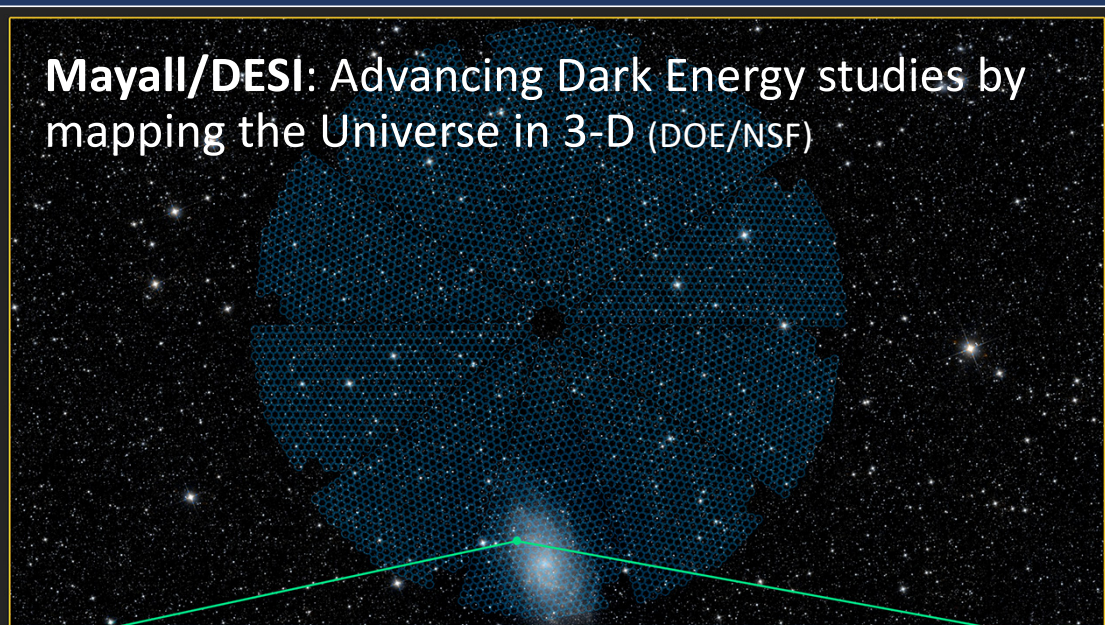


# Cutting-Edge Science from Kitt Peak



**WIYN/NEID:** Searching for near-Earth-sized Exoplanets as part of NN-EXPLORE (NASA/NSF)

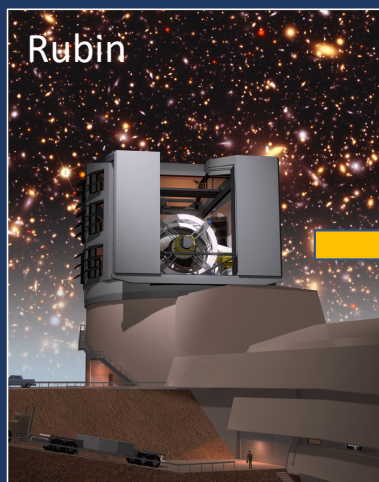
**Mayall/DESI:** Advancing Dark Energy studies by mapping the Universe in 3-D (DOE/NSF)



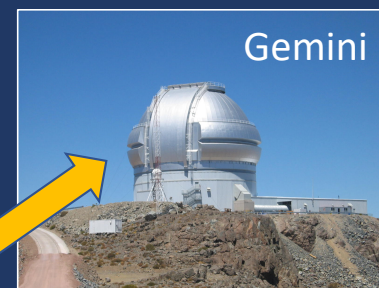


**Blanco/DECam:** 520 mega-pixel (62 CCD) optical camera surveying the southern sky with a 3 sqr. deg. field-of-view

## Time-Domain Astronomy Follow-up from Cerro Tololo/Pachón



**CSDC**  
**ANTARES**  
**AEON**

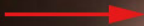


Rapid Response to Time-Domain  
and Multi-Messenger Alerts

0.6 days



2 weeks



Credit: The Dark Energy Camera GW-  
EM Collaboration and the DES  
Collaboration / PI: Berger

# Multi-Messenger Astrophysics with NOIRLab Telescopes



## Binary neutron star merger, GW170817

- Merger detected in gravitational waves by LIGO/Virgo, and at optical wavelengths by Blanco, SOAR, and Gemini-South
- The optical data confirm that binary neutron star mergers are major cosmic production sites of rare heavy elements, such as gold, silver and platinum.

*(for the press release, google NOAO & Cosmic Forge)*

# Gemini Maintaining Diverse, Agile Capabilities



## Aggressive development program

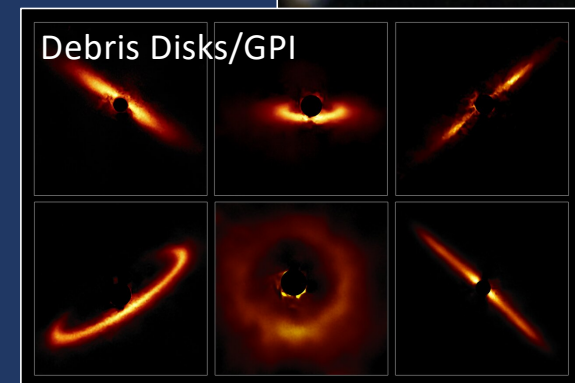
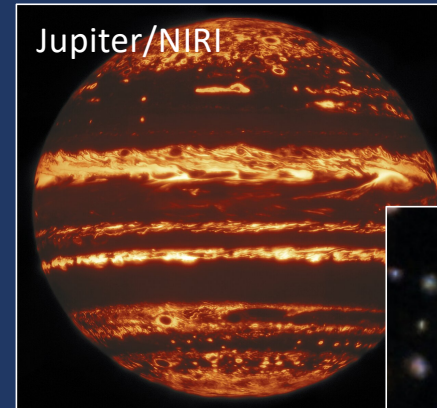
- SCORPIO 8-beam OIR imager/spectrometer
- GHOST high-R optical spectrometer
- GEMMA (MCAO and TDA program)
- GIRMOS, IGRINS-2...

## Popular Visiting Instrument program

- Maroon-X
- Alopeke/Zorro
- IGRINS...

## Continued support for needs of its broad, multi-national user communities

- Fast Turnaround Program
- Large and Long Programs

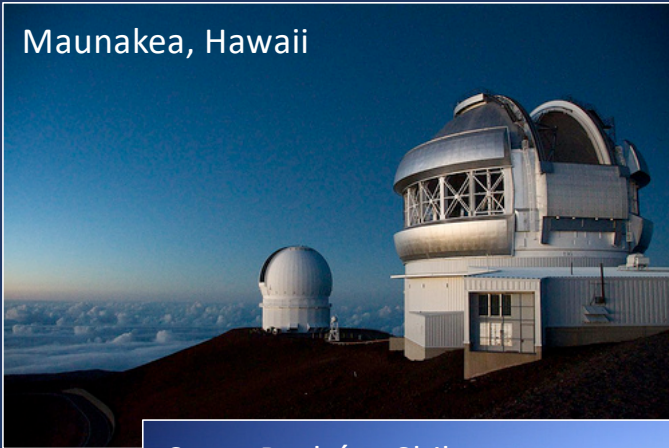




# International Gemini Partnership



Maunakea, Hawaii



Cerro Pachón, Chile



Gemini remains a separately-funded international facility governed by its own Board:

- U.S. (67%)
- Canada (18%)
- Brazil (7%)
- Rep. Korea (5%)
- Argentina (3%)

Chile and Hawai'i host partners

*New 6-yr International Agreement being finalized;  
to start 1 January 2022*



NRC-CNRC



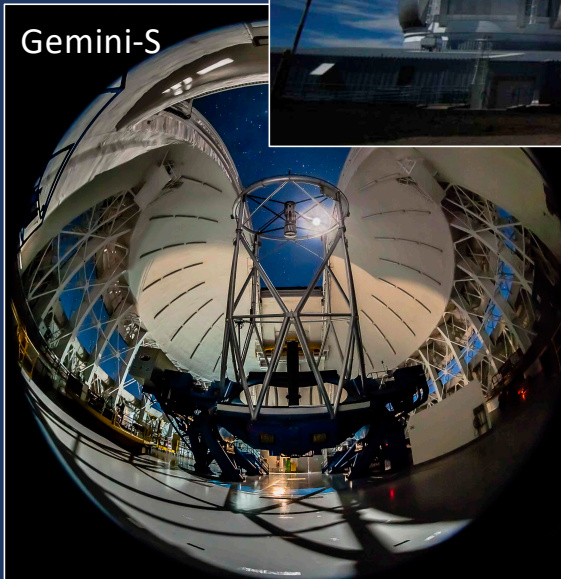
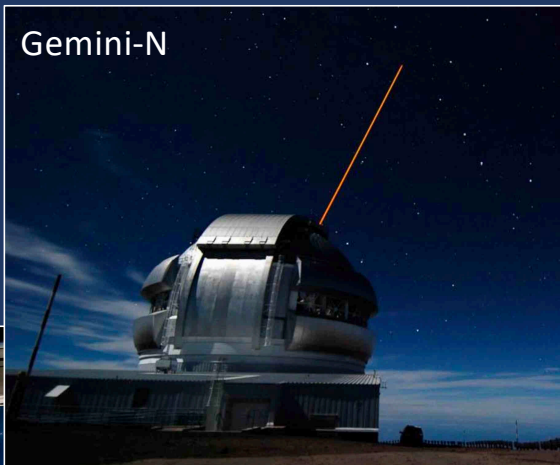
PÁTRIA AMADA  
BRASIL  
BRAZILIAN GOVERNMENT



Ministerio de Ciencia,  
Tecnología e Innovación  
Argentina

KASI 한국천문연구원  
Korea Astronomy & Space Science Institute

# Gemini's Strategic Vision

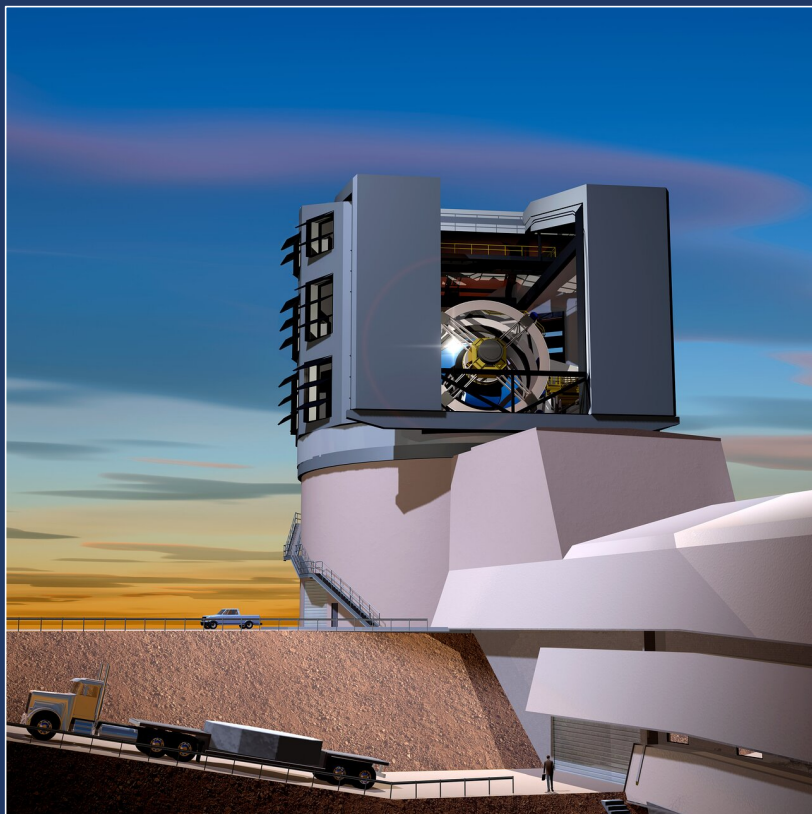


Strategic Vision developed by partners  
(*paraphrased here*):

- Follow-up of targets identified by Rubin (especially transients)
- Significant fraction of the time should remain for smaller PI-driven science
- Premiere facility for Visitor Instruments
- The future direction of the two Gemini telescopes should be allowed to diverge

**STAC:** *The Observatory should build on two current strengths: **adaptive optics** and **dynamic time allocation** via a queue.*

# Vera C. Rubin Observatory *Operations*

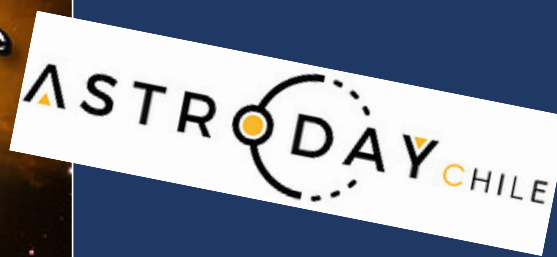


- A separately-funded NSF-DOE program within NOIRLab
- Only Rubin *operations* is part of NOIRLab (not *construction*)
- Operations funding ramping up over the next few years
- Transition of staff from construction to operations

*For more info see presentation by Ed Ajhar, Rubin Program Officer @ NSF, later today*



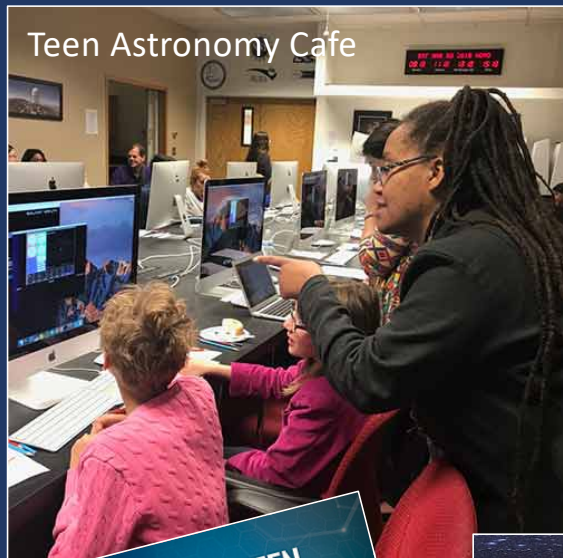
# Education, Outreach and Community Engagement





# Education, Outreach and Community Engagement

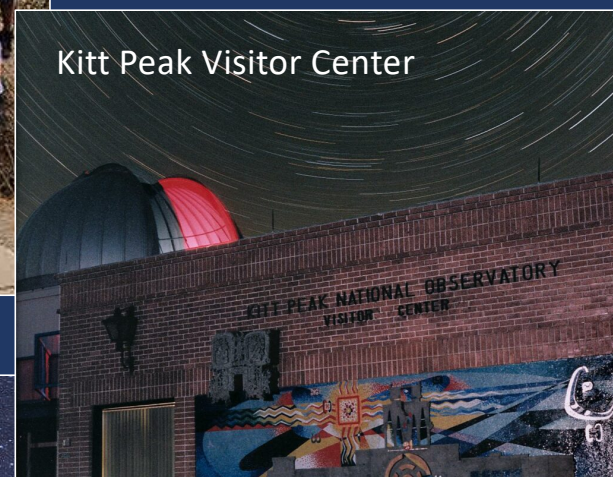
Teen Astronomy Cafe



Tohono O'odham Nation Summer Camp 2018



Kitt Peak Visitor Center



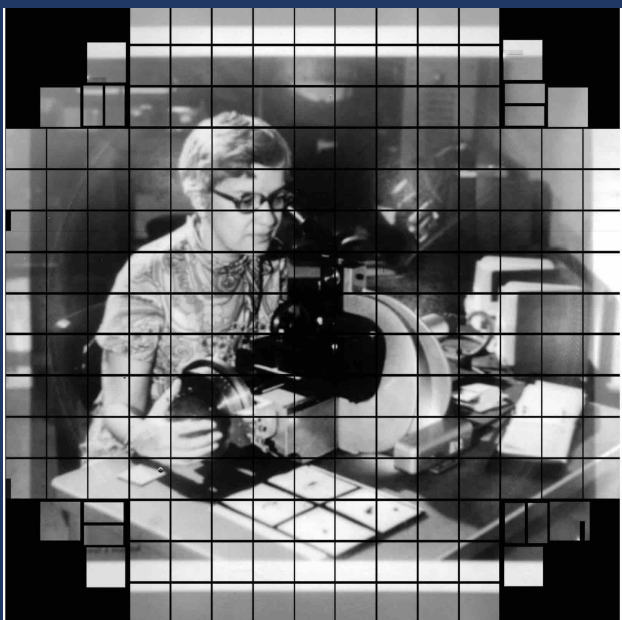
Tenat Observatories



AAAC Meeting – September 22, 2020



# Education, Outreach and Community Engagement



One of first 3200-megapixel images taken using the LSST camera CCD array and a 150-micron pinhole.

- Dedicating substantial effort during construction to produce an EPO program that can be deployed near the beginning of Science Operations.
- One of many goals is to provide non-specialists access to Rubin data by providing tools and interfaces that engage diverse communities.
- Rubin will integrate some of its E/PO effort with that of NOIRLab; E/PO linked to data stream may remain separate.



# New Websites and Newsletter

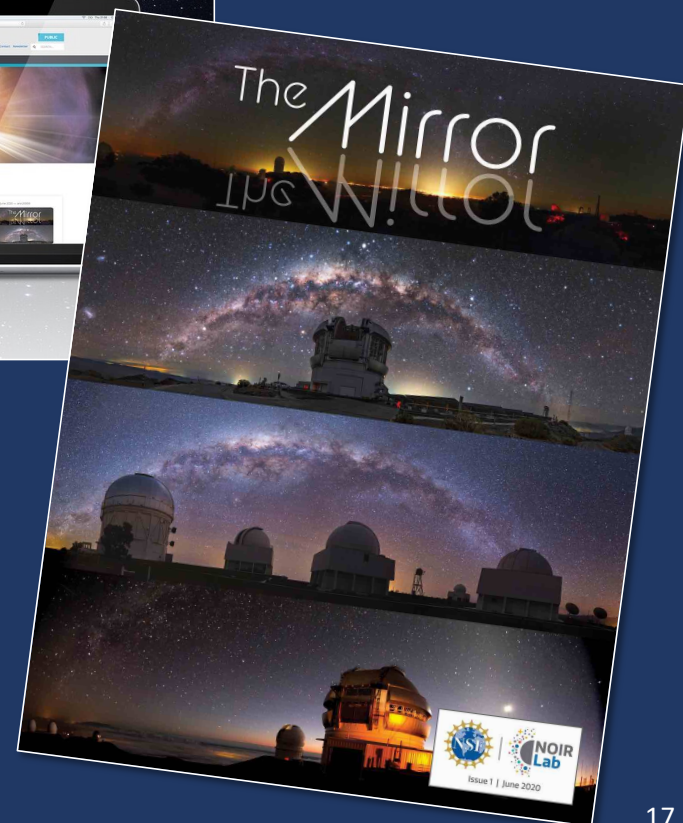


## Exploring the Universe, Sharing its Wonders

The Gemini Observatory consists of twin 8.1-meter diameter optical/infrared telescopes located on two of the best observing sites on the planet. From their locations on mountains in Hawai'i and Chile, Gemini Observatory's telescopes can collectively access the entire sky.

The international Gemini Observatory is a Program of NSF's NOIRLab.

About Gemini



AAAC meeting - September 22, 2020

# Partnerships



## Maintaining existing and developing new partnerships:

- International Gemini Observatory Partnership (incl. limited-term collaborators)
- NSF-DOE partnership through construction and operations to complete the 10-year Legacy Survey of Space and Time (LSST)
- NSF-DOE partnership for dark energy science (Mayall/DESI, Blanco/DECam)
- NASA-NSF exoplanet initiative (NN-EXPLORE)
- Community partnerships
  - SOAR: MCTIC/Brazil\*, NSF's NOIRLab, U. North Carolina Chapel Hill, Michigan State Univ.
  - WIYN: Univ. Wisconsin, Indiana Univ., NSF's NOIRLab, Univ. Missouri, Purdue Univ.
- Tenant Observatories program at KPNO and CTIO
- Exploring options for involvement in US-ELT Program (NOIRLab/GMTO/TIO)

\*Ministério da Ciência, Tecnologia e Inovações do Brasil

# NOIRLab and *Astro2020*



*NOIRLab will be the organization through which NSF executes any new programs in ground-based OIR astronomy following consideration of the Astro2020 recommendations*

## United States Extremely Large Telescope (US-ELT) Program

- Potential public-private partnership between
  - NSF's NOIRLab
  - Giant Magellan Telescope (GMT)
  - Thirty Meter Telescope (TMT)
- NOIRLab structure enables incorporation of US-ELT Program Office
  - Would provide the U.S. community access to GMT and TMT
  - Would provide common tools and services for U.S. users
  - Would enhance access for underserved communities
  - Would promote diversity across the program
- NOIRLab support of US-ELT is dependent on (among other milestones) a positive outcome from *Astro2020*





# NOIRLab Capabilities



AURA and the NOIRLab leadership are well placed to deal with the impact on operations of COVID-19 and other social concerns

- Established presence in Hawaii, Chile and Tucson
  - AURA has many years of experience operating and engaging with the local communities at the three sites.
- Established leadership, especially at the center management level
  - Kitt Peak, Cerro Tololo and CSDC leadership unchanged; on-site leaders at Gemini-N and Gemini-S unchanged; Rubin Ops Director from NOAO.
- Established staff, with only modest changes in duties for many so far
- AURA has managed much of the NOIRLab transition *prior* to COVID-19
  - Senior hires are largely in place.
  - Internal engagement/training, external outreach, business systems, etc..

# Thanks - Questions?



Images of the week  
from the NOIRLab  
website...



International Gemini  
Observatory/NOIRLab/NSF/AURA/B. Tafreshi



Credit:CTIO/NOIRLab/NSF/AURA/B. Tafreshi



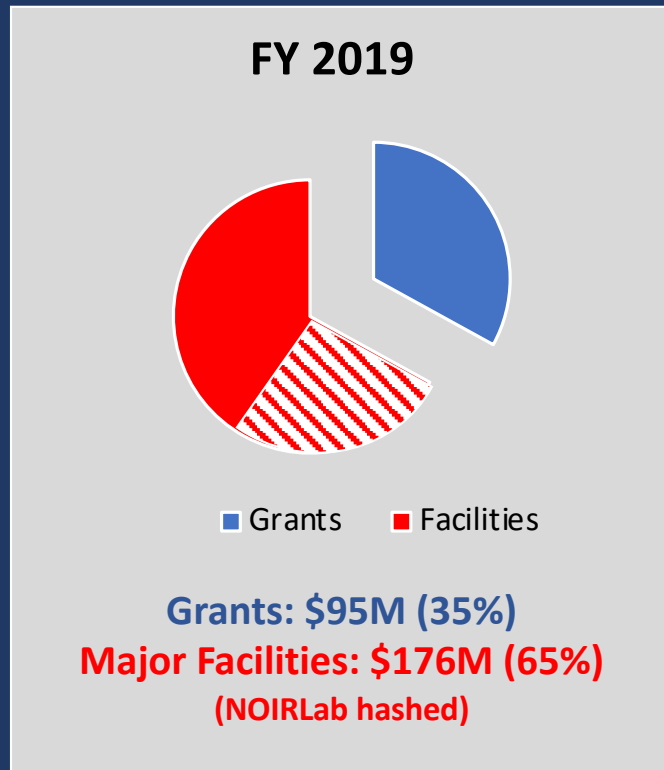
Credit: KPNO/NOIRLab/NSF/AURA



# Backup Slides



# AST Portfolio (FY 2019)



## Major Facilities Funding\*

AURA (optical-infrared): \$76.5M

- NSF's NOIRLab
  - MSO+CSDC
  - Gemini Observatory
  - Rubin Observatory
- National Solar Observatory
  - Daniel K Inouye Solar Telescope

Assoc. Universities Inc. (radio): \$97.2M

- National Radio Astronomy Observatory
- Atacama Large Millimeter/Submm Array
- Green Bank Observatory

Univ. Central Florida (radio): \$2.0M\*

- Arecibo Observatory

\* Excludes co-funding from other Divisions, MREFC funding, and hurricane repair funding for Arecibo.