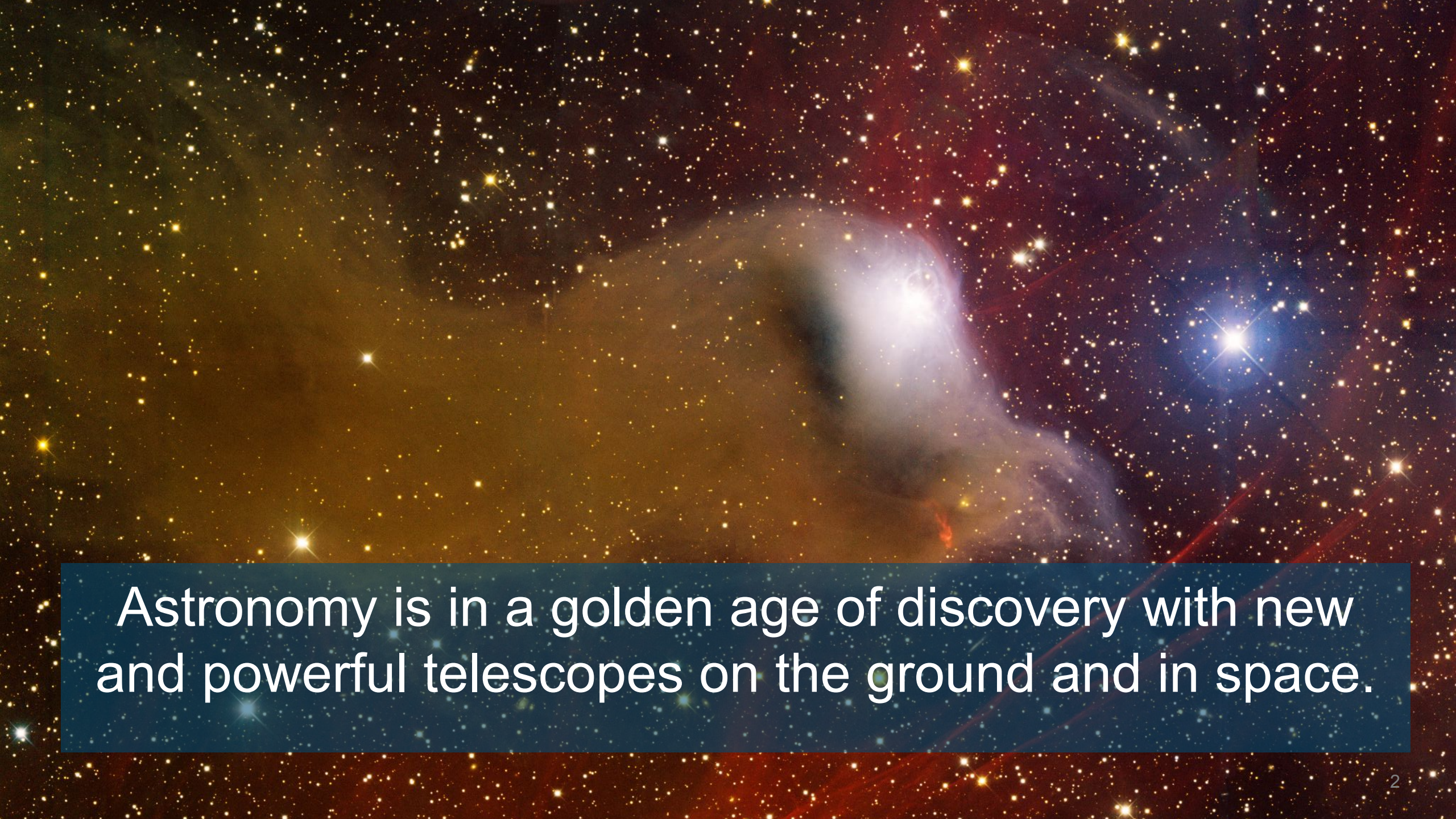


# NSF's NOIRLab

*Discovering Our Universe Together*





Astronomy is in a golden age of discovery with new and powerful telescopes on the ground and in space.

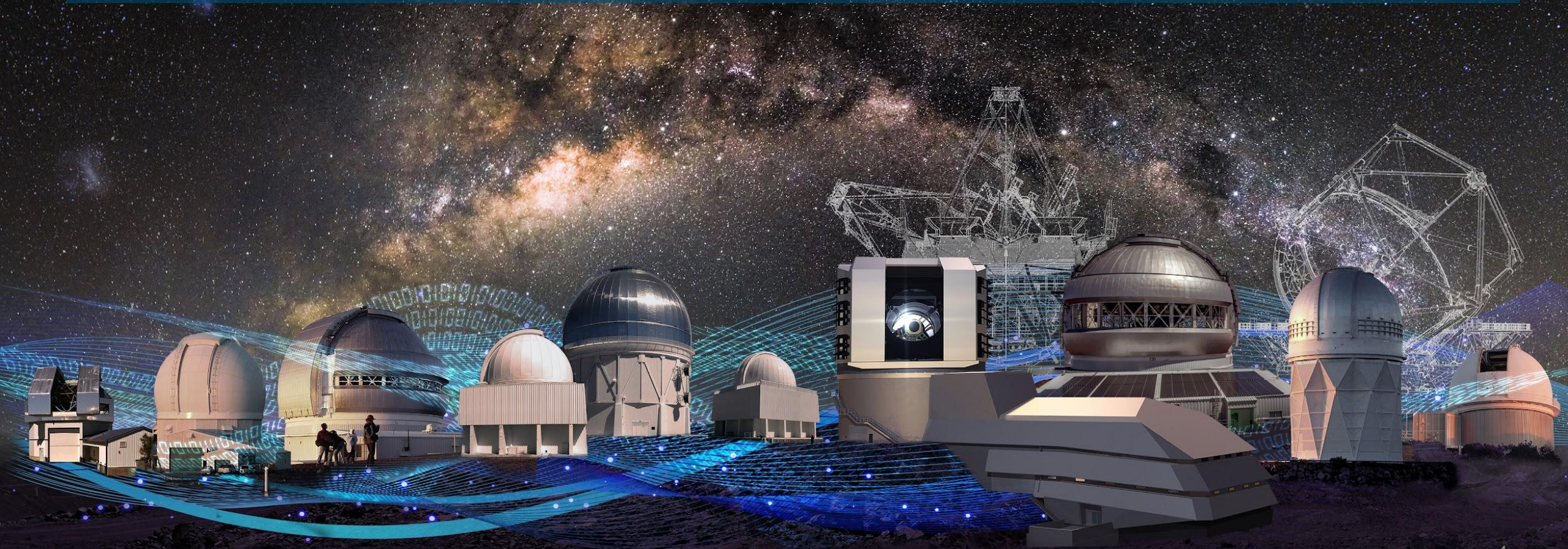


Astronomy tries to answer the largest philosophical questions of the human race: Where do we come from? Is there life elsewhere in the Universe?





For the first time, all of the ground-based optical observatories funded by the National Science Foundation are unified into a single organization.





# NOIRLab's mission:

*Enabling and sharing breakthrough discoveries in astronomy and astrophysics with state-of-the-art ground-based observatories, data products, and services for a diverse and inclusive community*



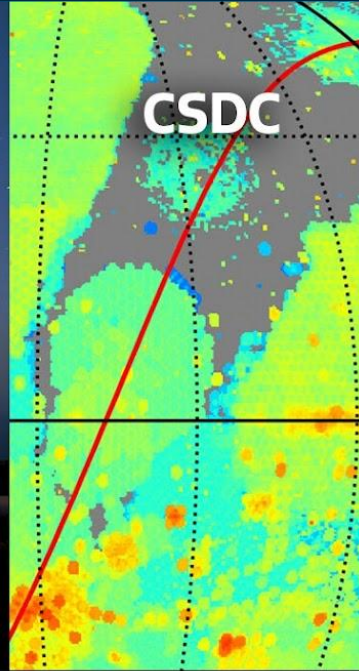


# NOIRLab's five Programs are:

**Kitt Peak**



**CSDC**



**Gemini**  
*With our international partners*



**Cerro Tololo**



**Rubin Observatory Operations**  
*An NSF-DOE Partnership*





**NSF's NOIRLab**  
 HQ, Tucson, Arizona

CSDC CTIO GEMINI OBSERVATORY KPNO RUBIN US-ELTP

**AURA Corporate Office**  
 HQ, AURA-O, CAS, NSF-funded HR

Washington DC | Baltimore, MD  
 La Serena, Chile | Santiago, Chile  
 Tucson, AZ | Hilo, HI

**NSF's NOIRLab**  
 Recinto, La Serena, Chile

CTIO CSDC GEMINI OBSERVATORY RUBIN

**Kitt Peak**

KPNO

Hawai'i

**Maunakea**

GEMINI OBSERVATORY

**NSF's NOIRLab**  
 Hilo, Hawai'i

GEMINI OBSERVATORY

**Cerro Tololo**

CTIO

**Cerro Pachón**

CTIO GEMINI OBSERVATORY RUBIN





The integration of these world-class facilities creates a powerful capability for discovery, technology development, STEM workforce growth, and education.





NOIRLab develops and operates a suite of state-of-the-art ground-based astronomical telescopes and their instruments at three unique observing sites: Chile, Hawai'i, and Arizona, with headquarters in Tucson, Arizona, USA.






NOIRLab hosts 70 of the most diverse and innovative ground-based telescopes in the world.






The background of the slide is a composite image. The top half shows a clear night sky with the Milky Way galaxy visible as a dense band of stars. Below the sky, there are three large, white, cylindrical astronomical observatories with domes, situated on a dark, flat landscape. The sky transitions from a deep blue at the top to a bright orange and yellow glow near the horizon, suggesting a sunset or sunrise. The observatories are illuminated from below, casting soft shadows.

The astronomical community is honored to have the opportunity to conduct astronomical research on Iolkam Du'ag (Kitt Peak) in Arizona, on Maunakea in Hawai'i, and on Cerro Tololo and Cerro Pachón in Chile. We recognize and acknowledge the very significant cultural role and reverence that these sites have to the Tohono O'odham Nation, to the Native Hawaiian community, and to the local communities in Chile, respectively.

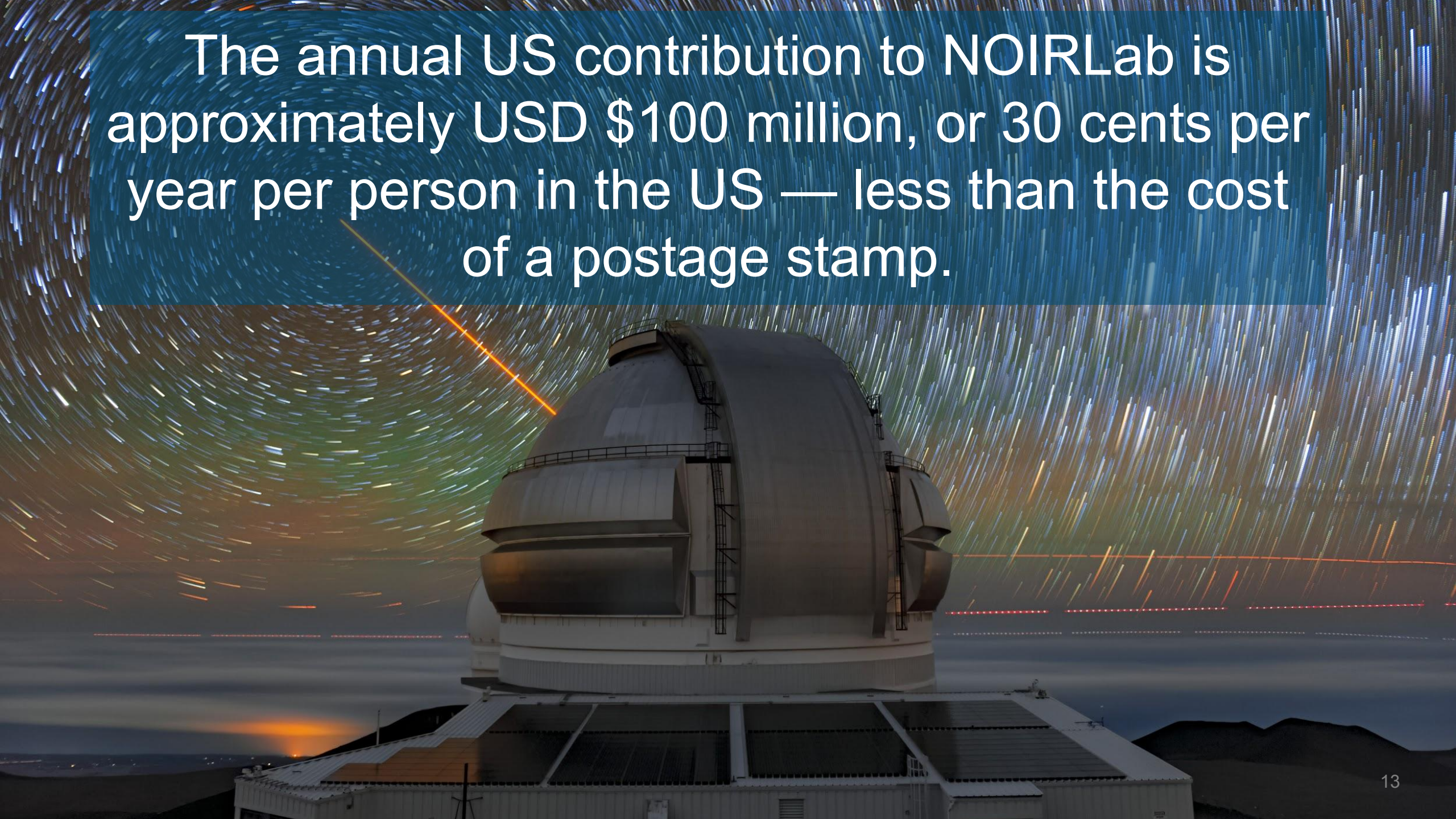




NOIRLab empowers astronomers to tackle the most pressing questions in astrophysics today, and opens up new discovery space for the future.



The annual US contribution to NOIRLab is approximately USD \$100 million, or 30 cents per year per person in the US — less than the cost of a postage stamp.







NOIRLab employs around 450 staff members.



A woman with long brown hair and safety glasses is looking intently at a dense array of colorful cables in a server room. The cables are bundled together and run across the room, creating a complex network. The woman is wearing a blue shirt and is positioned in the foreground, looking towards the camera. The background shows server racks and other equipment in a dimly lit room.


NOIRLab staff have identified their highest priority values for the organization. They are: transparency, respect and empathy, diversity and inclusion, accountability and responsibility, integrity and ethics, and safety.



NOIRLab is a Federally Funded Research and Development Center that operates as a matrix organization providing Scientific, Engineering, Facilities, IT, Safety, and Communication services across the Programs.

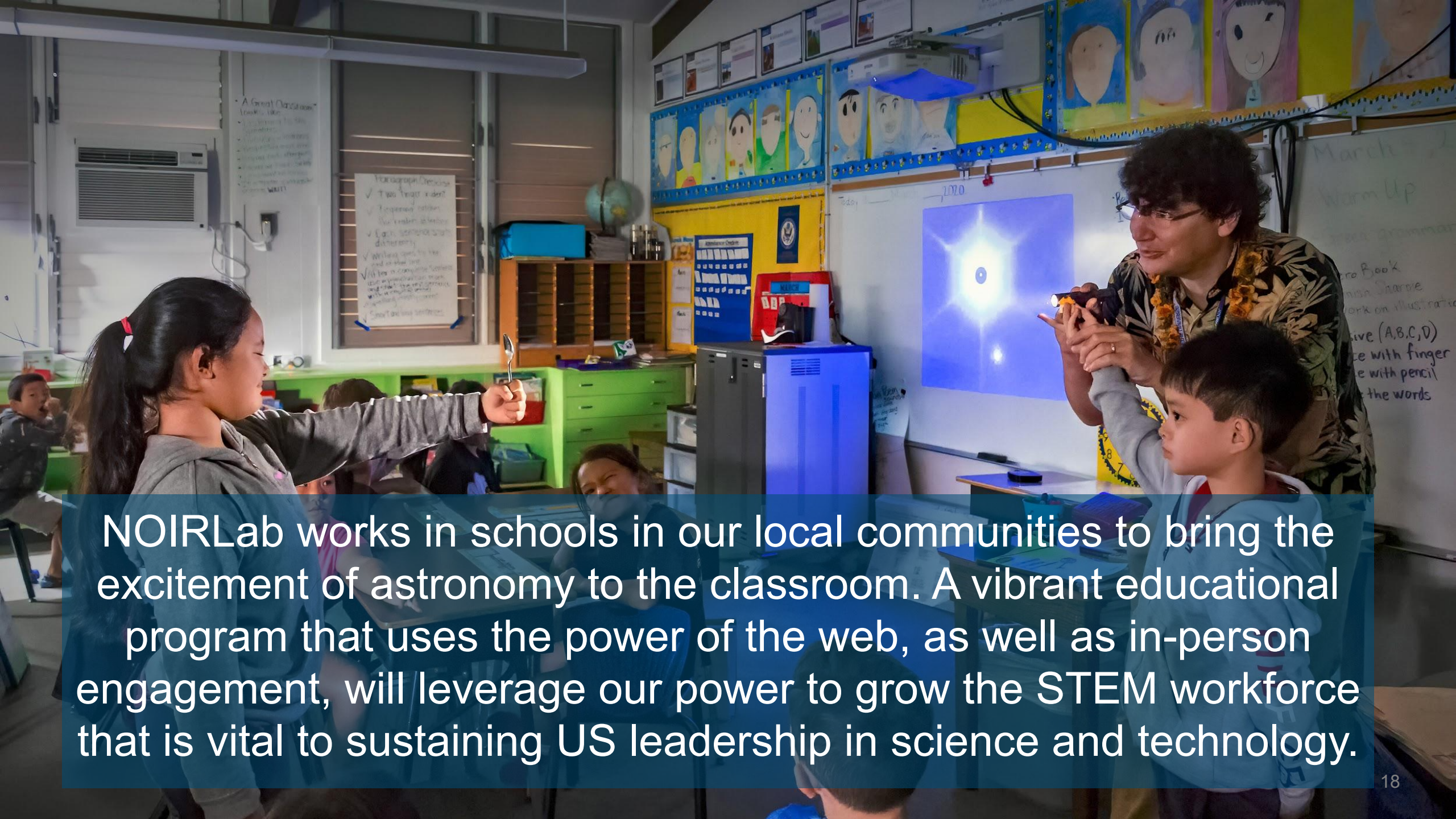




A night sky with the Milky Way galaxy visible, and several observatory domes on a mountain ridge.

NOIRLab has a vital role to play in the development of the STEM workforce, in sharing our passion for discovery, and in keeping the world informed of the exciting work done at our observatories.





NOIRLab works in schools in our local communities to bring the excitement of astronomy to the classroom. A vibrant educational program that uses the power of the web, as well as in-person engagement, will leverage our power to grow the STEM workforce that is vital to sustaining US leadership in science and technology.

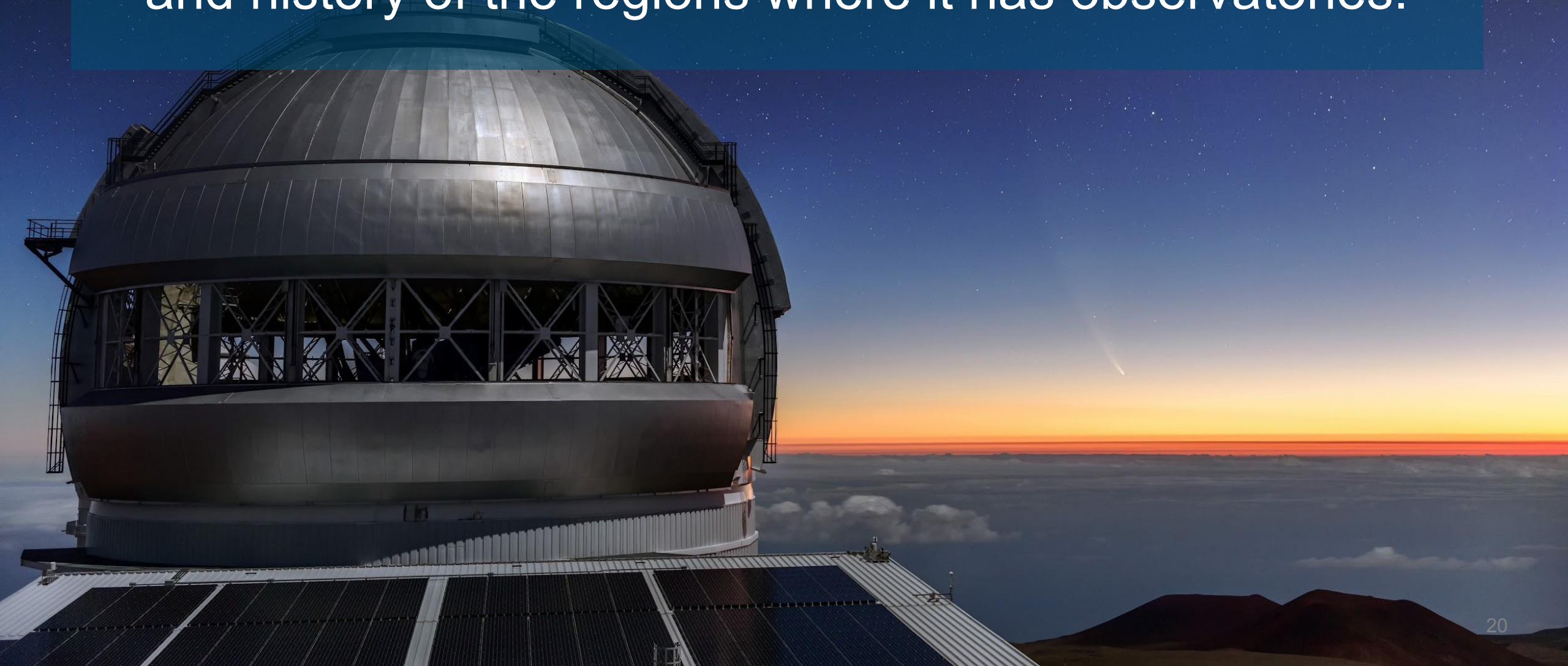


NOIRLab acts as a positive force in our local host communities and respects the needs, interests, and culture of the Indigenous and local people in Chile, Hawai'i, and Arizona.



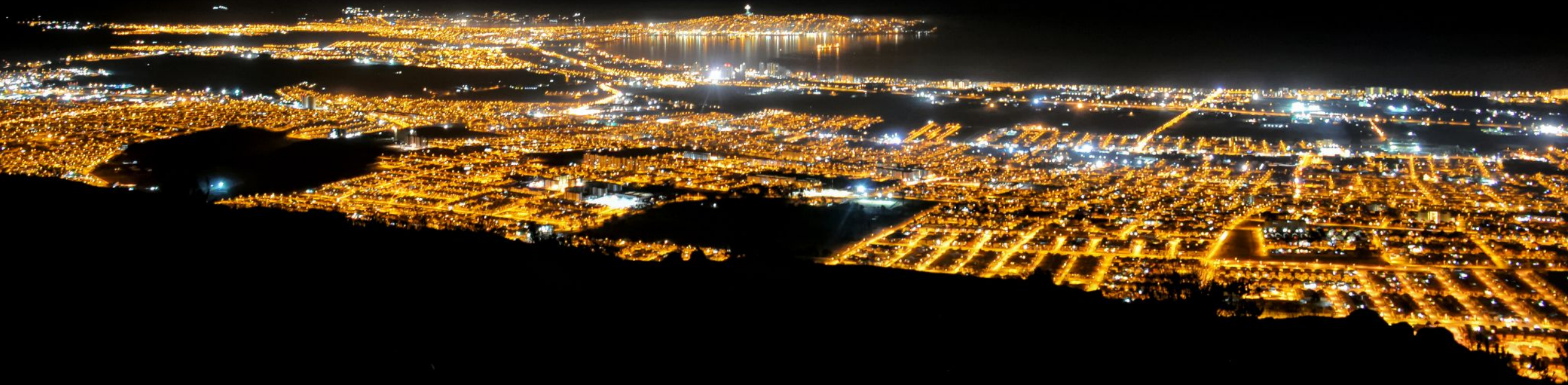


NOIRLab strives to be a trustworthy good neighbor, caring for local resources, environment, education, economy, and history of the regions where it has observatories.





Protection of the night sky is relevant not only for astronomers but for all citizens. The night sky is a human heritage that must be preserved and protected against light pollution.





NOIRLab is a cultural bridge between  
the US and Chile.








NOIRLab aims to set the highest standard for meaningful engagement with underrepresented communities, including local and indigenous communities.





NOIRLab promotes Chilean astronomy and related sciences through a series of national, regional, and local activities.



A vibrant nebula with orange and red hues against a starry blue background. The nebula has a complex, filamentary structure with a bright central star. The background is filled with numerous smaller stars of varying brightness.

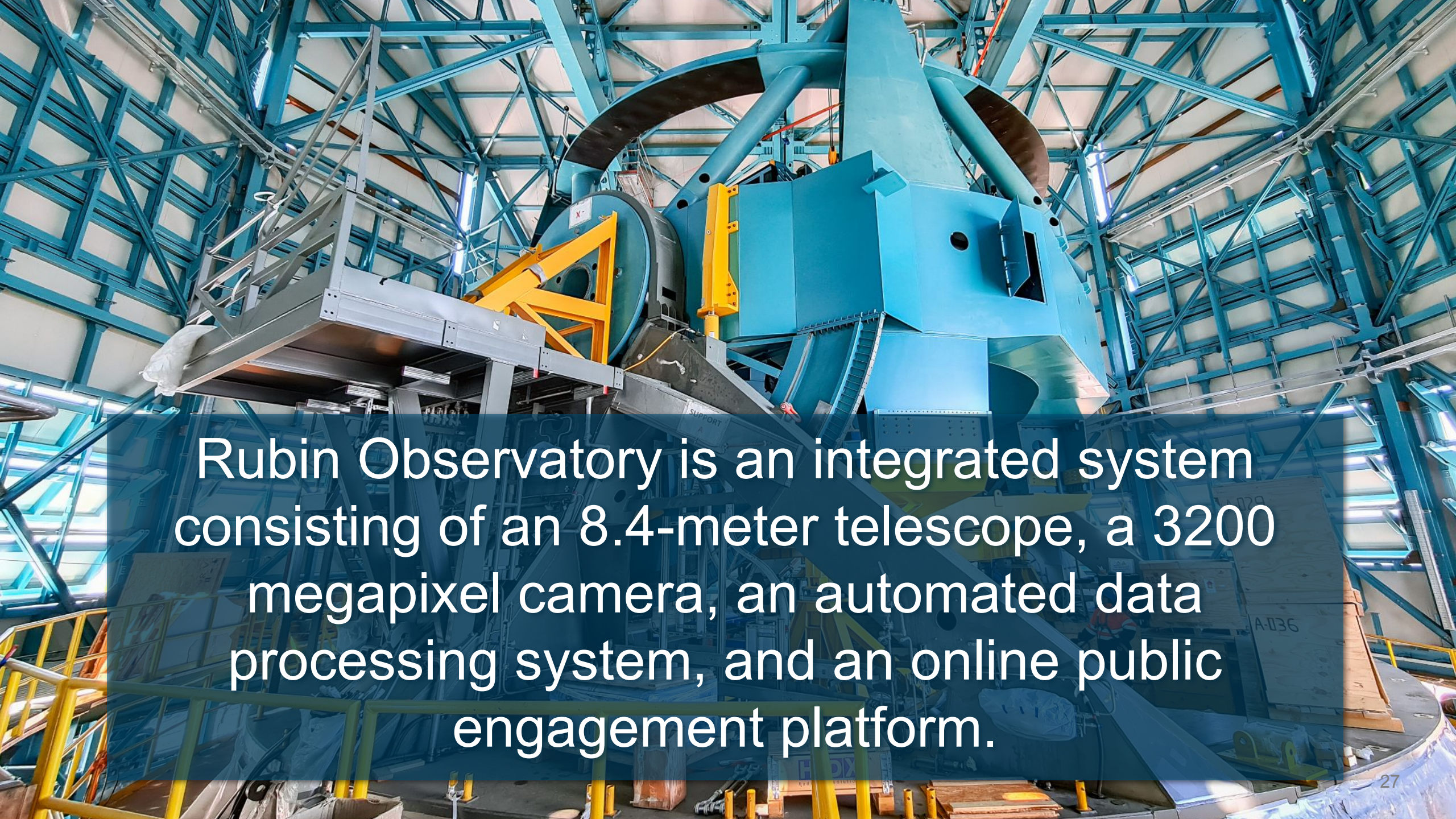
NOIRLab engages widely in the local communities in Hawai'i and Chile through many different outreach programs every year. In Hawai'i, we are partnering with the other Maunakea Observatories in programs such as AstroDay East & West, Journey Through the Universe, the Kama'aina Observatory Experience (bringing state residents to our telescopes), Maunakea Scholars, Akamai internship programs, and much more.



Vera C. Rubin Observatory is a new facility that will be a leading resource for cutting-edge astronomical science.

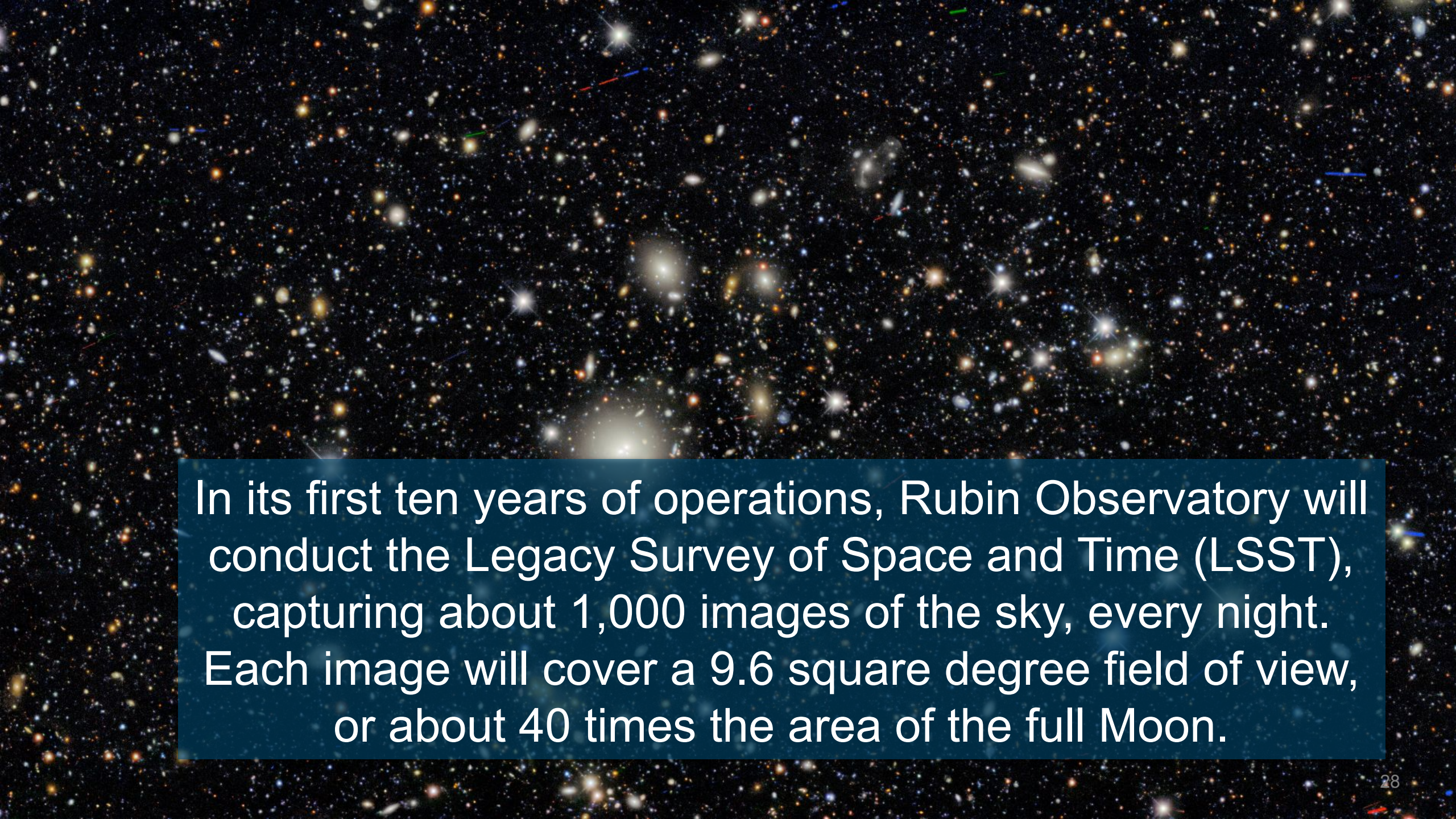




A large, blue-painted telescope structure is under construction inside a massive, steel-framed building. The structure is complex, with various beams and supports. A yellow crane or lifting mechanism is visible, supporting a large circular component. The building's interior is filled with a dense network of blue steel beams and girders. The lighting is bright, highlighting the industrial environment.

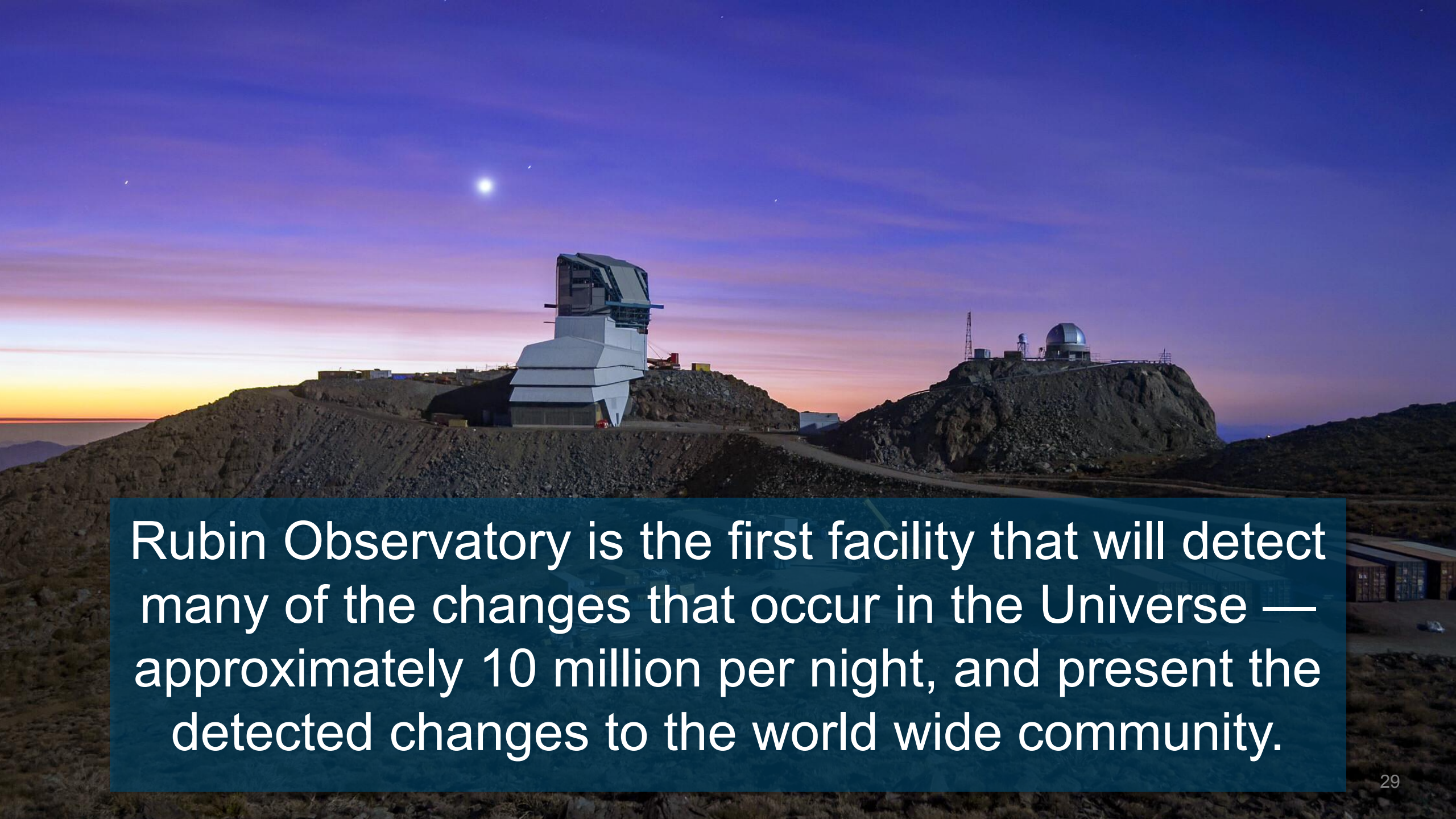
Rubin Observatory is an integrated system consisting of an 8.4-meter telescope, a 3200 megapixel camera, an automated data processing system, and an online public engagement platform.






In its first ten years of operations, Rubin Observatory will conduct the Legacy Survey of Space and Time (LSST), capturing about 1,000 images of the sky, every night. Each image will cover a 9.6 square degree field of view, or about 40 times the area of the full Moon.



A wide-angle photograph of the Rubin Observatory construction site at dusk. The sky is a gradient of purple, blue, and orange. In the foreground, a large, white, multi-tiered structure is under construction on a rocky hillside. In the background, another hillside features a completed observatory dome and other structures. The overall scene is illuminated by the soft light of the setting sun.


Rubin Observatory is the first facility that will detect many of the changes that occur in the Universe — approximately 10 million per night, and present the detected changes to the world wide community.





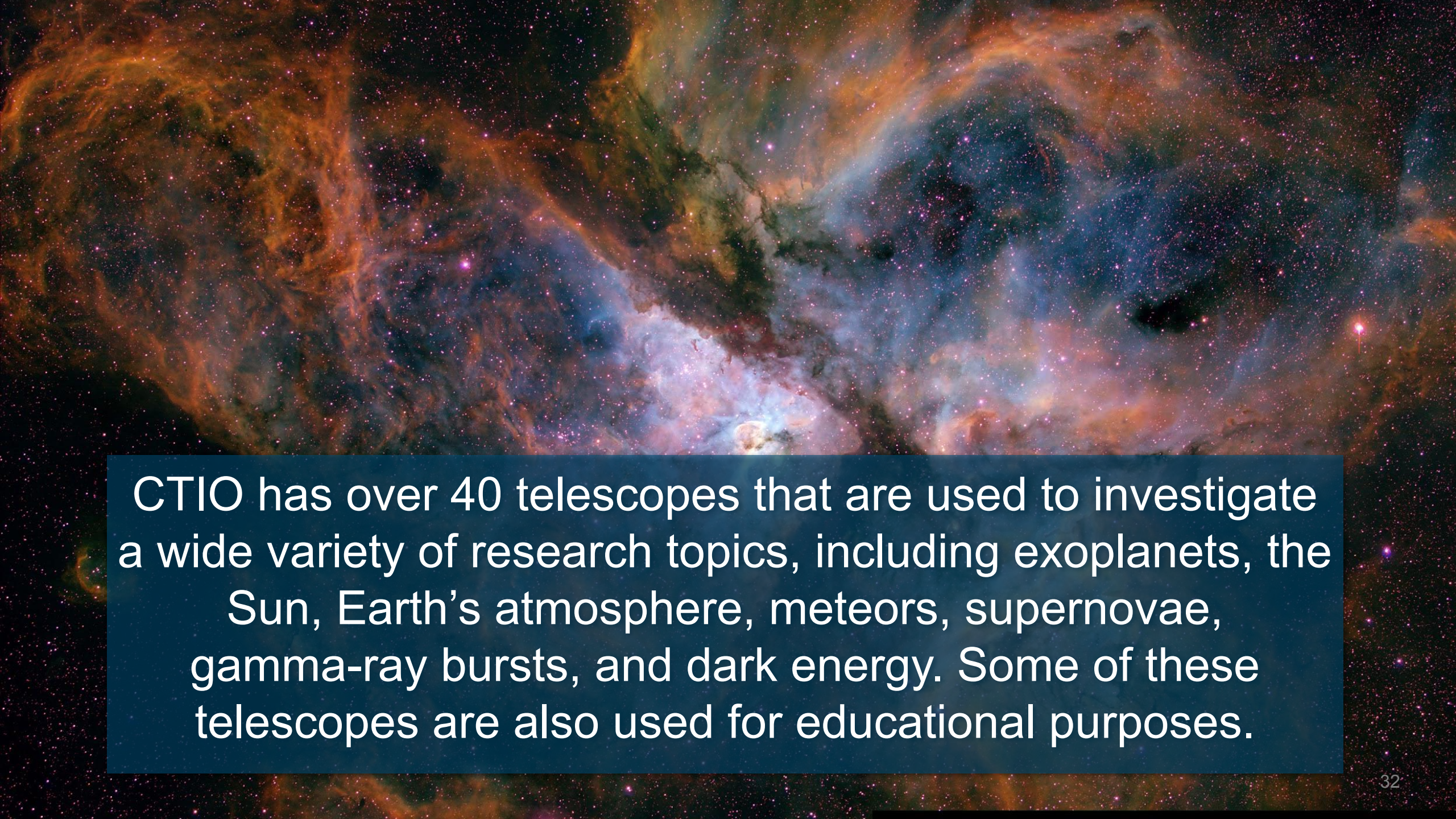
Rubin Observatory is supported by funding from the US National Science Foundation (NSF) and the US Department of Energy (DOE), and is operated by NSF's NOIRLab and SLAC National Accelerator Laboratory.



A night sky with the Milky Way galaxy and several large white observatory domes on a dark landscape. The Milky Way is visible as a bright, cloudy band of stars stretching across the upper half of the image. Below it, several large, white, dome-shaped observatory structures are scattered across a dark, flat landscape. The sky is filled with numerous stars, and the overall scene is illuminated by the ambient light of the night sky.

Since 1965, US astronomers have used Cerro Tololo Inter-American Observatory (CTIO) in Chile as the principal platform for their investigations of the southern skies





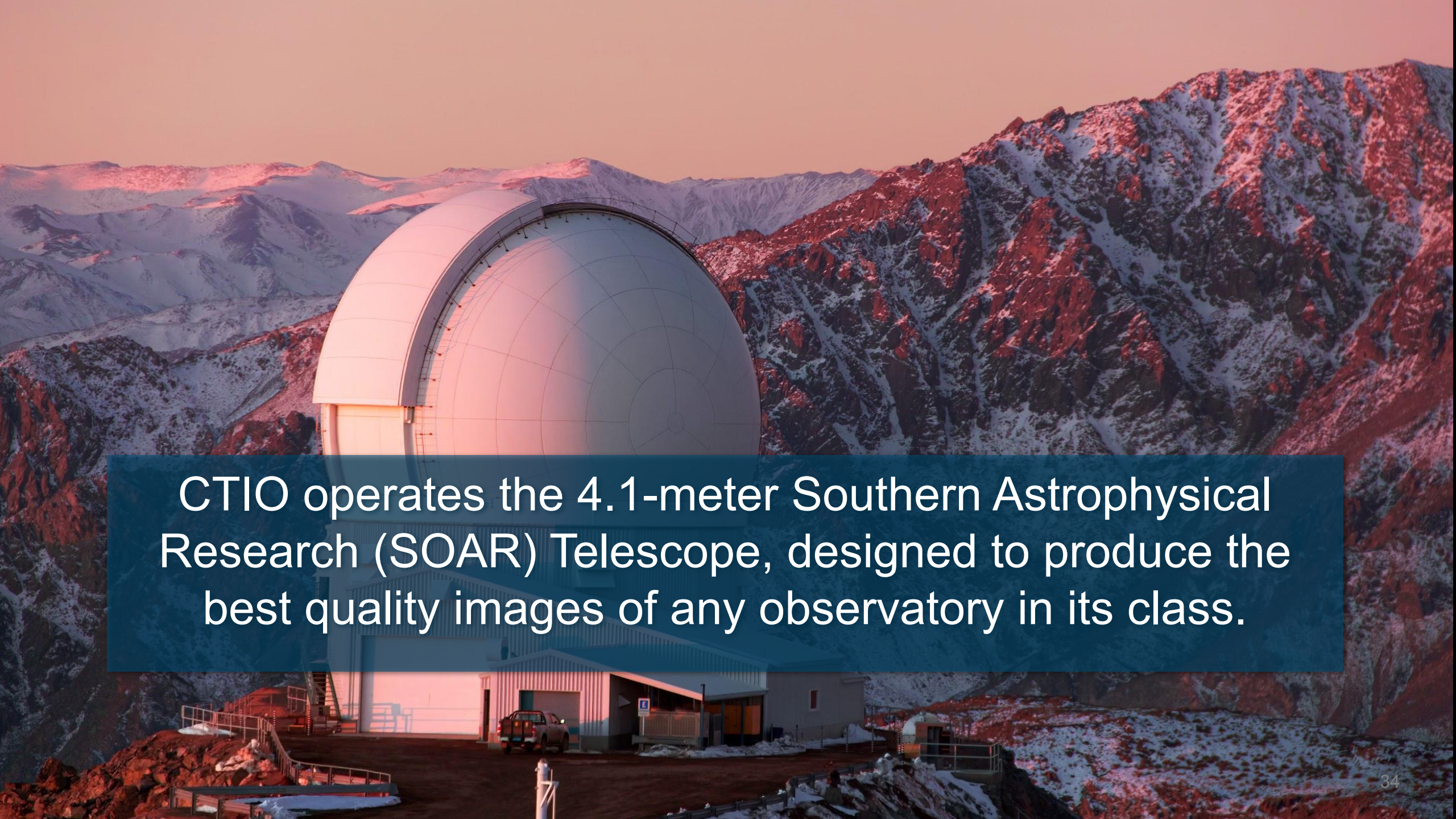
CTIO has over 40 telescopes that are used to investigate a wide variety of research topics, including exoplanets, the Sun, Earth's atmosphere, meteors, supernovae, gamma-ray bursts, and dark energy. Some of these telescopes are also used for educational purposes.



The largest telescope on Cerro Tololo, the Víctor M. Blanco 4-meter Telescope, features the Dark Energy Camera (DECam), a high-performance, wide-field CCD imager originally built with DOE-funding to carry out the Dark Energy Survey (DES).





A large white dome telescope is the central focus, set against a backdrop of rugged, snow-dusted mountains under a warm, orange-hued sky. The scene is captured during sunset or sunrise, with the light casting a golden glow on the telescope and the surrounding landscape. The telescope's dome is partially open, revealing the interior structure. In the foreground, a smaller building with a corrugated metal roof and a pickup truck parked nearby are visible, suggesting a remote observatory site.

CTIO operates the 4.1-meter Southern Astrophysical Research (SOAR) Telescope, designed to produce the best quality images of any observatory in its class.



The Community Science and Data Center (CSDC) supports and enables a broad range of science activities for the US ground-based optical and infrared astronomical communities.



The Time Allocation Committee at CSDC selects proposals for open-access observing time on telescopes through a peer-review process.



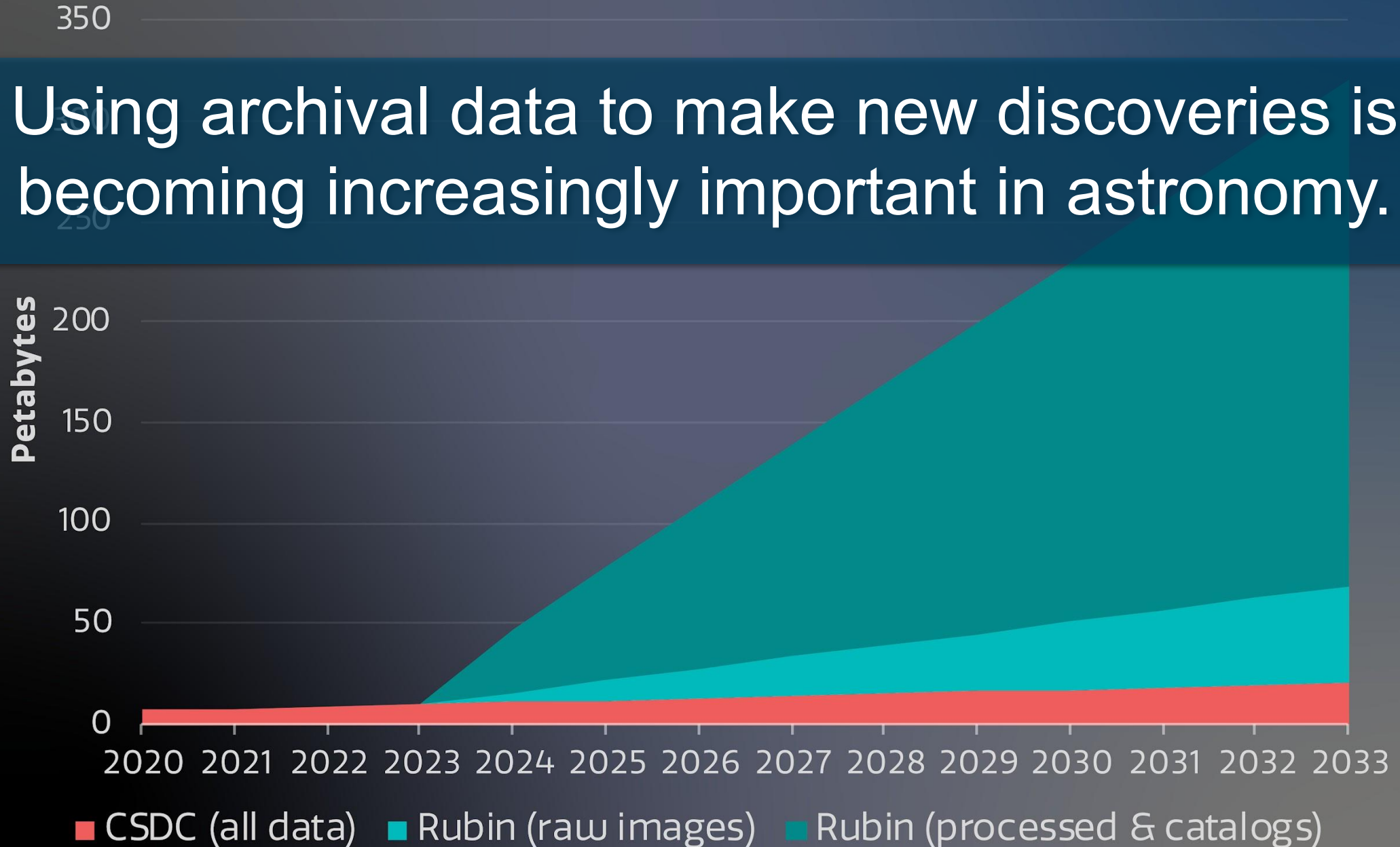


The US National Gemini Office, part of CSDC, serves as the interface between the US astronomical community and the international Gemini Observatory.

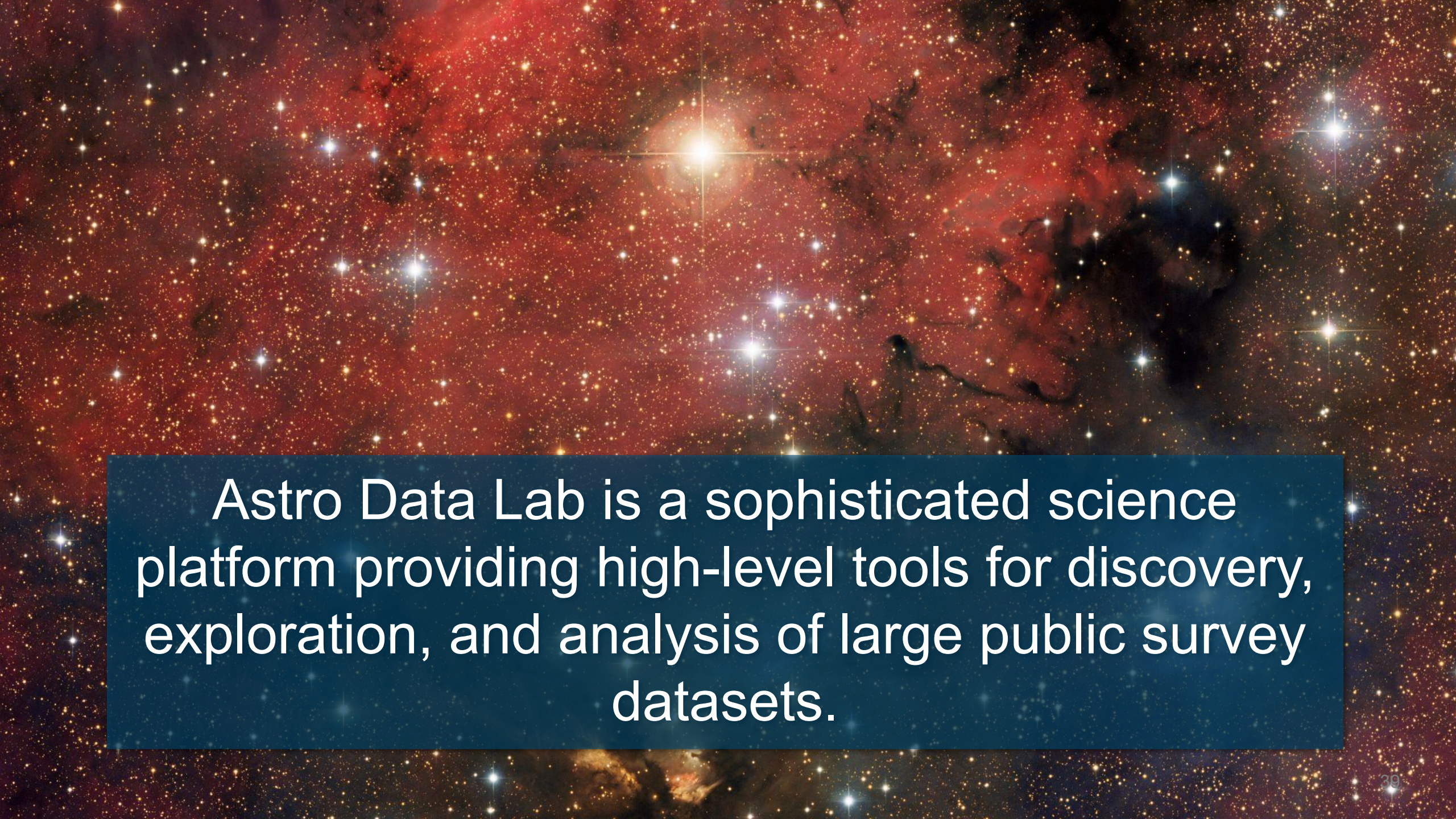


# NOIRLab Projected Archival Data Growth

Using archival data to make new discoveries is becoming increasingly important in astronomy.



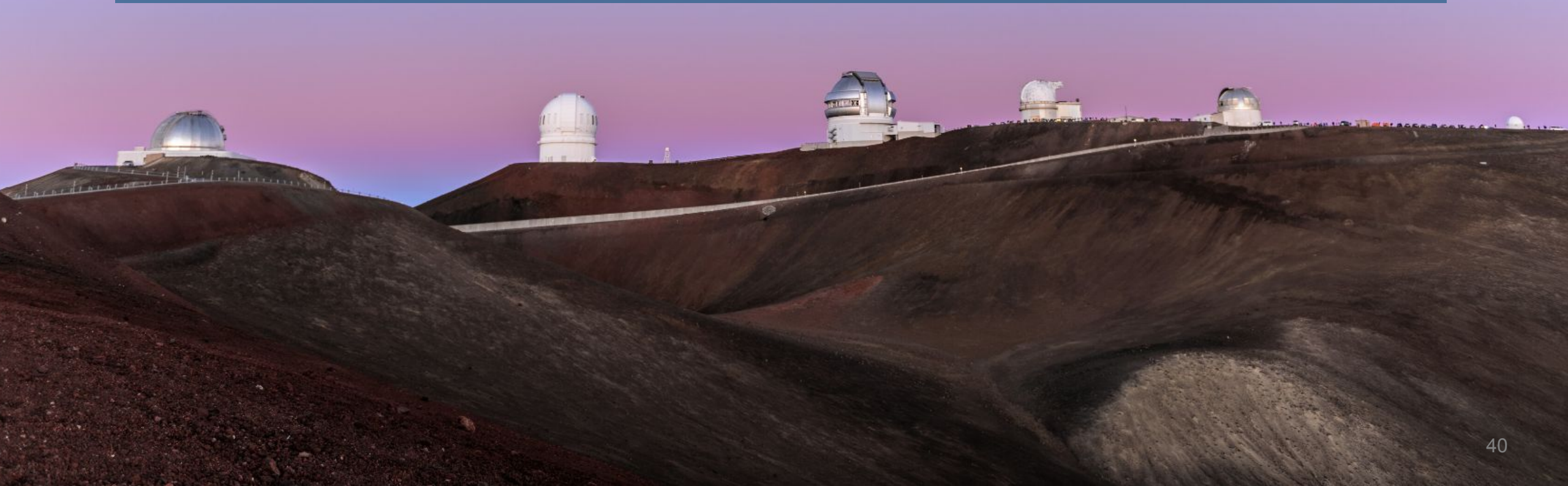





Astro Data Lab is a sophisticated science platform providing high-level tools for discovery, exploration, and analysis of large public survey datasets.



The International Gemini Observatory comprises twin 8.1-meter optical/infrared telescopes on two of the best observing sites on the planet. Gemini North is located near the summit of Maunakea in Hawai'i, and Gemini South is in the mountains of Chile on Cerro Pachón.







They are some of the most infrared-optimized telescopes in ground-based astronomy, and together, provide complete coverage of the sky.



The Gemini international partnership includes the United States, Canada, Chile, Brazil, Argentina, and Korea.






A night-time photograph of the Kitt Peak National Observatory. The sky is dark blue and filled with numerous stars. In the foreground, several white observatory domes and structures are visible on a rocky, forested hillside. The largest dome is centrally located and has a prominent, faceted base. To its left, there are two smaller domes and a cylindrical structure. The background shows a dark horizon with some distant lights.

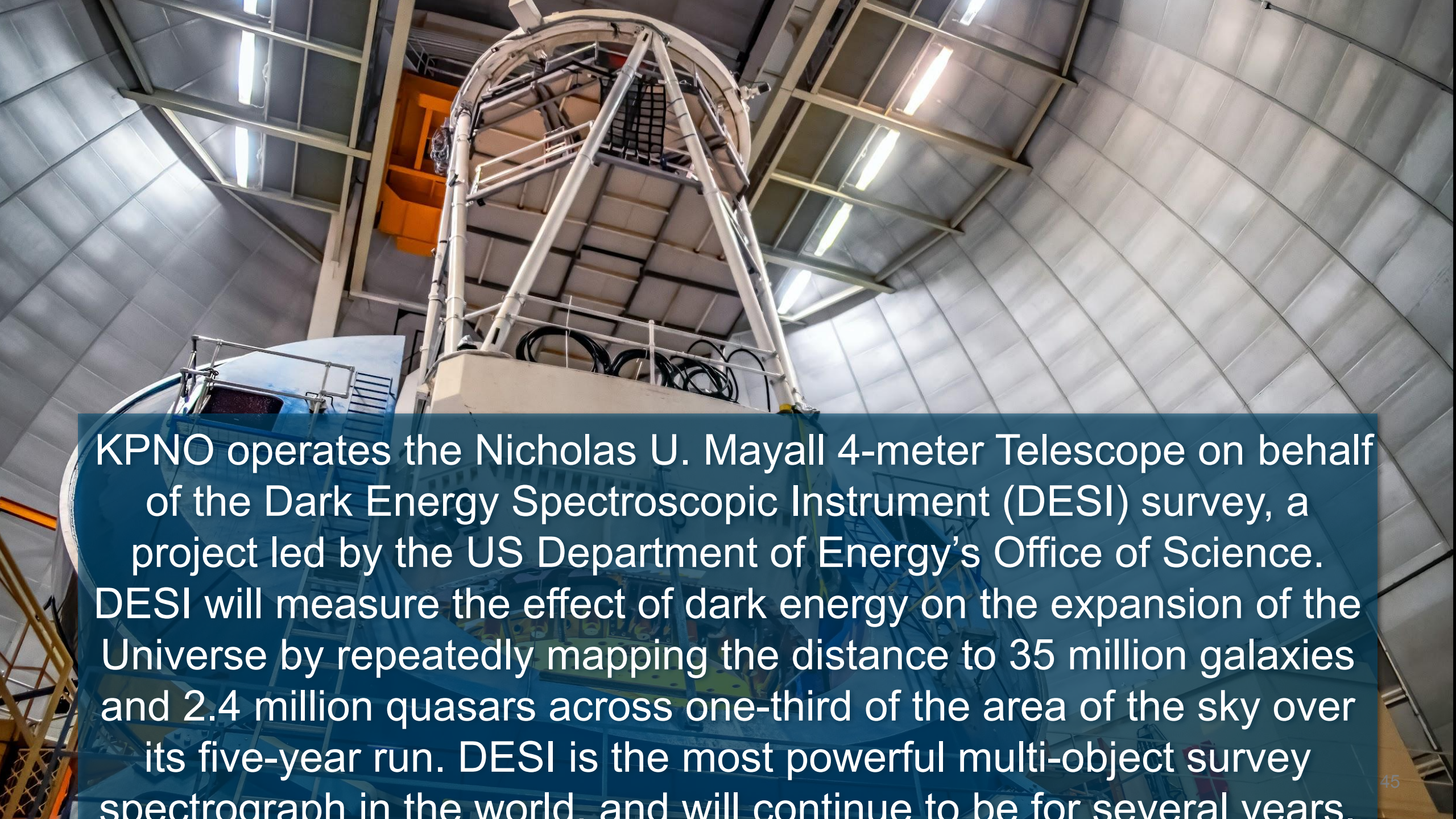
Founded in 1958, Kitt Peak National Observatory is home to one of the largest collections of optical and radio telescopes in the world. KPNO hosts the facilities of consortia that, between them, operate more than a dozen optical telescopes and two radio telescopes.





We are privileged to conduct research on I'oligam Du'ag (Kitt Peak) in Arizona and acknowledge the Tohono O'odham Nation as the caretakers of the *jewed* (land).






KPNO operates the Nicholas U. Mayall 4-meter Telescope on behalf of the Dark Energy Spectroscopic Instrument (DESI) survey, a project led by the US Department of Energy's Office of Science. DESI will measure the effect of dark energy on the expansion of the Universe by repeatedly mapping the distance to 35 million galaxies and 2.4 million quasars across one-third of the area of the sky over its five-year run. DESI is the most powerful multi-object survey spectrograph in the world and will continue to be for several years.



KPNO operates the 3.5-meter WIYN Telescope (a partnership between Indiana University, the University of Wisconsin, Pennsylvania State University, the University of Missouri-Columbia, Purdue University, NSF, and NASA), which hosts the NEID instrument. NEID is designed to measure the motion of nearby stars with extreme precision, with the potential to uncover Earth-mass exoplanets.


NOAO PUBLIC  
OUTREACH  
TELESCOPE





NSF's new "Windows on the Universe Center for Astronomical Outreach" at Kitt Peak will provide the public with a new way to experience the cutting-edge research carried out at Kitt Peak and NSF's other astronomy facilities around the globe.





KPNO has a visitor center open daily and nightly to the public, offering daytime guided tours and a variety of evening stargazing programs. The motto is “*Come and see for yourself!*” Visits to KPNO visitor center and tours of the mountain are free for residents of the Tohono O'odham Nation.





The US Extremely Large Telescope Program (US-ELTP) is a joint endeavor of NSF's NOIRLab and the organizations building the Giant Magellan Telescope and the Thirty Meter Telescope. These organizations envisage the US-ELTP as a system of two individual telescopes, one in each hemisphere, to provide astronomers in the United States with nationally funded, full-sky observing access.





# The Role of National Laboratories



The NSF's observatories provide a place for US scientists to advance basic research supported by expert engineering and scientific staff

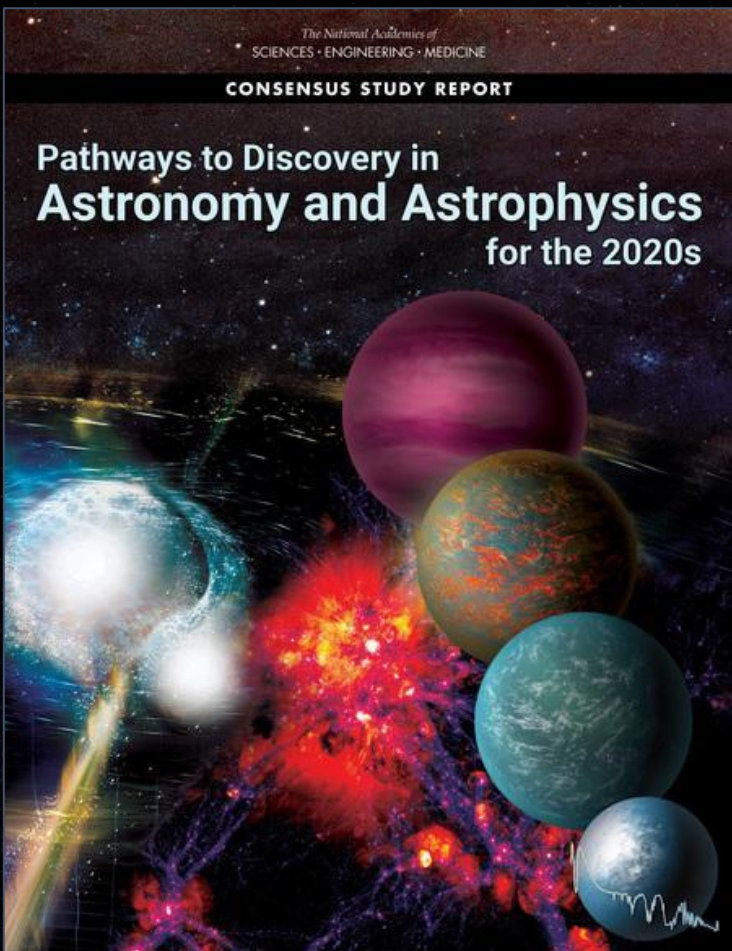
*Anyone with an idea* can propose to use NSF's NOIRLab facilities to advance their science - subject only to peer review

Education and early career programs at NSF's NOIRLab help develop the STEM workforce and increase participation by under-represented groups

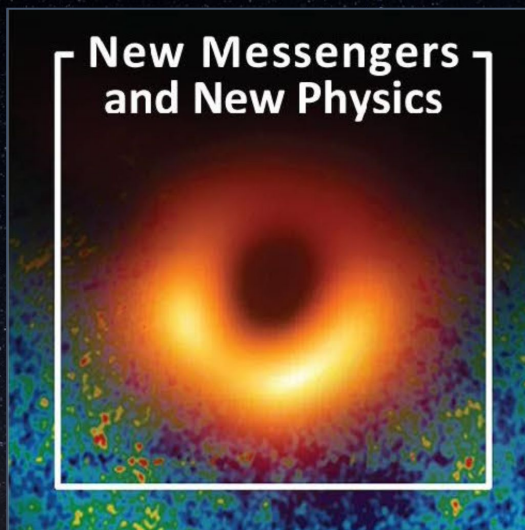




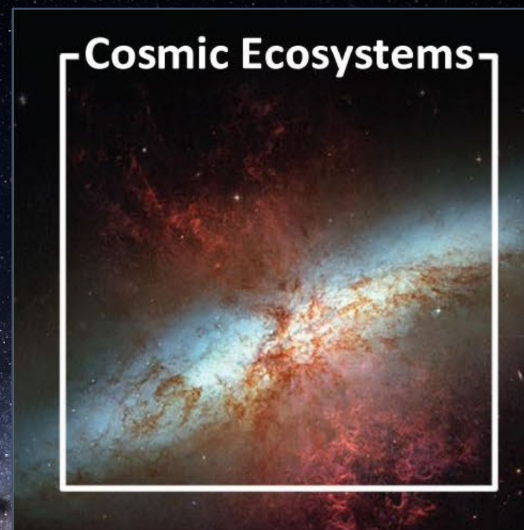
# The Big Science Questions



Where did it all come from?



How does it all work?



Are we alone?



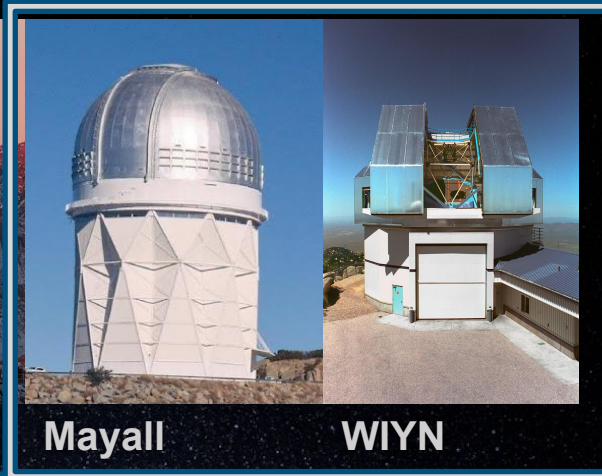
*We provide all US and partner scientists with the tools to tackle these questions – and others  
Anonymous peer review ensures equal opportunities for all*

*Discovering Our Universe  
Together*





# A diverse Tool Kit



Rubin

Gemini S

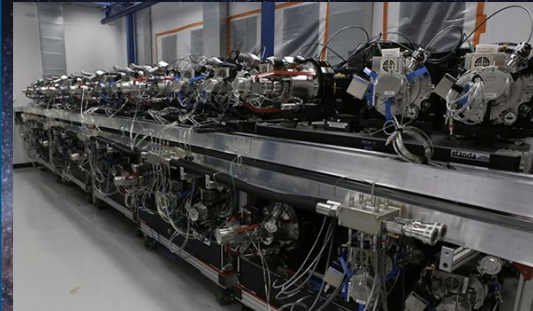
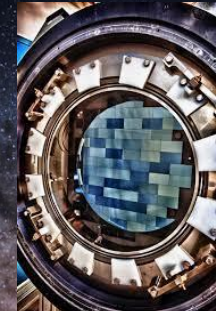
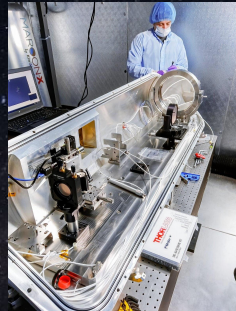
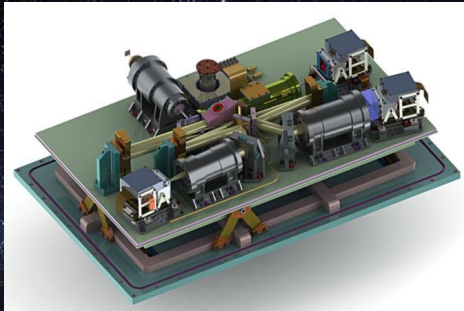
Gemini N

Blanco

SOAR

Mayall

WIYN



NEWFIRM  
NOAO  
@Blanco

IGRINS  
KASI/UT  
@Gemini S.

MAROON-X  
U. Chicago  
@Gemini N.

DECAM  
FermiLab  
@Blanco

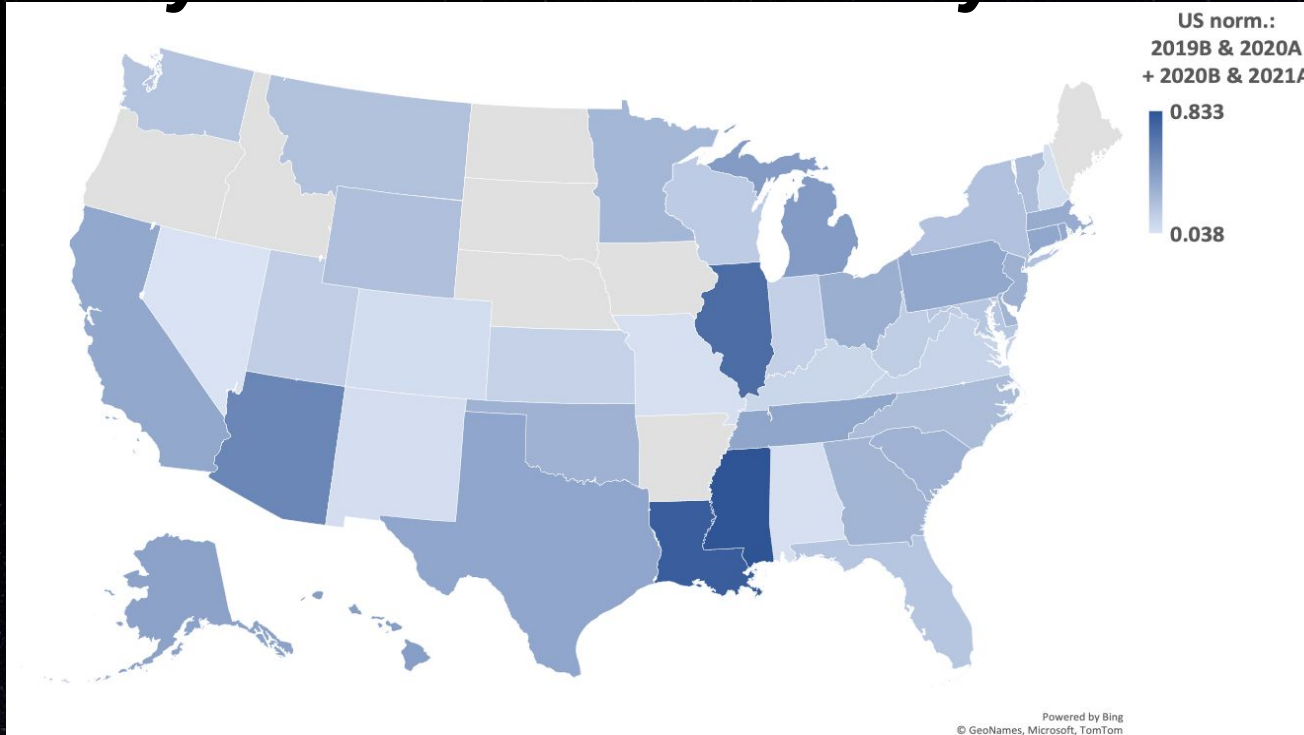
DESI  
LBNL  
@Mayall

NEID  
Penn State/NASA  
@WIYN

Discovering Our Universe  
Together



# NSF's NOIRLab



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

- 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





# National Data Center



The Data Revolution will not be televised  
*It is being streamed!*

NASA has well-supported data archives  
*The science multipliers are large*

Ground-based observatory archives are:  
Heterogeneous  
Uncoordinated  
Poorly connected to the space archives

NOIRLab can play a leading role in a national dialog on  
ground-space archive coordination





# Observatories in Harmony...



*...with their environment*

Sustainability program – more than just solar panels!

*...with local populations*

Partnerships with the Tohono O'Odham  
Engagement in Hawai'i  
Sensitivity in Chile

*...with our peers*

Cooperate, Coordinate, Partner for science

*Discovering Our Universe  
Together*





# Vital Partnerships



## DOE National Laboratories

Rubin, Dark Energy Survey, Dark Energy Spectroscopic Instruments

## NASA

NN-Explore Exoplanet Program

## International Partners

Gemini and SOAR Partners, US ELTP Partners

## US Institutional Partners

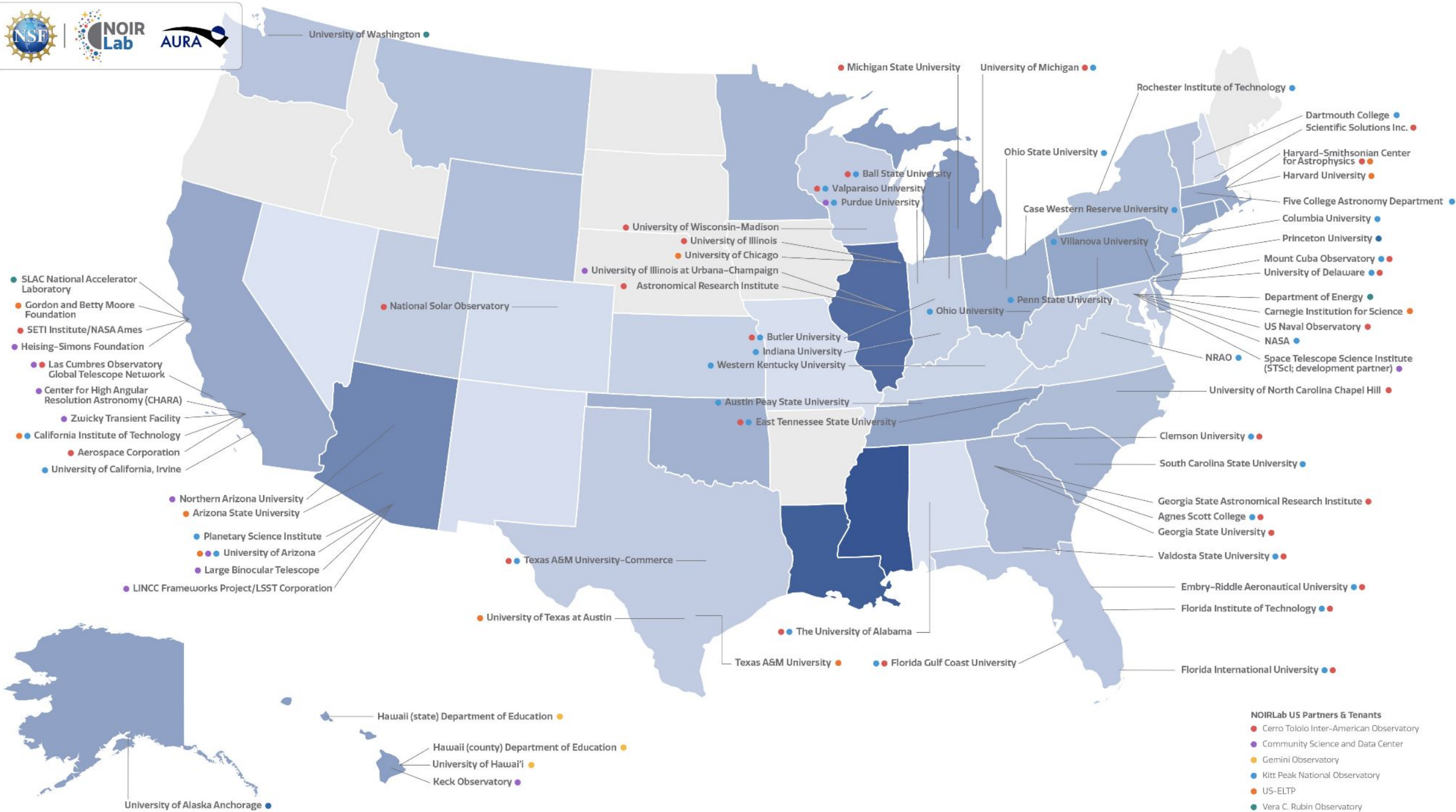
Instruments (e.g., MAROON-X, NEID, SCORPIO)

Large programs

Data archives and Data Science

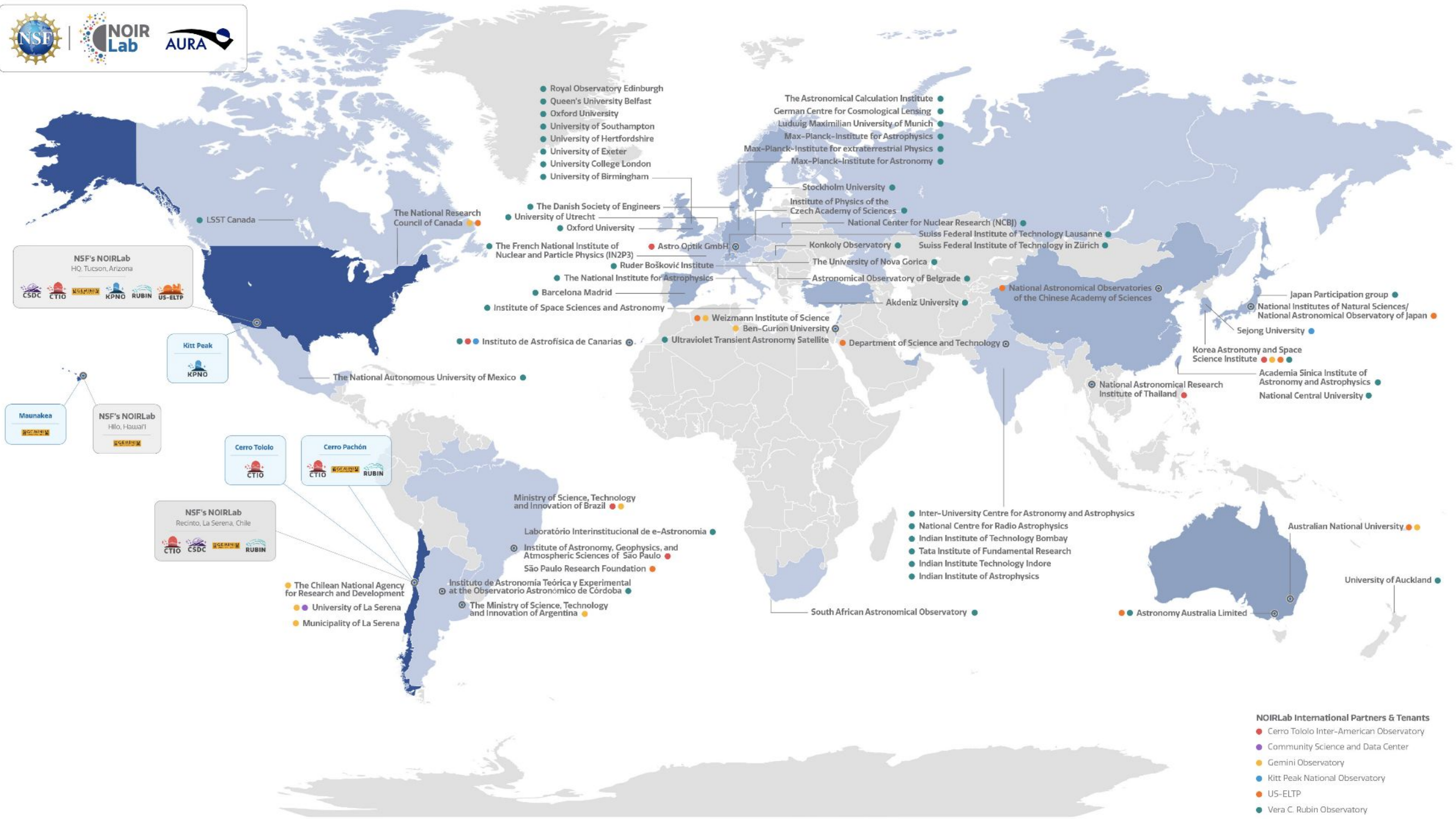
*Discovering Our Universe  
Together*





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





- Royal Observatory Edinburgh
- Queen's University Belfast
- Oxford University
- 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)
- Swiss Federal Institute of Technology Lausanne
- Swiss Federal Institute of Technology in Zürich

- The Danish Society of Engineers
- University of Utrecht
- Oxford University
- The French National Institute of Nuclear and Particle Physics (IN2P3)
- Ruder Bošković Institute
- The National Institute for Astrophysics
- Barcelona Madrid
- Institute of Space Sciences and Astronomy

- Astro Optik GmbH
- Konkoly Observatory
- The University of Nova Gorica
- Astronomical Observatory of Belgrade
- Akdeniz University

- National Astronomical Observatories of the Chinese Academy of Sciences
- Weizmann Institute of Science
- Ben-Gurion University
- Ultraviolet Transient Astronomy Satellite
- Department of Science and Technology

- 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  
Gemini

NSF's NOIRLab  
Hilo, Hawaii  
Gemini

Cerro Tololo  
CTIO

Cerro Pachón  
CTIO, Gemini, RUBIN

NSF's NOIRLab  
Recinto, La Serena, Chile  
CTIO, CSDC, Gemini, RUBIN

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

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





# A Vibrant Science Staff

## Scientists drive the future

- Science staff is our primary contact point with the community
- Active scientists – using NOIRLab telescopes – are best equipped to support users (e.g., STScI and HST)
- *“The best scientists provide the best service”* - R. Giacconi

## We have an opportunity to renew the science staff this decade

- Exoplanets, Cosmology, Stellar Explosions, ...
- Rubin Operations Team
- Adaptive Optics
- Generational Change





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Generational Change



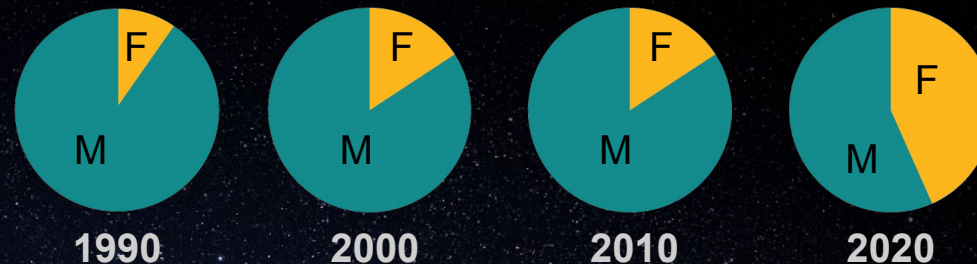


# An Agent for Change

## Improve Diversity and Inclusion

- Our leadership team
- Our staff overall
- NOIRLab's user base
  - Research inclusion initiative
  - Equitable and inclusive access
  - Fellowships and Internships to support the next Generation

Make up of Leadership Team  
NOIRLab (NOAO/ Gemini/ Rubin Ops)



## Sustainable Observatory Operations

- Reduced CO<sub>2</sub> footprint
- Improved H<sub>2</sub>O management
- Reduced waste

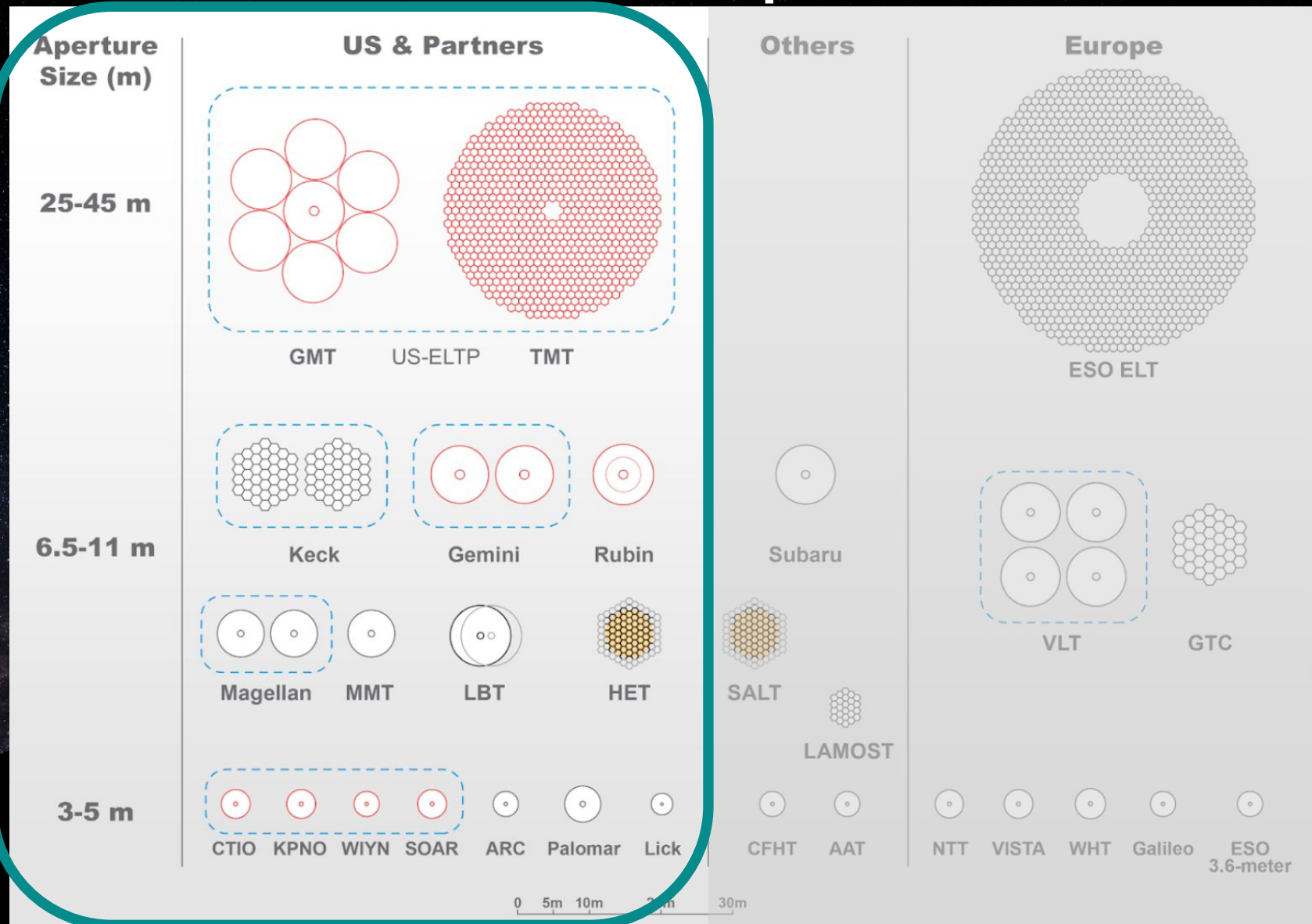




# International Landscape



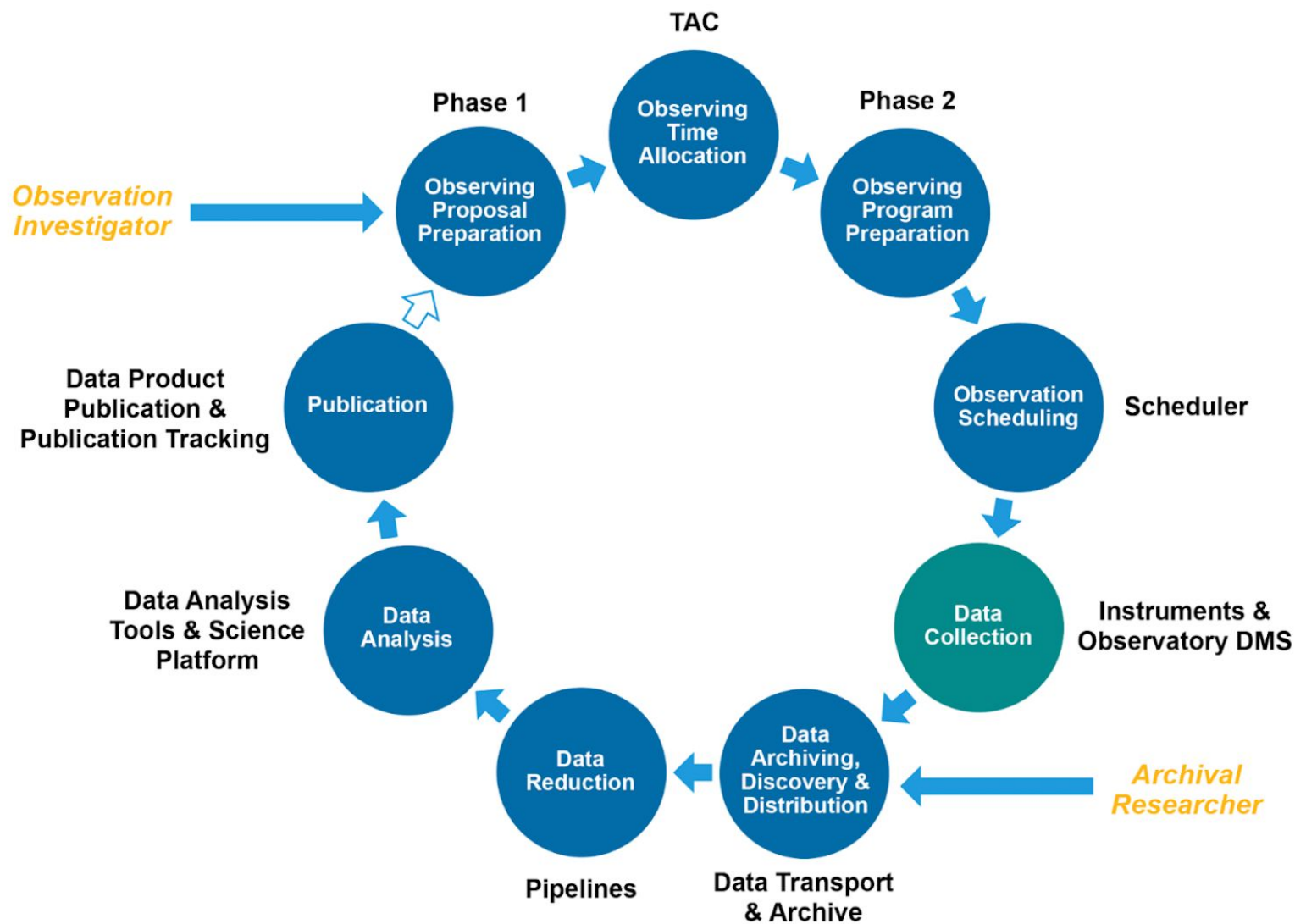
A true US  
“System”  
is needed to  
compete globally  
in the 2020s and  
2030s



Together



# End-to-End User Support

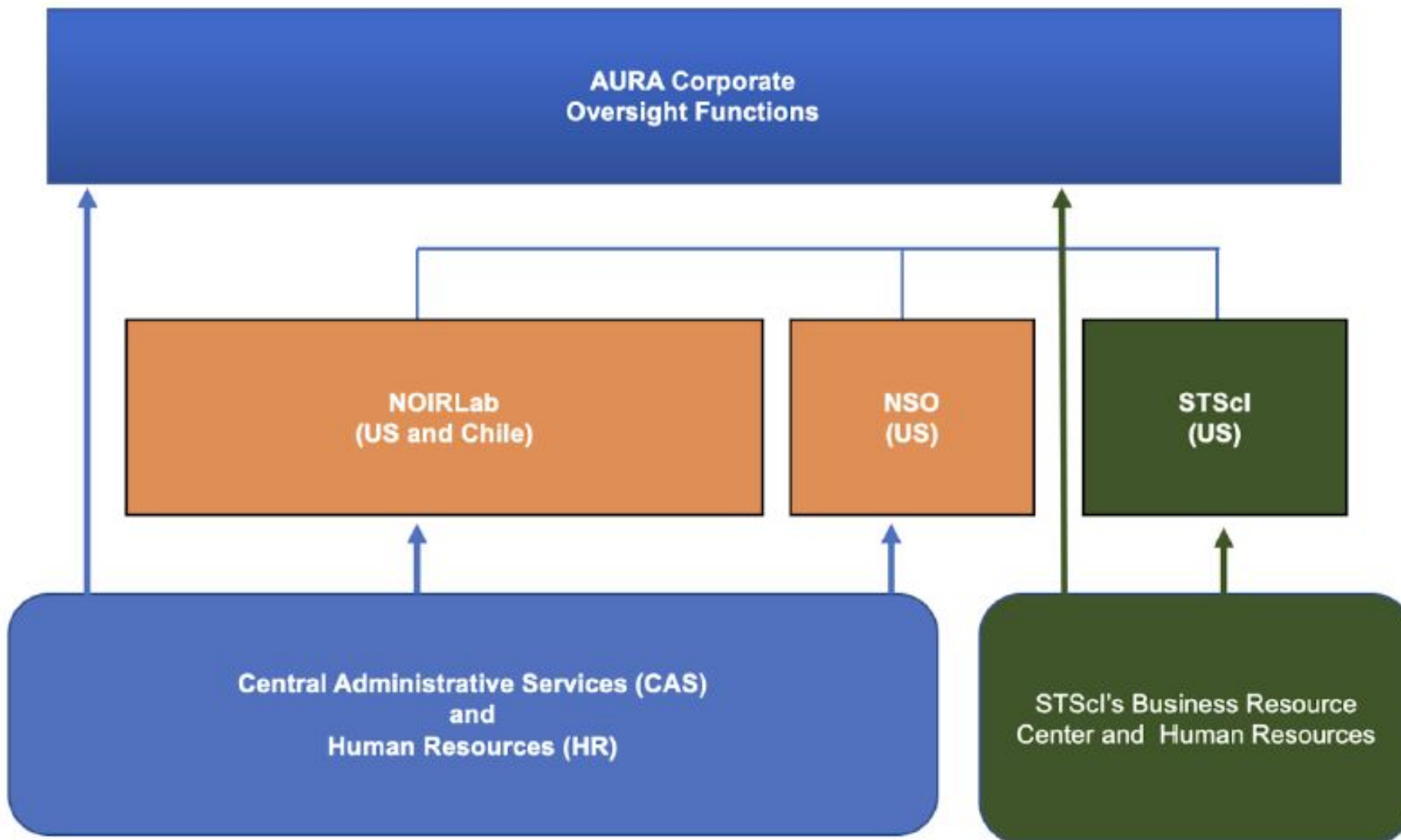


**NOIRLab provides the tools and support for all phases of the scientific life-cycle for both novice and power-users**





## AURA's Structure in 2025



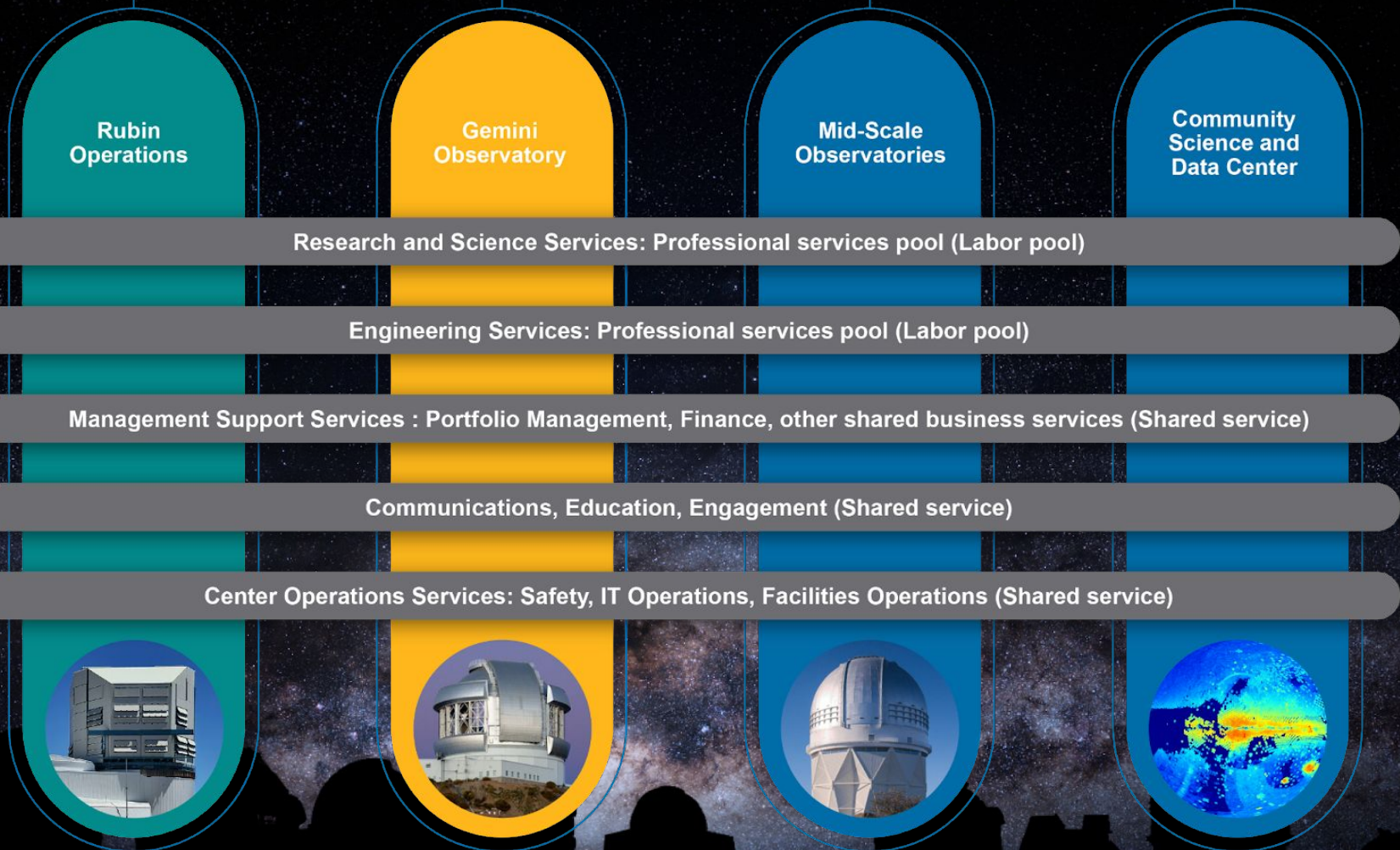




NOIRLab Directorate

How is NOIRLab organized?

How are labor and services shared and paid for?



Discovering Our Universe Together





# The reasons for choosing labor matrix and shared services



- Deliver high quality science to community
- Be a strong national center and the organizational “home” for future large US ground-based astronomy investments in response to Astro2020, e.g. US-ELTP
- Labor Matrix - science and engineering staff
  - Depth in available skills
  - Common standards in hardware and software
  - Career paths for staff => increases retention
- Efficiency — Shared services: Single point of contact for common functions. Common standards and processes.



## Research and Science Services

- Research staff
- Nighttime Operations staff

- Science Operations of NOIRLab Telescopes and Data Archives & Centers
- User and Data support
- Contribute to instrument development

- **Research time** for research staff
- L2 Managers; Prize Fellows
- Training, Misc, DEI
- Office Space, Computers, Library

### Who - Members

### What - Functional Labor Direct cost

### Shared (Indirect) Cost

## Engineering Services

- Engineering staff:
- Mechanical
- Electrical
- Optical
- Software,
- Systems/Project Managers

- Engineering Operations and Maintenance of NOIRLab Telescopes and Data Archives & Centers
- Software for all functions
- Contribute to instrument development

- L2 Managers
- Training, Misc, DEI
- Office Space, Computers