



# NSF's NOIRLab Town Hall

*Enabling Breakthrough Discoveries for a Diverse and Inclusive Community*

#420\_noirlab\_town\_hall

*14 January 2021*

237<sup>th</sup> AAS Meeting



# NOIRLab Leadership



**Beth Willman**  
*Deputy Director*



**Patrick McCarthy**  
*Director*



**Inger Jorgensen**  
*Assoc. Director*



**Adam Bolton**  
*CSDC Director*



**Jennifer Lotz**  
*Gemini Director*



**Lori Allen**  
*MSO Director*



**Bob Blum**  
*Rubin Ops  
Director*



**Abi Saha**  
*Director of Research  
Science Services*



**Lars Christensen**  
*Communications*



**Michiel van der  
Hoeven**  
*Engineering*

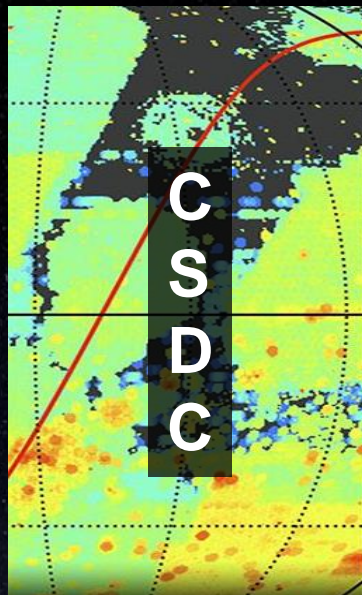
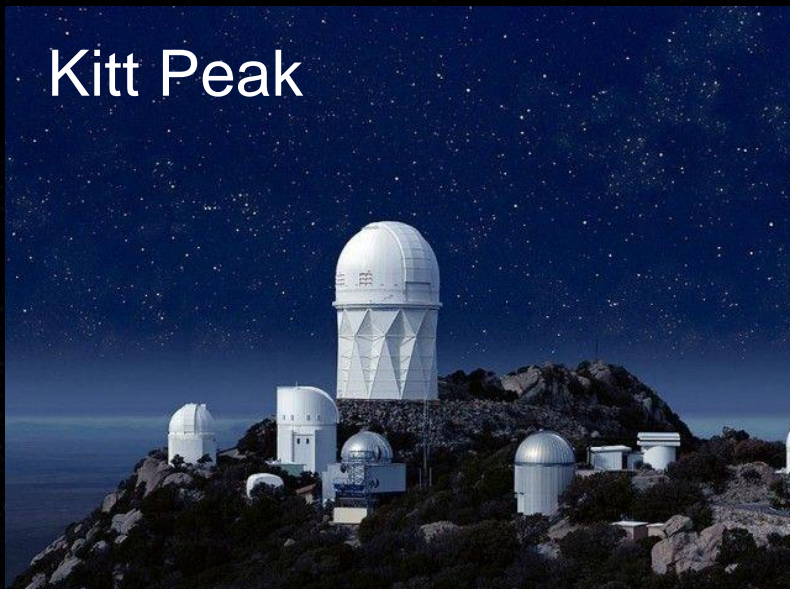


**John MacLean**  
*Operations*

...er Our Universe Together

# NSF's NOIRLab

Kitt Peak



Gemini

*With our international partners*



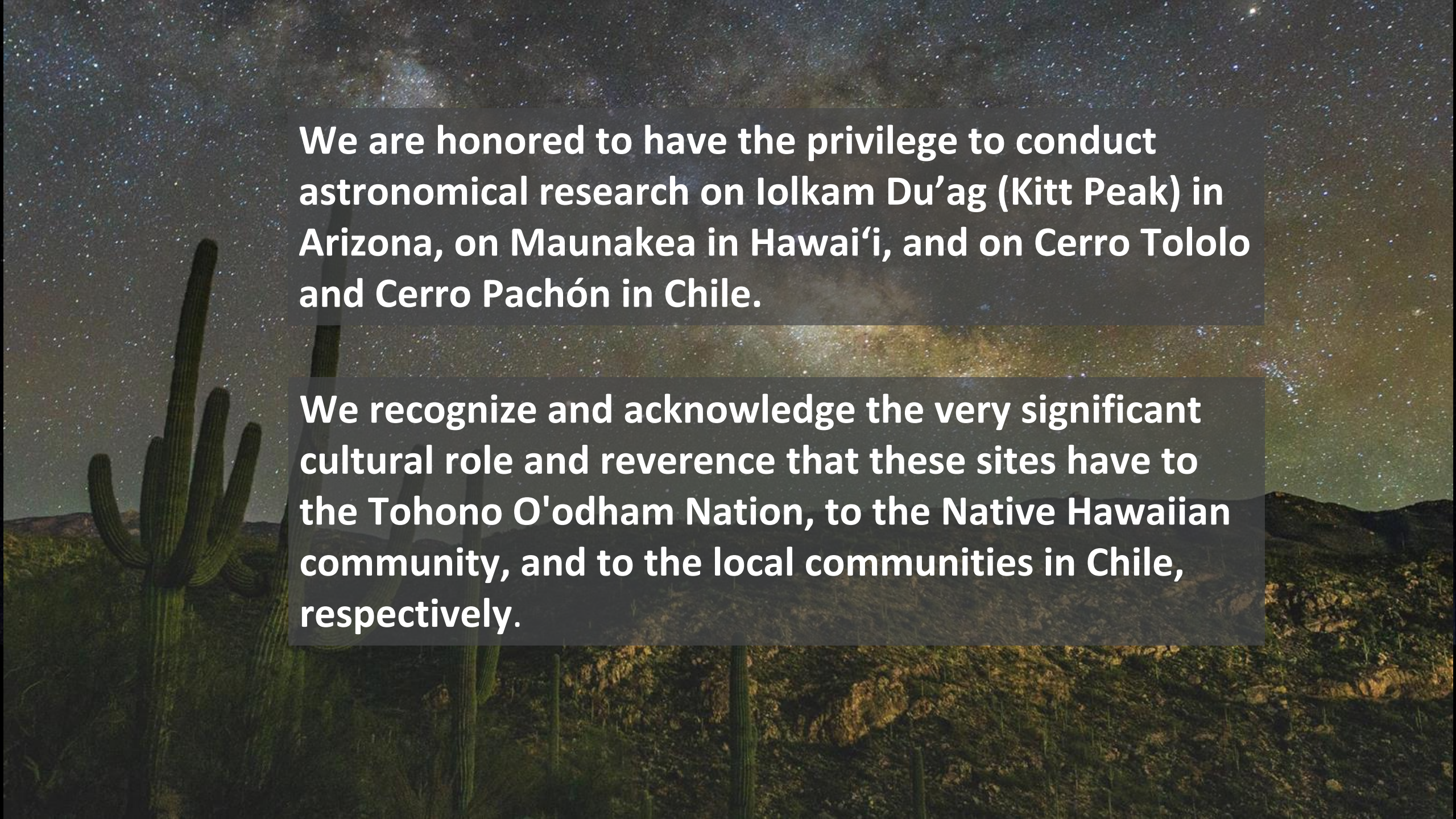
Cerro Tololo



Rubin Observatory Operations

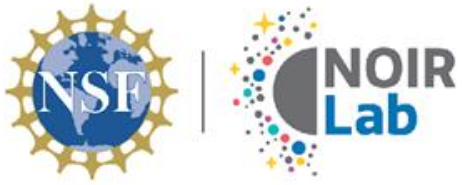
*An NSF-DOE Partnership*



A night sky with the Milky Way galaxy visible, set against a dark background with numerous stars. In the foreground, a large saguaro cactus stands on a dark, rocky landscape. The text is overlaid on a semi-transparent dark grey box.

**We are honored to have the privilege 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.**



# COVID Impact

All of our observatory sites were closed on March 16

Gemini North returned to operation in mid-May

All other sites returned to operation in late September

We thank NSF and AURA for supporting us throughout this pandemic

# Our Vision for NOIRLab

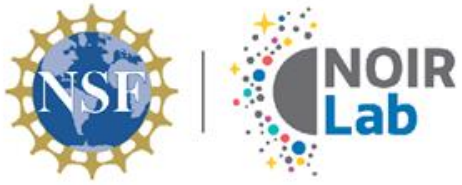
*A National Laboratory for OIR Astronomy from the Ground*

## Mission Statement

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

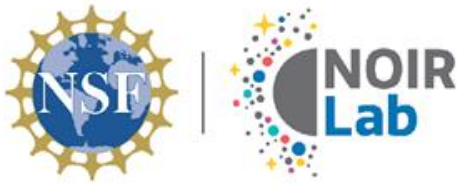


*Discovering Our Universe Together*



# NOIRLab Goals for 2020s

- Lead the world in **Survey and Data Intensive Astronomy** from the Ground
- Become The Leading Resource for **Time Domain Astronomy** in the US
- Conduct **High Precision Astronomy** From The Ground
- Create, Curate & Serve **High-Level Data Products & Data Analysis Software** for Our Instruments
- **Lead Community Discussions** Around New Directions, Planning & Implementation
- Be an **Agent For Change**



# Our Vision for NOIRLab

## Be an Agent For Change

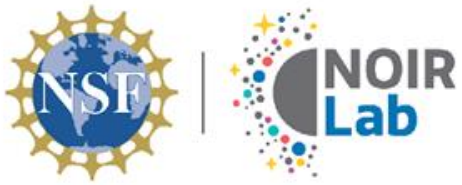
Make Diversity Part of Everything We Do

Lead by Example

Help Build the STEM workforce of Tomorrow







# Engaging with the User Community

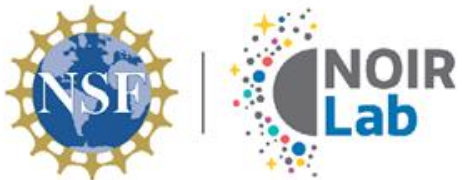
**We are evolving our modes of engagement, while sustaining existing approaches**

Strategic Advisory Committee (recently launched)  
*High-Level Guidance to Leadership Team*

Program-focused Standing\* and Ad Hoc Committees  
*Detailed guidance to Program Directors*

Cross-Cutting Advisory Committees (upcoming)  
*Time-Domain Astronomy*  
*Data Intensive Astronomy*

\*including Users Committees, Telescope Allocation Committees, Science and Technology Advisory Committees



# Gemini Observatory

Become The Leading Resource for Time Domain Astronomy in the US

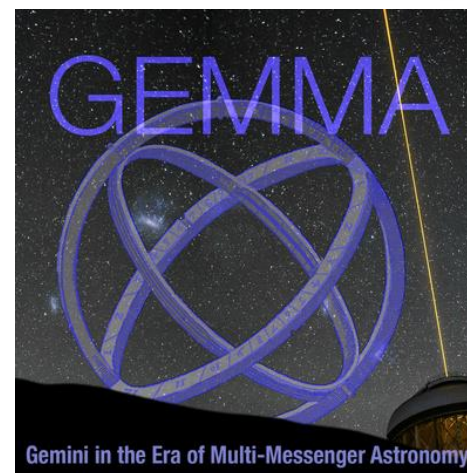
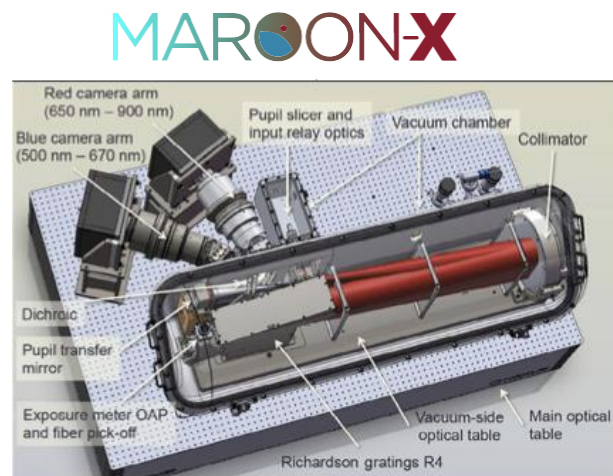
*AEON, Gemini Program Platform, SCORPIO*

Conduct High Precision Astronomy From The Ground

*Adaptive Optics, Precision Radial Velocity, High-Res spectroscopy, ...*

Create, Curate & Serve Data Reduction & Analysis Software for Our Instruments

*DRAGONS, Data Lab ...*



*Discovering Our Universe Together*

# Observing @ Gemini Observatory

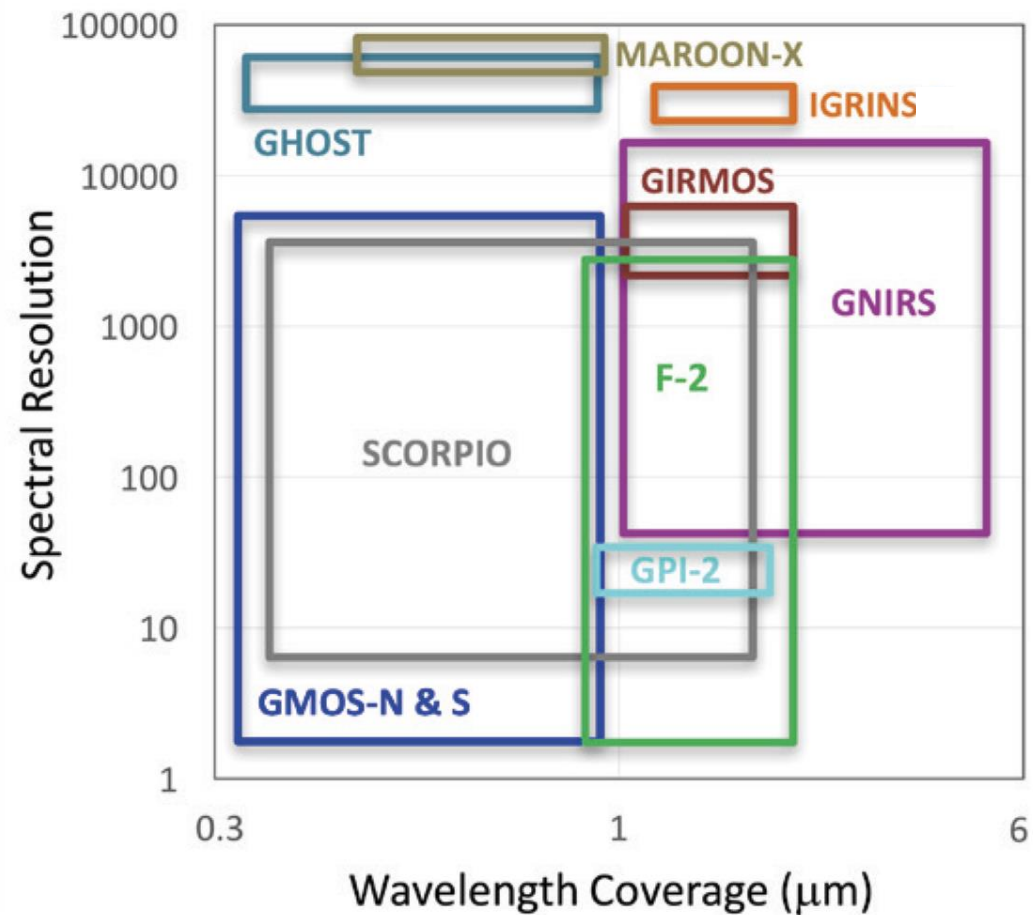
- Gemini-N and Gemini-S are currently operating
- Fast-Turnaround: due Jan 31 (monthly)
- 2021 Large & Long: Lol due Feb 8th, proposal Apr 1 (annual)
- 21B Semester: due Apr 1
- Director's Discretionary, Poor Weather (anytime)

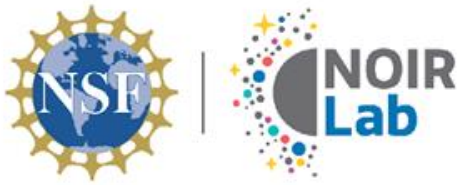


# High-Resolution Spectroscopy

Available Now: IGRINS and MAROON-X

Coming Soon: GHOST





# MARON-X

New Radial Velocity Instrument for M Dwarfs at Gemini-N

PI. Jacob Bean, U. Chicago

Goal: Sub  $m s^{-1}$  precision and reach to late M dwarfs out to 30 pc ( $V=17$ ).

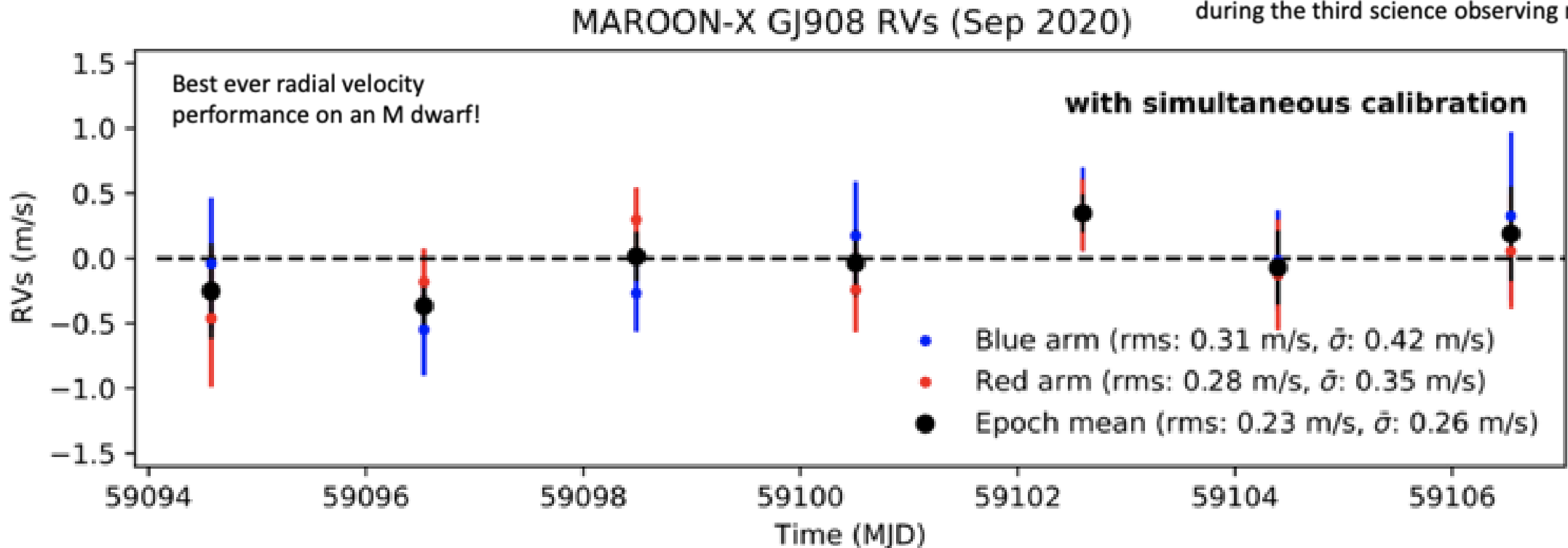
Approach: A highly-stabilized, fiber-fed spectrograph covering 500 – 900 nm at  $R=85k$  with simultaneous calibration feed and pupil slicing.

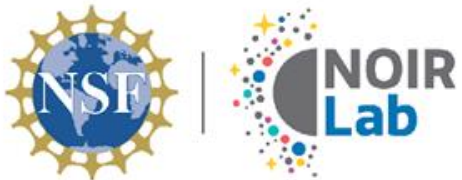
Status: The instrument is fully operational, first science data have been submitted for publication, open community began in 2020B.

# New Radial Velocity Instrument for M Dwarfs at Gemini-N

PI. Jacob Bean, U. Chicago

Data obtained one year after first light during the third science observing run





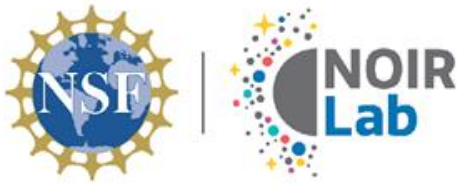
# Getting ready for Time-Domain

Friday Jan 8th - Media Workshop on Multi-messenger & Time Domain Astronomy

Monday Jan 11th - 4pm, Interactive Exhibit Hall, Gemini Program Platform Overview

Friday Jan 15th - 4:40pm, NOIRLab Booth  
DRAGONS (Data Reduction for Astronomy from Gemini Observatory North and South) demos

The screenshot shows the EXPLORE web interface. On the left, a sidebar lists various astronomical targets with their observation counts. The 'Targets' section is active, showing a search for 'GMO-N R831 1x300' and a filter for '<0.7" <0.3 mag Bright' with a duration of '1hr 33mins'. The main panel displays the 'Target Position' for 'andromeda', including RA (00:42:44.329720) and Dec (+41:16:07.300000). Below this, 'Proper Motion' parameters are shown:  $\mu$  RA (mas/y),  $\mu$  Dec (mas/y), Epoch (years), and Parallax. The 'RV' section shows a value of -300. On the right, a large image of the Andromeda galaxy is displayed with a green crosshair. Below the galaxy image, there is a graphic with the text 'Best Media Practices for Multi-institutional Science Collaborations' and a stylized blue and orange logo. At the bottom of the graphic, logos for NSF, NOIR Lab, GEMINI OBSERVATORY, and AURA are visible.

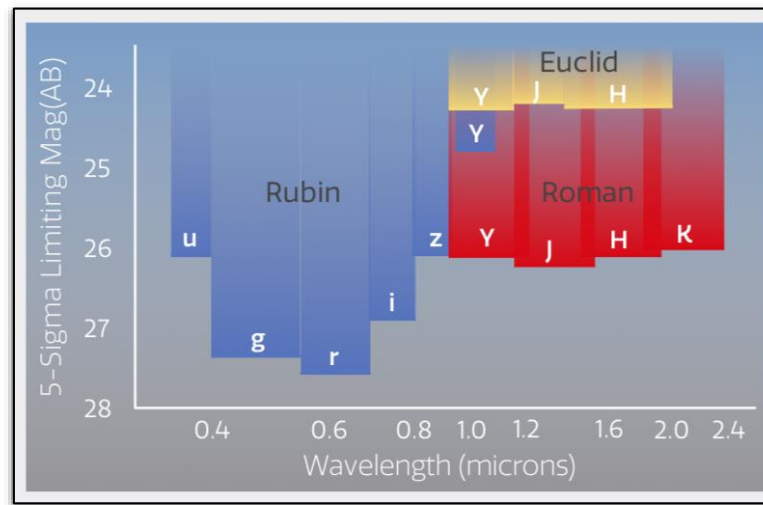
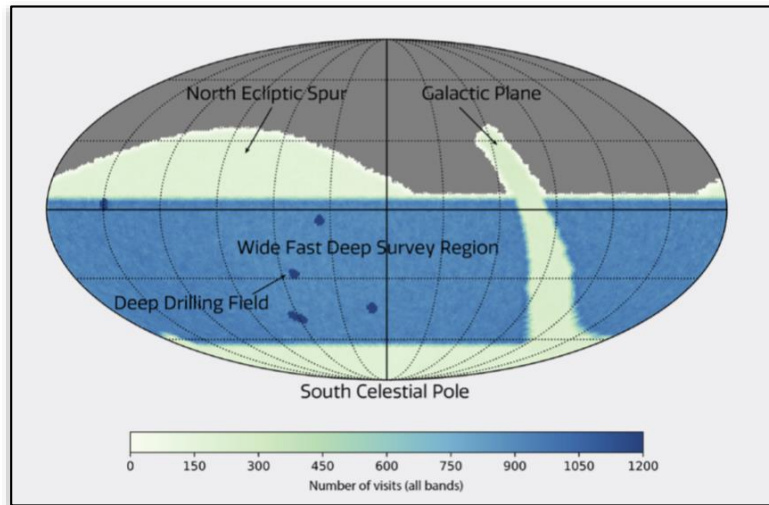


# Vera C. Rubin Observatory

The Vera C. Rubin Observatory mission is to create a vast astronomical dataset and web-based analysis environment for unprecedented discovery of the deep and dynamic universe.

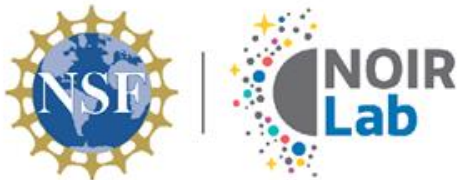
Lead the world in Wide-field Survey Astronomy from the Ground

Deploy Rubin as the world's most powerful engine for Time Domain Astronomy



*Discovering Our Universe Together*

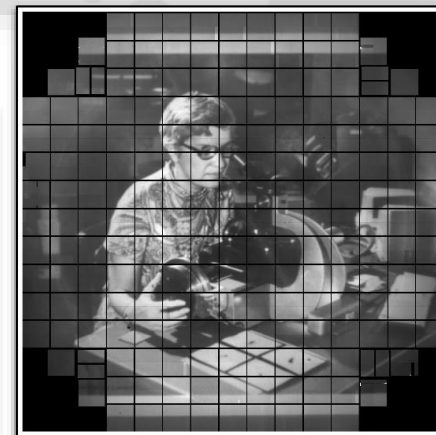
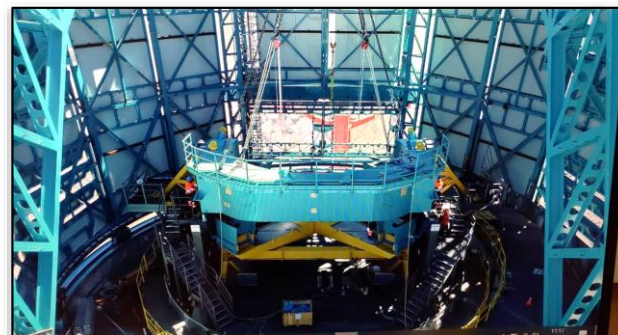
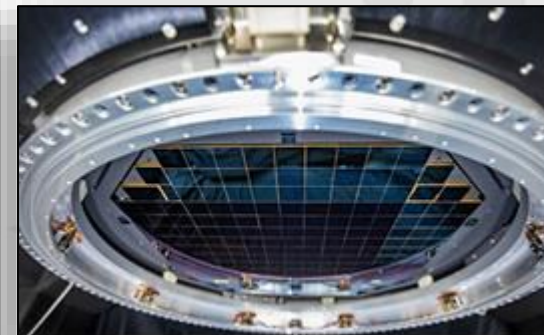




# Vera C. Rubin Observatory

## Current First light and Survey Schedule

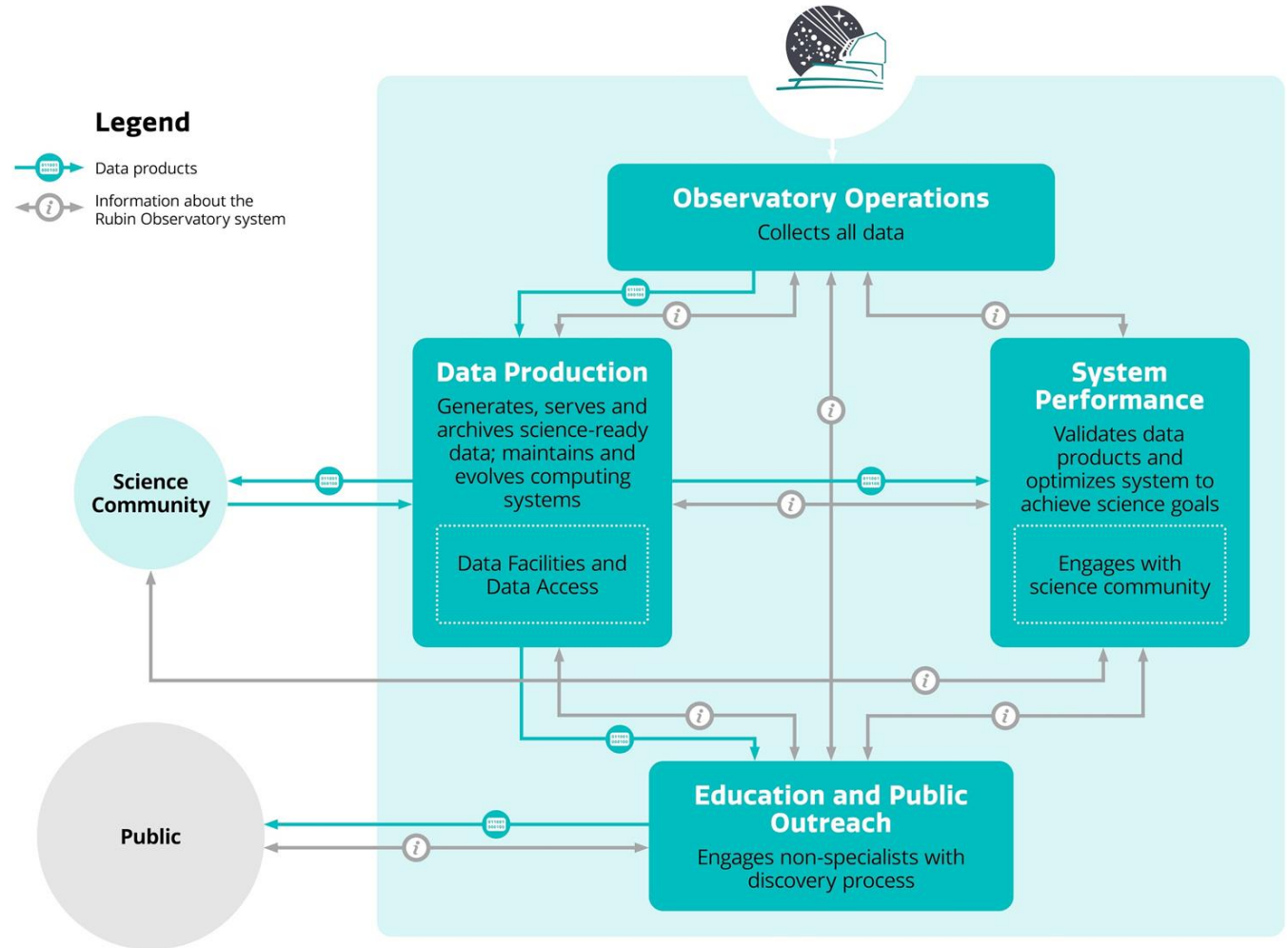
- Rubin Operations is planning for an October 01, 2023 start to full survey operations
- Engineering First Light ~ May 2022
- LSSTCam first light ~ October 2022
- Execute 10 year Legacy Survey of Space and Time: 2024 - 2033

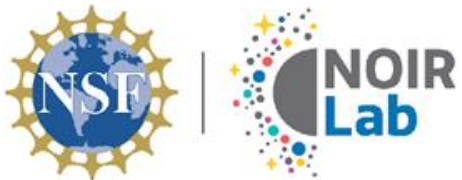


# Vera C. Rubin Observatory

## Transition to Operations

- Currently in pre operations (FY19 - FY23)
- Detailed Operations Plan finished this year
- Team ramping up (100 people, 40 FTE this year)
- Ramping up Operations experience in Google cloud based Interim Data Facility
- Major in kind contribution program for international participation
- Deep coordination with Construction team



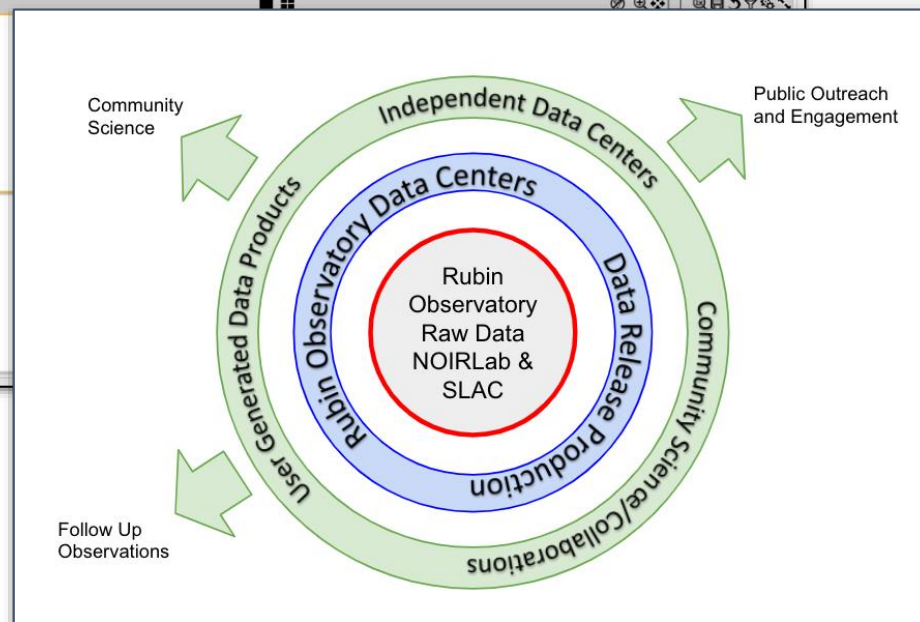
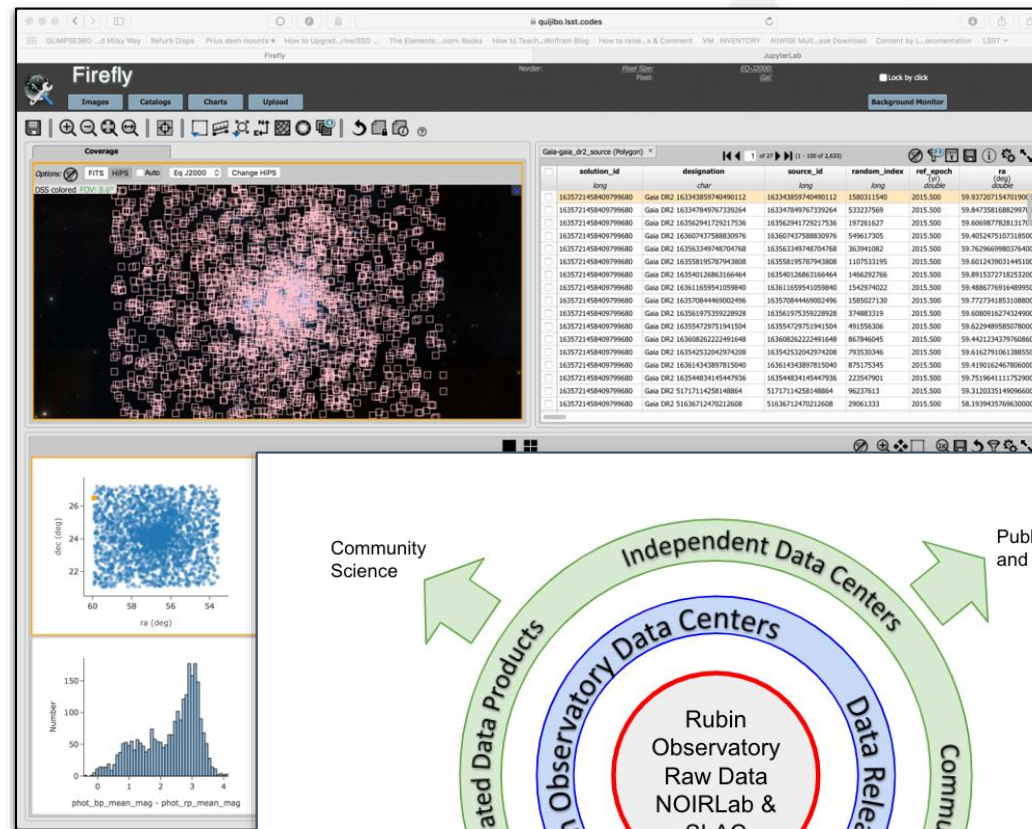


# Vera C. Rubin Observatory

## Engaging with the Rubin User Community

(come talk to us at the Rubin booth!)

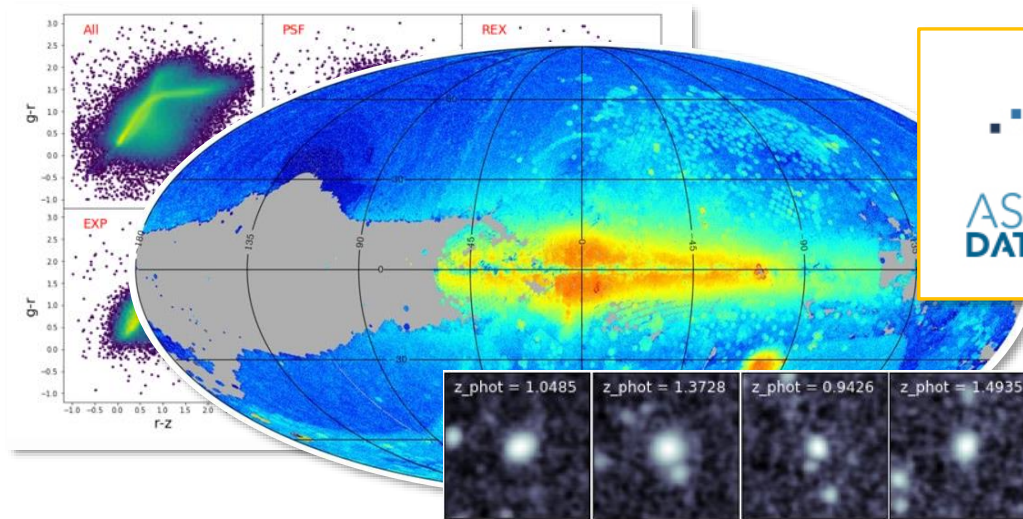
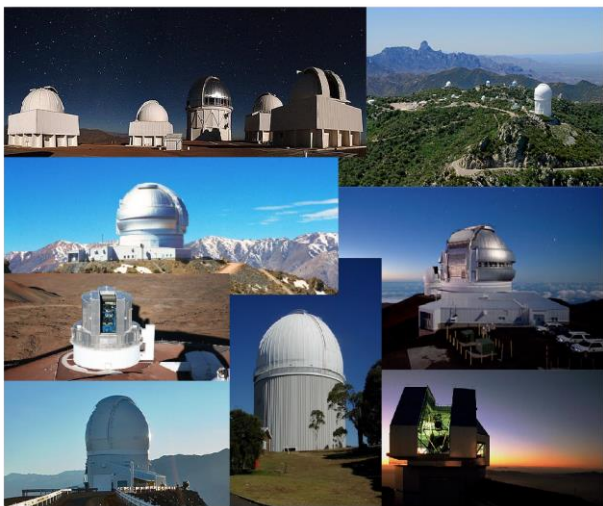
- Primary connection to Community is through **data products, nightly and annual.**
- Users connect via **Rubin Science Platform (RSP)** at the US Data Facility and other centers.
- Primary interface for **support** is the Community Engagement Team. They will manage **community.lsst.org** for user crowd sourced support as primary knowledge base.
- Rubin will have direct connections to Science Collaborations too.
- Programs for support of underserved and small institutions



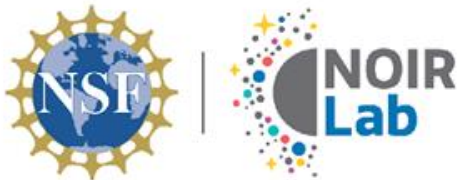
# Community Science and Data Center (CSDC)

*US community leadership in*

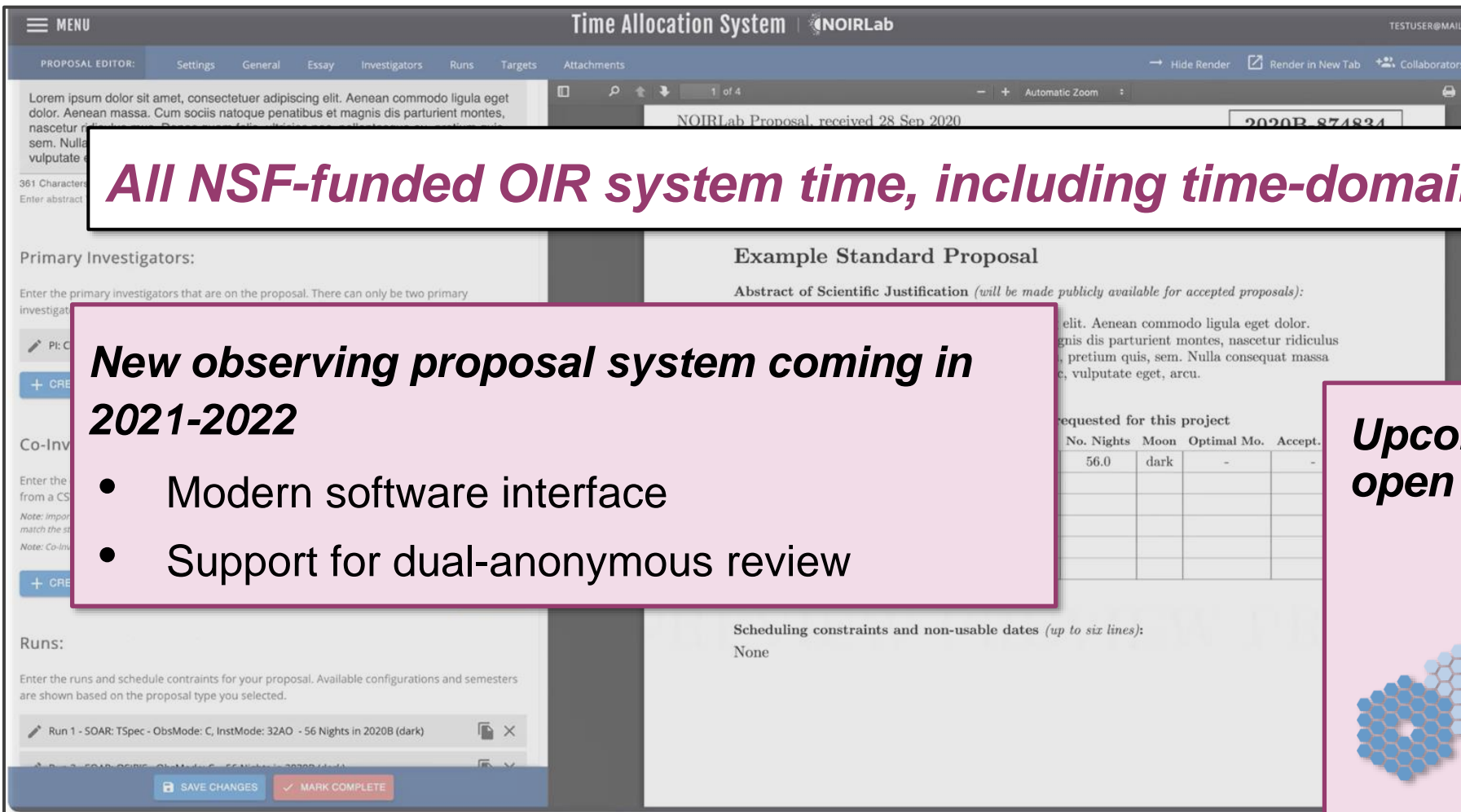
- **Survey-scale and data-intensive astronomy from the ground**
- **Time domain and multi-messenger astronomy**
- **Broadening research participation through *open access***



**NOIRLab Data Services Demo Session at 4:10 EST today**



# Open access observing




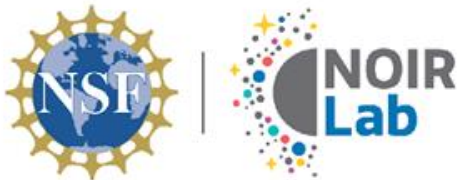
**All NSF-funded OIR system time, including time-domain and multi-facility**

**New observing proposal system coming in 2021-2022**

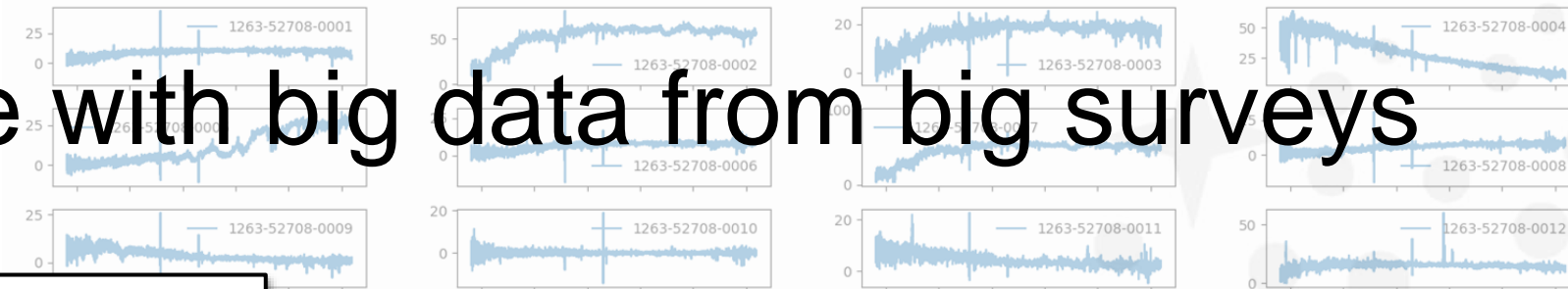
- Modern software interface
- Support for dual-anonymous review

**Upcoming NSF MSIP-enabled open access time**



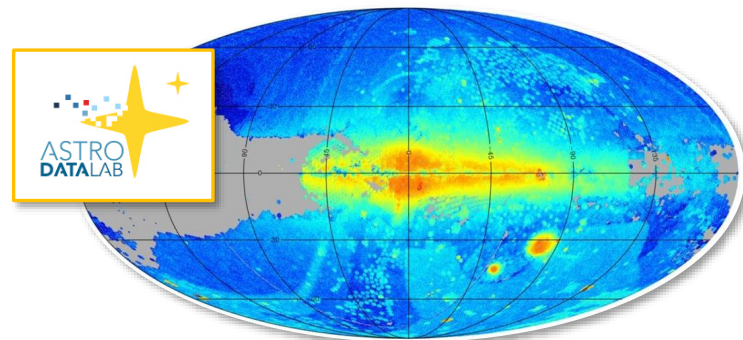
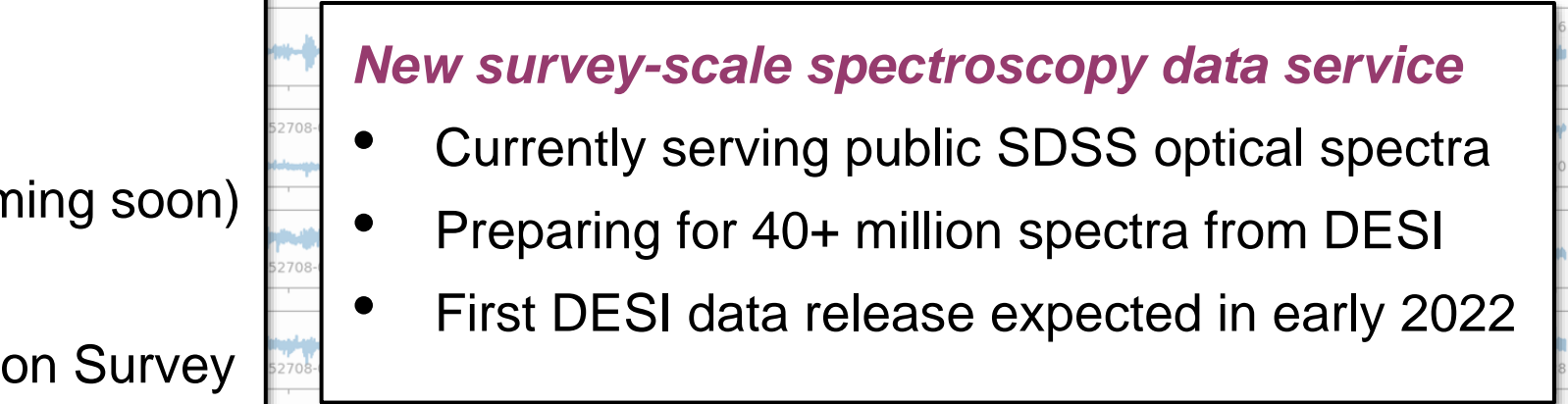


# Science with big data from big surveys



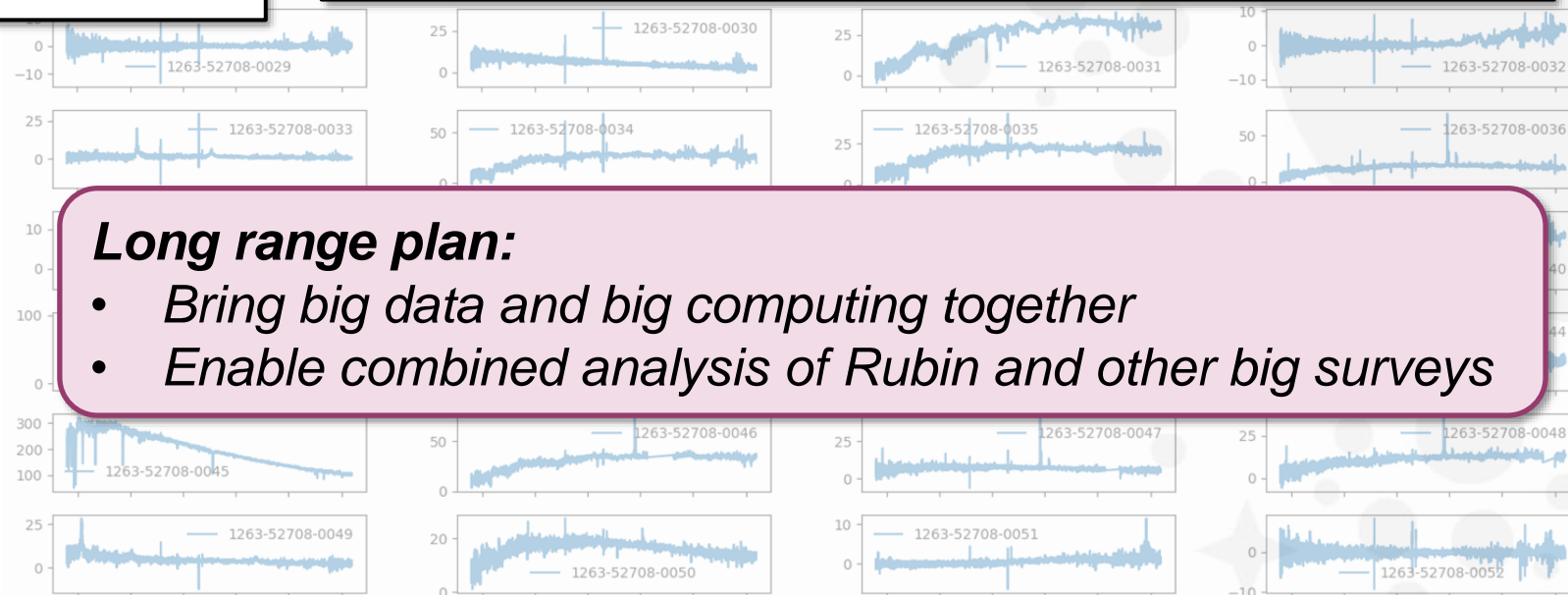
- New survey imaging & catalogs***
- Dark Energy Survey DR2
  - DESI Legacy Surveys DR9 (coming soon)
  - NOIRLab Source Catalog DR2
  - DECam Local Volume Exploration Survey

- New survey-scale spectroscopy data service***
- Currently serving public SDSS optical spectra
  - Preparing for 40+ million spectra from DESI
  - First DESI data release expected in early 2022



[datalab.noirlab.edu](http://datalab.noirlab.edu)

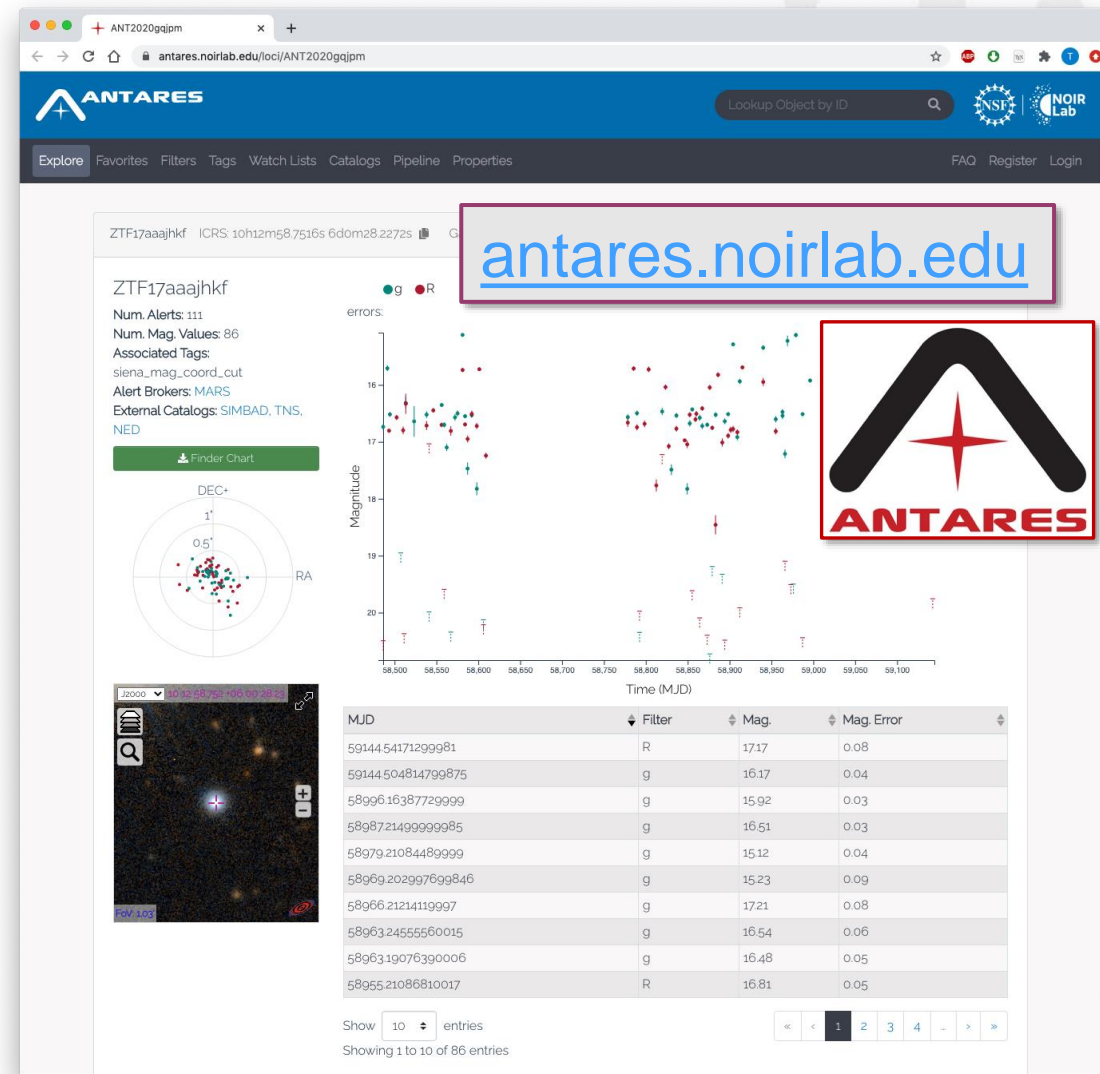
- Long range plan:***
- *Bring big data and big computing together*
  - *Enable combined analysis of Rubin and other big surveys*



## ANTARES

- A general purpose community event broker for time-domain astronomy
- Scalable to Rubin-LSST rate & volume
- Operating now for Zwicky Transient Facility public surveys

- ✓ Hosts user-defined Python filters
- ✓ Fast access to alert history database
- ✓ Support for “watchlist” uploads
- ✓ Webpage, Slack, and API alert distribution
- ✓ Integrates with ToO follow-up



# PI-oriented archives & data services

## ***New petabyte-scale Astro Data Archive for CTIO + KPNO***

- Modern software interface
- Fast & flexible search capabilities
- Interactive and programmatic interfaces

[astroarchive.noirlab.edu](http://astroarchive.noirlab.edu)

## ***New Gemini data publication & analysis support***

- Gemini GOGREEN survey data products hosted in Astro Data Lab; additional Gemini Large and Long Program data sets in future
- New Gemini data reduction example notebooks from US-NGO team (IRAF, DRAGONS)

[datalab.noirlab.edu](http://datalab.noirlab.edu)

[github.com/usngo](https://github.com/usngo)

## ***Long range plan:***

- *National ground-based OIR data archive*
- *Integrated data-science platforms for all NOIRLab telescopes*
- *Full-featured scientific data systems for TMT and GMT*

3000

4000

5000

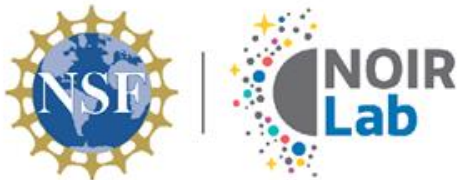
6000

$\lambda_{\text{rest}} [\text{\AA}]$

0  
50  
100  
150  
200

600  
650  
700





# Mid-Scale Observatories

**Lead in ground-based Survey and Data Intensive Astronomy**

*Dark Energy Survey, Dark Energy Spec. Survey, Legacy Surveys*

**Be a Leading Resource for US Time Domain Astronomy**

*Rapid-response Imaging & Spec. on Blanco, SOAR, Small apertures*

**Conduct High Precision Astronomy**

*Precision Radial Velocities with NE*



Blanco / DECam



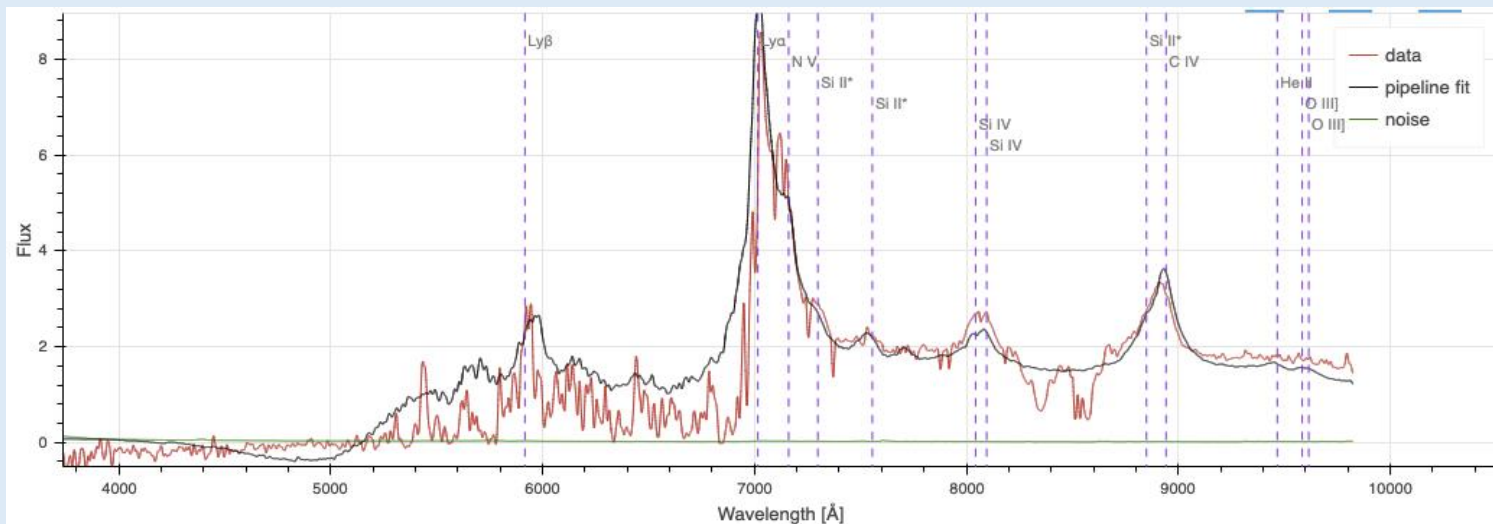
SOAR / AEON





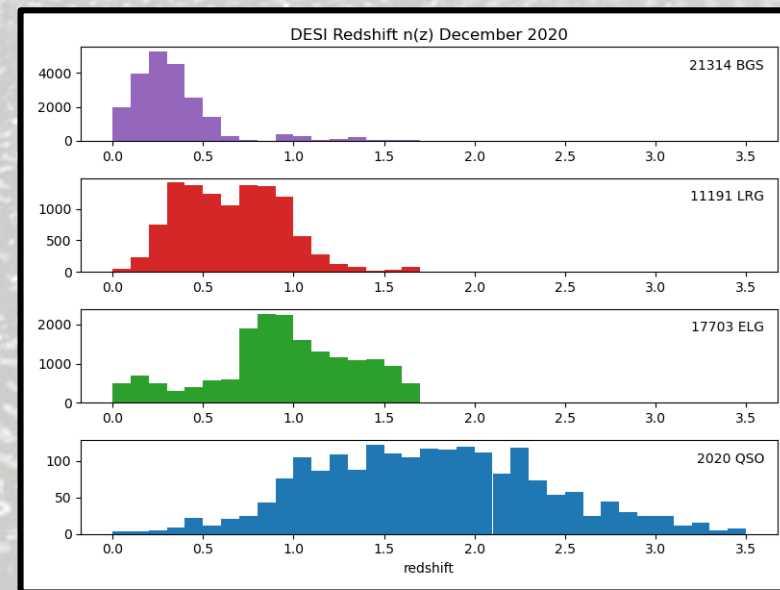
# DESI @Mayall

- Stage IV Dark Energy Experiment
- ~35M redshifts over 5 years
- Survey validation underway



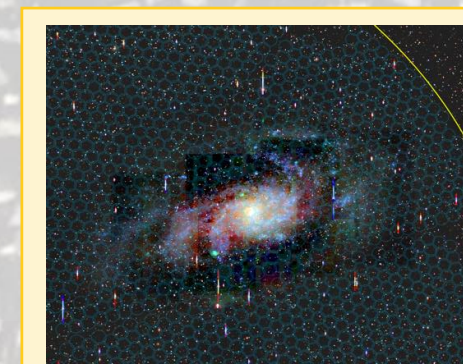
**Spectrum of  $z \sim 4.75$  QSO** (red line = data, black line = template)

Credit: DESI collaboration



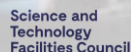
**>50K well-measured redshifts**

December 2020; DESI collaboration

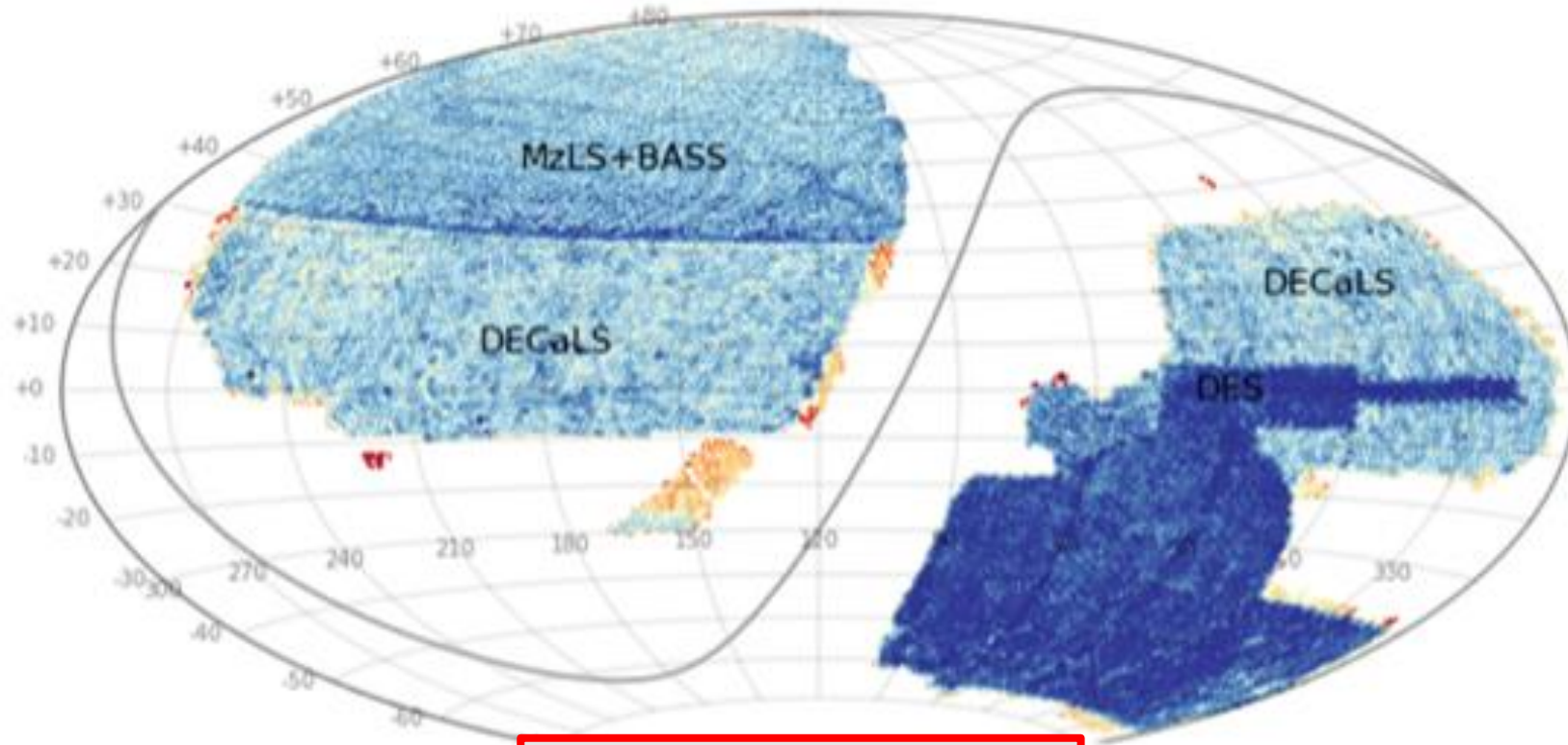


Bright-time science too!  
**Bright Galaxy & Milky Way Surveys**  
 Left: DESI on M33

Thanks to the DESI sponsors and Participating Institutions!

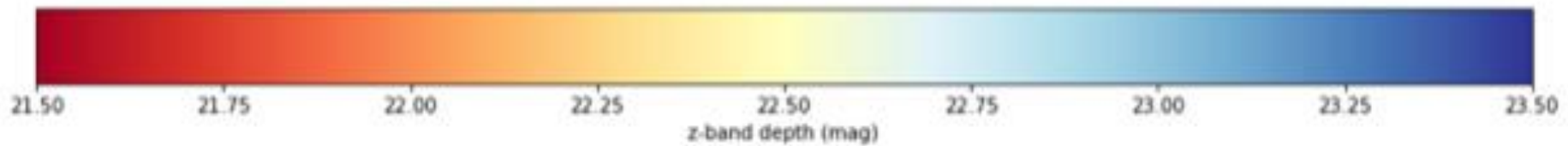


# Wide-field imaging @ Blanco



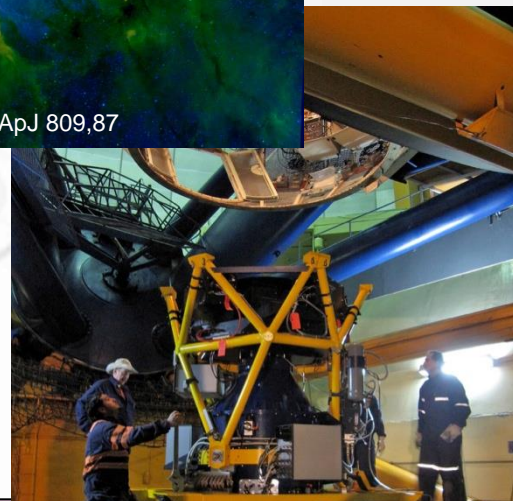
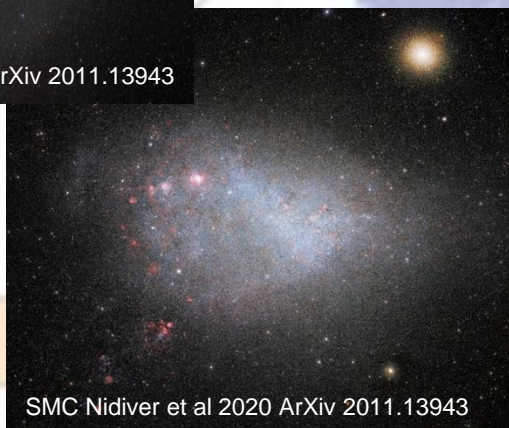
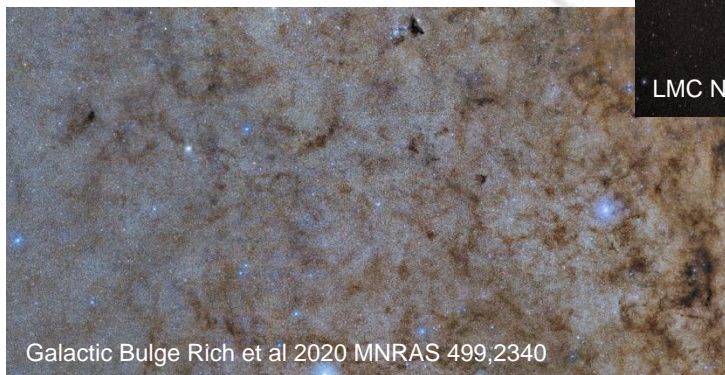
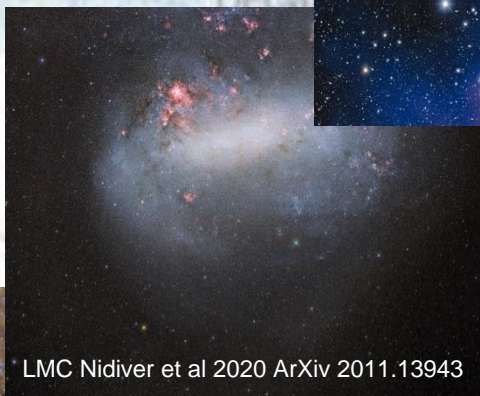
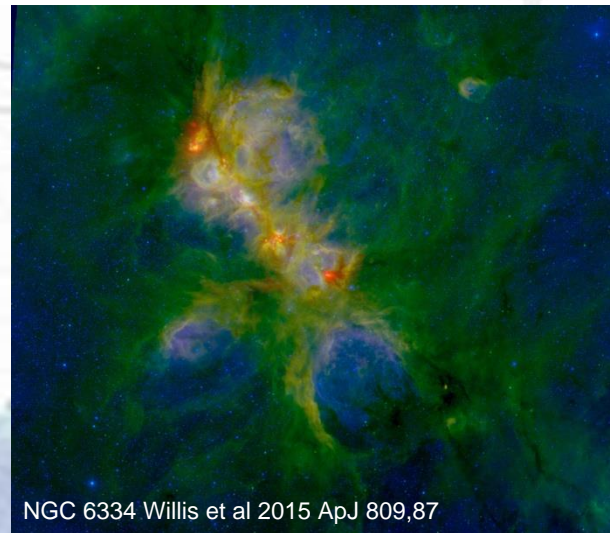
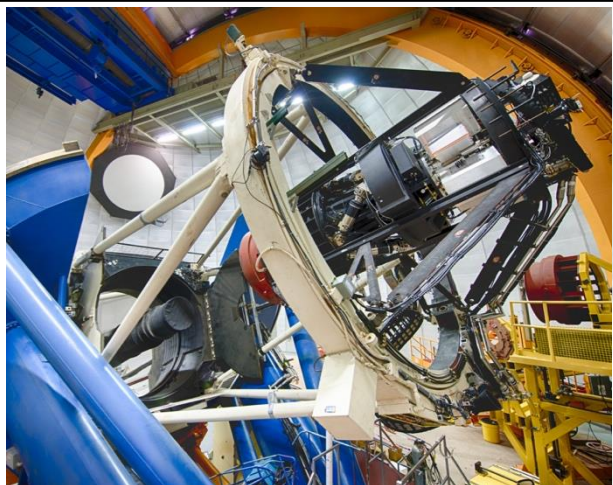
<https://www.legacysurvey.org>

Dark Energy Camera Legacy Surveys (DECaLS) DR9



# Wide-field imaging @ Blanco

## Optical – DECam



Near IR – NEWFIRM  
Returning for 2022B



<https://neid.psu.edu>

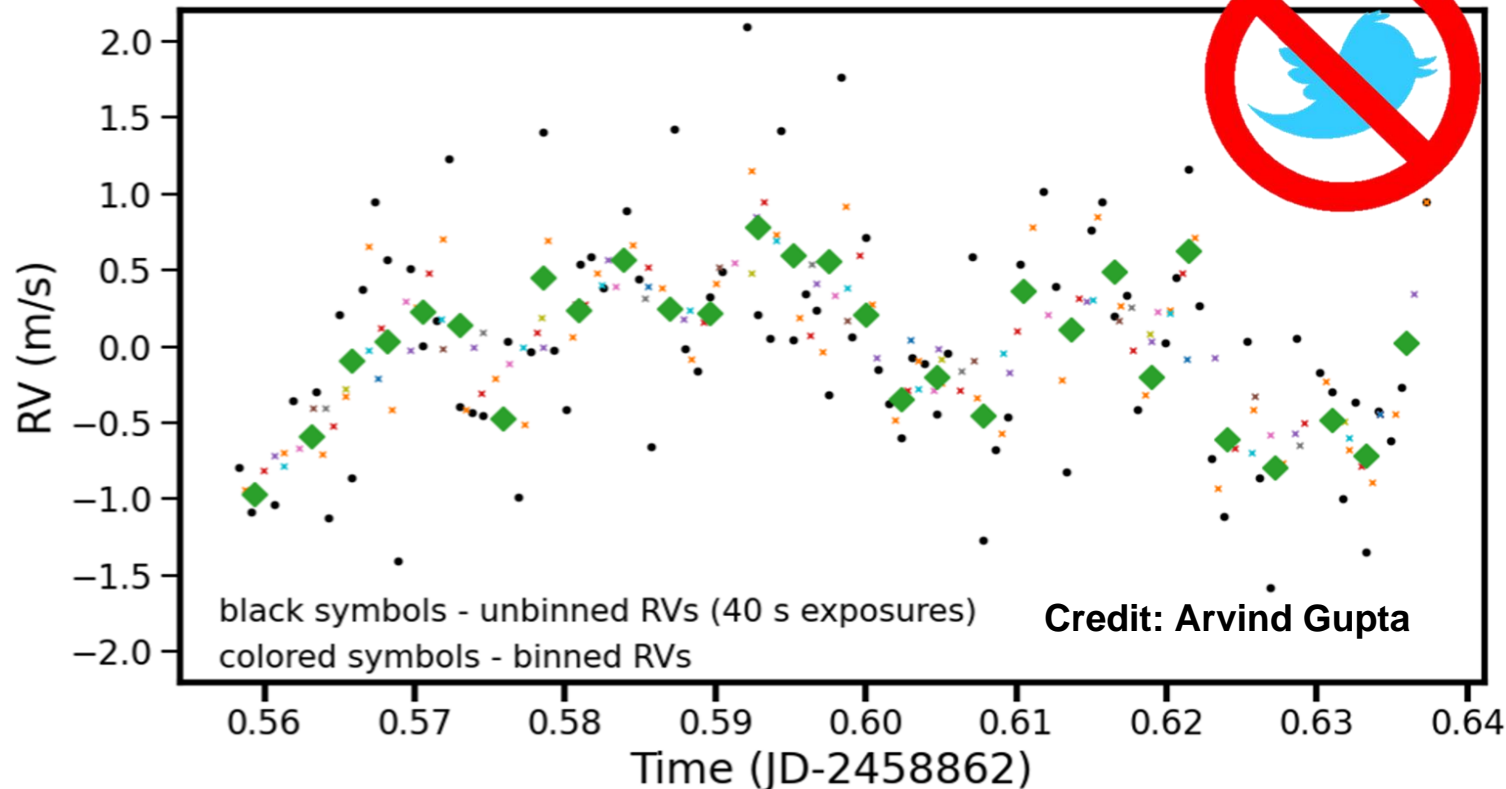
# NEID @ WIYN

- Core of **NN-EXPLORE**
- Precision Radial Velocities
- $\lambda\lambda 380-980$  nm,  $R \sim 120K$
- Goal: 30cm/s precision
- Data pipeline (NExSci)
- Time thru NOIRLab TAC



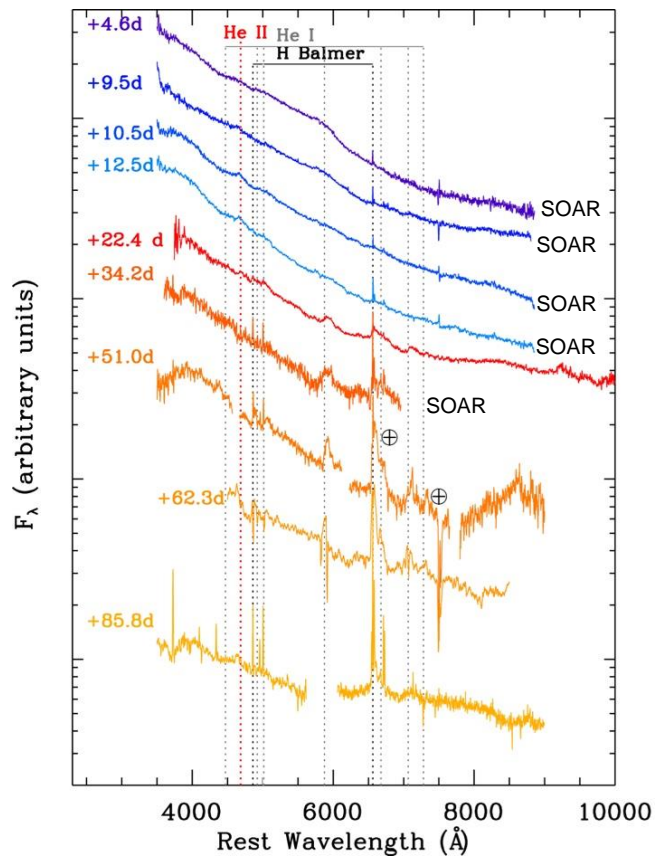
Solar telescope is monitoring the Sun daily; pipe-line reduced

(From the Tohono O'odham word "to see"; rhymes with "fluid")



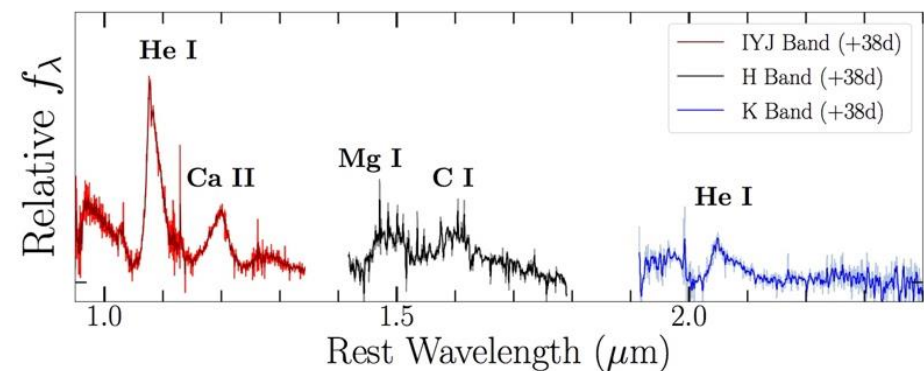
*Measured RVs for  $\tau$  Ceti == bright, RV stable star  
Averaging over stellar p-mode pulsations,  
NEID approaching target precision*

# Time Domain @ SOAR



SN2018Cow  
Margutti et al 2019 ApJ 872 18

Agile platform for follow-up with Optical (Goodman) and near-IR (TripleSpec-4) spectroscopy; expanding AEON queue capabilities

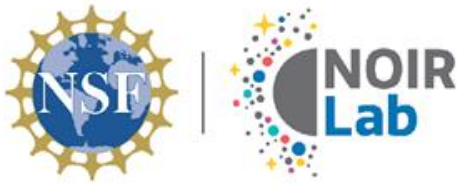


SN2019ehk (type Ib)  
Jacobsen-Galán et al 2020  
arXiv 2005.01782

# FY2021 Priorities

- DESI, NEID surveys fully operational @ Mayall & WIYN
- DESI/Mayall future(s) planning
- Expand wide-field imaging capabilities @ Blanco & SOAR
  - New narrow-band filters for DECam
  - Prepare NEWFIRM for installation @Blanco
  - Investigate ISPI upgrade for SOAR
- Strengthen stakeholder relationships
  - Tohono O'odham Nation and other Indigenous Communities
  - Operational partners
- Protect dark skies
  - Ground-based light pollution
  - Satellite constellations

**TODAY!**  
**Session 422: Astronomy**  
**& Satellite Constellations**



# Looking Ahead

*2020 was a challenging year for us all*

The prospects for 2021 are good

Exciting capabilities coming on-line

*New instruments, software data sets, preparing for Rubin*

Welcoming observers back!

Patrick McCarthy, NOIRLab Director  
[pmccarthy@aura-astronomy.org](mailto:pmccarthy@aura-astronomy.org)





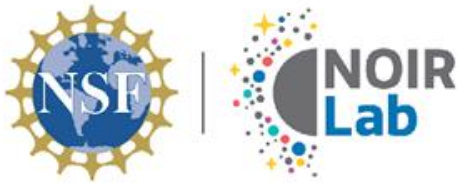
A special thank you to our  
sponsors, partners, and  
collaborators



Agencia Nacional de Investigación y Desarrollo  
Ministerio de Ciencia, Tecnología, Conocimiento e Innovación  
Gobierno de Chile

7th AAS Meeting

Discovering Our Universe Together



# Questions? #420\_noirlab\_town\_hall

The NOIRLab booth is in the NSF Exhibit Hall.

Join us there in the Town Hall After Party Breakout Room after clicking “Let’s Zoom”.

Take our Quiz!

(#exb\_noirlab)

