



U.S. National  
Science Foundation



Office of Science

# Rubin Observatory

**Tuesday 14 January, 2025**

**AAS TOWN HALL**



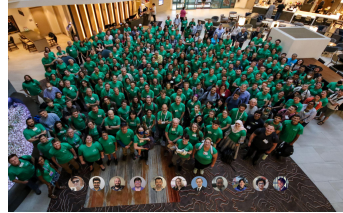
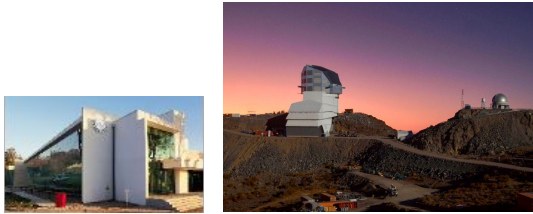
# Agenda

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- Welcome (Zeljko Ivezić) - 5 mins
- Status of construction and commissioning (Victor Krabbendam) - 20 minutes
  - 2024 Progress
  - Commissioning Camera on Sky
  - Construction Project Schedule
- On the road to operations (Bob Blum) - 10 mins
  - Early science
  - For Scientists: what to expect when
- Community initiatives (Bob Blum and Beth Willman) - 10 mins
- DOE & NSF Updates (Kathy Turner & Ed Ajhar) - 5 mins
- Q&A - 10 mins

# Terminology: Rubin, Simonyi, LSSTCam, LSST

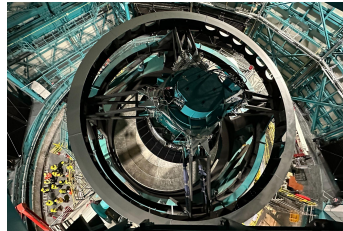
Project, facilities in Chile, Tucson and more → NSF-DOE Vera C. Rubin **Observatory** (**Rubin**)



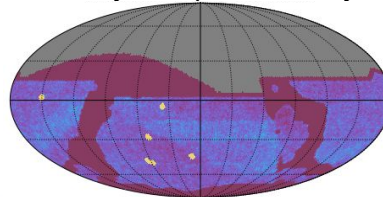
The astronomical Telescope → Simonyi Survey **Telescope**



DOE Funded Camera  
“**LSSTCam**”



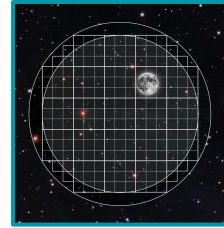
10 year optical survey → Legacy **Survey** of Space and Time



# Legacy Survey of Space and Time (LSST)

Survey the Southern sky  
every ~3 nights for 10  
years

9.6 sq. deg. field of view  
Survey ~18 000 sq. deg.



Wide-field survey with a  
fast cadence to faint  
magnitudes (~24.5), in 6  
filters (*ugrizy*)

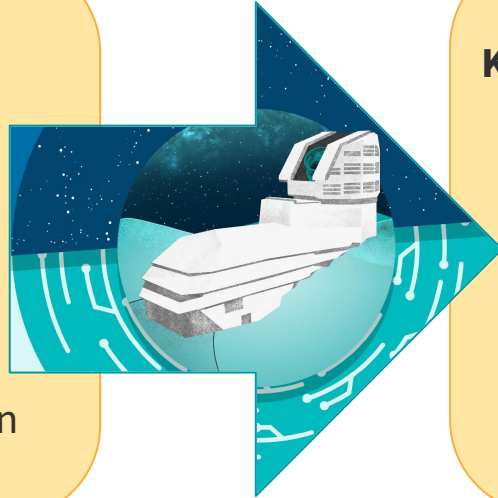


# What to expect from Rubin and LSST

## Big data set! 20 TB data/night

Over the ten-year survey:

- 20 billion galaxies
- 17 billion resolved stars
- 6 million orbits of solar system bodies
- Alerts per night ~ 10 million



## Key research areas:

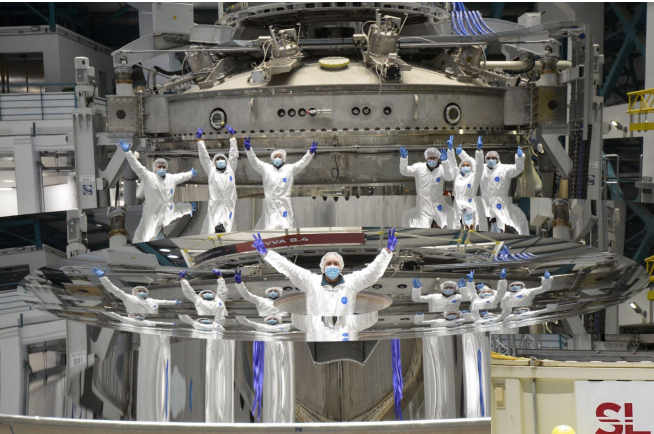
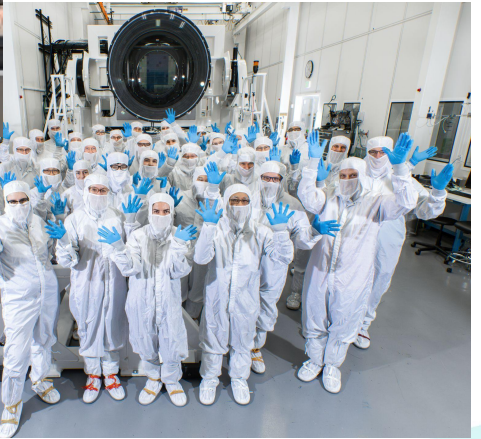
- Probing **dark energy** and **dark matter**
- An inventory of the **solar system**
- Exploring the **transient optical sky**
- Mapping the **Milky Way**

... and much more!

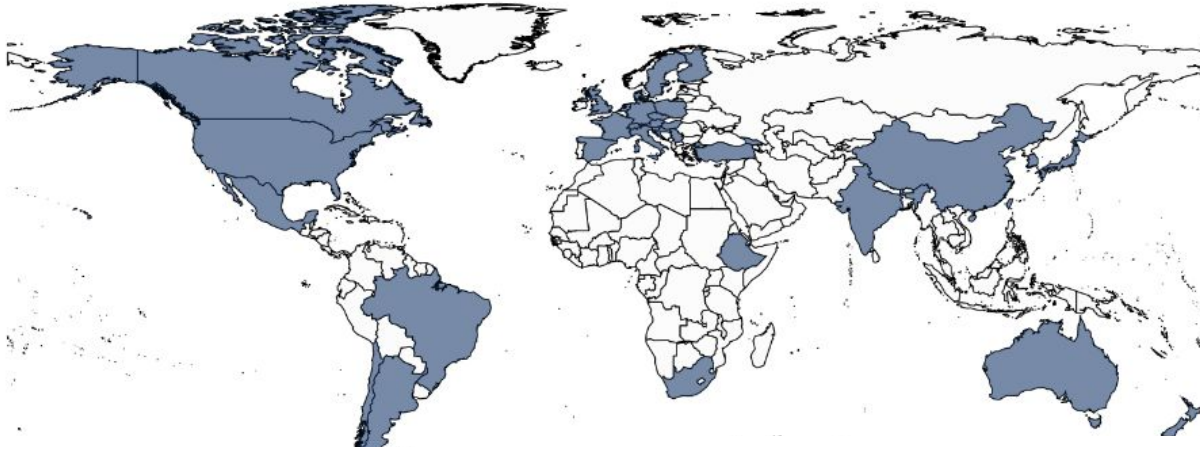
**Learn more at our Seminar for Science Writers!**

Thursday, January 14 | 12:45p – 1:45p  
Maryland Ballroom 5/6

# Teamwork!



# Recognizing the important broader Ecosystem



**LSST Discovery Alliance:** a non-profit, global alliance dedicated to Rubin LSST Science  
38 institutions/consortia, 7 current programs

**In-kind Commissioning program:** members contributing to Rubin Commissioning with value add service and capability

**Science Collaborations (SCs):** a [federation](#) of independent, worldwide communities of scientists, self-organized into groups based on research interests & expertise.

>2000 people, 2500 affiliations, 6 continents, 33 countries, 8 teams.

**In-kind program** members contributing to Rubin and the LSST science community in return for data rights.

43 teams, 30 countries, 153 contributions.

**And the Rubin Operations Team working along site to ensure a smooth transition**

Rubin Observatory's mission is to build a **well-understood system** that will produce an **unprecedented astronomical data set** for studies of the deep and dynamic universe, make the data widely **accessible to a diverse** community of scientists, and engage the **public** to explore the Universe with us.





# LSST Camera arrived on Summit in May 2024

One 747, dedicated to 3 containers and  
47 crates (~50 tons)  
San Francisco to Santiago



Then 9 trucks  
make deliveries for  
3 days to get LSST  
Camera to Summit



# LSST Camera in the summit clean room

- EO Test campaign of LSSTCam in summit clean room ended on Dec. 2<sup>nd</sup>.
  - Started Sept. 24<sup>th</sup> (when CCD back bias was switched on)
  - Over 56,000 images were captured and ingested at USDF
- Filters installed during testing
  - r, g, y, empty frame & pinhole
- Used testing campaign for upgrading and further tuning Filter Exchange System

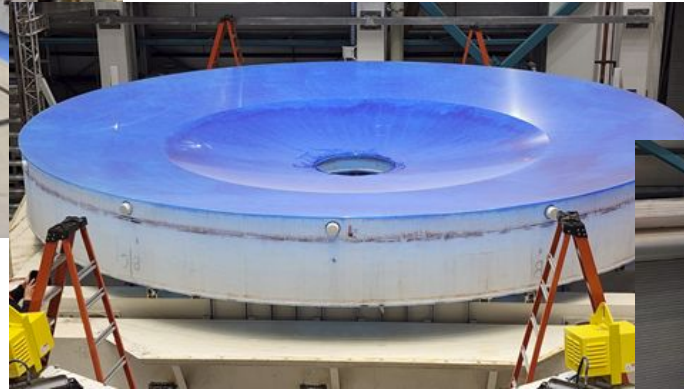


# Primary / Tertiary Mirror (M1M3) is home !

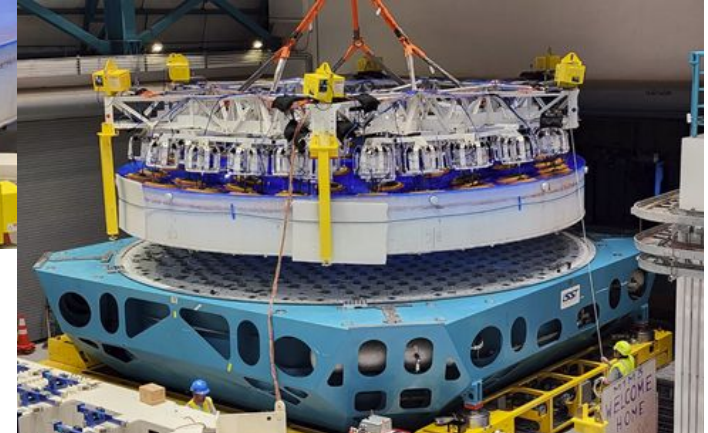
- Cast in 2008 and polishing finished in 2014
- System Test and then Shipped to Chile in 2019
- Brought to Summit Facility and integrated 2024



M1M3 arrives



M1M3 after 5 yrs of storage



Lifted onto support cell

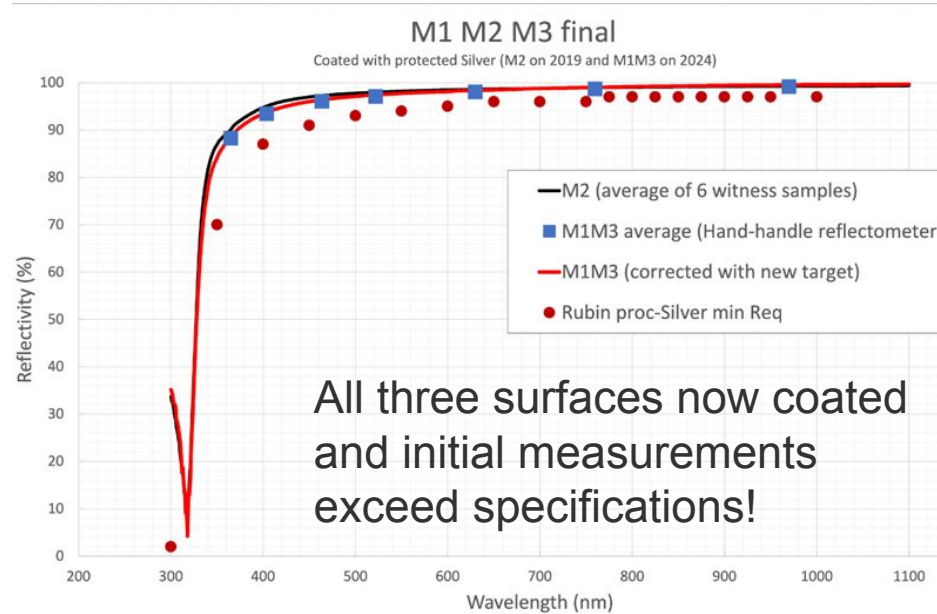


VON ARDENNE SKYVA GA

KONECRANES

60/1

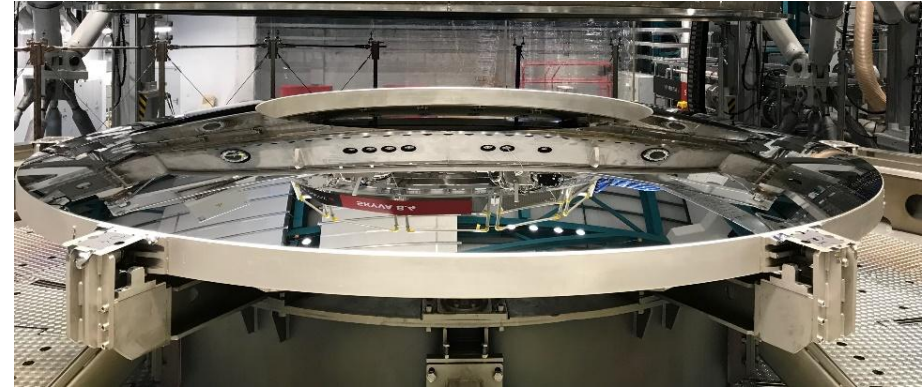
# Protected Silver Coating Quality is Excellent



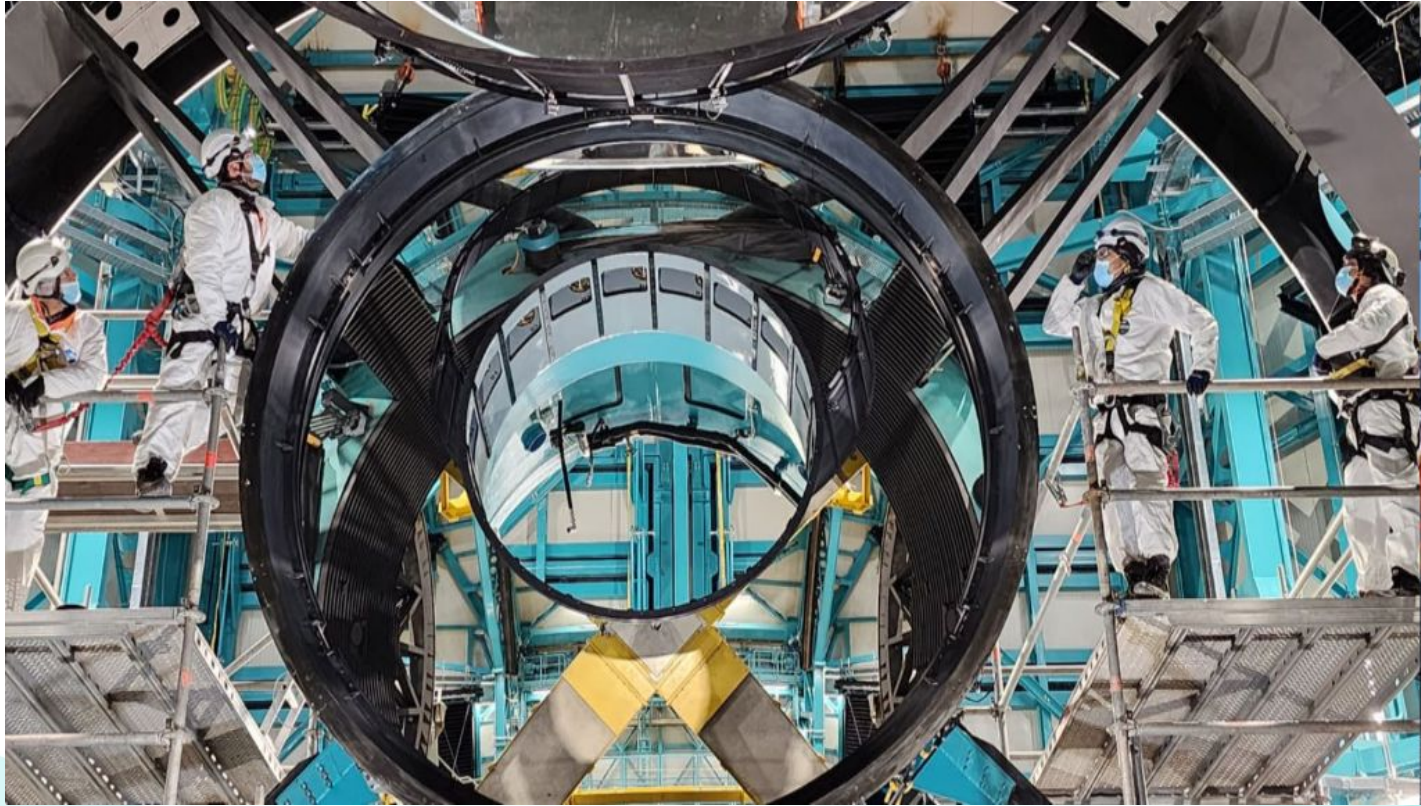
3.5 m M2 coated in July 2019 and stored



Corning® ULE® Glass



# Secondary Mirror (M2) installed on Telescope

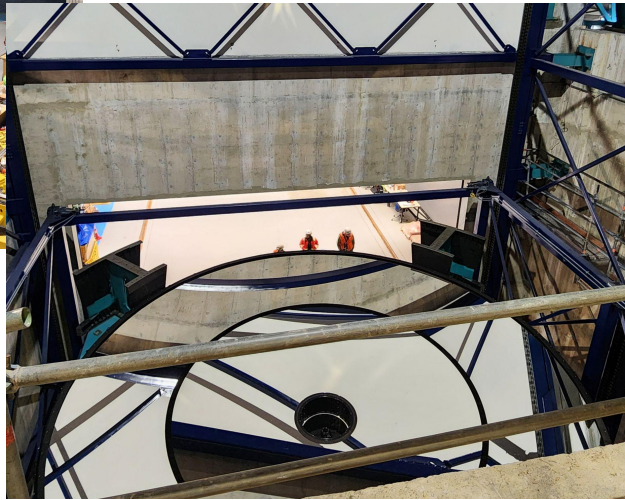


# Installing the Commissioning Camera (ComCam)!

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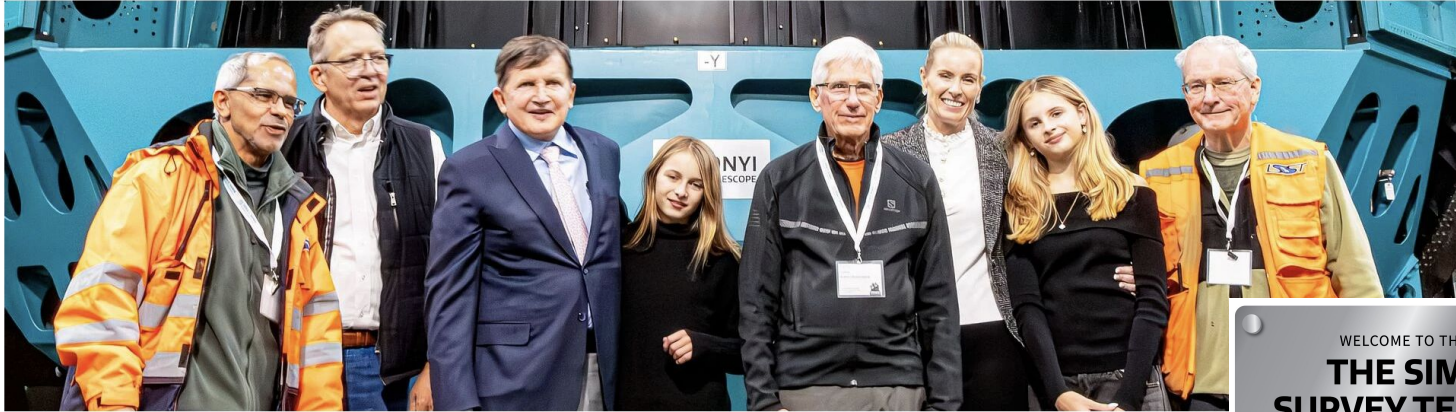
# The M1M3 Mirror final step in its long journey





# Simonyi Naming Event

News | [Simonyi Survey Telescope Dedicated at NSF-DOE Vera C. Rubin Observatory Ceremony](#)



## Simonyi Survey Telescope Dedicated at NSF-DOE Vera C. Rubin Observatory Ceremony

Simonyi family's \$20 million gift supports a new era of discovery

October 11, 2024

NSF-DOE Vera C. Rubin Observatory celebrated a landmark moment in astronomy and astrophysics with the dedication of the Simonyi Survey Telescope on 4 October 2024. With the Simonyi family as guests of honor, Rubin Observatory recognized the pivotal role of Charles and Lisa Simonyi's philanthropy in advancing construction of the Observatory and supporting research that will soon transform our understanding of

### Media



Simonyi Survey Telescope Dedication Ceremony at Rubin Observatory

## WELCOME TO THE HOME OF THE SIMONYI SURVEY TELESCOPE

THIS TELESCOPE IS NAMED IN HONOR OF THE SIMONYI FAMILY  
IN RECOGNITION OF THE GENEROUS GIFT FROM THE CHARLES AND  
LISA SIMONYI FOUNDATION FOR ARTS AND SCIENCES

## BIENVENIDOS A LA CASA DEL TELESCOPIO DE EXPLORACIÓN SIMONYI

ESTE TELESCOPIO ES NOMBRADO ASÍ EN HONOR A LA FAMILIA  
SIMONYI EN RECONOCIMIENTO A LA GENEROSA DONACIÓN DE LA  
FUNDACIÓN CHARLES Y LISA SIMONYI PARA LAS ARTES Y CIENCIAS

2024.10.04

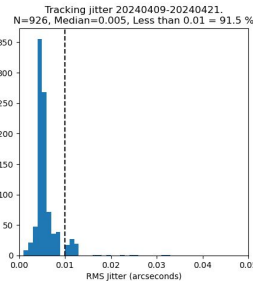
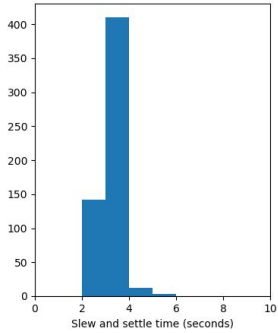
# Telescope is performing well

Relative Pointing Accuracy: **<1.0 arcseconds.**

Slew and settling time: **Data from multiple nights, >98% are below 4s**

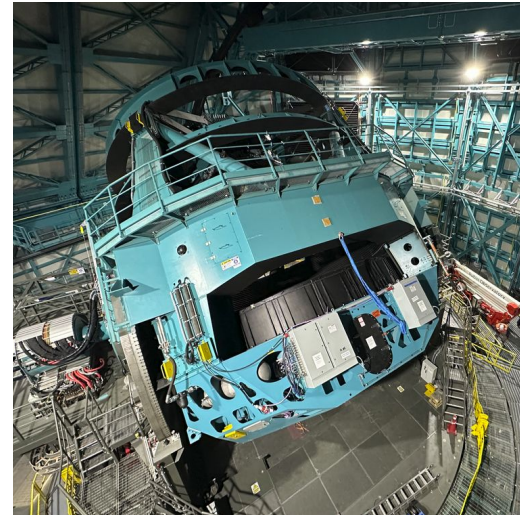
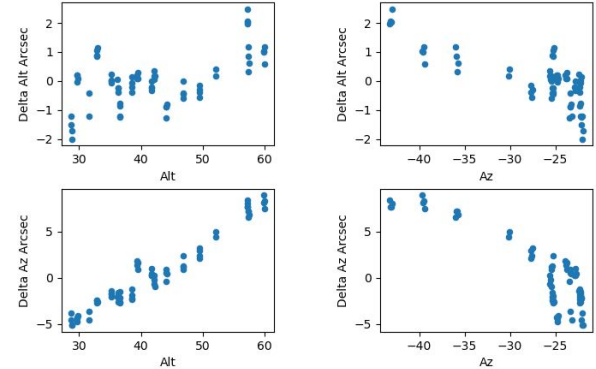
- Azimuth velocity:  $\pm 10.50^\circ/s$
- Elevation velocity:  $\pm 5.25^\circ/s$

20231220-:

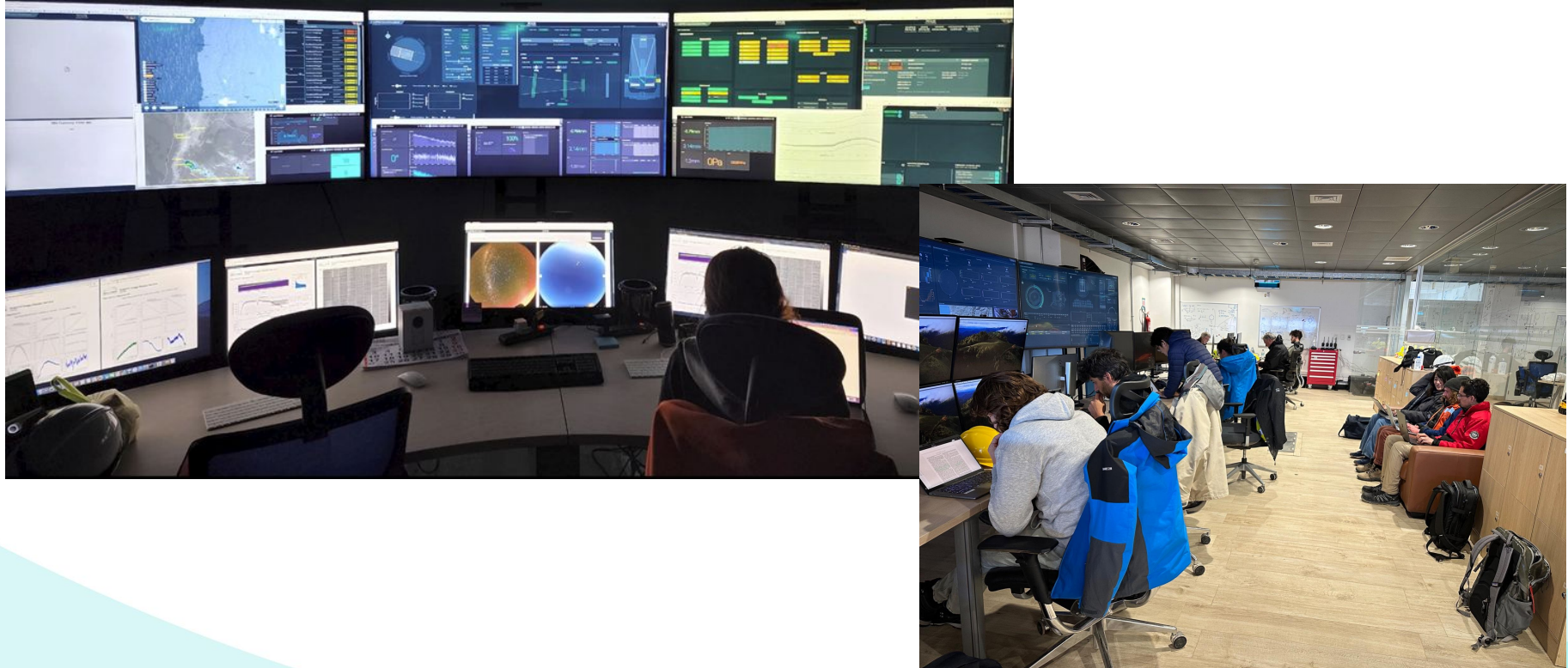


Tracking jitter: **92% within req <0.01 arcsec rms**

Narrow camera pointing errors Post seqNum 950 20240306



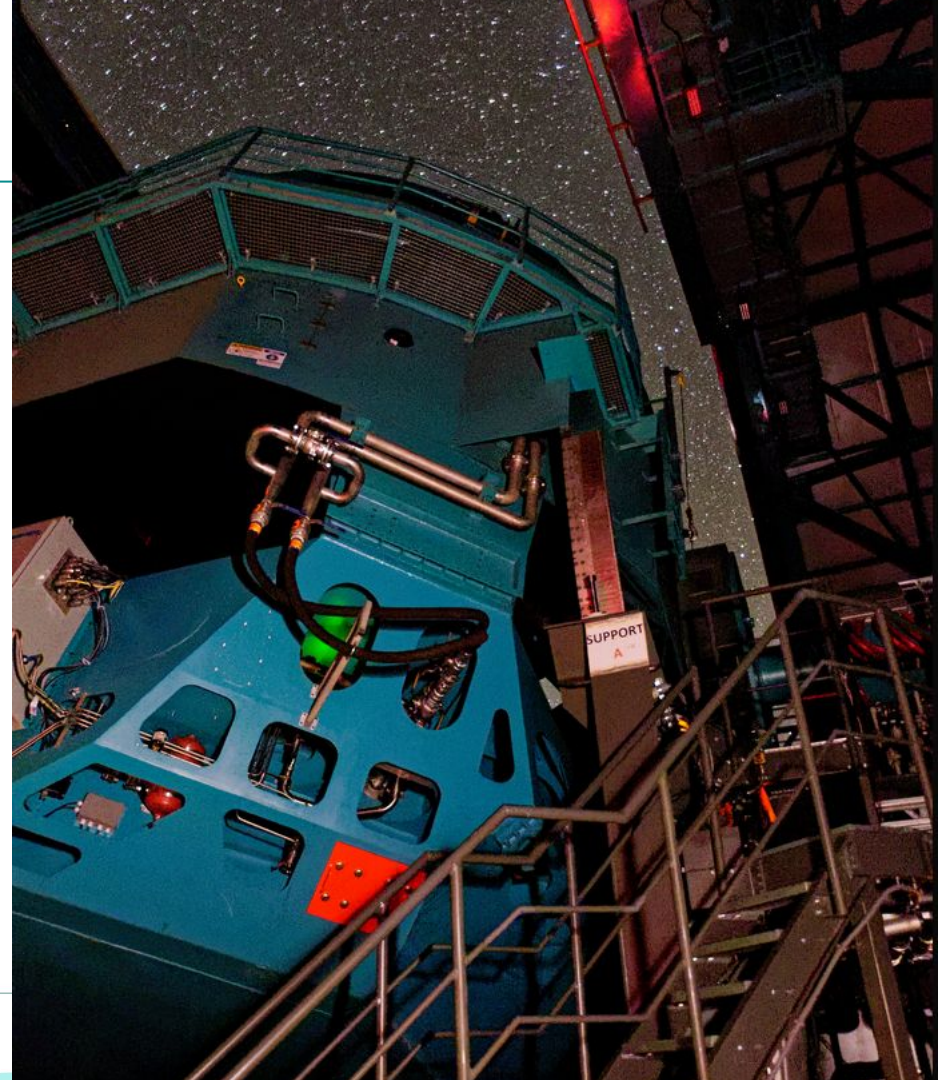
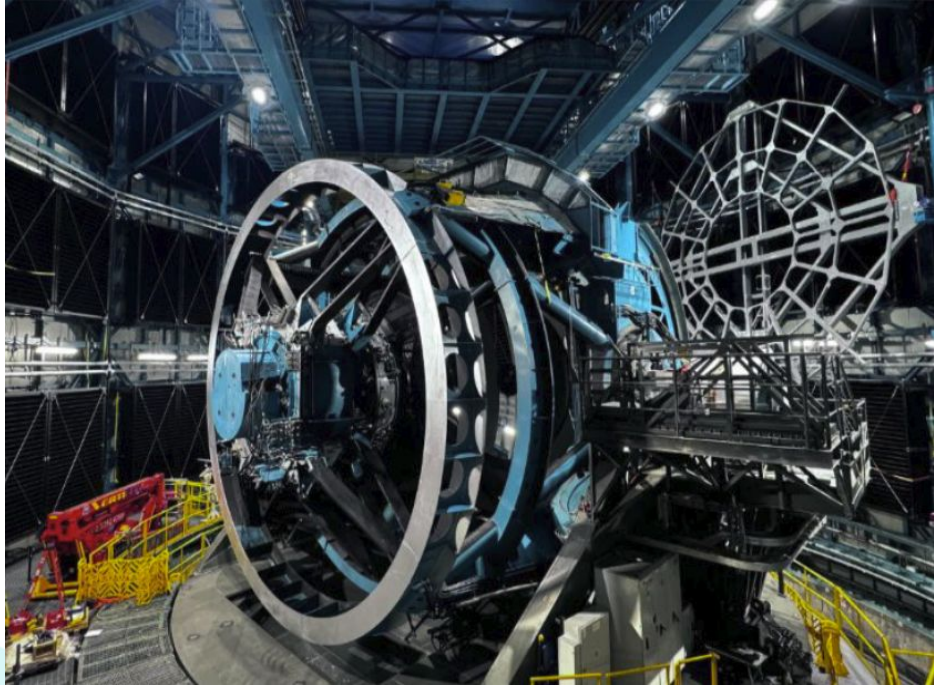
# Operating software and operators were ready.



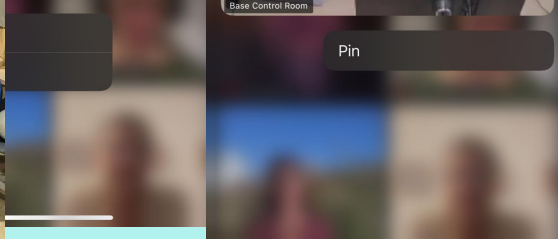
# Data systems in place to USDF through DM pipelines and quickviews...



# Systems Ready for First end-to-end Engineering Test

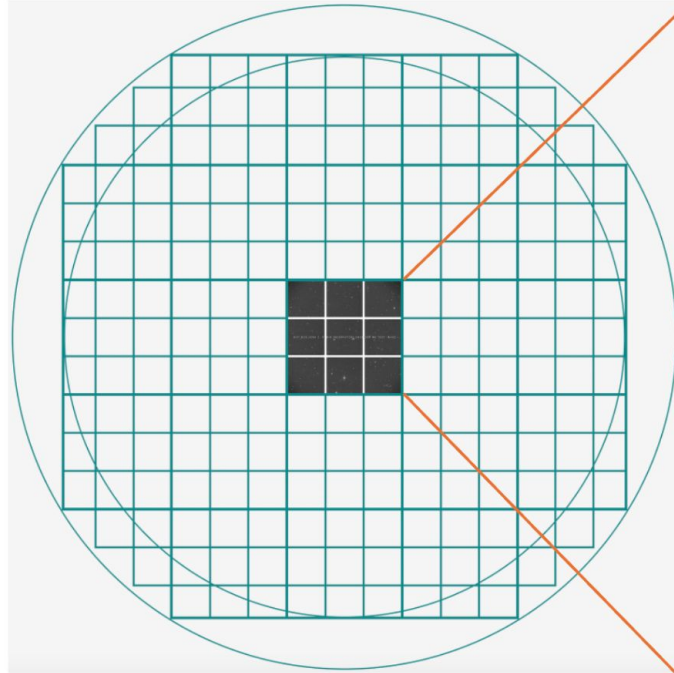


# Night #1



# First Engineering Image with ComCam

LSST Camera field of view



Commissioning camera: 9 CCDs with 144 Megapixels



189 science 4k x 4k CCDs, 3200 Megapixels

One of the first Rubin on-sky images from Oct 24, 2024

# First Engineering Image detail (ignore the watermark)

1/10th of one CCD



1 CCD

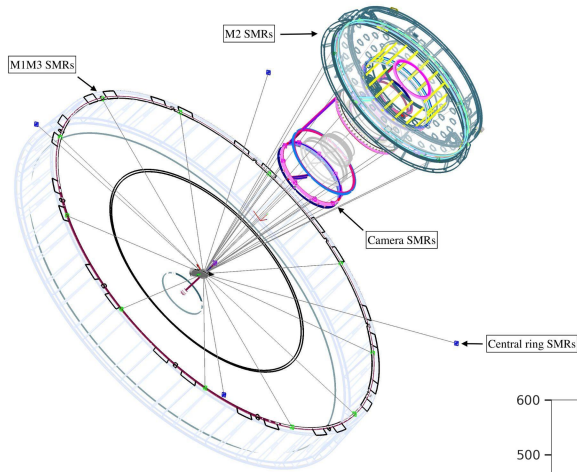


Rubin's Commissioning Camera: 9 CCDs

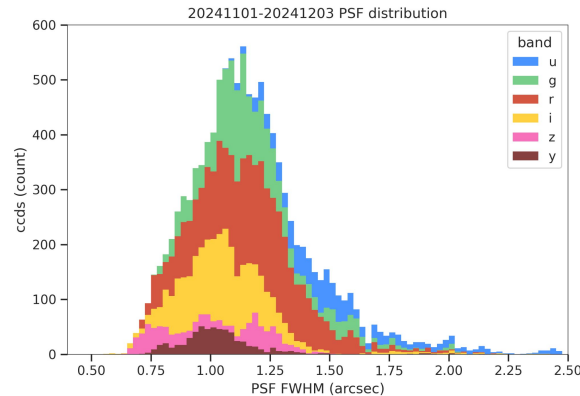




# For 7 weeks the Test Campaign Achieved our Goals



**Image Quality:**  
Multiple filters,  
consistency



**Active Optics:**  
Wavefront Sensing,  
Force Balance,  
Alignment, closed  
loop control

## Summit Rapid Analysis Framework



## USDF Rapid Analysis Framework

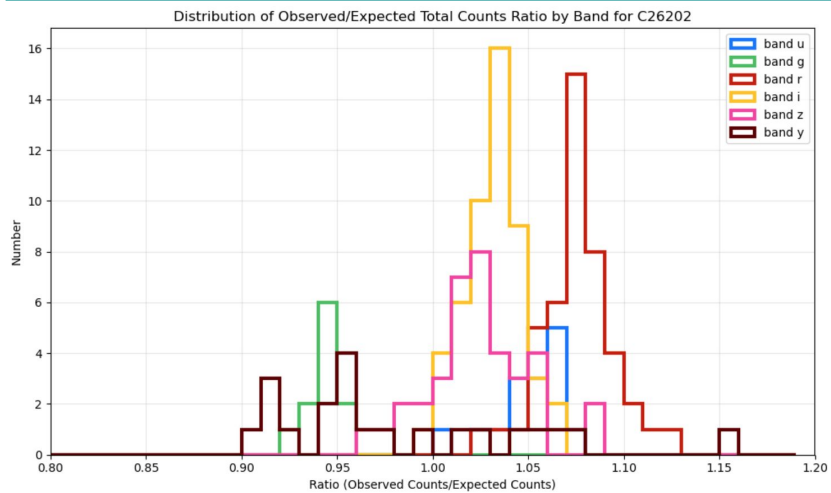


## USDF Prompt Processing Framework



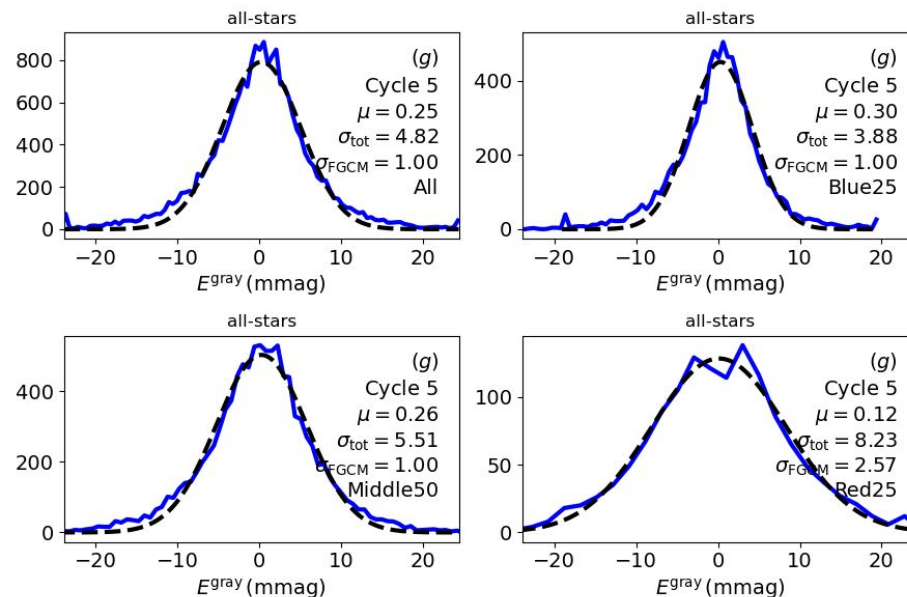
**Data Pipelines:**  
ISR, Fast look, Data  
flow timing...

# Testing and Commissioning Hardware and Software



**Throughput:** Quantitative measures of throughput

## Photometric Calibration: Repeatability, illumination, Airmass,



# Incredible 7 week Campaign to prepare for LSSTCam!

Weekly on Sky Commissioning summaries on [Community.org](https://www.community.org)

ComCam on-sky campaign [Interim report](#) is available (sitcomtn-149)

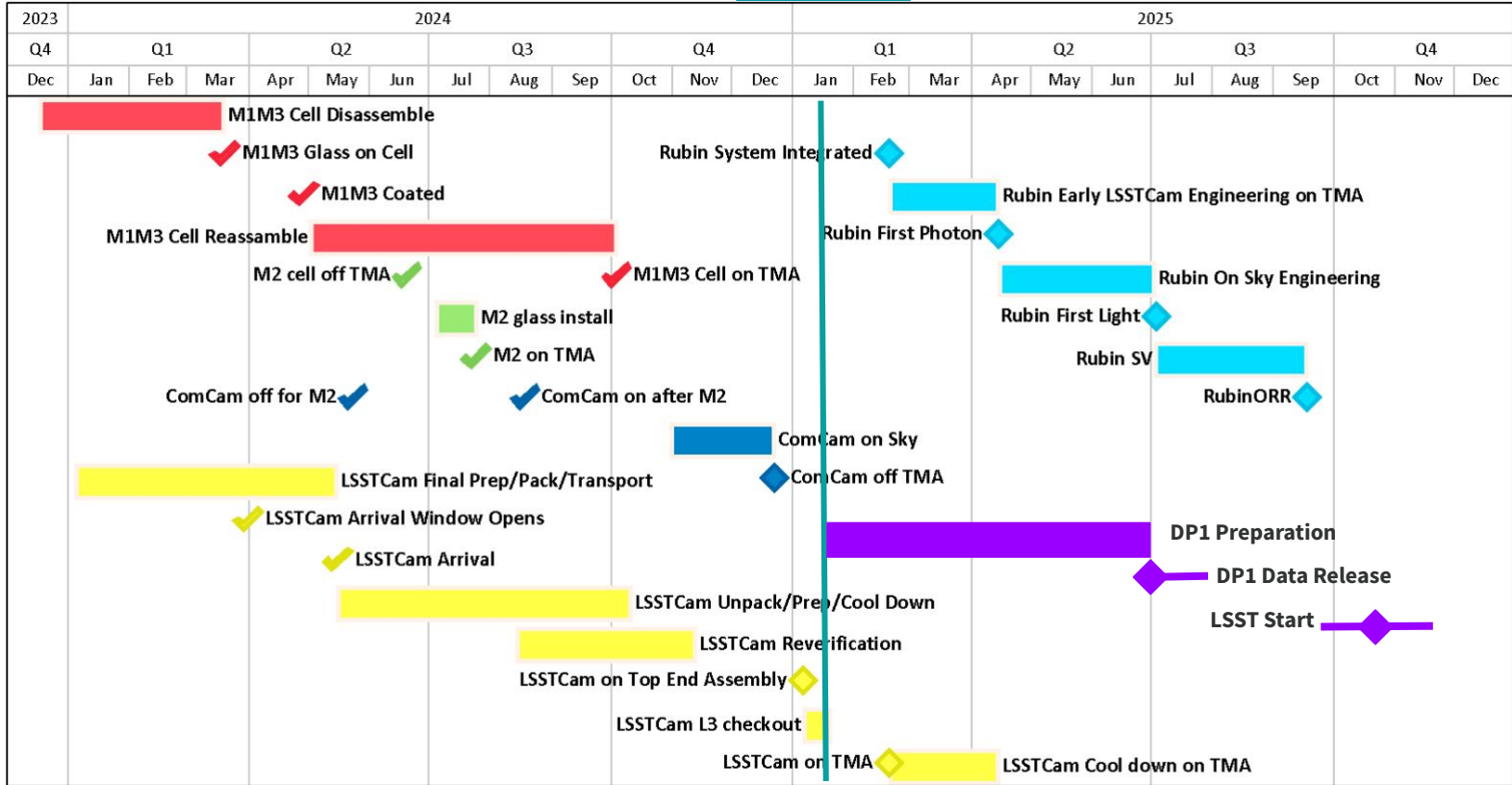
The campaign produced incredible data for engineering and system commissioning but it also is the data set for Data Preview 1

**An amazing accomplishment made possible by efforts from every single team member!!!!**



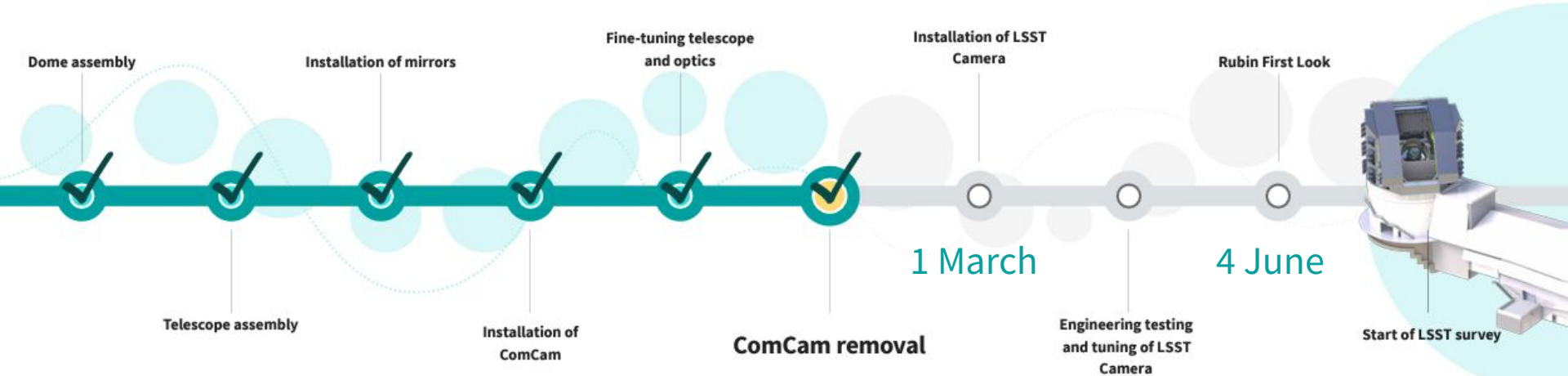
# The Schedule:

Today



# What to Expect in 2025

## NSF-DOE Vera C. Rubin Observatory towards Rubin 'First Look'



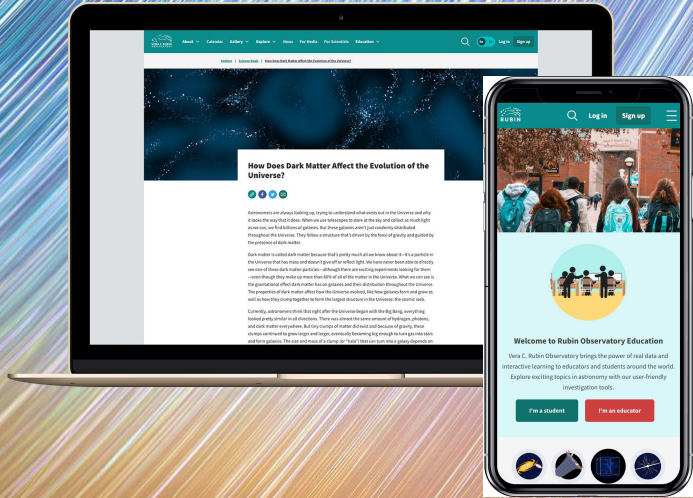
Full Transition  
to Operations in  
Late 2025

A large, white, multi-tiered industrial building with a prominent, tall, cylindrical tower on top, situated on a rocky, elevated terrain. The building has a complex, angular design. In the foreground, a wide, unpaved dirt road with visible tire tracks leads towards the building. To the right, there are several large, grey rocks and a yellow container. The sky is clear and blue. The overall scene suggests an industrial or mining site in a high-altitude or mountainous region.

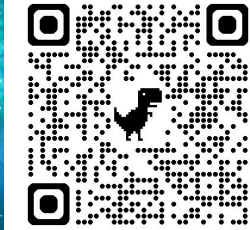
*On the road and close to  
Operations ...*

# Education and Public Outreach

Rubinobservatory.org



## Citizen Science



## Formal Education Investigations and teacher trainings





**Follow us on Social Media!**

     @VRubinObs

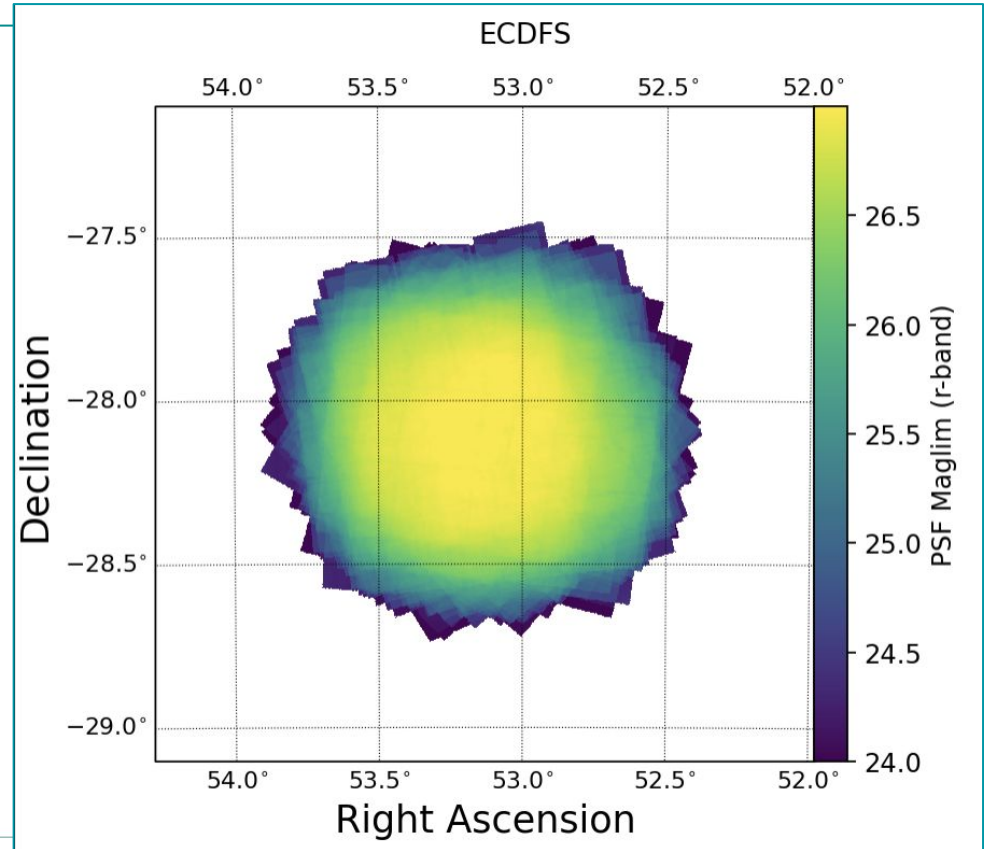
  @rubin\_observatory

  @RubinObservatory

# Early Science with DP1

ComCam data taking and processing exceeded expectations. An interesting data set for early science analysis preparation will be available to the community.

Target	u	g	r	i	z	y
47 Tuc	6	10	33	19	0	5
Rubin SV 38 7	0	44	55	57	27	0
Fornax dSph	0	5	26	13	0	0
ECDFS	53	230	257	177	177	30
EDFS ComCam	20	61	90	42	42	20
Rubin SV 95 -25	33	86	97	29	60	11
Seagull	10	37	49	3	13	0



# Early Science with DP1, DP2 and Alert Production

RTN-011 update is in progress following a highly successful ComCam campaign

- DP1: Expect coadded images. Stretch goals: Forced source Catalogs, all Difference Image Analysis (DIA) data products
- DP2: Baseline is 100 sq deg to 10 yr depth in *ugrizy* plus a 1000 sq deg pilot survey to 1 year depth in *griz*
- Alerts to begin in SV phase at low latency, and then ramp up on latency and sky coverage through Year 1. PVIs + catalogs available in year 1 of survey before DP2.

Rubin Early Science – Data Release Scenario								
	Jun 2021	Jun 2022	Jun 2023	Jun 2025 – Jul 2025	Mar 2026 – May 2026	Sep 2026 – Jan 2027	Sep 2027 – Jan 2028	Sep 2028 – Nov 2028
	DP0.1	DP0.2	DP0.3	DP1	DP2	DR1	DR2	DR3
	DC2 Simulated Sky Survey	Reprocessed DC2 Survey	Solar System PPDB Simulation	ComCam Data	LSST Cam Science Validation Data	LSST First 6 Months Data	LSST Year 1 Data	LSST Year 2 Data
Data Product								
Raw Images	●	●	-	●	●	●	●	●
DRP Processed Visit Images and Source Catalogs	●	●	-	●	●	●	●	●
DRP Coadded Images and Object Catalogs	●	●	-	●	●	●	●	●
DRP ForcedSource Catalogs	●	●	-	●	●	●	●	●
DRP Difference Images and DIA Catalogs	-	●	-	●	●	●	●	●
DRP SSP Catalogs	-	-	●	-	●	●	●	●

TABLE 1: Summary of Data Release data products expected in each data preview and early LSST data release. A dark teal dot denotes confirmed data products whereas a gray dot denotes data products that currently remain a stretch goal.



# “For Scientists” webpages: what to expect, and when

## Data and resources available now.

Visit the new “For Scientists” webpages: [rubinobservatory.org/for-scientists](https://rubinobservatory.org/for-scientists)

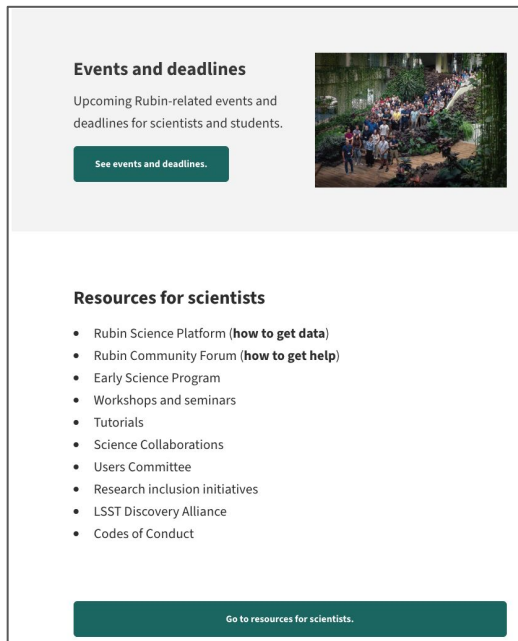
Get an account in the Rubin Science Platform (RSP): [rsp.lsst.io](https://rsp.lsst.io)

Access the “Data Preview 0” simulations via the RSP: [dp0.lsst.io](https://dp0.lsst.io)

Ask questions in the Rubin Community Forum: [community.lsst.org](https://community.lsst.org)

## Learning opportunities with Data Preview 0.

- Work through DP0 tutorials at your own pace.
  - Extragalactic & Galactic science: [dp0-2.lsst.io](https://dp0-2.lsst.io)
  - Solar System science: [dp0-3.lsst.io](https://dp0-3.lsst.io)
- Attend weekly Rubin Science Assemblies, Thursdays 9am Pacific.
  - Alternating weeks of guided tutorials and drop-in ‘office hour’ Q&A sessions.
  - [rubinobservatory.org/for-scientists/events-deadlines](https://rubinobservatory.org/for-scientists/events-deadlines)



The screenshot shows a webpage layout with two main sections. The top section is titled "Events and deadlines" and includes the text "Upcoming Rubin-related events and deadlines for scientists and students." Below this text is a dark green button with the text "See events and deadlines." To the right of the text is a photograph of a group of people gathered outdoors in a wooded area. The bottom section is titled "Resources for scientists" and contains a bulleted list of resources: "Rubin Science Platform (how to get data)", "Rubin Community Forum (how to get help)", "Early Science Program", "Workshops and seminars", "Tutorials", "Science Collaborations", "Users Committee", "Research inclusion initiatives", "LSST Discovery Alliance", and "Codes of Conduct". At the bottom of the screenshot is a dark green button with the text "Go to resources for scientists."

# For Scientists: what to expect, and when

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## New data and resources to be added this year.

“Data Preview 1” based on Commissioning Camera data.

- expected release between June & July 2025 concurrent with a Data Academy (see below)
- access will be via the Rubin Science Platform
- data products will include processed visit images and source catalogs and coadded images
  - locations of targeted fields: [community.lsst.org/t/9609](https://community.lsst.org/t/9609)
- DP1 resources will include documentation, tutorials, and a virtual seminar series

Alerts and Prompt Products from LSST Science Camera data.

- expected to begin between September & November 2025
- Prompt Products Database (PPDB) access will be via the Rubin Science Platform
- alerts access will be via participating brokers
  - resources will include documentation, tutorials, and virtual seminars
  - Community Alert Filters with the ANTARES Broker: [rtn-090.lsst.io](https://rtn-090.lsst.io)

# For Scientists: what to expect, and when

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## Opportunities for learning and networking in 2025.

Weekly Rubin Science Assemblies, Thursdays 9am Pacific (virtual).

- Alternating weeks of guided tutorials and drop-in 'office hour' Q&A sessions.
- [rubinobservatory.org/for-scientists/events-deadlines](https://rubinobservatory.org/for-scientists/events-deadlines)
- Thu Jan 23: “Data Preview 0 Review: Thank You Delegates!”
- Thu Feb 6: “Looking forward to Data Preview 1”
- Mar - May will feature DP1 prep sessions targeted for each of the LSST Science Collaborations.

Rubin Data Academy, June 2025 (virtual)

- One-week intensive virtual course on Rubin data access and analysis.
- Students are particularly encouraged to participate.
- **Our Goal is to have DP1 available for this academy. To be confirmed.**

Data Preview 1 Orientation & Onboarding Sessions (virtual)

- Quickstart sessions will coincide with the release of DP1.

Rubin Community Workshop, July 28 - Aug 1 2025 (Tucson AZ; hybrid)

# LSST Science is for Everyone!

\*mlg3k@uw.edu

## Research inclusion remains a priority.

### Rubin S3P: Supporting Science at SUIs Program

- SUI = Small/Underserved Institute
- One-on-one interviews available for faculty, to quickstart Rubin research.
- Custom virtual tutorials are available for research groups (students welcome!).
- Contact Gloria Fonseca Alvarez or Melissa Graham\* to get started.

### Users Committee Listening Sessions

- The UC solicits feedback and recommends improvements to the LSST data products, tools, and services.
- Their biannual meetings always start with a user listening session; the next one is Mon Apr 28, 8am Pacific.
- [rubinobservatory.org/for-scientists/committees-teams/users-committee](https://rubinobservatory.org/for-scientists/committees-teams/users-committee)

### Accessibility Initiatives

- Ensuring resources are accessible by neurodivergent and hearing- and vision-impaired astronomers.
- Pursuing external consultants on universal design and accessibility.
- Enabling Spanish-language translations for science resources (documentation, tutorials).





# LSST Discovery Alliance

A 501(c)(3) non-profit closely coordinating with the Rubin Observatory team; The aim is to ensure that any scientist with a great question for LSST has access to the resources needed to answer it.

[www.lsstdiscoveryalliance.org](http://www.lsstdiscoveryalliance.org)

# Cross-Disciplinary Innovation

- **LINCC Frameworks** - State-of-the-art software and analysis development
- **Project Dovetail** - Novel way to join astronomers with data and software engineers (exploratory phase)

## Cross-Disciplinary Training

- **Catalyst Fellowship Program** - Postdoctoral initiative for social scientists and astrophysicists
- **Data Science Fellowship Program** - Intensive training for graduate students
- **Summer Student Program** - Undergrad engagement at Rubin annual meeting

# Collaborative Network Development

- **Inclusive Collaboration Initiatives** - Building global, inclusive, collaborative networks
- **Science Catalyzing Grants** - Small grants for meetings and kick-starting new projects

## Special Session:

The Power of Collaborative Networks in the Era of Big Data  
Thursday, 10 - 11:30 am, Chesapeake 4-5



**LSST**  
Discovery Alliance



**Learn More**

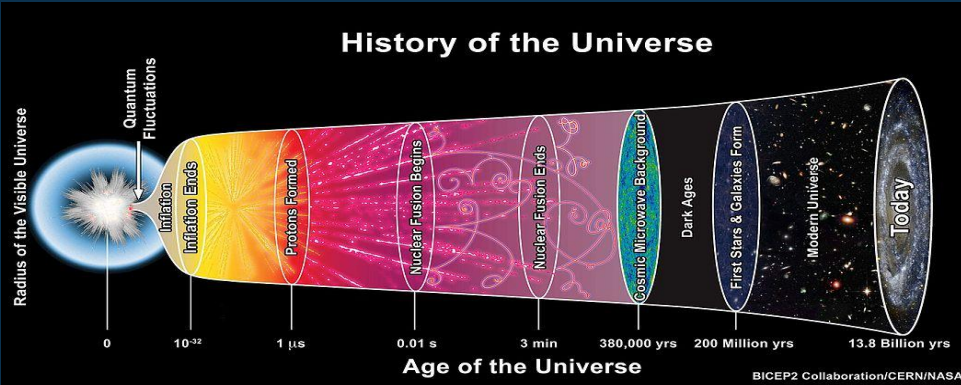
**Join**





The DOE Office of Science (SC) mission is to deliver the scientific discoveries & major scientific tools that transform our understanding of nature & advance our energy, economic, & national security

Office of High Energy Physics (HEP) mission is the fundamental nature of matter, energy, space & time.



HEP's Cosmic Frontier: uses naturally occurring data to study Dark Energy, Inflation using the CMB, search for Dark Matter particles and the Dark Ages.

Come and visit the DOE Office of Science Booth in the Exhibit Hall to learn more!

Scientific Areas are intertwined: High Energy/Particle Physics, Cosmology, Astrophysics, and Astronomy.



DOE supports ~ 85% of the U.S. HEP effort (in \$) at Universities + National Labs

Office of Science

[Energy.gov/science](http://Energy.gov/science)

# NSF-DOE Vera C. Rubin Observatory HEP/Cosmic Frontier roles

The NSF-DOE Rubin Observatory is the flagship project for the DOE/HEP Cosmic Frontier.



## Primary roles

- Construction phase: LSST Camera – shipped from SLAC to Chile in May 2024; will be mounted on Simonyi telescope in Feb.2025
- Operation's phase: U.S. Data Facility at SLAC

# Funding □ Notices of Funding Opportunity (NOFO) for research efforts at: <https://science.osti.gov/grants/FOAs/Open>

**Office of Science “Open Call” and “Early Career”:** research grants  
-- Check for specific High Energy Physics focus areas and for due dates

## Support for Broadening Participation

*RENEW (Reaching a New Energy Sciences Workforce)* - opportunities for historically underrepresented groups in STEM; internships, training programs, and mentor opportunities. <https://science.osti.gov/Initiatives/RENEW>

*FAIR: (Funding for Accelerated and Inclusive Research)* – for undergraduate students and faculty  
<https://science.osti.gov/Initiatives/fair>

## Workforce Development Programs

see <https://science.osti.gov/wdts> - workforce development

- Work at a DOE lab: Community College Internships (CCI); Science Undergraduate Laboratory Internships (SULI); SC Graduate Student Research fellowships (SCSGR); Visiting Faculty Program; Albert Einstein Distinguished Educator Program (K-12)
- DOE Scholars Program <https://orise.ornl.gov/doescholars/> - work at DOE or a lab

We are so excited watching Rubin come together...and ready to start data-taking this year!





# NSF Funding Opportunities for Rubin/LSST

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1. Primary Grants Programs
  - CAREER
  - Astronomy and Astrophysics Postdoctoral Fellowships Program (AAPF)
  - Astronomy and Astrophysics Research Grants Program (AAG)
2. Simonyi-NSF Scholar Awards - 50/50 split: Simonyi donation / NSF
  - Support proposals from early-career scientists with focus on Rubin science, including theoretical work and simulations
  - Now, supporting 14 Simonyi-NSF Scholars with \$6 million (FY 2023 and 2024)
  - For FY 2025, \$2 million available for support
  - For FY 2026, expect funding to continue
3. Rubin Operations support at about \$75 million/year total, split roughly equally between NSF and DOE.



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