

# Operations Boot Camp

Tuesday 13 OCT 2020, 08:00 PDT

Rubin Observatory

Session Webpage: [Confluence](#)

Slack Channel: #rubinops-bootcamp



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- Please, respect the Rubin Observatory [code of conduct](#) and note we are recording.



Rubin adheres to the principles of Kindness, Trust, Respect, Diversity and Inclusion in order to provide a learning environment that produces rigor and excellence.



Any discriminatory behavior against colleagues on any basis, such as gender, gender identity, race, ethnic background, national origin, religion, political affiliation, age, marital status, sexual orientation, disabilities or any other reason will not be tolerated.



If I witness any form of bullying, harassment or aggression I will follow the reporting instructions in the Code of Conduct.



**All talks at this workshop will be recorded.**

If you do not wish to be recorded, you are welcome to keep your camera off.



**Videos are posted the next working day.**

Each session will be posted on YouTube and embedded on the session's page.



**Give Slack questions a thumbs-up.**

Questions with more thumbs up may get priority if time runs short.



**Show your appreciation.**

Feel free to applaud at any time but especially at the end - Slack has a clap emoji.

## Part 1: Introduction to Rubin Observatory Operations

Amanda Bauer, Chuck Claver, Leanne Guy, Zeljko Ivezic, Phil Marshall, Wil O'Mullane, Bob Blum



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Welcome!

This boot camp serves two main goals

- 1) to make a brief introduction to Rubin Operations for staff and collaborators who may not be familiar with the current plans for operations and
- 2) deliver hands on and more detailed information for individuals working on operations activities in 2021.

This is to be a workshop format with questions/discussion and hands on sessions. Full “Survey Operations” is still ~3 years away but the pre-Operations is up and running building (and deploying) the operations plan!

**Bob Blum**, Director, Rubin Observatory Operations

**Amanda Bauer**, Deputy Director (NOIRLab) and Associate Director (AD) for Education and Public Outreach (EPO)

**Phil Marshall**, Deputy Director (SLAC)

**Chuck Claver**, AD for Observatory Operations

**Leanne Guy**, AD for System Performance

**Željko Ivezić**, Head of Science for Rubin's LSST

**William O'Mullane**, AD for Data Production



# Rubin Observatory

Intro to Operations In Four  
Slides  
5 minutes



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- Replanned Operations for COVID19 and US DF
- Replan assumes 1 year delay in construction. We will adapt the plan based on MREFC re-baseline and evolution from there (FY21 not an issue).
- Rubin Construction builds the system, completes it (based on detailed completeness criteria), and hands it over.
- Operations receives the system and runs it.
- Operations Readiness is based on a robust Ops plan and filled staffing profile in time for operations start.
- Working closely with SITCOM on Construction Completeness criteria and Operations readiness and coordination of activities generally with Construction

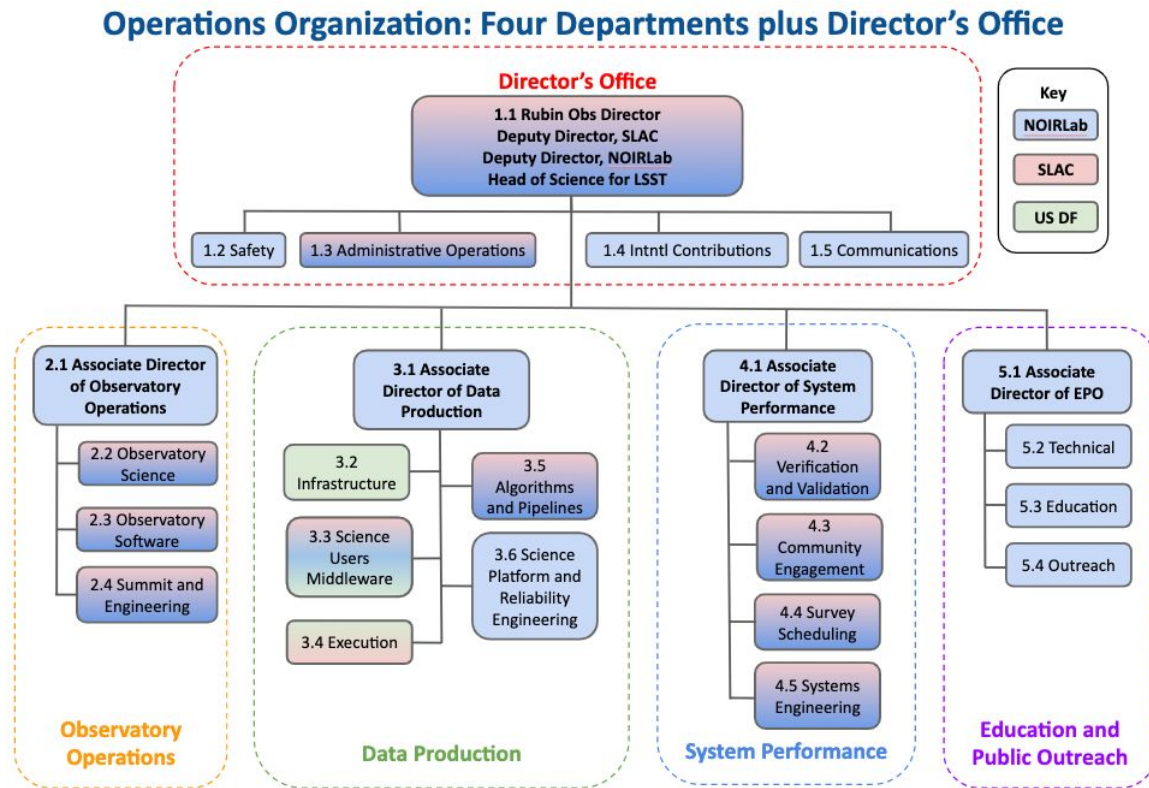
- Rubin Operations is a NOIRLab “program” (like Gemini) on the NSF/AURA side. On the DOE side, Rubin is SLAC’s highest priority HEP experiment, consisting of Rubin Observatory as the facility generating the LSST data, and LSST DESC the collaboration analyzing it.
  - Near term: on-boarding staff (SLAC and NOIRLab) and planning for NOIRLab IT Ops, CEE integration
  - Working with Victor and NOIRLab leadership to communicate trajectories of MREFC staff going to Rubin Ops and to NOIRLab.
  - Rubin Operations NSF funding proposal to go in with NOIRLab in December, 2021. [Full Plan with DOE activity approved at the same time.](#)
  - DOE Lab staff ramping up in their roles, funding managed by SLAC





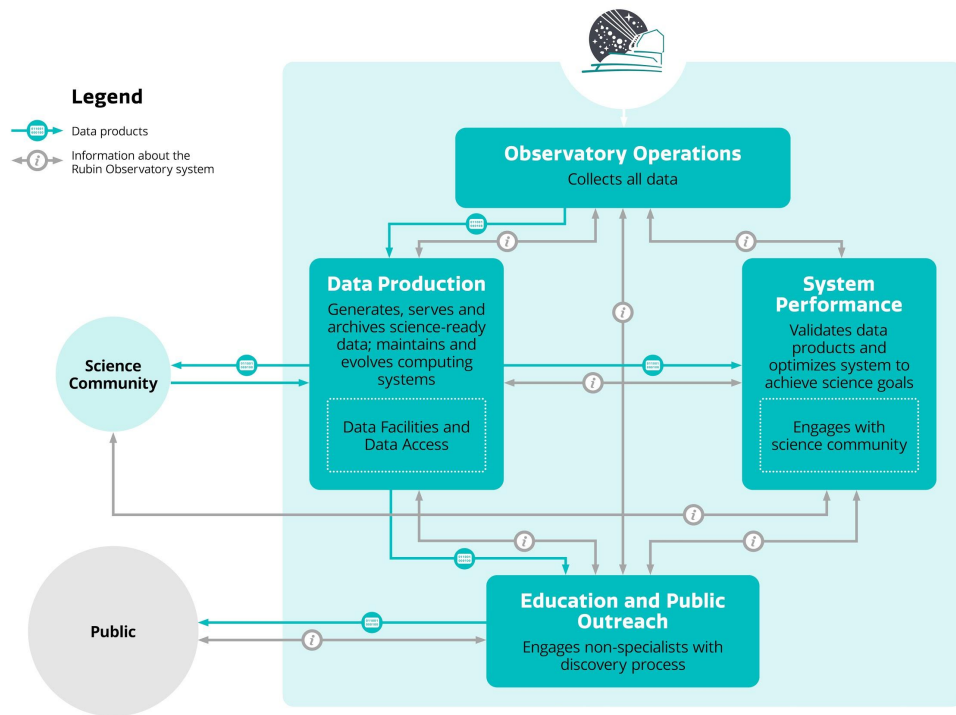
The Rubin team retains key expertise from construction, the operations partners and their affiliate institutions provide additional experience

- Leadership is initially weighted towards construction staff moving to NOIRLab
- DOE Labs add experience from LSSTCam (SLAC and BNL), FGST & LSST DESC (SLAC), DES (Fermilab)



# Rubin Operations Primer: The information flow through the Rubin system drives the design of its management structure

1. **Observe** sky relentlessly
2. **Produce data**
  - Check results
  - Emit Alerts
  - Release catalogs
3. Support community and learn from them, **Optimize** survey and system
4. Involve and inform the **public**



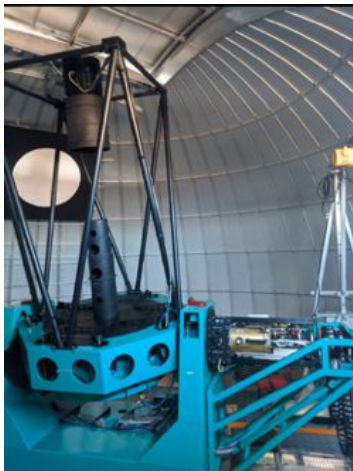
# Observatory Operations (ROO) 5 minutes



- Planning and executing daily and nightly activities, including procedures for “on-the-fly” decisions to adapt to evolving environmental conditions;
- Collecting, managing and transferring survey, calibration, engineering and environmental data from the summit to the Data Center;
- Real-time assessment and diagnosis of the raw data quality;
- Real-time tracking of survey progress metrics;
- Monitoring, maintaining, servicing and optimizing the operation of the telescope, camera, site software and other support equipment.

# Observatory Operations Facilities

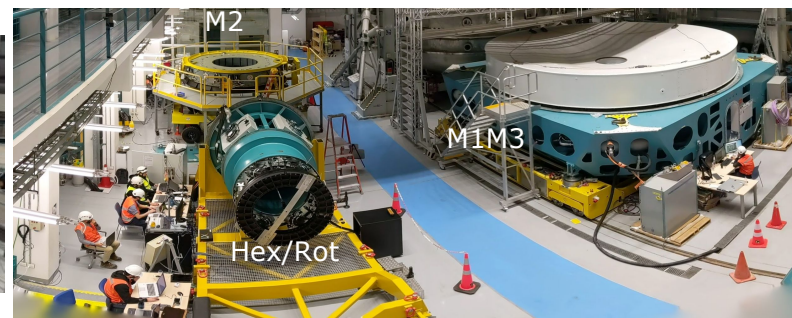
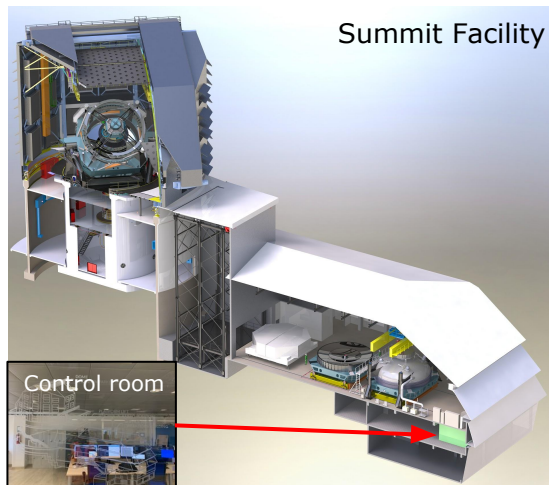
- Summit Facility Complex
- Atmospheric Characterisation Telescope
- Environmental Monitoring Systems
- Site infrastructure





# Observatory Technical Summary: Summit Facility & Telescope

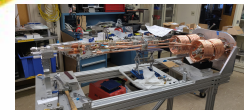
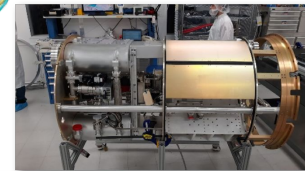
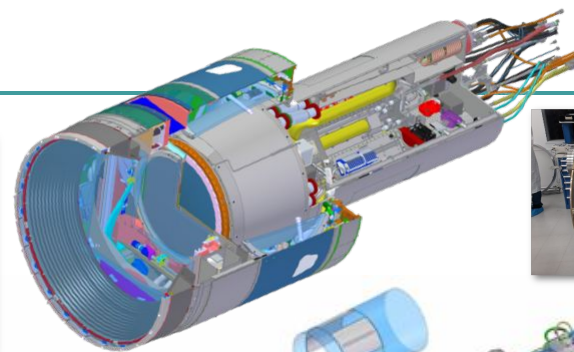
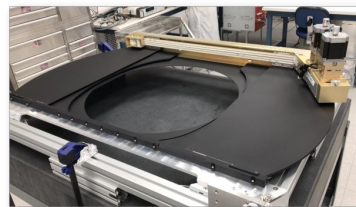
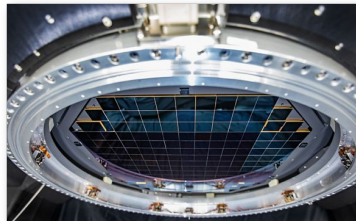
- 8.4m 3-mirror Telescope
  - Telescope Mount Assembly
  - 2 active mirror support systems
    - M1M3 (156 actuators)
    - M2 (72 actuators)
  - 2 actuated alignment systems for M2 and Camera
- Mirror coating plant
- Multiple utility systems
  - TMA high pressure oil supply
  - Coolant supplies
  - Electrical and backup systems
- Dome
- In-dome Calibration Systems





# Observatory Technical Summary: LSSTCam

- Focal plane uses 21 “rafts” of 3x3 sensors each
  - Two spare rafts for operations
  - Summit Facility includes lab space for servicing if need be
- Three key mechanisms
  - Shutter mechanism
  - Filter changer
  - Filter selection carousel
- Focal plane assembly uses two zones of refrigerated cooling
  - “Cold” to remove electronics heat
  - “Cryo” to hold sensors at operating temperature
  - Refrigeration uses 8 compressors
    - 2 “cold”
    - 6 “cryo”

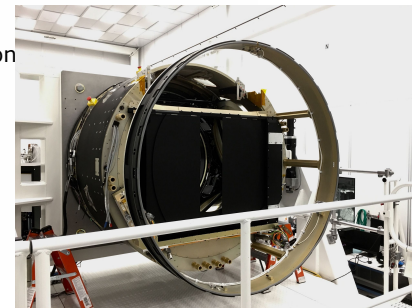


Refrigeration and  
Utility systems

Filter selection  
carousel

Shutter mechanism

Filter changer

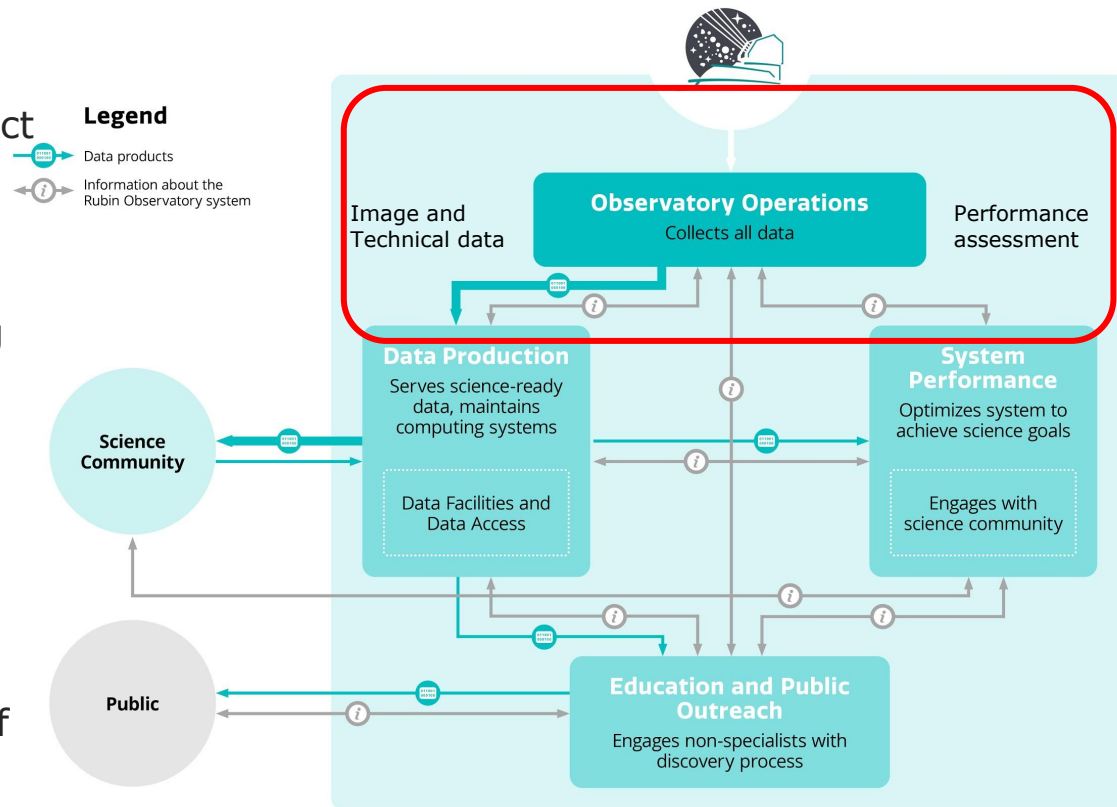


LSSTCam components needing routine operational support + maintenance

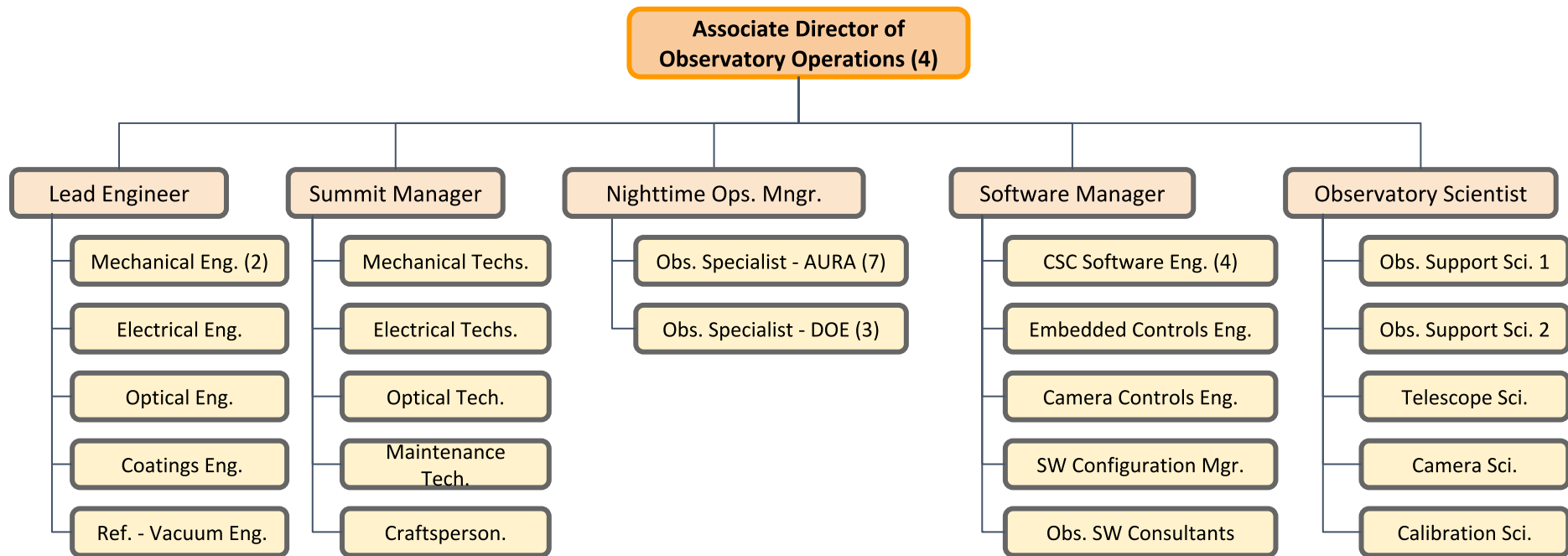
# Cross-Department Interactions

Our primary mission is to reliably and efficiently collect the environmental and survey data and deliver these data to the other departments for processing into science data products.

Cross-department interactions provide the necessary feedback to Observatory Operations to make improvements in efficiency and the quality of the survey data.



# Observatory Operations Organization



This structure is still under development, but is unlikely to change significantly.

# Rubin Observatory

Data Production (RDP)  
5 minutes



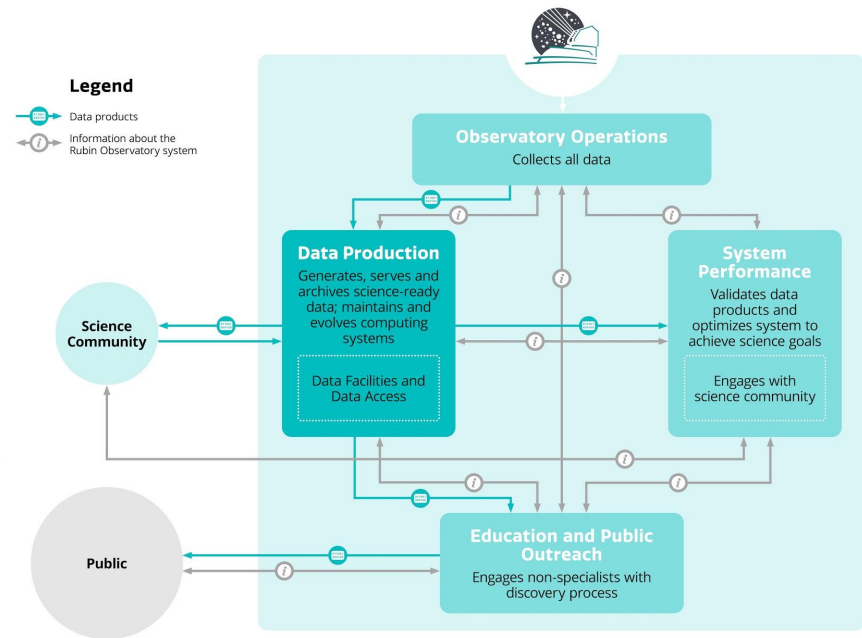
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# What is Data Production?

Deliver the science data products defined in LSE-163 to the community...

Will work with:

1. Observatory Operations to make sure the observations are good
2. System Performance to make sure we will meet science goals
3. EPO to communicate our successes



...and maintain & improve software and hardware systems

# Data Production Activities (I)

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- Receipt and archiving of scientific, calibration, and telemetry data from the Summit Facility on Cerro Pachón;
- Generation of Prompt Data Products, and distribution of those data products to the community;
- Generation of Periodic Data Releases, and distribution of those data releases to the community; After SP validation and DRB approval
- Archiving and preservation of all data products;
- Providing access to data products through the Science Platform (both via interactive user interfaces and via an API), the Bulk Download Service, and the Alert Filtering Service.



## Data Production Activities (II)

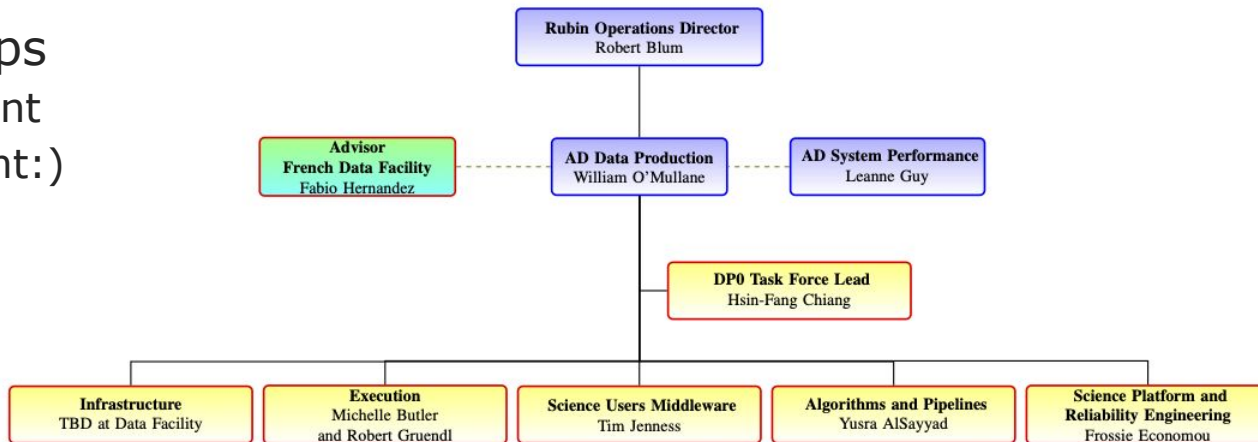
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- Develop and maintain the networking, compute, and storage systems which are used to acquire, transport, process, and store Rubin Observatory data.
- Develop and maintain the science data processing pipelines which are used to generate Rubin Observatory's data products, including:
  - Algorithm improvements/efficiencies taking account of new hardware
  - New capabilities and data products e.g. potential third party products built into the production run
  - Servicing requests from the System Performance department.
- In general keep abreast of technologies which may improve cost effectiveness or scientific productivity e.g. evolution of cloud offerings, new processors, new data techniques.

## Data Production Activities (III)

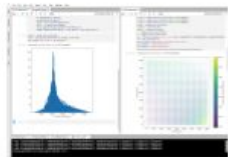
- In conjunction with the **System Performance** department:
  - Provide documentation for data products & software (**Community Engagement**)
  - Perform quality assessment of data products during processing and before release (**Verification & Validation**)
  - Develop & improve operational procedures (**Systems Engineering**)
- In conjunction with the **Observatory Operations** department:
  - Plan daytime calibration observations (**Observatory Science**)
  - Prioritize calibration and engineering activities (**Observatory Science**)
  - Monitor and potentially improve summit hardware performance
- In conjunction with the **Education & Public Outreach** department:
  - Ensure images and catalogs are available for **EPO**
  - Ensure citizen science is supported (image cutout, potential scrubbing and transfer to cloud)

- 5 teams for ops
  - 6 if you count management:)
- Advisors from facilities
- Strong link to System performance



- This is not set in stone its the first attempt at an ops structure which is not just DM construction
- For the initial preops DP0 is treated as a special task force

# Cyber Infrastructure Model, Petabytes to Science



Teams structured imprecisely  
following the  
cyberinfrastructure model

Notebook

Cmd Line

Portal

Alert Filtering

Pipelines

TopCat/Other

Developer Services

Execution, Users

## ASTRONOMICAL DOMAIN ENABLING SERVICES

Astro APIs (UWS, TAP+ etc.), Data Access (Butler, Rucio) Identity/Group services, AstroPy

Reliability, Pipelines

## SYSTEM SOFTWARE AND COMPONENTS

Helm/Terraform, Kubernetes, Pegasus, Condor, Docker, CDN, Jupyter Hub, Jenkins CI

Middleware

## HARDWARE RESOURCES

Compute (HPC, GPU), Storage, Database services

Infrastructure

Rubin IT

See Bauer et al, 2019 (2019arXiv190505116B)

# Rubin Observatory

System Performance (RPF)  
5 minutes



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Rubin Observatory System Performance department is responsible for ensuring that the LSST as a whole is proceeding with the efficiency and fidelity needed to achieve its science requirements at the end of the 10-year survey.

Includes the Wide-Fast-Deep (WFD) survey and all Special Programs (deep drilling fields and mini surveys)

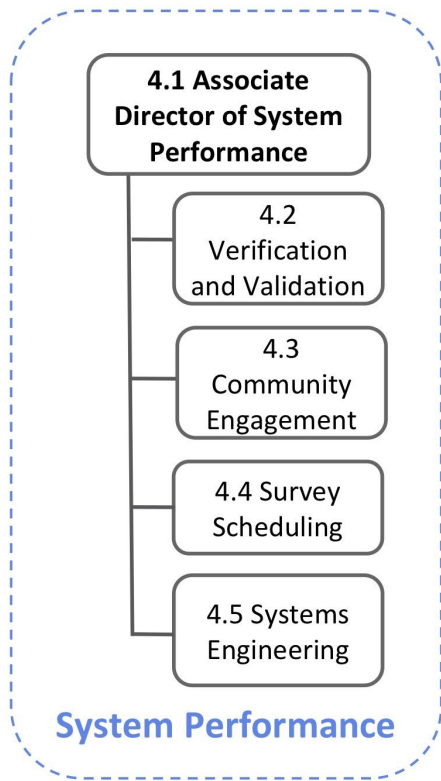


- Tracks and optimises the performance of the entire system including the:
  - performance of the observatory and the progress of the survey with respect to its science objectives
  - evaluation of strategies for improving the survey strategy,
- Provides QA and performance characterization analyses, and user feedback to the Data Release board as input to the assessment of Rubin Observatory's schedule to make annual data releases.
- Enable the community to access and analyze the data and publish results on the four LSST science pillars at an appropriate rate,

- Ensuring that survey progress is on track and that the survey strategy maximizes scientific output of the data products.
- Assessing, tracking and documenting the data product quality, assuring that the data products meet scientific requirements using SDQA and other tools.
- Providing QA and performance characterization analyses, and user feedback to the Data Release board as input to the assessment of Rubin Observatory's schedule to make annual data releases.
- Validation of the capability of the Science Platform to enable scientific analyses of the LSST data.

- Providing resources to support the community's scientific use of, and access to, the data products and services (e.g., documentation, user forums)
- Serving as the main interface with the scientific community (e.g., ingest, triage, and respond to feedback and help requests; represent project at conferences).
- Coordinating expertise from across The System (project and community) to resolve issues related to the scientific productivity.
- Overseeing committees that represent User interests and evaluate users' proposals for computing time with limited Science Platform resources.
- Assessing whether deliverables (data products and services) are science-ready and usable by the scientific community.

- Assessing observatory system performance and feeding this information back into the survey strategy.
- Oversight and implementation of Change and Process control through a Change Control Board (CCB) Chaired by the Chief Systems Engineer, including risk and opportunity management.
- Acting as the product owner of Rubin Observatory LSST Survey, its science data products and the Science Platform.



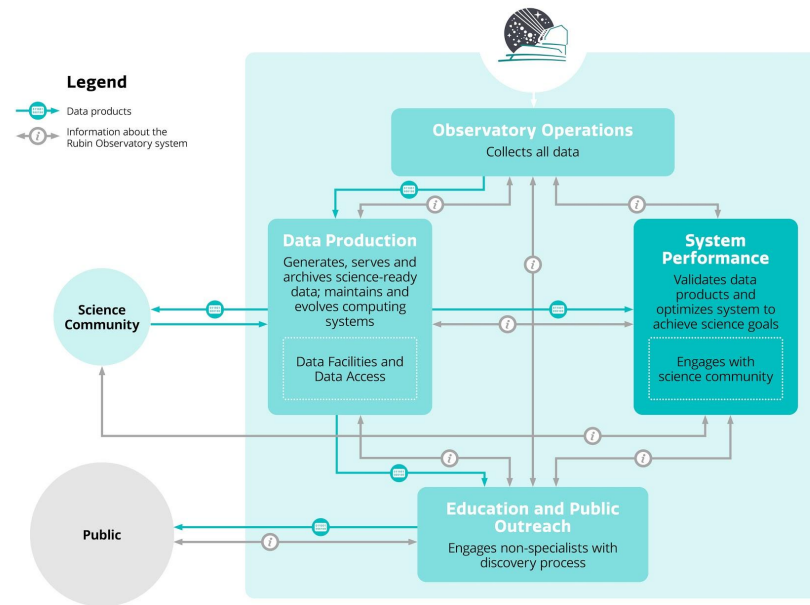
The System Performance department is an outward-facing and forward-looking department built around four teams:

- Verification and Validation – [Lead: Colin Slater](#)
- Community Engagement – [Lead: Melissa Graham](#)
- Survey Scheduling – [Lead: Lynne Jones](#)
- Systems Engineering – [Lead: Austin Roberts](#)

Leadership team includes the leads of each of these teams

# Key Inter-Department Activities

- Provision of updated scheduler software by the Survey Scheduling team to **Observatory Operations**,
- Communication of issues identified with data products, software deliverables, or RSP functionality from the Community Engagement team to **Data Production**,
- Development of user-facing scientific documentation with **Data Production**,
- Management and advice on processes and maintenance plans across **all departments** by the Systems Engineering team.
- Support the preparation of curated datasets for the general public with **Education and Public Outreach**

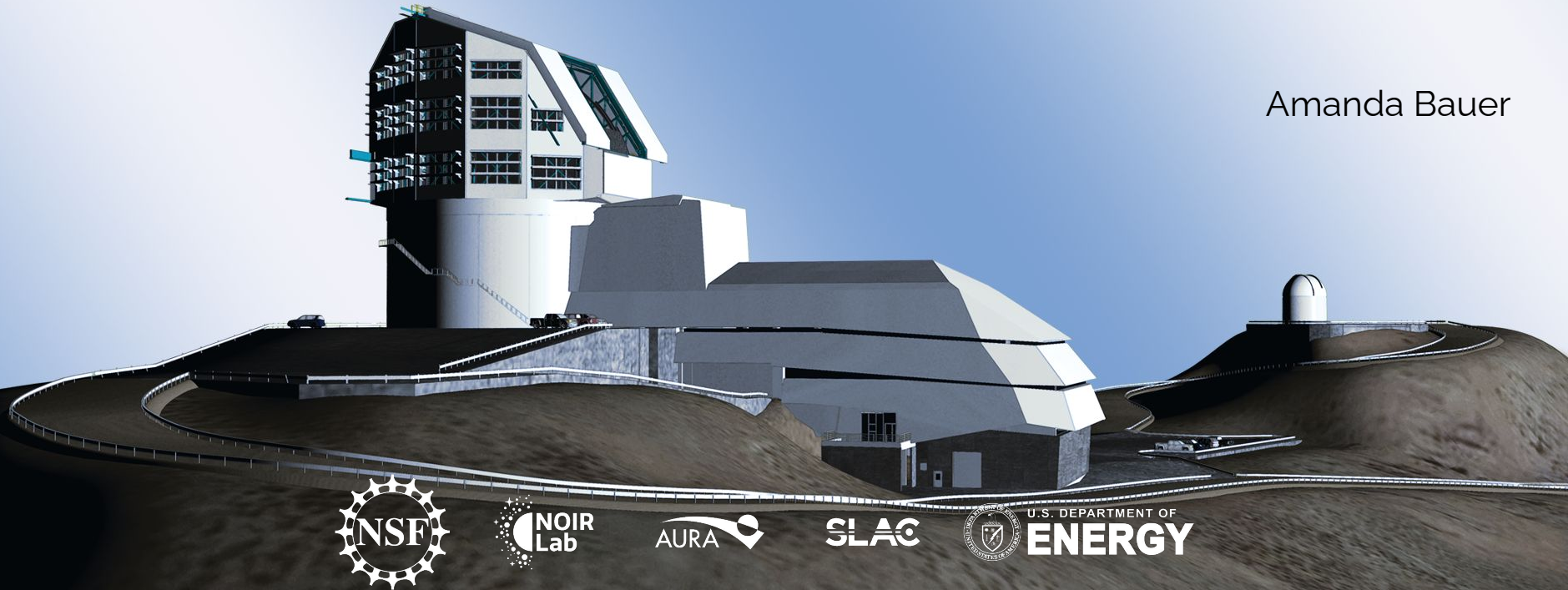




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# Education and Public Outreach (REO) 5 minutes

Amanda Bauer



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Rubin Observatory **EPO**'s mission is to offer accessible and engaging online experiences that provide non-specialists access to, and context for, LSST data so anyone can explore the Universe and be part of the discovery process.



Photo: Gianluca Lombardi (Gemini)

# Our Novel Approach to EPO

## Accessible

Designing specifically for the general public - not simply providing public access to professional research tools



Widgets to provide intuitive, non-intimidating interactions directly with the data; Skyviewer to explore all-sky images and recent discoveries

## Interesting

Providing narratives so data has context and meaning relevant to general experiences



News about exciting discoveries; curated Alert Stream highlights; profiles of people involved with Rubin Observatory

## Engaging

Encouraging discovery of new ideas and interactions by linking experiences across the website



Promotion of Citizen Science projects; images and features shareable directly on social media; videos about Rubin Observatory and science

## Capable of Reaching a Large Audience

Creating an online program adds potential to reach anyone with a cell phone and can support content creators everywhere



Online investigations and support materials for use in any classroom; free multimedia resources for all science centers; exploration for everyone

## Formal Education Program

Suite of classroom investigations that enable students to work with real LSST data

## Website & Skyviewer

Operations site to communicate science discoveries and all-sky viewer to explore the survey

## Citizen Science Infrastructure

Pipelines and project templates to enable the easy creation of citizen science projects

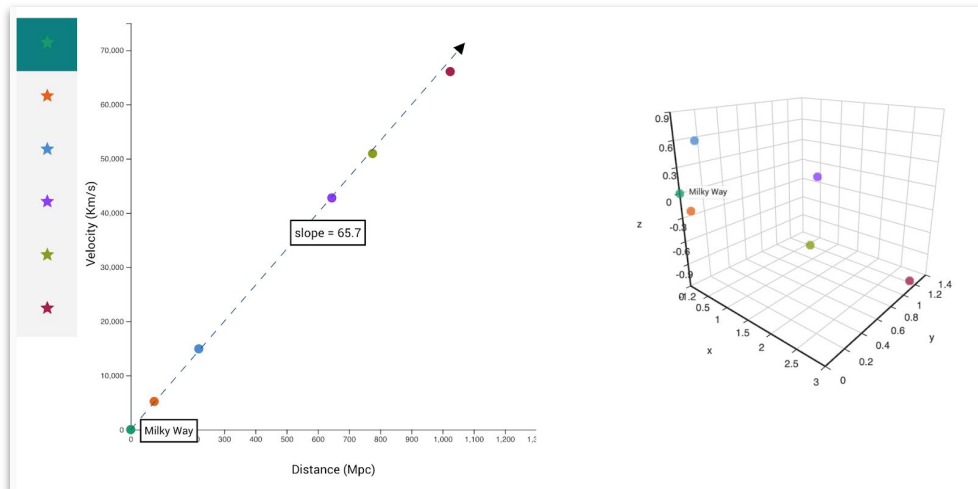
## Multimedia Gallery

Videos, graphics, & planetarium videos for use in talks, science centers, etc.

# Interactive Widgets

**Browser-based tools** for directly interacting with real astronomical data, designed around actions familiar to a typical web user

Can be used throughout our classroom activities but also the website in general **to transform a passive experience**, like reading an article, **to an interactive one** where people can explore LSST data themselves



Go play with demos of these tools!  
<https://epodemo.netlify.app>



# Rubin Observatory

In-kind Program  
5 minutes



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# The Rubin In-kind Program replaces the old international funding model, and brings new resources to the US science community

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- ~40 teams from outside the US and Chile have proposed to make in-kind contributions of telescope time, complementary datasets, computing resources and software development effort in return for LSST data rights
  - (This in-kind contribution program replaces the old “pay to play” model.)
- Rubin staff (the International Program Coordinators Greg Madejski, Knut Olsen and Steve Ridgway) are currently reviewing proposals for [Handbook](#) compliance and technical feasibility; Rubin’s Contribution Evaluation Committee (CEC) will then carry out a scientific value review (Nov through Feb)
- Contributions expected to start FY22 (or even earlier) following Rubin recommendation and US agency approval

## Rubin Operations will include several in-kind contributions, both as cost offsets and facility enhancements

- **UK Data Facility** proposes to take on ~25% of the annual data release processing, coordinated with the US DF (~25%) and Fr DF (50%)
  - The UK also proposes to fill some staff roles, including an IPC
- **6 teams proposing to stand up Independent Data Access Centers** to form a network centered on the US DAC at the US DF and a US IDAC at NOIRLab. Most are “lite” IDACs (catalog only, no RSP requirement)
- Several teams proposing **software development effort, in A&P team.** *Rubin Coordination Groups in photo-z and crowded field topic areas* to help the community provide coherent improvements to the pipelines
- UK, Spain, Italy, Korea, Japan, all proposing **commissioning effort** (mix of summit staff and remote data analysis effort)

- **Software development effort in science collaborations** makes up significant fraction of proposed contributions
  - Gives SCs a much needed boost as they prepare to analyze LSST data
  - Working to enable US research proposals that refer to US in-kinds
- **Telescope time** (eg SALT, Subaru, open via NOIRLab TAC, or coordinated through AEON) and complementary surveys (eg ULTRASAT, VST). Data to be shared via IDAC network

All in-kind contributions must be “embedded” in a Rubin or LSST SC “recipient group”, that reviews performance: international collaborators will join a team and contribute.

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## Questions and Answers 20 minutes



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