



# Community Science with the Rubin Science Platform and Data Previews

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NOIRLab (Tucson, AZ)

NAM 2023



U.S. DEPARTMENT OF  
**ENERGY**

## Research Interests:

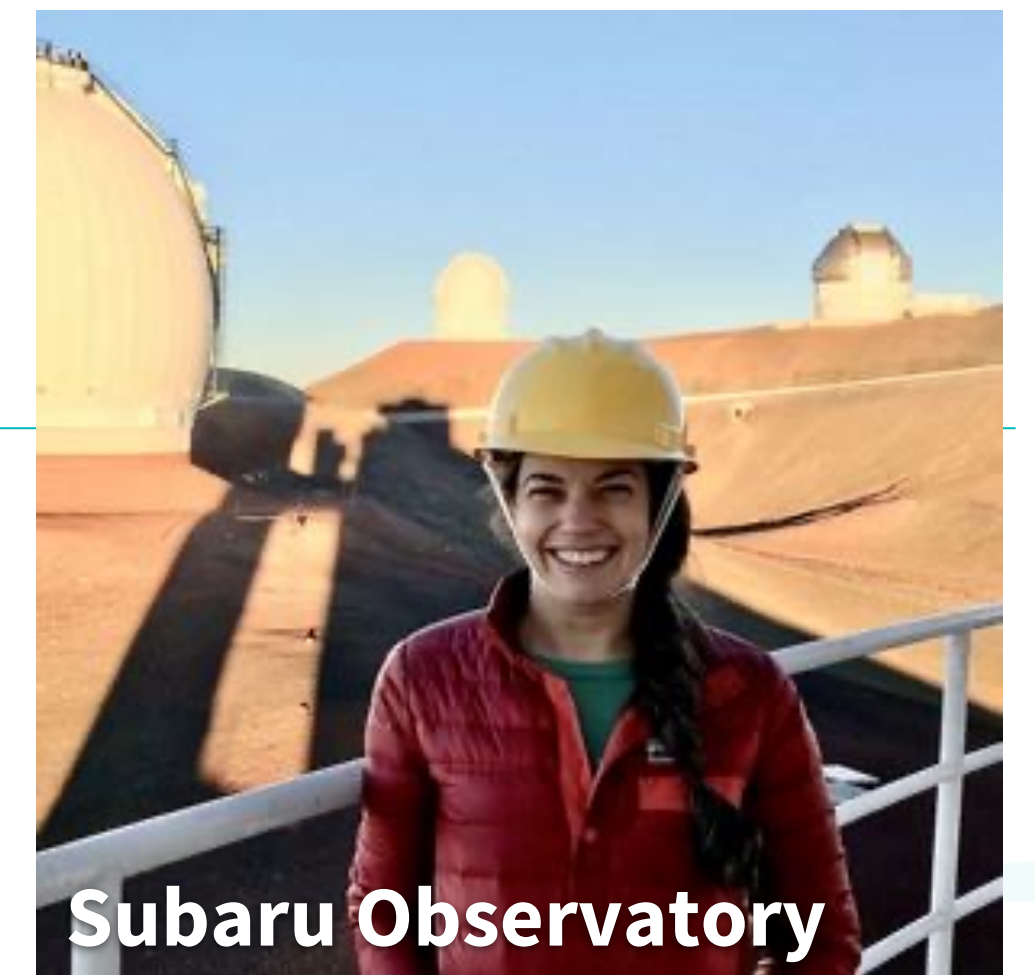
- Massive galaxy formation and evolution at high redshift ( $z > 1$ )
- Dusty star forming galaxies, elliptical galaxies, galaxy clusters
- Using telescopes on ground / in space from optical – submillimeter wavelengths

**Prior to joining NOIRLab:** University of Arizona / Steward Observatory

- JWST / Near-infrared camera (NIRCam) Instrument & Science team

**Now:** Assistant astronomer at NOIRLab / Rubin obs staff

- Rubin Community Science Team (CST) since August 2022
- Wide-area galaxy science with JWST  
P.I. of public PANORAMIC wide-area imaging survey at 1-5 micron



# Talk Overview

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- Rubin Science Platform (RSP): gateway to LSST and resources for researchers
- Latest updates to the Data Previews
- Rubin Early Science: Plans & Timeline
- How to get involved

*The UK is a key partner in Rubin Observatory Operations: now is the time to get involved and prepare for science using this unprecedented dataset!*

# Preparation for LSST

***A data set of unprecedented volume and complexity.***

*Billions of stars and galaxies.*

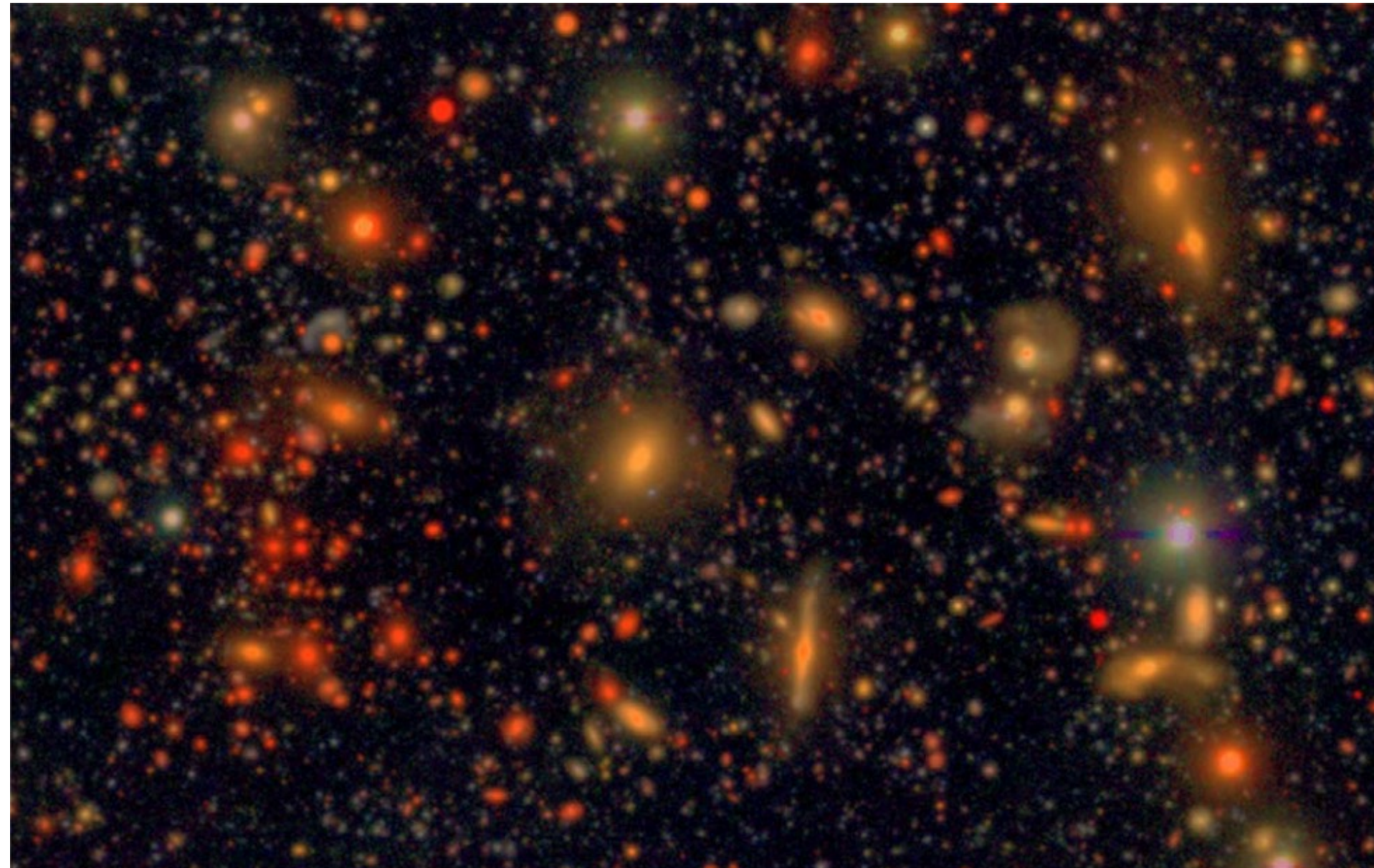
*Millions of transients, variables, and moving objects.*

*For these new challenges we need new tools.*



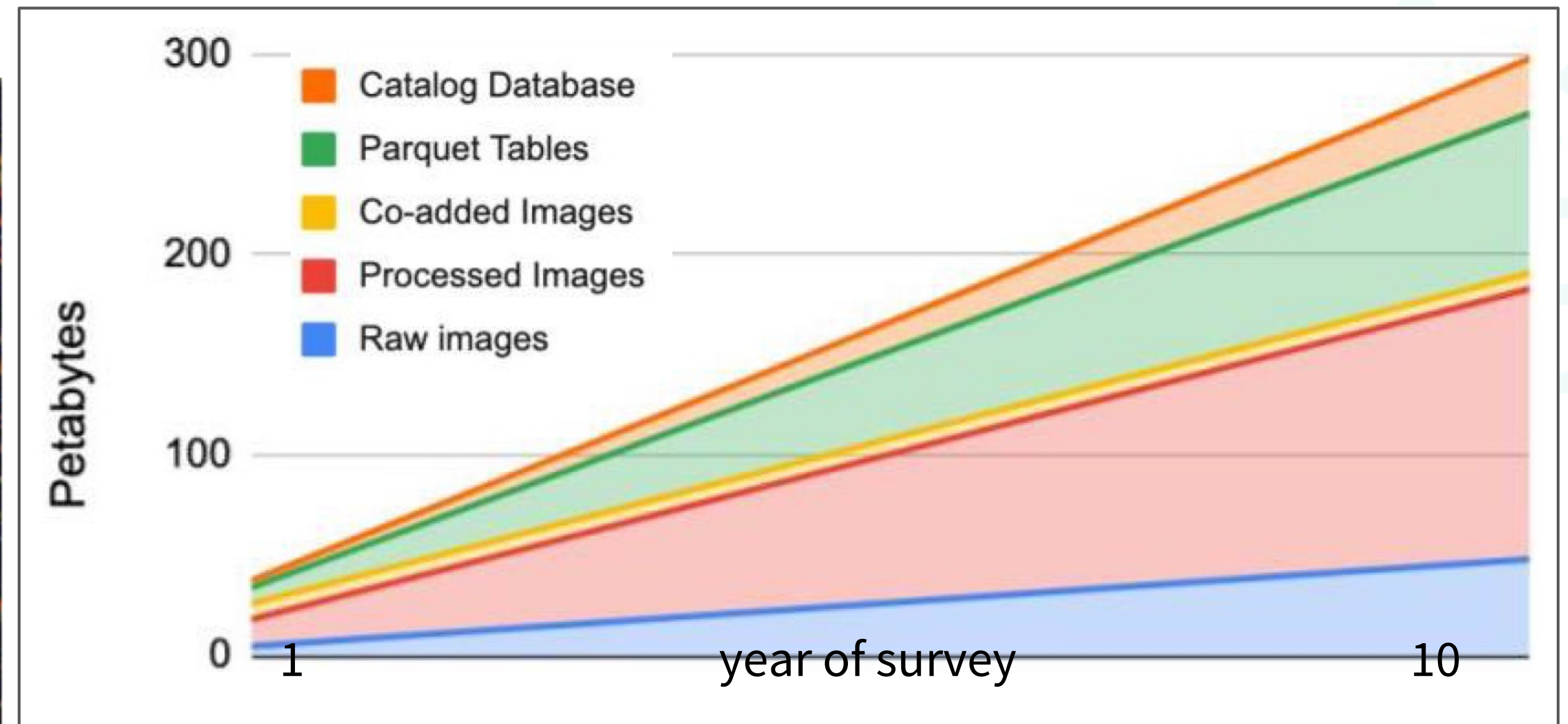
# Legacy Survey of Space and Time (LSST)

The final LSST 10-year sky map will be like having ~3 million of these, tiled over the entire southern sky.



Ivezić et al. 2019

The Rubin Observatory's total data holdings will start at ~40 PB and grow to ~300 PB over the 10-year LSST.



O'Mullane et al. 2021 (RTN-003.lsst.io)

# Rubin Science Platform (RSP)

It will not be possible to download the entire LSST data set, and scientists will need a venue for “**next-to-the-data analysis**”.

The **Rubin Science Platform (RSP)** is a set of integrated web-based applications and services running at the Rubin Observatory Data Access Centers (DACs).



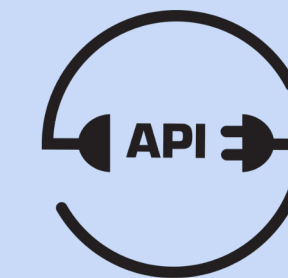
### Portal Aspect

exploratory analysis and visualization of the LSST archive



### Notebook Aspect

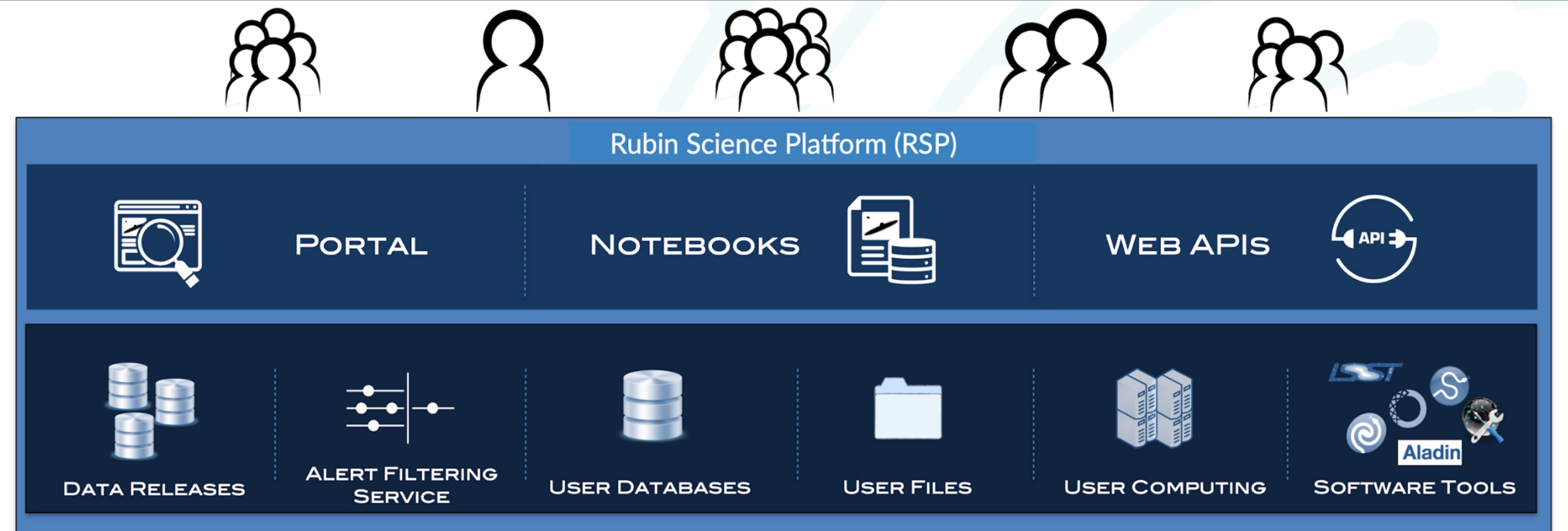
in-depth ‘next-to-data’ analysis and creation of added-value data products



### API Aspect

remote access to the Rubin archive via industry-standard APIs

The RSP will include tools to query, visualize, subset, and analyze the full LSST data archives in a stable software environment located “next-to-the-data”, along with storage space, compute resources, and remote access options.



# The RSP User Experience

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**Goal:** Democratize science by removing barriers to participation in LSST.

- abundant, discoverable documentation of the end-to-end system
- clear entry points and tutorials from beginner through advanced levels
- asynchronous, distributed, friendly support
- a stable software environment with compute resources
- prioritize research inclusion and seed expertise across the community
- enable anyone to become power user and push the cutting edge with LSST

DP0.2 HiPS Coverage Maps now available in the Portal 🎉

[Show more](#)

# Rubin Science Platform

## Portal

Discover data in the browser



[Learn more about the portal.](#)

## Notebooks

Process and analyze LSST data with Jupyter notebooks in the cloud



[Learn more about notebooks.](#)

## APIs

Learn how to programmatically access data with Virtual Observatory interfaces

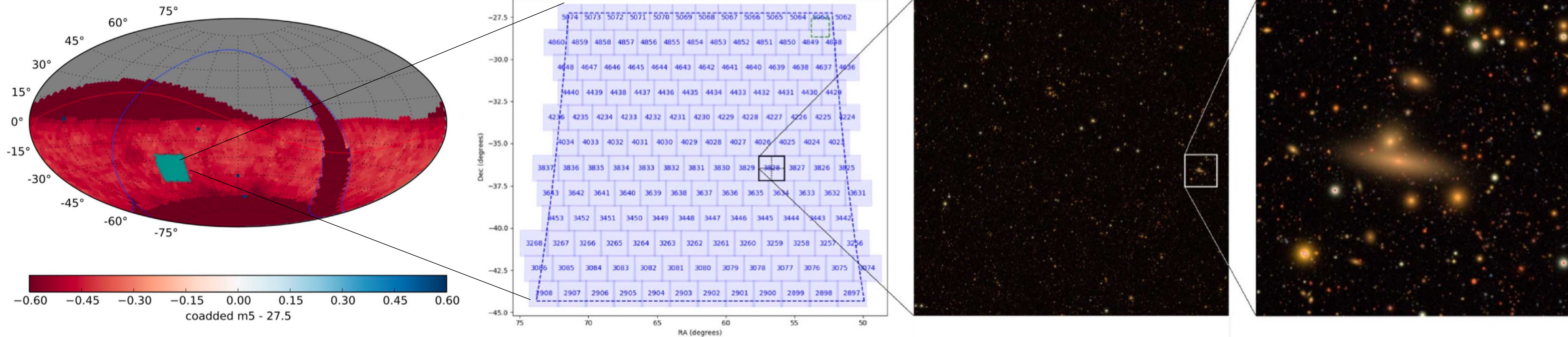




# RSP currently accesses DP0 (Data Preview 0) simulated data

Simulated LSST-like images and catalogs generated by the LSST Dark Energy Science Collaboration (DESC) for their Data Challenge 2 (DC2; [arXiv:2101.04855](https://arxiv.org/abs/2101.04855)).

**Simulated images** over 300 deg<sup>2</sup> for 5 years of an early baseline survey strategy in the wide-fast-deep (WFD) region (no deep drilling fields; non-rolling cadence).



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**Simulated astrophysical objects** in the WFD images include galaxies (with large-scale structure), Type Ia supernovae, and stars (10% are one of 3 types of variables).

**Imaging data products** include:

- processed visit images (PVIs), deep coadds, and difference images

**Catalog data products** include:

- SNR>5 detections and forced photometry in all image types

## What's in the Data Preview 0 (DP0) simulated dataset?

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**Phase 1: DP0.1** – The simulated DC2 data set, processed by the Dark Energy Science Collaboration using Version 19 of the LSST Science Pipelines (June 2021).

**Phase 2: DP0.2** – The same simulated DC2 data set but processed by the Rubin Data Management team using Version 23 of the LSST Science Pipelines (June 2022).

**Phase 3: DP0.3** – Simulated Solar System catalogs created by the Solar System Science Collaboration (led by Mario Jurić, coming soon in the summer of 2023).

# Future Data Previews and releases: the Path to Operations

<b>Rubin Early Data Release Scenario</b>	Jun 2021	Jun 2022	Jun 2023 - Sep 2023	Dec 2024 – Apr 2025	Aug 2025- Mar 2026	Feb 2026 – Nov 2026
<a href="https://lsst.org/scientists/early-science">lsst.org/scientists/early-science</a>	<b>DP0.1</b>	<b>DP0.2</b>	<b>DP0.3</b>	<b>DP1</b>	<b>DP2</b>	<b>DR1</b>
<b>Data Product</b>	<b>DC2 Simulated sky Survey</b>	<b>Reprocessed DC2 Survey</b>	<b>Solar System PPDB Simulation</b>	<b>First Light LSSTCam Data</b>	<b>LSSTCam Science Validation Data</b>	<b>LSST First 6 Months Data</b>
Raw images	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
DRP Processed Visit Images and Visit Catalogs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
DRP Coadded Images	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
DRP Object and ForcedSource Catalogs	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
DRP Difference Images and DIASources	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
DRP ForcedSource Catalogs including DIA outputs	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
PP Processed Visit Images	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
PP Difference Images	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
PP Catalogs (DIASources, DIAObjects, DIAForcedSources)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
PP SSP Catalogs	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
DRP SSP Catalogs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

# Alert production during the early science era

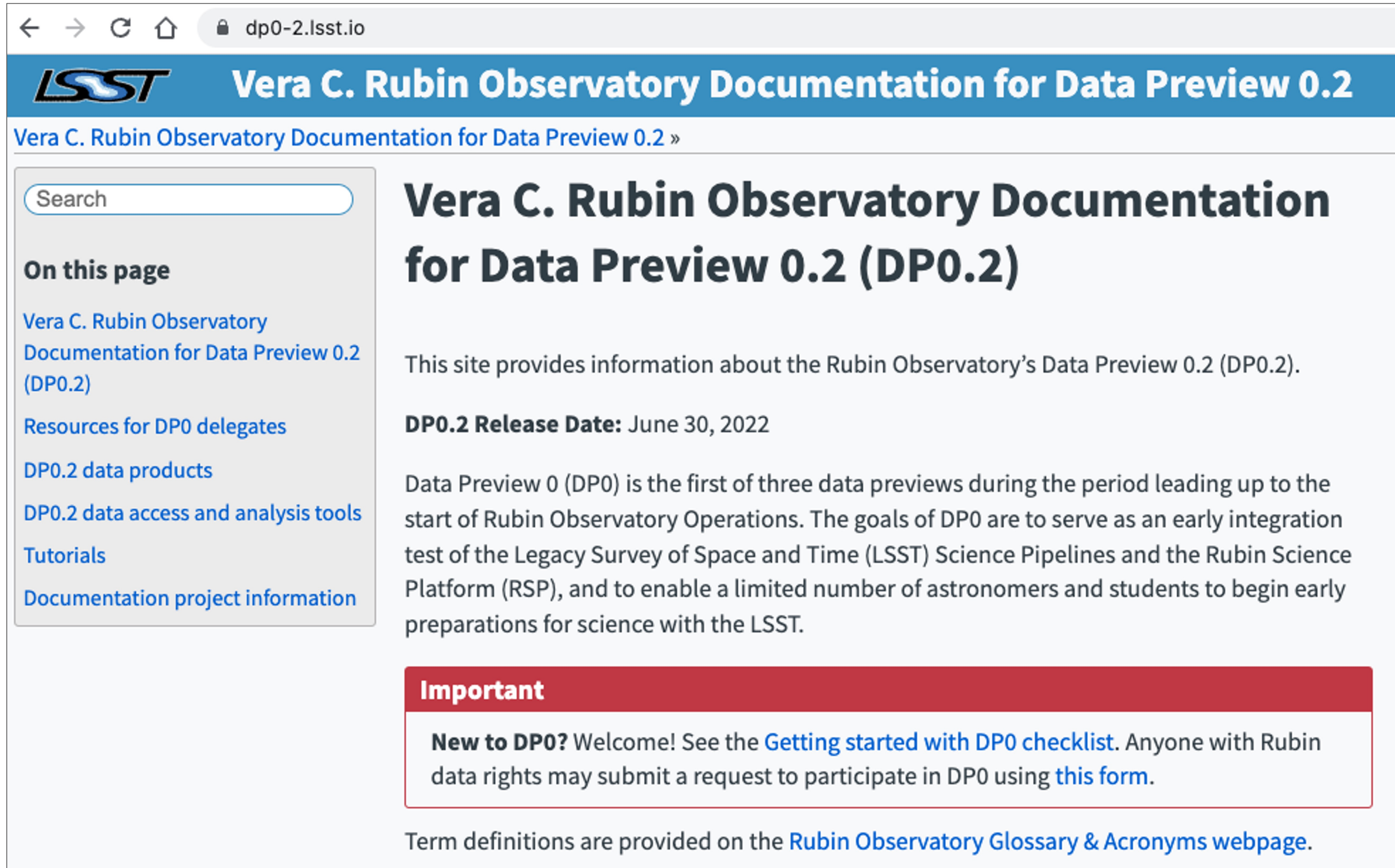
**Early science era:** up to and including DR1 (the release of the first 6 months of LSST data).

**The plan:** before DR1, begin alert production as soon as possible by generating templates from commissioning data, and then during year 1 generate templates *incrementally* (on-the-fly), for sky areas with sufficient data to produce and validate templates.

It is important to note that commissioning / incremental templates:

- might only exist for up to 10% of the sky by the end of commissioning (DP2)
- will be composed of at least 3 images (no single-visit templates)
- might not simply be the first 3 images, as templates must be validated
- might be of lower quality than operations-era templates (which require at least 5 images)
- will not be changed until the next data release

With fewer sky areas covered by templates there will be fewer alerts in the early-science era. Furthermore, alert production during early science will have a higher latency than 60 seconds.



The screenshot shows a web browser window with the URL [dp0-2.lsst.io](https://dp0-2.lsst.io). The page title is "Vera C. Rubin Observatory Documentation for Data Preview 0.2". The main heading is "Vera C. Rubin Observatory Documentation for Data Preview 0.2 (DP0.2)". The page content includes a search bar, a sidebar with navigation links, a main text block, and an important notice box.

**On this page**

- [Vera C. Rubin Observatory Documentation for Data Preview 0.2 \(DP0.2\)](#)
- [Resources for DP0 delegates](#)
- [DP0.2 data products](#)
- [DP0.2 data access and analysis tools](#)
- [Tutorials](#)
- [Documentation project information](#)

**Vera C. Rubin Observatory Documentation for Data Preview 0.2 (DP0.2)**

This site provides information about the Rubin Observatory's Data Preview 0.2 (DP0.2).

**DP0.2 Release Date:** June 30, 2022

Data Preview 0 (DP0) is the first of three data previews during the period leading up to the start of Rubin Observatory Operations. The goals of DP0 are to serve as an early integration test of the Legacy Survey of Space and Time (LSST) Science Pipelines and the Rubin Science Platform (RSP), and to enable a limited number of astronomers and students to begin early preparations for science with the LSST.

**Important**

**New to DP0?** Welcome! See the [Getting started with DP0 checklist](#). Anyone with Rubin data rights may submit a request to participate in DP0 using [this form](#).

Term definitions are provided on the [Rubin Observatory Glossary & Acronyms webpage](#).

[dp0-2.lsst.io](https://dp0-2.lsst.io)

DP0 is more than a data release; it is also an experience.

Documentation includes descriptions of the data and resources for delegates (virtual seminars, FAQ, etc.).

**Future work:** upgrades to the format and contents as we learn and receive feedback.

### DP0-Related Virtual Seminars

- Delegate Assemblies (biweekly, Fridays 9-11am PST)
  - presentations / tutorials by Rubin staff and delegates
- Stack Club (biweekly, Fridays 9-11am PST)
  - drop-in hack sessions with Rubin staff for individual or small group work
- Third Thursdays (monthly, 04:00 and 14:00 UTC)
  - drop-in “office hours” for the international community

### DP0 Delegate Feedback Surveys

DP0 Shared GitHub Repo for Code and Analyses ([delegate-contributions-dp02](#))

DP0 Virtual Summer School (June 2023; recordings are online)

Project and Community Workshop (Annual)

All resources are accessible starting at [dp0-2.lsst.io](https://dp0-2.lsst.io)



# Community Science

## The LSST community forum

community.lsst.org

**Community forum**

Welcome to the Vera C. Rubin Observatory LSST Community forum

This Community Forum is the main portal for community engagement and crowd-sourced support for science with the Rubin Observatory data products and services. Everyone is welcome to browse, ask questions, share knowledge, and discuss topics related to Rubin Observatory and the Legacy Survey of Space and Time (LSST).

all categories | all tags | **Categories** | Latest | Top | Bookmarks | Unread (34) | My Posts | + New Topic

Category	Topics	Latest
<b>News</b> News and announcements from Rubin Observatory.	137 3 unread	DM Status Report for June 2022 Data Management 0 2d
<b>Support</b> Community support venue for using the LSST software, services and data. Data Preview 0 3 unread   DP0 RSP Service Issues 2 unread Rubin Science Platform 1 unread   Camera   Lasair	555 17 unread	Rubin RSP Portal running very slowly 1 DP0 RSP Service Issues 6 2d
<b>Science</b> Public discussions about LSST science. Data Q&A   Statistics Q&A   Survey Strategy   Alerts & Brokers Early Science 1 unread   External Synergies Independent Data Access Centers   Photometric Redshifts Crowded Fields   Milky Way (Open) Project and Community Workshop 2022	370 4 unread	Lightcurve offset on difference images 5 Data Preview 0 dia, transients 8 2d
<b>Science Collaborations</b>	92	Deploying rubin-env 4.1.0 DM Notifications 1 3d
		DP0.2 Kick-Off Info Session slides & pre-recorded presentation Data Preview 0 dp0, announcements 0 3d

## Rubin Community Forum

*Most content is publicly viewable. Anyone may make an account to post new topics.*

Three main use-cases:

1. Q&A with Rubin staff.
2. User discussions.
3. Information distribution.

*A browsable searchable archive and a dynamic interactive platform.*

*Functionality includes notifications, direct messaging, user groups, and moderation.*





## Final Slide: Get involved in training and preparation for your own science with LSST!

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*The UK is a key partner in Rubin Observatory Operations, and UK scientists (**including students!**) can join as rights holders. Now is the time to get involved and prepare for science using this unprecedented dataset!*

Rubin DP0 Virtual Summer School was June 12-16, 2023  
Session recordings and activities are public:  
[ls.st/dp0-vss-2023](https://lsst.org/dp0-vss-2023)

Rubin Project and Community Workshop  
August 7-11, Tucson AZ (Free remote participation)  
<https://project.lsst.org/meetings/rubin2023/>

We are accepting new delegates! Tutorial notebooks, portal tutorials, and bi-weekly virtual seminars are available

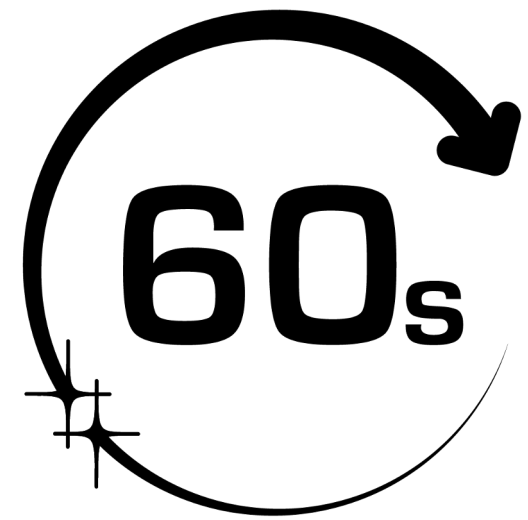
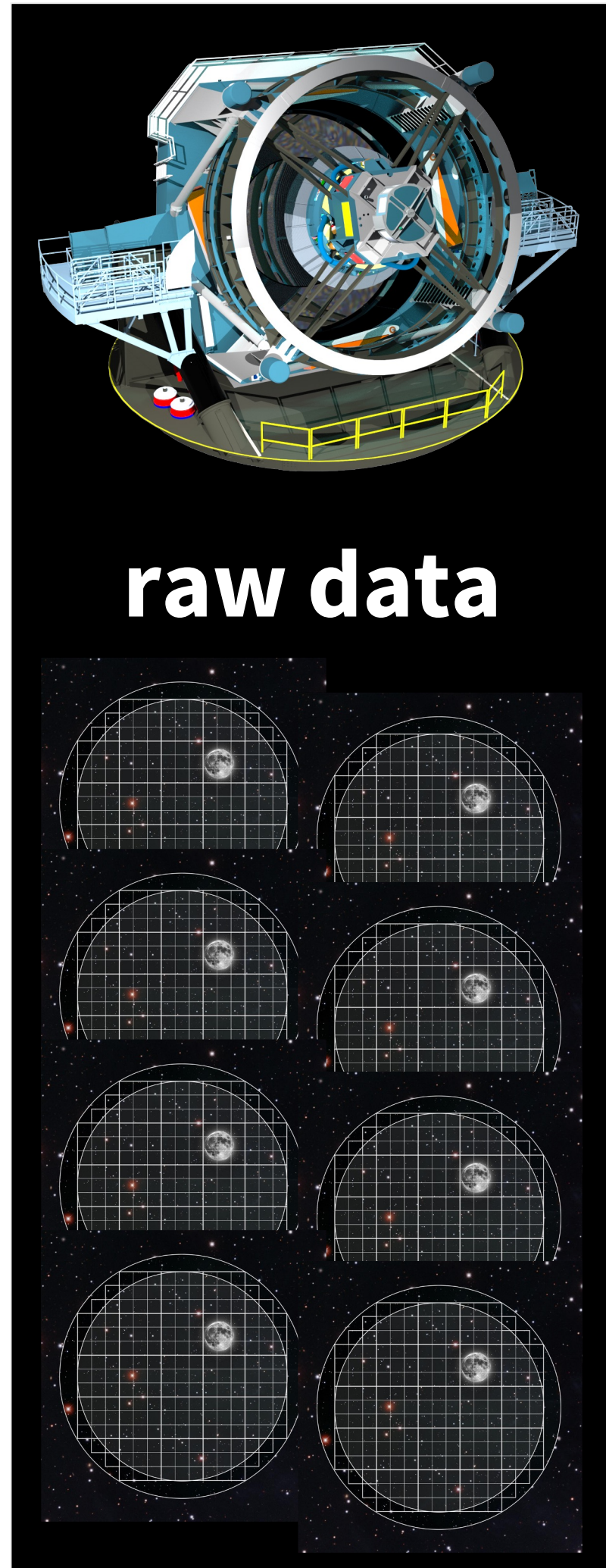
Scientists and students, visit [dp0-2.lsst.io](https://dp0-2.lsst.io) to obtain an account in the Rubin Science Platform and access the simulated data sets of Data Preview 0.

Join the discussion and receive news notifications in the Rubin Community Forum at [Community.lsst.org](https://community.lsst.org).

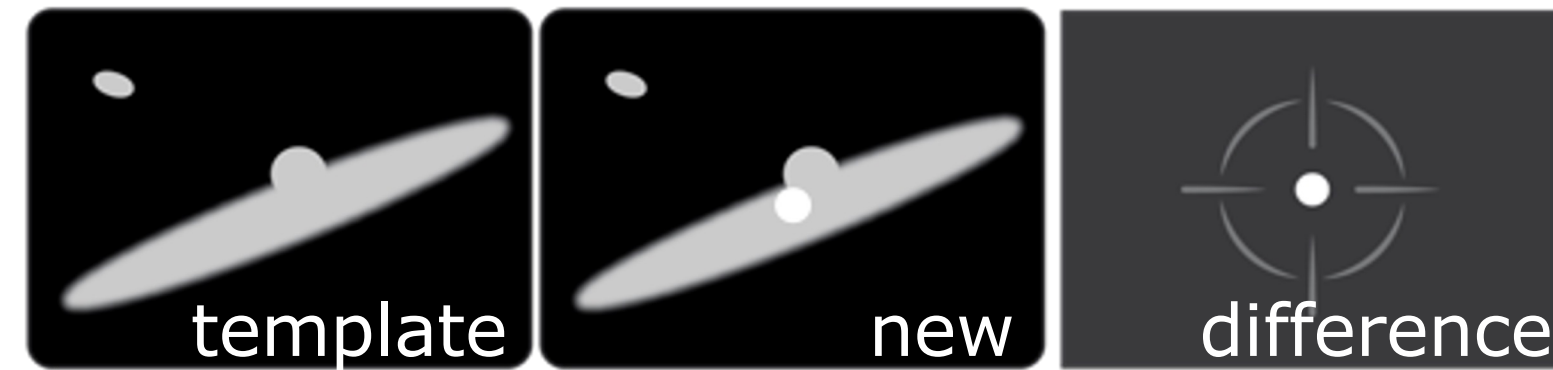
Visit [lsst.org/scientists](https://lsst.org/scientists) for News, Deadlines, and Events.

# Backup slides

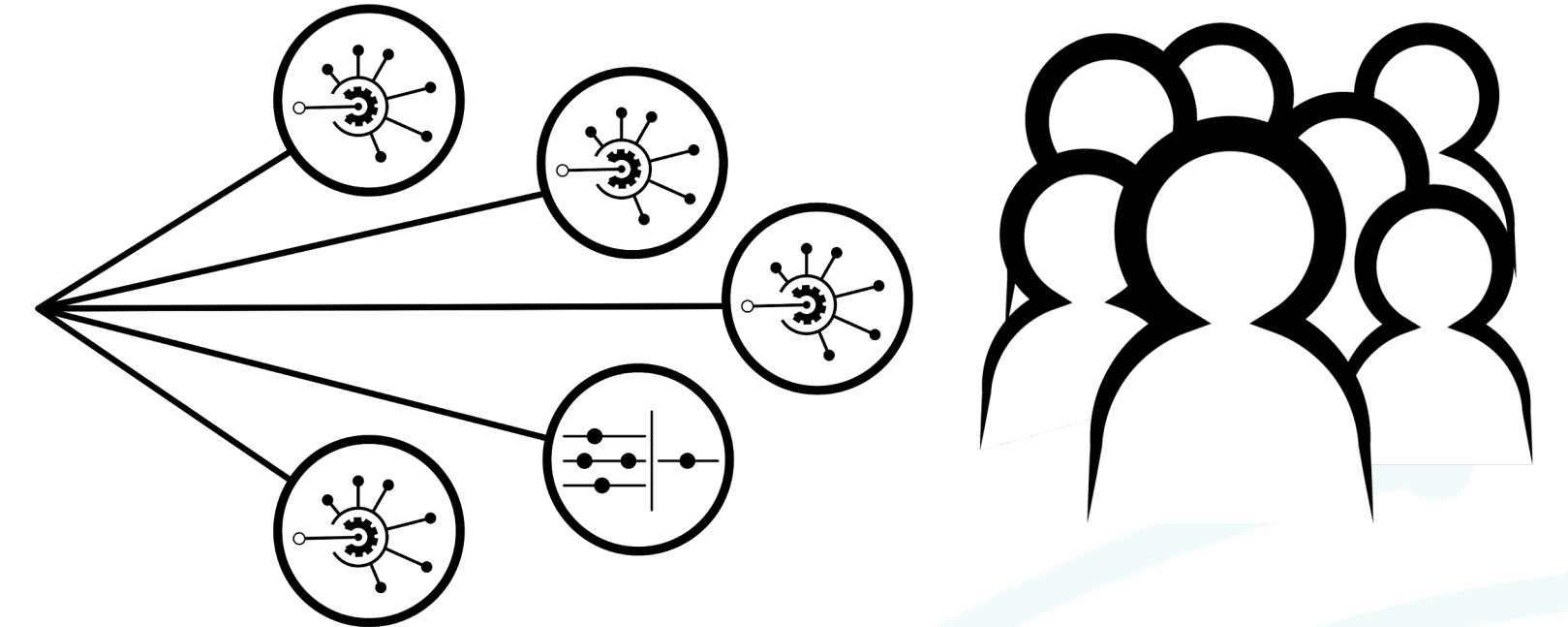
# Data Products



## Difference Image Analysis (DIA)



**In 60s**, raw images are processed, a template is subtracted, and difference-image sources are detected, associated, characterized, and...

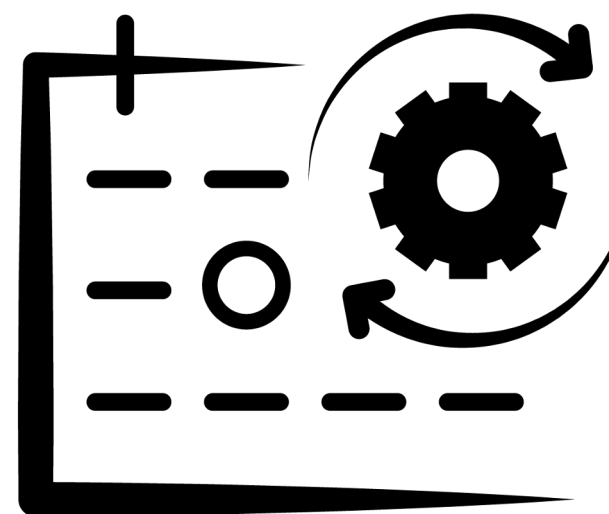


...distributed as alerts to brokers, where they can be rapidly analyzed by users.

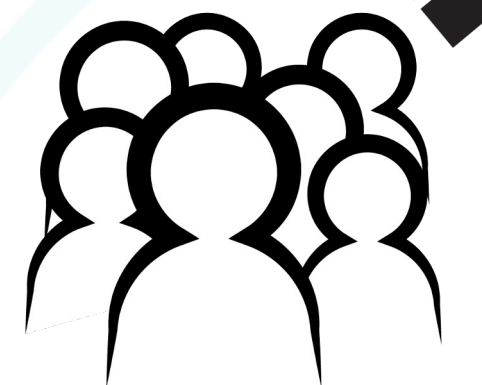


**In 24h**, the Prompt Products Database (PPDB) is updated with the DIA data products.

The Prompt (24h) and Data Release (annual) data products will be available for users to analyze via the Rubin Science Platform.

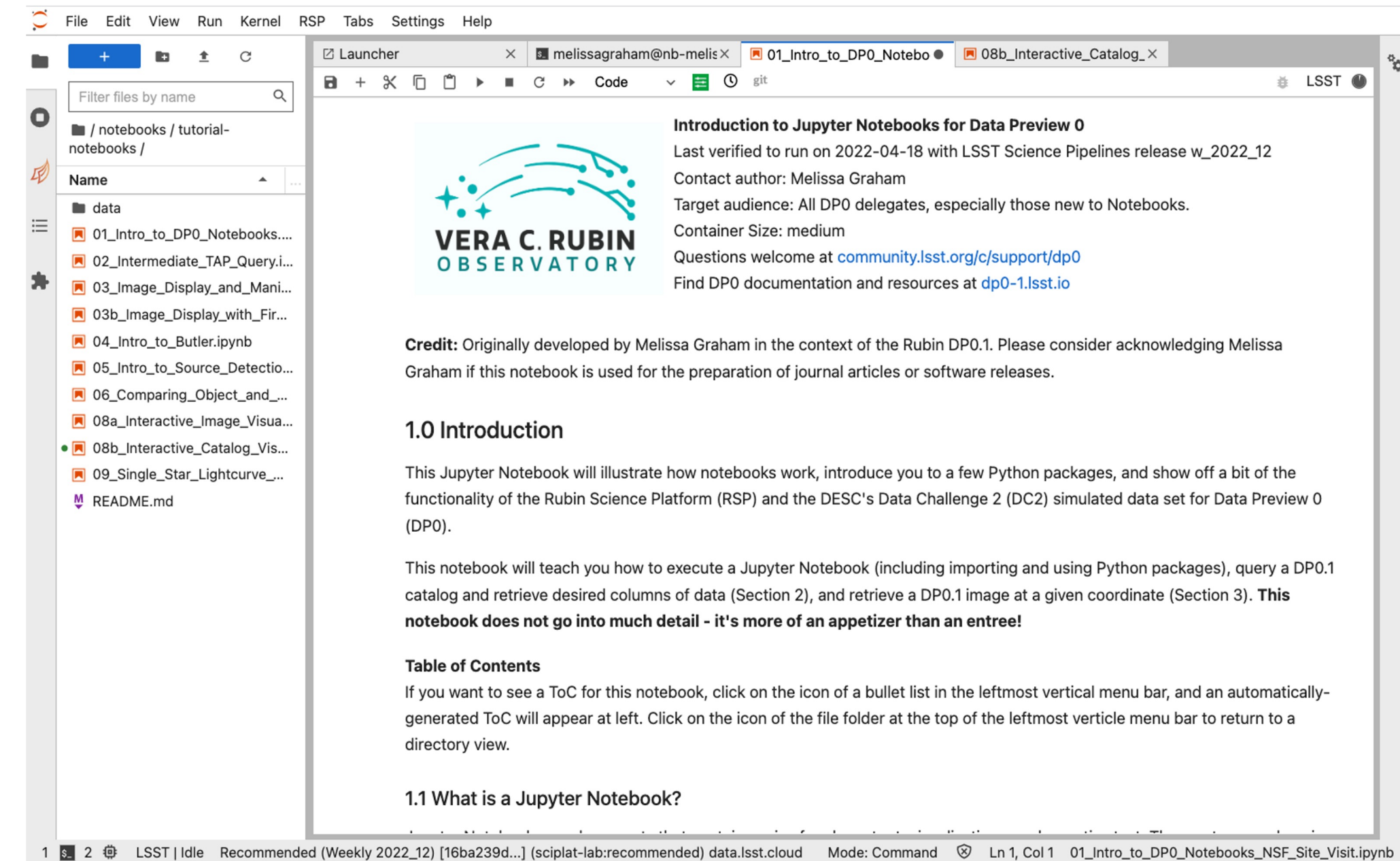


**Yearly** data releases include DIA, coadded images, and catalogs for all data to date.



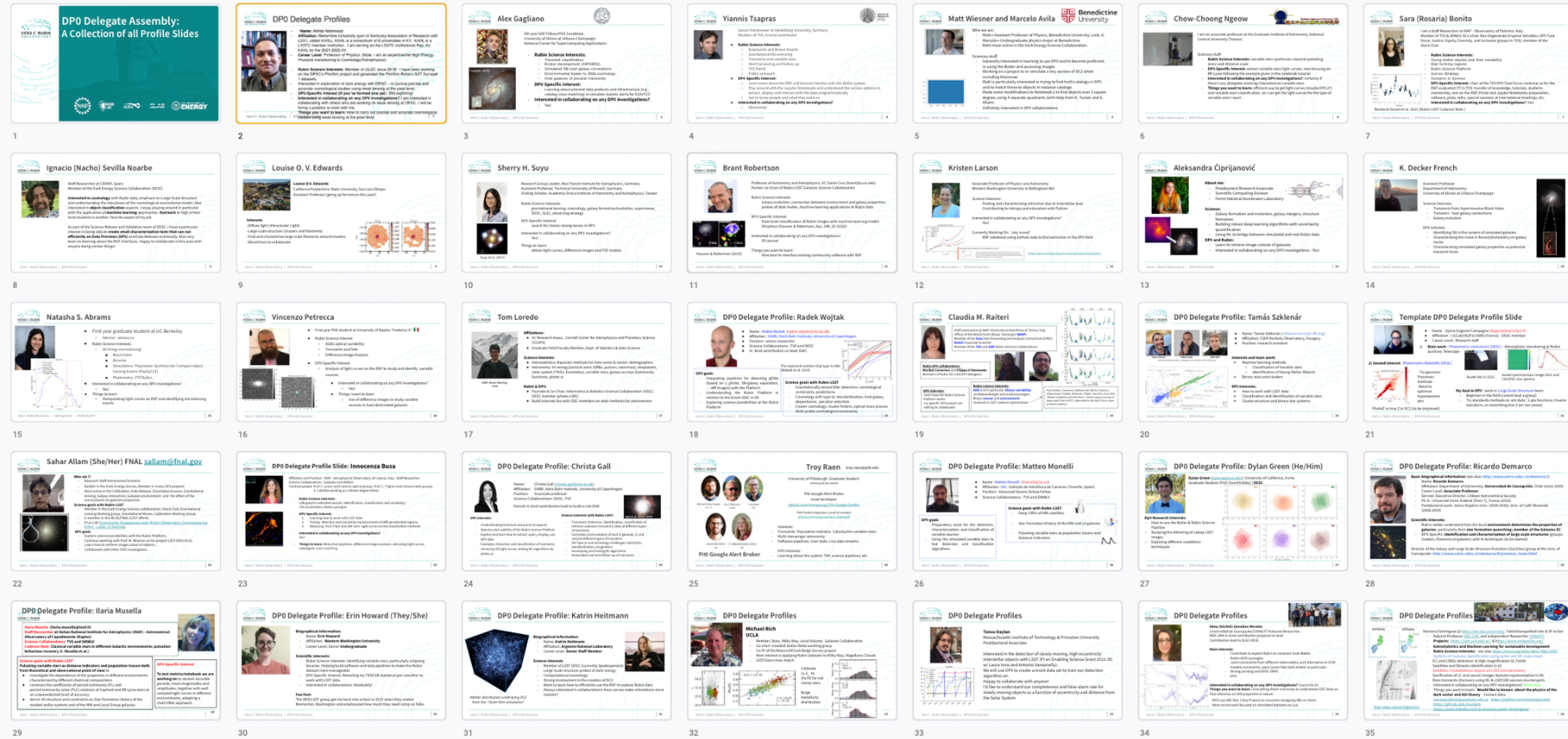
*Skill-focused, high-quality, Rubin-branded learning materials.*

- Jupyter Notebook, command-line, and Portal tutorials
  - introductory level "how-to" for the data access services
  - catalog queries & visualization techniques for large data sets
  - image display, reprocessing, & source detection
  - time-domain data sets (lightcurves)
  - shared GitHub repo for delegate-contributed tutorials
- **Future work:**
  - upgrades as work on the LSST Science Pipelines progresses
  - new tutorials for image services, advanced-level tool usage
  - new tutorials for end-to-end image reprocessing
  - new tutorials to broaden the scientific demonstrations



*The tutorials are very popular  
with delegates and receive  
positive feedback.*

# Community Science Delegate Engagement Examples



The grid displays 35 examples of DPO Delegate Profiles and assemblies. Each slide typically includes:

- Delegate Name and Photo:** A small portrait of the delegate.
- Who I am:** A brief bio including their current role and affiliation.
- Science Interests:** A list of topics they are passionate about, such as galaxy evolution, dark matter, or exoplanets.
- DPO Specific Interests:** How they plan to engage with the DPO community, including attending meetings, contributing to science, and collaborating with other delegates.
- Visuals:** Many slides feature astronomical images, data plots, or diagrams related to their research.

Examples of delegates shown include Alex Gagliano, Yianni Tsapras, Matt Wiesner and Marcelo Avila, Chow-Chong Ngeow, Sara (Rosaria) Bonito, Ignacio (Nacho) Sevilla Noarbe, Louise O. V. Edwards, Sherry H. Suyu, Brant Robertson, Kristen Larson, Aleksandra Čiprijanović, K. Decker French, Natasha S. Abrams, Vincenzo Petrecca, Tom Loredò, DPO Delegate Profile: Radek Wojtak, Claudia M. Raiter, DPO Delegate Profile: Tamás Szeklenár, Template DPO Delegate Profile Slide, Sahar Allam (She/Her) FNAL, DPO Delegate Profile Slide: Innocenza Busa, DPO Delegate Profile: Christa Gall, Troy Raen, DPO Delegate Profile: Matteo Monelli, DPO Delegate Profile: Dylan Green (He/Him), DPO Delegate Profile: Ricardo Demarco, DPO Delegate Profile: Ilaria Musella, DPO Delegate Profile: Erin Howard (They/She), DPO Delegate Profile: Katrin Heitmann, Michael Rich UCLA, DPO Delegate Profiles, and DPO Delegate Profiles.

Over 50 delegates did flash talks for DPO.1 or DPO.2; these are just a few of their slides.

*A growing team with expertise across the Rubin science pillars.*



**Melissa  
Graham**



**James  
Annis**



**Tina  
Adair**



**Greg  
Madejski**



**Douglas  
Tucker**



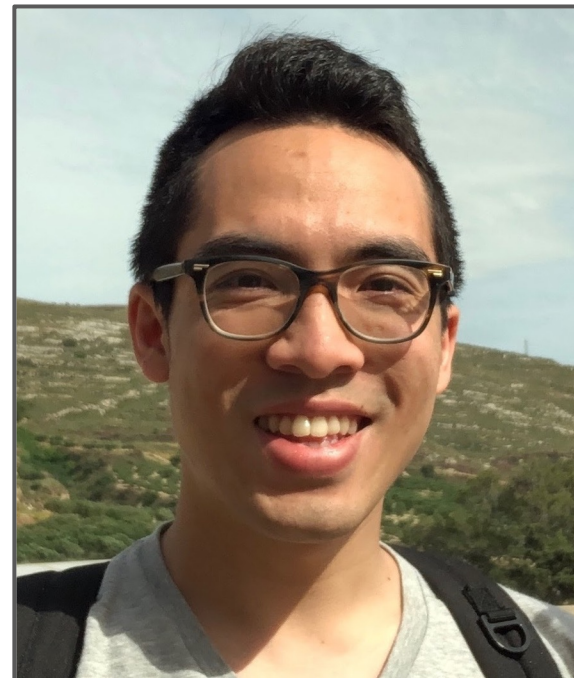
**Yumi  
Choi**



**Andrés  
Plazas Malagón**



**Brian Nord**



**Ryan  
Lau**



**Jeff  
Carlin**



**Aaron  
Meisner**



**Christina  
Williams**



**Gloria  
Fonseca Alvarez**

- Includes specialists in:
- documentation
  - citizen science methods
  - research inclusion

- Joining in 2023:
- Sarah Greenstreet

## Community Science Team (CST)

Maximize scientific results from Rubin by engaging the community.

The Rubin System Performance department is responsible for ensuring that the LSST is on-track to achieve its 10-year science goals.

Community Science is part of System Performance because the scientific results produced by the community are *a key success metric* of the The Rubin Observatory System.

**CST engages the *science community* to maximize scientific productivity and excellence in their use of the Rubin data products and services.**

### Community Science team goals:

- facilitate access to and analysis of LSST data
  - documentation, tutorials, workshops
  - accessible & inclusive resources
  - advocacy for users' needs
- coordinate expertise to resolve issues
  - deep dives into science applications
  - responsive & transparent communications
  - internal & external liaisons
- sustain a self-supporting community
  - online forums for peer-to-peer Q&A
  - opportunities for networking & collaboration
  - promote research inclusion