

Presented by:

Melissa Graham, Kristen Metzger, Sandrine Thomas, Stuart Marshall, Will Clarkson, Lauren Corlies, and Lynne Jones

Introduction to Rubin Systems, Jargon, & Acronyms

Welcome! In-lieu of an icebreaker, please enjoy this: ls.st/2022-fun-poll













Friendly reminders - CoC & Covid



Code of Conduct

Harassment and unprofessional conduct (including the use of offensive language) of any kind is not permitted at any time and should be reported.

Rubin Observatory adheres to the principles of kindness, trust, respect, diversity, and inclusiveness in order to provide a learning environment that produces rigor and excellence.



Use the confidential email <u>rubin2022-covid@lists.lsst.org</u> to request a test, report your test results, or ask questions.

Reporting bullying, harassment, or aggression.

The Rubin 2022 Organizing Committee has appointed designated contacts:

- Ranpal Gill (rgill@lsst.org)
- Andrew Connolly (ajc@astro.washington.edu)
- Melissa Graham (mlg3k@uw.edu)

Contact via email, Slack, or the Community Forum.

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Session Overview

Chair: Melissa Graham, Rubin/UW

Presenters:

Communications: Kristen Metzger The PCW: Melissa Graham Telescope & Site: Sandrine Thomas Camera: Stuart Marshall Data Management: Melissa Graham Survey Strategy: Lynne Jones Education & Public Outreach: Lauren Corlies Science Collaborations: Will Clarkson

Chat Moderator:

Slack: all speakers #day1-mon-slot3-intro-to-rubin

Agenda:

- Communications & the PCW (15 min)
 - communications: name, glossary, website, social
 - the PCW, sessions of interest
 - pause for questions (5 min)
- Rubin Obs. Systems (30 min total)
 - Telescope and Site (~4 min)
 - Camera (~4 min)
 - Data Management (~4 min)
 - Education and Public Outreach (~4 min)
 - Survey Strategy (~4 min)
 - pause for questions (5 min)
- Rubin Obs. Science Collaborations (15 min)
 - what are they?
 - what do they do?
 - why should I join?
 - pause for questions (5 min)

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Speaker: Kristen



Communications - Naming

Vera C. Rubin Observatory (Rubin Obs./Rubin),

which refers to both the institution and the physical building on Cerro Pachón, will conduct the

Legacy Survey of Space and Time (LSST)

using the

Simonyi Survey Telescope

https://project.lsst.org/documents/name-use-guide



"VRO" is not used in written or spoken communications; use "Rubin Observatory" and then shorten to "Rubin"

Speaker: Kristen



Communications - Glossary

Searchable database of terms and acronyms.

https://www.lsst.org/scientists/glossary-acronyms

Gloss	ary & Acronyms	
Acronyms Astronomy	and Glossary of terms used in the LSST project, Data Management, and /	d
nclusion criter	ion: should to be in some way LSST related.	
Don't see what	t you're looking for? Request a term!	
Search: task	×	
Term	Definition	Tags
CmdLineTask	A special kind of Task that can read its inputs and write its outputs using a Butler, and can run easily from the command-line. CmdLineTask is a specific implementation of the concept of a command-line task. CmdLineTasks are being phased out in favor of PipelineTasks.	DM
command-line task	An enhancement of a Task in the LSST Stack context, it is the equivalent of a data processing pipeline and may be run directly from the shell command-line. A command-line task minimally consists of: a configuration and metadata,	DM

A CSV file containing glossary and acronym definitions is available in the lsst-texmf package: https://github.com/lsst/lsst-texmf/blob/ma ster/etc/glossarydefs.csy

A PDF rendering of key terms: https://lsst-texmf.lsst.io/_static/examples/ glossary-table.pdf or

ls.st/glossary-table-pdf

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LSST System Requirements

Communications - Website

Start here: https://www.lsst.org/scientists

	What will LSST data loo LSST will deliver calibrated images and data products generated by the commu	Dk like? data products on a daily and annual basis. Th anity.	e project will also host some related	
	Prompt data products: • Source catalogs from difference imaging (available z4 hours after acquisition)			
	Images (available 24 hours after acqu Within 60 seconds of readout: alerts Data releases (weartu):	uisition) about sources that changed relative to a refe	rence image. including moving objects	
	Data releases (yearly): a a galatia and morp necessing of all the data taken from the start of the survey until a given data hypotally 6 months before the releases. a calibrated mappin a source catelogy with positions, flux, shapes, etc., a light cross. B and more about the planeted data product, B and more about the planeted data product. Hopfer spectrated data product, but the simulation framework. Hopfer spectrated and open-source book on it for you is simulate everything from how LST could make to downstore out may, how gift passes through the balanceop equation and specials out the detector and what alart and catalogues of aboutments outwards.			
	Catalogs	Images	Survey Strategy	
	The second secon			
Key Project Documents	1	Most Recent	PST Talks	
Linkd ⁰ LSST Data Policy		See the collection of Project Science		
Link@ Science Requirements Document				
Link@ Data Products Definition Document				
Linka? LSST Science Book				
Linke® LSST: From Science Drivers To Reference Design And An	iticipated Data Products	M. M.		
Link@ Summary of Data Management Principles		View full originals/dov	wnload 🗗	
Link@		PDF Presentations		



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Communications - Social Media

rubin-digest-join@lists.lsst.org

Connect on Social Media

Communications-team@lists.lsst.org To receive email updates send



@VRubinObs



- @VRubinObs
- @rubin_observatory
- http://ls.st/z6u



linkedin.com/company/rubinobservatory

a blank email to:

<u>www.lsst.org</u>



community.lsst.org



Join the open Community Forum at <u>community.lsst.org</u>

Built on the Discourse Platform.

Search and read posts without an account.

Participate with a free account.

Speaker: Kristen



Come talk to us here or at a meeting!





The Project and Community Workshop

Grassroots: attendees organize & chair sessions.

PCW Features:

- Daily Plenaries
 - Mon: Construction
 - Tue: Operations
 - Wed: LSST Science Collaborations
 - Thu: Keynote Speakers
 - Fri: Breakout Summaries
- Parallel Breakout Sessions
 - Science-focused sessions for the community
 - Technical sessions focused on project team work
 - EPO and DEI sessions for everyone
- The Unconference (Wed)
- Lightning Stories (fun staff profiles)
- Posters
 - Mon/Wed, LSSTC-supported students
 - plus they give flash talks during plenaries
 - Tue/Thu, contributed posters from anyone

All sessions are open to all attendees.

Below are some unique session types.

DEI sessions

Tue 11:00 – Equity and Inclusion Workshop Tue 13:30 – How To Foster Trust in the Workplace Thu 13:30 – Rubin-related Initiatives Toward Diversity, Equity and Inclusion

The Unconference: suggest a topic on the board and upvote others'. Rooms are assigned before the session (Wed 15:30).

Breakout Summaries: see a single slide review of every session (Fri).

Rubin Research Bytes: contribute a post about your Rubin-related research via Community.lsst.org. (No live session!)

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Questions via:

- hands raised in the room
- Slack channel #day1-mon-slot3-intro-to-rubin



Rubin Obs. Systems - Telescope and Site

Goal: Acquire, calibrate, and schedule the survey

- T&S elements:
 - Structures located on the summit and at the base
- Both the Main Telescope and the AuxTel
- Telescope Mount Assembly (TMA) : Very compact and stiff
- Dome with light screen crawl to follow the TMA
- M1M3 and M2 mirror systems, Camera hexapod/Rotator & M2 Hexapods
- Control software including
 - SAL: Service Abstraction Layer = communication channel
 - **EFD:** Engineering Facility Database
 - **CSC:** Controller SAL Components (controllers)
 - **Scheduler:** brain of the Observatory
 - LOVE: LSST Observing Visualization Environment
- Calibration System (AuXTel & in-dome Cal)
- **Coating Plant**: Coating Chamber, washing station





Software - Tuesday 15:30am-17:00am PST

AT - Wed 11:00am-12:30am PST



Telescope and Site

Mirror Systems:

- Unique three-mirror optical design accommodates a 3.5-degree field of view feeding a large camera
 - 8.4-meter Primary Mirror (M1)
 - 3.4-meter Secondary Mirror (M2)
 - 5.0-meter Tertiary Mirror (M3)
- Compact optical arrangement (f/# = 1)
- Laser Tracker for alignment

Active Optic System (Wed 11:00am-12:30am PST):

- M1M3 has 156 actuators and its Look-up-Table (LUT)
- M2 has 72 actuators and its LUT
- Camera and M2 Hexapods and their LUTs
- Wavefront sensors on the corner rafts of the camera

Calibration System: to measure throughput and understand systematics

- In Dome calibration (throughput)
 - calibration screen
 - collimated Beam Projector (CBP)
- AuxTel (atmospheric transmission)





Wavelength (nm)



System Integration & Commissioning (SITCom)

- Level-3 Software Integration while we have the majority of components on level 3 including the commissioning camera (ComCam)
- Integration of the components and ComCam on the TMA
- System Verification Part 1
- LSSTCam Integration on the TMA
- System Verification Part 2
- Science Verification/Validation





Speaker: Stuart



Camera Main Elements

Focal plane in cryostat:

- diameter 634mm
- 189 science CCDs (4kx4k, each segmented into 16 parallel readout chains), arranged in 21 rafts, plus corner rafts.
- 10 micron pixels (0.2 arcsec), 3 Gigapixels for ~10 sq. degree field of view
 6 filters: *ugrizy* (320nm to 1100 nm)



Speaker: Stuart



All Camera Elements Built and Are Being Integrated at SLAC



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Camera Status and Look Ahead

- Completed
 - Filter exchange, shutter, purge systems functional tests (partial)
 - Cryostat integrated with Camera body: April 2022
 - L3 lens installed: March 2022
 - BOT EO testing: February 2022
- L1-L2 lens assembly integration September 2022
- Camera functional testing complete October 2022
- Pumped coolant system operational December 2022
- Full Camera EO testing complete early March 2023
- Camera arrival in Chile late March 2023
- Camera re-assembly and functional verification through July 2023
- Camera Optical test and characterization (on level 3) to October 2023



The Data Management System (DMS)





LSST Science Pipelines (pipelines.lsst.io)

Prompt Processing

Alert Production (60 seconds) Prompt Products (24 hours)



DIASource: a source in a diff image DIAObject: DIAsources at a sky coord Alert: ascii of data for a DIASource Broker: receives and processes alerts SSObject*: moving object record

Prompt Products Database (PPDB) has catalogs of DIASources/Objects. Prompt products includes images.

Data Release Processing

Data Releases: DR1-11 (0.5-10 yr)

Images

standard visit: a 30s image in a filter calexp: processed visit image (PVI) coadd: deep stack of all visits tract: spherical convex polygon of the LSST all-sky tessellation image patch: quadrilateral portion of a tract

<u>Catalogs</u>

Source: a source in a single image Object: all sources at a sky coordinate ForcedSource: forced photometry of all sources in all single images

And reprocessed DIA data products.

User Processing

User-Generated Data Products

Reprocessed images and/or catalogs using the DM science pipelines or custom pipelines.

Can be generated, stored, and shared via the Science Platform.

Like all Rubin data products, those generated by users are subject to the Rubin data rights policies. Is.st/Ido-013



The DMS from Construction to Operations

Construction-era: Data Management team

- building the LSST Science Pipelines and the Rubin Science Platform
- Data Previews during Commissioning
 - release LSST-like data products for community analysis
 - Data Preview 0 (DP0)
 - happening now, with simulated data
 - Data Previews 1 & 2 (DP1 & DP2)
 - happening over the next few years, with commissioning data
 - DP1: data from commissioning camera "ComCam" (single-raft)
 - DP2: data from the full LSST Science Camera
 - All DP access will be via the Rubin Science Platform
 - access is limited for DP0, will increase throughout the DPs

Operations-era: Data Production team

- processing and serving the LSST data over 10 years
- maintaining and evolving the data products and services

LSST Science Pipelines -- Software written by Rubin staff to process LSST images and generate LSST data products. See <u>pipelines.lsst.io</u>.

Rubin Science Platform (RSP) --Software infrastructure for data access and analysis; Notebook, Portal, and API aspects.

Data Previews (DPs) -- LSST-like data products and RSP access prior to operations.

Data Production -- The Rubin Observatory Department responsible for data products and services during operations.



Education and Public Outreach

EPO provides online data-driven experiences that are accessible and approachable, adding real-world context and opportunities for people to engage with Rubin Observatory and explore the Universe.

EPO serves all non-scientist audiences that are interested in Rubin.

Our Program includes:

- Interactive data experiences in the browser
- Website for Operations
- Skyviewer
- Classroom Activities & Support Materials
- Citizen Science Infrastructure
- Communications & social media strategies

EPO will enter Operations in October 2022!



Speaker: Lauren



Education and Public Outreach

If you'd like to hear more about EPO at the PCW:

- *Tuesday:* There's an App for That: Good UX and How it Helps Complicated Ideas Feel Approachable
- Thursday: EPO Keynote Plenary on Thursday
- *Thursday:* Exploring the Solar System with Rubin EPO

If you'd like to hear more about EPO in other ways:

- Join our Slack channel! #epo
- Follow Rubin on social media!

Try out some of our data interactions! <u>https://epodemo.netlify.app/</u>

Speaker: Lynne



Survey Strategy



The Baseline Survey Strategy was designed to meet the basic requirements to achieve the core science goals of the Legacy Survey of Space and Time (LSST; requirements described in <u>ls.st/srd</u>).

The Wide-Fast-Deep (WFD) survey:

- footprint should cover at least 18000 deg²
- average of 825 visits per field over 10 years
 ~3 day cadence (time between visits)
- same-night same-field re-visit "pairs"

Deep Drilling Fields (DDFs): single pointings with many more images obtained more rapidly

Mini-Surveys: areas with specially designed observing strategies for certain science goals. E.g., the North Ecliptic Spur (NES), the Galactic Plane and Bulge, and the South Celestial Pole (SCP).

Speaker: Lynne



Survey Strategy

To address these open questions, the Rubin Observatory LSST Scheduler Team is generating a wide variety of simulated surveys.

One OpSim run consists of:

Input:strategy parameters like area, revisit rate, etc.Generate:10 years of moon cycles, weather patterns, TOO, etc.Schedule:10 years of observations based on the input strategyOutput:an OpSim database of observational metadata

To help scientists evaluate these simulations, the LSST Scheduler Team built the *Metrics Analysis Framework* (MAF), a code package that enables the derivation of scientific results from the OpSim database.

A *metric* is a measure of scientific performance, such as the number of detections of a type of object, the 10-year co-added depth, etc.

Terminology

OpSim run

A simulated 10-year survey for a given strategy.

OpSim database

Observational metadata for one OpSim run.

MAF

Metrics Analysis Framework, a software package of tools to read and analyze an OpSim database.

SCOC

Survey Cadence Optimization Committee, who generate survey strategy recommendations



Questions via:

- hands raised in the room
- Slack channel #day1-mon-slot3-intro-to-rubin



Unprecedented data volume to be leveraged for multiple science goals.





Why and how are people preparing for LSST?

The scope and potential for science with the Rubin Observatory LSST is as enormous as the unprecedented volume and complexity of the LSST data products.

Correspondingly, the technologies, methodologies, policies, and collaborative strategies for research with LSST are evolving to meet this challenge.

- assembling 'precursor' data sets
- generating sophisticated new algorithms
- building software infrastructure
- establishing policies for collaboration
- investigating synergies with future facilities

Speaker: Will



LSST Science Collaborations



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wiclarks@umich.edu Acronym

Speaker: Will



Rubin LSST Science Collaborations



2000+ members, physicists, astronomers, data scientists, software engineers

Growth from 2018 (dark bars) to 2022 March (light)

Credit: FBianco TLoredo

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wiclarks@umich.edu



The Rubin SCs aspire to be an inclusive and supportive environment for scientists interested in pursuing LSST-based science.

SCs Federation Charter

- No membership fees.
- No requirement to be affiliated with any organization.
- No requirements on time-commitment for basic membership.



Credit: FBianco



Science Preparation:

- prepare for LSST
- provide expert advice and analysis to Rubin
- train, educate, engage the scientific community
- fundraise for our teams and their projects
- develop and implement research inclusion practices
- collaborate on software development (including in-kind)

SC members enjoy and benefit from a supportive collaborative environment that places them in the best position to generate science with Rubin data!

Find out how to join at: <u>https://www.lsstcorporation.org/science-collaborations</u>





Training, support, and collaboration in preparation for LSST science.



Rubin LSST metrics hackathon 2020

n event organized by the Rubin LSST Science Collaborations. August 6-7 2020





Provide expert analysis and advice to Rubin

https://iopscience.iop.org/journal/0067-0049/page/rubin_cadence

THE ASTROPHYSICAL JOURNAL SUPPLEMENT SERIES

Rubin LSST Survey Strategy Optimization

PI: Federica Bianco



The Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST) will provide unprecedented data that will be made available to all US and Chilean scientists and to international member scientists for a diverse range of astrophysical investigations, from cosmology to solar system studies and from stellar astrophysics to transients to galaxy evolution. In any synoptic survey such as this one, the choice of cadence—the pattern in which the telescope moves across the sky and periodically revisits each field—is of vital importance in maximizing the scientific utility of the data. Yet, identifying the optimal cadence for a broad range of scientific goals is a challenge. As part of the survey design and characterization process, Rubin Observatory involved the LSST science community by soliciting Cadence White Papers and Cadence Notes. Peer-reviewed journal articles describing scientific investigations that motivate and support these notes are published in this focus issue as a record of the factors which influenced survey design, and for guidance for future surveys that may confront many of the same issues faced by Rubin Observatory.

A A IOP

JOURNAL LINKS

Submit an article

Journal home

About the journal

Author instructions

Editorial board

Copyright and permissions

Ethics policy

Article charges

Special issues and focus issues

100400

Contact us

9 papers published, ~3 in review, more expected

OPEN ACCESS

Optimization of the Observing Cadence for the Rubin Observatory Legacy Survey of Space and Time: A Pioneering Process of Community-focused Experimental Design

Federica B. Bianco et al 2022 ApJS 258 1

+ Open abstract 📄 View article 😤 PDF

OPEN ACCESS

Preparing to Discover the Unknown with Rubin LSST: Time Domain Xiaolong Li *et al* 2022 ApJS 258 2 + Open abstract R View article

OPEN ACCESS

Blazar Variability with the Vera C. Rubin Legacy Survey of Space and Time Claudia M. Raiteri *et al* 2022 *ApJS* 258 3

+ Open abstract 🛛 🐨 View article 🔭 PDF

OPEN ACCESS

The Impact of Observing Strategy on the Reliable Classification of Standard Candle Stars: Detection of Amplitude, Period, and Phase Modulation (Blazhko Effect) of RR Lyrae Stars with LSST

Nina Hernitschek and Keivan G. Stassun 2022 ApJS 258 4

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OPEN ACCESS

Optimizing Cadences with Realistic Light-curve Filtering for Serendipitous Kilonova Discovery with Vera Rubin Observatory Igor Andreoni et al 2022 ApJS 258 5 + Open abstrat IP Vera writele PS PDF

OPEN ACCESS

Give Me a Few Hours: Exploring Short Timescales in Rubin Observatory Cadence Simulations Eric C. Bellm et al 2022 ApJS 258 13

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OPEN ACCESS

The Impact of Observing Strategy on Cosmological Constraints with LSST Michelle Lochner *et al* 2022 *ApJS* **259** 58

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Target-of-opportunity Observations of Gravitational-wave Events with Vera C. Rubin Observatory
Igor Andreoni et al 2022 ApJS 260 18
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EDDE

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DP0 new friends program:

https://community.lsst.org/t/invitation-for-dp0-delegates-to-participate-in-the-lsst-science-collaborations-new-friends-program/5700

Motivation: DP0 has attracted many scientists and students who are new to working with Rubin Observatory, the Legacy Survey of Space and Time (LSST), and/or the LSST Science Collaborations. It can be challenging for new people to figure out how to participate in the Science Collaborations (SCs) and how the SCs interact with Rubin Observatory. The SCs have many experienced members who want to share what they know with newcomers, to welcome and support them as they get started on their path to Rubin science – especially now during this opportunity provided by DP0.

Science Collaboration Representatives ("SC Reps") are volunteering to serve as a friendly and informal point of contact for new-to-Rubin DP0 delegates. They will be available to help answer any questions related to the SCs, and will also ensure that their new friend knows how to find information about their SC (e.g., meeting times, committees, documentation) that is relevant to their interests.

How do I get involved? If you are a DP0 delegate interested in being partnered up with an SC Rep, or if you are an SC member who is interested in serving as an SC Rep, please use this form to indicate your interest: https://forms.gle/ZhPHgX3RNqQrVPhdA 6.

The Rubin Community Engagement Team (CET) is helping to facilitate this program by reaching out to all DP0 delegates to inform them of this program and helping to match delegates with SC Reps. The CET will also organize a few "networking sessions" for all new friends. The first "SC New Friends Meet-and-Greet" will be during a breakout session of the DP0 Delegate Assembly on Friday July 30, starting at 10am US Pacific time (i.e., in the second hour of the assembly).



wiclarks@umich.edu



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https://lsst-sci-prep.github.io/

We are delighted to announce a new research and community-building initiative for members of the three participating Rubin Science Collaborations: <u>Transients and</u> <u>Variable Stars (TVS)</u>, <u>Stars, Milky Way and Local Volume (SMWLV</u>) and the <u>Solar</u> <u>System Science Collaboration (SSSC)</u>.

This has been made possible by generous support from the <u>Heising-Simons</u> <u>Foundation</u> for research in galactic and Solar System science, with a particular focus on ensuring equity of opportunity, in keeping with the Foundation's goals.

wiclarks@umich.edu



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Speaker: Will



LSST Science Collaborations

Science Collaborations Report

Wed 9am Tucson time Ritz-Carlton Ballroom

Come and hear more about the Science Collaborations' plans and activities.

wiclarks@umich.edu (SCs coordinator)



wiclarks@umich.edu



Questions via:

- hands raised in the room
- Slack channel #day1-mon-slot3-intro-to-rubin



Resources to Get (More) Involved

Join a Science Collaboration:

https://www.lsstcorporation.org/science-collaborations

Use the Rubin Observatory Community Forum:

Community.lsst.org

Access resources and publications:

- Community Engagement Team video playlist ls.st/cet-playlist
- Rubin Observatory "For Scientists" Webpage: lst.org/scientists
- <u>LSST: From Science Drivers to Reference Design and Anticipated</u> <u>Data Products</u> (Ivezić et al. 2019)
- Rubin Observatory technical documents, <u>lsst.io</u>
- The Science Book: lst.org/scientists/scibook











1. What inspires you?

🔘 A. This picture of the Cerro Pachón summit under a full moon. (Image credit: Rubin Observatory / NSF / ...



O B. Attending Rubin-related meetings. (Image credit: Rubin Observatory / NSF / AURA)



🔵 C. Reading the Rubin news on the Rubin website in the Rubin digest and Community.



🔘 D. Seeing Vera C Rubin's image seen through the Rubin LSST camera. (Image credit: LSST Camera Team...



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ACTOMYTHS & GLOSSALY





2. What should we do with the Science Camera after the LSST is complete?

A. Pour in 5000 L of pisco sour and put a tap on it.



B. Sell it for parts to raise funds for LSST V2.0. (Image credit: SLAC, DOE)



C. As it is the size of a small car, add wheels and drive off into the sunset.



D. Fill it with 240 corgi puppies, of course! (Image credit: Margaux Lopez, PCW 2018)



2. What should we do with the Science Camera after the LSST is complete? 23 responses



🔲 Сору

- A. Pour in 5000 L of pisco sour and put a tap on it.
- B. Sell it for parts to raise funds for LSST V2.0. (Image credit: SLAC, DOE)
 C. As it is the size of a small car, add
- wheels and drive off into the sunset.
- D. Fill it with 240 corgi puppies, of course! (Image credit: Margaux Lopez, PCW 2018)



Fun Poll Results

3. This year's PCW Science Keynote speaker, Marcia Rieke, will speak about JWST. Choose your favorite JWST first light image. (Image credit: NASA, ESA, CSA, and STScI)

24 responses



Сору

8

favorite JWST first light image. (Image credit: NASA, ESA, CSA, and STScI)

3. This year's PCW Science Keynote speaker, Marcia Rieke, will speak about JWST. Choose your

🔘 A. Carina Nebula



O B. Stephan's Quintet



C. Southern Ring Nebula



O D. WASP 96-b



O E. SMACS 0723





Fun Poll Results



C. ConCam

🔵 D. CanCam

🔵 E. ComCan

O F. ComCon

4. What is this?!





Fun Poll Results

Which fact about Vera Rubin motivates you to pursue your astronomy goals?





A. Since there were no women restrooms she was not allowed at () the Palomar observatory, so she fixed this by adding a skirt to the men's bathroom sign.



B. She earned her bachelor's degree from Vassar College in astronomy in 1948, where she was the only 0 graduate in astronomy that year. (Image credit: Vassar College Archives and Special Collections)



telescope from scratch. (Image

credit: Carnegie Institution for

Science, DTM Archives)

of Sciences.

D. Verubin Nebula, which appears in Season Three of Star Trek: be elected to the National Academy Discovery, is named after her.



F. She revolutionized the entire way in which we understand the composition of the universe by E. At age fourteen, she built her own 0 providing the first proof of the existence of dark matter via galaxy rotation curves!! (Image credit: Rubin & Ford 1970)

Which fact about Vera Rubin motivates you to pursue your astronomy goals? 24 responses



A. Since there were no women restrooms she was not allowed at the ... B. She earned her bachelor's degree from Vassar College in astronomy in 1... C. She was the second woman to receive both the Gold Medal of the Ro... D. Verubin Nebula, which appears in

Сору

- Season Three of Star Trek: Discovery,... E. At age fourteen, she built her own t...
- F. She revolutionized the entire way in...