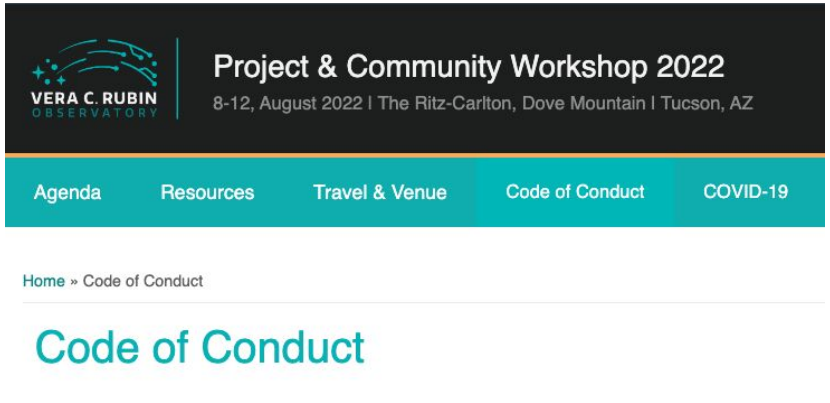
Photo-z commissioning plans

Alex Malz (CMU)
John Franklin Crenshaw (UW)

Friendly reminders - CoC & Covid



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.

Check name-tags for these contact comfort level stickers.

Thank you for masking indoors!

Use the confidential email rubin2022-covid@lists.lsst.org 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.

Friendly reminders - virtual participation

Virtual participants should be muted when they're not speaking.

In-person participants should speak into the room microphone(s), or the chair should repeat all questions into the microphone, so that the virtual participants can hear what is said.

In the Rubin2022_PCW Slack Space, all participants can use the session's channel for Q&A and discussion.

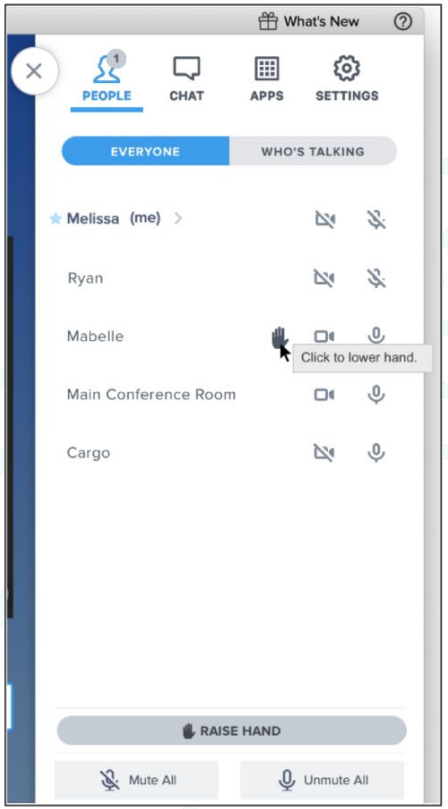
The channel name convention is, e.g.: #day1-mon-slot3a-intro-to-rubin

In BlueJeans, virtual participants should:

use the BlueJeans "raise hand" feature and wait for the moderator to call on you before speaking

or

use the BlueJeans chat functionality to ask questions or make comments.



Session goals - John Franklin + Alex

Goal: to catalyze thinking about SC-specific PZ-related commissioning goals

Panel discussion aims:

- To identify common needs
- To introduce community resources
- To establish XSC connections to develop shared solutions

Outline

1. Rubin Data Management (~10 min)
   a. The roadmap to LSST Object photometric redshifts (& the 2021 PZ Letters of Recommendation)
   b. The PZ Commissioning Team, the PZ Validation Cooperative, and the Data Previews
2. Representatives of extragalactically inclined SCs (<5 min each)
   a. Informal panelist introductions
   b. (Optionally) What are your SC's commissioning plans/aspirations with respect to photo-zs?
3. Resources (5 min each): What do you have to offer to photo-z efforts for Rubin commissioning?
   a. Redshift Assessment Infrastructure Layers (RAIL)
   b. LIneA in-kind contribution
   c. LINCC Frameworks

Q&A and Discussion (45 min)

Photo-z commissioning plans

Rubin DM + SIT-Com

Rubin Data Management - Melissa Graham

In the annual Data Releases, the Object table will have photometric redshift estimate(s).

DM will select one or more existing, community-vetted algorithms that meet a set of minimum scientific attributes and serve the widest variety of science applications.

Roadmap to Object photo-z: dmtn-049.lsst.io

- *Sep 2021* — *Letters of Recommendation regarding Object PZ*
- *Feb 2022* — *Summary of the LoR; shortlisted PZ estimators announced*
- *mid-2022* — *PZ Commissioning Team formed*
- 2023 — PZ Commissioning Team work proceeds
- by Jul 2024 — Data Preview 1 released, PZ Validation Cooperative begins
- by Nov 2024 — Survey Start
- early 2025 — Final decisions made by DM regarding Object PZ for DR1
- by Mar 2025 — Data Preview 2 released, PZ Validation Cooperative continues
- by Jan 2026 — Data Release 1

Rubin Data Management - Melissa Graham

Letters of Recommendation for LSST Object Photo-z (2021-2022)

- The call for "Letters of Recommendation" invited the community to "*define their minimum scientific needs … and/or to advocate for one or more PZ estimators*".
- DMTN-049 described the "minimum scientific attributes" and technical constraints.
- There were 20 submissions total. All are available at community.lsst.org/c/sci/photoz.
    - 13 advocate for particular estimators
        - 3 are post-processing codes
        - 2 are in early stages of development
        - 3 are in later stages of development (shortlisted)
        - 5 have established performance records (shortlisted)
    - 6 describe science use-cases and related needs
    - +1 "non-LoR" describing DESC's photo-z work

- The 5 estimators with established performance will be prioritized for implementation
    - GPz, DEmP, DNF, LePhare, BPZ

Rubin Data Management - Melissa Graham

The PZ Commissioning Team (2022-2024)

Science community members were invited to join: community.lsst.org/t/6310.

This team will:

- develop infrastructure for PZ validation in the Rubin Science Platform
- guide early implementation and validation for at least a few shortlisted PZ estimators
- have access to the pre-release commissioning data
- enable broad participation in the “PZ Validation Cooperative” with Data Preview 1

The team so far:

-Ignacio Sevilla Noarbe
-Alex Malz
-Sam Schmidt
-Julia Gschwend
-Markus Rau
+2 people from LINCC
-Bryce Kalmbach
-Eric Charles
-John Franklin Crenshaw
-Shahab Joudaki

Rubin Data Management - Melissa Graham

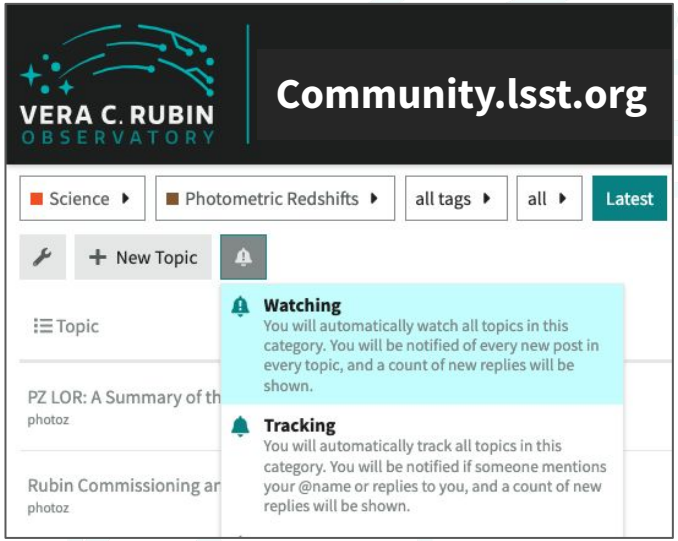
The PZ Validation Cooperative (Data Preview 1 & 2, 2024-2025+)

By DP1's release (Jul 2024), the PZ Commissioning Team will have assembled the experience and infrastructure to support science validation for PZ estimators by the broader community.

- by Jul 2024 DP1 released
- by Nov 2024 LSST operations start
- ~early 2025 DM decision on Object PZ for DR1
- by May 2025 DR1 processing commences

The science community will be guided on how to use DP1 and how to provide input to DM in 2024.

Until then, join an LSST Science Collaboration (e.g., DESC), participate in DP0 if possible, and set yourself to "watching" the "Photometric Redshifts" category in the Rubin Community Forum.



Rubin Data Management - Melissa Graham

Pause for questions.

Rubin Observatory SVV - Keith Bechtol

Evaluating galaxy photometry including photo-z is an important component of commissioning science validation.

Current planning for on-sky observations with LSSTCam includes deep multiband imaging in fields that would support photo-z estimation and validation. This is currently envisioned as one of the top priorities after achieving “system first light”. See “Science Verification and Validation” session Tuesday 9 August 2022.

- LSSTCam “System Optimization” phase: planning for 10-20 yr LSST WFD equivalent depth, ugrizy, for a collection of dithered pointings around an LSST Deep Drilling Field covering a few tens of square degrees.
  - Ideally, we collect similar dataset with ComCam over a smaller area, but this is schedule dependent.
- LSSTCam “Science Validation” Survey phase: possibilities include a “pilot” LSST-WFD-like survey covering ~1000 deg^2 in multiple bands, and increasing LSST DDF coverage
- Community-sourced suggestions for candidate target fields (SSSC, TVS + SMWLV, Galaxies, SLSC and DESC)

Plan that Photo-z Commissioning Team will be embedded in wider commissioning science team, most likely as part of a “Science Unit” devoted to galaxy photometry so as to provide opportunities for collaboration and coordination with other aspects of science verification and validation.

Rubin Observatory SVV - Keith Bechtol

ComCam

		~3 months	~1 month	
Electro-optical Testing at Level 3	In-dome Engineering	On-sky Engineering	System Optimization	**remove ComCam, install LSSTCam**
biases, darks, flats	suite of in-dome calibration	pointing, AOS testing star flats, dithering around bright stars, airmass scans	20-year LSST WFD equivalent depth, synthesizing LSSTCam FoV, prioritizing LSST DDF	

LSSTCam

		~3 months	~1-2 months	~1-2 months
Electro-optical Testing at Level 3	In-dome Engineering	On-sky Engineering	System Optimization	Science Validation Survey(s)
biases, darks, flats	suite of in-dome calibration	pointing, AOS star flats, dithering around bright stars, airmass scans	20-year LSST WFD equivalent depth in fields for extragalactic, Galactic, and Solar System science, ~100 deg^2 in multiple bands with dense temporal sampling	Menu includes increased coverage of LSST DDFs Pilot LSST WFD survey, ~1000 deg^2 in multiple bands to 1-2 year LSST equivalent depth Astrophysical targets / ToO

Science Collaborations

Galaxies Science Collaboration - Sam Schmidt

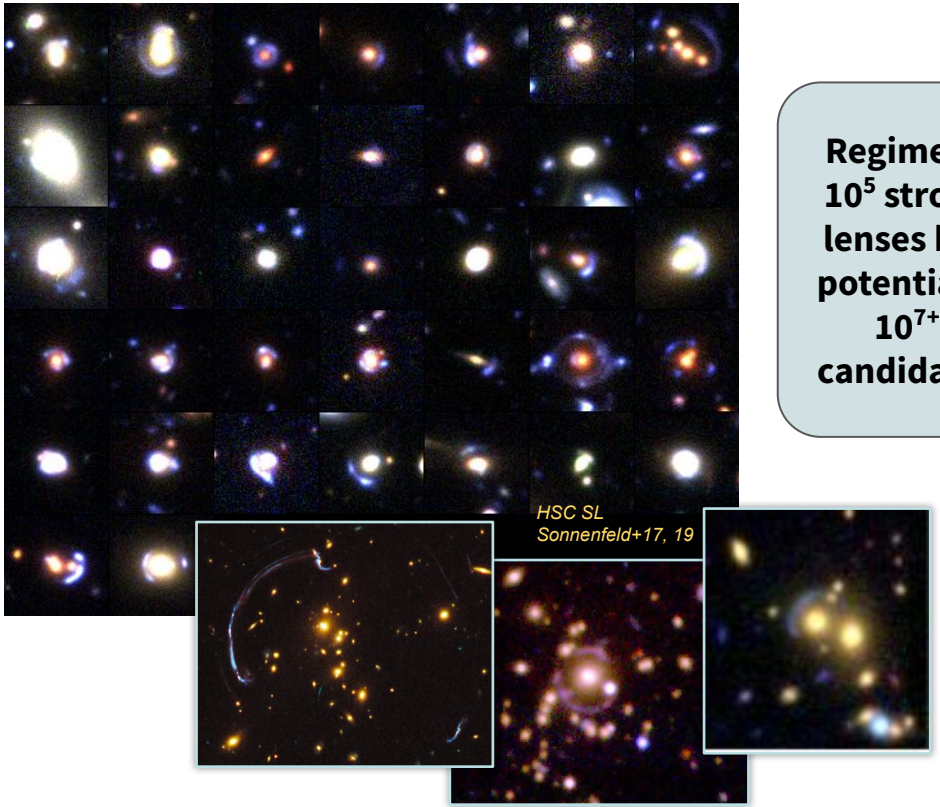
- The Galaxies SC encompasses a wide range of science applications ranging from faint local galaxies to the highest redshift galaxies detectable by Rubin.
- Much of Galaxies science is heavily dependent not just on PZ, but jointly derived physical parameters (M*, SFR, restframe colors, host galaxy E(B-V), etc…).
- It will be difficult to meet the needs of all science cases with a general-purpose Rubin-provided DM catalog.
- In-kind efforts to include DeMP/GPz to simultaneously derive physical parameters, or estimate Z and use CIGALE to fit physical parameters separately.
- Galaxies SC LoR has more detail, available HERE

Galaxies SC during Commissioning

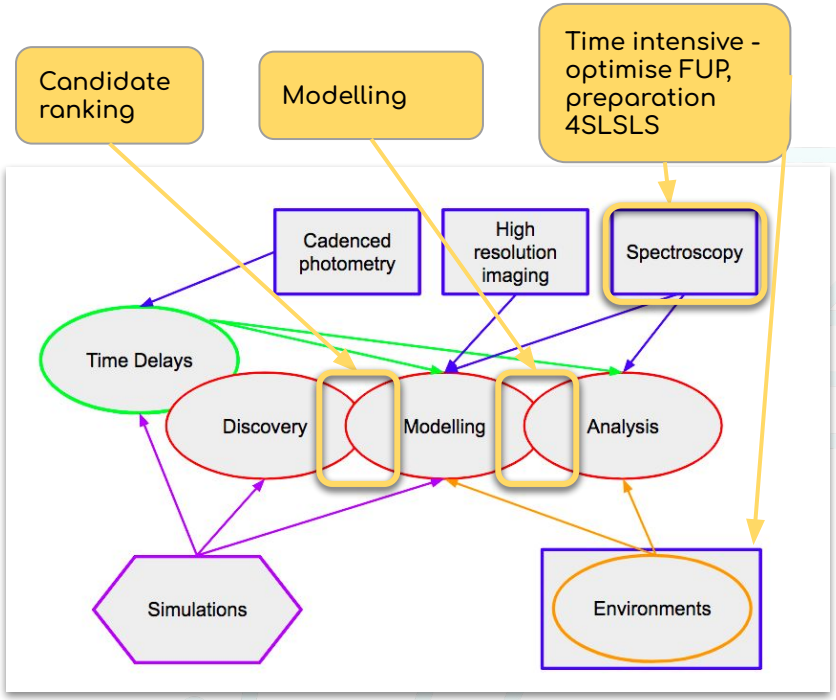
- Galaxies SC has not made many firm plans for PZ-related Commissioning activities
- Most logical place for DEmP/GPz development is `RAIL` & PZ Validation Cooperative: test whether DEmP+CIGALE⇨physical params meets all SC needs.
- Physical parameter estimates obviously benefit greatly from extra bands, particularly NIR. Using deep fields (e.g. COSMOS, CDFS-S) with multi-wl data during commissioning should inform performance of six-band Rubin results. For optimal results, really want joint-processing with at least NIR data in deep fields.
- CIGALE developers may be able to add some expertise on SEDs employed in PZ Validation Cooperative.
- Longer term: NIR info from Euclid/Roman could greatly improve PZ/phys param estimates in overlap regions, thinking about how to facilitate serving of data would benefit many science cases.

SL - Aprajita Verma

All SL cases (all scales) benefit from accurate photo-zs for **lens and source images**

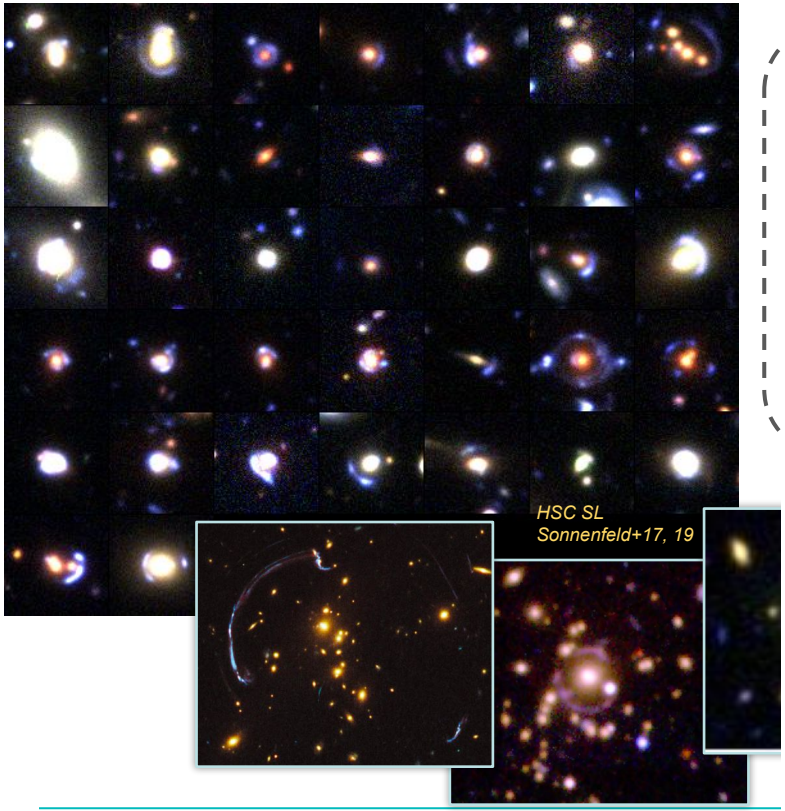


Regime of 10^5 strong lenses but potentially 10^{7+} candidates



SL - Aprajita Verma

All SL cases (all scales) benefit from accurate photo-zs for **lens and source images**

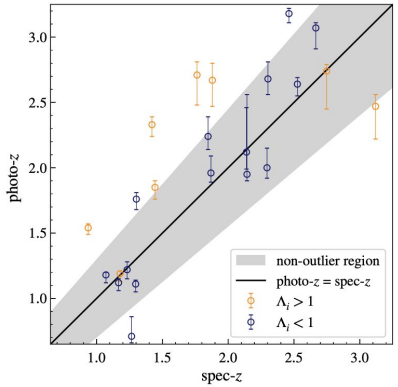


commissioning

Deblending

Accurate Photometry

Photo-z (& properties)



Langeroodi+ 2022

Main factors affecting accuracy:
Deviations of lens from Sérsic
Contrast - lens:image (Λ)

Λ<1: outlier fraction 20% (limited by template fitting* process)
Λ>1: outlier fraction 75% (limited by accuracy of photometry/colours)

Λ<1 OK, Λ>1 will remain problematic without **good deblending & accurate photometry**

***GPz LoR:**
https://community.lsst.org/t/lor-for-the-gpz-pz-estimator/5862

Acronyms & Glossary

DESC - Shahab Joudaki, Markus Rau

We love Accurate Cosmology

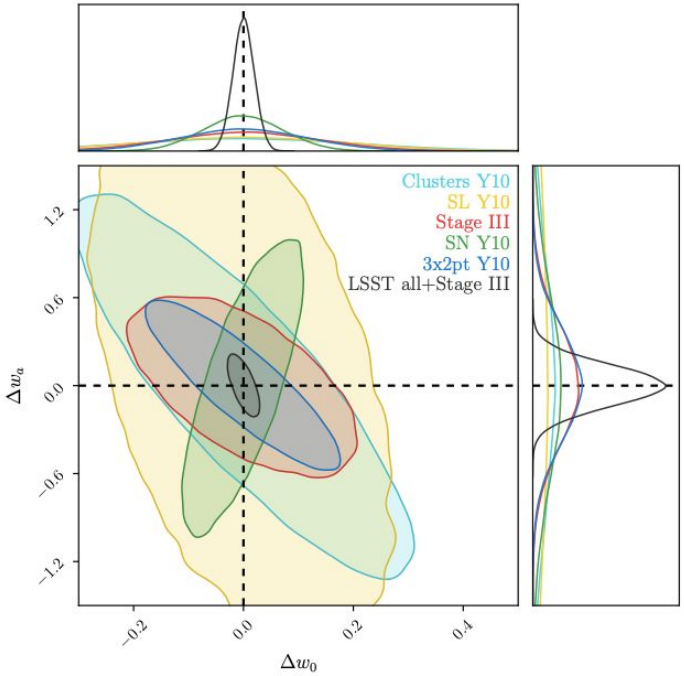
We study one of the most pressing conundrums of modern science: Dark Energy and the formation of structure.
To achieve our objectives we research new methods for obtaining state-of-the-art, robust cosmology constraints that will take best advantage of the full statistical precision of the LSST data.

We are a Vibrant and Inclusive Scientific Community

We work hard to maintain a positive and respectful collaborative working environment.

We tackle LSST's Big Data Challenge

We carry out method development and research in data science to build robust, high-throughput software pipelines to simulate, re-process, and analyze images and catalogs at LSST scale.



DESC Science Requirements Document

DESC Commissioning Goals

- Photometric redshifts of individual galaxies and redshift distributions of samples of galaxies obtained from commissioning data should be produced and validated by the **R**edshift **A**ssessment **I**nfrastructure **L**ayers (RAIL) pipeline.
- The PZ working group in DESC is currently developing and validating the capabilities of RAIL and other pipelines, along with curated reference catalogs, in science projects.
- The development of RAIL is supported by DESC simulations and efforts/challenges that evaluate the science readiness of the RAIL pipeline.
- The validation and application of our redshift estimation pipeline spans multiple working groups in DESC, such as weak lensing, large-scale structure, and time domain.
- The **goal is to guarantee science readiness** to LSST precision and ensure the scalability of RAIL to LSST big data cosmology.
- The development and validation is currently supported by 3 pipeline scientists and 6 in-kind contributors, in addition to a vibrant and highly active PZ working group.

AGN Science Collaboration - Roberto Assef

TVS - Ashley Villar

- Transients and variable stars SC is interested in a broad range of topics. We will focus on extragalactic science
- The majority of our transient events occur within host galaxies, and the redshift is used to help classify sources.
- The properties of hosts have *some* correlation to the transients, of varying level of correlation strength and complexity of the properties. For example core-collapse supernovae strongly prefer star-forming galaxies (“easy” to identify given blue colors). Tidal disruption events prefer post-starburst galaxies (no clue how to identify).
- To search for anomalies, we must minimize catastrophic failure.

Science Collaborations

Pause for questions.

Community resources

RAIL - Alex + John Franklin

RAIL is code to enable flexible experimentation with photo-z data products. Use it to:

- forward-model mock data including sources of systematic error
- stress-test estimators under realistically complex conditions of imperfection
- compare photo-z data products by many metrics

https://github.com/LSSTDESC/RAIL

LSSTC Slack #desc-pz-rail

DESC PZ DC1 experiment arXiv:2001.03621 conclusions and next steps

From AAS 237 talk 443.05

Each photo-*z* posterior estimator is distinguished by its implicit prior.

→ The implicit prior must be isolated to use photo-*z* posteriors for DESC cosmology.

No photo-*z* posterior estimator is perfect, even with perfect prior information.

→ We must probe the response of estimators under realistically imperfect prior information.

Traditional metrics of photo-*z* posterior performance are inappropriate.

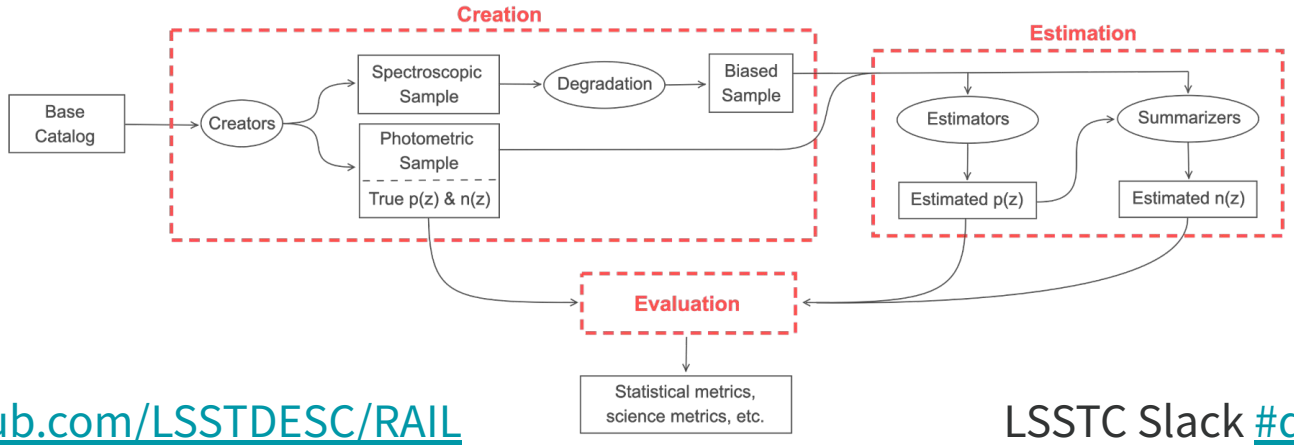
→ To evaluate principled metrics, we must compare estimates to true photo-*z* posteriors.

RAIL - Alex + John Franklin

RAIL is code to enable flexible experimentation with photo-z data products. Use it to:

- forward-model mock data including sources of systematic error
- stress-test estimators under realistically complex conditions of imperfection
- compare photo-z data products by many metrics

RAIL is modular, extensible, public, and designed for community contributions.



https://github.com/LSSTDESC/RAIL

LSSTC Slack #desc-pz-rail

LIneA - Julia Gschwend

BRA-LIN in-kind contribution program

- Lite IDAC
- Software + Data Products
  - DESC Pipe. Sci.
  - **PZ Server (under development)**
  - **PZ Training Set Maker (designing)**
  - **PZ Compute (scalability tests)**
  - **FTEs for commissioning process (myself**
    - BRA-LIN work plan includes FTEs to the PZ Validation Cooperative;
    - Open to redefine scope depending on the commissioning process.

Beta version test phase soon!

LIneA - Julia Gschwend (clean slide)

BRA-LIN in-kind contribution program

- Lite IDAC
- Software + Data Products
  - DESC Pipe. Sci.
  - PZ Server
  - PZ Training Set Maker
  - PZ Compute
  - FTEs for commissioning process (myself - 0.05 FTE)
    - BRA-LIN work plan includes FTEs to contribute to the PZ Validation Cooperative;
    - Open to redefine scope depending on DM needs for the commissioning process.

LIneA = Inter-institutional Laboratory of e-Astronomy

(but in Portuguese)
www.linea.org.br

BRA-LIN key-people:

- Program Lead: Luiz da Costa
- Program Manager: Julia Gschwend
- IDAC Cont. Lead: Carlos Adean
- PZ Cont. Lead: Julia Gschwend
- DESC Pipeline Scientist: Sandro Vitenti
- In-kind Program Coordinator (from Rubin): Aprajita Verma

LINCC - Rachel Mandelbaum

The LINCC Frameworks team aims to provide advances in cross-cutting software infrastructure to enable the community's analysis tools to work at the scale and complexity demanded by the LSST. *(Check out the recent white paper: https://arxiv.org/abs/2208.02781)*

In the realm of **photo-z and commissioning**, we aim to:

- Provide effort, from software developers working in close collaboration with scientists, on cross-cutting (rather than science use-case specific) software infrastructure.
- Make the best use of resources by coordinating our efforts with the extragalactic LSST SCs (esp. the DESC PZ RAIL team), Rubin DM, and in-kind teams (e.g., LIneA).

The software developer involvement means our team may be more suited for certain tasks (e.g., on data representation, optimization, etc.) than others (e.g., catalog curation).

Q&A + Discussion