LSST Discovery Alliance

Helping Scientists Use Rubin's LSST

LSST
Discovery
Alliance

Agenda

1. Intro (10 + 2 min) - Beth Willman

2. Frameworks (8 + 2 min) - Alex Malz

3. Catalyst Fellowship (8 + 2 min) - Tansu Daylan and Somayeh Khakpash

4. Data Science Fellowship Program (8 + 2 min) - Jake Kurlander and Guillem Megias

5. Inclusive Collaboration Initiative (8 +2 min) - Beth Willman

6. Breakout groups to discuss Early Science (20 min)

7. Report out and full group discussion (12 min)

History

The LSST Corporation (LSSTC) was founded in 2003 as a not-for-profit 501(c)3 Arizona corporation to initiate the Large Synoptic Survey Telescope project and to advance the science of astronomy and physics.

University of Arizona, Research Corporation, University of Washington, and NOAO (now NOIRLab) were the founding organizations.

Today

Our goal is to maximize the impact of Rubin LSST through support from member institutions, grants from foundations, and donations from corporations and private donors. We are committed to changing how science is done, how it's funded, and who's at the table.

What we do - We facilitate resources and funding to help scientists study data of this unprecedented scale and complexity.
How we do it - We develop bold programs and funding opportunities that accelerate transformative breakthroughs in astrophysics through inclusion, scientific networks, and multi-disciplinary collaboration. We collaborate closely with Rubin Observatory and Science Collaborations.

Foundation Support: Schmidt Futures, Brinson, Heising-Simons, Templeton, Research Corp, Moore

- **Catalyst Fellowship** - This flagship program is a unique three- to four-year fellowship for post-doctoral researchers in both astrophysics *and* social sciences. (Director, J. Sokoloski - LSST-DA)
- **LINCC Frameworks Project** - This ambitious five-year program will develop advances in software infrastructure for the scientific community to help effectively analyze the enormous volume and complexity of Rubin LSST data. (PIs A. Connolly - UW, R. Mandelbaum - CMU, J. Sokoloski - LSST-DA)
- **Data Science Fellowship** - This innovative two-year training program develops diverse cohorts of astronomy students with the essential skills for science with large, complex datasets. (Director, A. Miller - Northwestern)

Current Programs

- **Small Grants Program** - Periodic calls for small grants are designed to provide members with agile and timely support to prepare for Rubin LSST science.
- **Inclusive Collaboration Initiative** - This funded suite of programs incentivize inclusion through childcare support, best practices in inclusive collaboration, and institutional partnerships.
- **Summer Student Program** - A program for students at member institutions to attend the annual Rubin LSST meeting, present LSST-related research, and receive professional development. (Director, R. Oelkers - TAMU)

Current Members

Adler Planetarium	LIneA	Texas A&M
Breakthrough Listen at Berkeley	Las Cumbres Observatory	Institute of Physics Czech Republic
Carnegie Mellon	MPIA	Penn State
Chile	Northwestern	University of Arizona
Columbia University	NOIRLab	University of Illinois Urbana-Champaign
IN2P3	Princeton	Oxford
INAF	Purdue	Pitt
Johns Hopkins	Rutgers	University of Washington
KIPAC/Stanford	Schmidt Futures	Yale
Kavli IPMU	SLAC	

Member Benefits - Access to Programs

- Priority access to all LSST Discovery Alliance programs, including graduate student training, student network development, workshops, and software incubator proposals
- Eligibility to host a prize postdoctoral fellow
- Eligibility to request grants for LSST-related science and funded student travel
- Eligibility to initiate a funded Expansion Partnership

- **Leverage our work for your institution by helping design future programs**
- Attract faculty and students by demonstrating your commitment to big data in astrophysics
- Show your dedication to inclusive and diverse scientific discovery
- Establish a model for multiplying the scientific impact of a federally-funded research facility through private funding
- Shape plans and programs through the Institutional Board and elected Executive Board.
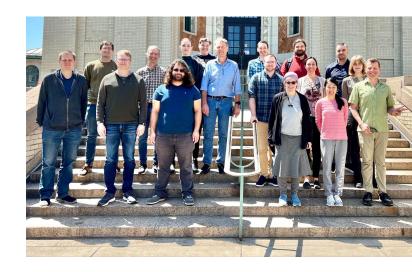
The LINCC Frameworks Project
LSST Interdisciplinary Network For Collaboration And Computing

A collaboration between UW, CMU, LSSTC,
Pitt, and NOIRLab to build software,
frameworks, and systems for key LSST science.

PIs:

Andy Connolly (UW)

Rachel Mandelbaum (CMU)

Director of Engineering:

Jeremy Kubica (CMU)

https://www.lsstcorporation.org/lincc/frameworks

LINCC Frameworks Mission

The LINCC Frameworks team's mission is to *enable LSST science* by developing *scalable, productionised software* in *collaboration* with the Rubin community. LINCC Frameworks aims to:

- be engineering- and algorithm-focused,
- collaborate with other software efforts (e.g. by contributing to standard community tools/libraries),
- synergize with Rubin resources (e.g. by building on the Rubin Science Platform), and
- coordinate with the community to maximize utility and minimize duplication of effort.

LINCC Frameworks Team Members

Software Engineers

- Wilson Beebe
- Doug Branton
- Sandro Campos
- Carl Christofferson
- Melissa DeLucchi (TL: CMU)
- Olivia Lynn
- Sean McGuire
- Drew Oldag (TL: UW)
- Max West

Project & Research Scientists

- Neven Caplar
- Colin Chandler
- Mi Dai
- Kostya Malanchev
- Alex Malz
- Samuel Wyatt
- Tianqing Zhang

https://www.lsstcorporation.org/lincc/frameworks/team

LSST Discovery Alliance

SCHMIDT FUTURES

Workshop: From Data to Software to Science with the Rubin Observatory LSST

Goals: To enable *interactive development* for exciting scientific use cases with early LSST data, and to identify shared computational/technical challenges and needed technological advances associated with them.

	Cross-matching	Photo-z	Selection functions	Time series	Image reprocessing	Image analysis
Cosmology	✓✓	✓✓	✓✓	✓✓	✓	✓
Extragalactic static	✓✓	✓✓	✓✓		✓✓	✓
Extragalactic transient	✓✓	✓✓	✓	✓✓	✓	✓
Extragalactic variable	✓✓	✓	✓	✓✓	✓	✓
Local Universe transient & variable	✓✓		✓	✓✓		
Local Universe static	✓✓		✓✓		✓	✓
Solar system	✓		✓✓	✓✓	✓	✓✓

whitepaper at https://arxiv.org/abs/2208.02781

SCHMIDT **FUTURES**

Common technical areas

** Area of current development

1. Scalable Cross-matching**: real-time (low-latency) positional matching of ~10k sources to ~10 catalogs of ~1Bn sources; offline/batch match-and-join of ~1Bn sources to catalogs of ~1Bn sources.

2. Photometric redshifts**: characterizing and updating photo-z (PDFs) tailored to specific science cases in parallel; storage of uncertainties (~10TB for LSST data)

3. Selection function determination: building on DM selection function capabilities; extending to broad science cases (scalar and vector selection functions)

4. Scalable job execution system**: parallelizing analyses (feature extraction, classification, model-fitting, analysis, inference) for ~1Bn sources

Common technical areas

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5. Sky image access and reprocessing at scale: reprocessing subsets of images (cutouts and full-focal plane data); scalable data access services, processing infrastructure, and processing software (built from DM software)

6. Object image access and analysis at scale: processing individual (object-level) images (e.g. deblending, classification) in parallel; scalable image cutout service of arbitrary size; ability to link results to archival data

7. Time series analysis support infrastructure**: enabling parallelized parametric and empirical model fitting, feature extraction, classification, anomaly detection; produce, store, link, and update outputs in step with the alert stream timescales
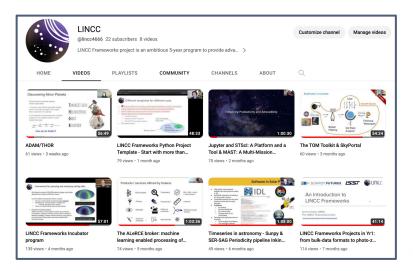
Incubators

Incubators support researchers at LSSTC member institutions and the broader community to work directly with the LINCC Frameworks team to achieve software-centric science goals.

Goal: Establish long-term software development collaborations that serve both the selected teams and LINCC Frameworks.

Three calls per year; apply at
https://www.lsstcorporation.org/lincc/content/incubators

Tech Talks

- Tech Talks showcase the work done by the broad Rubin software and archives community.

- Past presenters include brokers, in-kind contributors, data centers, and LINCC Frameworks software engineers.

- Future plans include talks by Roman software group and the results of the incubators.

2nd Thursday of the month,
10 am Pacific at
https://ls.st/lincc-talks

Catalyst Fellowship - Overview

- Astrophysics and Social Science prize postdoc fellowships for scientists with extraordinary promise in Rubin LSST science and positive impact in the LSST community.
- 3-4 year terms at US and international LSST-DA member institutions
- Funded mentoring teams include LSST Science Collaboration representation and connections with the LINCC Frameworks software teams
- Annual symposia to bring Catalyst community together
- Funded by private philanthropic foundations – currently the John Templeton Foundation

JOHN
TEMPLETON
FOUNDATION

Program Director - Jeno Sokoloski, Program Manager - Andrew Sturner

Catalyst Fellowship - Overall impact to date

- Selection complete for Fall 2022 and 2023 cohorts.
- 130 applications received, 14 fellows chosen (12 in astrophysics, 2 in social science)
- 40+ co-author papers already, including in Nature and Nature Astronomy
- 1st Annual Catalyst Symposium – October 23-25, 2023 in Tucson
- Aiming for a new call for fellowship applications in late 2024

Arrykrishna Mootoovaloo   Azalee Bostroem   Christopher Carroll

Somayeh Khakpash   Tansu Daylan   Emily Cunningham
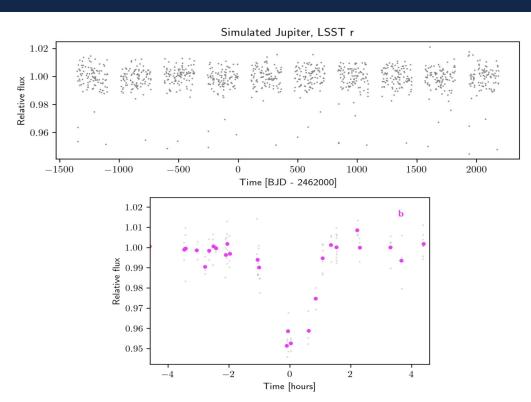
Get to know our Current Fellows

Program Director - Jeno Sokoloski, Program Manager - Andrew Sturner

Transiting exoplanet detection using LSST

Simulated Jupiter, LSST r

Data Science Fellowship Program

Fellows come from every sub-field of LSST with the intent of supporting a broad cross section of the community.

Data Science *for* Astronomy intended to prepare the community for the Legacy Survey of Space and Time by teaching (**both!**) technical and professional skills necessary for science with large surveys.

Core technical topics taught by expert guest instructors (~70 as of Session 19):

> Week-long sessions focus on Statistics (Bayesian & Classical), Machine Learning, Time Series Methods, Image Processing, Databases & Software Engineering, Visualization, Communication & Data Ethics and **build across sessions.**

Program Director - Adam Miller, DSFP Postdoctoral Fellow - Bryan Scott

DSFP - Impact to Date

Sustained Impact: Session 19 will be held in September 2023 (Session 1 was held in August 2016). LSST Y1 data will provide new opportunities for impact - we are thinking carefully about how best to evolve the program with early survey data.

Local Impact: Each session is held at a rotating host institution to maximize the impact of the program. 5 local auditing students join the program and the DSFP community. Lunches with local faculty provide opportunities for professional connections across astronomy.

International Impact: ~140 current fellows and program alumni. International fellows are broadening participation in LSST. Fellows have joined us from every inhabited continent, including current participants from Africa and South America.

Program Director - Adam Miller, DSFP Postdoctoral Fellow - Bryan Scott

DSFP - Impact on Alums

Research Impact: Average of 30 papers/cohort as author or co-author

Career Impact: Most program alumni remain in their PhD programs. However, as of the last outcomes census in 2021, **~3 program alumni were now in tenure track faculty positions and ~10 in Prize Postdoctoral Fellowships**.

Social & Community Impact: External programmatic review highlights that current fellows report an improved sense of belonging in astronomy, and increased access to mentorship and collaboration opportunities beyond those available solely through their home institutions.

Program Director - Adam Miller, DSFP Postdoctoral Fellow - Bryan Scott

DSFP Sponsors

LSST Discovery Alliance provided ~$100k of funding to initiate the DSFP. Northwestern/CIERA has hosted DSFP since its initiation.

Inclusive Collaboration Initiative

An initiative to (i) build diversity, equity, and inclusion into all Discovery Alliance programs and (ii) help embed practices and structures that foster DEI more broadly into the Rubin LSST science community.

Pilot Childcare Support Program

Inclusive Collaboration Proposal Call

Expansion Partnership Program

Childcare Support Program

- This 2023 pilot program is an LSST-DA/IceCube partnership.
- Designed to **increase inclusion of parents with young children in collaboration meetings**, and to **understand the extent and impact of childcare needs** on members of the Rubin LSST and IceCube scientific communities.
- **13 childcare support grants** have been awarded to participants in the 2023 PCW and LSST@Europe5.
- **Grants ranged from $100 - $4000**, and have been awarded to individuals in the US, South America, and Europe.
- Grants are sent directly to individuals in advance of the meeting.

Inclusive Collaboration Proposal Call

- Builds on the Inclusive Collaboration recommendation focus areas the *From Data to Software to Science (DS2)* workshop held in 2022:
  - Build sustainable cross-institutional partnerships
  - Strategies for dealing with authorship
  - Strategies for fostering an inclusive team environment
  - Strategies for working with students
- Is directing ~$100,000 USD towards work on the development, documentation, and dissemination of policies and best practices related to Inclusive Collaboration.
- 22 proposals were submitted; **Oversubscribed by nearly 4x.**

Expansion Partnership Program

This program was designed to:

- make LSST science accessible to research communities that might otherwise be excluded.
- increase the diversity of LSST Discovery Alliance member institutions and support their active participation in LSST-DA, so that our scientific programs are designed to position a diverse and inclusive community to participate in Rubin LSST science.

We incorporated experience from the Rubin Community Science Team DPO work, Street & Bianco Leveling the Playing Field program, and the SDSS4 Faculty And Student Teams program.

Expansion Partnership Program

The program is structured to support engagement of small, under-resourced, and/or under-represented institutions in Rubin LSST science.

- This engagement is via partnerships with institutions well integrated into Rubin LSST science and via membership in the LSST Discovery Alliance.
- LSST-DA membership will position faculty and students at Expansion Institutions to participate in (i) Rubin LSST science networks and (ii) the design and development of new programs to support their use of Rubin LSST data.

Basic information about becoming a member -
https://www.lsstcorporation.org/node/385

What is an Expansion Partnership?

An Expansion Partnership is between two institutions (or consortia), one of which classifies as an "Expansion Institution" and the other of which is an institution that is already established within the Rubin LSST science community. Through this program, a paying member institution may choose to confer LSST-DA membership to an Expansion Institution at no additional cost to anyone. Each institution in the partnership will be a full institutional member of LSST-DA. All member institutions benefit from access to resources, influence and visibility, and participating in a like-minded community that wants to establish new norms of inclusive participation in astrophysics.

The paying member of an Expansion Partnership will be expected to:
- Work actively to include the Expansion Institution in their astronomical community and to integrate them into the LSST-DA Institutional Board
- Be publicly recognized as an Expansion Sponsor, on the LSST-DA website

Expansion Partnership Funding

Funded support for 10 partnerships that initiate between October 2023 and October 2025.

For each partnership:

- $14,000 in one-time support to invest in each expansion institution's success.
- $5,000 in annual support for partnership student participation in Rubin LSST-related research travel - e.g. a conference or to another institution.
- $3,600 in annual support for expansion sponsor and expansion institution to attend annual LSST-DA Board Meeting.
- Sponsored cohort development meeting in 2024 and 2025.

What early* science opportunities do you want to jump on (i.e. what is the first paper you expect to write), and what resources are needed to seize those opportunities?

- DP1 ~ early 2025
- DP2 ~ early 2026
- DR1 ~ late 2026

*Using the Rubin definition that "Early science is any science enabled by Rubin for its community through and including the first data release, DR1."