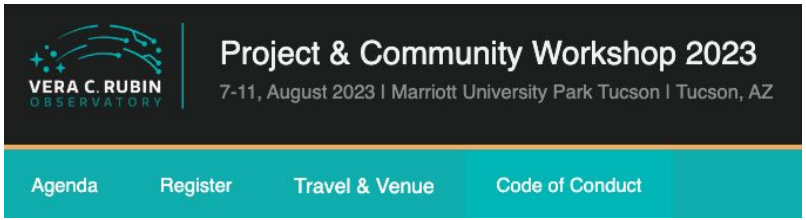
Reminder - Code of Conduct

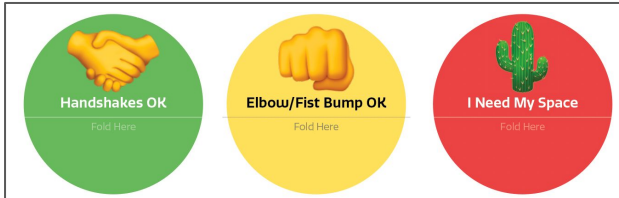


Harassment and unprofessional conduct (including the use of offensive language) of any kind is not permitted at any time and should be reported to:

- Andrew Connolly (ajc@astro.washington.edu),
- John Franklin Crenshaw (jfc20@uw.edu), and/or
- Alysha Shugart (ashugart@lsst.org).

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.

full code of conduct



Check name-tags for these contact comfort level stickers.

Wear a mask if you want to!

Use the confidential email rubin2023-covid@lists.lsst.org to request a test, report your test results, or ask questions.

If someone is wearing a pin like this, and it indicates a low social battery, please give them their space or offer to restart the conversation at a later time.

If you feel unsafe at any time send an email to rubin2023-helpline@lists.lsst.org

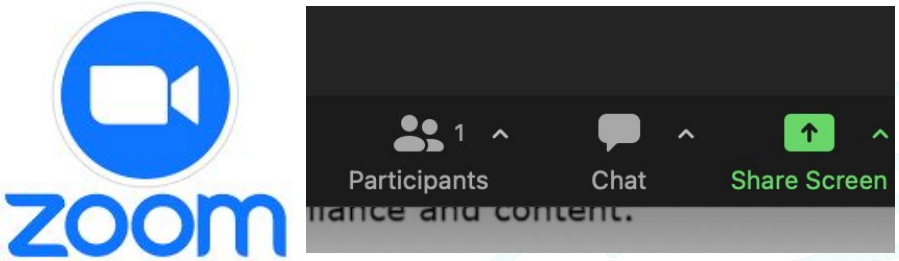
Reminder - Virtual Participation

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 Rubin2023_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 Zoom, use the chat to:
- request to unmute to ask a question, or
- type your question so someone can speak it aloud.

The Zoom "raise hand" feature is generally harder for moderators to track, and is not preferred, but may be used at the discretion of the session chair.

VERA C. RUBIN OBSERVATORY

The Rubin Science Collaborations

Plenary - Wed Aug 9, 2023

Science Collaborations Coordinator: Will Clarkson
With presentations from: Colin Orion Chandler, Renée Hložek, François Lanusse, Sara Bonito, Igor Andreoni, Simona Mei, Tansu Daylan, Franz Bauer

NSF AURA U.S. DEPARTMENT OF ENERGY SLAC CHARLES AND LISA SIMONYI FUND FOR ARTS AND SCIENCES LSST CORPORATION

Session Chair:
Melissa Graham

Rubin Science Collaborations: Session plan

1. Science Collaborations overview
2. Some highlights from the science collaborations
3. Issues and challenges
4. How to contribute and get involved

5. Lightning Stories (20 min)

wiclarks@umich.edu

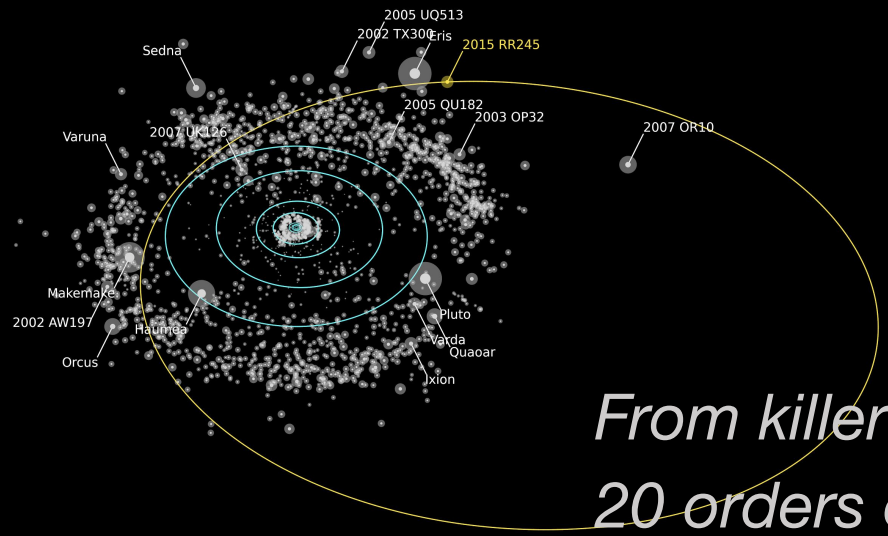
Rubin Science Collaborations: who we are

The Rubin Observatory/LSST Science Collaborations (SCs) comprise a federation of independent, worldwide communities of scientists, self-organized into collaborations based on their research interests and expertise. Main activities:

- 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)

Rubin Science Collaborations

Unprecedented data volume to be leveraged for multiple science goals.



From killer asteroids to the distant Universe:
20 orders of magnitude in distance scales
60 orders of magnitude in energy scales

Slide credit:
Melissa Graham

wiclarks@umich.edu

The 8 Rubin Science Collaborations

Solar System Science Collaboration (Colin Orion Chandler, Meg Schwamb)

Dark Energy Science Collaboration (Renée Hložek, Tesla Jeltema)

Informatics & Statistics Science Collaboration (François Lanusse, Ashley Villar)

Transients & Variable Stars (Igor Andreoni, Sara Bonito)

Galaxies Science Collaboration (Sugata Kaviraj, Simona Mei)

Stars, Milky Way & Local Volume (Peregrine McGehee, Will Clarkson)

Strong Lensing Science Collaboration (Graham Smith, Timo Anguita → Simon Birrer from 09/23)

Active Galactic Nuclei (Niel Brandt, Gordon Richards)

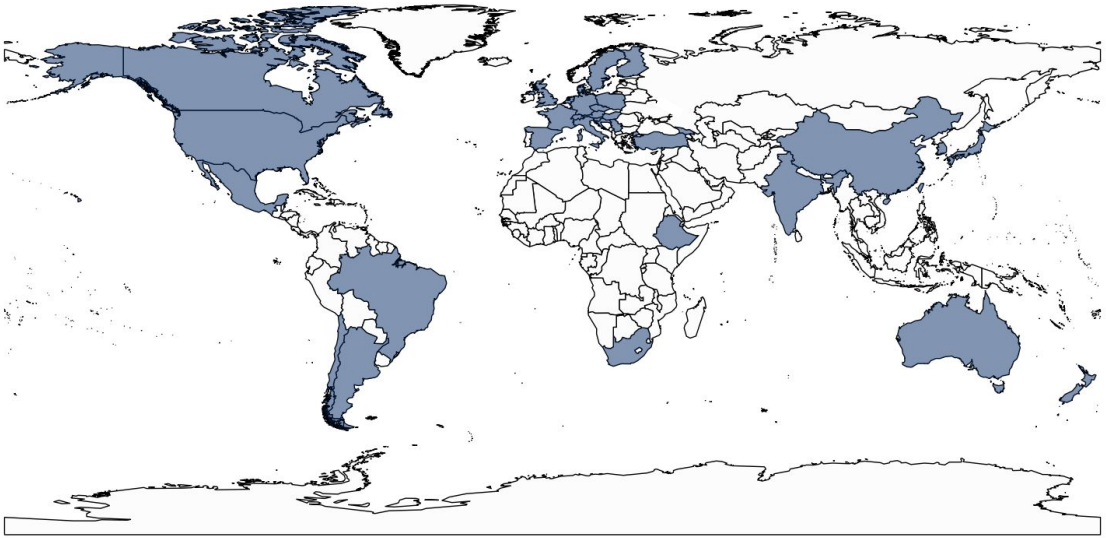
wiclarks@umich.edu
Acronyms & Glossary

Rubin Science Collaborations: who we are

SCs Federation Charter

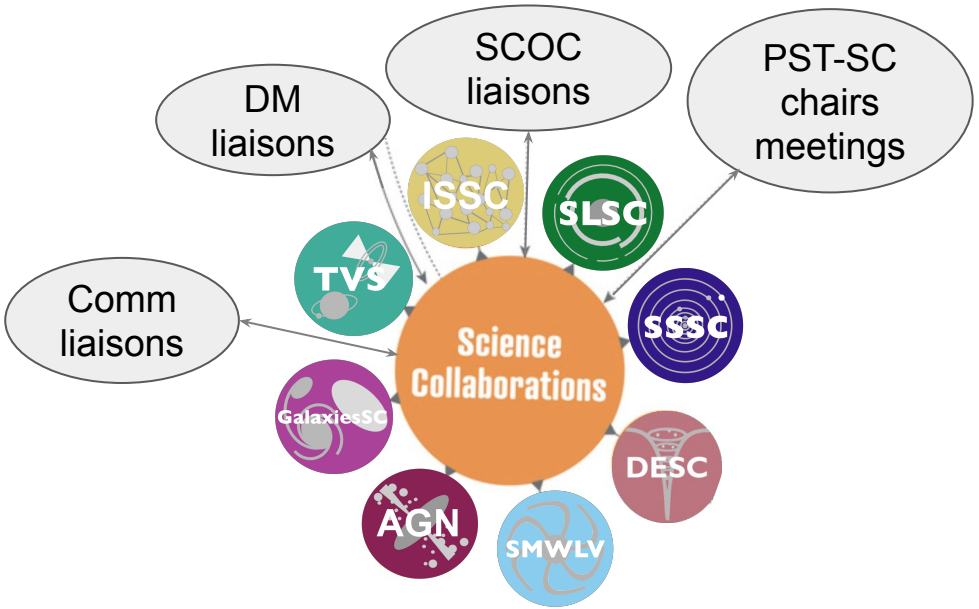
8 Science Collaborations as autonomous, self-managed teams

- >2000 people, 2500 affiliations, 6 continents, 29 countries
- No membership fees.
- No requirement to be affiliated with any organization.
- No requirements on time-commitment for basic membership.
- No constraints **from Rubin** on data-rights status to join an SC



wiclarks@umich.edu
Acronyms & Glossary

The SCs are plugged in to all the elements of the Rubin ecosystem.



Standing committees

- CEC Committee
- Rubin Users' Committee
- SCOC
- LSSTC SC Adv. Comm
- SC's DEI Council

ad-hoc committees

- Euclid DP Committee
- Impact of delays in pixel access

- SC Coord. On Research Incl. Team
- SC Coord. on SAC
- SC Coord. on LSSTC Exec Board
- SC Coord. On PCW SOC

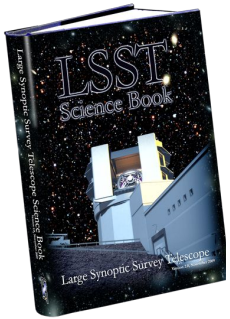
Credit: Federica Bianco

Rubin Science Collaborations: what we do

The Rubin Observatory/LSST Science Collaborations (SCs) comprise a federation of independent, worldwide communities of scientists, self-organized into collaborations based on their research interests and expertise. Main activities:

- 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)

Preparing for LSST



LSST Science Book, 2009

Prepared by the LSST Science Collaborations, with contributions from the LSST Project.

Enabling collaboration across science areas


The Astrophysical Journal Supplement Series, 258:3 (13pp), 2022 January https://doi.org/10.3847/1538-4365/ac3bb0

Blazar Variability with the Vera C. Rubin Legacy Survey of Space and Time

Claudia M. Raiteri[1], Maria I. Carnerero[1], Barbara Balmaverde[1], Eric C. Bellm[2], William Clarkson[3], Filippo D'Ammando[4], Maurizio Paolillo[5], Gordon T. Richards[6], Massimo Villata[1], Peter Yoachim[7], and Ilsang Yoon[8]
[1] INAF-Osservatorio Astrofisico di Torino, Via Osservatorio 20, I-10025 Pino Torinese, Italy; claudia.raiteri@inaf.it
[2] DIRAC Institute, Department of Astronomy, University of Washington, 3910 15th Avenue NE, Seattle, WA 98195, USA
[3] University of Michigan-Dearborn, Dearborn, MI, USA
[4] INAF-Istituto di Radioastronomia, Via Gobetti 101, I-40129 Bologna, Italy
[5] Università degli Studi di Napoli Federico II, I-80126 Napoli, Italy
[6] Department of Physics, Drexel University, 32 S 32nd Street, Philadelphia, PA 19104, USA
[7] University of Washington, Seattle, WA, USA
[8] National Radio Astronomy Observatory, Charlottesville, VA, USA
Received 2021 October 15; revised 2021 November 10; accepted 2021 November 17; published 2021 December 22

e.g. Raiteri et al. 2022 ApJS 258, 3

SC roadmaps document the needs of the Rubin users' base and set the direction of science efforts

A Software Roadmap for Solar System Science with the Large Synoptic Survey Telescope

Megan E. Schwamb[1], Henry Hsieh[2], Michele T. Bannister[3], Dennis Bodewits[4], Steven R. Chesley[5], Wesley C. Fraser[3], Mikael Granvik[6,7], R. Lynne Jones[8], Mario Jurić[8], Michael S. P. Kelley[9] + Show full author list

Published March 2019 • © 2019. The American Astronomical Society. A

Research Notes of the AAS, Volume 3, Number 3

Citation Megan E. Schwamb *et al* 2019 *Res. Notes AAS* **3** 51

Large Synoptic Survey Telescope Galaxies Science Roadmap

B. Robertson, M. Banerji, +47 authors Members of the Lsst Galaxies Science Collaboration • Published 4 August 2017 • Physics • arXiv: Astrophysics of Galaxies

Participation in the in-kind contribution program:

- Evaluation of contributions (the CEC)
- 80 contributions with an SC as primary or secondary recipient
- Incorporating in-kind contributions into SC's efforts

Providing expert analysis to Rubin

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

2017 COSEP

Science-Driven Optimization

of the LSST Observing Strategy

Prepared by the LSST Science Collaborations,
with support from the LSST Project.

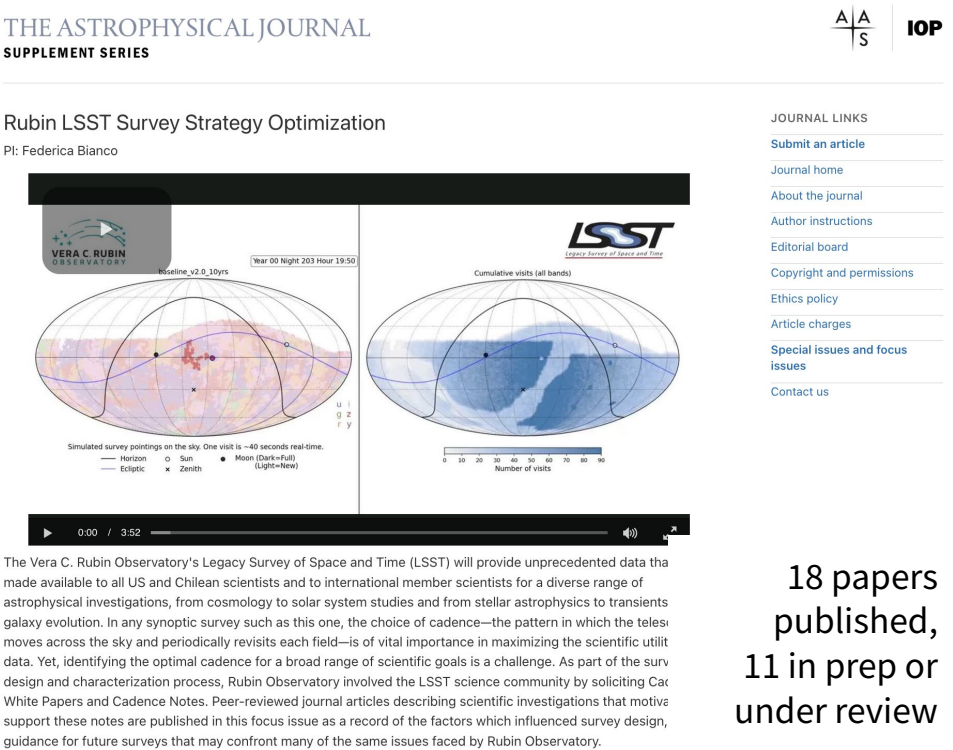
https://github.com/LSSTScienceCollaborations/ObservingStrategy

2018: Survey strategy white papers
https://www.lsst.org/submitted-whitepaper-2018

46 papers, 467 authors

2021: Cadence Notes
https://www.lsst.org/content/survey-cadence-notes-2021

39 notes, 218 authors



18 papers published, 11 in prep or under review

wiclarks@umich.edu

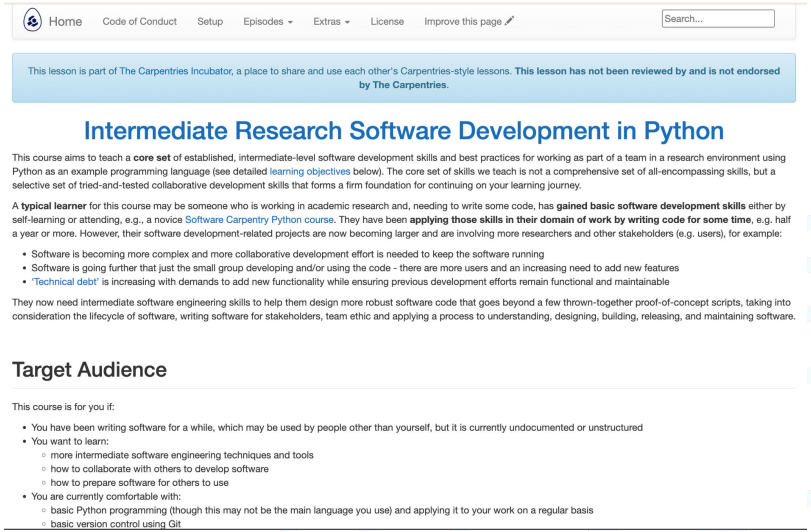
Training, Education & Engagement
Example: Software training

Professional training provided by Software Sustainability Institute and the Software Carpentries

- Course materials **freely available**
  https://lsst-sci-prep.github.io/

Paid for IEEE Course in software requirements engineering

PI: Rachel Street, TVS



wiclarks@umich.edu

Fundraising for our teams and their projects

~$1e4 and below

- SC's are in a good position to know about and propose for programs within the Rubin ecosystem (e.g. LSSTC's Enabling Science calls; LINCC; LSST-DA's Inclusive Collaborations program)
- Expertise to help members propose for internal or regional grants

~$1e5-1e6

- Leverage diversity of expertise to help members prepare PI funding proposals to agencies
- Multi-SC proposals to foundations (e.g. HSF-funded Preparing For Astrophysics with LSST, PI Rachel Street - https://lsst-sci-prep.github.io/)

BUT - funding is still a challenge!

wiclarks@umich.edu
Acronyms & Glossary

Develop and implement research inclusion practices

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

All the Rubin SC's are active in improving research inclusion within their collaboration.

The SC's DEI Council exists to help harness and coordinate these efforts, to share knowledge and experience, and (where appropriate) to promote effective DEI practices within the SC's and the Rubin organizations. Members:

AGN	Matthew Temple	SLSC	Aprajita Verma	SC's	Will Clarkson (chair)
DESC	Ian Dell'Antonio	SMWLV	Sara Bonito	AURA/NSF	Sandrine Thomas
Galaxies	Manda Banerji	SSSC	Laura Inno	SLAC/DoE	Phil Marshall
ISSC	Lior Shamir	TVS	Federica Bianco	NOIRLab	Ameera McBride

wiclarks@umich.edu
Acronyms & Glossary

Collaborate on software development (including in-kind)

Engaging in Data Preview 0 (DP0)

- DESC created the simulated data set being used for DP0.1 & DP0.2 (Galactic / extragalactic, images & catalogs)
- SSSC created the simulated data set being used for DP0.3 (Solar system catalogs)
- TVS “DP0 task force” preparing for time-domain science with DP0.2
- Science Collaboration members have contributed notebooks, tutorials, and presentations on DP0 during “Delegate Assemblies”

wiclarks@umich.edu

Directing in-kind contributions

Primary Recipients	Type	Number of Contributions	Equivalent Value ($M)
AGN	Telescope Time and Datasets	1	0.1
AGN	Directable SW Effort	7	4.3
DESC	Telescope Time and Datasets	4	2.4
DESC	Non-directable SW Effort	6	3.5
DESC	Directable SW Effort	24	17.3
Galaxies	Non-directable SW Effort	3	2.5
Galaxies	Directable SW Effort	8	4.3
Solar System	Directable SW Effort	2	1.2
SMWLV	Non-directable SW Effort	1	1.2
SMWLV	Directable SW Effort	3	2.0
Strong Lensing	Non-directable SW Effort	1	0.3
Strong Lensing	Directable SW Effort	2	1.6
TVS	Telescope Time and Datasets	3	2.7
TVS	Non-directable SW Effort	3	1.7
TVS	Directable SW Effort	12	10.1
	Totals:	80	55.1

Figure credit: Phil Marshall

wiclarks@umich.edu

Rubin Science Collaborations: what we do

The Rubin Observatory/LSST Science Collaborations (SCs) comprise a federation of independent, worldwide communities of scientists, self-organized into collaborations based on their research interests and expertise. Main activities:

- 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)

Rubin Science Collaborations: Session plan

1. Science Collaborations overview
2. Some highlights from the science collaborations
3. Issues and challenges
4. How to contribute and get involved

5. Lightning stories (20 min)

Rubin LSST Science Collaborations

Science collaboration presentations

- Each SC rep will present for about 6 minutes. If time permits, we can take some questions after the last SC has presented.
    - Reminder: the session Slack Channel (**#day3-wed-0900-plenary-sci-collabs**) is the place to ask questions that persist after the meeting (please indicate to which SC you are asking the question).
- Show appreciation 👋 and upvote questions you are interested in 👍

SSSC: http://www.lsstsssc.org

Solar System Science Collaboration (Colin Orion Chandler, Meg Schwamb)

Dark Energy Science Collaboration (Renée Hložek, Tesla Jeltema)

Informatics & Statistics Science Collaboration (Francois Lanusse, Ashley Villar)

Transients & Variable Stars (Igor Andreoni, Sara Bonito)

Speaker: Colin Chandler (UW)

A few foci: Inner/outer Solar System, Near Earth Objects, Kuiper Belt Objects, Interstellar Objects

LSST will catalog over 5 million Main-Belt asteroids, almost 300,000 Jupiter Trojans, over 100,000 NEOs, and over 40,000 KBOs!

SSSC: http://www.lsstsssc.org

Chairs: Colin Orion Chandler (UW/LINCC/DiRAC; coc123@uw.edu)
Meg Schwamb (QUB; mschwamb.astro@gmail.com),

Number of members: 200+

Discover 5+ million small Solar System bodies, A billion observations

The SSSC exists to support scientists in preparing for and using the revolutionary LSST dataset and to organize the LSST Solar System science community.

We welcome everyone interested in Solar System science.

SSSC: http://www.lsstsssc.org

2023 LSST SSSC Sprint (Flagstaff, Arizona)

Recent activity:

- Papers, e.g.,
  - "Tuning the Legacy Survey of Space and Time (LSST) Observing Strategy for Solar System Science" (Schwamb+ 2023, ApJS)
- Tools, e.g.,
  - Sorcha survey simulation tools (LINCC Frameworks Incubator)
  - Preparing for in-kind contributions
- 2023 SSSC Sprint
  - Discussion, development, and writing
- New co-chair: Colin Chandler

SSSC: http://www.lsstsssc.org

Plans for the next year:

- Working Groups are gearing up
  - Community Software/Infrastructure Development
  - Active Objects
  - Near Earth Objects & Interstellar Objects
  - Inner Solar System
  - Outer Solar System
  - Technosignatures Think Tank*
- Services Development/Deployment
  - Event notification system - **seeking feedback now**
- Sprints and Observing Proposal Workshops
- Utilizing DP 0.3 (includes simulated Solar System objects!!!)

August DP 0.3 Release: A big thank you to:

- Rubin Solar System Processing Team
- Rubin Community Science Team
- Rubin Science Platform & Database Teams

*New cross-community entity seeking synergies between planetary astronomy and technosignature research.

DESC: https://lsstdesc.org/

Solar System Science Collaboration (Colin Orion Chandler, Meg Schwamb)

Dark Energy Science Collaboration (Renée Hložek, Tesla Jeltema)

Informatics & Statistics Science Collaboration (Francois Lanusse, Ashley Villar)

Transients & Variable Stars (Igor Andreoni, Sara Bonito)

Speaker: Renée Hložek (University of Toronto)

High accuracy, high precision measurements of fundamental cosmological parameters using data from the LSST by combining five dark energy probes:

- Clusters of galaxies
- Large scale structure
- Strong lensing
- Supernovae
- Weak lensing

Dark Energy Science Collaboration

- Our scientific aim: Exploring the physics of the Dark Universe
  - Dark energy, dark matter, neutrinos and signatures of inflation
- Our objectives: (visit DESC webpage for more details)

- Producing accurate cosmology results
- Supporting a vibrant & inclusive scientific community
- Meeting LSST's big data challenge
- Learning continuously from each other

Our approach: Combining five cosmological probes: Clusters of galaxies, large-scale structure, supernovae, weak lensing and strong lensing (see Science Overview Document)

Spokesperson team:
Renée Hložek (U. Toronto)
Tesla Jeltema (UC Santa Cruz)

hlozek@dunlap.utoronto.ca
tesla@ucsc.edu

1,200+ members, 240+ full members (with voting rights on policies etc).
For DESC membership apply here

https://lsstdesc.org/


The DESC collaboration at SLAC, 2023

Examples of Current Efforts

Some science highlights:

- > 70 papers published
- Started a DESC mentorship program in 2022: 14 initial pairings, we hope to grow in 2023
- New Science Plan for Year 1 analyses
- Lots of new science initiatives/challenges including STatic Analysis Roundtable (STAR), Extended LSST Astronomical Time-series Classification Challenge (ELAsTiCC), Tomographic challenge (see some highlights next)

Some collaboration highlights:

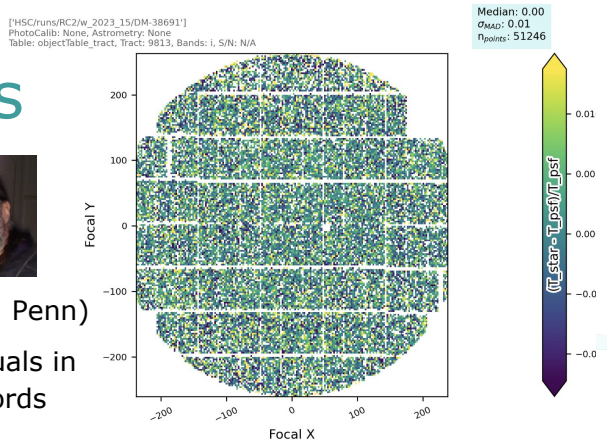
- Lots of work by the DESC Collaboration Council to improve DESC policies and climate
- First DESC Demographics survey by the DESC EDI Committee

Recent DESC Science Highlights

Commissioning: >100 DESC members are making in-kind contributions to Rubin Obs commissioning through the International In-kind Program and US/Chile Announcement of Opportunity Program (see SITCOMTN-050)

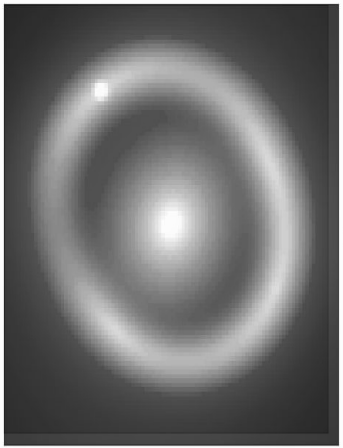
Mike Jarvis (U. Penn)

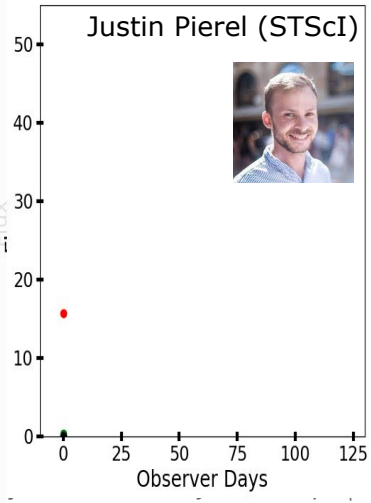
PSF size residuals in focal plane coords



Science validation: DESCQA and value-added contributions to analyis tools

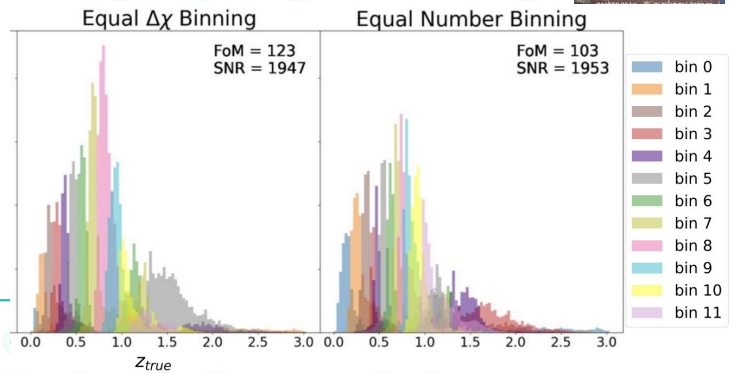
Strongly Lensed Supernovae: Combining pixel-level simulations and observing strategy to simulate lensed SNe light curves with Rubin





STatic Analysis Roundtable (STAR): Coordinated static science projects including one to find optimal binning for 3x2pt weak lensing signal using CNN

Irene Moskowitz (R



Challenges/opportunities

- ***Photo-z:*** accurate redshifts require testing algorithms and spectroscopic redshift calibration (see slides and recordings from photo-z session Monday and spec-z on Tuesday)
- ***Survey cadence:*** Next steps involve testing the cadence for optimal DDF and uniform WFD
- ***Blending***: We are testing deblending algorithms and pushing impact through to cosmology
- ***Photometric calibration:*** Our current work is testing the impact of calibration on cosmology
- ***Transients/alerts:*** We are preparing for the alert stream and running ELAsTiCC sims for broker readiness
- ***Shear:*** Current efforts are to test our shear pipeline end-to-end

We want to continue to build connections across other science collaborations through inter-collaboration agreements, joint projects and shared expertise – please get in touch if there are ways to support each other!

ISSC: https://lsstissc.github.io/

Solar System Science Collaboration (Meg Schwamb, Colin Orion Chandler)

Dark Energy Science Collaboration (Renée Hložek, Tesla Jeltema)

Informatics & Statistics Science Collaboration (Francois Lanusse, Ashley Villar)

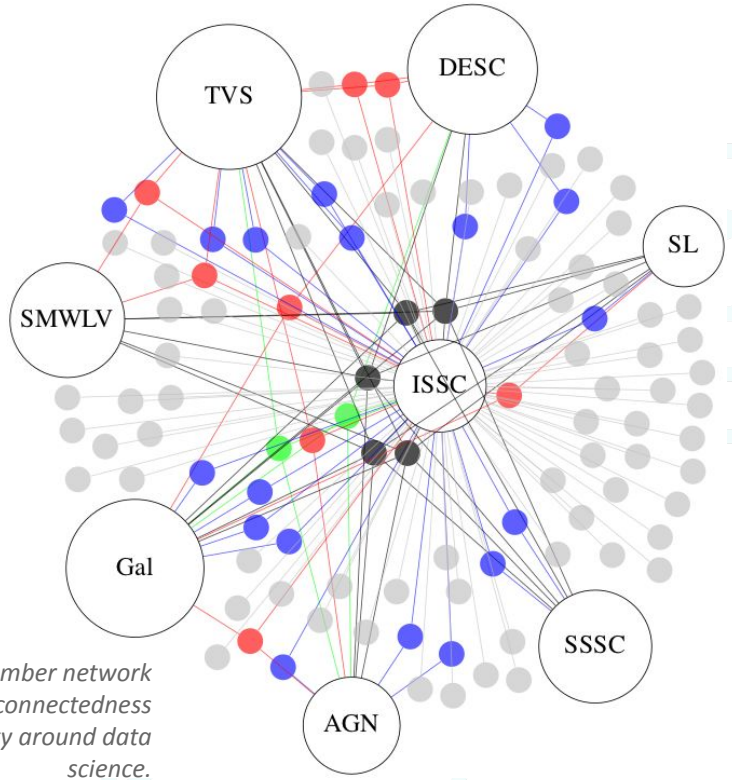
Transients & Variable Stars (Igor Andreoni, Sara Bonito)

Speaker: François Lanusse

Experts in statistical and machine learning methods, from astronomy and data science communities, interested in the development and implementation of sophisticated methods of data analysis to advance science with the Rubin Observatory, and to push the frontiers of data science.

Informatics & Statistics Science Collaboration

- The ISSC is a community of 130+ members with the following objectives:
  - Provide a community of astro-focused data science experts for **consultation/guidance**
  - Stimulate and guide **new interdisciplinary research** on methods/algorithms
  - **Coordinate methodological developments** across the LSST community, promoting synergy and reducing duplication of effort



The ISSC member network illustrating the interconnectedness of the Rubin community around data science.

https://issc.science.lsst.org

Highlights From Recent Activities

Workshop:

- Bayesian Deep Learning for Cosmology and Time Domain Science
  Paris, APC, June 2022, led by E. Aubourg, F. Bianco, A. Boucaud, F. Lanusse, C. Roucelle, C. Schafer
  *Funded by the 2020 LSSTC Enabling Science Call, **co-sponsored by TVS, DESC, ISSC**.*

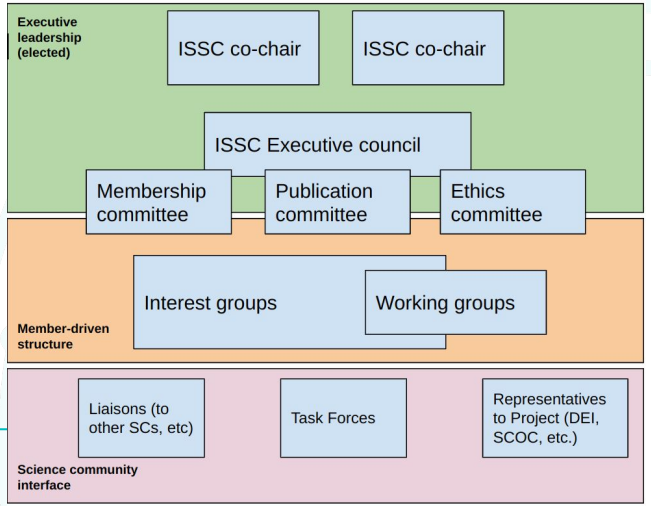
Examples of Projects from ISSC members:

- **Strong lensing time delay estimation with CARMA processes**
  - Penn State/Imperial/Harvard (Antoine Meyer, ***Hyungsook Tak***, ***Aneta Siemiginowska***, David van Dyk)
    arxiv: 2207.09327
- **Detecting Tidal Features using Self-Supervised Representation Learning**
  - LSSTC Enabling Science ISSC Ambassadors project (Sarah Brough, ***Francois Lanusse***, Alice Desmons)
    arxiv: 2307.04967
- **Training set robustness of GP-based photo-z estimators**
  - LSSTC Enabling Science ISSC Ambassadors project (Natalia Stylianou, ***Alex Malz***, Peter Hatfield, ***John Franklin Crenshaw***, Julia Gschwend)
    arxiv: 2202.12775

The ISSC is Evolving!

- The Collaboration has started a **deep restructuring effort** in 2023
  - A new **ISSC Charter was ratified last month**
    - Defines **broad Interest Groups** led by the ISSC, but **welcoming participants from any SC**
      - Can host topical seminars, discussion groups, workshops, etc.
    - Defines focused **Working Group** structures which could be **co-led between the ISSC and other SCs**:
      - E.g. for the development of particular tools
    - First groups will get started in the fall!

- **Great time to get involved** if you want to lead new activities!
  - If you have a use-case or idea to create inter-SC connections, let us know!
    #issc-ask-the-issc to easily get in touch with us!



TVS: https://lsst-tvssc.github.io/

Solar System Science Collaboration (Colin Orion Chandler, Meg Schwamb)

Dark Energy Science Collaboration (Renée Hložek, Tesla Jeltema)

Informatics & Statistics Science Collaboration (Francois Lanusse, Ashley Villar)

Transients & Variable Stars (Igor Andreoni, Sara Bonito)

Galaxies Science Collaboration

Active Galactic Nuclei (Niel Brandt, Gordon Richards)

Speakers: Igor Andreoni & Sara Bonito

Enhance research into a wide range of variable and transient phenomena in both galactic and extragalactic contexts: planets, variable stars, eruptions, explosions, mergers.

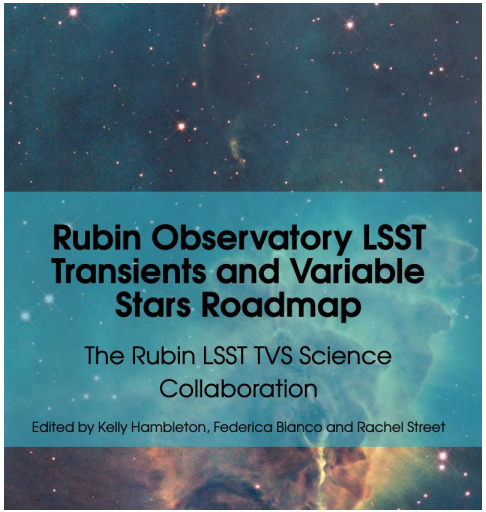
TVS: https://lsst-tvssc.github.io/

Highlights 2022/23:

- **> 500** members 🎉
- **> 12** papers published this year - significant input for survey strategy
- **20** Kickstarter projects
- **33** in-kind projects for which TVS is recipient
- TVS Colloquia: on-going (organizer Priscila Pessi)
- Workshops/conferences organized (e.g. software, DP0, survey strategy)
- 2022/23 Science Highlights SLIDE DECK

Sessions at PCW by TVS subgroups and Task Forces: TVS (Mon); Data accessibilities (Tue, + community science team); True Novelties (Thur); Crowded Fields (Fri; +SMWLV)

TVS: A broad range of topics



Microlensing
Eclipsing Binary Stars
Cataclysmic Variables
Neutron Star Binaries
Black Hole Binaries
Supernovae
Intermediate-Luminosity Optical Transients
Light Echoes of eruptions and explosions
EM counterparts of GW events
Justice Equity Diversity Inclusion

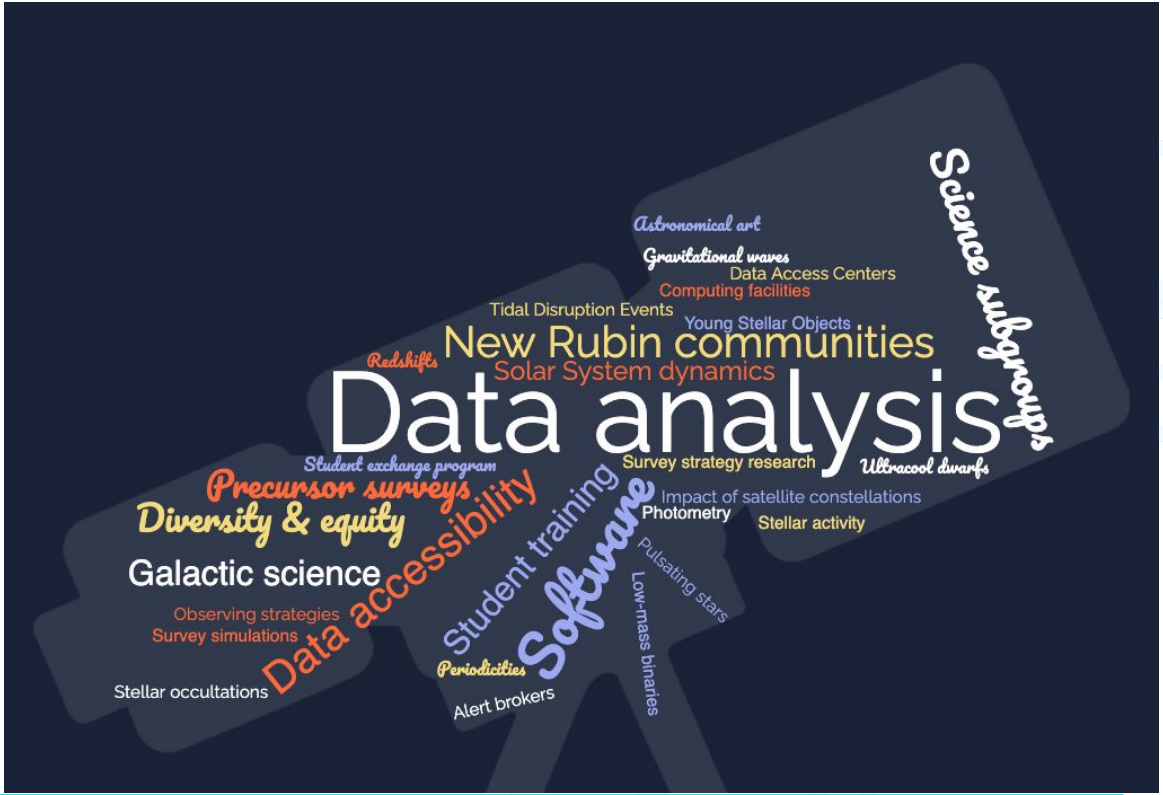
Young stellar objects
Pulsating Stars
Cepheids and RR Lyrae Stars
Long Period Variables
Brown Dwarfs
GRB
Blazars
Transiting Exoplanets
Alert Brokers
SETI
Tidal Disruption Events
…

TVS: Kickstarter Projects

Science collaborations:
TVS & SMWLV & SSSC

35 projects, **20** TVS

Kickstarter PI and image credit:
Rachel Street



HEISING-SIMONS FOUNDATION

TVS: Opportunities

Opportunities:

- **Task Forces** - renewed yearly - of transversal SC interest
  - DP0 platform learning support, specific for TVS science
  - Software (including in-kind connection)
  - Commissioning
  - Crowded field photometry
  - Survey Strategy

- Bi-weekly TVS **calls** + subgroup/task-force **activities** + **announcements**

- Look out for institutional Fellowships related to in-kind

TVS: Challenges

Challenges [work in progress!]:

- Lack of dedicated financial support
- Transition towards using real data, alert streams via brokers
- Coordination when LSST data come in (role of subgroups). Can coordination improve the science?

Galaxies: https://sites.google.com/view/lsstgsc/home

Speaker: Simona Mei

Core goal: perform extra-galactic science over ~90% of cosmic time

~5 billion galaxies observed with LSST!

Galaxies Science Collaboration (Sugata Kaviraj, Simona Mei)

Stars, Milky Way & Local Volume (Peregrine McGehee, Will Clarkson)

Strong Lensing Science Collaboration (Graham Smith, Timo Anguita → Simon Birrer from 09/23)

Active Galactic Nuclei (Niel Brandt, Gordon Richards)

Collaboration (François Lanusse, Ashley Villar)

Transients & Variable Stars (Igor Andreoni, Sara Bonito)

Galaxies: https://sites.google.com/view/lsstgsc/h

We are a ~300 people collaboration (new members are very welcome!)

Monthly collaboration-wide telecons with talks and updates

The Rubin Galaxies collaboration meeting, Paris, June 2023

Working groups:

Active galactic nuclei
Galaxy environment
Galaxy morphology
Low-surface-brightness science
SED-fitting and photometric techniques
Strong lensing
Survey strategy

See our presentations at the The Rubin Galaxies Science Collaboration session on Monday for contacts and activities

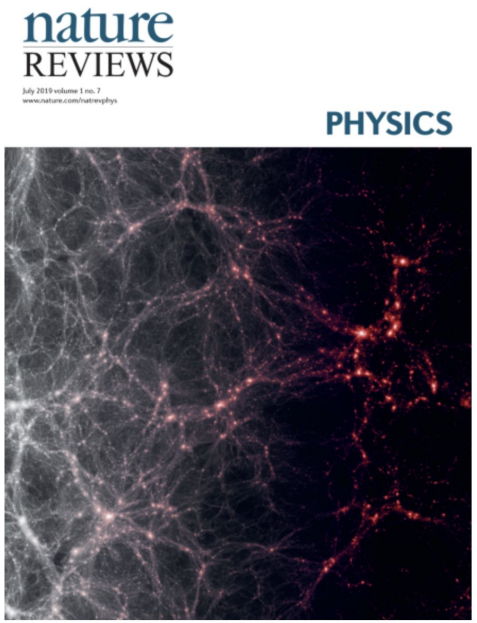
LSST Galaxies Science Roadmap

Large Synoptic Survey Telescope
Galaxies Science Roadmap

Robertson, Brant E.[1], Banerji, Manda[2], Cooper, Michael C.[3], Davies, Roger[4], Driver, Simon P.[5], Ferguson, Annette M. N.[6], Ferguson, Henry C.[7], Gawiser, Eric[8], Kaviraj, Sugata[9], Knapen, Johan H.[10,11], Lintott, Chris[4], Lotz, Jennifer[7], Newman, Jeffrey A.[12], Norman, Dara J.[13], Padilla, Nelson[14], Schmidt, Samuel J.[15], Smith, Graham P.[16], Tyson, J. Anthony[15], Verma, Aprajita[4], Zehavi, Idit[17], Armus, Lee[18], Avestruz, Camille[19], Barrientos, L. Felipe[14], Bowler, Rebecca A. A.[4], Bremer, Malcolm N.[20], Conselice, Christopher J.[21], Davies, Jonathan[22], Demarco, Ricardo[23], Dickinson, Mark E.[13], Galaz, Gaspar[14], Grazian, Andrea[24], Holwerda, Benne W.[25], Jarvis, Matt J.[4,26], Kasliwal, Vishal[27,28,29], Lacerna, Ivan[30,14], Loveday, Jon[31], Marshall, Phil[32], Merlin, Emiliano[24], Napolitano, Nicola R.[33], Puzia, Thomas H.[14], Robotham, Aaron[5], Salim, Samir[34], Sereno, Mauro[35], Snyder, Gregory F.[7], Stott, John P.[36], Tissera, Patricia B.[37], Werner, Norbert[38,39,40], Yoachim, Peter[41], Borne, Kirk D.[42], and Members of the LSST Galaxies Science Collaboration

[1]*Department of Astronomy and Astrophysics, University of California, Santa Cruz, Santa Cruz, CA 96054, USA,* [2]*Institute of Astronomy, Kavli Institute for Cosmology, University of Cambridge, Madingley Road, Cambridge CB30HA, UK,* [3]*Department of Physics and Astronomy, University of California, Irvine, 4129 Frederick Reines Hall, Irvine, CA 92697, USA,* [4]*Department of Physics, University of Oxford, Denys Wilkinson Building, Keble Rd., Oxford, OX1 3RH, UK,* [5]*International Centre for Radio Astronomy Research (ICRAR), University of Western Australia, Perth, Australia, WA 6009, Australia,* [6]*Institute for Astronomy, University of Edinburgh, Royal Observatory, Blackford Hill, Edinburgh, EH9 3HJ, UK,* [7]*Space Telescope Science Institute, 3700 San Martin Drive, Baltimore MD 21218, USA,* [8]*Rutgers University, 136 Frelinghuysen Rd., Piscataway, NJ 08854-8019, USA,* [9]*Centre for Astrophysics Research, University of Hertfordshire, College Lane, Hatfield, Herts AL10 9AB, UK,* [10]*Instituto de Astrofsica de Canarias, E-38200 La Laguna, Spain,* [11]*Departamento de Astrofsica, Universidad de La Laguna, E-38206 La Laguna, Spain,* [12]*Department of Physics and Astronomy and PITT PACC, University of Pittsburgh, 3941 O'Hara St., Pittsburgh, PA 15260, USA,* [13]*NOAO, 950 N. Cherry Ave, Tucson, AZ 85719, USA,* [14] *Instituto de Astrofsica, Pontificia Universidad, Católica Chile, Vicuña Mackenna 4860, Santiago, Chile,* [15]*Department of Physics, University of California, Davis, One Shields Ave, Davis, CA, 95616, USA,* [16]*School of Physics and Astronomy, University of Birmingham, Edgbaston, B15 2TT, UK,* [17]*Department of Astronomy, Case Western Reserve University, 10900 Euclid Avenue, Cleveland, OH 44106, USA,* [18]*IPAC/Caltech, 1200 E. California Blvd. MS314-6, Pasadena, CA 91125, USA,* [19]*Kavli Institute for Cosmological Physics, University of Chicago, 5640 South Ellis Ave., Chicago, IL 60637, USA,* [20]*H.H. Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol, BS8 1TL, UK,* [21]*School of Physics and Astronomy, University of Nottingham, Nottingham, NG7 2RD, UK,* [22]*Cardiff University, School of Physics and Astronomy, The Parade, Cardiff, CF22 3AA, UK,* [23]*Departamento de Astronomía, Universidad de Concepción,Casilla 160-C, Concepción, Chile,* [24]*INAF - Osservatorio Astronomico di Roma, Via Frascati, 33, I-00078, Monte Porzio Catone (Roma), Italy,* [25]*Department of Physics and Astronomy, 102 Natural Science Building, University of Louisville, Louisville KY 40292, USA,* [26]*Department of Physics, University of the Western Cape, Bellville 7535, South Africa,* [27]*Colfax International, 750 Palomar Avenue, Sunnyvale, CA 94085, USA,* [28]*University of Pennsylvania, Department of Physics & Astronomy, 209 S 33rd St, Philadelphia, PA 19104, USA,* [29]*Princeton University, Department of Astrophysical Sciences, 4 Ivy Lane, Princeton, NJ 08544, USA,* [30]*Instituto Milenio de Astrofsica, Av. Vicuña Mackenna 4860, Macul, Santiago, Chile,* [31]*Astronomy Centre, University of Sussex, Falmer, Brighton, BN1 9QH,*

Robertson +17, ArXiv:1708.01617



Robertson +19, Nature Rev. Phys, 1, 450

https://tinyurl.com/lsstgalaxies

Galaxies: https://sites.google.com/view/lsstgsc/home

- LSST will provide a new window onto galaxy formation and evolution
- We will probe the rarest cosmic environments
- The gravitational lensing signals will enable us to understand the interplay between galaxy formation and evolution, and galaxy dark matter halos
- LSST will be unique in unveiling the low-surface-brightness features around galaxies
- Machine learning techniques will address galaxy study challenges, such as morphological classification and deblending.
- Existing ancillary data and new observational programs will enable us to make full use of the power of LSST

Galaxy Morphology

Scientific Challenges:

Extreme data volumes and an evolving dataset Billions of objects imaged at high cadence means significant computational challenges. **New methods needed for efficiently identifying and characterising galaxies and their sub-structures**.

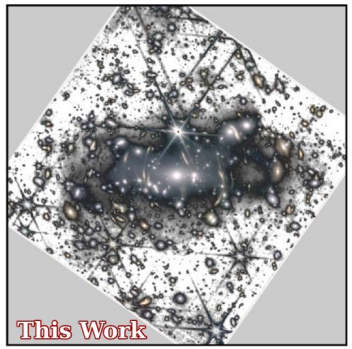
An unfamiliar, unexplored discovery space: Poorly understood biases. Unknown underlying populations. Leveraging LSST for the discovery of new classes of rare and/or faint objects.

Members of the working group are involved in a number of complementary projects combining supervised/unsupervised machine learning and non-parametric structural measures.

Slack channel: #galaxies-morphology

Chairs: Jeyhan Kartaltepe (jeyhan@astro.rit.edu)
Garreth Martin (garrethmartin@kasi.re.kr)

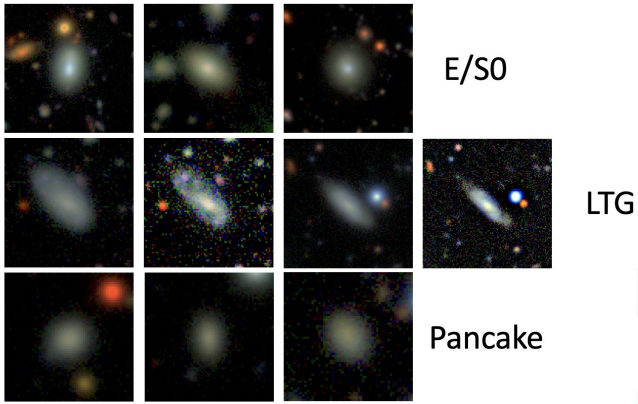
Low surface brightness science with Rubin



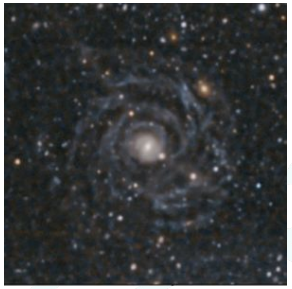
ICL w/ JWST (Montes & Trujillo 2022)

- Intracluster light, stellar halos, tidal debris
  - Historical records of galaxy/cluster dynamical histories
  - Sensitive probes of dark matter halos
  - Cluster growth: key cosmological constraint

- Dwarf galaxies:
  - Most abundant kind of galaxy
  - Sensitive tracers of environmental influence & baryonic feedback
  - Key to numerous cosmological mysteries: missing dwarfs, galaxy downsizing, too big to fail



Example dwarf morphologies (Lazar et al. in prep.; see M. Jones 's presentation at the Rubin Galaxies session)

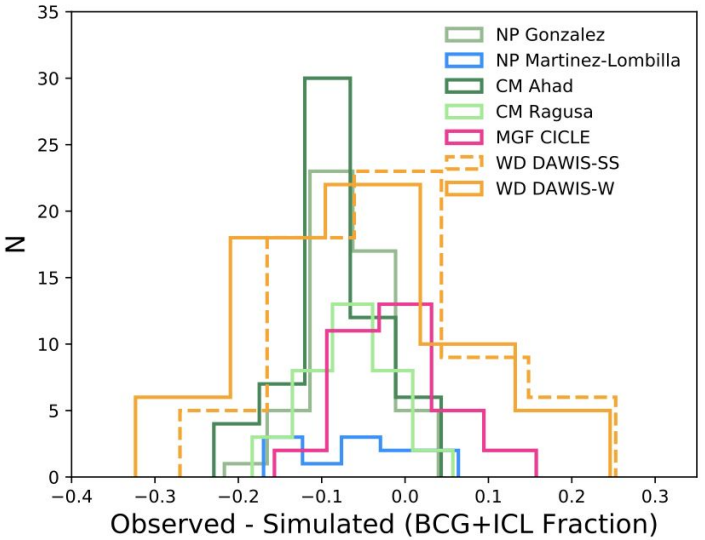


Malin 1, deep image (Galaz et al. 2015)

- The rare and the extreme
  - Giant LSBs (Malin 1; Impey & Bothun 1989)
  - Ultra-faint (Virgo I, M_V=-0.8; Homma et al. 2016)
  - Ultra-LSB (Antlia 2; $\langle\mu_e\rangle$~32 mag arcsec^{-2};Torrealba et al. 2019)
  - Dust-rich LSB (Junais et al. 2023; presentation at the Rubin Galaxies session)

Do observers and simulators measure the same quantity of Intra Cluster Light (ICL)? Brough et al. (submitted)

- Comparing observers and simulators ICL fraction measures from LSST-like mock *r*-band images of 61 14 < LogM/M⊙ < 14.5 clusters from the Horizon-AGN, Hydrangea, IllustrisTNG and Magneticum simulations
- Observed Brightest Cluster Galaxy+ICL light fractions are offset from simulations by ~0.05dex. The offset does not depend strongly on the observers' method.



Current collaboration-wide discussions

- Publication policy: a draft will be circulated in the next few months for collaboration-wide input
- Input to commissioning: in-kind contributions to SIT-COM, definition of the science validation (SV) metrics that are most relevant for galaxy studies, help to refine SV targets
- Engage with Early Science

SMWLV: https://rubin-smwlv.github.io/

Speaker: Will Clarkson (UM-Dearborn)

Some topics:

- The Solar Neighborhood
- Star Clusters
- Variable Stars
- Galactic Bulge
- Galactic Structure and ISM
- Magellanic Clouds
- Near Field Cosmology

190 Members

Stars, Milky Way & Local Volume
(Peregrine McGehee, Will Clarkson)

SMWLV slides: Peregrine McGehee

SMWLV Star Clusters Subgroup

Extragalactic Star Cluster Science with the Nancy Grace Roman Space Telescope's High Latitude Wide Area Survey and the Vera C. Rubin Observatory: https://arxiv.org/abs/2306.12620

The Nancy Grace Roman Telescope's High Latitude Wide Area Survey will have a number of synergies with the Vera Rubin Observatory's Legacy Survey of Space and Time (LSST), particularly for extragalactic star clusters. Understanding the nature of star clusters and star cluster systems are key topics in many areas of astronomy, chief among them stellar evolution, high energy astrophysics, galaxy assembly/dark matter, the extragalactic distance scale, and cosmology.

Rubin Observatory LSST Stars Milky Way and Local Volume Star Clusters Roadmap: https://arxiv.org/abs/2306.17333

The Vera C. Rubin Observatory will undertake the Legacy Survey of Space and Time, providing an unprecedented, volume-limited catalog of star clusters in the Southern Sky, including Galactic and extragalactic star clusters. The Star Clusters subgroup of the Stars, Milky Way and Local Volume Working Group has identified key areas where Rubin Observatory will enable significant progress in star cluster research.

SMWLV slides: Peregrine McGehee

Other SMWLV Subgroup highlights

The SMWLV Near-Field Cosmology Subgroup

Chair: M. Dall'Ora; Active since 2022; Members: 37; Regular meetings once per month

Last 12 months activities:

- Subgroup Roadmap, focused on the resolved stellar populations
- Joint meeting with the DESC DM Subgroup

The SMWLV Galactic Structure and ISM Subgroup

Chair: P. McGehee; Active since 2022; Members: 18; Regular meetings once per month. Last 12 months activities:

- Subgroup Roadmap, focused on stellar populations, astrometry, Gaia synergies

SMWLV slides: Peregrine McGehee

The SMWLV/TVS Crowded Stellar Fields Task Force

Chairs: M. Dall'Ora (TVS), R.M. Rich (SMWLV); Spokesperson: K. Hambleton; Active since 2018

Members: 34, from SMWLV and TVS SCs; Regular meetings every two weeks, **PCW23 session 0900 Friday**

Last 12 months activities:

- Development of a python code for the period search within the Kickstarter program "Stellar variability with Rubin-LSST" (PI: M. Monelli)
- Validation of a DAOPHOT/ALLFRAME pipeline for the crowded stellar fields, in cooperation with the Italian in-kind contribution "Stellar populations and variable stars in crowded fields"
- Collaboration with the SMWLV Stellar Clusters Subgroup

Future projects:

- Testing & validation of the Rubin-LSST DIA efficiency in benchmark fields
- A summary of the state-of-the-art period finding algorithms, ranked by variability types

SMWLV slides: Peregrine McGehee

Survey Strategy - Final Design

SMWLV science goals inform the final design, including footprint, filter balance, and cadence, of the coverage of non-WFD (“Wide Fast Deep”) areas of the Galaxy:

- Crowded field areas including the Galactic Bulge and Galactic Plane
- Magellanic Clouds
- South Celestial Pole

A joint TVS/SMWLV taskforce (Led by Rachel Street and Jay Strader) will be suggesting new OpSim runs to explore choices in these areas and on choosing and evaluating metrics to assess the results of these runs.

The effort will be over the next few months, with a goal of being done by the end of November.

SMWLV slides: Peregrine McGehee

SLSC: https://sites.google.com/view/lsst-stronglensing

Speaker: Tansu Daylan (Washington University at St. Louis)

Some topics:

- Galaxy Mass and structure of $10^{4\text{-}5}$ lenses!
- Cosmography (lensed QSO, SNe, transients)
- Quasar microlensing

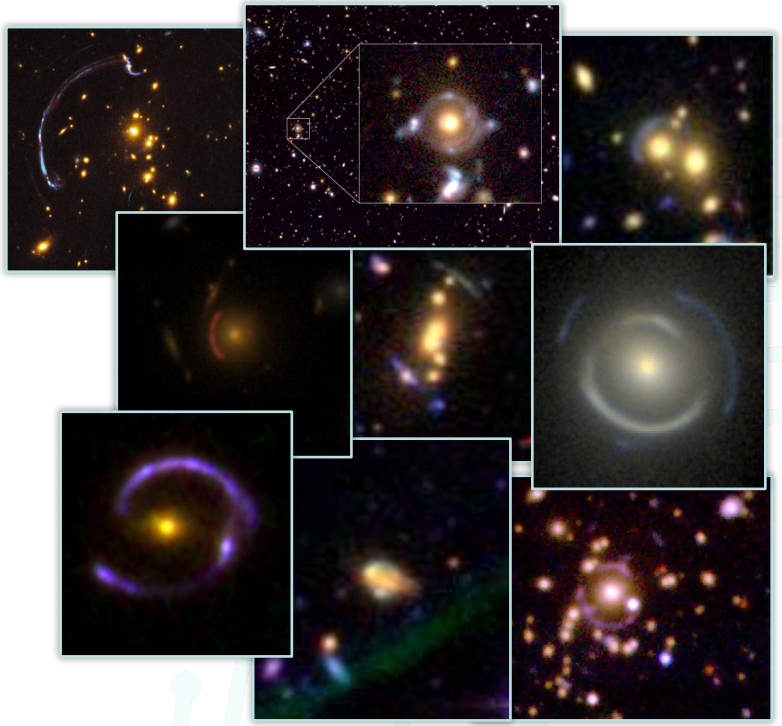
121 Members

Strong Lensing Science Collaboration (Graham Smith, Timo Anguita → Simon Birrer from 09/23)

Strong Lensing Science Collaboration

Presenter: Tansu Daylan

Co-chairs: Timo Anguita - tanguita@gmail.com
Graham Smith - gps@star.sr.bham.ac.uk
Simon Birrer - simon.birrer@stonybrook.edu (soon!)



Overview of SLSC science:

- Mass and structure of **dark matter halos**: 10^5 strong lenses spanning galaxies, groups and clusters
- Time delay **cosmography**: lensed QSO, SNe, GWs
- Quasar **microlensing**: accretion disk structure of 10^3 lensed AGN and IMF of lensing galaxies
- **Gravitational telescopes**: resolved properties of high-redshift galaxies
- Physics of lensed **explosive transients** (SNe, TDEs, KNe, GWs, GRB afterglows)
- *Many more*...

Strong Lensing Science Collaboration

Presenter: Tansu Daylan

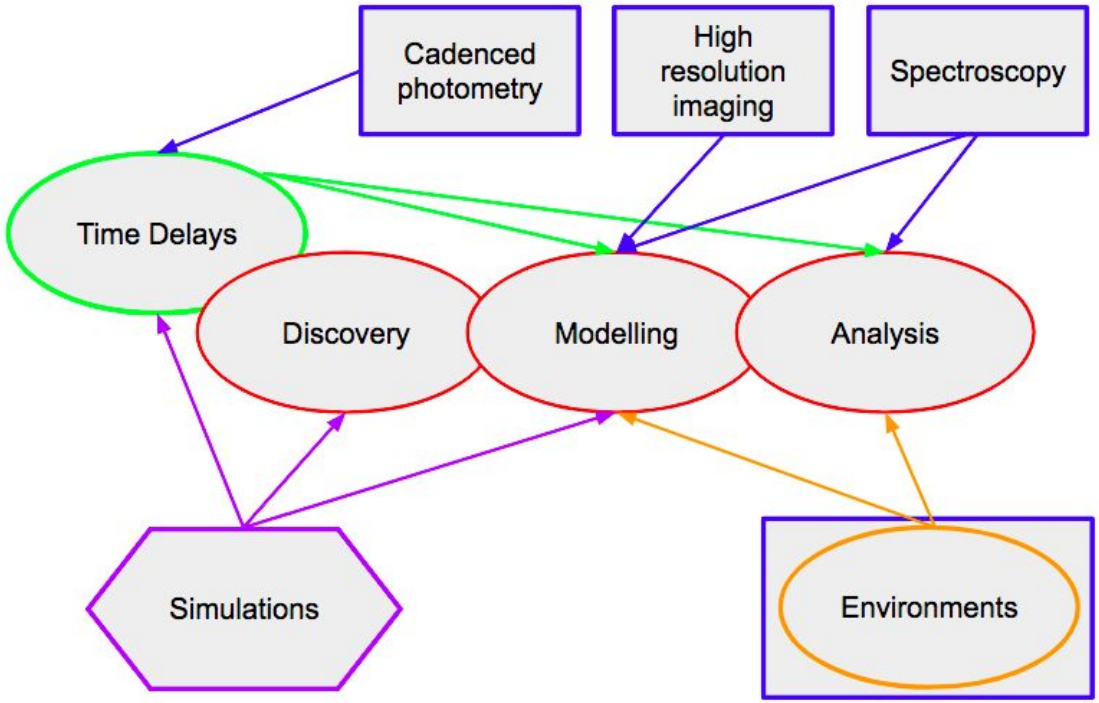
Some active projects:

- Developing SL-**Pipeline** joint with DESC
- SL **discovery** system including ML, algorithms, citizens, fast modelling: **all** can plug in to pipeline
- Building all-sky **watchlists** of lenses before survey operations, ready for early lensed transient discovery
- In-kind: Optimal **image quality** stacks for SL discovery
- In-kind: SL **database**
- SLSC/DESC-SL representation in the **commissioning** team (SITCom**)**
- Preparations for 4MOST Strong Lensing Spectroscopic Legacy Survey (**4SLSLS**), joint with DESC-SL & Euclid and **ChANGES-LEN**

Critical data / observing requirements:

- Single visit and stacked pixel **cutouts** up to ~2x2arcmin as fast as embargo allows
- **Non-standard** alert packets for a defined list of targets (sub-threshold, and larger cutouts)
- Optimal **image quality** stacks for static SL discovery
- Good seeing in one **blue band** required for sensitivity to lensed star-forming galaxies
- **Early Reference Survey** for rapid SL discovery and full WFD template image
- **Target of Opportunity** programme including deeper than WFD depth
- Prefer **survey area** over cadence because lenses are rare and SL science is exciting :)

SLSC Tasks Overall Schematic



LSST data alone (doesn't preclude other data being useful)
Covers all scales gal-gal, gal-group, gal-cluster, compound, exotic lenses)

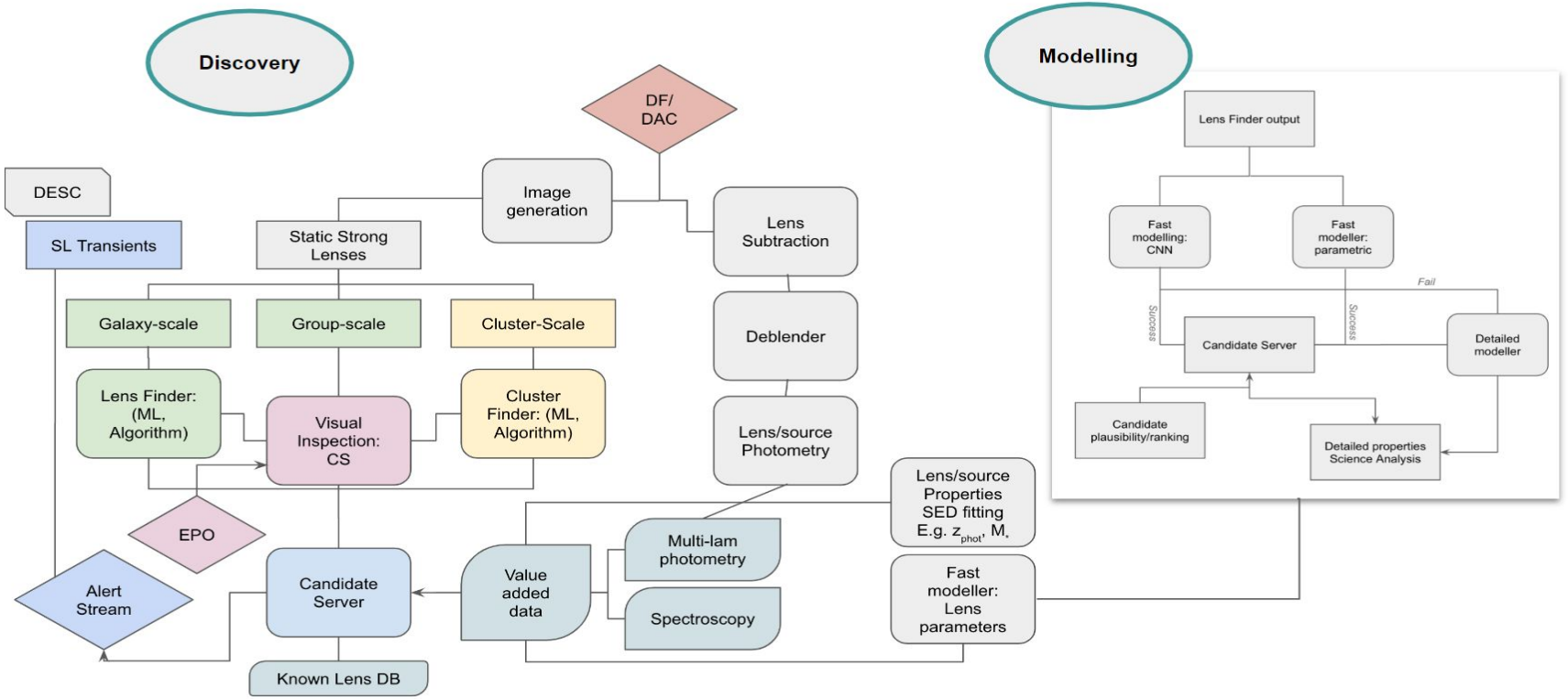
Sims activity planned or developed

External data will be critical for science objectives

Environments

New regime from Rubin data coupling time resolved information with discovery (traditionally separate), also DESC, DM, galaxies science, AGN microlening

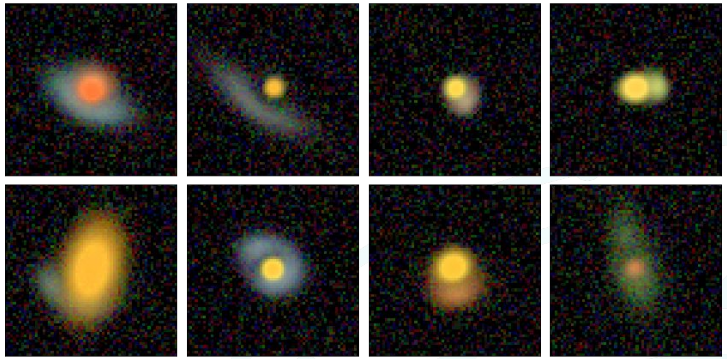
Discovery + Modelling “zoom-in”



Strong Lensing Science Collaboration

The Future - We need you!

- Discovery and modelling challenges
- Infrastructure to deliver SL candidates and perform analyses, and to discover lensed explosive transients
- Ethics Panel
- Managing In-Kind Contributions
- Commissioning and early science planning
- Develop stronger inter SC connections and projects DESC, Galaxies SC, AGN SC, TVS, ISSC with common science goals and technical infrastructure requirements



Simulated LSST-like galaxy-galaxy lenses of a prototype of the simulation pipeline.

Join us!

Anyone (at any career stage) with interests related to strong lensing enabled science is welcome to join. No minimum requirement.

https://sites.google.com/view/lsst-stronglensing

- Monthly joint meetings with the DESC-SLWG
- **First LSST-wide SL F2F meeting** in March 2024 in Oxford UK.

AGN: https://agn.science.lsst.org/

Speaker: Franz Bauer (PUC-Chile)

Tens-of-millions of AGN to be discovered with LSST!

Some topics:

- Time variability studies, including searches for binary BH systems
- SMBH transients

Active Galactic Nuclei (Niel Brandt, Gordon Richards)

AGN: https://agn.science.lsst.org/

Current Membership

Currently have 181 members - Grew by 37 (20%) over past year!

168 associate and 13 full members

Largest National Memberships

Country	Number of Members
USA	82
Brazil	17
Italy	17
UK	14
Chile	12
Serbia	9
Australia	5
Germany	5
Argentina	4
Poland	4

Slides: Gordon Richards, Niel Brandt

AGN: https://agn.science.lsst.org/

Current efforts and Science highlights:

Recent AGN Science Collaboration meeting supported by NRAO/NAASC in Charlottesville, VA (24-26 July 2023): “New Era of AGN Science with the Vera C. Rubin LSST”: 35 in-person participants with ~10 online.

Many SC members also attended the “Restless Nature of AGNs: 10 years later” conference in Napoli, Italy (26-30 June 2023).

Recent paper describing the AGN SC’s 2021 Data Challenge and the submissions to it: Savic et al. (2023, ApJ, accepted, arXiv:2307.04072). Prizes (but not the challenge development) came from an LSSTC Enabling Science award.

Working on implementing a new project posting system to encourage internal cross-collaboration.

AGN: https://agn.science.lsst.org/

Challenges and/or opportunities:

As was the case in 2022, the AGN SC has insufficient funding to enable interaction with

- Software Engineers (LINCC)
- In-Kind Contributors
- Catalyst Fellows
- Cadence Optimization

Multiple PIs would need >~$50k to properly support these efforts and ensure that LSST maximizes its AGN science output.

Richards will be stepping down as co-chair, partly for personal reasons and to give younger members a chance, but mostly due to lack of graduate student funding needed for LSST work. A funded co-chair from Europe or Chile may help balance the other US-based co-chair.

Rubin Science Collaborations: Session plan

1. Science Collaborations overview
2. Some highlights from the science collaborations
3. Issues and challenges
4. How to contribute and get involved

5. Lightning stories (20 min)

The funding challenge

The SC's gratefully acknowledge support from LSSTC (now LSST Discovery Alliance), including: Small PI-driven grants; workshop funding; and collaboration infrastructure support for the SC's. Here follow some initiatives that have derived support from the Enabling Science initiatives:

- 2018 - e.g. PLAsTiCC
- 2020 – e.g. Participation in the LSST AGN data challenge
- 2021 - ~33 one-year investigations funded, across the community (including SC's)
- 2022 - Rubin-related student research and PCW22 attendance

BUT:

Obtaining support for larger efforts (to fund, e.g. PhD students, postdocs…) remains a major challenge (and key priority!) for the Science Collaborations. The majority of SC's science is not currently funded.

The funding landscape at the $10^{4\text{-}5}$ level is also unclear… how will activities like sprints, hackathons, travel support for early career- and under-represented groups in STEM, be funded once main-survey data start to flow mid-2025?

Prompt preparation for early-LSST science

With Rubin first-light mid-late 2024, can expect big proposals for ~2024 May.

Updates on construction / commissioning timeline in Feb/Mar and Aug/Sep 2024 would be of huge help to the scientific communities as they prepare proposals for science enabled by Rubin data.

How will in-kind contributions of observing time work?

- For example, will observing time availability / timescales / proposal scenarios be finalized by mid-2024?

wiclarks@umich.edu
Acronyms & Glossary

Observing strategy: decisions and timeline

The SC's will need a schedule of decisions for the observing strategy and update process. *How can we help?* E.g.

- When are decisions about template generation expected?
- What happens if commissioning fails to cover some important part of parameter space (e.g. astrometry at high airmass) - when would supporting analysis for new observations be needed?
- A rough timetable of SCOC deliberations planned for the 2023/2024 and 2024/2025 years would help the SC's allocate effort to assist.

wiclarks@umich.edu
Acronyms & Glossary

Commissioning and Science Verification

What is the most useful way for the SC's to work with our commissioning liaisons over the next ~6 months, to assist with commissioning and SV? Example questions:

- What communication about the status of the alert stream can we expect during science verification?
- Will commissioning products be distinguished by parameter space in some way? (E.g. observations XYZ probe saturation and bright-object measurements; observations ABC probe astrometry at a wide range of airmasses, etc.)

wiclarks@umich.edu
Acronyms & Glossary

Access & participation in Rubin meetings

Many SC members (particularly early career researchers) can typically only attend 1 “big” meeting a year in-person. Particularly important now that LSST data are about to flow.

Some possibilities to improve ECR participation:

- Less expensive venue (already for PCW23 - thank you!!)
- Make ***all*** the breakout sessions remote-capable ($$) - and/or fully online meeting
- Merge PCW with a science conference (perhaps every other year?)
- Discrete-ish scheduling for “project” and “science” components w/2 day overlap?

wiclarks@umich.edu
Acronyms & Glossary

Person-power

The SC's are volunteer organizations, and effort is always needed to help us prepare for and do LSST science! Example opportunities:

- Intra-SC working group (scientific, technical, other)
- Membership committee
- Code of conduct committee

Early career researchers: this is a great opportunity to develop some scientific leadership and collaboration experience

wiclarks@umich.edu
Acronyms & Glossary

Rubin Science Collaborations: Session plan

1. Science Collaborations overview
2. Some highlights from the science collaborations
3. Efforts and challenges
4. How to contribute and get involved

5. Lightning stories (20 min)

wiclarks@umich.edu

Rubin LSST Science Collaborations

The Rubin Observatory/LSST Science Collaborations (SCs) comprise a federation of independent, worldwide communities of scientists, self-organized into collaborations based on their research interests and expertise.

THANK YOU!!

SC Coordinator: Will Clarkson (wiclarks@umich.edu)
Find out how to join at
https://www.lsstcorporation.org/science-collaborations

Rubin Science Collaborations: Session plan

1. Science Collaborations overview
2. Some highlights from the science collaborations
3. Efforts and challenges
4. How to contribute and get involved

5. Lightning stories (20 min)

VERA C. RUBIN OBSERVATORY

Rubin 2023 Lightning Stories

Julio Constanzo
Agnès Ferté
Clare Higgs
Ryan Lau

NSF NOIR Lab AURA SLAC U.S. DEPARTMENT OF ENERGY

VERA C. RUBIN OBSERVATORY

Julio Constanzo

IT Network Engineer
Joined Rubin August 2018

NSF NOIR Lab AURA SLAC U.S. DEPARTMENT OF ENERGY

This is how my journey started

Fun Fact #1: I was working in ALMA as a contractor during 2015-2016 period when I heard about the LSST project.

Fun Fact #2: During early 2018 I quit my job as network engineer in a big insurance company to pursue other dreams.

The kid in me still wanted to be rockstar musician.

That same day I was contacted by LSST to start working as an IT helpdesk support staff in La Serena.

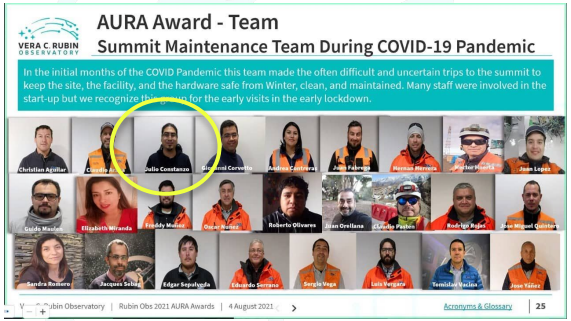
Then, my entire life changed.

From Helpdesk to Network Engineer – COVID19 and the ACI Saga

How I became the Network Engineer of Vera C. Rubin Observatory:

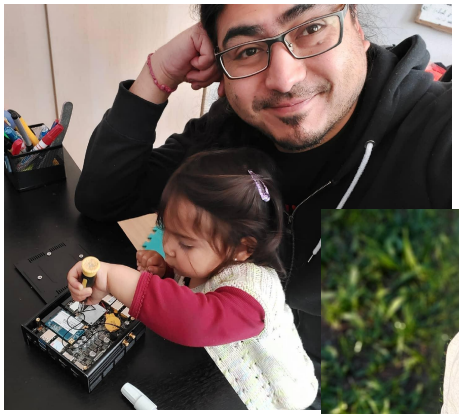
During Covid19 pandemic I was the only Network Engineer on site to support the construction.

- Summit shutdown and power-on challenge
- ACI review and Network Re-engineering
- Cisco ACI shutdown and new network infrastructure

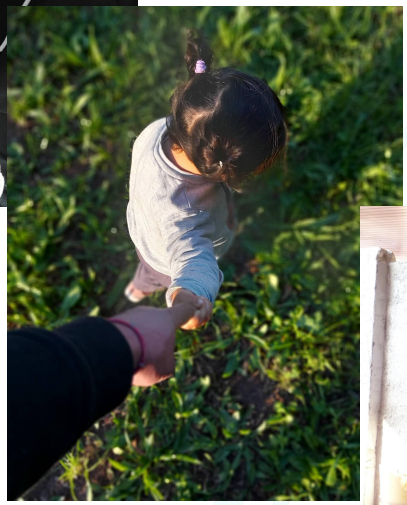


It's a long way to the top if you wanna Rock'n'Roll

Fun Fact #3: I used to play in a Thrash Metal band based in Santiago, Chile.



Someday you're going to look back on all the progress you've made & be glad you didn't quit



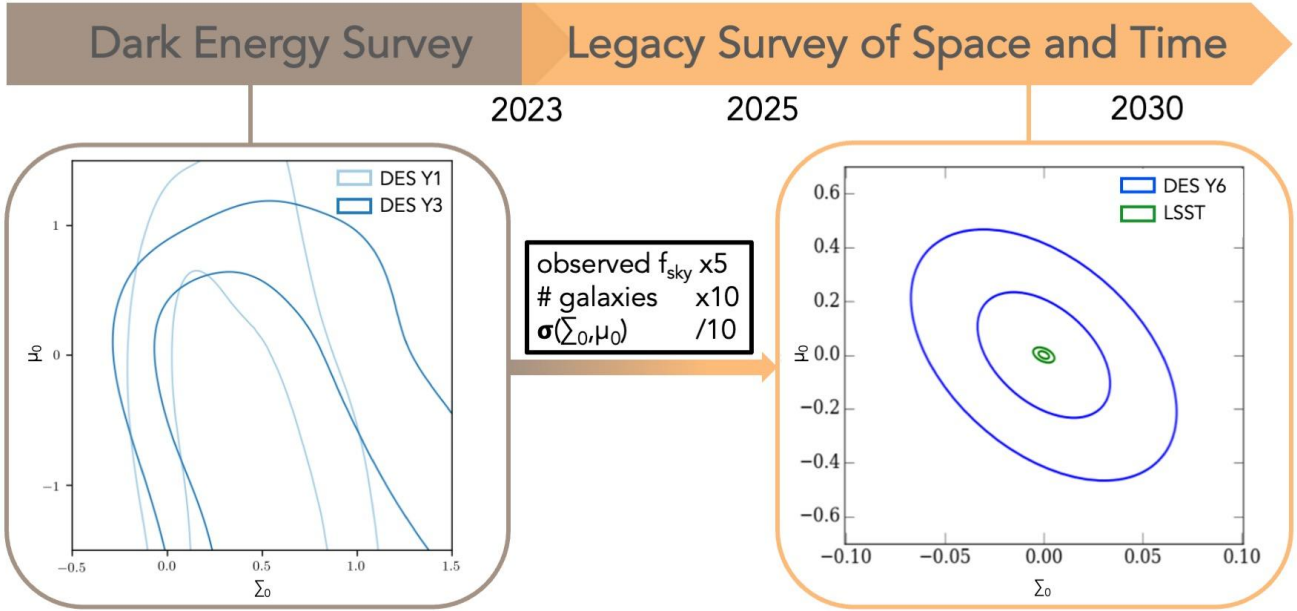
VERA C. RUBIN OBSERVATORY

Agnès Ferté

Rubin Operation Scientist
Joined Rubin August 2022

NSF NOIR Lab AURA SLAC U.S. DEPARTMENT OF ENERGY

Trying to prove Einstein wrong



DES Collaboration (incl. **Ferté**), PRD, 2019
DES Collaboration, co-leads: Muir & **Ferté**, PRD, 2023

Ferté, Kirk, Liddle, Zuntz, PRD, 2019

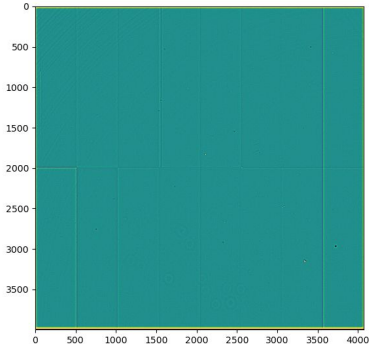
+ Other cosmology tests with LSST: working with SULI student Kevin Hong, **check out Kevin's poster**!

Rubin Roles

Member of the **calibration** team in Pipeline & Algorithm

Chris Waters, Merlin Fisher-Levine, Eli Rykoff, Andrés Plazas Malagón

=> Implement correction of CCD effects (**I**nstrument **S**ignature **R**emoval)



Member of the **In-kind Program Coordination** (IPC) team

Aprajita Verma, Knut Olsen, Steve Margheim, Steve Ridgway, Greg Madejski + Bob Blum, Phil Marshall

=> Coordination of international in-kind contributions, especially software.

2 related sessions (“Science analysis software and infrastructure for LSST” and “Rubin In-Kind Program: Community session”) on Wednesday to learn more.

& beyond

Dark Energy Survey Year 6

- Cosmology with weak lensing and clustering full DES data

Outreach, EDI

- Co-chair of LSST-DESC **E**quity, **D**iversity, **I**nclusion committee
- Outreach: public talks, podcast, videos
  Local talk on LSST yesterday for SpaceDrafts with Aaron Meisner!

Machine Learning

- Co-PI with Tomasz Kacprzak on DES deep learning cosmology with NERSC
- **ML with Rubin Observatory's data**
  Session on Friday - co-chair with Yuanyuan Zhang

Climate change

- Outreach on climate change
- Urgency to lower our impact

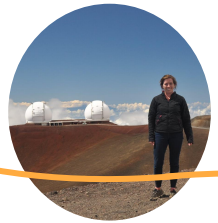
VERA C. RUBIN OBSERVATORY

Clare Higgs

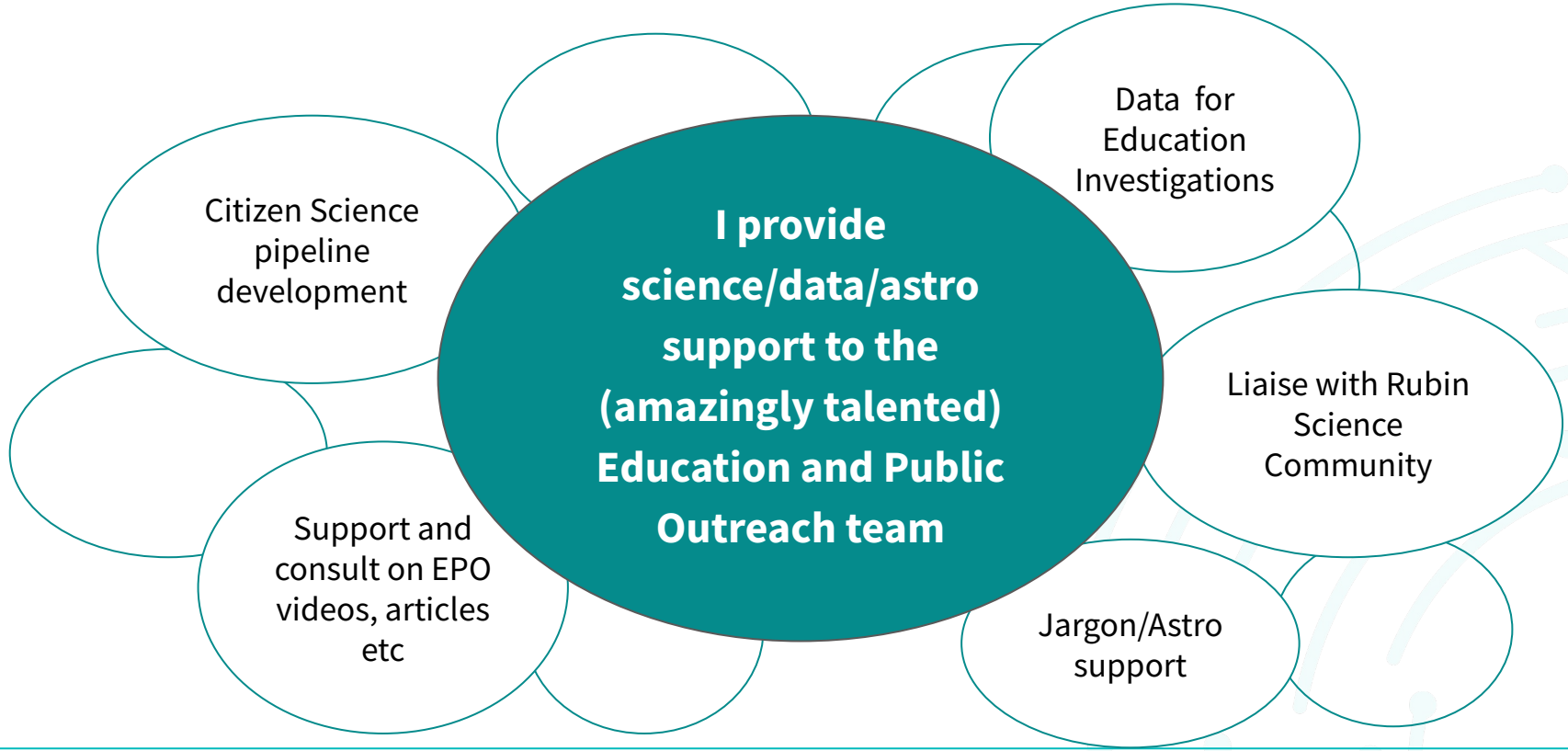
Astronomy Outreach Specialist on the EPO Team
Joined Rubin July 2022

NSF NOIR Lab AURA SLAC U.S. DEPARTMENT OF ENERGY

My Road to Rubin



What do I do with Rubin?



Las Campanas Observatory, Chile, 2017

VERA C. RUBIN OBSERVATORY

Ryan Lau

Community Scientist on the CST Team
Joined Rubin July 2022

NSF NOIR Lab AURA SLAC U.S. DEPARTMENT OF ENERGY

A short bio

Born and raised: Honolulu, HI

Now: Assistant Astronomer at NSF's NOIRLab in Tucson, AZ
- Member of the Rubin Community Science Team (as of July 2022)

PhD from Cornell University
- Studying extreme environment of the Galactic Center with the Stratospheric Observatory for Infrared Astronomy (SOFIA)

Research Interests
- Dust, massive and evolved stars, stellar transients/variables, infrared and time-domain astronomy

- Looking forward to synergies with JWST, Rubin, and other NOIRLab facilities (Gemini, Kitt Peak, CTIO)!

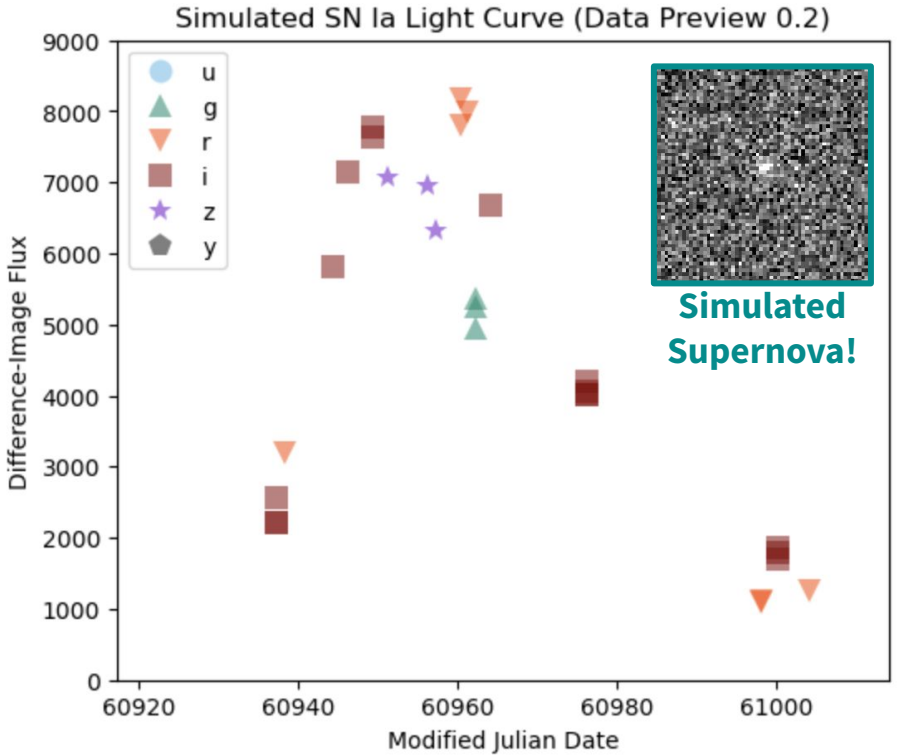
RL w/ PhD advisor Terry Herter on SOFIA in 2012

JWST observation of nested dust shells around a Wolf-Rayet binary (Lau et al. 2022)

My Role as a Rubin Community Scientist

Supporting astronomers using Rubin data to do their science

- Familiarization with the **R**ubin **S**cience **P**latform (RSP)
- Currently utilizing the **D**ata **P**review **0.2** (DP0.2) simulated LSST-like data
- Focused on time-domain science cases (transients and variables)



Other Stuff: Music and Skateboarding

"Postdocumentarians" playing a show in Pasadena, CA (2017?)

At the "skate park" by Catalina high school in Tucson (June 2023)