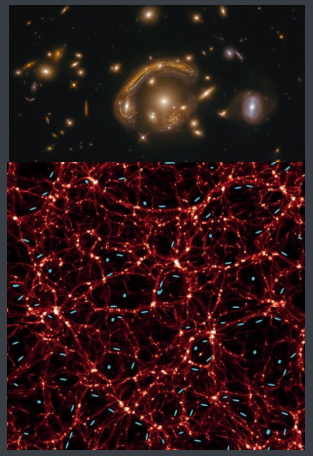
Rubin Observatory/LSST Science Collaborations

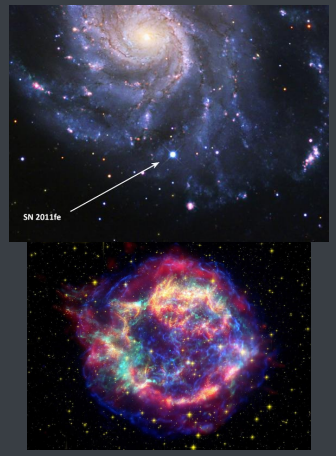
V. Ashley Villar
ISSC, Co-chair
Harvard University

Rubin science pillars

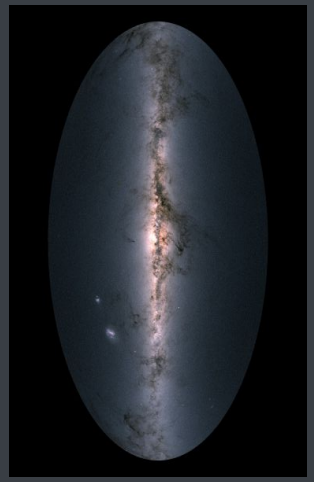
Cosmology
Understand dark energy and dark matter, and the origin and fate of the universe, by studying gravitational lensing and large-scale structures across cosmic time.



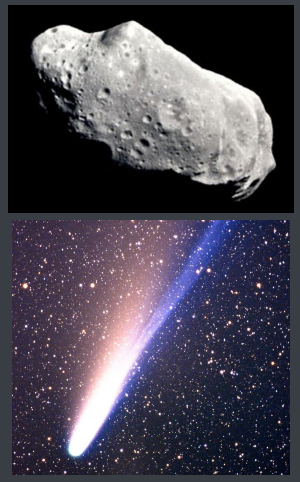
Transient Phenomena
Understand evolutionary processes by studying how stars and compact objects (e.g., black holes) change brightness, interact, merge, and explode.



The Milky Way
Understand the structure and evolution of our Galaxy's bulge, disk, and halo – and its satellites and tidal streams – by mapping the stars of the Milky Way.



The Solar System
Understand the formation and evolution of our Solar System, and the risk of potentially hazardous asteroids, by making a full inventory of objects down to ~100 m scales.



Slide credit: M. Graham

The Rubin Science Collaborations

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)

Galaxies Science Collaboration (Sugata Kaviraj, Simona Mei)

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

Strong Lensing Science Collaboration (Timo Anguita, Graham Smith)

Active Galactic Nuclei (Niel Brandt, Gordon Richards)

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

Slide credit: W. Clarkson

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Galaxies Science Collaboration

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

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

https://lsst-sssc.github.io/

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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

https://lsstdesc.org/

The Rubin Science Collaborations

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

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.

https://lsstissc.github.io/

The Rubin Science Collaborations

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

Galaxies Science Collaboration (Sugata Kaviraj, Simona Mei)

Dark Energy Science Collaboration (Renée Hložek, Tesla Jeltema)

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

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

Smith)

Transients & Variable Stars (Igor Andreoni, Sara Bonito)

Active Galactic Nuclei (Niel Brandt, Gordon Richards)

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

The Rubin Science Collaborations

Galaxies Science Collaboration (Sugata Kaviraj, Simona Mei)

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

~5 billion galaxies observed with LSST!

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

The Rubin Science Collaborations

Some topics:

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

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

https://milkyway.science.lsst.org/

The Rubin Science Collaborations

Some topics:

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

Solar System Science

Galaxies Science Collaboration (Sugata Kaviraj, Simona Mei)

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

Strong Lensing Science Collaboration (Timo Anguita, Graham Smith)

Collaboration (Francois Lanusse, Ashley Villar)

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

The Rubin Science Collaborations

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

Some topics:

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

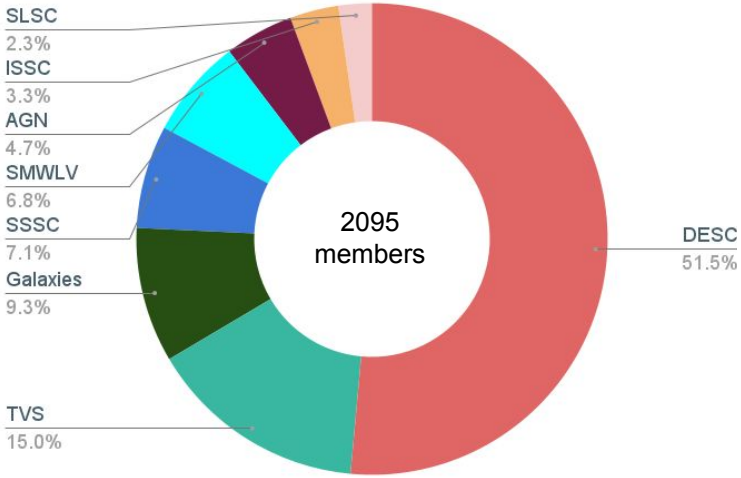
Active Galactic Nuclei (Niel Brandt, Gordon Richards)

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

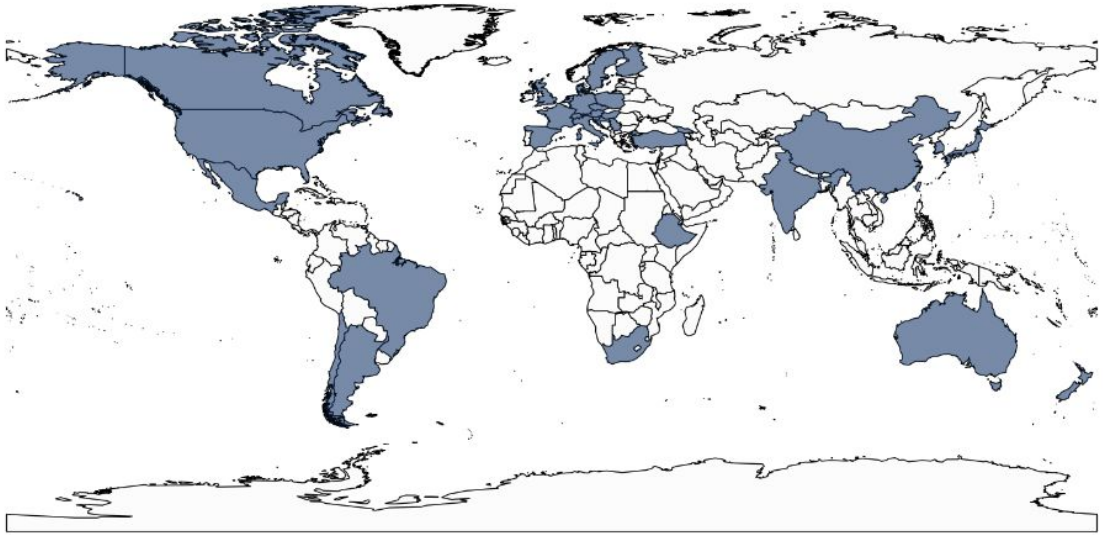
The Rubin Science Collaborations

SCs Federation Charter

8 Science Collaborations as autonomous, self-managed teams



>2000 people, 2500 affiliations, 6 continents, 33 countries



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Slide credit: W. Clarkson

Why and how are people preparing for LSST?

The scope and potential for science with the Rubin Observatory LSST is as enormous as the unprecedented volume and complexity of the LSST data products. Correspondingly, the technologies, methodologies, policies, and collaborative strategies for research with LSST are evolving to meet this challenge.

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

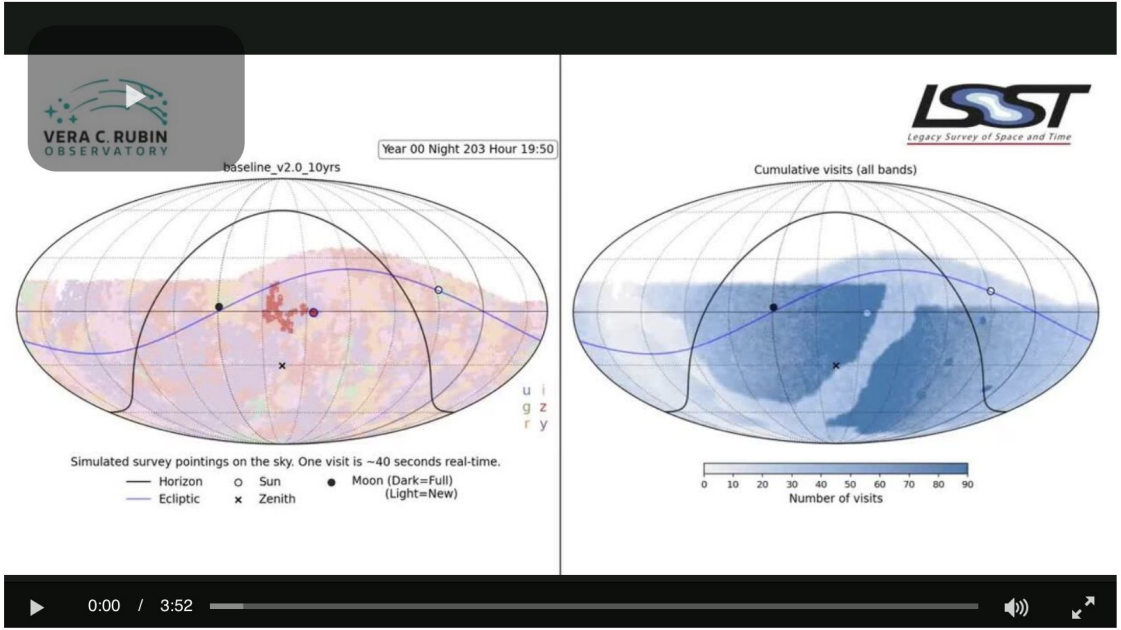
Slide credit: W. Clarkson

SCs provide expert analysis and advice to Rubin

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

Rubin LSST Survey Strategy Optimization

PI: Federica Bianco



OPEN ACCESS

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

Claudia M. Raiteri *et al* 2022 *ApJS* **258** 3

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)bserving Strategy on the Reliable Classification of Standard Candle Stars: Detection of Amplitude, Period, ulation (Blazhko Effect) of RR Lyrae Stars with LSST

and Keivan G. Stassun 2022 *ApJS* **258** 4

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ences with Realistic Light-curve Filtering for Serendipitous Kilonova Discovery with Vera Rubin

l 2022 *ApJS* **258** 5

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-lours: Exploring Short Timescales in Rubin Observatory Cadence Simulations

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)bserving Strategy on Cosmological Constraints with LSST

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rtunity Observations of Gravitational-wave Events with Vera C. Rubin Observatory

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.egacy Survey of Space and Time Stellar Content with TRILEGAL

2022 *ApJS* **262** 22

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f Supermassive Black Hole Accretion Disk Reverberation Mapping

ević *et al* 2022 *ApJS* **262** 49

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SCs are an excellent place to build new collaborations, especially for early career researchers!

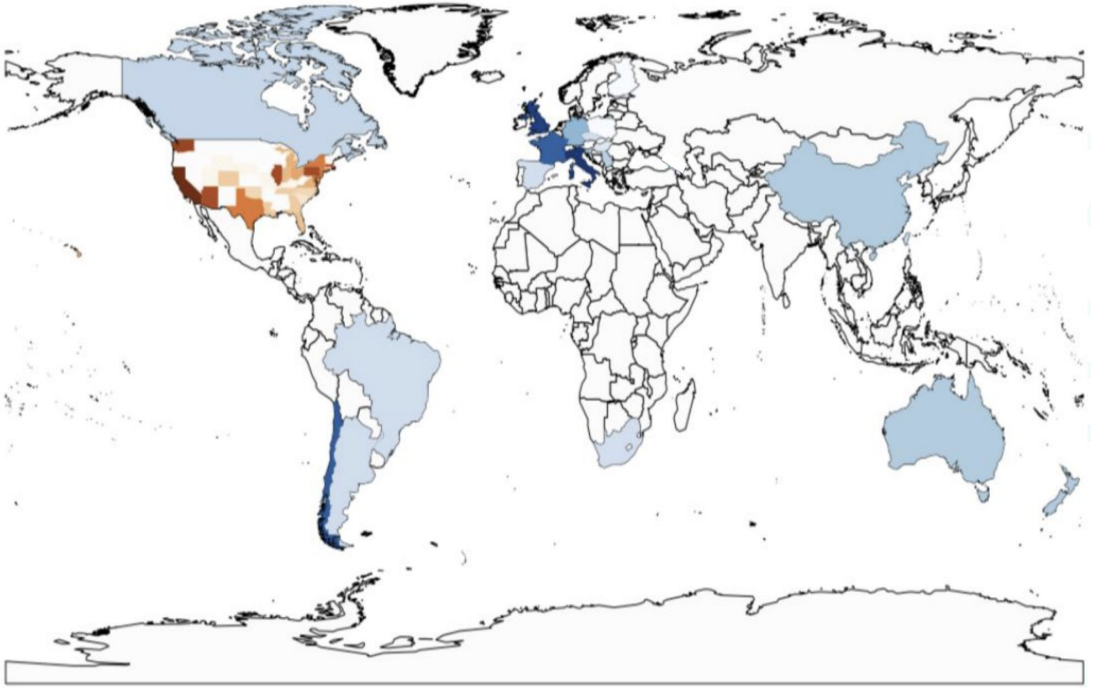
slack

Data Challenges

Journal Club

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

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



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Get involved!

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