



Rubin Galaxies Science Collaboration

Simona Mei (APC/IN2P3/Univ. Paris Cité)

LSST France

November 2024

Scientific goals



Co-chairs: Sugata Kaviraj and Simona Mei

Number of members: ~330 (new members are very welcome)

LSST France members: 12 (6 at APC, 1 IJCLab, 4 LAM, 1 Observatoire de Strasbourg)

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

Advances expected from LSST:

- **Revolutionary statistics** across full spectrum of extra-galactic studies
- Vast **discovery space in the 'low-surface-brightness' regime** (e.g. dwarfs outside local group, intra-cluster light, faint galaxy outskirts, tidal features)
- **Statistical studies of rare and/or extreme objects** (e.g. starbursts, massive high-z systems) especially when combined with IR surveys
- **Intersection with computer science** will drive new technologies (e.g. machine learning) for big data astrophysics

Organizational structure



Working groups

Active galactic nuclei (James Mullaney)

Galaxy environment (TBD)

Galaxy morphology (Garreth Martin and Jeyhan Kartaltepe)

Low-surface-brightness science (Mireia Montes and Aaron Watkins)

SED-fitting and photometric techniques (Sam Schmidt and Rebecca Bowler)

Strong lensing (Aprajita Verma)

Survey strategy (H Ferguson, B Holwerda, B Robertson and D Burgarella)

Committee members and liaisons

In-kind operations managers - Brant Robertson and Pierre-Alain Duc

Contributions Evaluation Committee representatives - Manda Banerji and Brant Robertson

Survey cadence optimisation committee liaison – Louise Edwards

Rubin-Euclid WG - Manda Banerji

Data management liaison - Dan Taranu

Commissioning liaison - Lee Kelvin

DEI council – Manda Banerji

LSST Galaxies Science Collaboration

The [Legacy Survey of Space and Time \(LSST\)](#) is a ground-breaking, 10-year optical survey of the entire southern sky, which will be carried out by the Simonyi Survey Telescope at the Vera C Rubin observatory. The project is jointly funded by the [National Science Foundation \(NSF\)](#) and the [US Department of Energy \(DOE\)](#). The LSST Galaxies Science Collaboration (LSST GSC) is a scientific organization charged with using LSST data to understand the formation and evolution of galaxies over cosmic time.

The LSST GSC is one of the original nine LSST Science Collaborations founded in 2006, and made important contributions to the [LSST Science Book](#) released in 2009. This detailed science case helped LSST become the top-rated priority for ground-based astronomical facilities in the [2010 Decadal Survey](#) and obtain NSF and DOE funding. [Scientists in the LSST GSC](#) will conduct a wide range of extragalactic research programs with LSST data, and will help the LSST Project develop critical data and software products that will enable astronomers from all over the world to conduct cutting-edge research programs of their own. Information about the organization and structure of the LSST GSC can be found in the [LSST GSC Charter](#).

[Sugata Kaviraj](#) and [Simona Mei](#) serve as the current Chairs of the LSST GSC. Previous LSST GSC Chairs were Manda Banerji, Brant Robertson, Michael Cooper and Harry Ferguson.

The collaboration is always accepting new membership applications from eligible scientists who are interested in extragalactic research with LSST. For more information, please visit our [application webpage](#) or [contact the collaboration](#).



Apply for Membership

Application Process and Eligibility Criteria

The LSST Galaxies Science Collaboration (LSST GSC) accepts applications from eligible scientists who have rights to LSST data and are active in extragalactic research. The LSST GSC grants memberships based on the applicant's eligibility, their expected participation level, and their scientific interests related to the goals of the LSST GSC.

The membership eligibility criteria are detailed in the LSST GSC Charter, but eligible scientists include:

- All scientists employed or studying at institutions in countries with LSST data rights (e.g., Chile, US).
- Scientists employed by the LSST Project.
- Members of institutions or consortia (not in the US or Chile) that have explicit data rights agreements with the LSST, such as IN2P3.
- Individuals who have data rights agreements with the LSST and their Designees.

Researchers who do not fall into the categories above but would like to join the collaboration as an observer should [contact](#) the LSST GSC.

If you have questions about the application process, please [contact](#) the LSST GSC.

① If you meet the eligibility criteria and wish to apply for membership, please do so using the [application form](#).

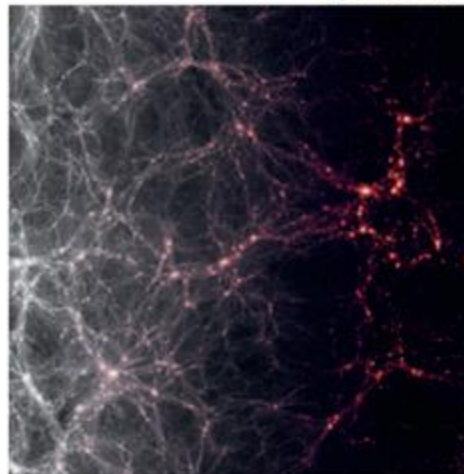
Roadmap



nature
REVIEWS

July 2018 volume 1 no. 7
www.nature.com/naturereviews

PHYSICS



Large Synoptic Survey Telescope Galaxies Science Roadmap

Robertson, Brent E.¹, Banerji, Mandi⁷, Cooper, Michael C.², Davies, Roger⁸, Driver, Simon P.³, Ferguson, Anne M. N.⁹, Ferguson, Henry C.¹, Gawiser, Eric⁴, Kaviraj, Sugata⁵, Krupar, Johan H.^{10,11}, Lintott, Chris¹, Lotz, Jennifer¹², Newman, Jeffrey A.¹³, Norman, Dara I.¹⁴, Padilla, Nelson¹⁴, Schmitt, Samuel J.¹⁵, Smith, Graham P.¹⁶, Tyson, J. Anthony¹⁷, Verma, Aprajita¹⁸, Zehavi, Ido¹⁹, Amos, Lee²⁰, Avezave, Camille²¹, Barrientos, L. Felipe²², Bowler, Rebecca A. A.²³, Brusa, Malcolm N.²⁴, Conselice, Christopher J.²⁵, Davies, Jonathan²⁶, Demarco, Ricardo²⁷, Dickinson, Mark E.²⁸, Galaz, Gaetano²⁹, Grazian, Andrew³⁰, Holmved, Bernt W.³¹, Jarvis, Matt J.³², Kahlwanji, Vishal^{33,34}, Lacerda, Jon³⁵, Marshall, Phil³⁶, Merlin, Emiliano³⁷, Napolitano, Nicola R.³⁸, Pavia, Thomas H.³⁹, Reibelman, Aaron⁴⁰, Salim, Samir⁴¹, Serrano, Mauro⁴², Stryker, Gregory F.⁴³, Stott, John P.⁴⁴, Tissera, Patricia B.⁴⁵, Wempe, Norben^{36,46,47}, Yachin, Peter⁴⁸, Borne, Kirk D.⁴⁹, and Members of the LSST Galaxies Science Collaboration

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arXiv:1708.01617v1 [astro-ph.GA] 4 Aug 2017

Robertson +17, ArXiv:1708.01617

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

<https://tinyurl.com/lstgalaxies>

Current activities



- Management of in-kind contributions embedded within the SC:
 - Low-surface-brightness science (LSB optimized sky subtraction, detection of LSB structures)
 - Photo-z and SED fitting pipelines
 - Morphological parameter estimation pipelines
 - Distance measurements through SBF
 - Tools for cross-matching LSST with ancillary surveys (radio, IR etc)
- Regular activities: monthly telecons, face-to-face meetings, LSB WG challenges
- 20 years of in-kind staff effort
- Publication policy update
- MoU with Wily Way Science Collaboration for globular cluster studies (2024); coming shortly with other collaborations: DESC, AGN, etc.

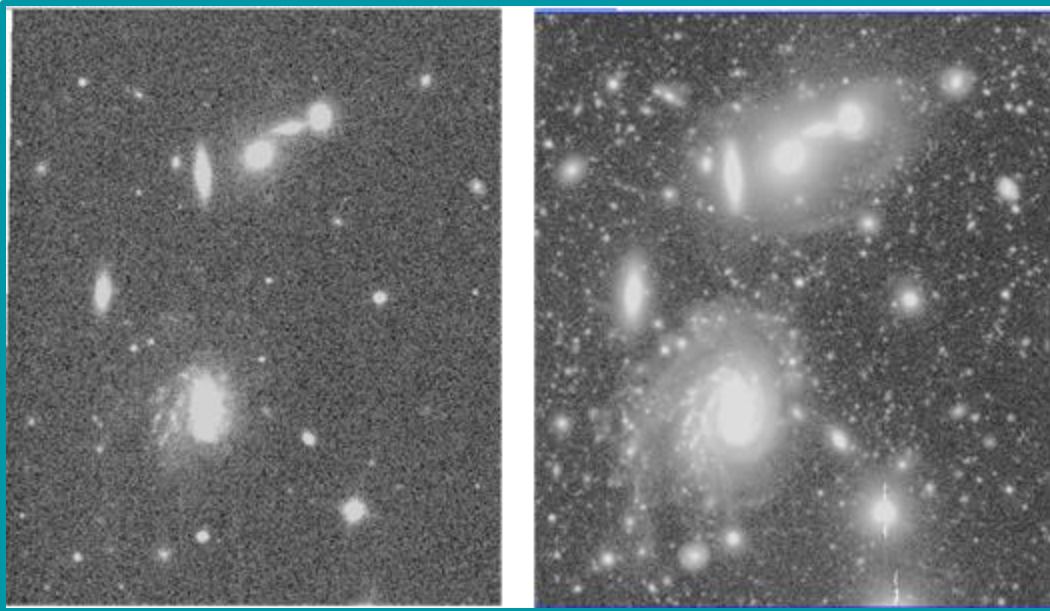
WP: Low surface brightness science



LSB studies and the associated infrastructure required to exploit LSST data.

- Meetings every other month (science talk + discussion)
- Slack channel: [#galaxies-lsb](#)
- LSB coordination group, to include SCs beyond Galaxies

Chairs: Aaron Watkins (U. Hertfordshire, a.watkins@herts.ac.uk) and Mireia Montes (IAC, mmontes@iac.es)



g SDSS
~27 mag/arcsec²

g HSC
30.9 mag/arcsec²

3 papers published : Martin et al. 2022, Desmons, Brough et al. 2024 & Watkins et al. 2024
LSST France: Pier-Alain Duc (Obs. Strasbourg), Sylvie Dagoret-Campagne (IJCLab)

WG: SED fitting and photo-z



The ramping up of the Rubin Photo-z Validation Cooperative may be an opportunity to kick-start engagement (**LSST France : LAM: Stephane Arnouts, Veronique Buat, Denis Burgarella, Olivier Ilbert, APC: Simona Mei**)

- Working to investigate a number of potential PZ algorithms to determine which to implement as part of DM processing
 - Opportunity to engage Galaxies-related in-kind contributions
 - Potential to emphasize the needs of the Galaxies WG in Rubin-provided products, e.g. physical parameter estimates
 - Beyond VC: plan for needs not covered by DM-provided catalogs
 - Some details on the PZVC in DM tech note [DMTN-049](#)
 - Link to [PZ Galaxies LOR](#) (Sept 2021)
 - Installation of the Pasquet et al. (2019) in DESC/RAI
 - CIGALE (dust modeling)
- Anyone interested in getting involved or leading Galaxies PZ projects, contact samschmidt@ucdavis.edu

WG: Morphology



Studies of galaxy morphology in the deep-wide era, addressing the challenges of LSST's extreme data volumes

- Quantitative morphologies – [ML models to efficiently and robustly predict structural parameters \(e.g. CAS, Gini-M20\) from imaging including unbiased predictions that are independent of resolution, noise etc.](#) – Leads: Liza Sazonova, Michael Balogh
- Hubble type and feature classification – [Automatic morphological classification of galaxies into detailed Hubble types with independent identification of morphological structures like bars, rings and merging features. Contrastive learning with supervised fine-tuning approach to account for imbalanced morphological distributions](#) – Lead: Antonio Vazquez Mata
- Unsupervised estimates of morphology – [Extremely fast and efficient classification of galaxies using fully unsupervised learning. Based on visual similarity by autonomously grouping objects with common morphology together into clusters, allowing for identification of broad morphological classes and the presence of other features](#) – Lead: Ilin Lazar

Slack channel: [#galaxies-morphology](#)

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

WG: AGN



Lots of overlap with the AGN Science Collaboration, but with more emphasis on the co-evolution of galaxies and AGN and how the presence of an AGN affects the measurement of galaxy properties.

Please email James if you would like to join:

j.mullaney@sheffield.ac.uk

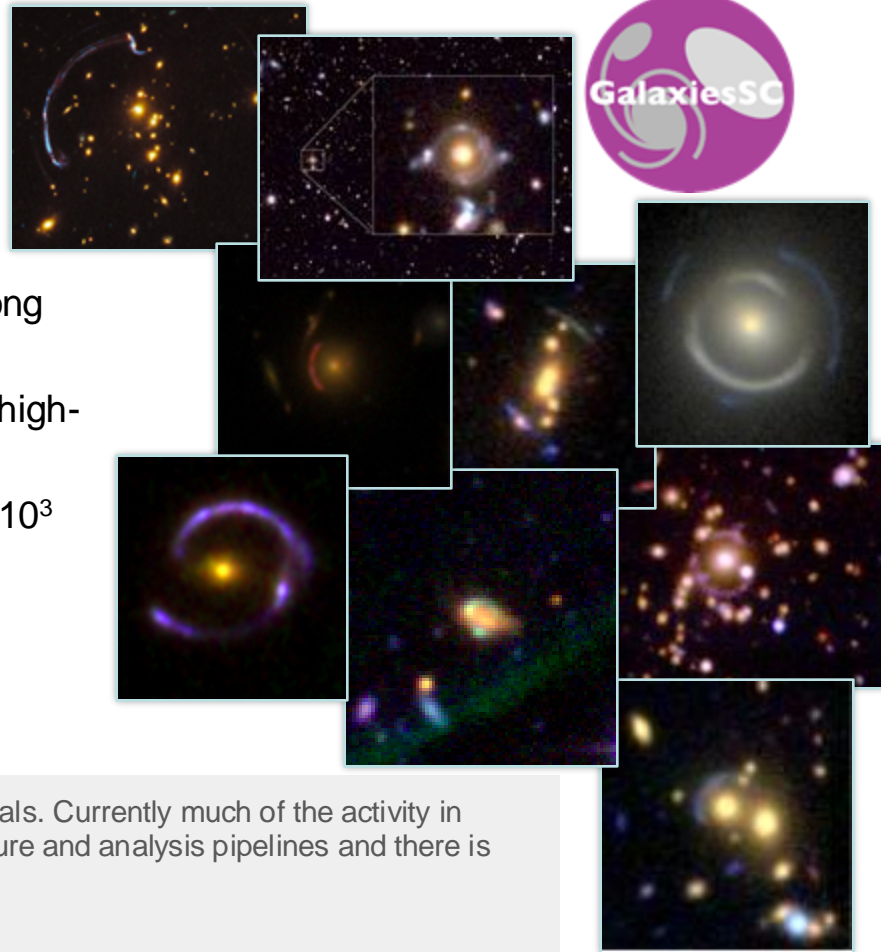
WG: Strong lensing

Examples of Strong Lensing science:

- Mass and structure of **dark matter halos**: 10^5 strong lenses spanning galaxies, groups and clusters
- **Gravitational telescopes**: resolved properties of high-redshift galaxies
- Quasar **microlensing**: accretion disk structure of 10^3 lensed AGN and IMF of lensing galaxies
- Physics of lensed **explosive transients** including extragalactic ones
- *Many more...*

Cross-SC effort: Overlaps SLSC, DESC, Galaxies SC, AGN SC, TVS goals. Currently much of the activity in collaboration between SLSC & DESC-SLTT towards preparing infrastructure and analysis pipelines and there is still much to do! **Rubin-wide SL meeting Mar 2024.**

Please contact aprajita.verma@physics.ox.ac.uk if you are interested.



Publication policy committee

Committee members: Sarah Brough, **Pierre-Alain Duc**, Nandini Hazra, Garreth Martin, **Simona Mei (chair)**, Kanak Saha, Liza Sazonova

The publication policy has been discussed since last summer and the final document will be soon uploaded on the SC webpage

MoU with other collaborations

DESC: Chair and deputy contacted - LSB, Clusters, ...no planned date yet, it will probably be in the next months

AGN: Simulation and observation links discussed - coevolution AGN/galaxies, AGN in dwarf galaxies - no planned date yet, it will probably be in the next months

MW: The Star Clusters Working Group (WG) is a cross Science Collaboration WG, working across the LSST Galaxies and the Stars, Milky Way and Local Volume Science Collaborations.

Other? Please contact us

Thanks!