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

https://tinyurl.com/lsstgalaxies

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

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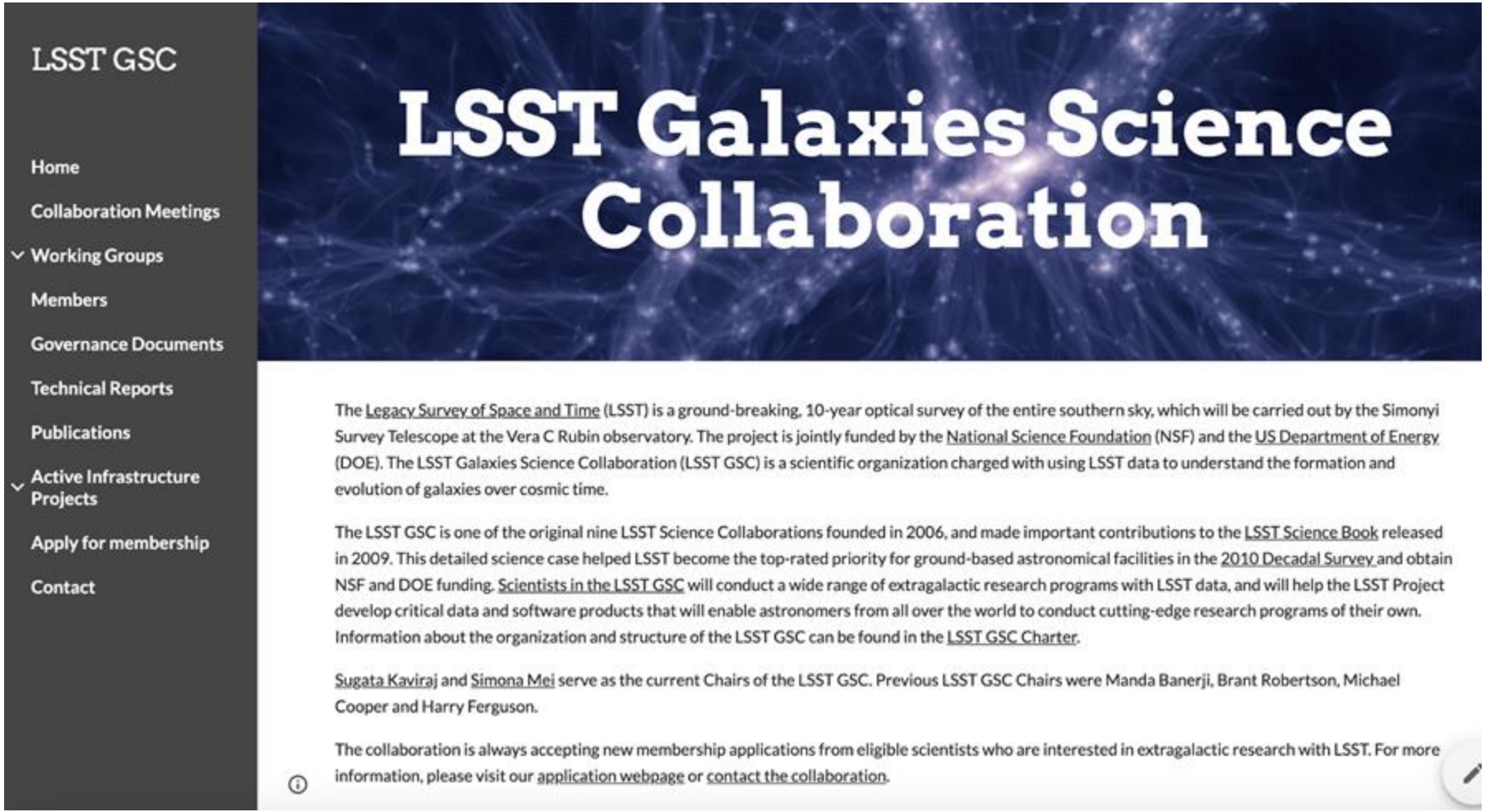

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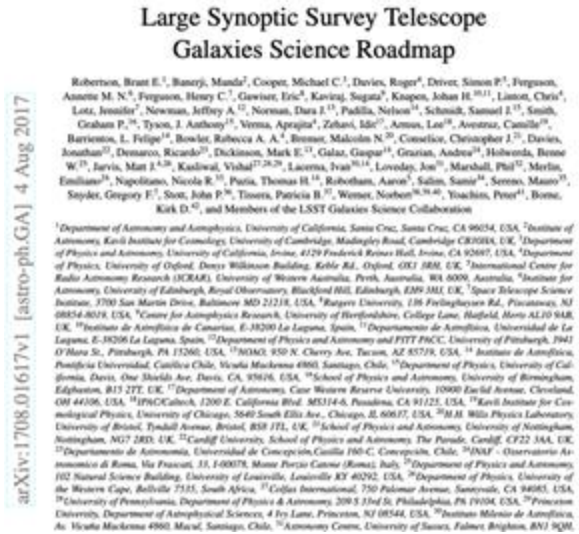
Roadmap



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], Kavirai, Sugata[9], Knapen, Johan H.[10,11], Linton, 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], Graziani, Andrea[24], Holwerda, Benne W.[25], Jarvis, Matt J.[4,26], Kaviraj, 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], Serrano, 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

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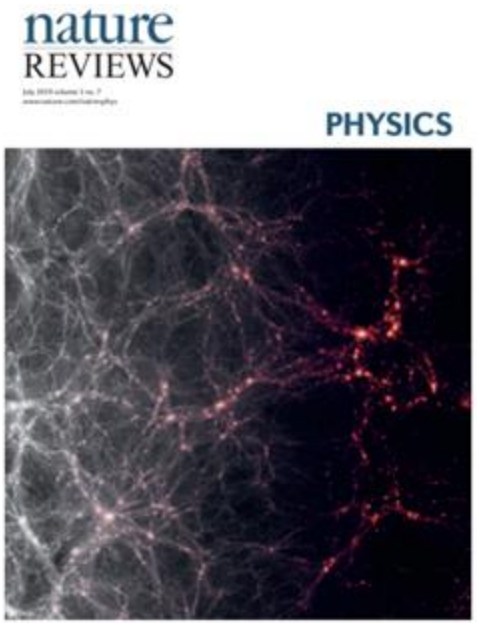
arXiv:1708.01617v1 [astro-ph.GA] 4 Aug 2017

Robertson +17, ArXiv:1708.01617



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

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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

g SDSS
~27 mag/arcsec^2

g HSC
30.9 mag/arcsec^2

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)

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/PAU
- 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)

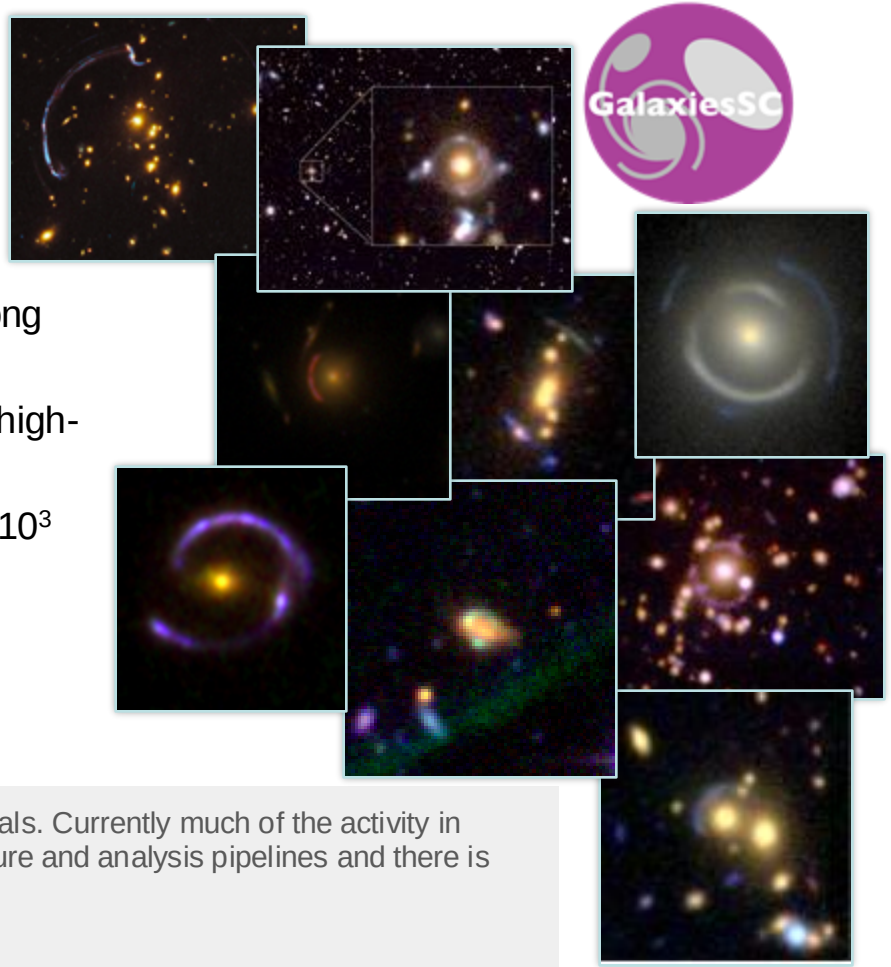
WG: AGN

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!