

Rubin Observatory's Legacy Survey of Space and Time

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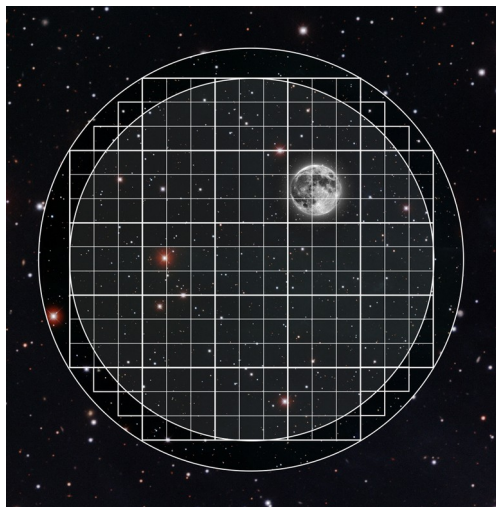
On behalf of the Brazilian Participation Group

**Fink-Brazil Workshop
CBPF, May 09, 2024**

Legacy Survey of Space and Time

Unprecedented amount of data!

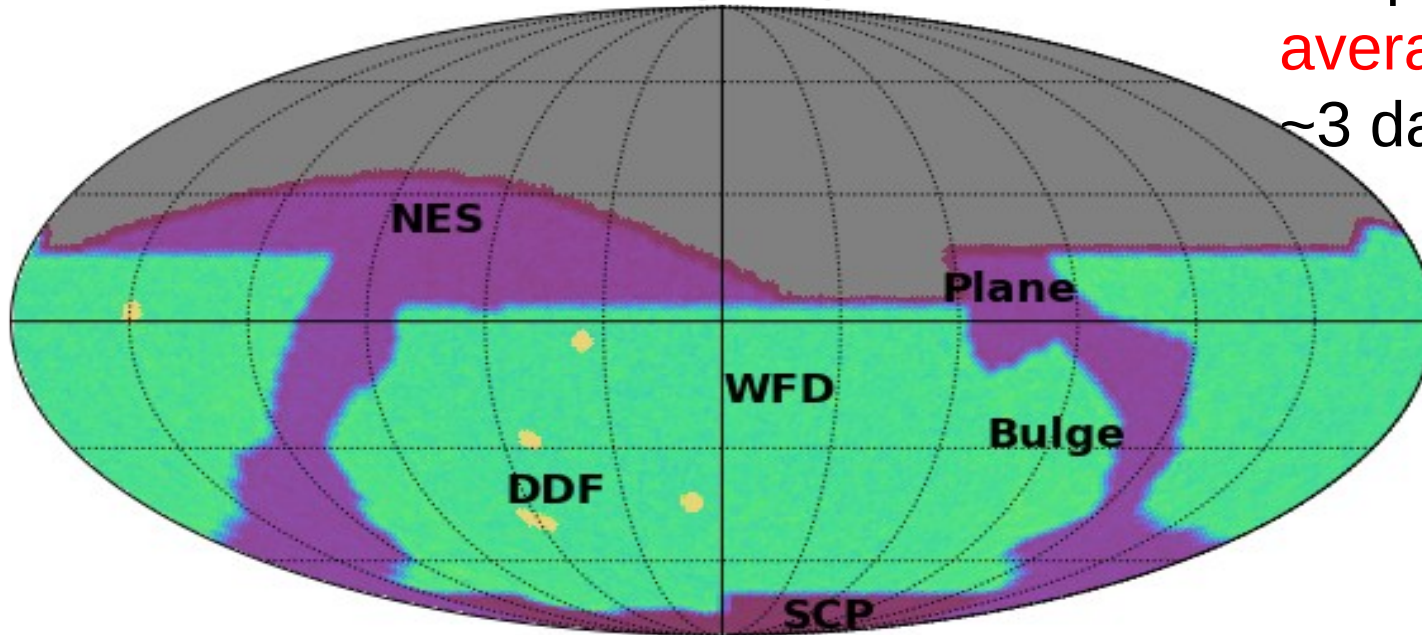
- Probing dark energy and dark matter
- Taking an inventory of the solar system
- **Exploring the transient optical sky**
- Mapping the Milky Way



- **LSST** is a 10-year survey to be conducted at the **Vera Rubin Observatory** in Chile (CTIO):
 - **Simonyi Survey Telescope** - 8.4 meters primary mirror; 9.6 deg² field of view (> 40 times the area of the full moon);
 - **LSSTCam** - largest digital camera ever built (SLAC): 3.2 Gigapixels, 189 science CCDs; Photometry - 6 filters (ugrizy);
- Rubin First Light - 26 March 2025

Survey footprint

Baseline survey footprint (v2.1)



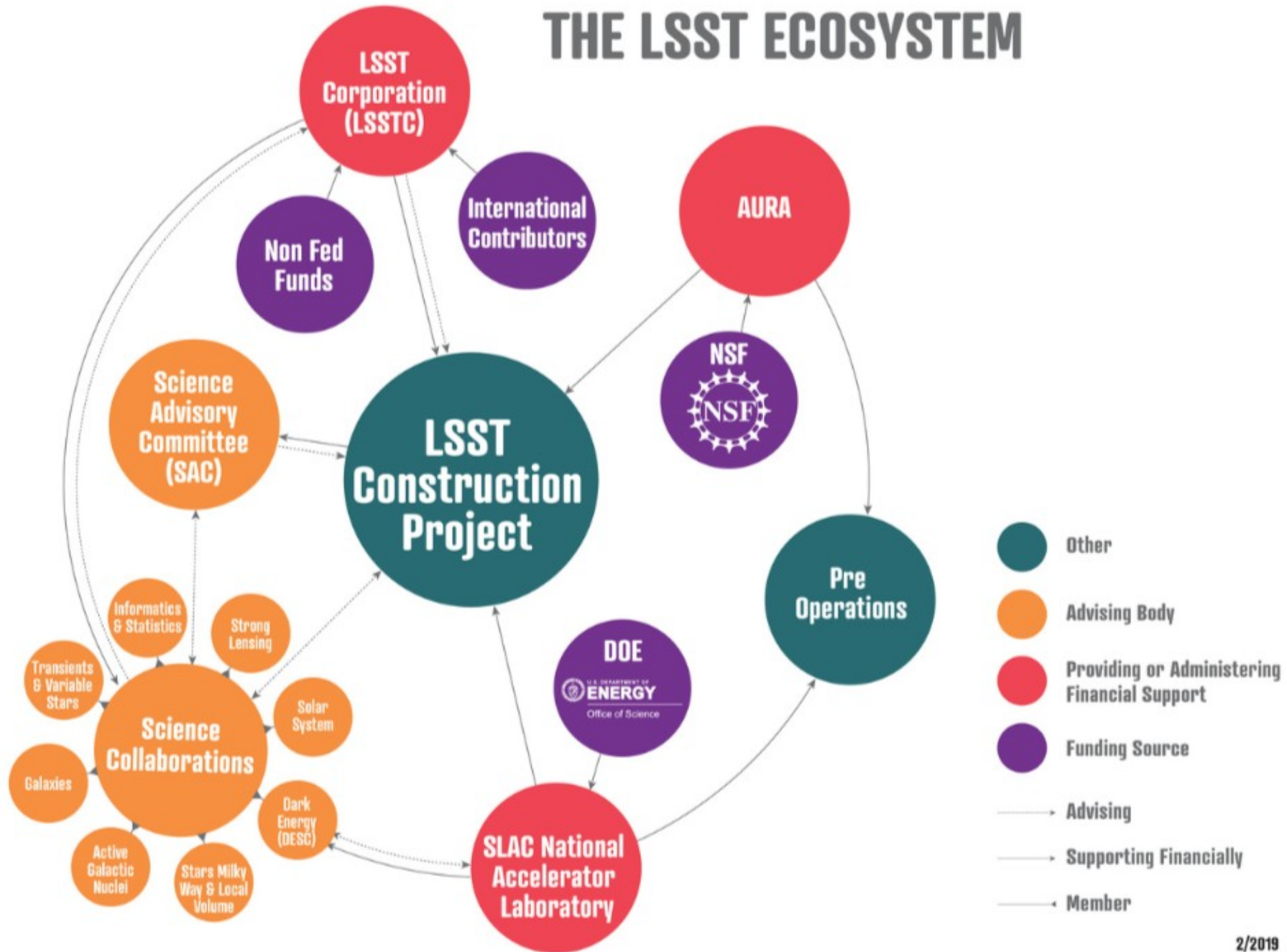
The Wide-Fast-Deep (WFD) survey:
footprint should cover at least **18000 deg²**
average of 825 visits per field over 10 years
~3 day cadence (time between visits)

Photometric redshift calibrated to a
precision of $\sim 0.002 (1+z)$

<https://www.lsst.org/scientists/keynumbers>

F. Bianco et al., APJ Suplem. Series, 258:1

THE LSST ECOSYSTEM



LSST Science Collaborations

8 Science Collaborations
(autonomous and self-managed teams)



Active Galactic Nuclei



Stars, Milky Way, and Local Volume



Dark Energy



Strong Lensing



Informatics and Statistics



Galaxies



Transients and Variable Stars



Solar System

LSST - Brazilian Participation Group

Coordinator: Rogério Rosenfeld

Spokesperson: Tassia Ferreira



MoA with Brazil signed in 2015 – 10 PIs (+40 juniors).

An additional 15 PIs (+60 juniors) were secured by LIneA through in-kind contribution: an IDAC, contribution to the photometric redshift effort and pipeline scientists.



LIneA activities (including BPG/LSST) are supported by:



Coordinator: L. da Costa

LIneA is an Institutional Member of the LSST Discovery Alliance: L. da Costa (representative).



BRA-LIN in-kind contribution program for LSST:

- Lite IDAC
- Software + Data Products for Photo-z
- Pipeline Scientist

BRA-LIN key-people:

- Program Lead: Luiz da Costa
- Program Manager: Julia Gschwend
- IDAC Contribution Lead: Carlos Adean
- PZ Contribution Lead: Julia Gschwend
- DESC Pipeline Scientist: Clécio Bom, Sandro Vitenti
- In-kind Program Coordinator (from Rubin): Aprajita Verma

- Independent Data Access Center (IDAC)

- Access of proprietary LSST data to members
- Access of public data using the Science Server
- 5 PB storage, 500 TB database, 500 cores
- Process photo-z measurements
- Acquisition of equipment has started

New PIs possible through LIneA in-kind contributions which are essential for doing science with LSST:

Photometric redshift

Julia Gschwend et al:

Photo-z Server – data and metadata photo-z related repository.

Training Set Maker – pipeline to generate training and validation sets for photo-z estimation from public spectroscopic data.

Complementary data products – photo-z measurements for all objects in public data releases.

Brazilian Participation Group (PIs)



Active Galactic Nuclei:

Thaisa Bergmann, Sandro Rembold,
Rogemar Riffel, Rogério Riffel,
Jaderson Schimoia



Dark Energy:

Clécio Bom, Luiz da Costa,
Marcos Lima, Valério Marra,
Bruno Moraes, Mariana Penna-Lima,
Rogério Rosenfeld, Sandro Vitenti



Informatics and Statistics:

Daniel de Oliveira, Rafael Izbicki,
Reinaldo Rosa



Strong Lensing:

Clécio Bom



Stars, Milky Way, and Local Volume:

Ana Chies, Charles Bonato
Kepler Oliveira, Basílio Santiago



Galaxies:

Ana Chies, Sandro Rembold, Rogemar
Riffel, Rogério Riffel, Reinaldo Rosa,
Jaderson Schimoia



Solar System:

Altair Gomes, Julio Camargo,
Valério Carruba, Felipe Ribas



Transients and Variable Stars:

Clécio Bom

Transients and Variable Stars

- **Clecio de Bom, Swayamtrupta Panda** (+ students, postdoc):
 - Gravitational wave and neutrinos follow-up
 - multi-wavelength characterization
 - classification/characterization of variable sources



Informatics and Statistics

Rafael Izbicki: calibration of photo-z codes (also DESC)

Reinaldo Rosa (+ students, postdoc):

- Deep Learning for Galaxy Morphological Classification
- Data Science Strategies for MMA



Stars, Milky Way, and Local Volume

- **Ana Chies, Charles Bonato** (+ students, postdoc):
 - Extragalactic globular clusters as tracers of galaxy assembly across different galaxy types and environments,
 - multiple populations of galactic globular clusters.
- **Basílio Santiago, Adriano Pieres** (+ students):
 - Mapping stellar populations;
 - Finding new ultrafaint dwarf satellite galaxies.



Solar System Science Collaboration

Júlio Camargo, Rodrigo Bonfleur, Gustavo Rossi (+students):

Stellar occultation, astrometry

Valério Carruba (+ students):

Asteroid dynamics, asteroids physical properties, Machine Learning applied to small bodies



Active Galactic Nuclei

Thaisa Storchi-Bergmann, Jaderson Schimoia, Rogemar Riffel, Sandro Rembold, Rogério Riffel, Swayamtrupta Panda (+ students):

LSST light curves and host galaxies of highly variable AGN;
Photometric reverberation mapping of AGNs.

DESC



- **Valério Marra, Céicio Bom** (+students):
 - (CB) Cosmology with dark sirens and strong lensing.
 - (VM) Forecast on constraining the standard model with dark sirens and LSST galaxies
- **Bruno Moraes** (+students, postdoc):
 - Neutrino cosmology : measuring the sum of neutrino masses with LSST and interplay with nuisance models.
 - Photometric redshifts : modeling and characterization of the cosmological tracer redshift distributions.
 - Peculiar velocities with SNIa : estimators for measuring velocities with LSST SNe, combination with traditional probes.
- **Rogério Rosenfeld** (+students, postdoc) :
 - Extensions of Λ CDM.
 - Non-Limber computations.
 - Mitigation of baryonic effects.

DESC



- **Mariana Penna-Lima, Sandro Vitenti (+students):**
 - Cluster Cosmology, cluster mass estimation.
 - Auto- and Cross-correlations between LSST and external probes.
 - Validation / cross-check between the Core Cosmology Library (CCL) and the Numerical Cosmology Library (NumCosmo).
- **Sandro Vitenti (in-kind):**
 - Firecrown developer (co-lead): DESC tool to build the likelihoods, parameter estimators.
- **Tassia Ferreira:**
 - Co-covener of the Modeling and Combined Probes Working Group.
- **Mariana Penna-Lima:**
 - Collaboration Council : member since January 2024.
 - Membership Committee : (co-)chair since April 2021.
 - Speakers Bureau : co-chair since February 2024.