The Large Synoptic Survey Telescope

The LSST is a new kind of telescope. Currently under construction in Chile, the LSST is designed to conduct a ten-year survey of the dynamic universe. LSST can map the entire visible sky in just a few nights; each panoramic snapshot with the 3200-megapixel camera covers an area 40 times the size of the full moon.

Images will be immediately analyzed to identify objects that have change or moved: from exploding supernovae on the other side of the Universe to asteroids that might impact the Earth.

In the ten-year survey lifetime, LSST will map tens of billions of stars and galaxies. With this map, scientists will explore the structure of the Milky Way, determine the properties of dark energy and dark matter, and make discoveries that we have not yet imagined.

Scientists in the US and Chile, LSST's International Affiliates, and the general public are invited to share in this voyage of discovery. What will you find?

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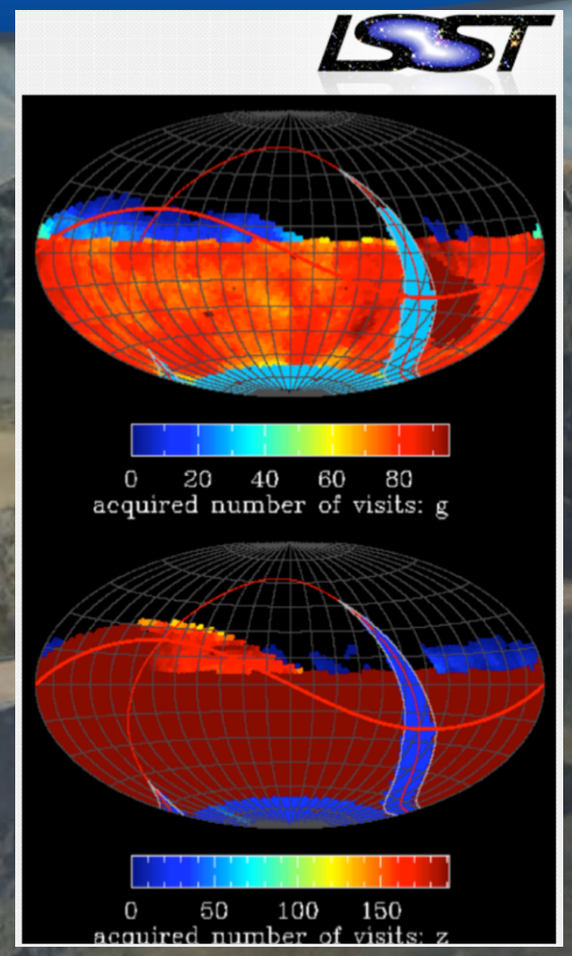
LSST: a digital color movie of the Universe...



LSST in one sentence:

An optical/near-IR survey of half the sky in ugrizy bands to r~27.5 based on ~1000 visits over a 10-year period:

More information at www.lsst.org and arXiv:0805.2366

A catalog of 20 billion stars and 20 billion galaxies with exquisite photometry, astrometry and image quality!

INAF entered LSST in 2017 with a formal agreement (MoA) with the LSST Corporation.

Participation was agreed for 15 PIs (“owner of “data rights”) for 10 years of the nominal survey, at the cost of 200k$ (indexed 2013) for each PI.

This implies a INAF commitment for about 300k€/year

Each PI can give access to 4 more “young researchers” (post-doc/PhD)

INAF informally declared its intention to re-assess (potentially upward) the level of engagement after ~3 years of participation (i.e. now)

During these three years, 75 (15x5) INAF scientists have actively participated to LSST (work in the SC, simulations, science plans, conferences etc).

This model has been completely flipped by NSF and DOE

MoA are not valid any more.

Participation from international partners is regulated by “in-kind” contribution.

These “in-kind” must be negotiated between MoA holders (INAF) and NSF/DOE.

three categories

- Contributions that could offset LSST Facility Operations costs will be dealt with by direct interaction between LSST and certain groups, and are not requested here. (Those groups will be asked to submit an LOI that includes *all* their proposed in-kind contributions, for simplicity. Their proposed “added value” contributions will be evaluated by the CEC at the same time as the other in-kind contributions sought here.)

- Contributions that could enhance the LSST system for the benefit of the US science community may be proposed. Please feel free to contact us to discuss specific ideas.

- Contributions that expand the resources available to the US science community may be proposed. Please feel free to contact us to discuss specific ideas; we will put you in touch with the chairs of the relevant LSST Science Collaboration if you have not already contacted them. Please also mention the LSST Science Collaborations that you are already in contact with, so that we can catch any missed connections more easily.

- Examples of the type of in-kind contribution likely to be acceptable following a positive CEC evaluation include:

    - ○ Observing time, dedicated to proposals led by US PIs, at key non-US facilities. (Observing time contributed only to subsets of the US community will not be accepted by the US agencies.)

    ○ Access to surveys or proprietary datasets of high value to the US community, including (but not restricted to) datasets complementary to the LSST survey and which enable high priority LSST science.

    ○ Dedicated software development effort, to be either embedded in one or more LSST Science Collaborations and assigned to a needed analysis pipeline, or focused on a particular enhancement to the LSST system.

- As a rough guide, and in order to achieve "comparable commitments to the ones that were made in the original MOAs," you can assume that:

    - ○ 1 FTE year of dedicated effort (at the appropriate skill level) will be approximately sufficient to obtain data rights for 1 PI for the duration of the survey (13 years, US FY22 through FY34).

    - ○ The equivalent cost of the US agencies providing the same 1 FTE year of effort is about $300k; this may also be used as a guide when considering the value of other resources, including observing time, again using US prices.

Deadlines:

Nov 22 Letter of Intent from MoA holders;
March 31, 2020 Final submission of “in-kind” proposals

INAF has submitted a LoI on November 22, 2019

- **General desire to increase the size of the participation (not quantified)**

Potential areas:

Analyses of LSST data sets

Here the goal is to identify a subset of the LSST data that matches a key scientific goal for the Italian community. In this case we are interested to provide LSST with a complete package that includes:

- The development of specific software for the analysis of these data (either customizing the standard LSST pipeline or developing new tools);
- The treatment (possibly starting from raw images) of LSST data;
- The full release of the data products (catalogues and all derived quantities) to the American LSST community and/or worldwide, as agreed with the US agencies.
-

Dedicated Software tools

The contribution here is the development of specific software tools that can be made available to the entire LSST ecosystem, developed, documented, released and maintained by INAF. Typical examples are photometric tools for crowded stellar fields, software for deblending and matched photometry of deep extragalactic fields, machine-learning based photometric redshifts, stellar classification, numerical simulations, identification and characterization of variable stars and transients, algorithms for the detection of galaxy clusters in photometric surveys, and others.

Follow-up of LSST targets

The goal here is to use INAF-owned observing time at major observational facilities to follow-up specific sets of LSST sources. Again, the goal is to provide the US community with a self-consistent package including:

- Selection of specific sources for follow-up, in collaboration with and under the guidance of the relevant Science Collaborations;
- Observations carried on under INAF-owned telescope time at optical telescopes, the most relevant being:
  - Intermediate-resolution single-slit spectrographs extending from the UV to the near IR (SOXS@NTT, NTE@NOT);
  - High-resolution single-slit spectrographs in the optical (PEPSI@LBT) or optical-IR (HARPS+GIANO@TNG);
  - Wide field imaging data in the optical domain with the VST at Paranal, delivering high quality ugriz images over a 1sqdeg field. Despite being much less efficient than LSST, this instrument can be dedicated to massive follow up of specific LSST fields for complementary observations with different cadence (typically faster than the average 3-day LSST period) and/or in the u-band filter. Support in the photometric calibration of LSST data.
  - Data reduction and analysis of the acquired data;
  - Release and dissemination of the final data products (spectra, catalogues, classification) to the US LSST community.
  -

Some of these instruments may be available to the Italian community through dedicated instrument consortia. In these cases, the agreement will take into account the specific commitments and regulation of each relevant consortium.

Direct contribution to Science Collaborations
INAF scientists are deeply involved in the operations of several SC both with functional work that is beneficial to the entire LSST project (like chairing several SC committees, working groups and “Tasks Forces”) and by providing unique expertise, tools and other intellectual properties.

Observing time at major telescopes
INAF directly operates or a number of facilities in the northern hemisphere. In principle, INAF can deliver part of its observing time to US agencies as a payback for the LSST participation. Admittedly, this is not our preferred avenue to LSST partnership, but we are ready to explore it if requested.
The most obvious infrastructures are the LBT (8m optical-IR), the TNG (3.5m optical-IR) and the Italian VLBI network that includes among others the 64m radio telescope SRT.

Support to commissioning operations.
We finally remark that INAF is available to provide a specific support to the LSST commissioning activities, in three broad areas:
- Direct manpower contribution of highly qualified and experienced staff, in technical areas related to the telescope construction and observations, directly operating in Chile under LSST’s management directives;
- Dedicated observations with ancillary telescopes to provide LSST with calibration data sets (e.g. deep U band images with VST or LBT);
- Direct manpower contribution and computing resources for data analyses of LSST commissioning data, always under the general directives of the LSST team

Our goal within March 2020 is to define the projects for in-kind contribution.

Priority:
- Analysis of LSST data sets
- Follow-up of LSST targets
- Development of specific software

Goal: to use the ~300k€/yr already planned to support projects in these fields.
Note that a single project employing 5 FTE/yr corresponds to 60 PIs….

Data Rights (see document on the webpage)

After a proprietary period of two years, all the LSST data become public.

Alert packets of transient and variable data derived from prompt nightly processing will be public immediately

Although the data will be public after two years, access to the data will not be made available through LSST Data Access Centers (DACs) in the US and Chile for non-data rights holders.

The alert stream is public immediately. Prompt data products available within 24hr of the time taken at the telescope are proprietary for 2 years after the data release in which they are contained, and then become public. Data releases are a consistently processed version of raw images obtained before the release date and include catalogs and meta-data associated with the image set. Data releases are proprietary for two years following their release through the DACs then become public

LSST Users are not allowed to distribute proprietary LSST data products to non-users (although they are allowed to share derived data products

The entire set of raw images and calibration files used to produce processed images are proprietary and will be accessible to LSST Users through the LSST DACs.

The real-time alert stream is public. The contents of the alerts database that records and stores all issued alerts is public; however, access to the LSST alert database at the LSST DACs will be restricted to LSST Users.

Publication policy is “free” - but must respect data rights

LSST Users are free to collaborate with any User or non-user. Users cannot share access to the LSST DACs or proprietary data with non-users but are free to share derived data products generated from proprietary data products. This includes coordinates of up to 1000 objects for follow-up observations

non-user contributes computer code, simulations, or scientific ideas to a paper using LSST data, but never touches the LSST data. This is unambiguous; they are allowed to be co-authors.

A new comet is found by a LSST User in stacked deep drilling images, but is not found by the LSST Solar System Processing System and not included in the public Prompt data products (e.g., the alert stream or through the Minor Planets Center). This LSST User has a colleague who could obtain immediate follow-up for scientific analysis (e.g., color evolution, gas outflow measurements), but this colleague is a non-user. The comet's ephemerides are a DDP which may be shared with the colleague.

The Discovery of a New Local Group Galaxy in Proprietary Data

LSST Users have access to the original catalog.
If they use their software to make the catalog the data are still proprietary.
If they select a subset for spectroscopic follow-up this can be shared with non-users

A community broker run by a LSST User accesses proprietary data products in the DAC, e.g., the forced-photometry light curves, and uses its own algorithm to classify objects (i.e make a determination of the nature of the object beyond its characteristics conveyed in the alert packet. E.g., “high redshift galaxy”). The classifications are a DDP and can be shared publicly. The forced-photometry is public, but the access to the prompt products database is still restricted to the LSST Users (see DPOL-504).

Riunione Nazionale 9-10 gennaio 2020 (Roma Monte Mario)

Registrazione: entro 22/12/2019

Manifestazione interesse per PI: scadenza 8 gennaio 2020

Proposta preliminare per in-kind: scadenza 8 gennaio 2020