The TVS Roadmap

LSST Project and Community Workshop 2019
Session: TVS (Melissa's Slide Deck)
Friday August 16, 9:00-10:30am

Large Synoptic Survey Telescope

Slide Deck Contents

Purpose of the Roadmap
Structure of the Roadmap
Collated List of Identified Activities

Purpose of the Roadmap

To identify and prioritize the activities required to enable science with LSST.

The TVS-SC Roadmap identifies five types of **activities**:

- Assembling precursor observations or sample sets
- Developing theory and models for data interpretation
- Building computational resources and infrastructure
- Creating tools for data processing and analysis
- Upgrading current facilities (e.g., new/refurbished instrumentation)

Why write a roadmap?

- To stimulate preparations (task forces and studies now) and avoid future road*blocks*
- Communicate between sub-groups/collaborations and reduce redundant efforts
- Build a stronger base from which to apply for funding
- To do science now with a long-term vision that will reward us in the future

Where does it go?

A living document to be occasionally (re)posted to arXiv.

Structure of the Roadmap

Chapters *approximately correspond to the LSST Data Products used:**

2	Time Sensitive	Prompt Data Products (60s-24h)
3	Non-time Sensitive	Data Release Data Products (Annual)
4	Deep Drilling Fields	Special Programs or User-Generated Data Products
5	Mini-Surveys	

Additional (empty) chapters titled:
6 Tasks
7 Classification
8 L3

Sections correspond to science cases:
- Extrinsic Galactic and Local Volume
- Intrinsic Galactic and Local Volume
- Extragalactic

Additional sections:
2.1 Prompt Data Products (done)
2.5 Broker Interaction (empty)
2.6 Facility Requirements (polarimetry)
2.7 Computational Requirements (empty)

3.1 DR Data Products (done)
3.5 User-Generated Data Products (empty)

Sub-sections are science topics (e.g., “GRBs”), **each of which have two components:**
- Low-hanging fruits
- Pie in the sky

**exceptions might exist for user-generated data products built from the Prompt/DR data products of the WFD survey*

Collated List of Identified Activities

MLG read through the roadmap and picked out items that fall into each of the five activity categories:

- Assembling precursor observations or sample sets
- Developing theory and models for data interpretation
- Building computational resources and infrastructure
- Creating tools for data processing and analysis
- Upgrading current facilities (e.g., new/refurbished instrumentation)

Caveat 1: The following slides were assembled while Roadmap was still evolving.
Caveat 2: I did not read Chapters >4, so DDF/Mini-Surveys is not covered.

Collated List of Identified Activities

Assembling precursor observations or sample sets

- S.2.3.1 (EXor) and S.3.3.1 (Pulsating Stars) mention assembling public surveys of photometry and **constructing light-curve libraries** to help refine diagnostic tools for classification & sample selection
- S.2.4.1 mentions *"using also literature and archive data [we can] obtain light curves with baselines of many decades"* → indicates pre-assembly of archival samples would be useful (but not explicitly defined)
- S.3.2.1 (transiting exoplanets) remarks on TESS overlap → indicates need to **assemble sample of TESS stars** which are unsaturated in LSST images
- S.3.3.3 (Long Period Variables) mentions *"A systematic search of lightcurves typical of SySt in available databases (OGLE, Catalina, ATLAS) should be carried out to prepare LSST characterization."*
- S.3.3.5 (EXor/UXor) describes systematic monitoring *"is ongoing … to **construct template spectra** … a reference for spectroscopic follow-up"* with LSST

Collated List of Identified Activities

Developing theory and models for data interpretation

- S.2.3.1 mentions that no EXor/FUor (pre-main sequence star) models *"provide a realistic view of the observed burst phenomenology"*, but as a side-note, not a statement of intent to generate the models
- S.2.4.3 (Blazars) mentions that the origin of blazars' high-energy radiation is still debated, with leptonic and hydronic models, but not whether this debate prohibits LSST data analysis and needs resolving
- S.3.3.2 (Cepheids & RR Lyrae) mentions the **need to build complete theoretical scenarios for pulsational models in the LSST bands ugrizy**
- S.3.3.6 (CVs) remarks that **for dwarf novae, *"Better population models*** *are needed to provide comparison of the resulting number densities with expectations"*
- S.3.3.9 (ILOTs) mentions that *"**theoretical development on envelope inflation and atmosphere modelling** is needed to predict a range of LBV colours as a function of metal contents"*

Collated List of Identified Activities

Building computational resources and infrastructure

- S.2.3.1 mentions that the full light-curve history of EXor/FUor bursts will be needed in order to fully interpret Alerts → indicates that **brokers must develop LSP interfaces** (but this is not stated explicitly)
- S.2.4.1 (blazars) mentions that immediate reactions to optical and high-energy flares, or PeV neutrinos, with optical, NUV, X-Ray, and/or radio follow-up will be necessary → indicates that **brokers and/or follow-up network infrastructure is needed** (but these needs are not fully described)
- S.3.3.1 (Pulsating Stars) quantifies that **storage for precursor-survey catalog data**, required for classification and sample selection tools, requires memory of ~1TB and infrastructure development

Collated List of Identified Activities

Creating tools for data processing and analysis

- S.2.3.1 (EXor/FUor) and S.2.3.3 (NSBs) mention LSST+eROSITA co-analysis → indicates that some **tools need to be developed for co-analysis of data sets (but not explicitly defined or discussed)**
- S.2.4.1 (ILOTs) mentions *"with periodic stacks we can largely exceed this [30 Mpc] distance limit"* or *"monitor [the decline] to late phases"*, and *"stack frames collected before and after the explosion"* for environment studies → indicates a need for **User-Generated Data Product of intermediate coadds (but not explicitly described)**
- S.3.2.1 (transiting exoplanets) mentions that LSST's detection efficiency for transits could be *"calibrated by trying to recover exoplanets that are found by TESS around stars in the magnitude overlap"*, **but no prioritization or plan for doing this** is discussed
- S.3.2.3 (microlensing) mentions that time-domain simulations of microlensing events will be needed in order to characterize bias (and mentions alerts & brokers, so should perhaps be in S.2 instead?) → indicates that **tools for simulated events needs to be developed (but not explicitly described)**
- S.3.3.1 (Pulsating Stars) mentions **light-curve classification algorithm development**, and tools for *"the propagation of frequency aliases into the asteroseismic solution space"*
- S.3.3.3 (Long Period Variables) identifies a *"**need [for] deep-learning software** to search for subgroups of OGLE and future LSST Miras that would decrease the P-L relation scatter"*

Collated List of Identified Activities

Upgrading current facilities (e.g., new/refurbished instrumentation)

- S.2.6 'Facility Requirements' mentions that *"blazar science … would highly benefit from a support telescope of the meter class equipped with a **polarimeter**"*, but doesn't discuss whether anything appropriate currently exists or is planned, and if not, or how this might come to be
- S.3.3.3 'Long Period Vars' mentions that *"LSST would need to have **filters to discriminate C/O chemistry** (arXiv:1903.06834)"*, potentially pointing to upgrades after year 10? (see also arXiv:1903.06834)

MLG Remarks

It was quite challenging to identify ***activities*** embedded in the text.

This will inhibit the objectives of the Roadmap (initiating task forces and studies, communicating actions between subgroups and collaborations, identifying potential funding application topics).

Variety of interpretations of “Roadmap”:

- some text describes detailed science cases or observing strategy, but this kind of stuff could/should (and maybe also is) in the Science Book, the COSEP, and the OSWPs

- some text describes the kind of future follow-up (or co-temporal data) to be obtained, but without roadmap context (i.e., will it be possible with future facilities, are new reduction/analysis tools needed)

- some text (S.3) describes the roadmap for science once LSST is underway, providing timescales for what kind of science can be done at, e.g., years 3 and 10 (S.3.3.2, S.3.3.3), which is a different interpretation of “roadmap” but also seems quite useful a contribution