Observing Stategy and SN Cosmology

Ph.Gris

LPC Clermont-Ferrand

Observing Strategy and SN Cosmology

- The LSST defined a so-called "baseline cadence":
  - optimizes the amount of sky covered in any given night
  - allows the entire sky visible at any time of the year to be covered in about three nights.
- The survey requirements on depth lead to roughly 825 visits (summing over the six fillters) in the 10-year LSST survey to any given point on the sky.
- The cadence is designed to give uniform coverage at any given time, and reaches survey goals for measuring stellar parallax and proper motion over the ten-year survey.

-> Deep-Wide-Fast component of the survey covers: ~18,000 deg2 of high Galactic latitude sky 85% of the available observing time.

- Remaining 15% of the telescope time:
  - Imaging at low Galactic latitudes.
  - Imaging in the South Celestial Cap
  - Imaging in a series of four Deep Drilling Fields, single pointings (~5 times more exposures in all filters)
  - Imaging in the Northern portions of the Ecliptic Plane.

With this observing strategy, how many SuperNovae of "good quality" will LSST collect per year ?

Observing Strategy and SN Cosmology

- **3 steps from exposures to SN cosmology:**
  a) **Supernova detection: light curves from image processing (the stack)**
  b) **Supernova classification: use machine-learning algorithms to classify SN types**
  c) **Intrinsic supernova brightness estimation: fit the calibrated flux to a light curve model with a set of parameters**

These three items will depend on the observing strategy of LSST (number and quality of LC points)

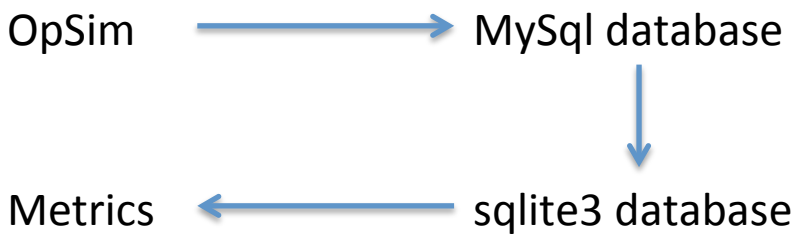
a) may be studied with the stack, while b) and c) may be covered with simulations: Operation Simulator (OpSim)+SN LC simulators (SNcosmo, SNANA, …)

OpSim+MAF

- The Operations Simulator (OpSim) is an application that simulates the field selection and image acquisition process of the LSST over the 10-year life of the planned survey.
- Each visit or image of a field in a particular filter is selected by combining science program requirements, the mechanics of the telescope design and the modelled environmental conditions.
- The output of the simulator is a detailed record of the telescope movements and a complete description of the observing conditions as well as the characteristics of each image.

Metrics Analysis Framework (MAF)

- Comprehensive set of analysis tools for reading and interacting with the database.
- Analysis scripts to gain insight into a simulated survey.
- Users may write their own scripts (python)
- A given observation is defined as a DataSlice (a given area in (RA,DEC) depending on the mapping chosen).



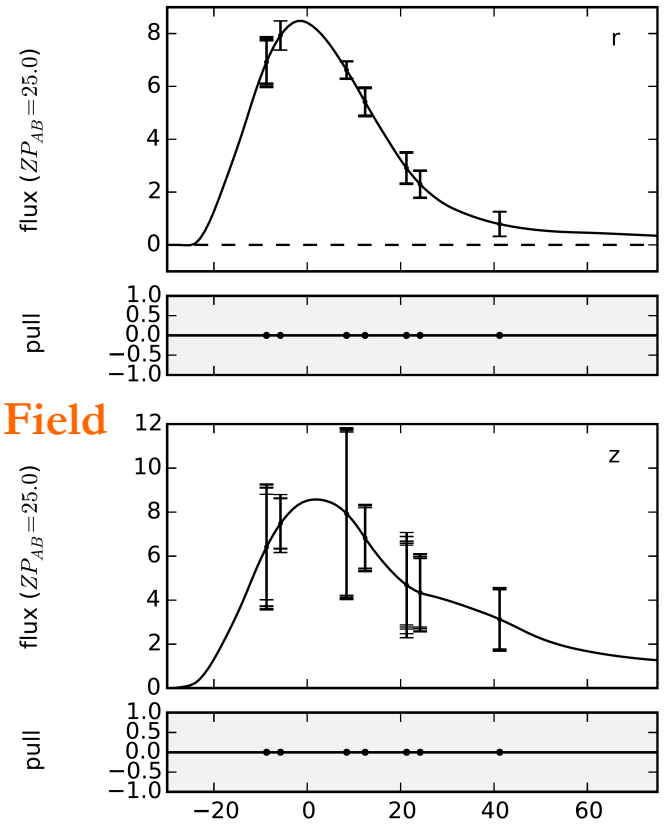
SN Metrics

- **PerSNMetric for each of the following components:**
  - **SN discovery: given the observations in a time window corresponding to the lifetime of a supernova, evaluate the probability of detecting a transient**
  - **SN classification: given the observations in a time window corresponding to the lifetime of a supernova, evaluate the probability of accurately classifying the transient**
  - **SN light curve characterization quality: given the observations in a time window corresponding to the lifetime of a supernova, evaluate the quality of characterization**

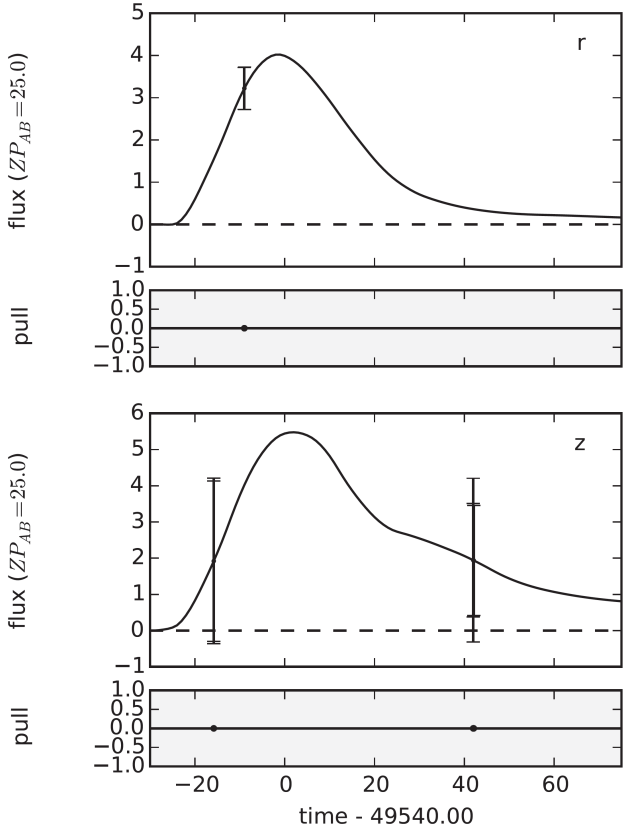
-> Work in progress, still pending questions

SN Metrics

Deep Drilling Field



Main Survey



SNcosmo, z=0.5
Uncertainties ?
Impact of the simulator ?
Redshift dependance?

Rolling cadence ?