LSST Photometric Specifications and Precursor Data

The LSST optical photometric bands (u,g,r,i,z,y) are similar to those used in the Sloan Digital Sky Survey (SDSS) (Fukugita et al. 1996). The combined efficiencies of the optics and filters, sensor quantum efficiency, and typical atmospheric extinction are shown in the figure.

Design specifications for LSST stellar photometry are given below. The first three specifications are relative quantities defined within the native LSST photometric system in AB magnitudes. These are for bright stars not limited by photon statistics in a single exposure (e.g. r < 21).

LSST Design Specifications for Stellar Photometry

<table>
<thead>
<tr>
<th>Specification</th>
<th>Repeatability (μm)</th>
<th>Spatial Uniformity (μm)</th>
<th>Color Uniformity (μm)</th>
<th>Absolute (μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(AB rms)</td>
<td>0.005</td>
<td>0.010</td>
<td>0.005</td>
<td>0.020</td>
</tr>
</tbody>
</table>

Measurements of Atmospheric Composition and Extinction

Spectra of probe stars in or near each LSST field will be monitored by the 1.4 meter Auxiliary Telescope (AT) to determine changes in atmospheric composition. The AT will also measure broad-band photometric magnitudes of standard stars (e.g., DA white dwarfs) over wide ranges of zenith angles. These will be combined with atmospheric models (e.g., MODTRAN4) to extract accurate corrections for atmospheric extinction 2) at real time at arbitrary wavelengths.

Auxiliary Telescope

The AT will be instrumented with a low-resolution (R ~ 100) spectrograph and imager. Cumulative stellar counts at the North Galactic Pole extracted from SDSS data (Ivezić 2006) confirm ~ 200 stars in each LSST field with r < 15 AB. These measurements will be used to infer the properties of stars in each LSST field.

Calibration of LSST Instrument and Data

The LSST process decouples establishment of an internal relative calibration from assigning absolute optical flux to celestial objects. The latter task requires determination of a single zero point for each filter band for the accumulated multi-epoch data set. celestial sources will be used to define the internal photometric system. Standardization of photometric scales will be done through observation of stars with well-understood SEDs in science images.

References


Measurement of Instrument Response

A system to use a tunable laser to calibrate the combined telescope and camera response function (x,y,z) is being developed. (Stubb and Tonry 2006)

References

MODTRAN, 29 Randolph Road, Hanscom AFB, MA 01731.
NIST Special Publication 204-41, NIST Calibration Services, 1996.

LSST All Sky Reconstruction

The LSST process decouples establishment of an internal relative calibration from assigning absolute optical flux to celestial objects. The latter task requires determination of a single zero point for each filter band for the accumulated multi-epoch data set. celestial sources will be used to define the internal photometric system. Standardization of photometric scales will be done through observation of stars with well-understood SEDs in science images.

Accumulated Survey

All Sky Reconstruction (~ Monthly, i.e. ~ 10 Epochs)

Auxiliary Data

Atmospheric Extinction Z(az,el,t)

Instrumental Response Function (x,y,z,t)

Calibrated Photodiode

Tunable Laser

Dome Screen

Auxiliary Telescope

The AT will be instrumented with a low-resolution (R ~ 100) spectrograph and imager. Cumulative stellar counts on the North Galactic Pole extracted from SDSS data (Ivezić 2006) confirm ~ 200 stars in each LSST field with r < 15 AB. These measurements will be used to infer the properties of stars in each LSST field.

There will be 200 main-sequence stars with 17 < r < 20 on every chip in every LSST image. An internal network of standard stars will be established during LSST commissioning, and will be periodically optimized with increasing precision and definition as the multi-epoch survey proceeds. This effectively utilizes the best observing conditions to define the internal LSST photometric scales.

Well understood DA white dwarf stars (WDs) will be reference standards for LSST photometry. The density of DA WDs with magnitudes 17 < g < 20 is great enough (Eisenstein 2008) that, even at high galactic latitudes, one will be in a large fraction of LSST science images. The spectra and magnitudes of several DA WDs visible from Carmen Parapet have been measured from above the atmosphere with HST (Bookiol 2001).

Measurement of Instrument Response

A system to use a tunable laser to calibrate the combined telescope and camera response function (x,y,z) is being developed. (Stubb and Tonry 2006)