Calibrations of LSST Camera and Telescope Systems

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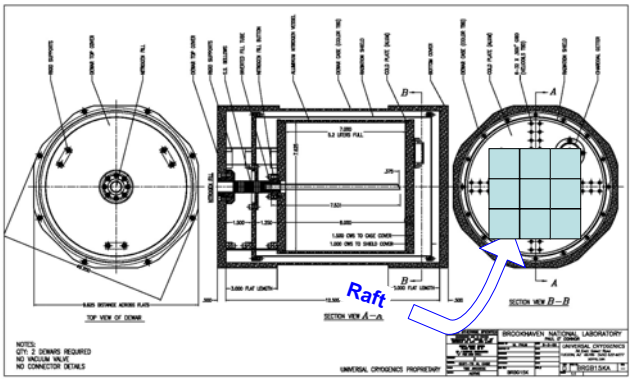
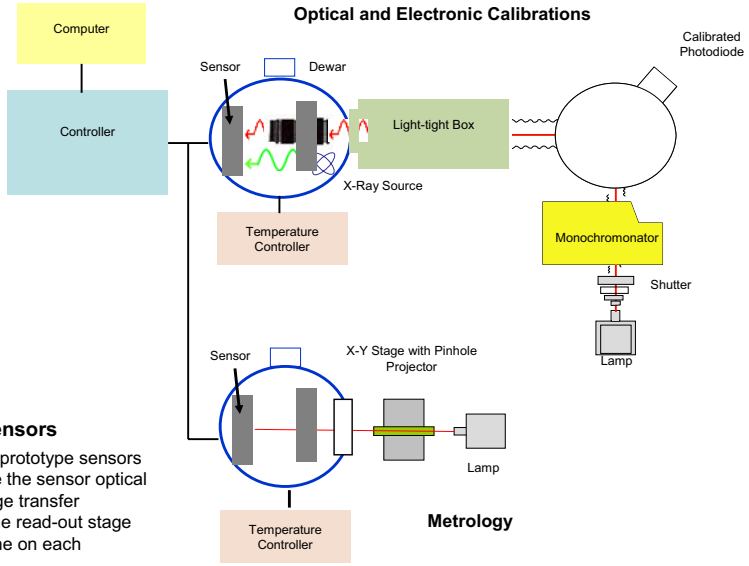
Large Synoptic Survey Telescope

The unique three-mirror design of the LSST optics, the size and performance specifications of the sensor mosaic in the focal plane of the camera, and the data rate that will be generated by the LSST operating cadence and observing plan create need for careful test and calibration of LSST systems during construction and operations. This poster describes the planned program that will be carried out during construction and operation of the LSST. A new precision photometric calibration technique using a tunable laser is described.

Plan View of Two-Dewar Set Up Showing a Raft of Nine Sensors



Optical and Electronic Calibrations



Laboratory Metrology and Calibrations of Camera Prototype Sensors

This system will be used to verify the metrology and optical and electrical performance of prototype sensors supplied by industrial vendors. The parameters that will be studied with this set up include the sensor optical quantum efficiency as well as electrical parameters such as the cell full-well charge, charge transfer efficiency, traps and defects, cross talk and persistent image, and the noise and gain of the read-out stage on the chips. An imaging test to determine the intrinsic PSF of the sensor will also be done on each completed raft of nine sensors.

In-Situ Camera Sensor Calibration and Verification of Signal Integrity

The LSST science program demands optimum operational efficiency of the telescope and camera systems in order to maximize time on the sky. The LSST focal plane is read out in over 6000 segments that each consist of a FET output stage on the sensor, a custom front-end ASIC, and an ADC circuit. Use of radioactive sources is being considered to provide calibration and verification of the integrity of signal through-put in each read-out chain. Additional capability to inject a voltage pulse at the ASIC is also being considered to allow verification of read-out integrity during and following routine maintenance of the camera.

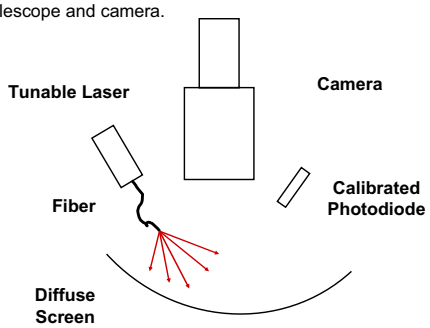
It will be possible to use radioactive sources in conjunction with flat-field screen Illumination to measure gain and linearity of the camera electronic circuits (including the on-chip FET readout stage) independent of the external QE of the detector. This is done by varying the intensity of the screen illumination to "bias" the electronic signal across its dynamic range while measuring signals from radioactive sources.

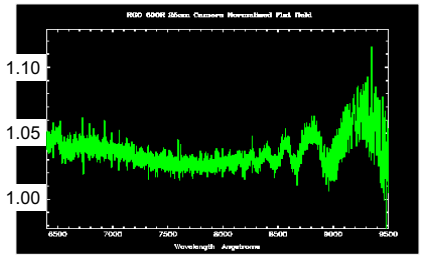
Integrated LSST Telescope and Camera System Calibration

A tunable laser, in conjunction with a calibrated photodiode with relative response known to better than 1% (Larson, Bruce and Parr, NIS special publication 250-41), will be used to determine the throughput of the complete LSST imaging system. Dispersed light from the laser will illuminate a pupil-sized flat-field screen, and the flux of light emanating from the screen measured by the photodiode will normalize the response of each pixel in the camera. Flats taken at different wavelengths will provide relative throughput measurements of the telescope mirrors, the refractive optics, the camera filters, and the camera detector.

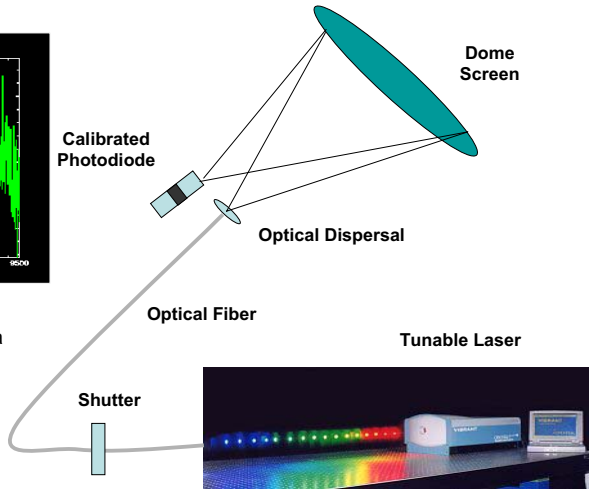
Laboratory Calibration of Camera Systems

The fully-assembled LSST Camera systems will be calibrated in the laboratory before being transported and integrated with the telescope optical systems. This will be done using the same technique that will be employed to calibrate the fully integrated telescope and camera.





Total system response to light with 650 nm < λ < 950 nm. (Data are for a single pixel from the CTIO Blanco prime focus camera, and are relative throughput with arbitrary normalization.)



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