The LSST focal plane array (FPA) will be the largest ever made. The sensors must produce low read noise, high QE in the red, and a very tight PSF. This will all be necessary to do the science at the LSST. The principle underlying the development plan is that for an FPA involving about 200 large format (4k x 4k) sensors, an industrial approach has to be developed and adopted. In this initial phase of CCD development, we have targeted specific technology challenges at competitively selected vendors, with the goal of establishing both the technical characteristics of actual sensors, based on our projected requirements, and the industrial feasibility of their production. The CCD technology challenges we have targeted in particular are over-depleted high resistivity devices in the 100 micron thickness range with a biased conductive window. Initial test results from the first devices in a smaller format resulting from this study program will be presented, demonstrating that these challenges can be overcome.

The LSST CCD Development Program

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Sensor characterization procedures

- QE measurements
- monochromator setup
- PSF measurement techniques
- development: virtual knife edge technique
- modulation transfer function MTF
- Fe55 measurements
- gain CTE noise
- Dark current and defects characterization
- Linearity and Well capacity
- Afterglow (residual image)
- Flattness measurement station

Sensors key performance requirements:

- Quantum Efficiency (QE)
- Point Spread Function (PSF)
- Dark current and defects
- Afterglow (residual image)
- Gain, Linearity, Noise, Crosstalk, Charge Transfer Efficiency CTE, Flatness, Operating temperature, Temperature & stability, etc.

PSF measurement techniques:

- virtual knife edge
- PSF spot parameters
- Stabilities & vibrations
- CCD controller optimization

Leakage Current measurements

- Leakage Current
- temperature, 100K/1K

Afterglow (residual image)

- bias subtracted using zero exposures
- no “after glow” signal on the level of 0.03% (measurement accuracy)

Leakage Current measurements

- High-FoV study (contracept) device
- sensor characterization
- LST equipment
- Deep

PSF measurement techniques:

- modulation transfer function MTF
- MTF projectors
- Stabilities & vibrations
- Analysis

QE setup and results

- Elements for QE determination
- Group in BNL
- Measurement setup
- Test data
- QE measurement
- Calibration

CCD sensors development program

- Industrial approach
  - study devices from industrial vendors are already available for testing
- Technology challenges
  - thick ~100um devices with biased conductive window
  - high resistivity silicon substrate
  - over-depletion to create high E field
- Sensor characterization
  - optimized setups for specific tests
  - data acquisition automation
  - data analysis packages

Fe55 measurements

- Angular - bias peak position, sub
- E (keV)
- Lx, Lz - 0.6556 keV
- area to create enchant, 32x32 (eV)
- F - F-ratio, 0.12
- N - age of sensor: noise, electrons

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