The LSST CCD Test Stands

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**Introduction:**

The LSST science sensor production clean room at Brookhaven National Laboratory will be the "factory floor" for testing and integrating sensors and electronics into 21 9-CCD camera modules, called Raft Tower Modules (RTMs). The production environment is organized into enumerated test stands involving the requisite compliment of cryostats, optics, tooling, and metrology apparatus.

The CCD tests and associated custom hardware are highlighted here.

**Height Metrology**

- Measurement of CCD flatness and the absolute height of the imager surface using a medical CMM
- All tests done in air with CCDs electrically inactive
- Test setup also used for CCD baseplate and 9-CCD array

**Single-CCD EO Testing**

- Initial electro-optical test is most important test a single sensor will undergo. Two instances built.
- Flat field illumination system comprising arc lamp, filters, shutter, monochromator, and integrating sphere feeds optical tunnel.
- CCD read out by commercial controller.
- Unise interface runs test suite, monitors pressure and temperature.
- Cooling provided by Polycold closed-cycle cryocooler
- Chamber supports CCD within its handling jig
- Fe-SS exposure for Charge Transfer Efficiency measurement provided by in-vacuum source-carrier/actuator

**RTM Cryostat**

- Each RTM cryostat has a dedicated handling cart.
  - Carries cryostat as well as cryocooler compressors
  - Cryocoolers not to be disconnected from cryocooler compressors for normal operation; cart remains tethered during cryostat handling operations
  - Cart allows cryostat to be rolled and docked to TS8 without special handling

**RTM EO Testing**

- 9-CCD (full RTM) version of Test Stand 3. Flat field illumination system comprising arc lamp, filters, shutter, monochromator, and integrating sphere feeds dark box (optical tunnel)
- RTM cryostat docks to dark box, supported by handling cart
- RTM tested as complete/self-contained imaging and readout system for first time after final assembly
- Data fed from cryostat to DAS optically
- PC interface (CCS) controls RTM and runs test suite
- RTM cryostat (also Commissioning Camera cryostat) provides LSSTCam-like dual thermal zone operating environment for RTM
- Fe-SS exposure provided by four X-ray Exposure Devices (XEDs): in-vacuum source-carrier/actuators

**9-CCD In-Vacuum Height Metrology**

- In-vacuum flatness metrology for the RSA imaging surface (9 CCD mosaic)
- Measures relative deviation in mosaic’s surface height to ~0.5µm
- Tests Raft Sensor Assembly flatness before integration into Raft Tower Module and again as a complete RTM. Tests occur both at room temperature and at -300°C
- Differential measurement uses optical reference flat and two Keyence LK-H082 triangulation sensors
- Symmetrical design, material choice, and cryostat mounting arrangement are athermalization features.
- Crystal placed on optical table by powered handling system
- PC interface runs test suite and generates data product

**X-ray Exposure Devices**

- Custom in-vacuum radiosource source carrier and actuator, present in all electro-optical cryostats.
- Fabricated using conventional printed circuit board manufacturing methods
- To eliminate the possibility of virtual leaks from normal motor windings, stator coils were designed into a monolithic PCB, making an intrinsically vacuum-compatible foundation for a motor, as well as mechanical baseplate.