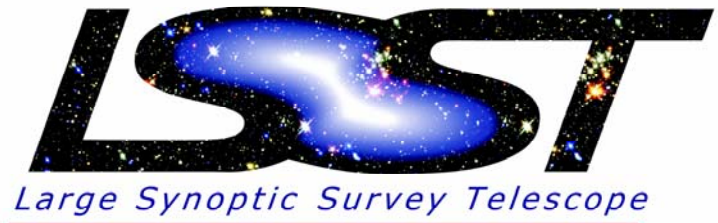


Mechanical Design of the LSST Camera

Martin Nordby (SLAC), Layton Hale (LLNL),
and the LSST Camera Team

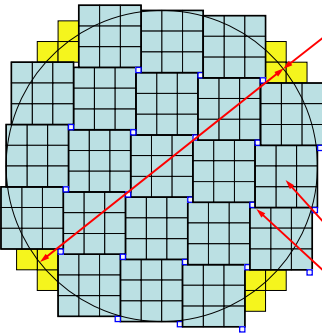


The LSST Camera requires three large (1.6 m, 1.1 m and 0.73 m) refractive optics, five 0.78 m auto-changing color filters, a mechanical shutter with 0.76 m aperture, and a tiled focal plane array spanning 0.64 m, along with associated electronics. While the three-mirror design of the telescope places rigid constraints on the outer dimensions of the camera, the optical elements and focal plane sensors demand accurate alignment of the camera components to meet LSST science requirements. Work has been underway to allocate control volumes, devise workable concepts for the mechanisms, and design structural elements. This poster outlines the key driving requirements for each of the major camera sub-assemblies, along with the current concepts for their design and operations.

Focal Plane Assembly Integrating Structure

Focal Plane Mechanical and Thermal Design

Focal plane is in vacuum to eliminate convection heat transfer.
Detectors with supporting electronics package as 3 x 3 arrays called Rafts.
Rafts are manufactured co-planar to a master fixture so as to be interchangeable with respect to its three-vee kinematic coupling, which is duplicated on the integrating structure at multiple positions.
Detectors are conductively cooled independent from the rafts and integrating structure.

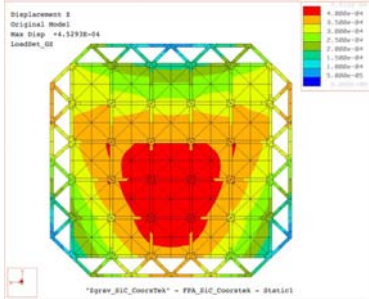


3.5° field of view
D = 15 detectors
A = 176.7 unit detector area

Focal Plane Requirements	
Requirement	Value
Detector packaging	~200 ea. ~42 mm sq.
Flatness over entire focal plane	10 μm p-v
Operating temperature	173 +/- 1 K
Temperature variation	+/- 0.15 K / night
Temperature uniformity, each detector	+/- 0.3 K

3 x 3 array of detector's form a raft, which mounts to the integrating structure
~ 0.5% loss from 16 wavefront sensors

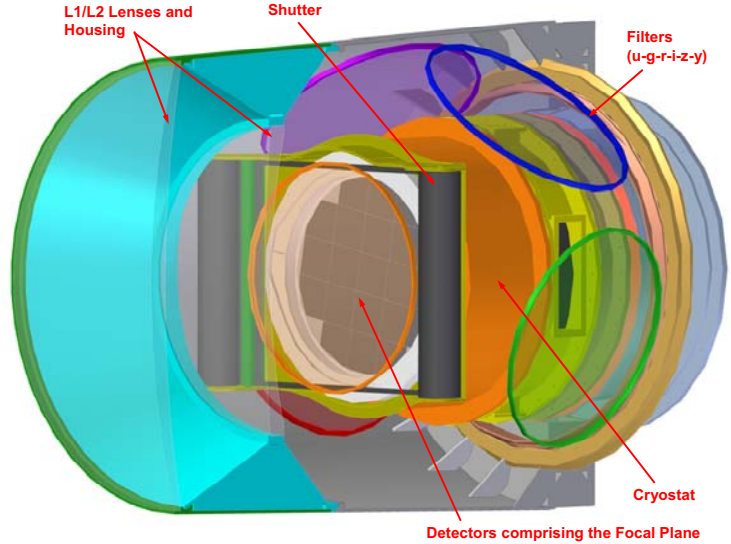
Focal Plane Layout



0.25 μm p-v distortion under 1g out-of-plane gravity load (SiC)

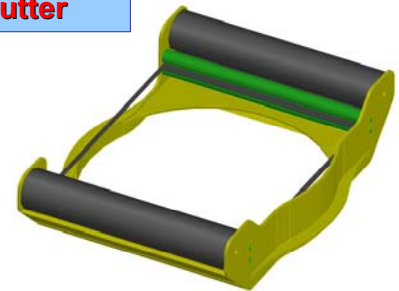
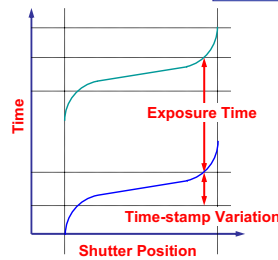
Integrating Structure Material Comparison Matrix				
Property	Unit	Alum.	Invar 36	SiC
Total mass with rafts (25 kg)	kg	100	246	112
P-V gravity sag over aperture				
0-90 elevation angle	μm	1.350	1.400	0.250
30-90 elevation angle	μm	0.675	0.700	0.125
45-90 elevation angle	μm	0.395	0.410	0.073
60-90 elevation angle	μm	0.181	0.188	0.033
Mode shape and frequency				
Mode 1, torsion/twist	Hz	205	184	463
Mode 2, X translation	Hz	241	217	546
Mode 3, Y translation	Hz	339	321	775
Mode 4, Z translation	Hz	366	346	846
Elastic modulus / density	SI	25.56	17.67	130.16
Thermal conductivity / CTE	SI	10.00	8.08	75.00

Cut-Away View of LSST Camera Assembly



Detectors comprising the Focal Plane

Shutter

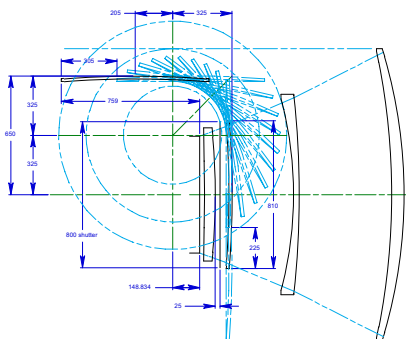


Shutter Design

Two-sheet design allows arbitrarily short exposure times
Shutter sheets must roll up to fit within the camera envelope

Shutter Operational Requirements	
Requirement	Value
Maximum time-stamp variation	1.0 second
Minimum exposure time	1.0 second
Maximum allowed exposure time variation	0.10%
Operational life	10 ⁷ cycles

Filters, Filter Changer, and Storage Carousel

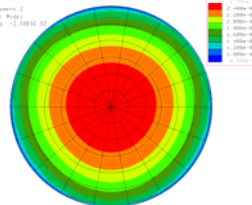
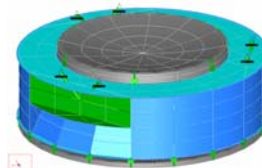


Changer/Carousel Design

Carousel holds 5 filters: g-r-i-z-y
Rail-type changer engages carousel for automatic changing
Manual load-lock changer for inserting a 6th filter (u-filter)

Changer/Carousel Operational Requirements	
Requirement	Value
Number of filters in carousel	5
Maximum filter change time	2 minutes
Approx. number of changes	4 / night
Operational life	2x10 ⁴ cycles

L1, L2, and L3 Lens Mechanical Packaging



L1 under 1g out-of-plane gravity load (2 μm/fringe)

Lens Design

L1 and L2 mount as a pre-assembled/tested unit
L3 forms the vacuum window on front of cryostat

The LSST research and development effort is funded in part by the National Science Foundation under Scientific Program Order No. 9 (AST-0551161) through Cooperative Agreement AST-0132798. Additional funding comes from private donations, in-kind support at Department of Energy laboratories and other LSSTC Institutional Members.

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Research Corporation
The University of Arizona
University of Washington

Brookhaven National Laboratory
Harvard-Smithsonian Center for Astrophysics
Johns Hopkins University
Las Cumbres Observatory, Inc.

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