Optically fed by LSST's fast and wide-field optics, the camera has a 9.6 square degree field of view and a 3.2 Gigapixel focal plane array. The focal plane is tiled by 189 4Kx4K CCD science sensors with 10\( \mu \text{m} \) (0.2 arcsec) pixels and also houses four diagnostic ("corner raft") packages that provide guide and wavefront-sensors at opposing sides of the field. The modular focal plane array has a parallelized readout scheme, allowing the entire array to be read in 2 seconds. Dedicated front- and back-end electronics boards housed within the cryostat operate sensors in raft groups (3x3 sensors; 144 data channels) while mechanically identical "rafts" are precision-mounted on a rigid silicon carbide grid structure. Three large, refractive lens elements act as the optical corrector (the third, L3, provides the vacuum barrier for the cryostat), and one of six possible band-pass filters is positioned in the beam at any given time. Mechanisms within the camera include a mechanical shutter and a carousel filter change assembly. The camera control system manages all aspects of camera operation including image capture, thermal monitoring and control, vacuum control, filter changes, and communication with the observatory control system. The data acquisition system records and pre-processes raw images, provides up to 3 days of storage capacity, and provides very high throughput data transfer to downstream data management.

**The 32pix Camera**

LSST combines a wide-field (9.6 deg\(^2\)) 8.4m class primary mirror and a 3.2 Gpix CCD array. 15 sec exposures generate ~20 TB of science data per night. Short view- and setting-times of the telescope, together with fast shutter-actuation, sensor read out and filter exchange are each crucial for high efficiency observing: a high-observing efficiency — extenuate product.

Image quality is maintained through a combination of fine guide control and active optics (AO) compensation of the three mirror surfaces and camera/mirror alignment via two hexapods. AO compensation data are acquired using wavefront curvature sensors and guide sensors located on the focal plane.

The science CCD array is highly modular: 16 channels per sensor, 9 sensors per raft, and 21 rafts mounted in the focal plane assembly (FPA). Each channel represents a small fraction — 0.00033° — of the FPA and the channels (1 Mpix each) are read out synchronously in ~2 seconds.

Front- and back-end electronics are located in the raft tower assembly located at each science raft, all located inside of the cryostat vacuum. Power dissipation per channel (FEE+NET) is ~3.6 watts during readout and half of this value (quiescent) during exposure.

Lens deformations induced by equilibrium thermal gradient and gas pressure differential create small aberrations in the compensated, "best-focus" image quality. This necessitates pre-correcting for such effects in the design. Together with a "flat" (~10\( \mu \text{m} \) max peak-to-valley) focal surface composed of 183 individual surfaces, this design meets the image quality requirements under operating conditions. Extensive finite element analysis modeling, thorough physical characterization of parts and synthesis of inspection data — each play Integral roles in this precision instrument assembly.

**Cameras Mechanical Overview**

Cut-away sectional view of the camera, showing the 32 rafts, a filter in position, and shutter and the focal plane. Below is a riveting view showing more detail of the filter exchange mechanism, carousel and camera hexapod.

**Science raft tower detail**

A building block of the full FPA. Flexible cables and thermal straps join the 3x3 raft of sensors (top) to the front-end electronics. The back end module is not shown.

- Thick (100\( \mu \text{m} \)) CCD sensors
- Packaged sensors mounted onto ARi camera & SCC mount with 3 differential screw adjusters: 1stfix
- Rigid SiC raft base with kinematic mount
- Front End Board: 6 raft
- ASPIC (Analog Signal Processing ASIC): 2/CCD; 15kW
- SCC (Sensor Control Chip – ASCIC): 3 CCD; 27kW
- Slow controls/monitoring

**Corner raft tower detail**

Mechanical hold-downs shown here are shared with the science rafts.

**A unit of science data**

15 second exposures on one science sensor (146 square arcminutes; 1.9% of focal plane). This true color image is from three leg scale gr -15 sec snapshot. (Courtesy, image simulation team.)

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**The Camera for LSST and its Focal Plane Array**

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[Image of LSST camera and its components with labels and diagrams]

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**LSST is an effort to construct a large-aperture, digital survey telescope to be built on Cerro Pachón, an elevation of 2650 meters in the Atacama Desert of northern Chile. LSST is a US-led project in partnership with Australia, Brazil, China, Chile, Columbia, India, Japan, Mexico, the Netherlands, Panama, South Korea, Taiwan, the United Kingdom, and the European Southern Observatory.**