LEOSat LSST Camera Crosstalk

Characterizing Rubin LSST Camera Anomalies with Realistic Images

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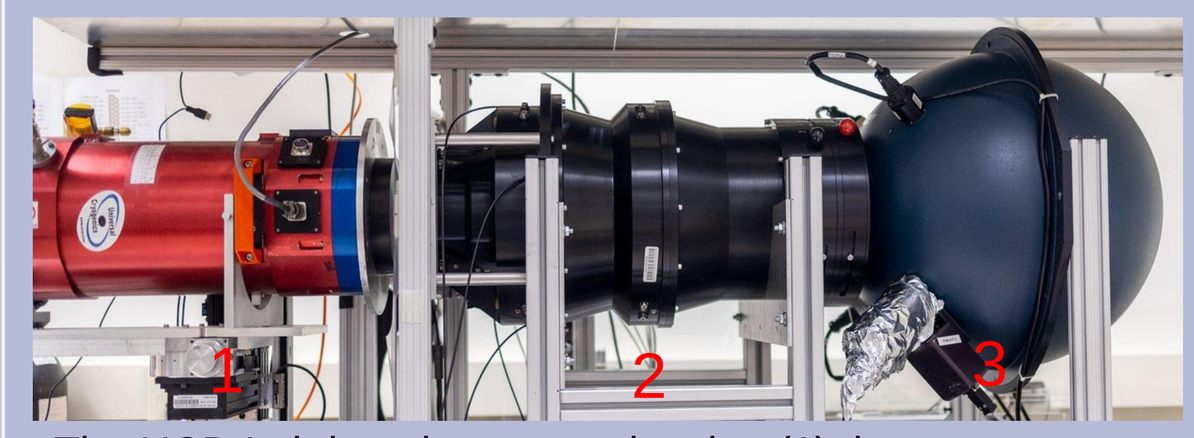
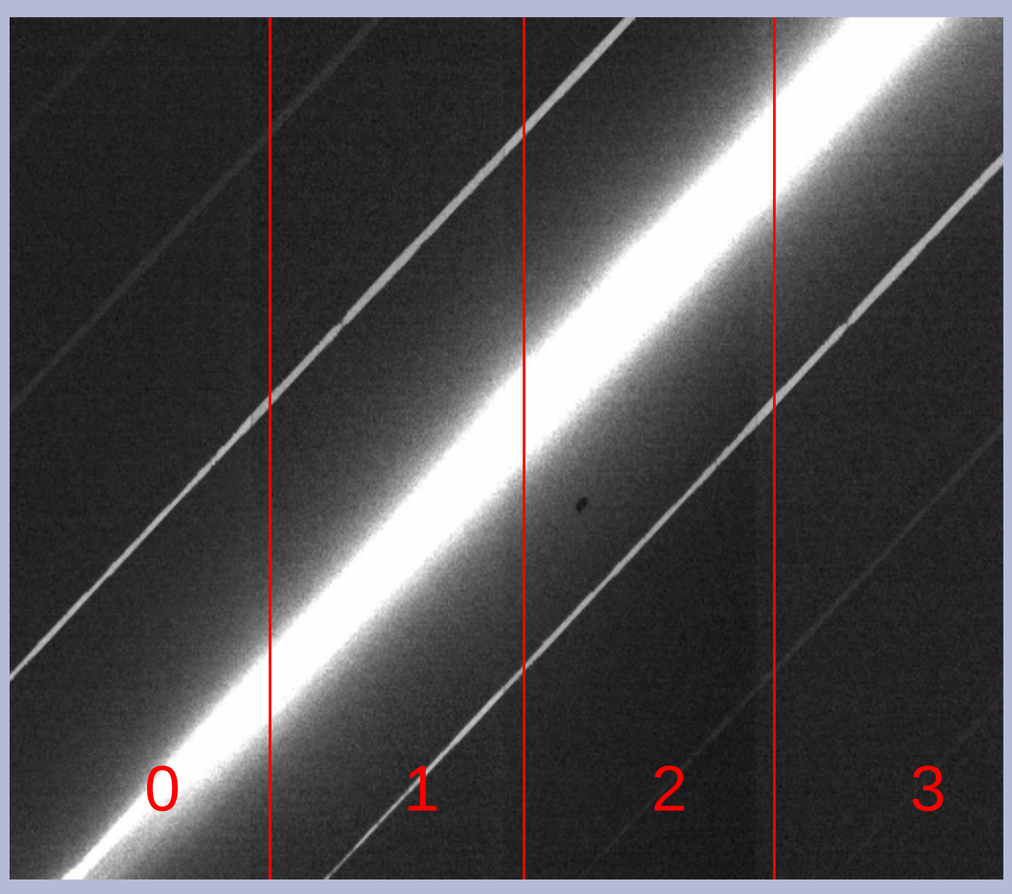
Simulating Realistic Images with Rubin LSST Camera Electronics:

The UC Davis Lab is uniquely equipped to study photometric and astrometric distortions in the LSST camera.

- Science grade ITL and e2v CCDs identical to those used in the LSST camera.
- Sophisticated optics to produce realistic astronomical scenes and simulating the seeing of the Simonyi Telescope.[1]
- REB5 readout electronics identical to those used to read out data in the LSST camera.



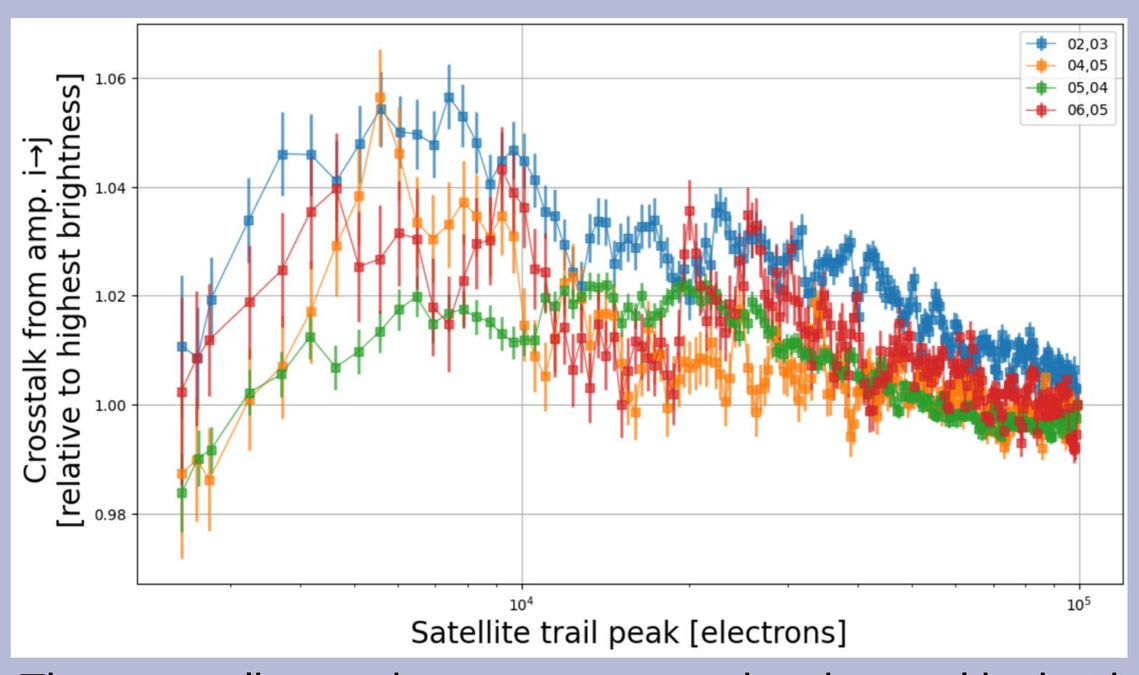
The UCD Lab imaging setup showing (1) the x-y-z stage mounted dewar containing an LSST camera science CCD, (2) the LSST Beam Simulator which mimics ths beam patern of the Simonyi telescope to produce realistic astronomical images from various image masks, and (3) a scattering sphere light source.



An image from the UCD Lab simulating a satellite streak crossing four CCD segments. This produces a bright streak where the satellite would pass (0), but also an echoing crosstalk signal in the nearest (1) amplifier segment, and in farther (2 and 3) amplifiers.

Studies of Nonlinear Crosstalk from Low Earth Orbit Satellites (LEOSats):

LEOSats produce novel streak and crosstalk effects in the LSST camera. The UCD lab is poised to study its cause and create mitigation strategies.



The crosstalk seen in our camera readout is novel in that it does not scale linearly with satellite streak brightness.[2] This implies the source is not just capacitive coupling in our electronics. It may come from an on-chip or other electronics effect. It is therefore vital that our seeing and readout electronics match those in the Rubin LSST Camera.

The UCD Lab can bypass the CCD and inject simulated video signals directly into the readout electronics. Above is a four CCD segment image (scaled to be easily viewable) with an injected vertical stripe in the left amplifier segment. Crosstalk is seen in the neighboring segments.

This technique allows us to pinpoint the source contributions of the crosstalk and isolate CCD effects from electronics effects

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References:

[1] Tyson, et al. *LSST Optical Beam Simulator* (2014), arXiv:1411.5667

[2] Tyson et al. *Mitigation of LEO satellite brightness and trail effects on the Rubin Observatory LSST* (2020), arXiv:2006.12417

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