Monitoring DES/LSST Data Quality

Steve Kent Mar. 24, 2014

- **Goals for monitoring data quality**
  - **Exclude bad data from processing**
  - **Flag fields as bad for observing plan**
  - **Identify hardware problems**
  - **Monitor site conditions**
- **Monitoring is a "process"**
  - **Always discovering new things to monitor**
  - **Software systems must be flexible**

Things that affect data quality

- Seeing
- Clouds
- Sky brightness
- Pointing errors
- Bright ghost images.
- Bright scattered light
- Airplane trails
- Noisy electronics
- Dome Occlusions
- Weird readouts
  - Vsub off
  - Shutter failures
- Telescope moving
- Flatfield lamp brightness variations

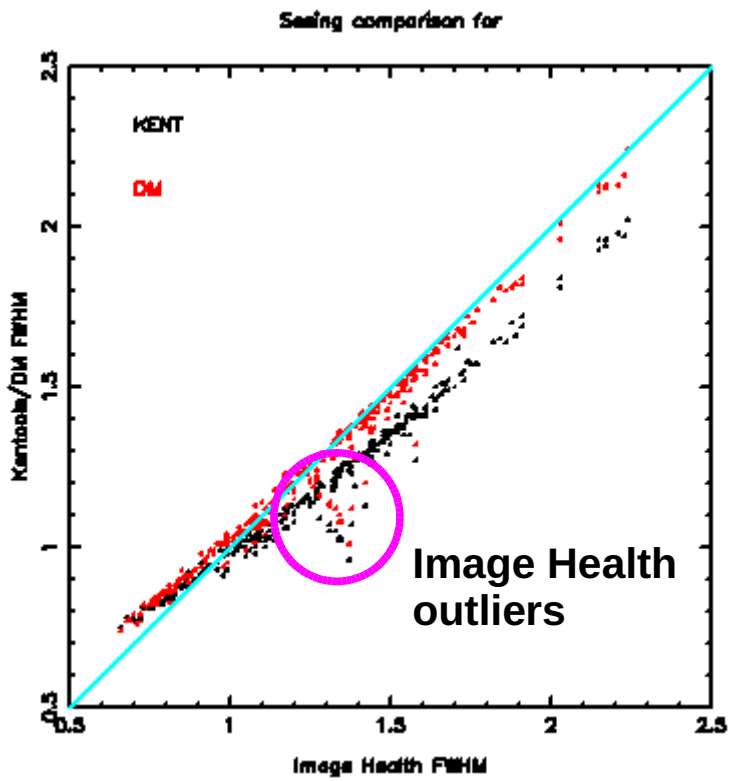
Systems that we have

- **IMAGE HEALTH - Part of online DAQ. Quick inspection of every CCD; measures noise, FWHM, other parameters**
- **QUICK REDUCE - Operates independent of DAQ. Runs SExtractor on subset of CCDs measures FWHM, ellipticity, #objects, ... Makes nice web pages**
- **KENTOOLS - will describe next**
- **Data Management - Runs SExtractor on all CCDs. Provides “official” assessment of data quality based on FHWM, sky, clouds**

“kentools”

- Leftover software from SDSS - well vetted
  - Command line oriented (but can be scripted)
- Original goal - support commissioning
  - First “donut” analyses for telescope collimation
  - Whisker analysis of stellar PSFs in support of weak lensing
  - Telescope pointing errors
- Now part of DECam operations
  - Automated measurement of PSF, sky, clouds
  - Automated centering of Supernova fields
  - Manual inspection of data by observers
- Guiding principles:
  - Lazy and impatient
    - (e.g., type “center” to get pointing corrections for most recent image)

Battling FHWM's



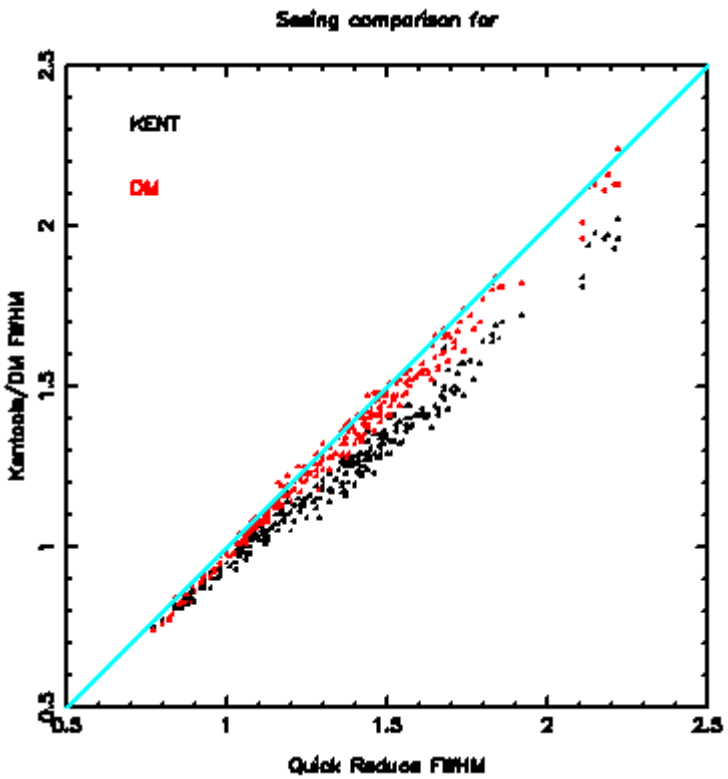
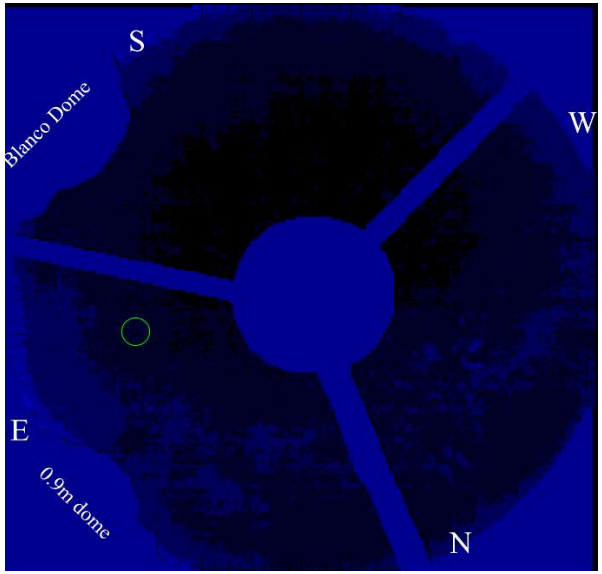


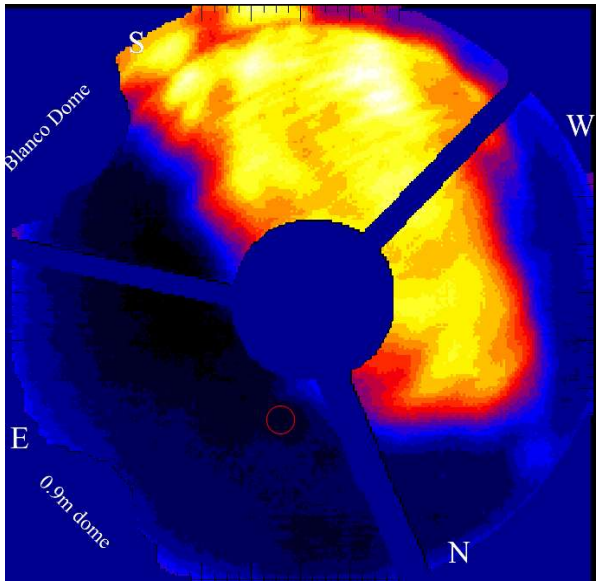
Image Health v.
DM (red)
QC (black)

Quick Reduce v.
DM (red)
QC (black)

Clouds

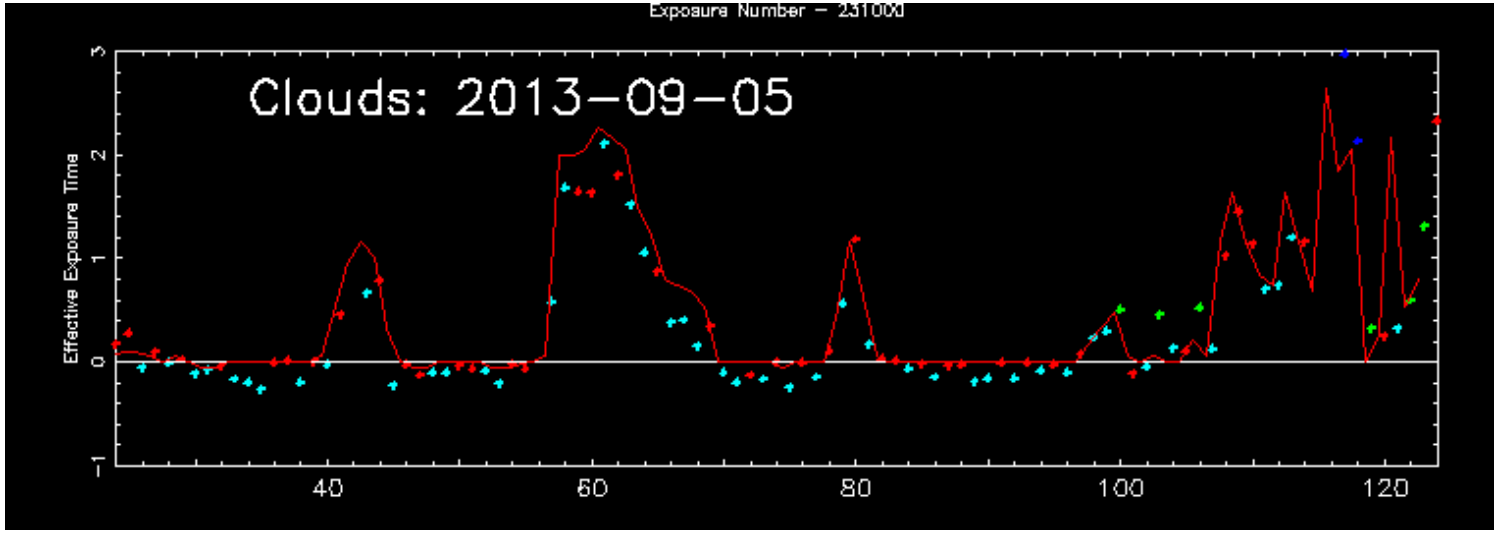
- **Even in Chile, there are clouds sometimes**
- **RASICAM:**

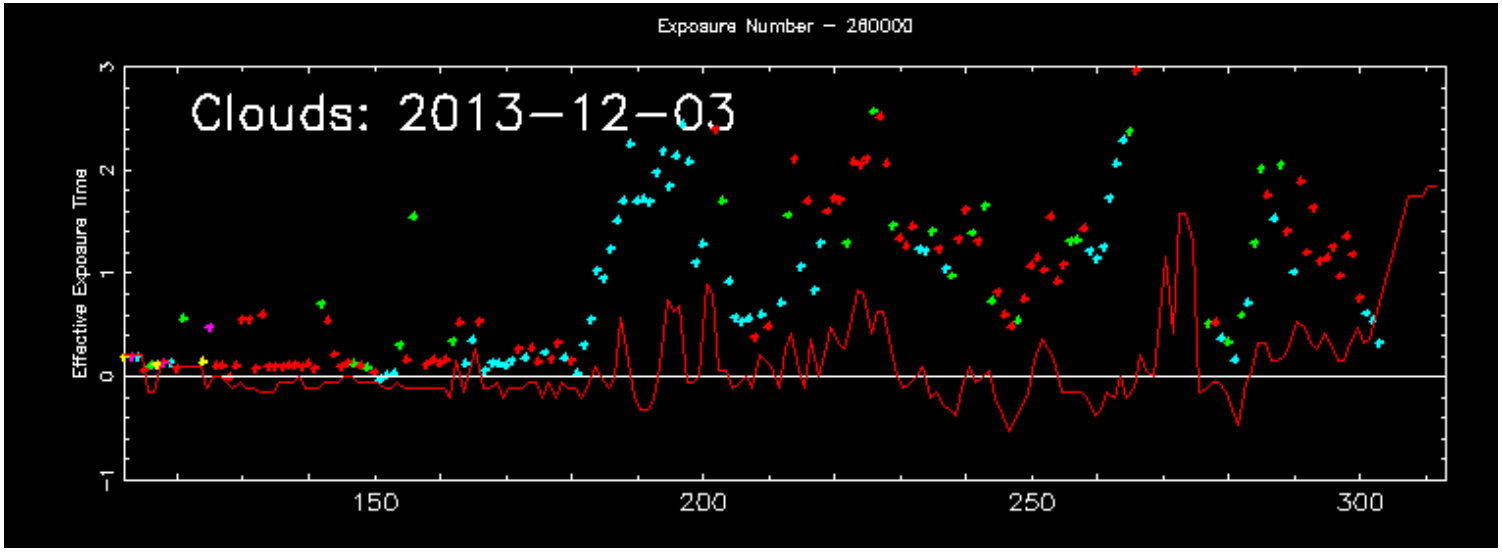




- **Compare against catalogs**
  - **NOMAD - Only B, J photometry are usable. B photometry has zonal offsets**
  - **APASS - Good photometry but does not cover entire sky; limiting magnitude too bright**

RASICAM v. Catalogs





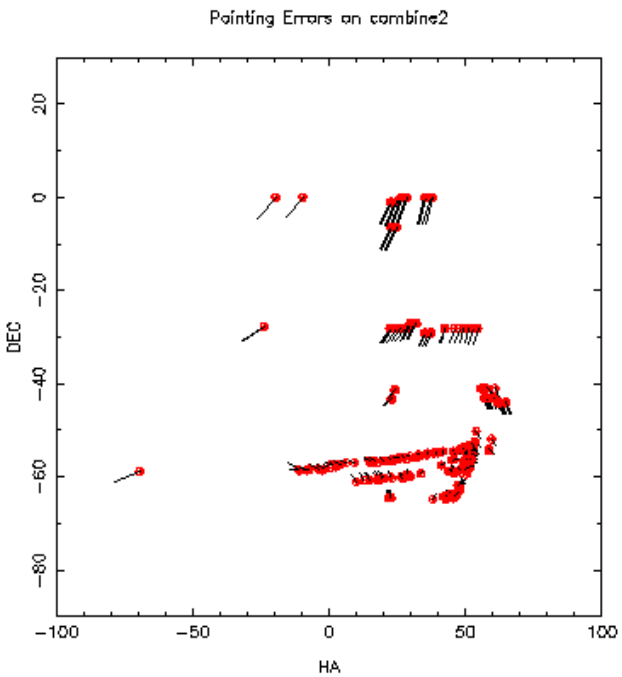
Points: Photometry from catalogs

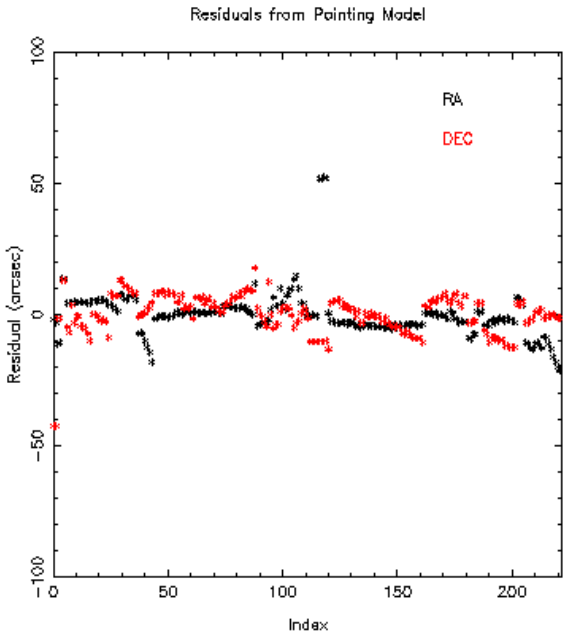
Red line: Rasicam

Sometimes Rasicam matches photometry but not as well as one would like.

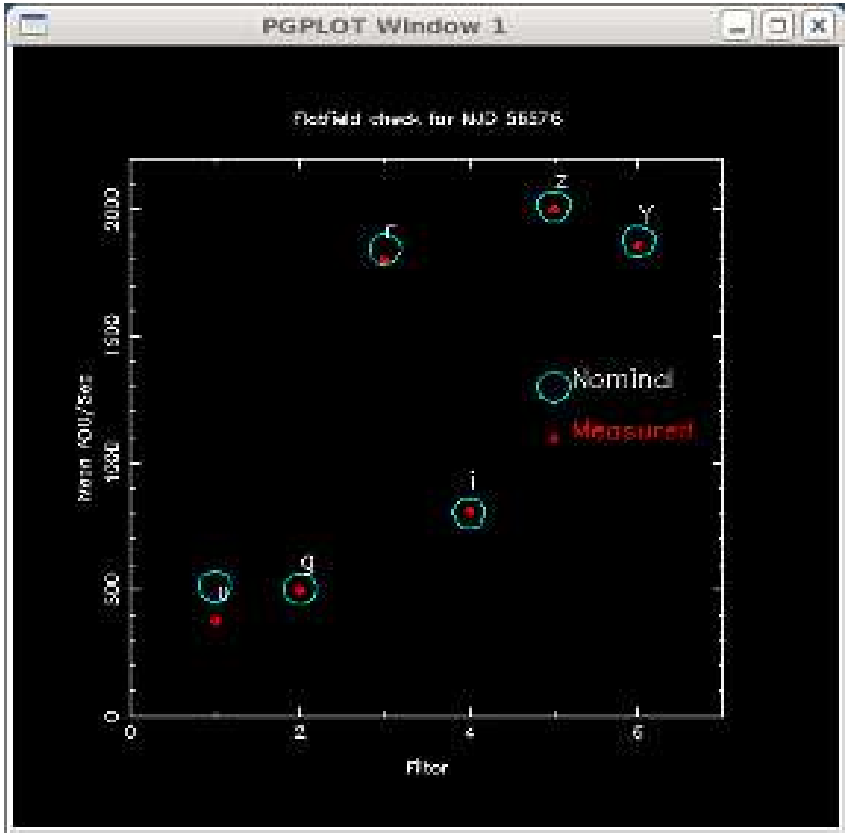
Pointing Corrections

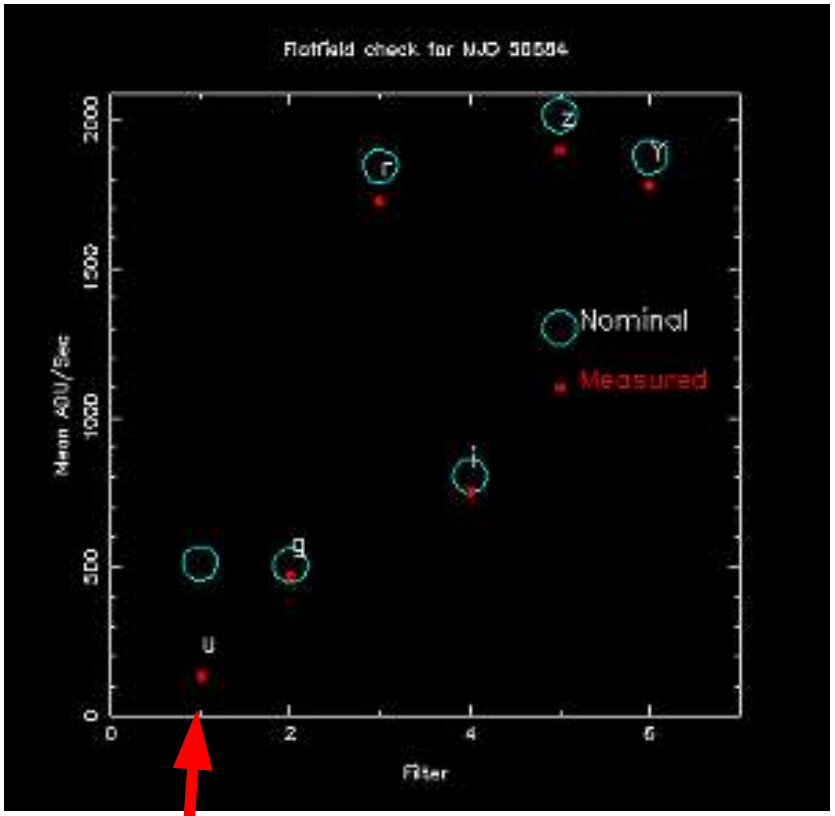
- Pointing affected by many small contributions (e.g., hexpod translation for collimation.)
- Fast computation to match 2 CCDs to NOMAD
- Early on pointing errors of order 5 arcmin
- Currently 5 arcsec rms each coordinate but occassionally bigger
- SN program wants repeatability to < 10 arcsec, so we recenter telescope first.





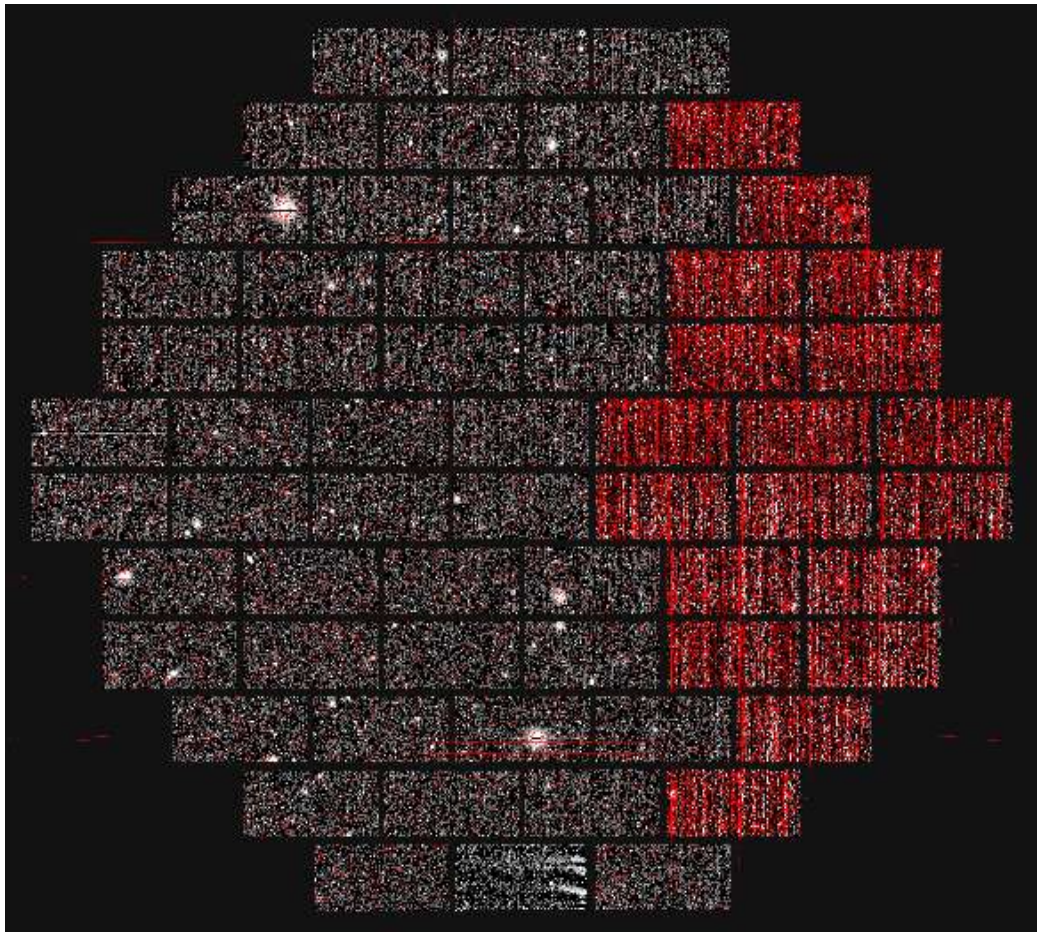
Flatfield Monitoring





Intent was to catch shutter errors during afternoon calibrations. What we did catch was LEDs declining in brightness, particularly u.

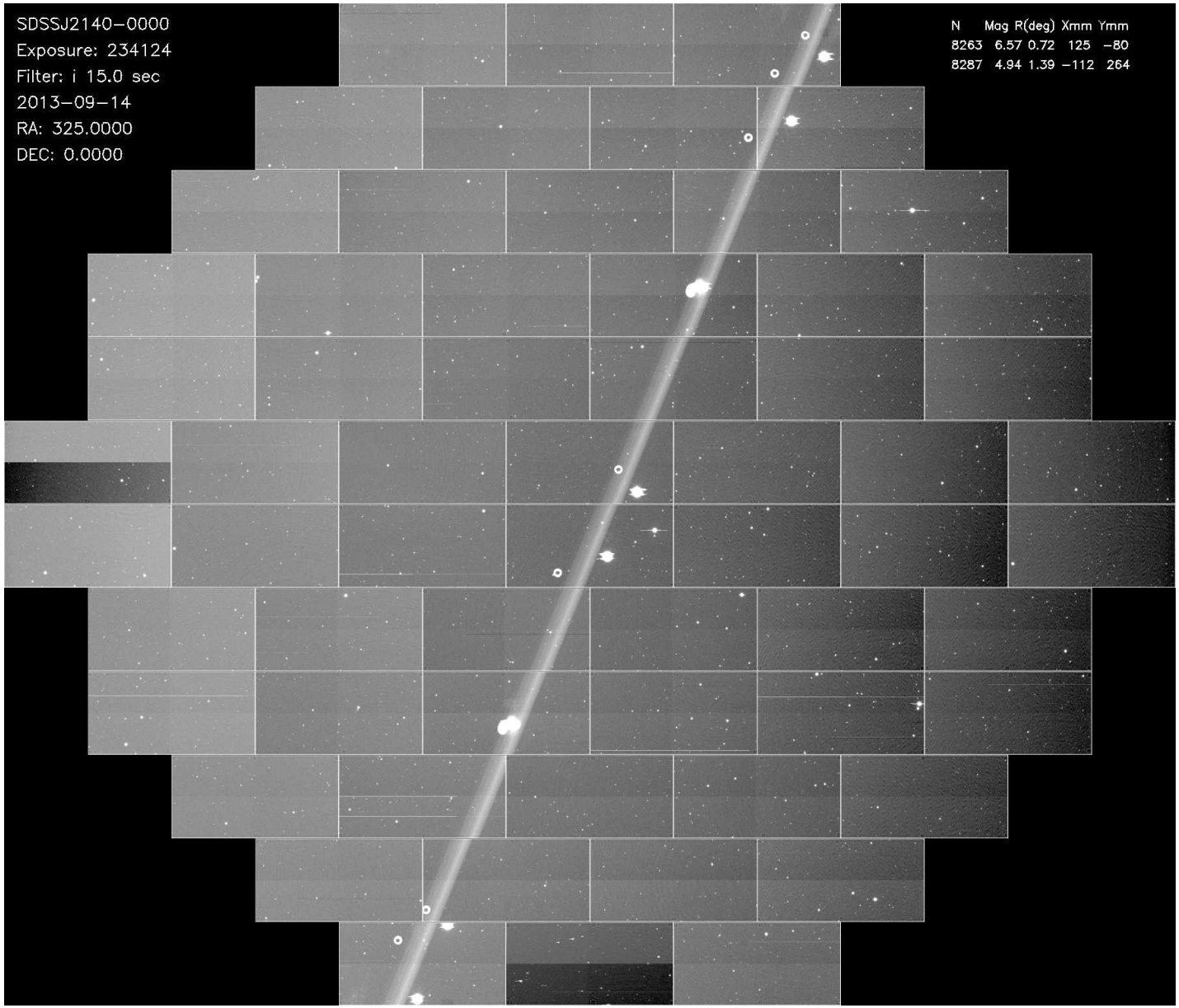
Electronic noise



258478

- Noise in bkp1
- Worst Nov. 13 & 28, 2013
- Spikey noise - not flagged by normal histogram noise measurements
- Identify by excess number of objects found in 1st cut for all CCDs for a given backplane

Airplane trails



In Y1, 16 exposures total identified by eye.

3 distinct flight paths

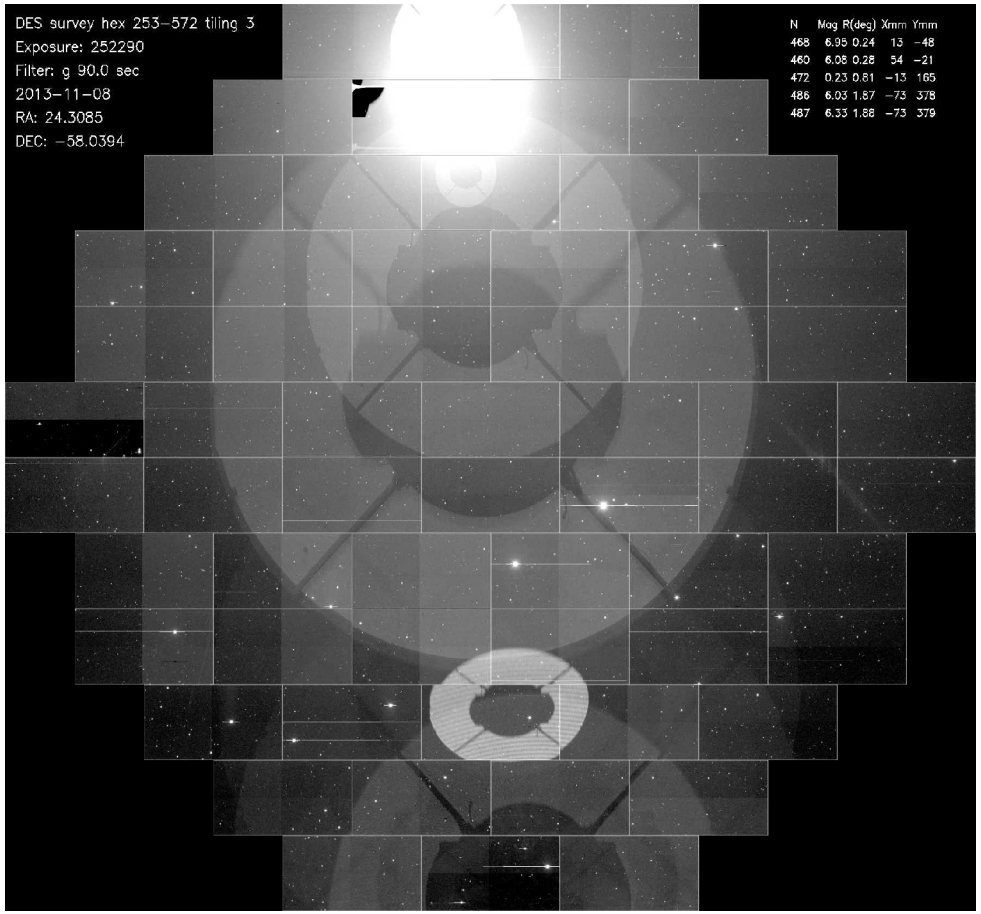
Rate: 25 * W airplanes per year, where W = width of field (deg)

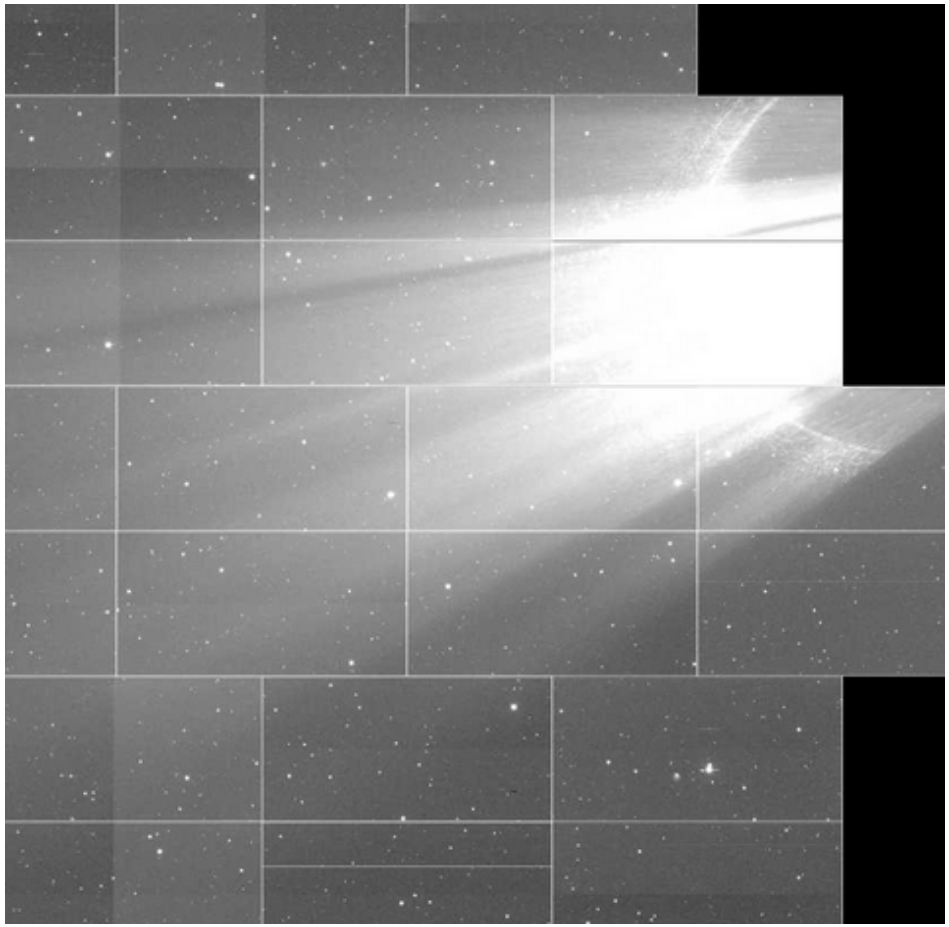
==> LSST 88 per year

Ghosts and Scattered Light

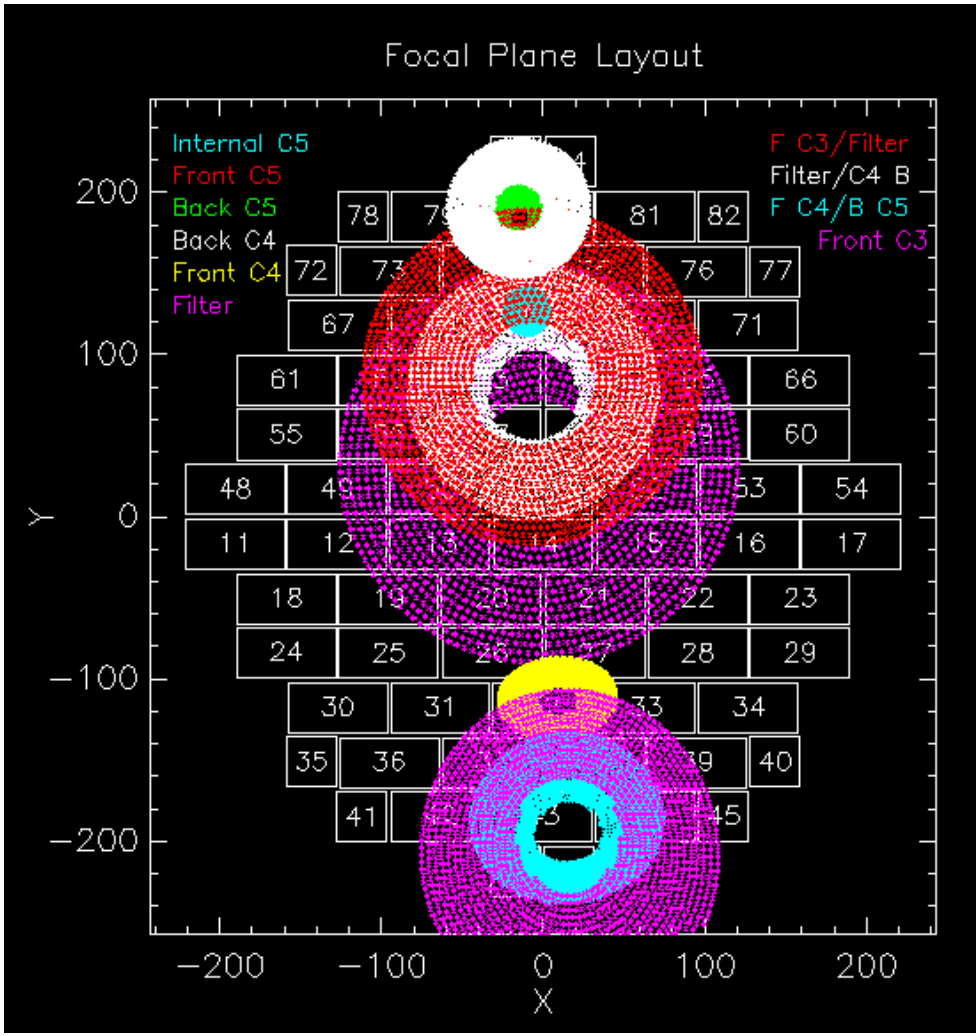
- **Seem to afflict every camera**
  - **GAIA: "One unexpected characteristic we have noticed during commissioning concerns stray light ..."**

Achernar

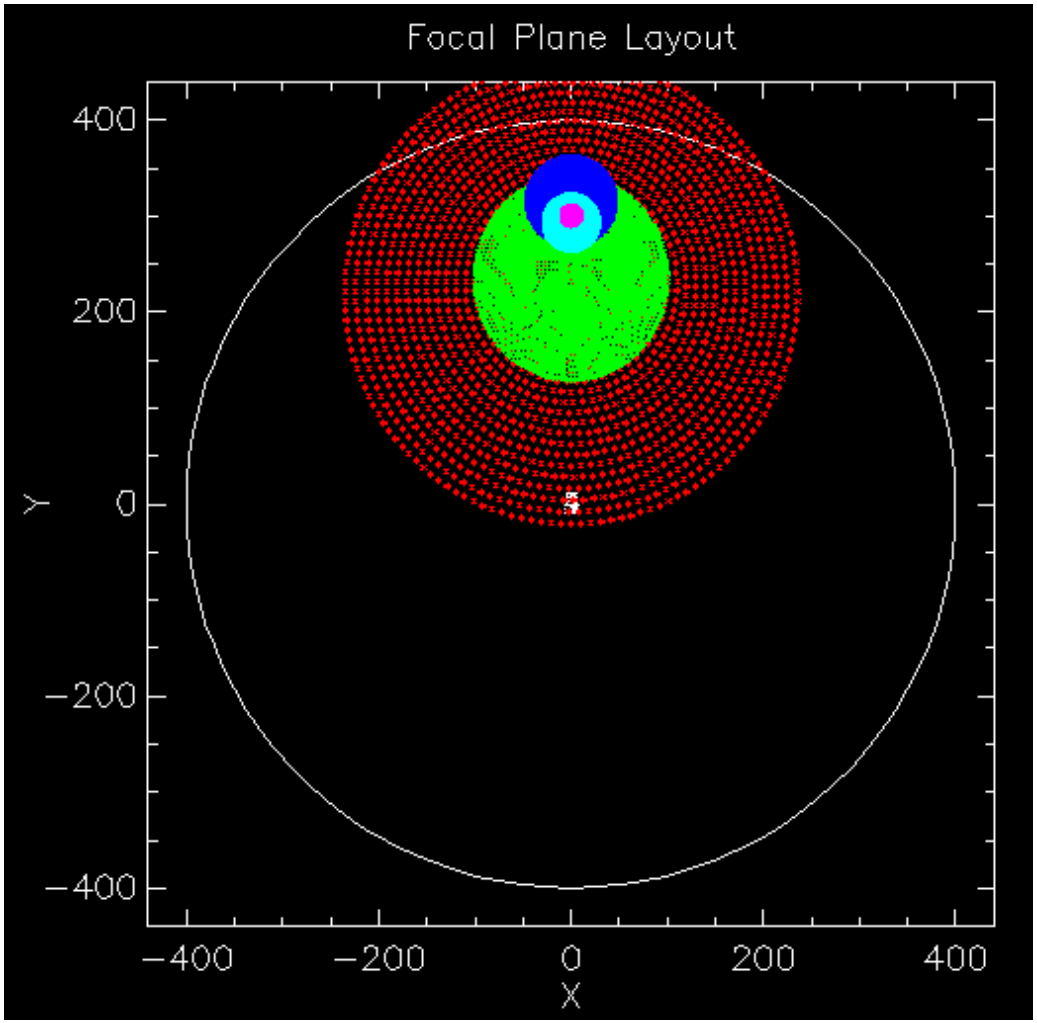




Ghosts: DECam v. LSST



DECam Ghosts

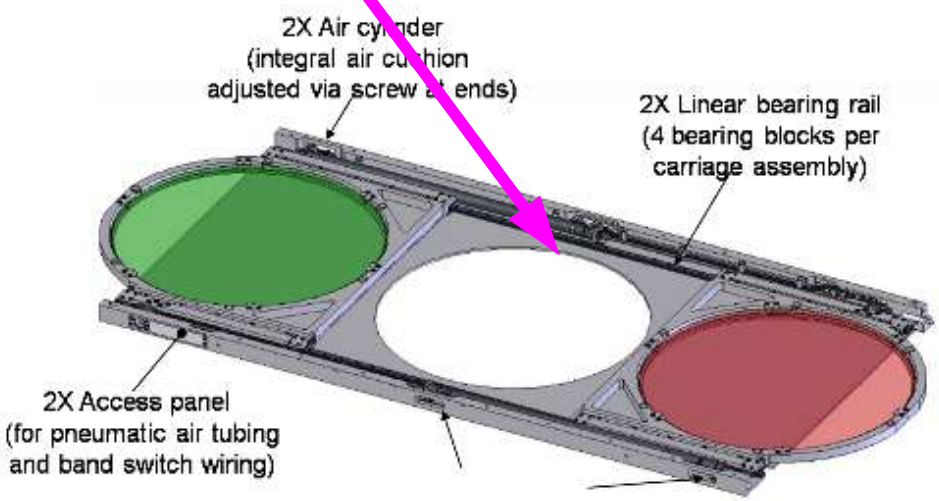


LSST Ghosts

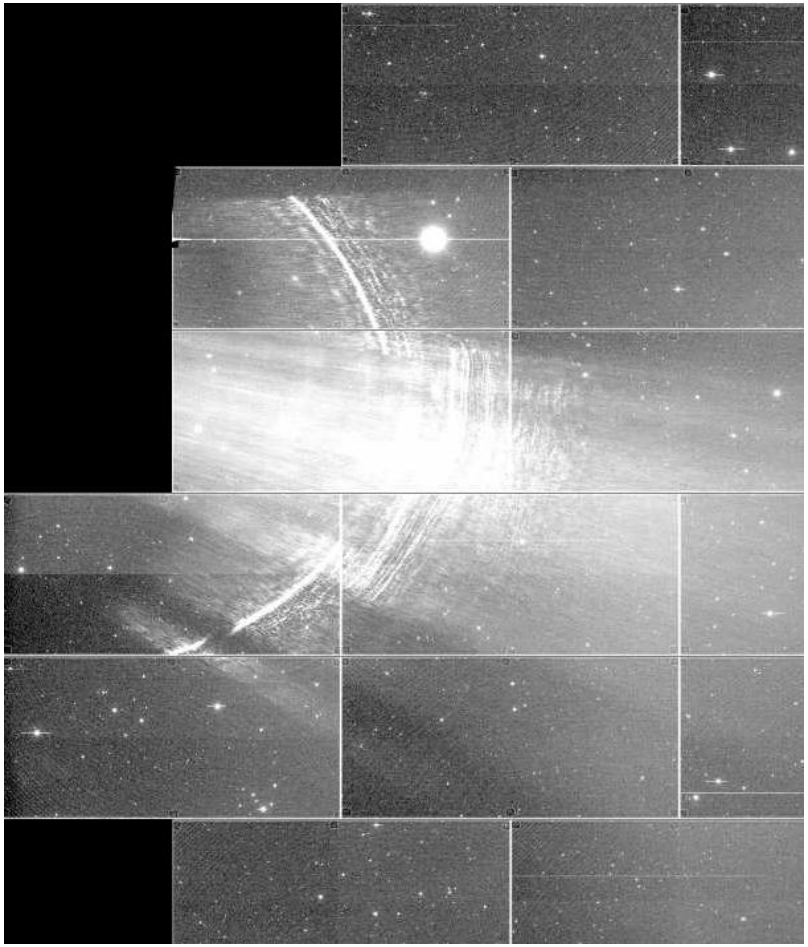
Update on Scattered Light

Steve Kent Mar. 19, 2014

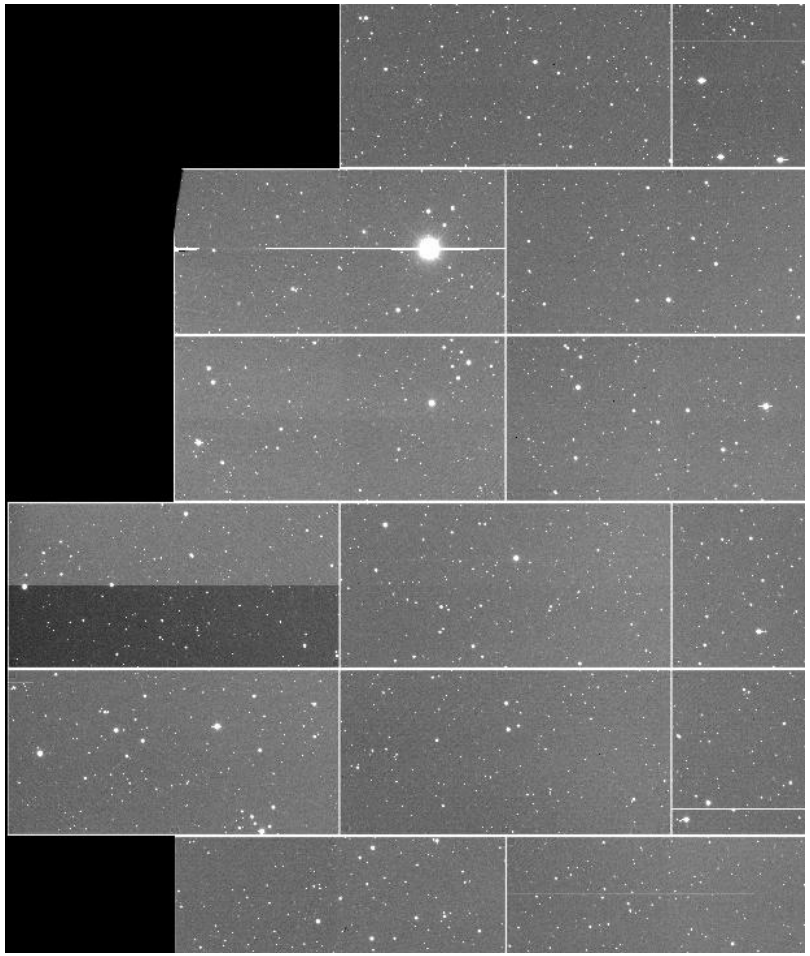
Painted March, 2014



Canopus 1.67 degrees away from field center



Before



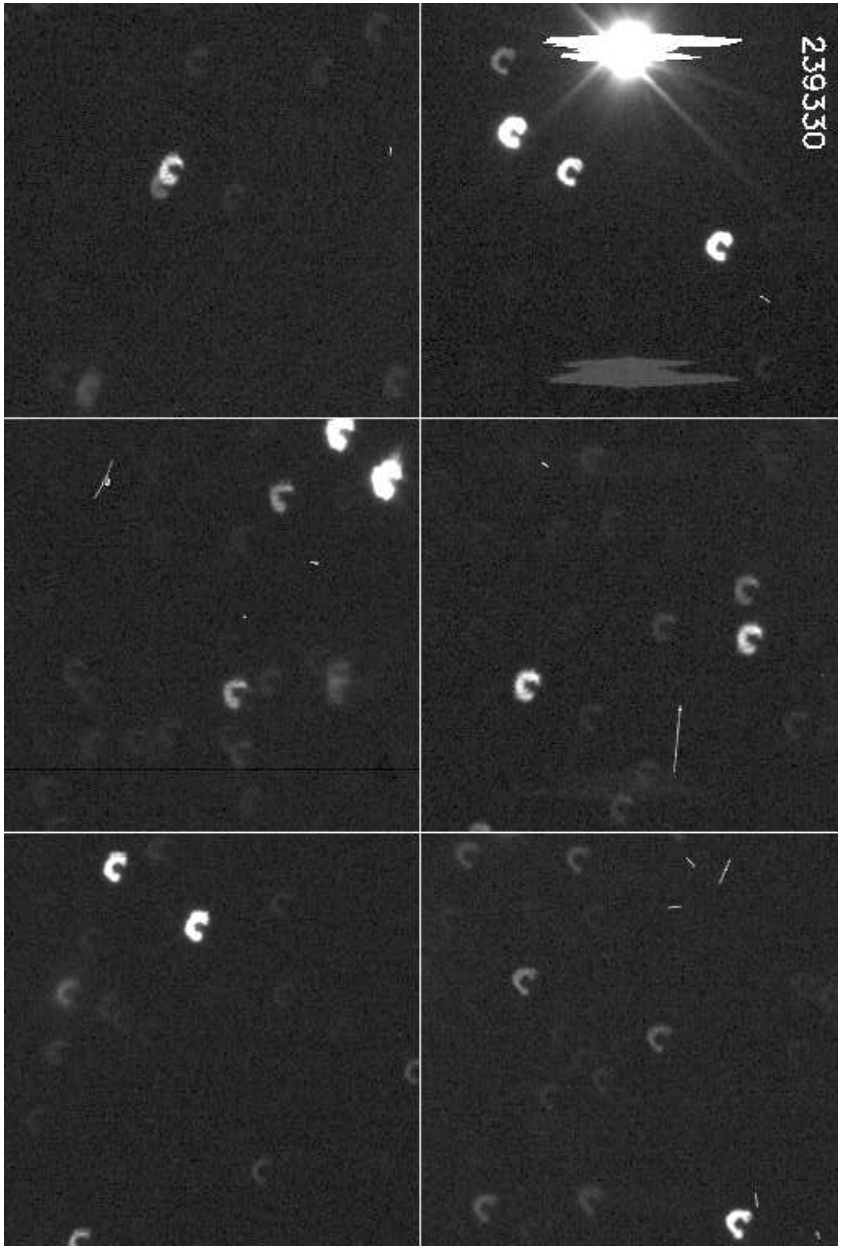
After

All Hail
Aeroglaze Z306!

CertaPro Painters®

Residential. Commercial. Interior. Exterior.

Dome Occlusions



- Dome partially blocks telescope beam
- Only reliable detection is eye scan
- 67 images total, mostly standard stars
- Problem largely solved by early December

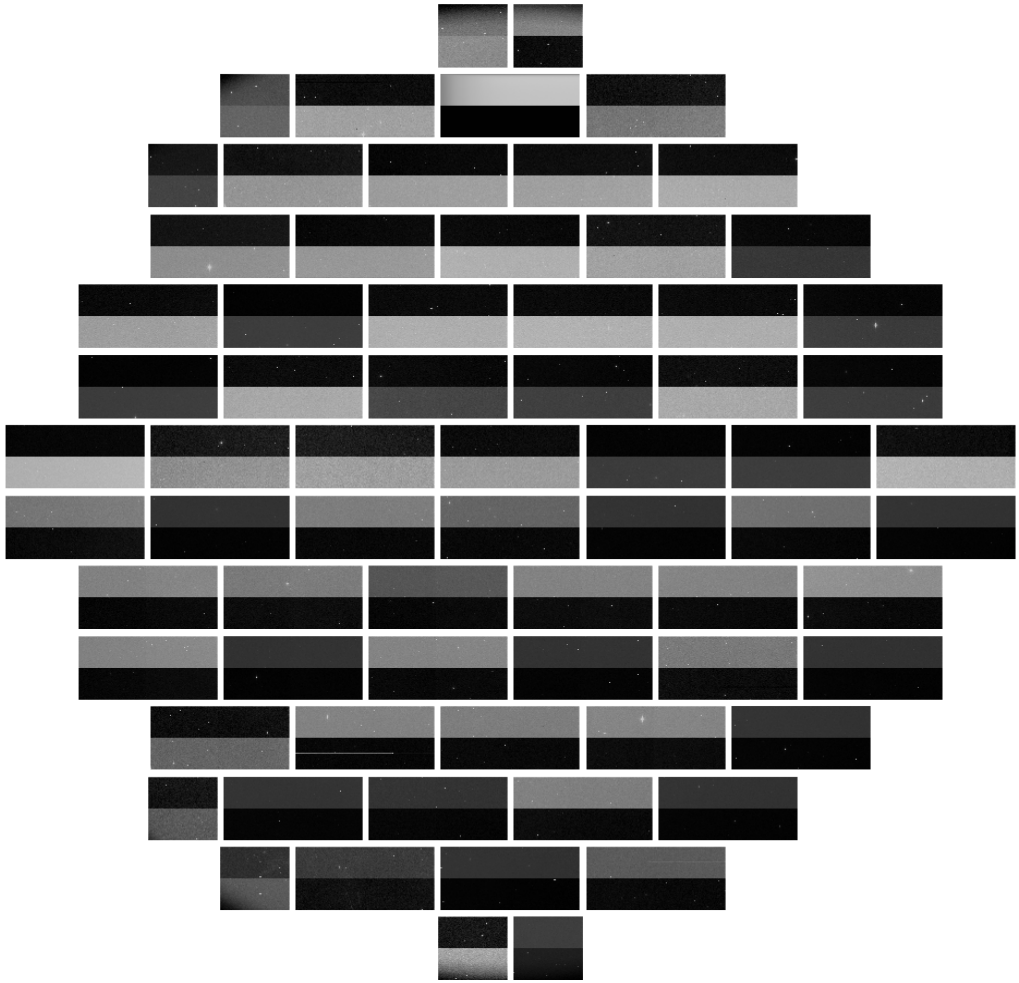
Lessons Learned

- Duplicate QA systems useful to cross-check each other (range of filters, exposure times, star densities, etc)
- Simulated data useful for developing software in advance of going to the telescope
  - Get header keywords straight
- Lab data useful in advance (e.g., CCD frame layout and bias/noise properties)
- Determine X/Y, RA/DEC, “left right”, amplifier naming conventions, etc. in advance of going to the telescope
- Real data from prior surveys can be useful (e.g. SDSS donut data)
  - No simulation will prepare you for Baade's Window
- We really need a good all-sky photometric catalog down to ~17th or so mag in all optical bands.

Extra Slides

Visualization - needs work

SDSS “wall of monitors”



DECam “comfort display”