

New 42" Camera Status

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Outline

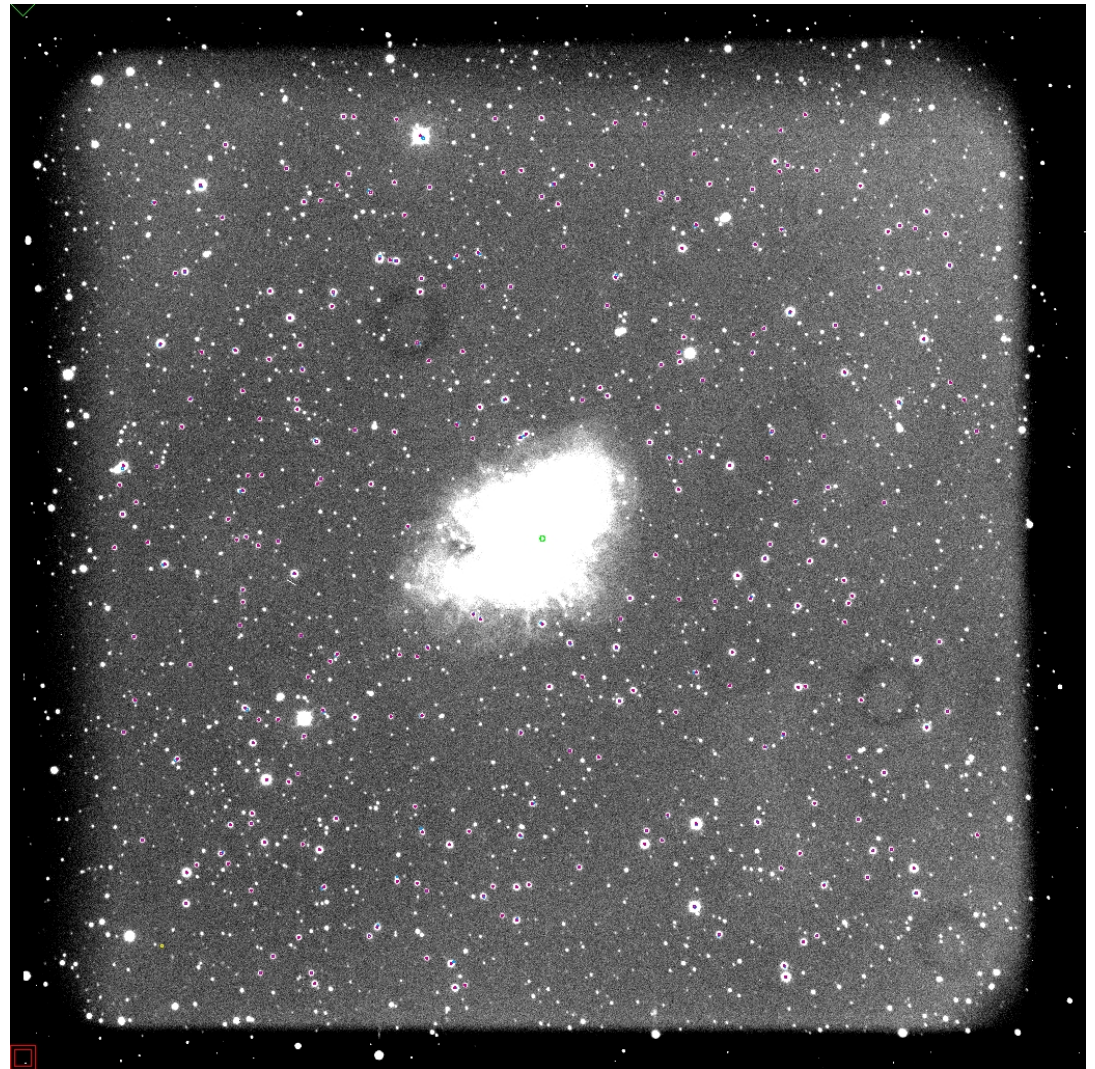
- General Comments
- Plate scale, field of view, field orientation (Peter)
- Read times, gain/noise/linearity/full well
- Vignetting by the filter edges
- Fringing in the I band
- > Shutter performance in terms of flat fields and stellar photometry
- Focus vs. filter and focal plane tilt (Tom)
- > Throughput, color terms (Georgi)
- Odds and Ends
- LOIS/LOUI arrangement
- Demonstration of camera operation in the lab

General Comments

- CCD: 4Kx4K 15 micron e2v CCD231
 - Physically larger than the SITe by $30/24 = 1.25x$
 - Uses the same filters; they limit the field of view
 - Filter wheel common to SITe; camera switch is involved
- Can use 1, 2, or 4 amplifiers
- Pixel size suggests 2x2 binning most common use case. All engineering work at 42" done this way.
- Dynamic range of the CCD pushes 16 bits
- Uses a sliding blade type of shutter
- Uses a Cryotiger mechanical cooler, no LN
- Uses the new LOIS/LOUI control software system
- Remote/robotic operation possible in principle

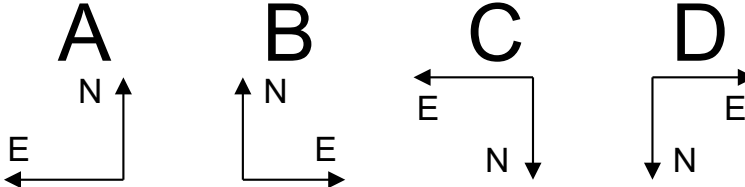
Plate scale, Field size & Orientation

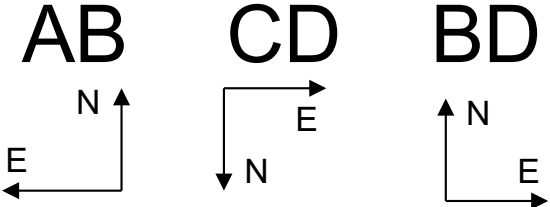
- Scale
 - Move: $0.74''/\text{px}$
 - 2x2 binned
 - Plate Solution:
0.7402 to
 $0.7404''/\text{px}$
 - Rotation: -0.29
degrees, but will be
different next time.
- Field of view
 - 25.3 arcmin,
vignetted
 - ~ 22 arcmin
unvignetted
 - SITE is 20.2 arcmin



Display Orientations

- Many possible amplifier combinations.
 - Strip scanning uses E-W columns
 - Possible, but not described here
- Default is single A amplifier

- Single: A B C D ((0,0) in lower left)
- 

- Two: AB CD BD (AC not possible)
- 

- Four: ABCD or ALL
- 

Gain, Noise, Speed, Linearity, & Full Well

- Goal: Allow choice of slow (quiet) and fast (noisy), details TBD
- More distant goal: Allow two full well options
 - Right now we support “Mode 1”, limited by the output node capacity of $\sim 200\text{Ke}$ with low noise
 - Plan to support “Mode 2”, limited by either the pixel capacity ($\sim 350\text{Ke}$ unbinned) or the output node capacity of $\sim 600\text{Ke}$ with higher noise.
- Current state is that we’ve only done one case (~ 1.8 us/px) as shown next.
- Running too fast makes 4 amplifiers not work - it overruns the fiber bandwidth of 2.5 Mpx/sec.

Gain, Noise, Speed, Linearity, & Full Well

- Current Configuration Properties, full frame plus 50 columns of overscan
- Table below shows read times for various amplifier combinations. Doesn't include display time!

Unbinned		2x2 binned	
A	33.6 sec	A	9.9 sec
AB or CD	17.6 sec	AB or CD	5.4 sec
BD	17.3 sec	BD	5.1 sec
ABCD	9.2 sec	ABCD	2.0 sec

Gain, Noise, Speed, Linearity, & Full Well

- Gain & Noise

Amplifier	C	D
Gain (e/DN)	4.67	4.77
Noise (e)	5.4	5.3
Amplifier	A	B
Gain (e/DN)	4.82	4.62
Noise (e)	5.4	5.5

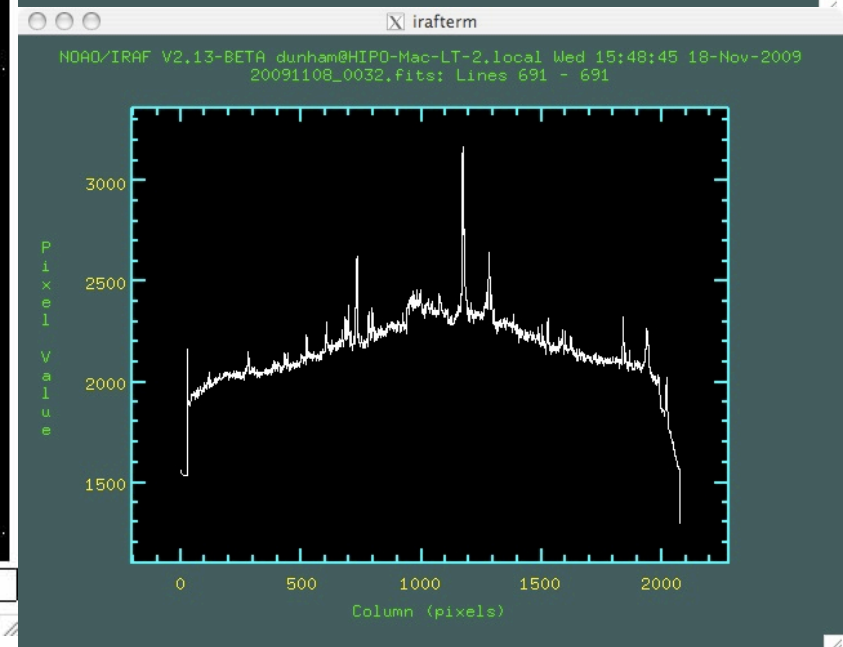
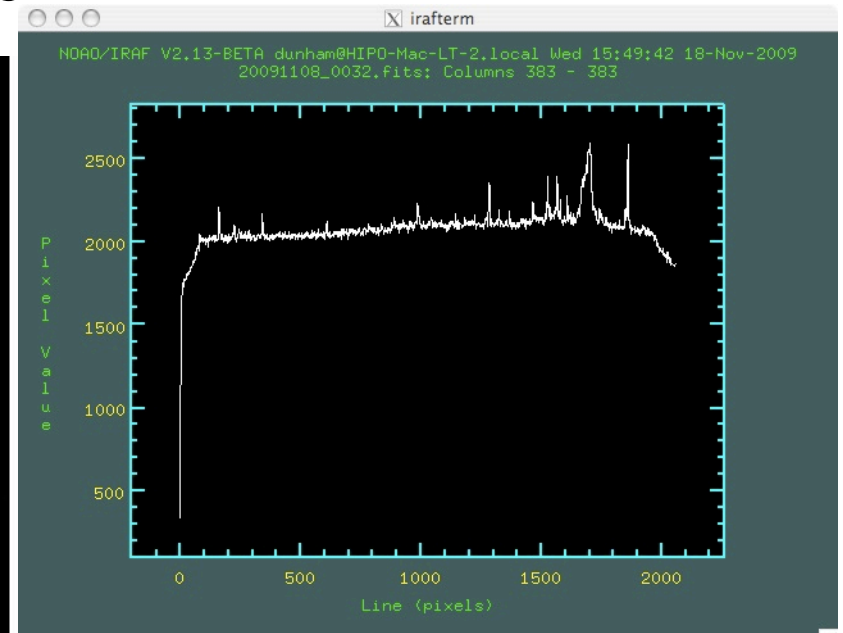
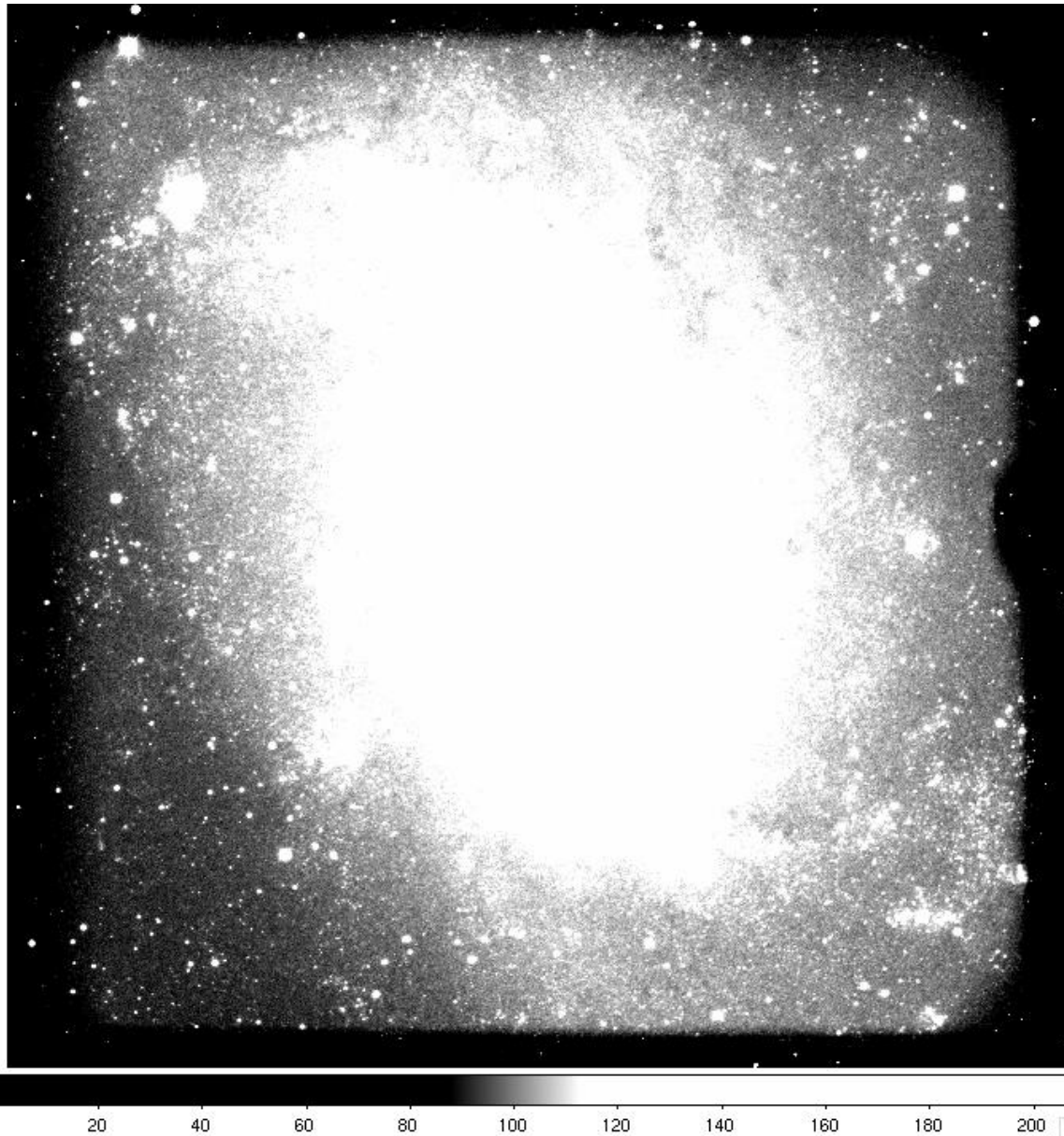
Gain, Noise, Speed, Linearity, & Full Well

Funny things start to happen around 40000 ADU

Gain, Noise, Speed, Linearity, & Full Well

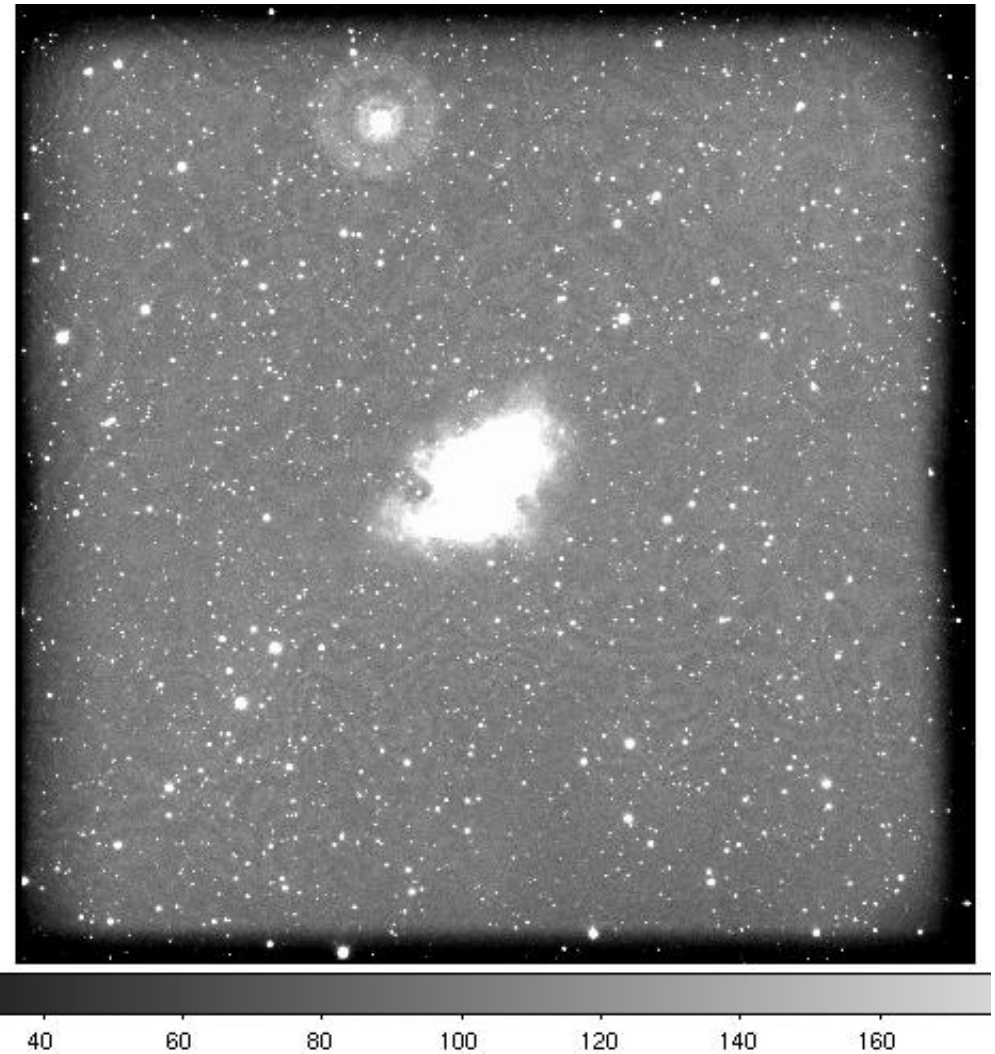
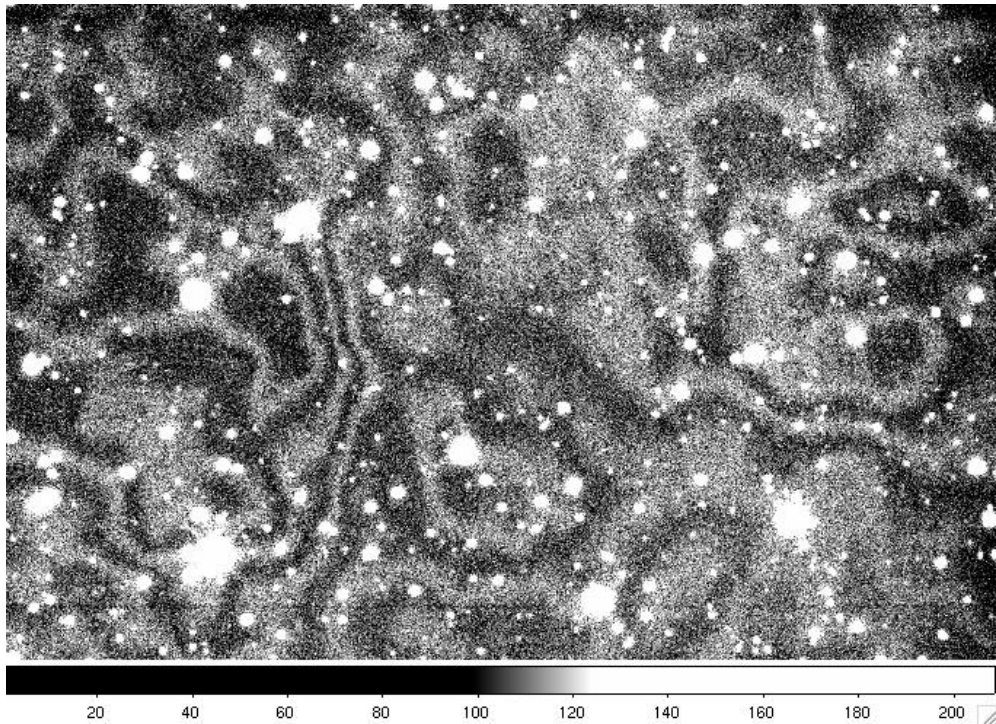
Possible shutter calibration offset?

Vignetting by Filter



I Band Fringing

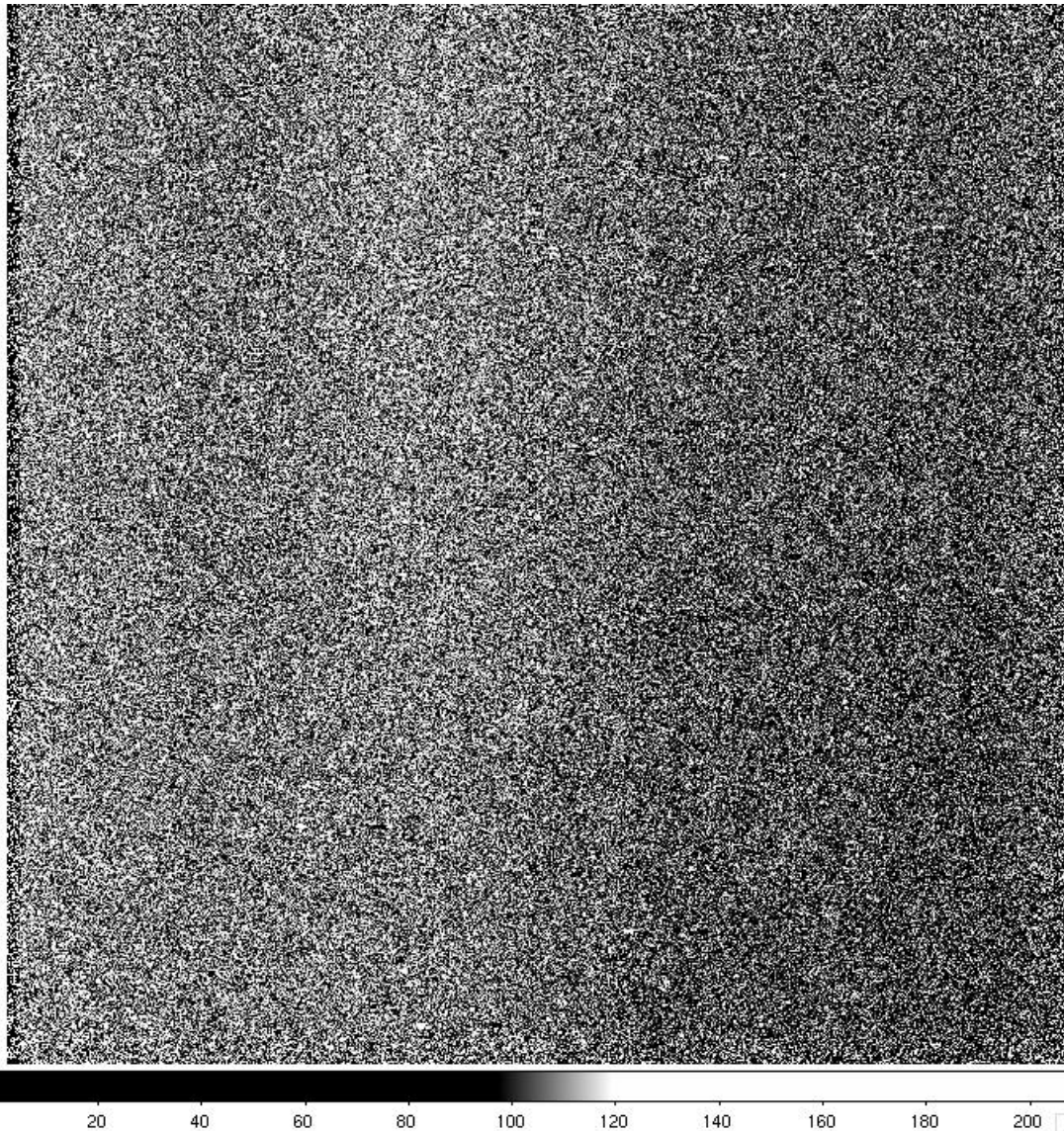
- Fringing seen in this 100 sec I band image (OS160 on 091108 UT)
- 4.5% to 6.0% P-P amplitude



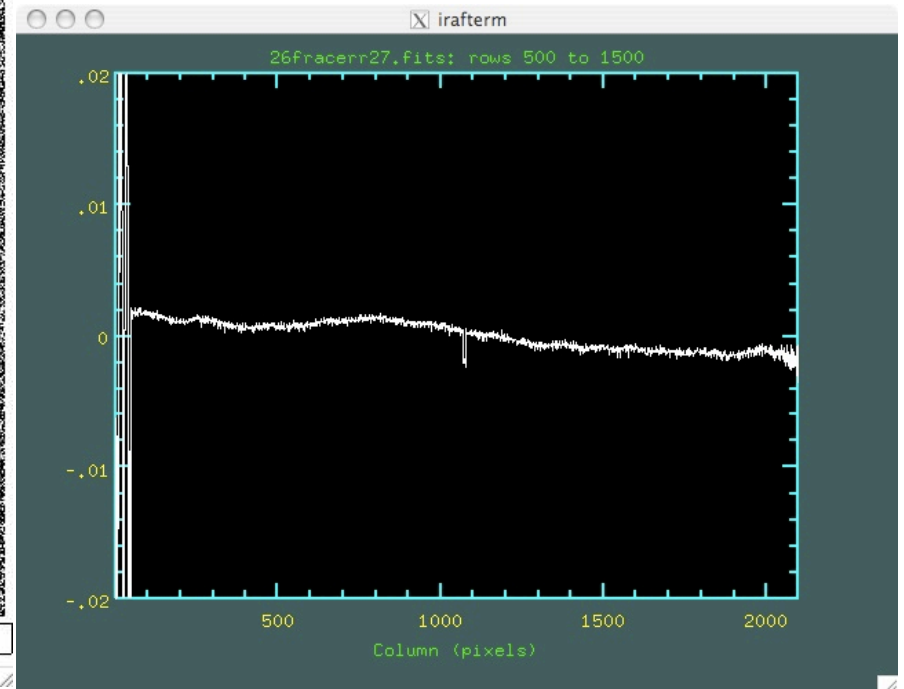
Shutter Performance: Flats

- Took twilight flat pairs on 20091109 UT
 - Shutter blades move in opposite directions
 - Exposure times ranged from 0.01 sec to 10 sec.
- Subtracted bias frames from each flat
- Took the ratio of the pairs
- Subtracted the DC value of the ratio
 - Due to changing twilight sky brightness
- Looked at the images & slices through them
- The shutter has a fixed motion pattern that is fractionally larger at shorter exposure times.

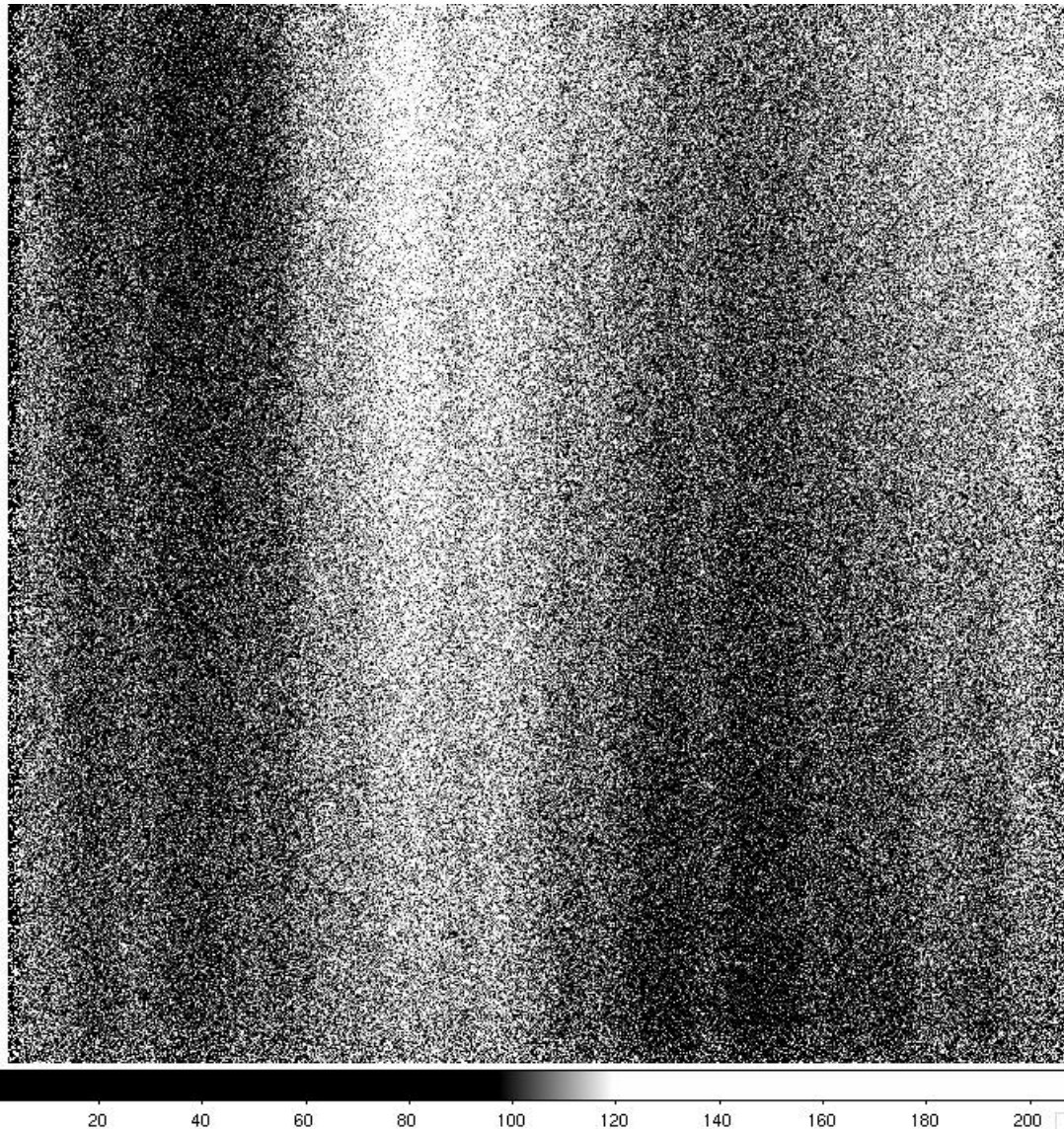
Shutter Performance: Flats



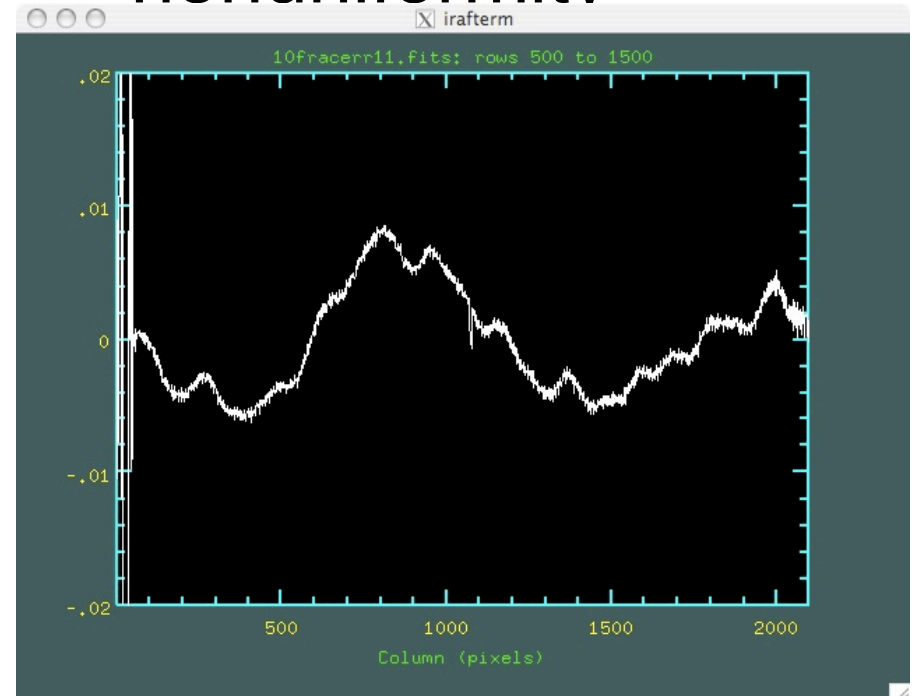
- 1 sec. exposure
- $\pm 2\%$ full scale
- $\pm 0.2\%$ nonuniformity including the drift part



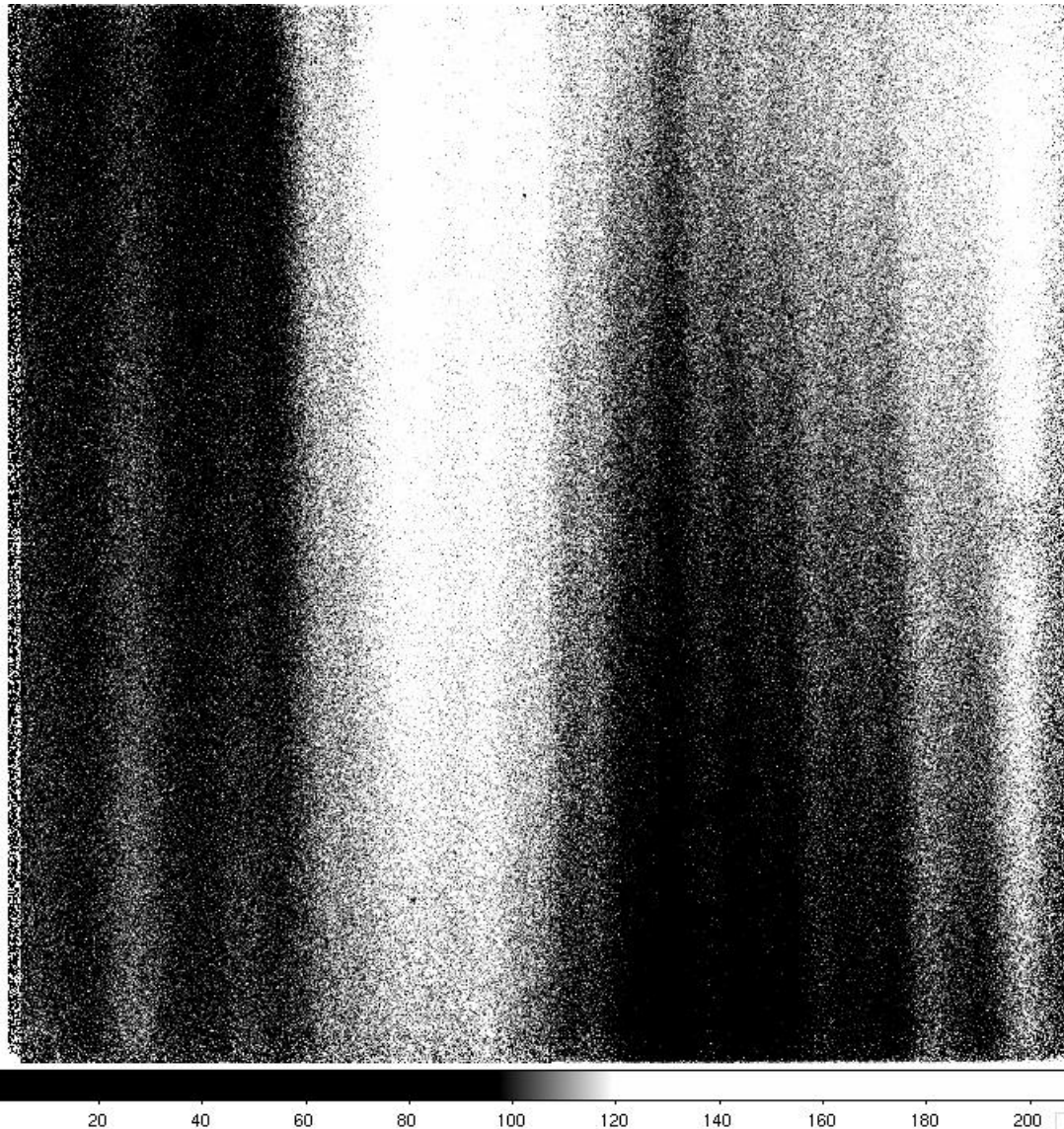
Shutter Performance: Flats



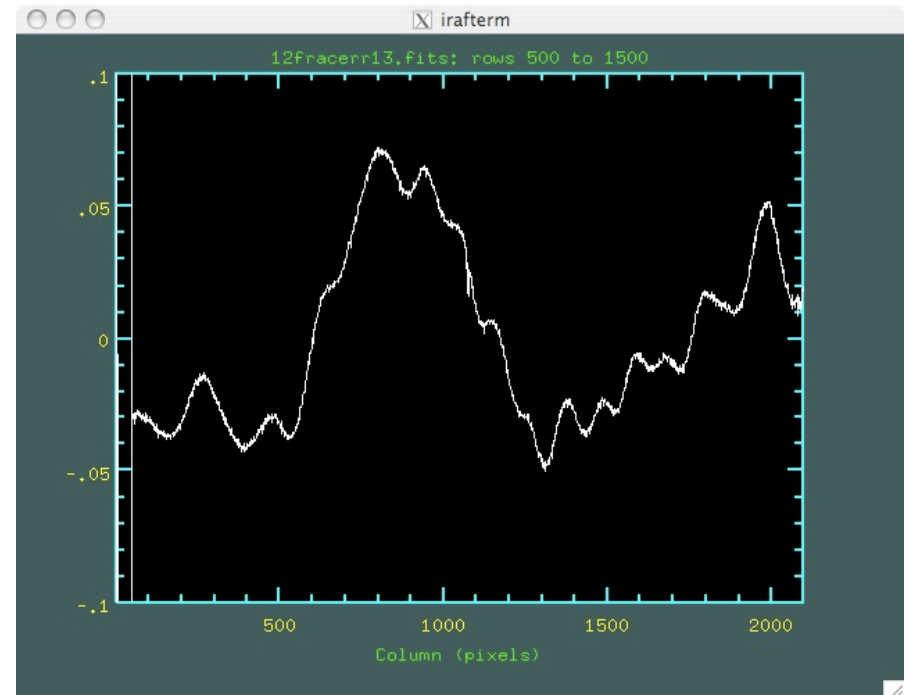
- 100 msec. exposure
- $\pm 2\%$ full scale
- $\pm 0.8\%$ nonuniformity



Shutter Performance: Flats

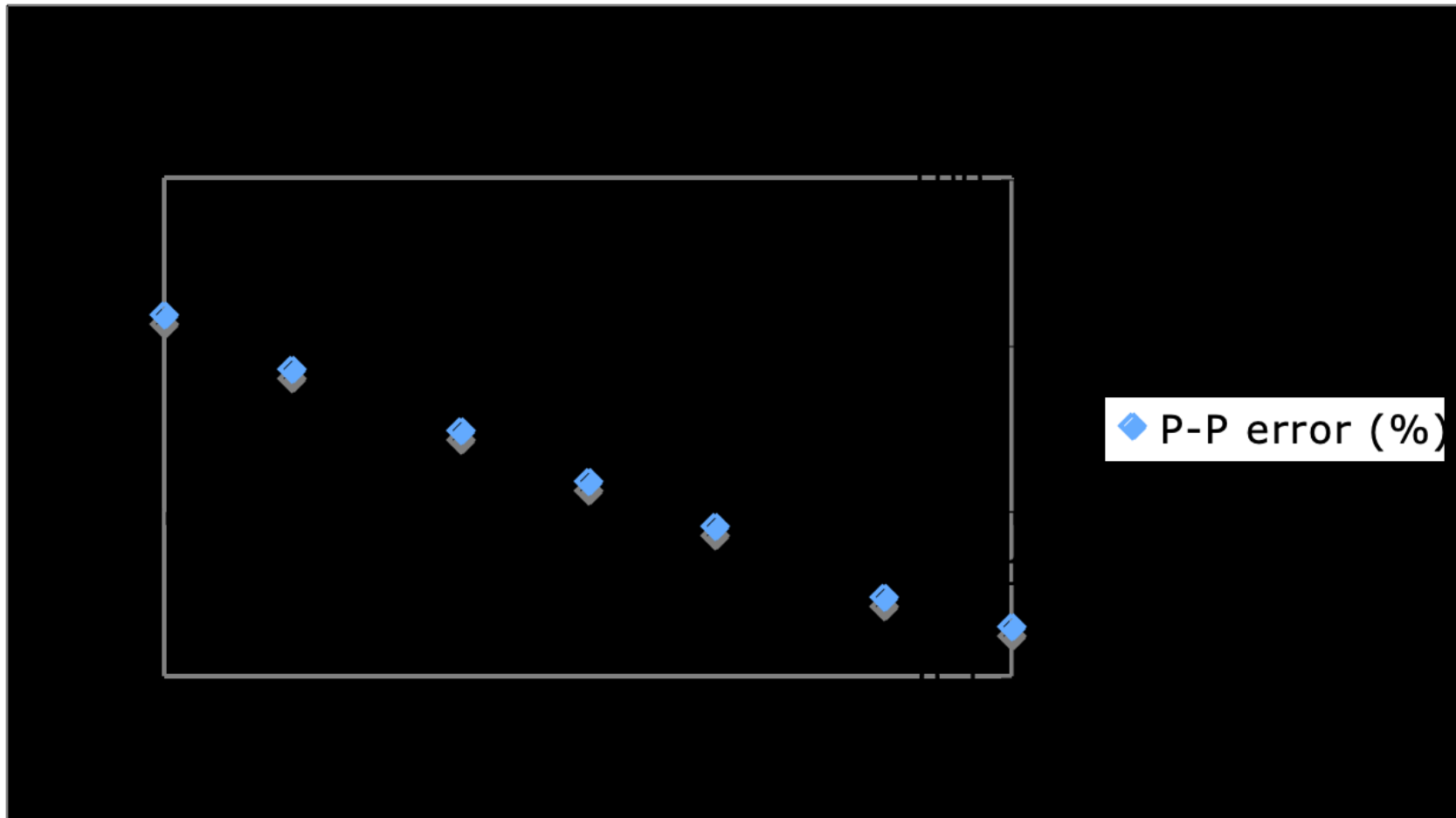


- 10 msec. exposure
- $\pm 10\%$ full scale
- $\pm 7\%$ nonuniformity



Shutter Performance: Flats

- Summary of flat pair test results



Shutter Performance: Stars

- On 20091109 UT took exposures in a 1,2,5 sequence from 10 ms to 20 sec on part of SA 114-176

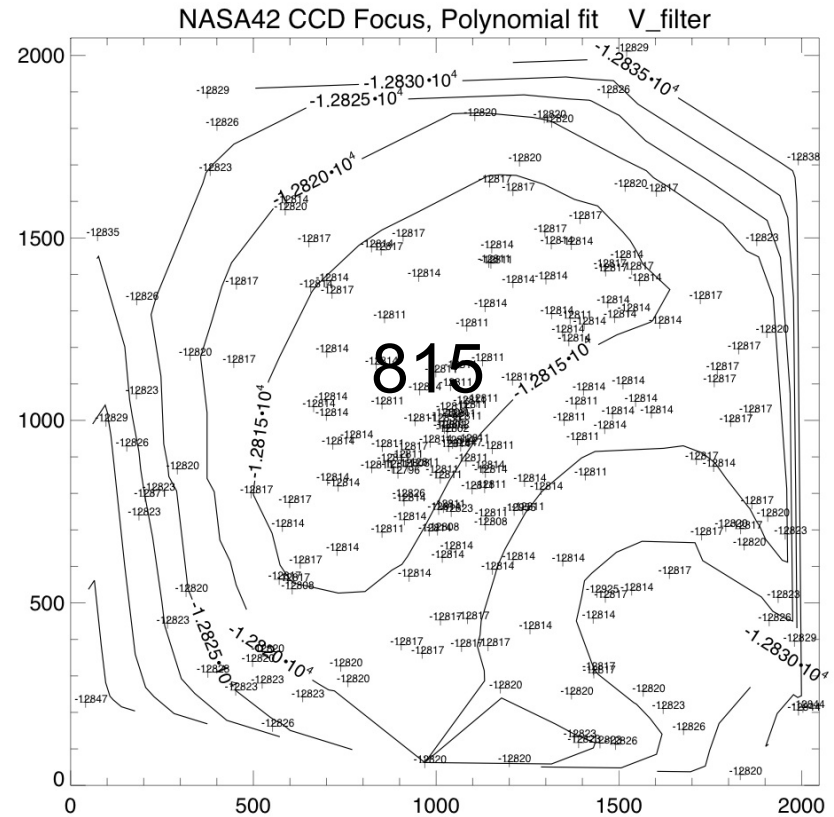
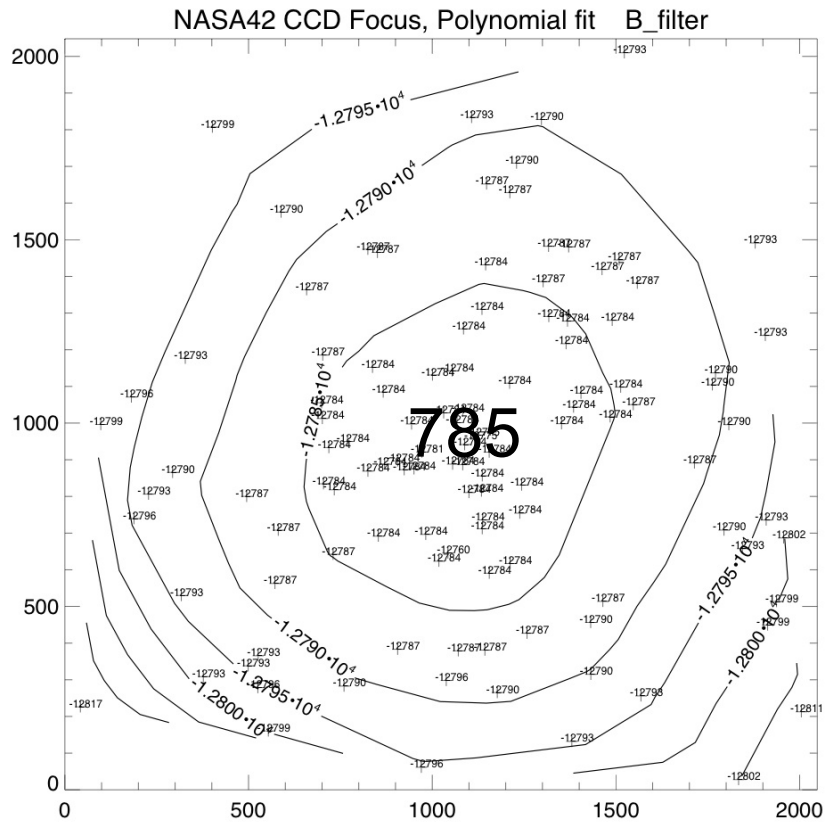
.01	132	143	Analysis not quite finished
.02	133	144	
.05	134	145	Look at saturation behavior with IRAF on 139
.10	135	146	
.20	136	147	
.50	137	148	
1.00	138	149	
2.00	139	150	
5.00	140	151	
10.00	141	152	
20.00	142	153	

Focus vs Filter and FP Tilt

- Tom did this analysis
- There isn't a significant CCD tilt
- There is significant radial focus variation across the CCD
 - Correct magnitude for RC field curvature
 - Opposite sign! Don't understand this.
 - Significant filter-to-filter differences. Don't understand these either.
- Best to focus partway to the edge
 - Split the difference on the center-to-corner focus
 - Focus deviation in this case $\sim \pm 15$ steps = ± 0.6 arcsec
- V,R,I have about the same focus; B is ~ 30 steps more positive.

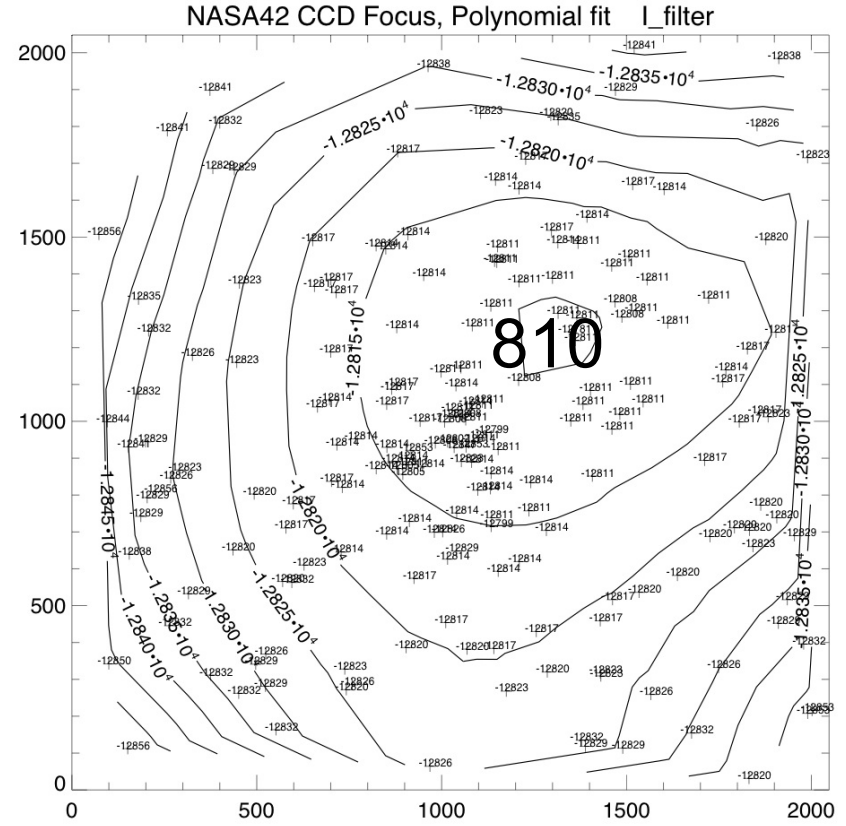
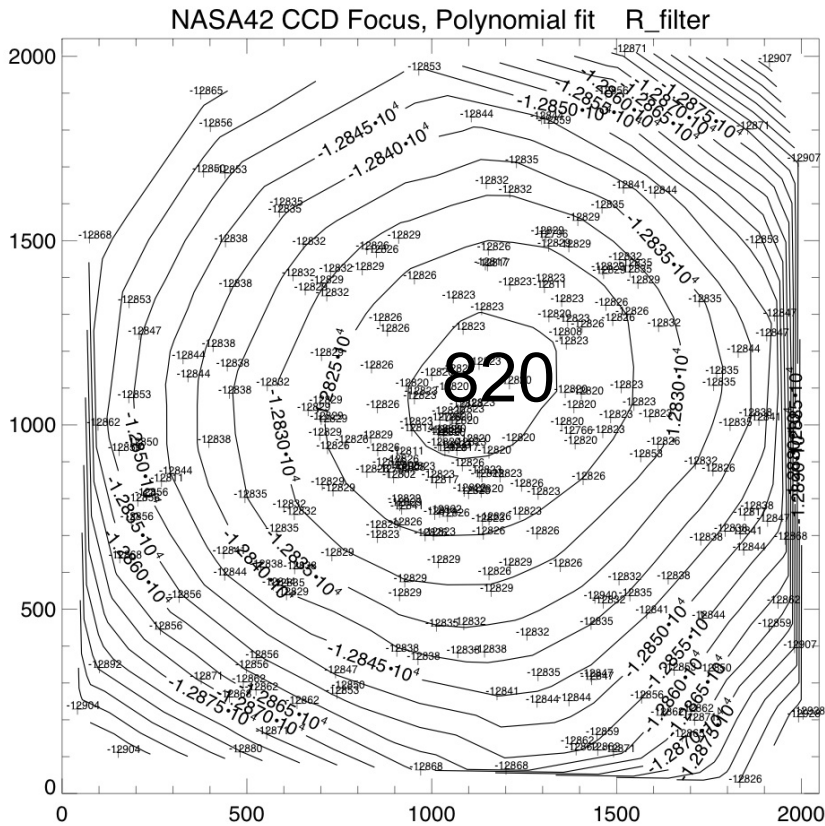
Focus vs Filter and FP Tilt

- B and V
- Contour interval is 5 steps



Focus vs Filter and FP Tilt

- R and I
- Contour interval is 5 steps



Throughput

- Not done. Need to look at spectrophotometric standards and put together a model of system transmission for this.

Color Terms

Odds and Ends

- Funny saturation behavior
 - Probably related to node capacity limit instead of charge capacity in the pixel
- Need to fix the DC restore problem
- Multiple amplifiers have issues with the “pipeline” pixels in the Leach controller.
- Low-level dark streaks behind saturated stars
- Frame-transfer HIPO data acq. Modes available in principle

Work Items

- Finish up gain/noise/speed/linearity in the lab
 - Choose the slow and fast cases
- Finish up the shutter test on stars - analysis
- Examine the possible shutter calibration issue
- Look at the overall throughput - analysis
- New big disk for hall; second display probably needed using a Sewell USB video adapter.
- A few mechanical things for Ralph.
- Control software mods
 - Pretty long list right now
 - Add more based on real observing experience

LOIS/LOUI Arrangement: I

- Split off LOIS' GUI function, moved to LOUI
- Reliability greatly improved
- Three main programs:
 - LOIS: Retains most control functions
 - TCL scripting function unchanged
 - LOUI: GUI, written in java
 - Available for multiple platforms
 - Two image display options: ds9 & LOUI internal
 - Active MQ message broker, not obviously visible to the observer.
 - Can run almost anywhere.

LOIS/LOUI Arrangement: II

