

The WIYN One Degree Imager: Updates and recent progress

Ralf Kotulla
University of Wisconsin – Milwaukee
02/18/2013 @ UW Madison



Content

- What is pODI
- User interfaces
- Image products
- What works and what doesn't
- Pipeline, Portal & archive
- Quicklook pipeline



What is pODI

- Original plan (~2002-05):
- 1 square degree
- 64 OTAs with 4Kx4K → ~ 1 GPixel
- OT shifting as ~semi-adaptive optics to improve seeing
- Focus sensors to maintain perfect focus



ODI: Specs

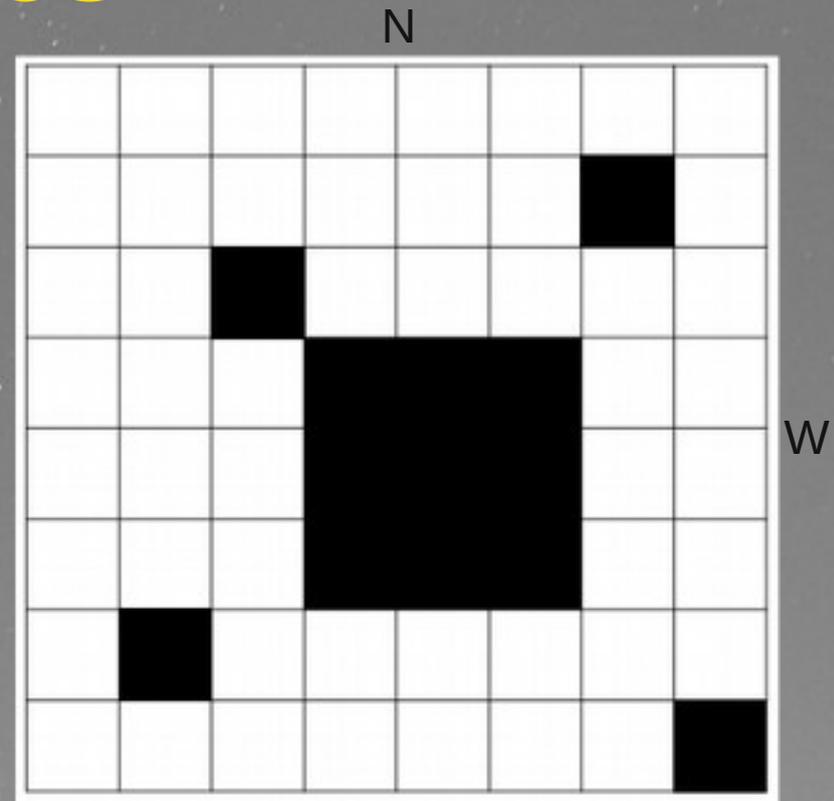
Field of view:

~25x25 arcmin in center
+ 4x 8x8 “guide fields”

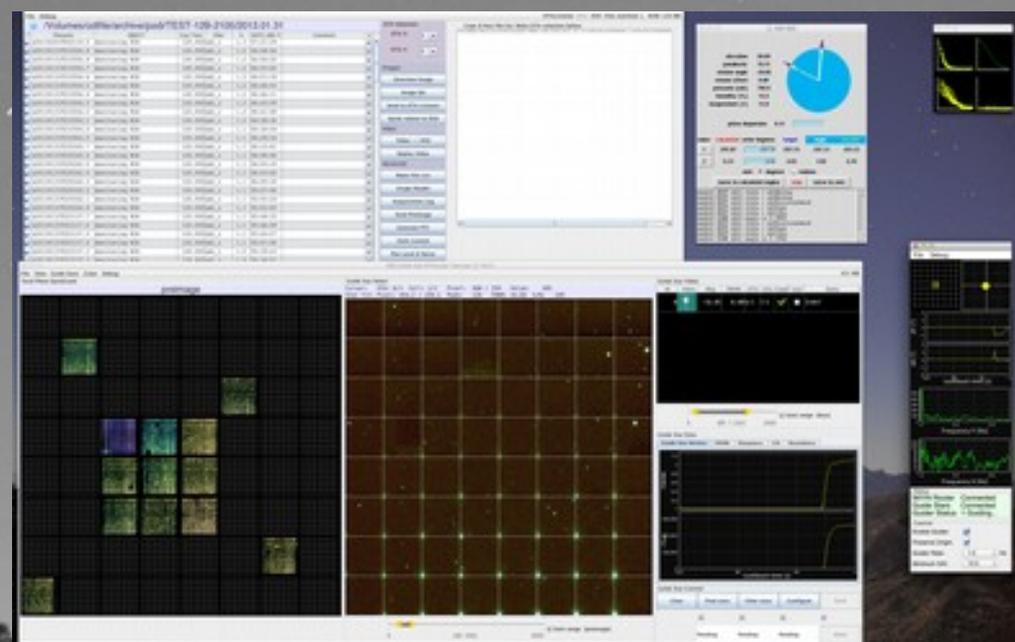
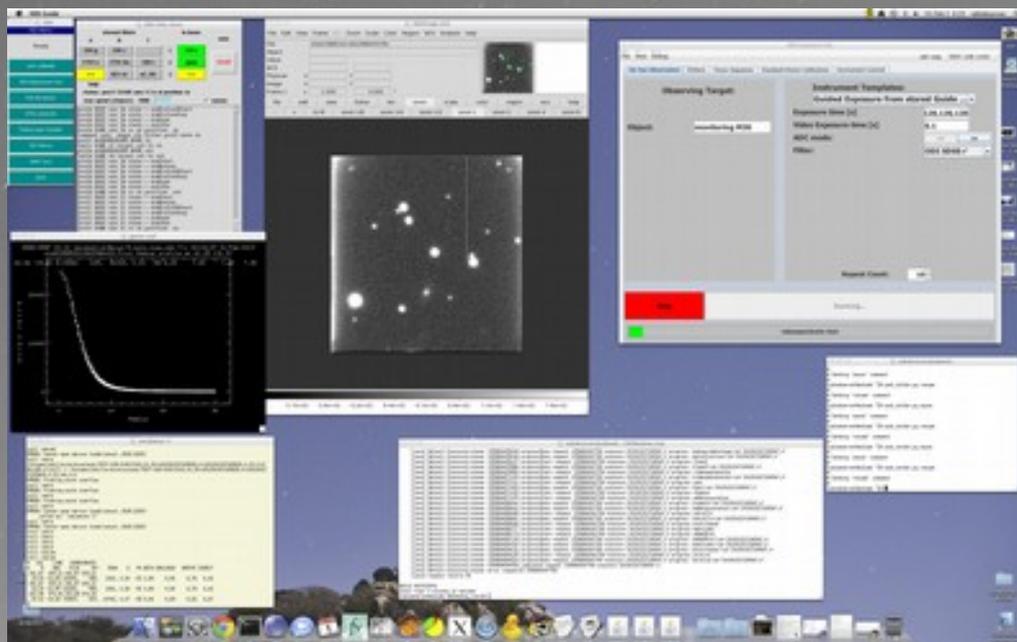
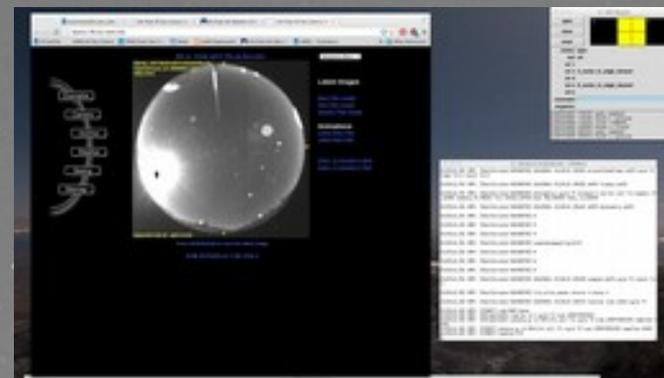
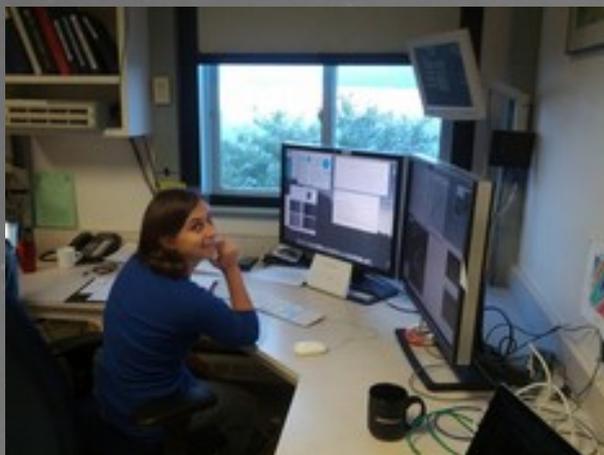
Pixel scale: 0.11"

Readout-time: 7s

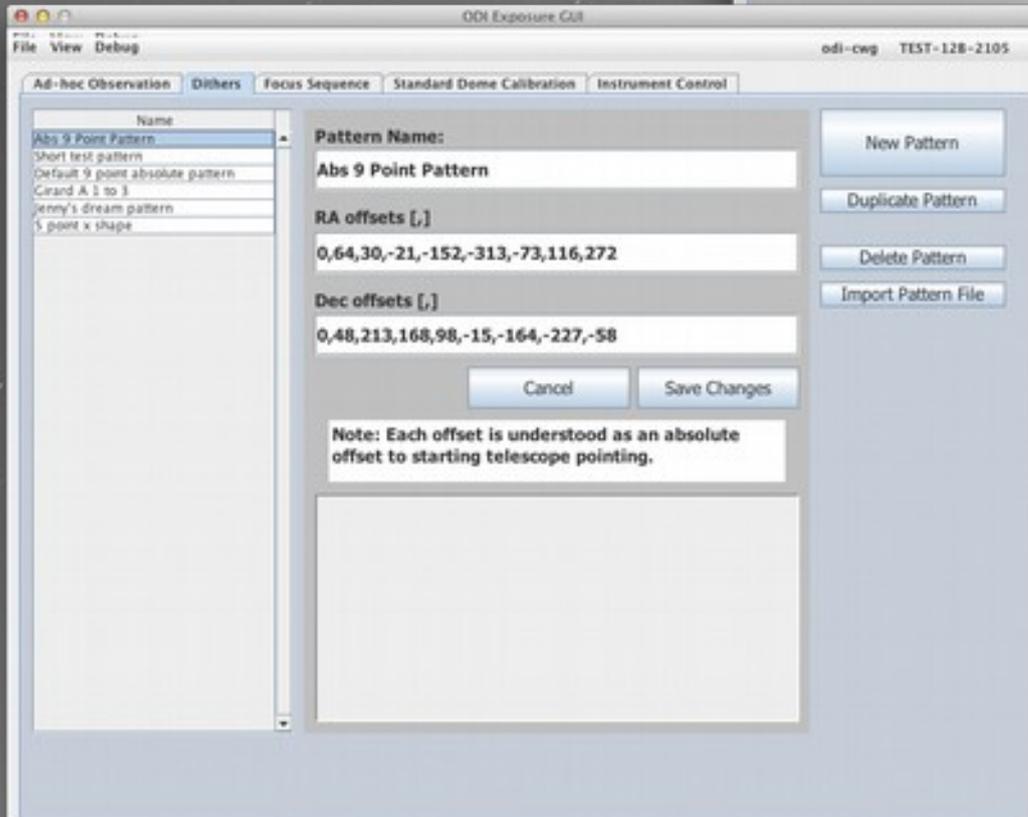
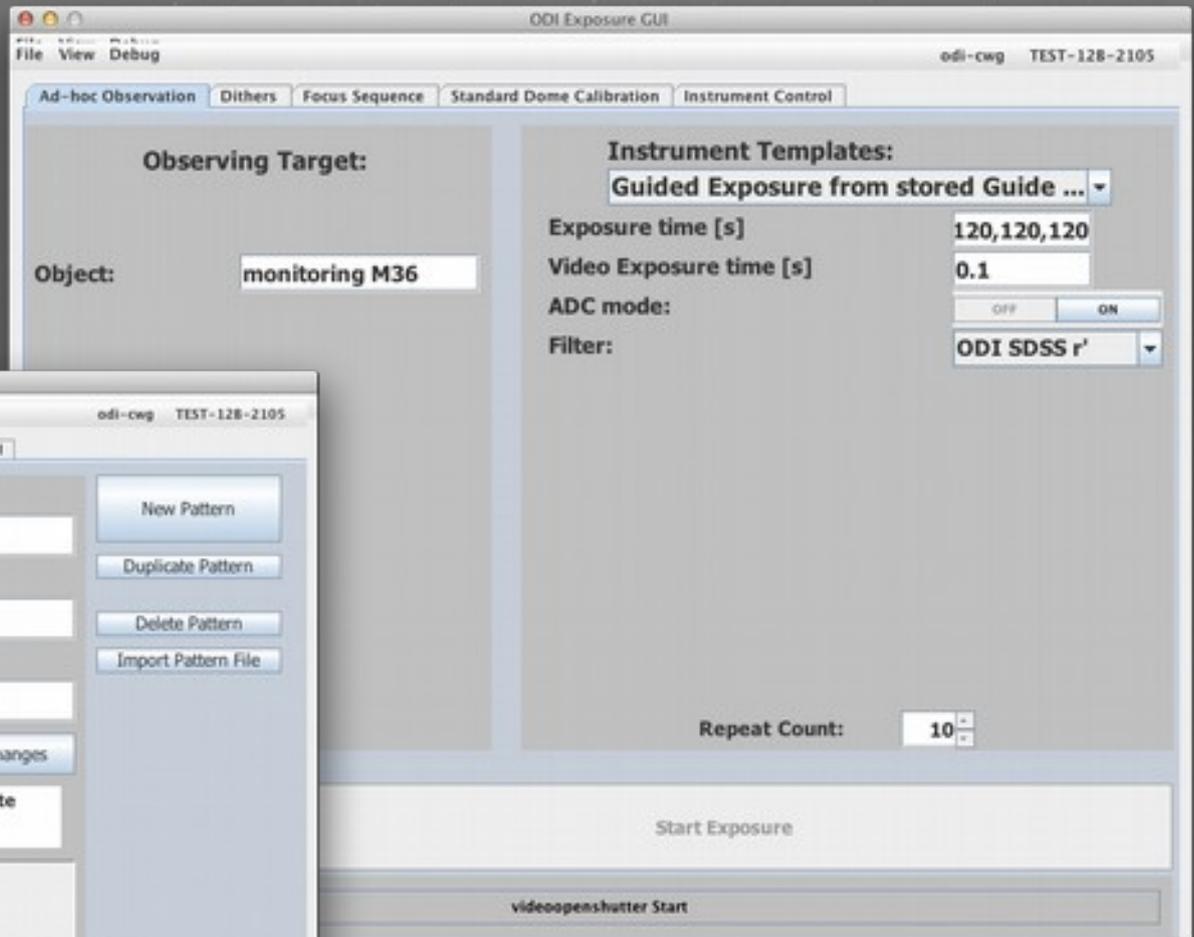
Filters: SDSS griz + SDSS u, H α , OIII
+ all Mosaic filters on request



User interface



ODI exposure GUI



OTA Listener and Guide star tool

The image displays a complex software interface for OTA (Over-The-Air) operations, divided into several functional windows:

- OTA Listener (Top Left):** A table listing OTA files with columns for filename, date, time, filter, and status. The path is `/Volumes/odfile/archive/podi/TEST-128-2105/2013.01.31`.
- OTA Selection (Top Center):** A control panel for selecting OTA files, including buttons for "Overview Image", "Image Get", "Send to OTA Listener", "Quick reload to DSR", "Video", "Video -> DSR", "Replay Video", "Advanced", "Make File List", "Image Header", "Acquisition Log", "Send Footage", "Generate PTC", "Dark Current", and "Flat Level & Noise".
- ADC (Top Right):** A window showing ADC data with a circular plot and various parameters: elevation (50.89), parabolic (79.72), rotator angle (-28.80), rotator offset (0.88), pressure (psk) (795.3), humidity (%) (13.5), and temperature (C) (13.8). It also includes a table for calculated angles and a "move to calculated angles" button.
- Guide Star & Preview Tool (Middle):** A window for selecting guide stars, showing a grid of stars and a "preimage" window on the left. It includes fields for "Corner", "OTA", "C/L", "L/I", "Pixel", "Value", "Star", "Pixel", "Peak", "R/R", "S/N", and "Z".
- Guide Star Views (Middle Right):** A window showing a grid of stars with a "faint range" slider and a "Guide Star Data" section with "Finds", "Sharpness", and "Roundness" metrics.
- Guide Star Control (Bottom):** A control panel with buttons for "Clear", "Find stars", "Filter stars", "Configure", and "Send". It also includes a "Pending" status indicator.
- ADC ADC (Right Side):** A window showing ADC data with a circular plot and various parameters: elevation (50.89), parabolic (79.72), rotator angle (-28.80), rotator offset (0.88), pressure (psk) (795.3), humidity (%) (13.5), and temperature (C) (13.8). It also includes a table for calculated angles and a "move to calculated angles" button.
- ADC ADC (Bottom Right):** A window showing ADC data with a circular plot and various parameters: elevation (50.89), parabolic (79.72), rotator angle (-28.80), rotator offset (0.88), pressure (psk) (795.3), humidity (%) (13.5), and temperature (C) (13.8). It also includes a table for calculated angles and a "move to calculated angles" button.

What does data look like?

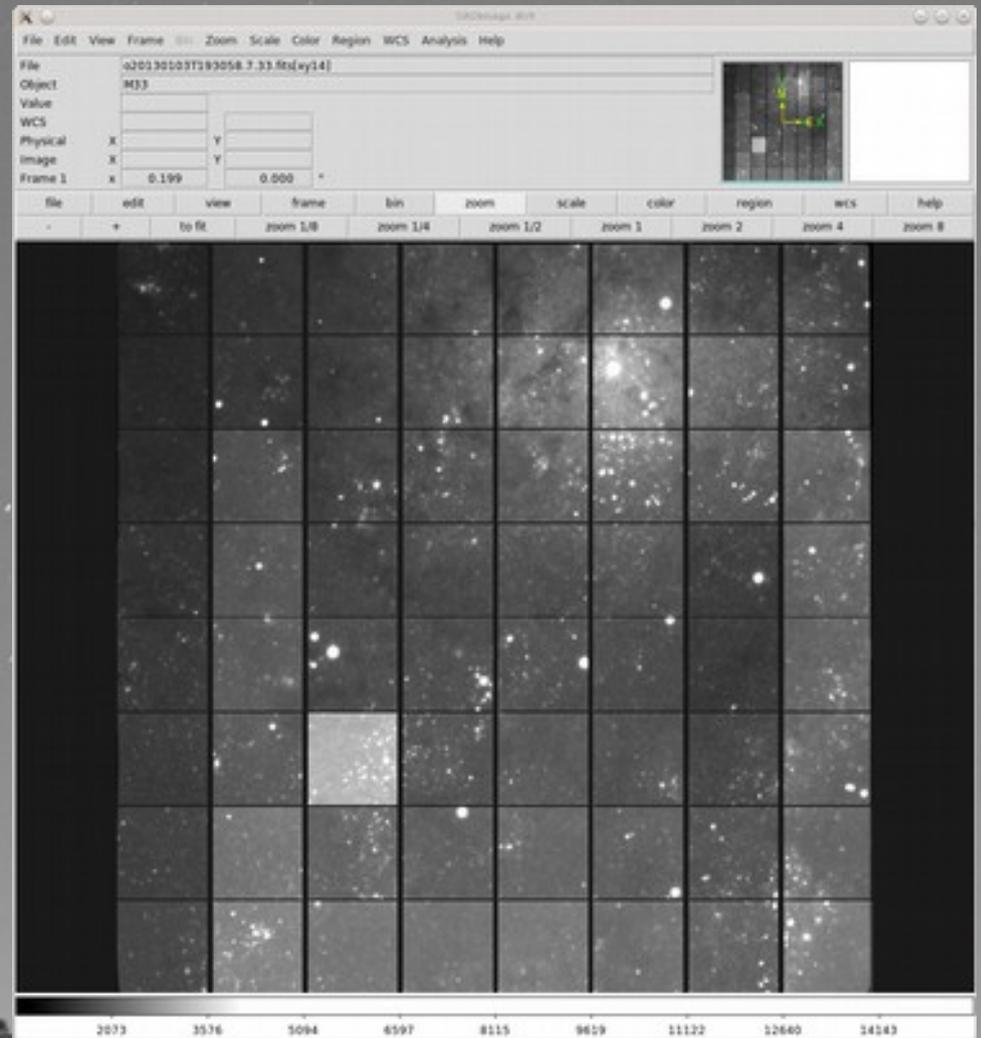
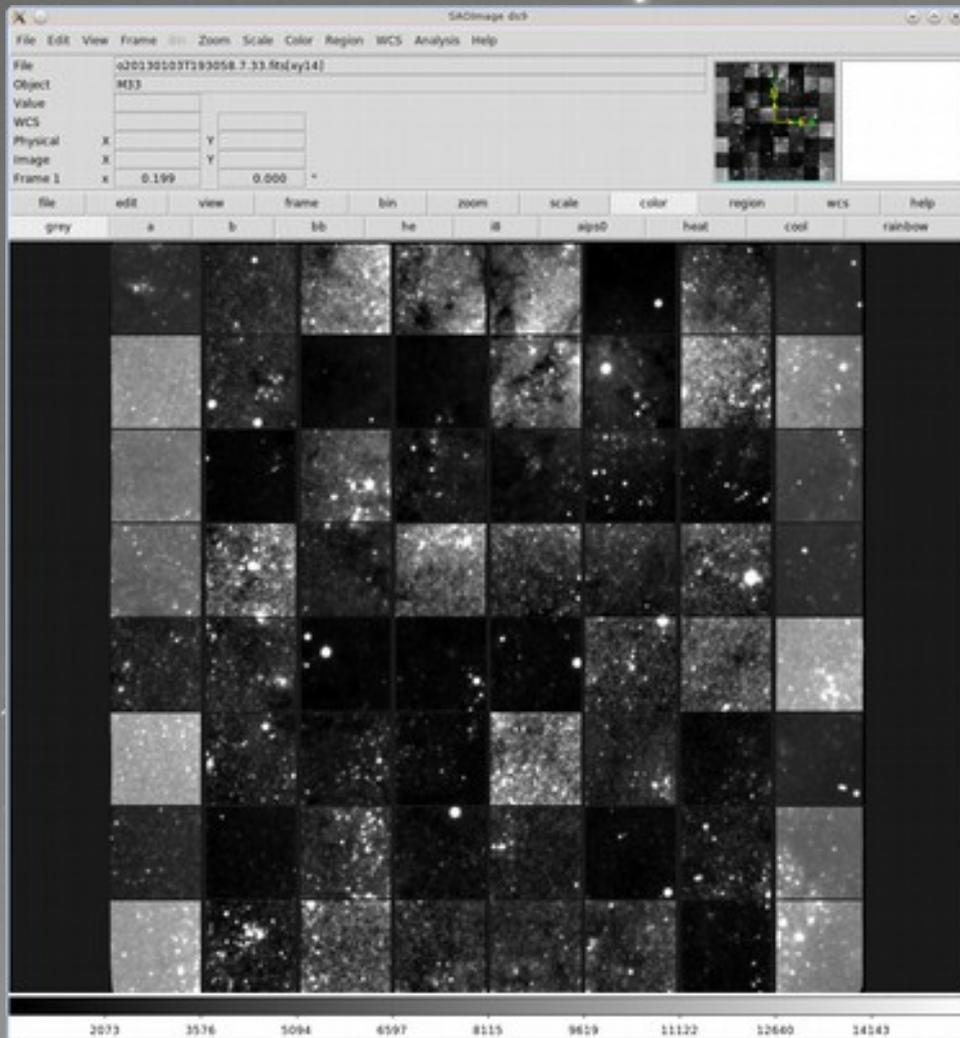
```
rkotulla on galev: /backup2/podi_raw
(galev) /backup2/podi_raw > ls o20121220T044346.0
exposure.log                               o20121220T044346.0.24.bin8.jpeg          o20121220T044346.0.43.bin64.jpeg
metainf.xml                                o20121220T044346.0.24.fits              o20121220T044346.0.43.bin8.jpeg
o20121220T044346.0.00.bin64.jpeg          o20121220T044346.0.24.txt              o20121220T044346.0.43.fits
o20121220T044346.0.00.bin8.jpeg          o20121220T044346.0.32.bin64.jpeg        o20121220T044346.0.43.txt
o20121220T044346.0.00.fits               o20121220T044346.0.32.bin8.jpeg        o20121220T044346.0.44.bin64.jpeg
o20121220T044346.0.00.txt               o20121220T044346.0.32.fits            o20121220T044346.0.44.bin8.jpeg
o20121220T044346.0.16.bin64.jpeg         o20121220T044346.0.32.txt            o20121220T044346.0.44.fits
o20121220T044346.0.16.bin8.jpeg         o20121220T044346.0.33.bin64.jpeg        o20121220T044346.0.44.txt
o20121220T044346.0.16.fits              o20121220T044346.0.33.bin8.jpeg        o20121220T044346.0.55.bin64.jpeg
o20121220T044346.0.16.txt              o20121220T044346.0.33.fits            o20121220T044346.0.55.bin8.jpeg
o20121220T044346.0.22.bin64.jpeg         o20121220T044346.0.33.txt            o20121220T044346.0.55.fits
o20121220T044346.0.22.bin8.jpeg         o20121220T044346.0.34.bin64.jpeg        o20121220T044346.0.55.txt
o20121220T044346.0.22.fits              o20121220T044346.0.34.bin8.jpeg        o20121220T044346.0.61.bin64.jpeg
o20121220T044346.0.22.txt              o20121220T044346.0.34.fits            o20121220T044346.0.61.bin8.jpeg
o20121220T044346.0.23.bin64.jpeg         o20121220T044346.0.34.txt            o20121220T044346.0.61.fits
o20121220T044346.0.23.bin8.jpeg         o20121220T044346.0.42.bin64.jpeg        o20121220T044346.0.61.txt
o20121220T044346.0.23.fits              o20121220T044346.0.42.bin8.jpeg        o20121220T044346.0.jpeg
o20121220T044346.0.23.txt              o20121220T044346.0.42.fits            temp
o20121220T044346.0.24.bin64.jpeg        o20121220T044346.0.42.txt
```

→ Each exposure is a directory full of files

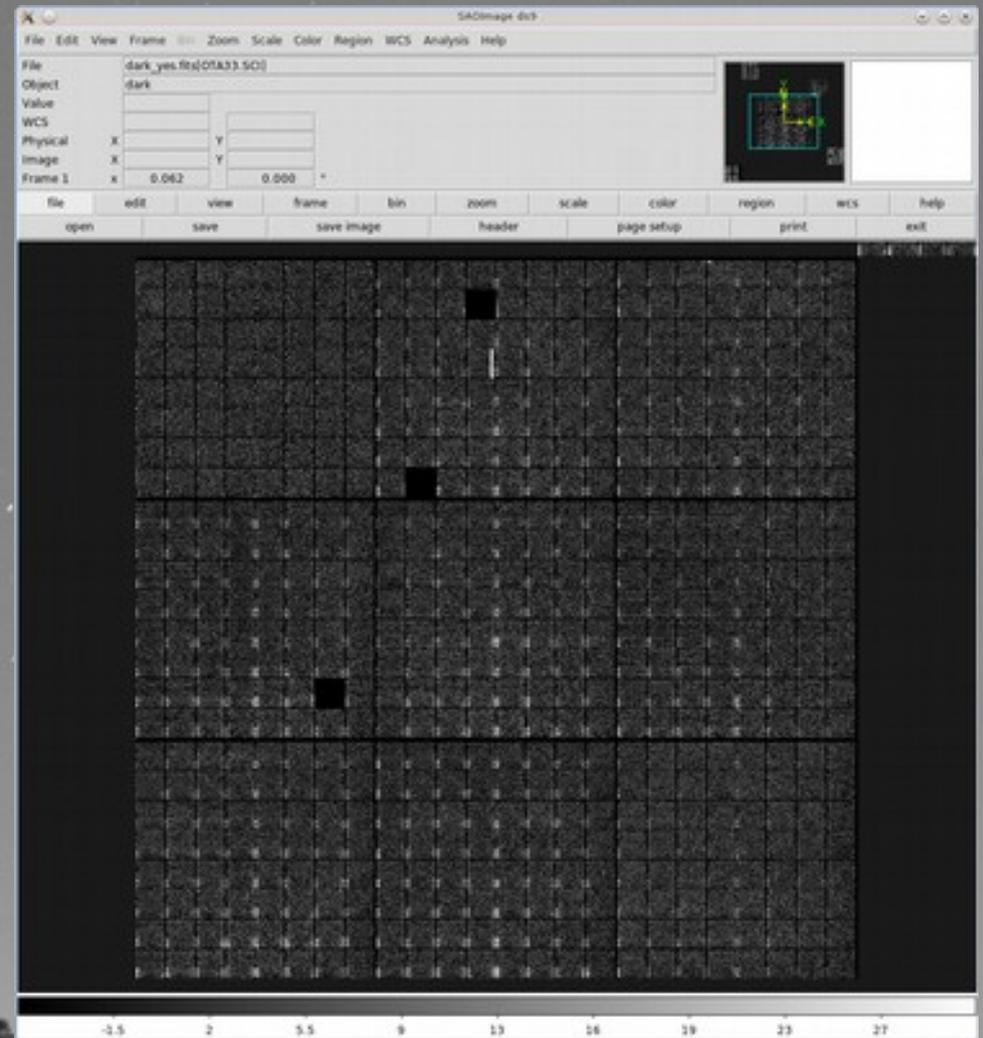
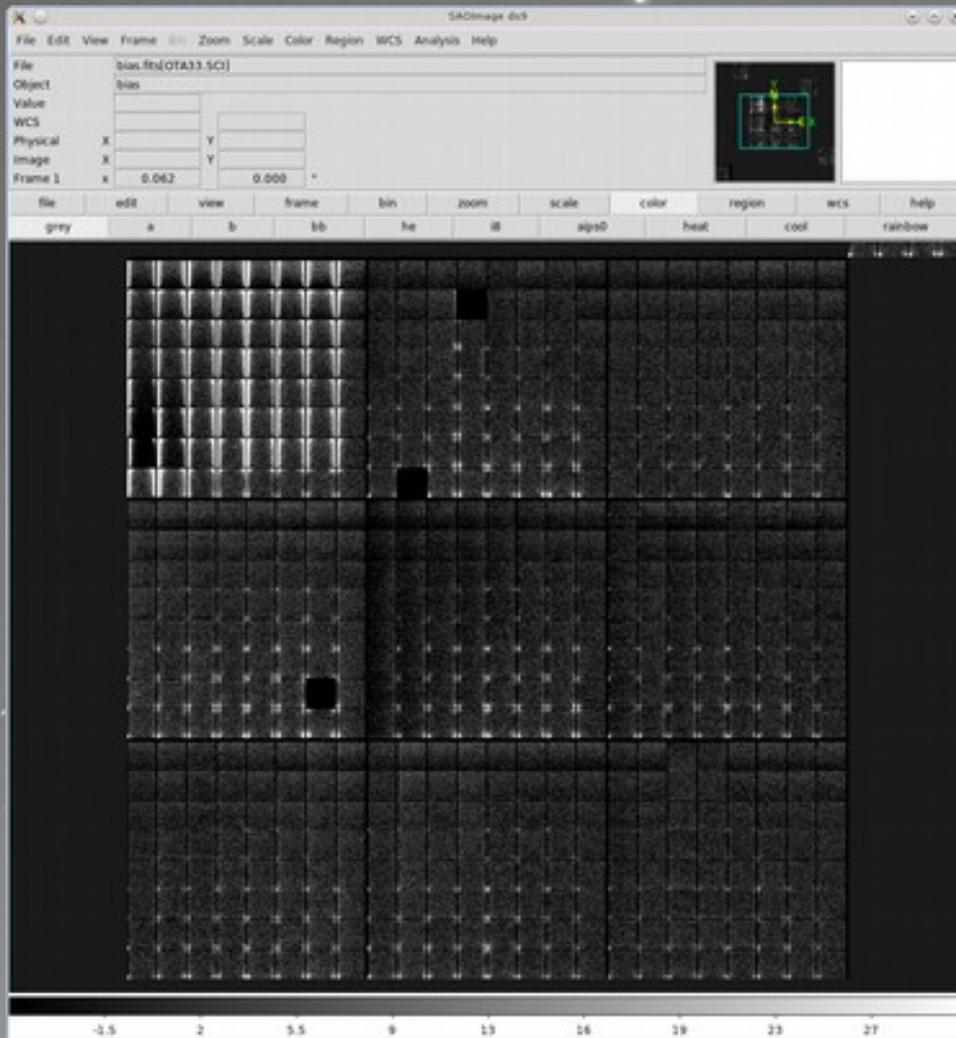


A closer look at OTA 3,3

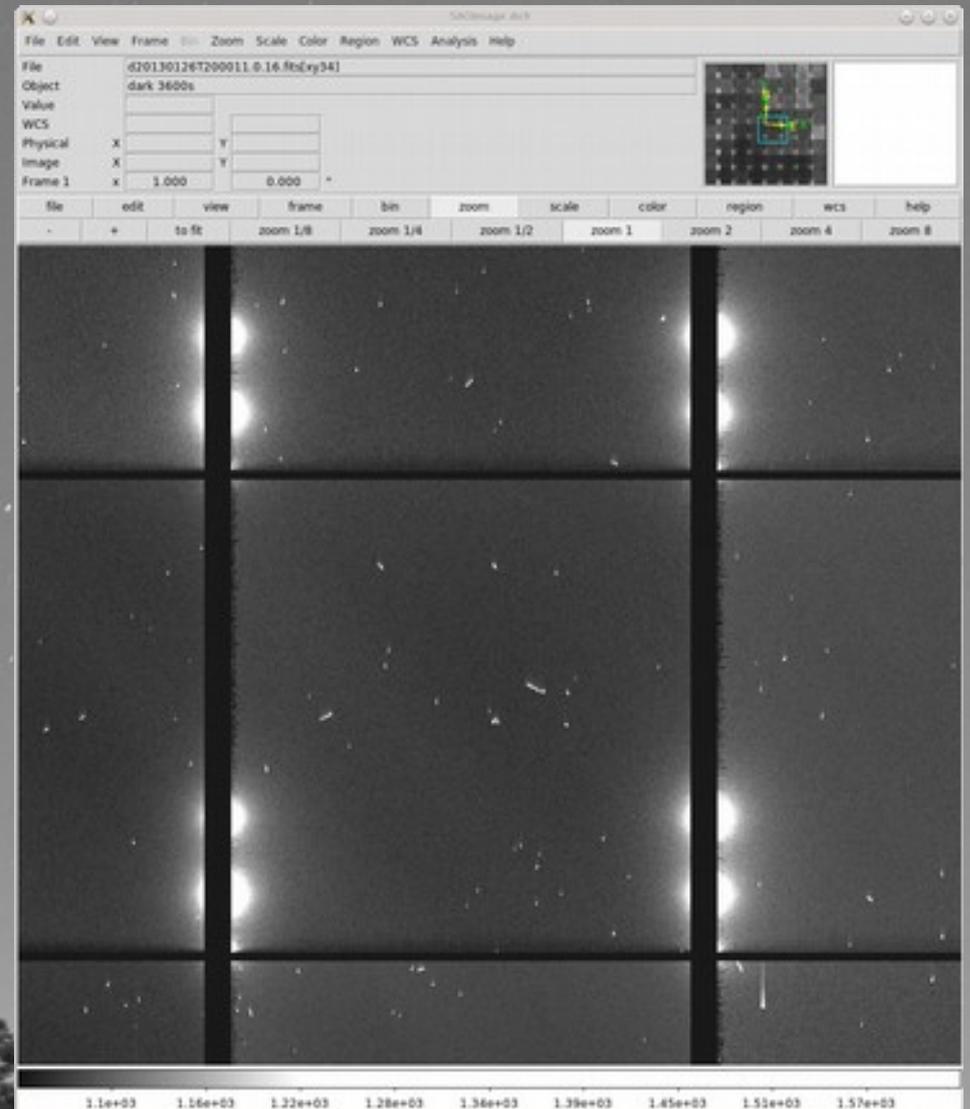
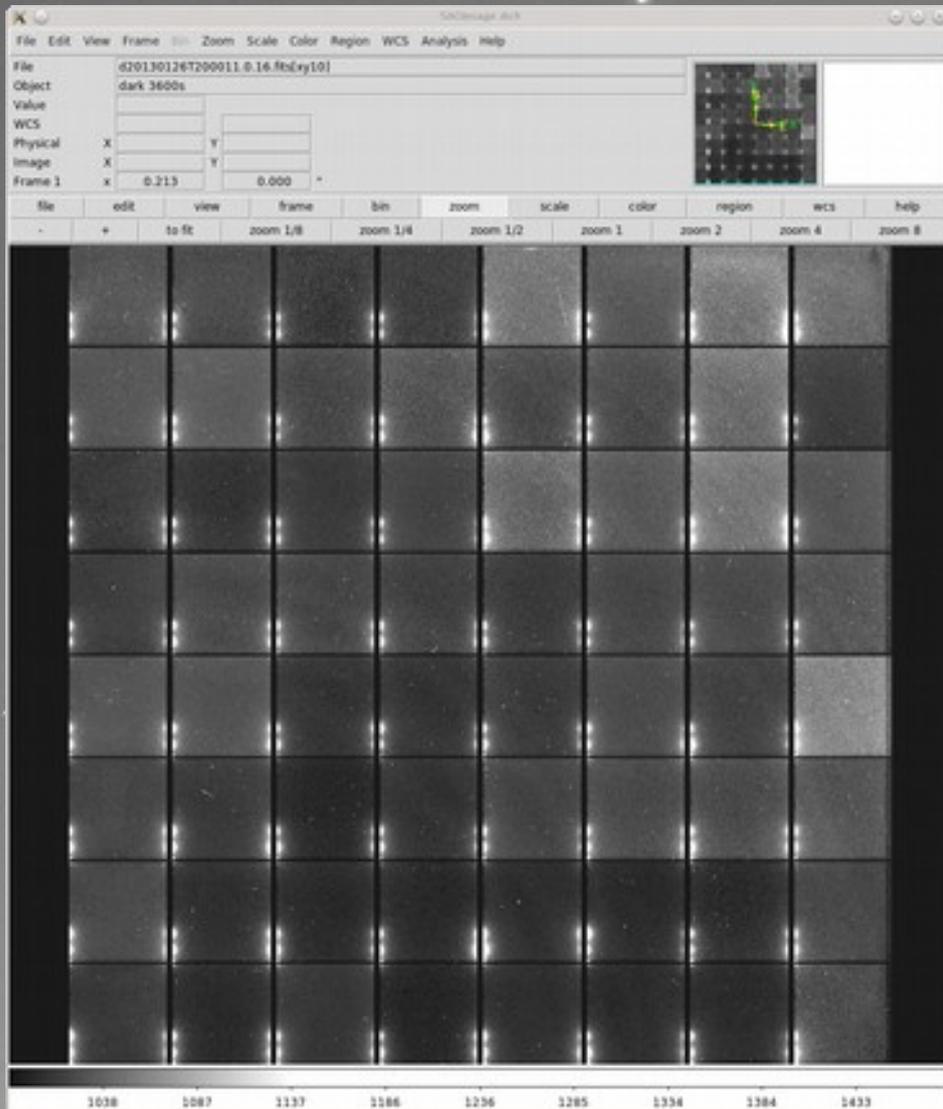
1 OTA = 64 cells (w/ 64 overscan regions/gains/etc) = 1 fits w/ 65 extensions



Calibrations: Bias and dark



readout glow and detector glow



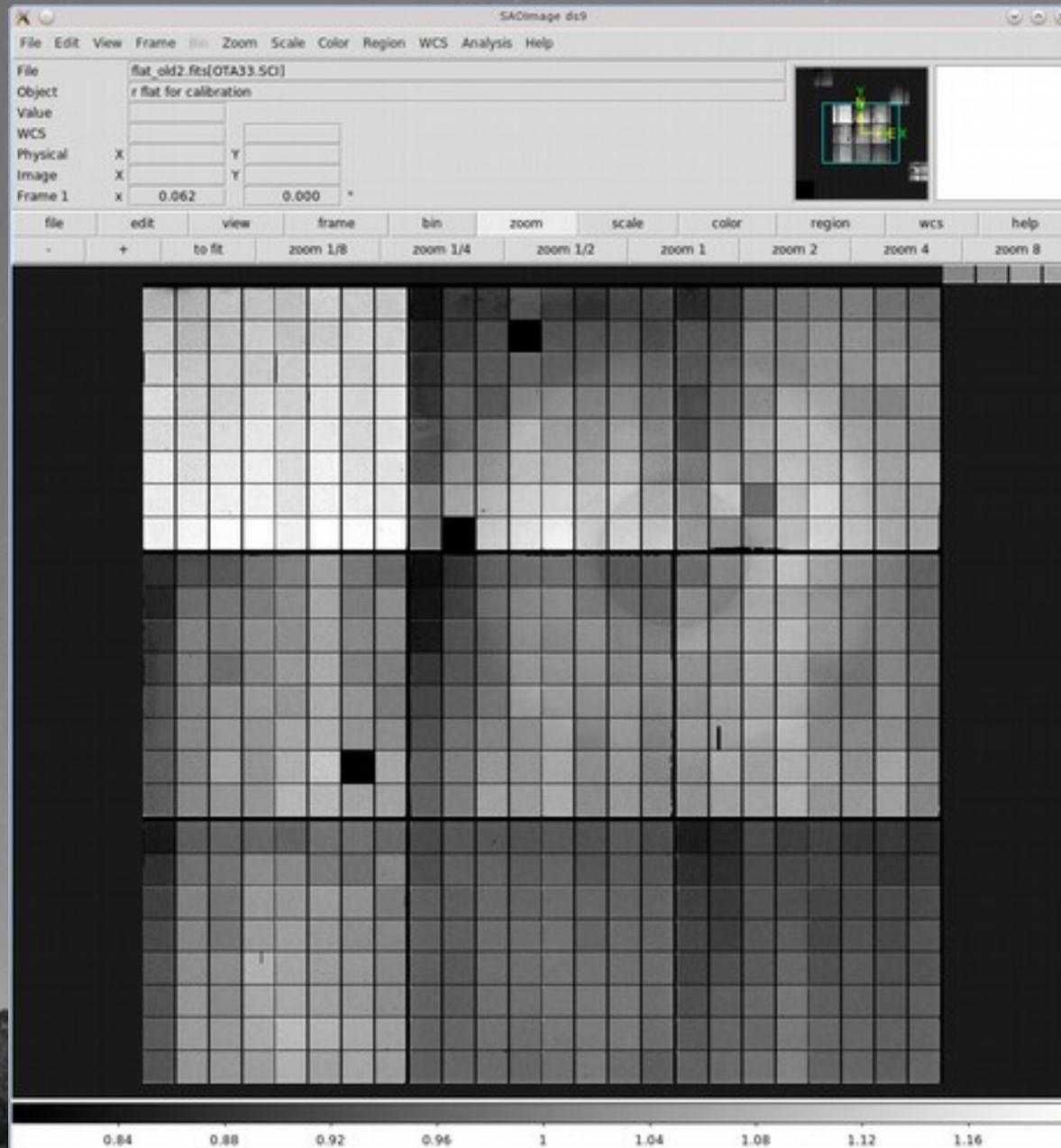
Trailing at low background levels

Potential problem for frames with background levels < 50-70 counts:

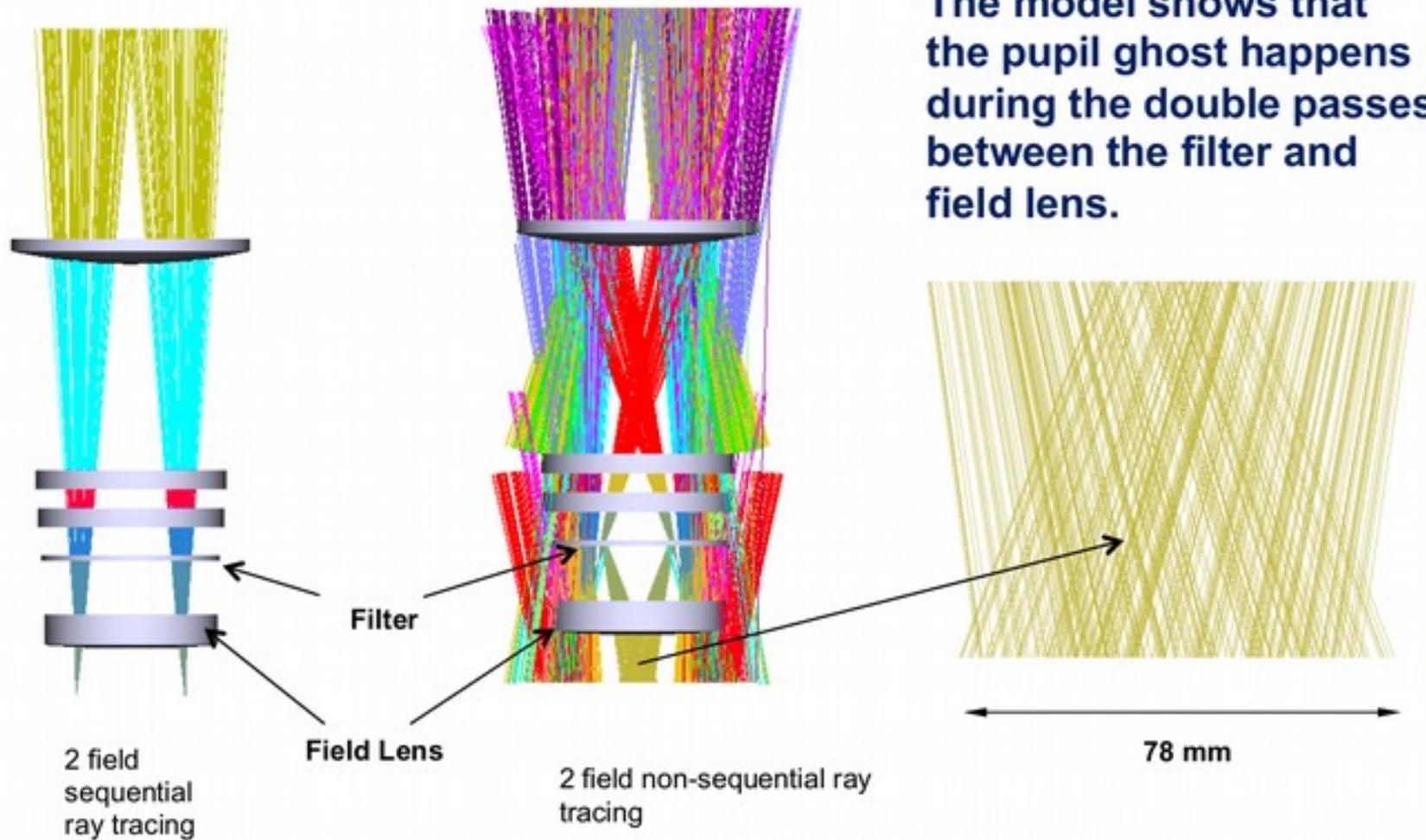
- short exposures:
guiding,
U-band during dark time
- narrow-band data



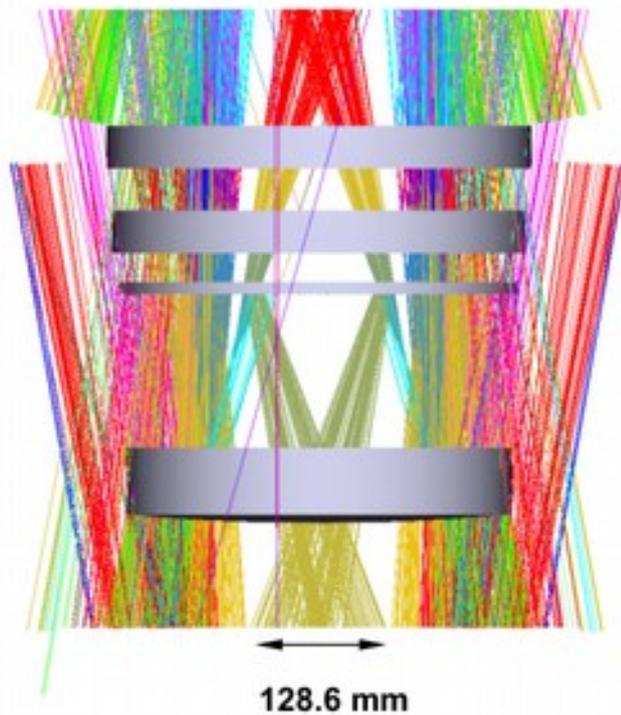
Flat-fields: pupil ghost



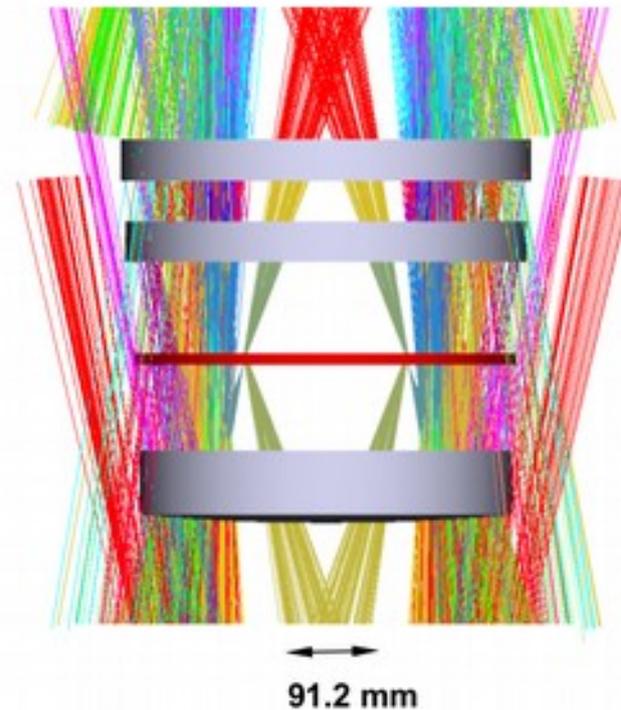
ODI Pupil Ghost Images: Non-sequential Results



ODI Pupil Ghost Images: Change Filter Position Can Reduce The Intensity of The Pupil Ghost Image.



Move filter 31 mm forward, the diameter of the pupil ghost increase to 128.6 mm(the first filter position)



Move filter 31 mm backward , the diameter of the ghost pupil increase to 91.2 mm (the third filter position)

Comparing L2 and L1 flats

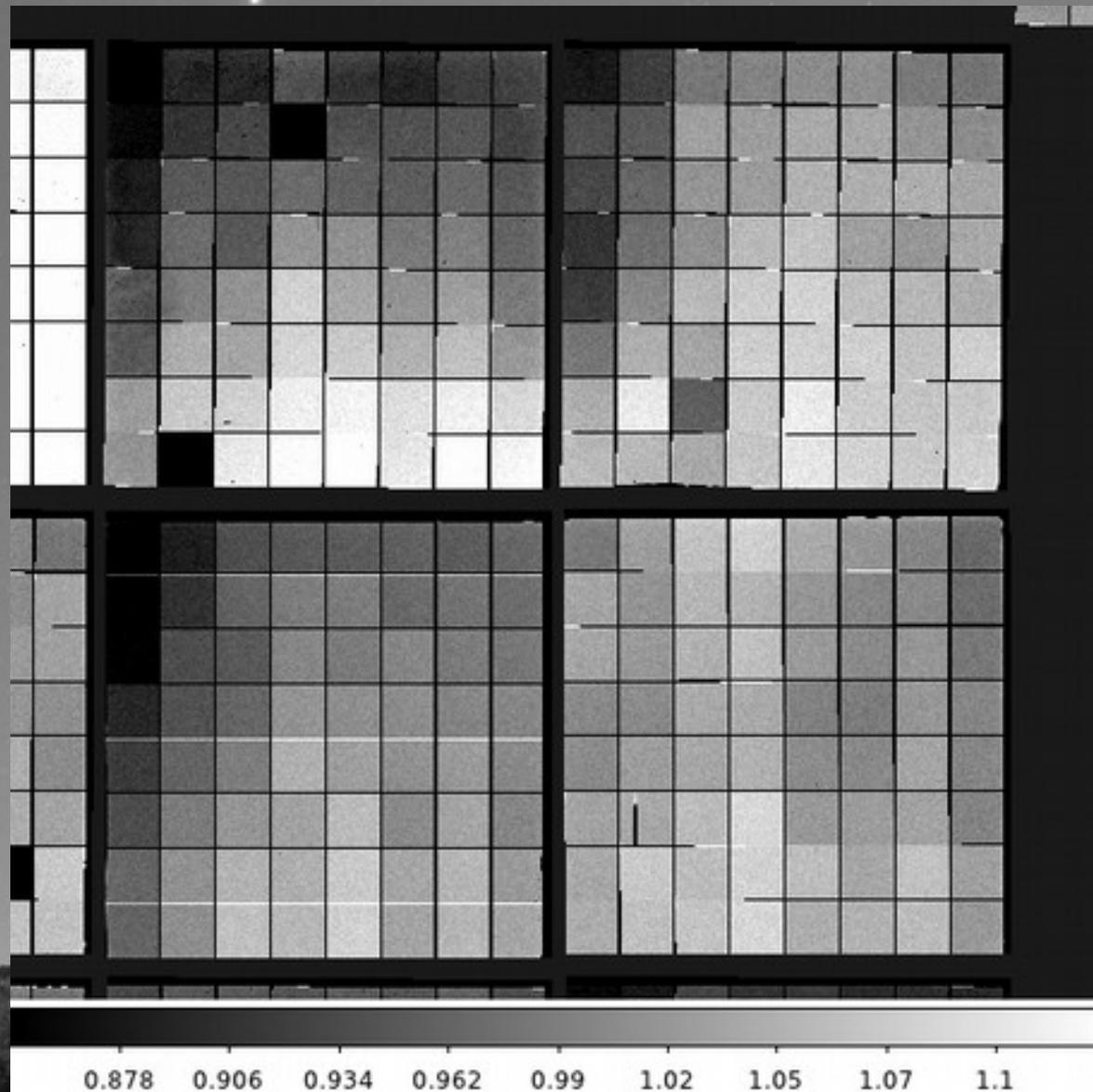
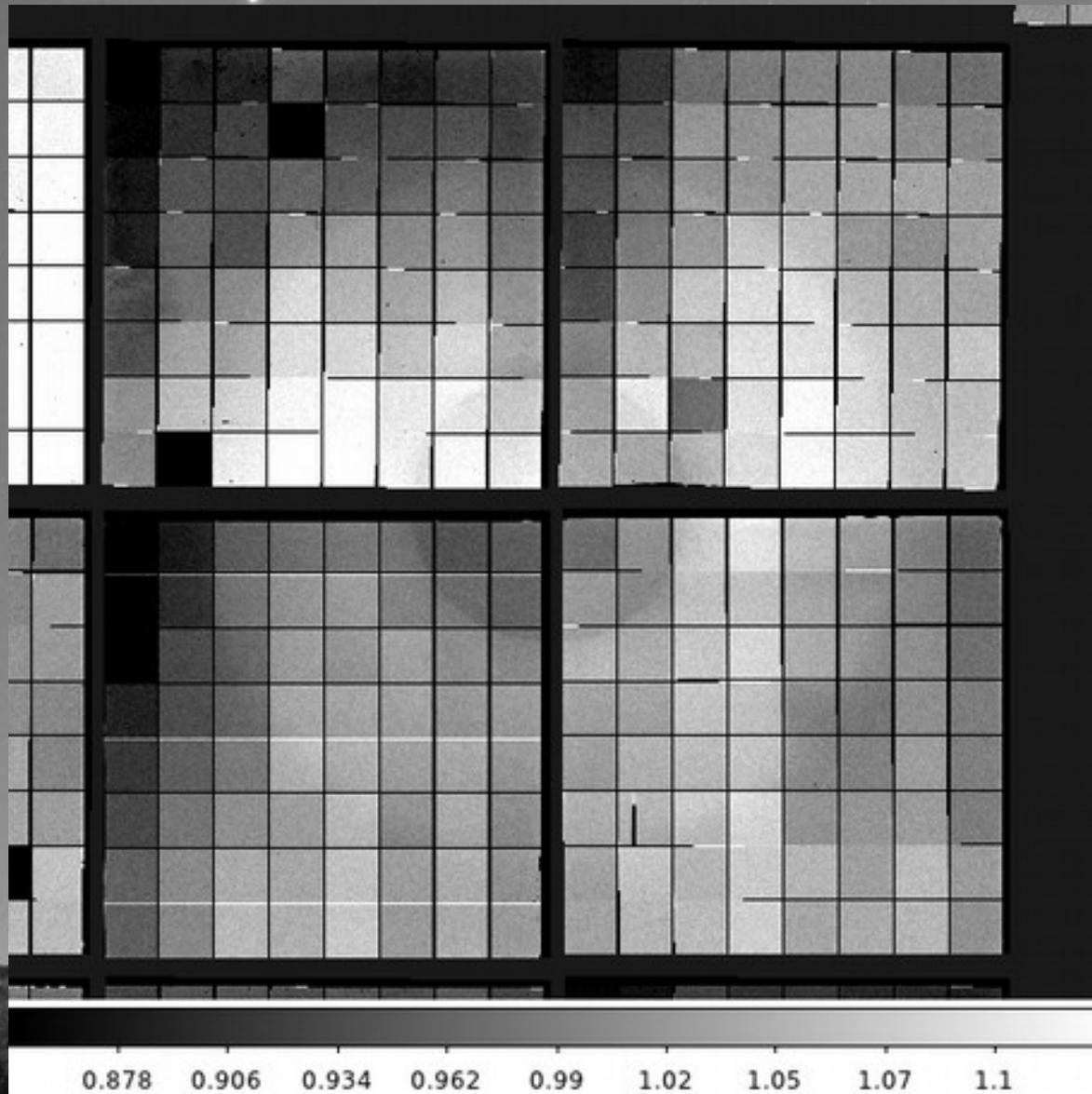


Image of pupil ghost template and before and after



Standard Calibration Plan

The screenshot shows a software window titled "ODI Exposure GUI" with a menu bar (File, View, Debug) and a status bar (odi-cwg TEST-128-2105). The "Standard Dome Calibration" tab is active, displaying a configuration interface for dome calibrations. The interface includes sections for "Dark & Bias" and "Flat Fields", each with several checkbox options. A large empty rectangular box is present below the flat field options, and a "Start Exposure" button is at the bottom.

ODI Exposure GUI

File View Debug odi-cwg TEST-128-2105

Ad-hoc Observation Dithers Focus Sequence **Standard Dome Calibration** Instrument Control

ODI Standard Dome Calibrations

Dark & Bias:

10 x Bias 3 x 600 sec dark

Flat Fields:

5x Dome Flat g' 5x Dome Flat r' 5x Dome Flat i'

5x Dome Flat z' 5x Dome Flat U' 5x Dome Flat g'

5x Dome Flat g' 5x Dome Flat g' 5x Dome Flat g'

Start Exposure

OT shifting

Principle:

(charge in) pixels follows image motion

Modes:

- Fast guiding (≥ 1 guide star)
- Coherent guiding (≥ 3 guide stars)
- Local guiding (>1 guide star per OTA)



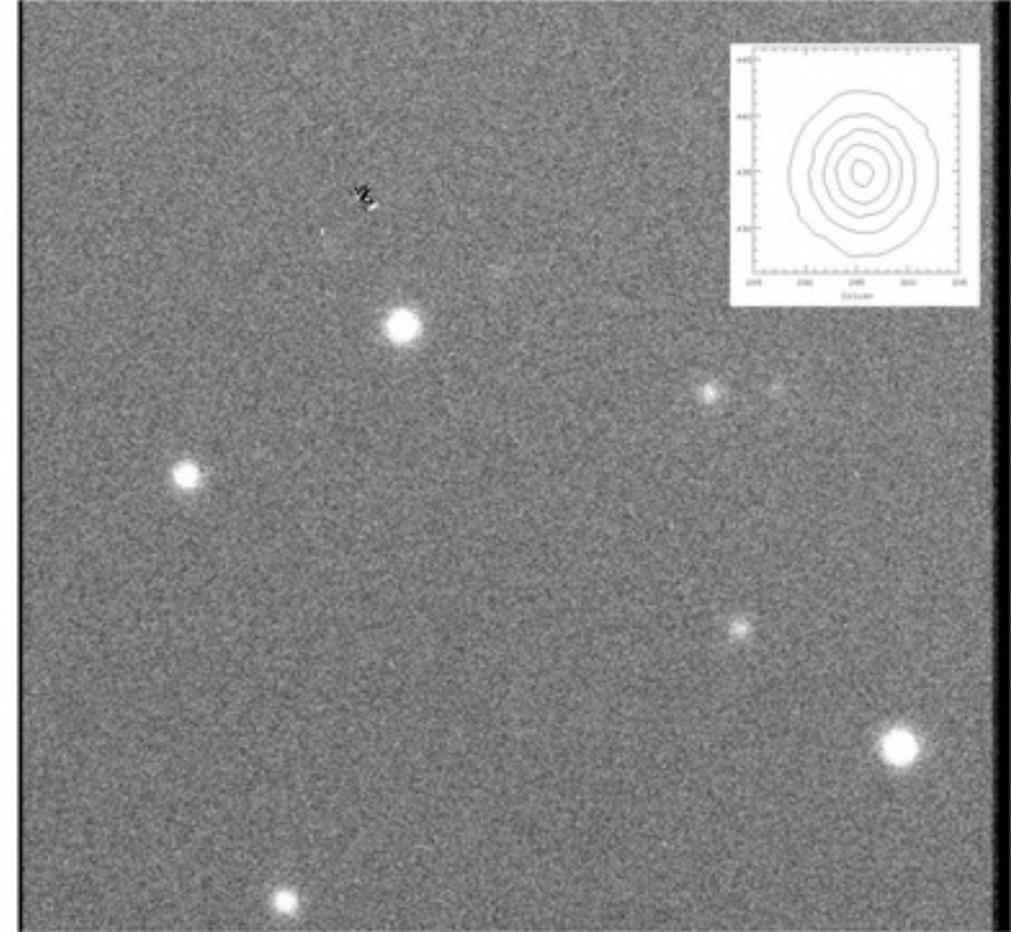
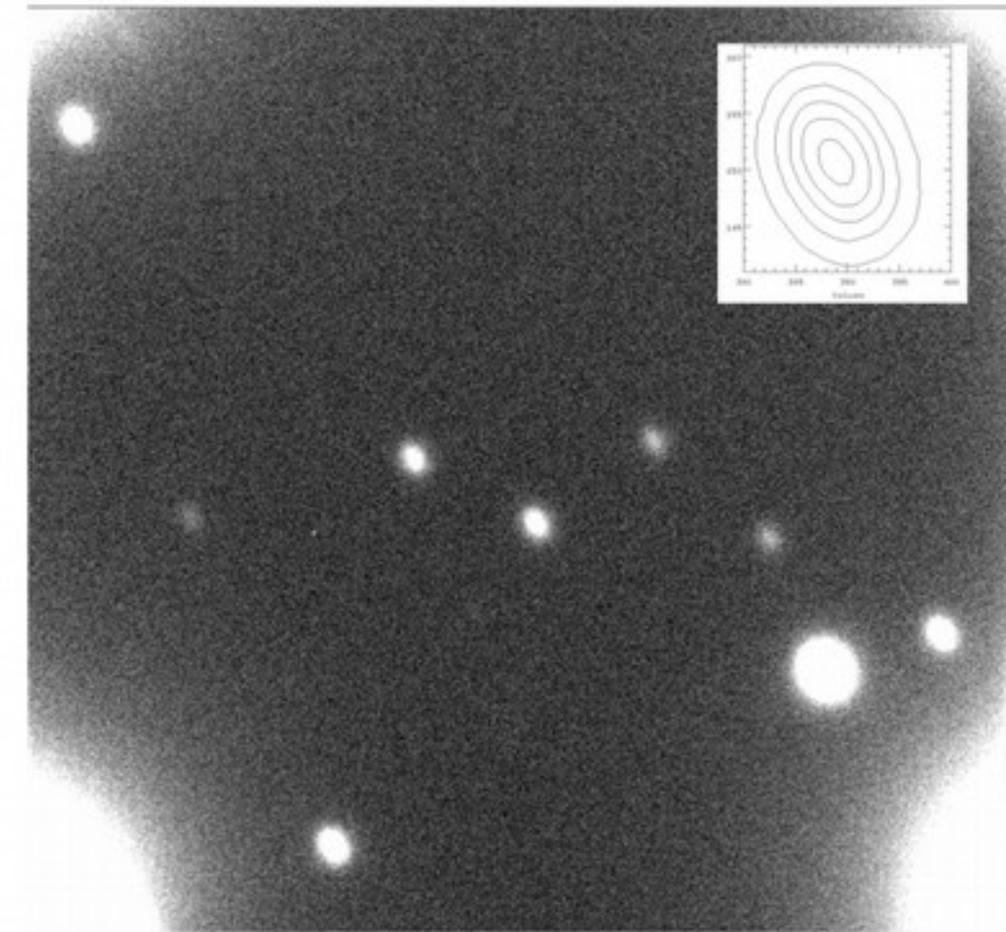
OT shifting: Pros

- Better seeing or at least rounder stars
- Reduced windshake in windy conditions



pODI Coherent Correction Mode

First Light Jan 23 2013



No OT-correction: Elongated stars due to telescope drift.

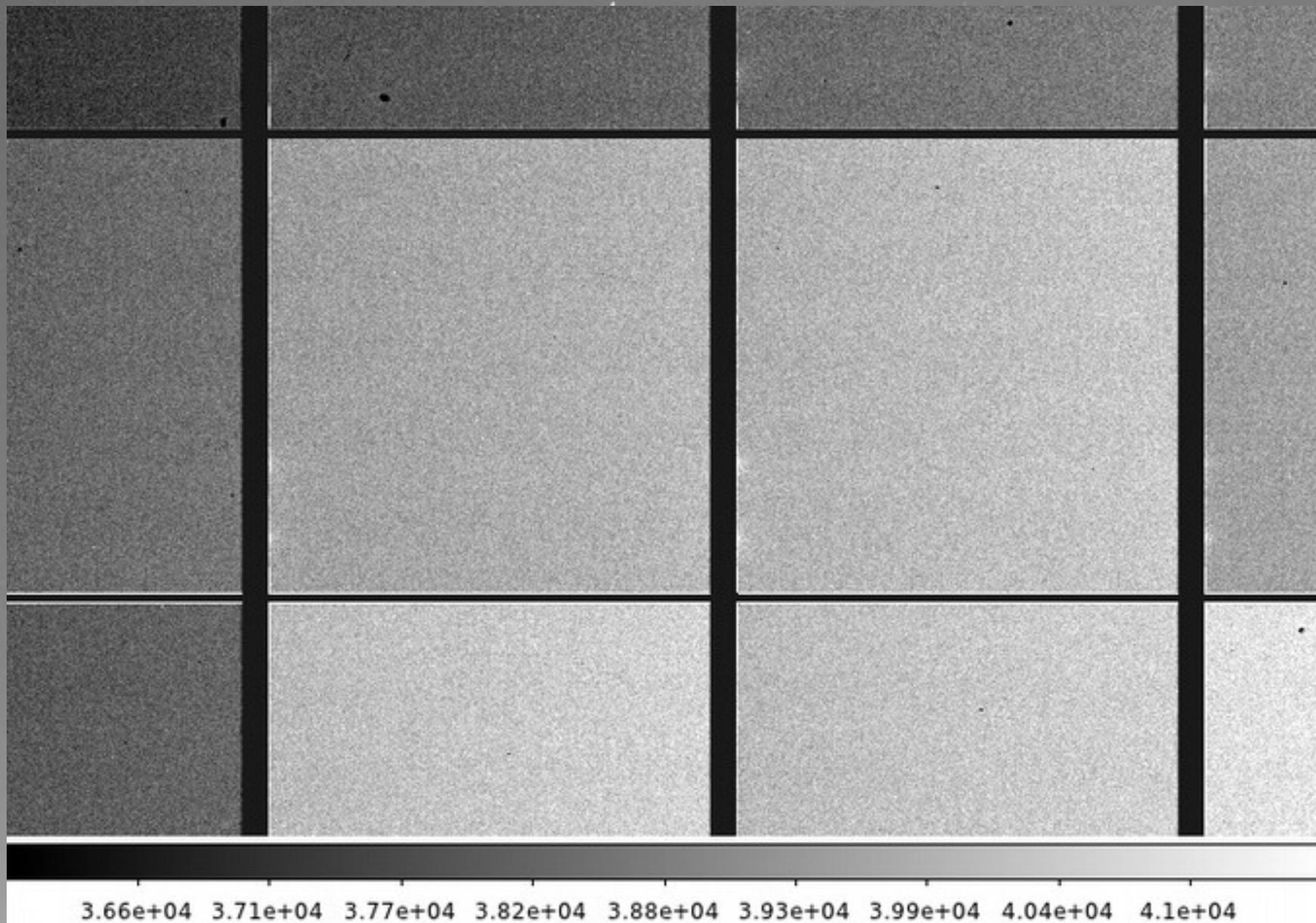
OT-correction applied: Round stars, telescope drift is compensated.

OT shifting: cons

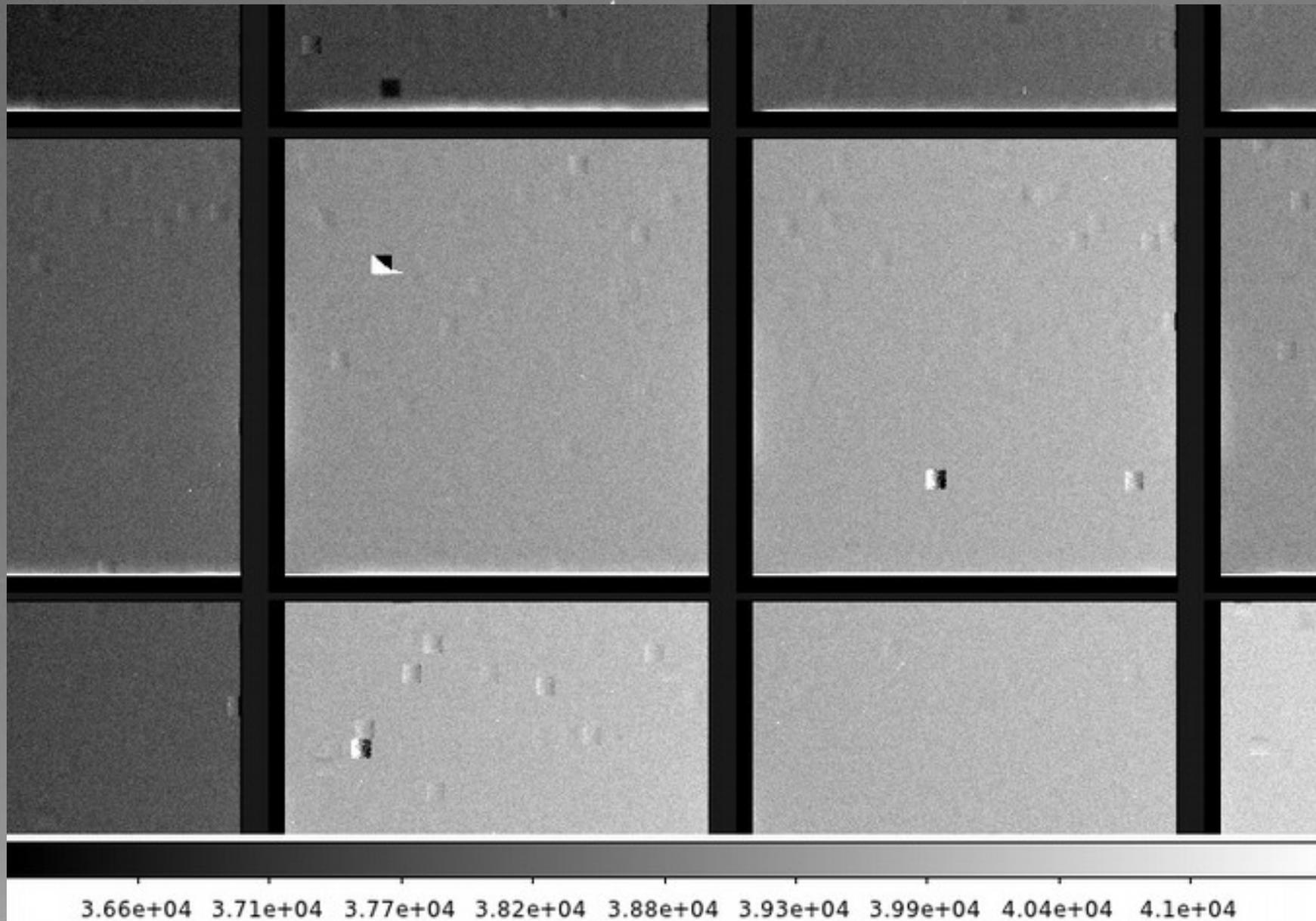
- Traps cause image artefacts
- slightly smaller detector area (shift pixels off chip)
- Needs (many) bright guide stars
- For now: Guide readout too slow to make OT shifting effective (work in progress)
- Data reduction trickier: Need to convolve calibration files with shift history



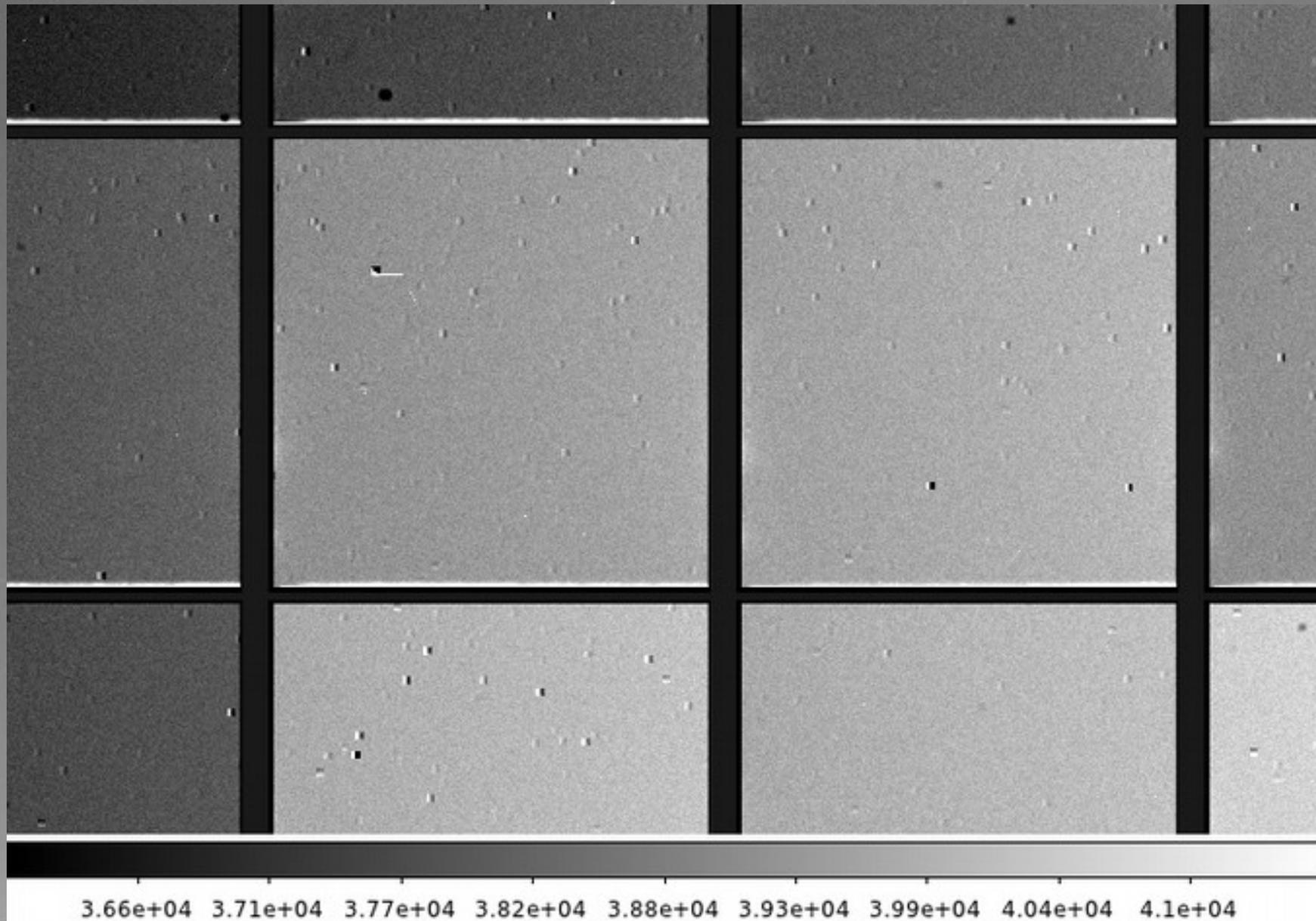
OT shifting artefacts



OT shifting artefacts



OT shifting artefacts



Atmospheric dispersion corrector

- Two rotating prisms

elevation 49.40
parallactic 79.03
rotator angle -29.64
rotator offset 0.00
pressure (mb) 799.9
humidity (%) 15.6
temperature (C) 15.6

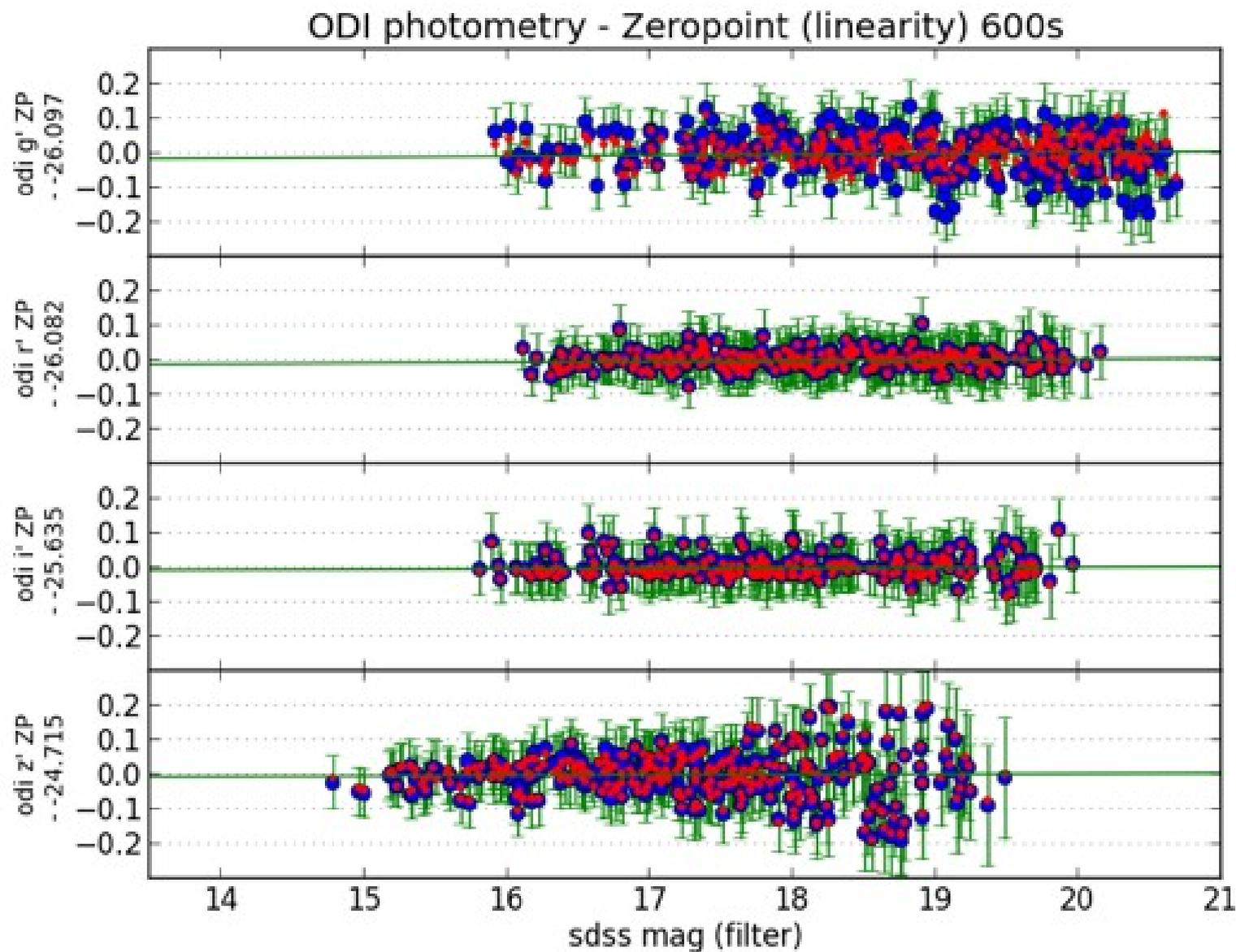
prism dispersion 0.12

index	calculated	enter degrees	target	angle	encoder
1	294.10	297.74	297.74	297.73	297.23
2	6.62	4.93	4.93	4.92	5.76

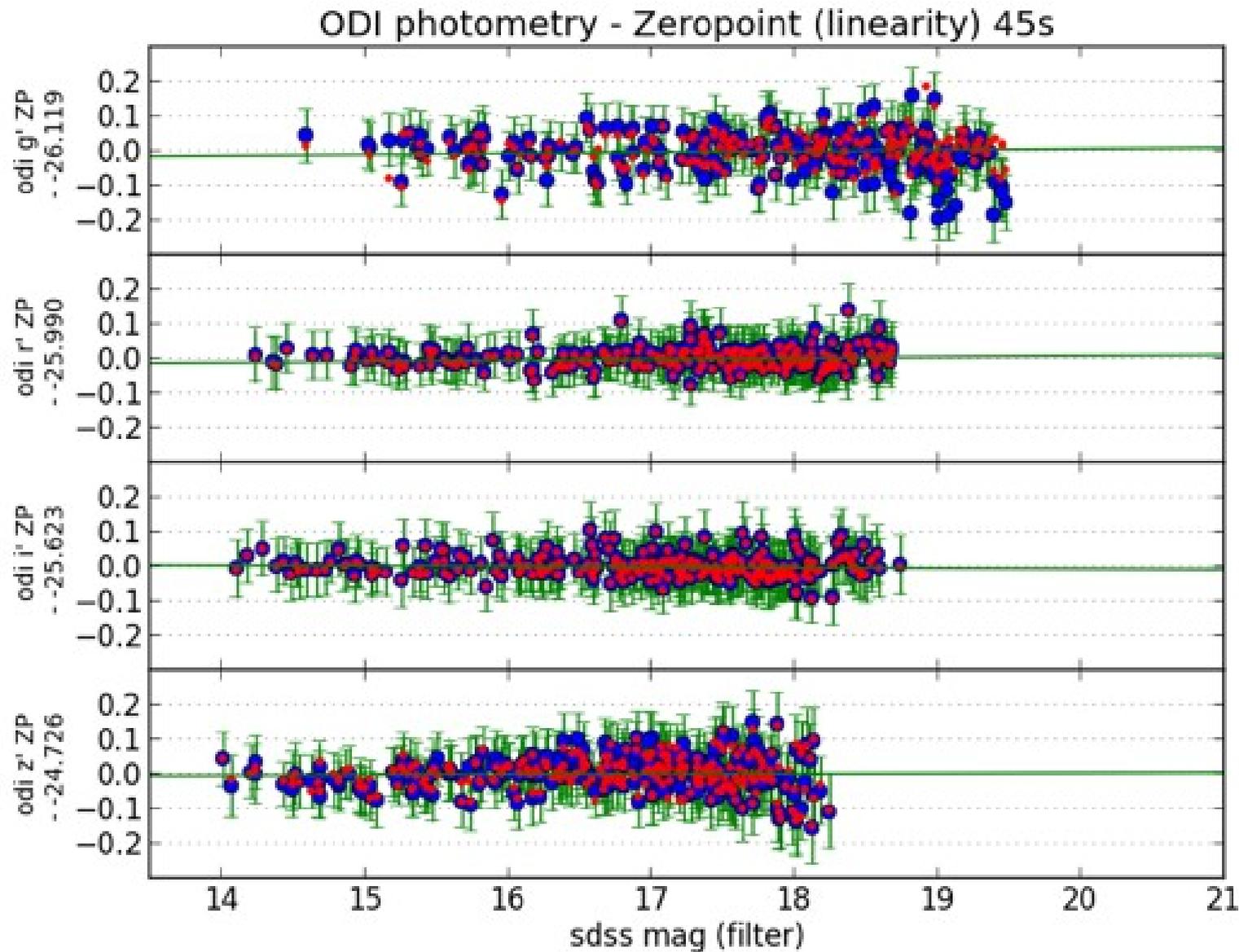
unit: degrees radians

```
angle1 BUSY adc1 state = adcMoving
angle2 BUSY adc2 state = adcMoving
angle2 BUSY adc2 state = adcPositionCheck
angle2 BUSY adc2 state = adcDone
angle2 BUSY adc2 state = adcIdle
angle2 DONE adc2 angle is 0.0859
angle1 BUSY adc1 state = adcPositionCheck
angle1 BUSY adc1 state = adcDone
angle1 BUSY adc1 state = adcIdle
angle1 DONE adc1 angle is 5.1964
```

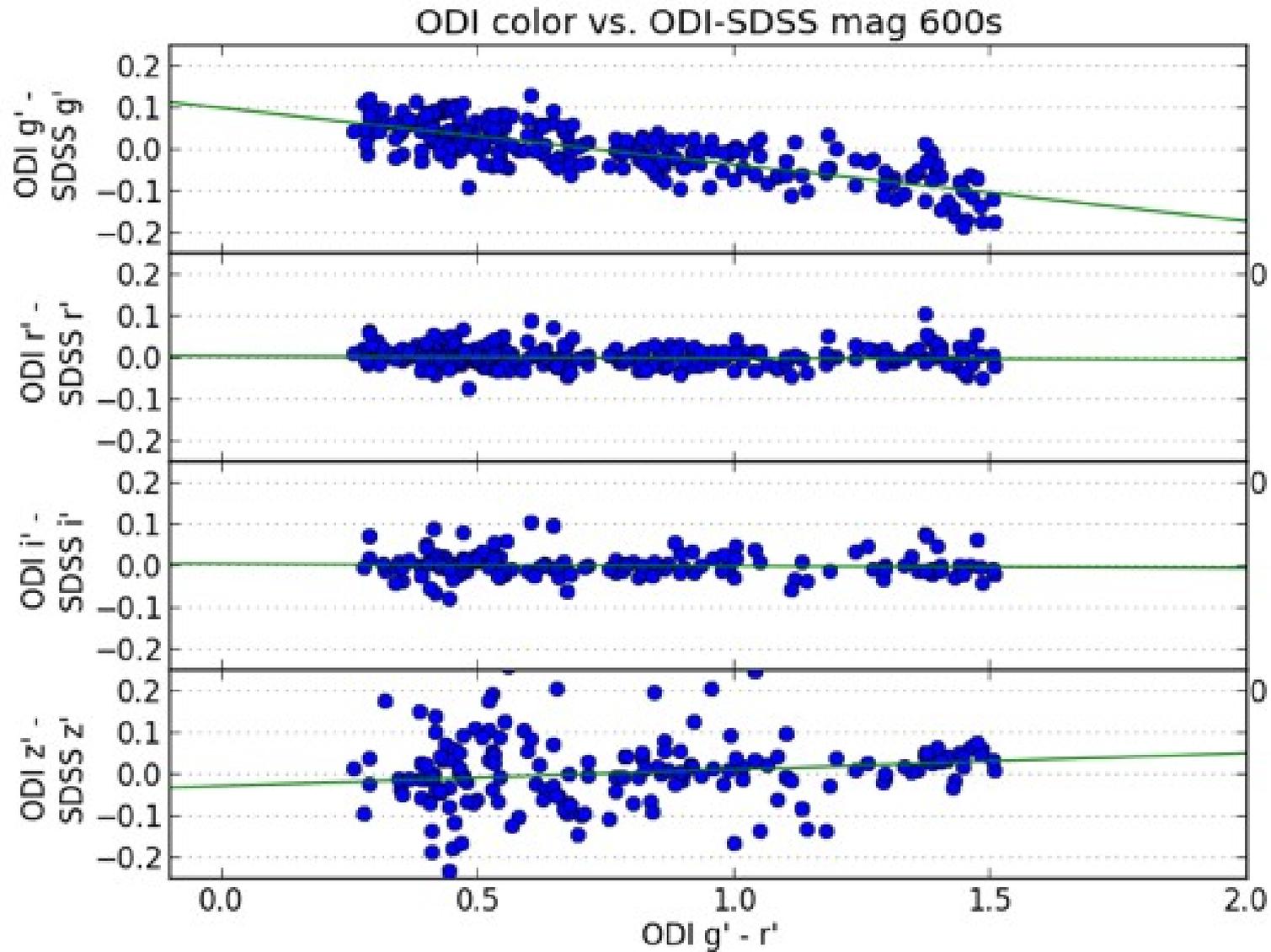
Photometric calibration



Photometric calibration



Color terms ODI vs SDSS



Portal, Pipeline & Archive (PPA)

- portal.odi.iu.edu
- Run by Indiana U.
- Frontend to access/download/manipulate data
→ demo
- Official pipeline still under construction
Rumours: Release at end of month



pODI Quickreduce pipeline

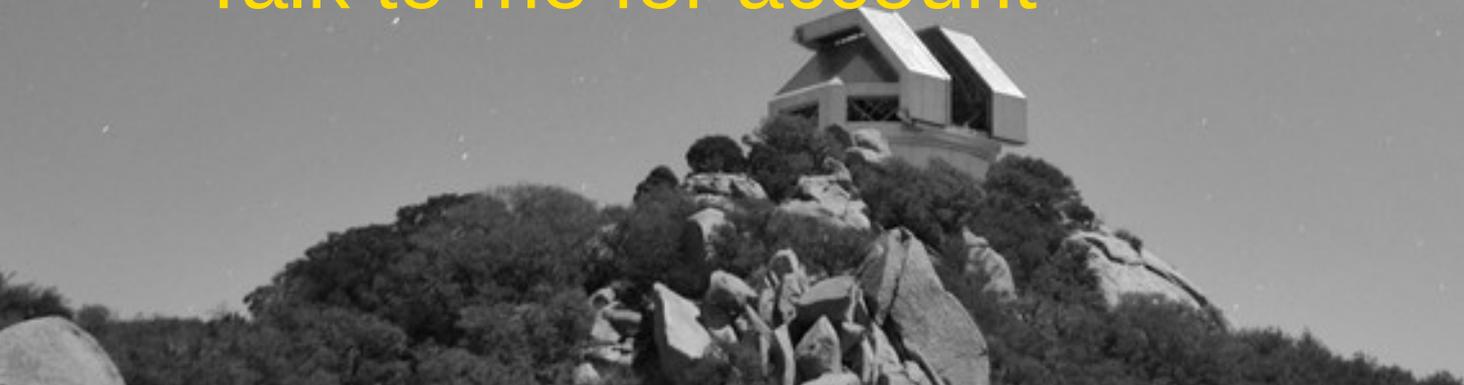
- Basic reduction directly at telescope (overhead, bias, dark, flat, [WCS], [[photometry]])
- Help judge data quality
- Written in Python, publicly available
- No IRAF/pyRAF
- Made in Wisconsin :-)



Data reduction facility at UW

Local pODI reduction:

- 8-core machine
- 54 GB memory
- External Raid disk with ~10 TB capacity
- Raid-0 Solid State Drives with 1 GB/s read/write speed
- Talk to me for account

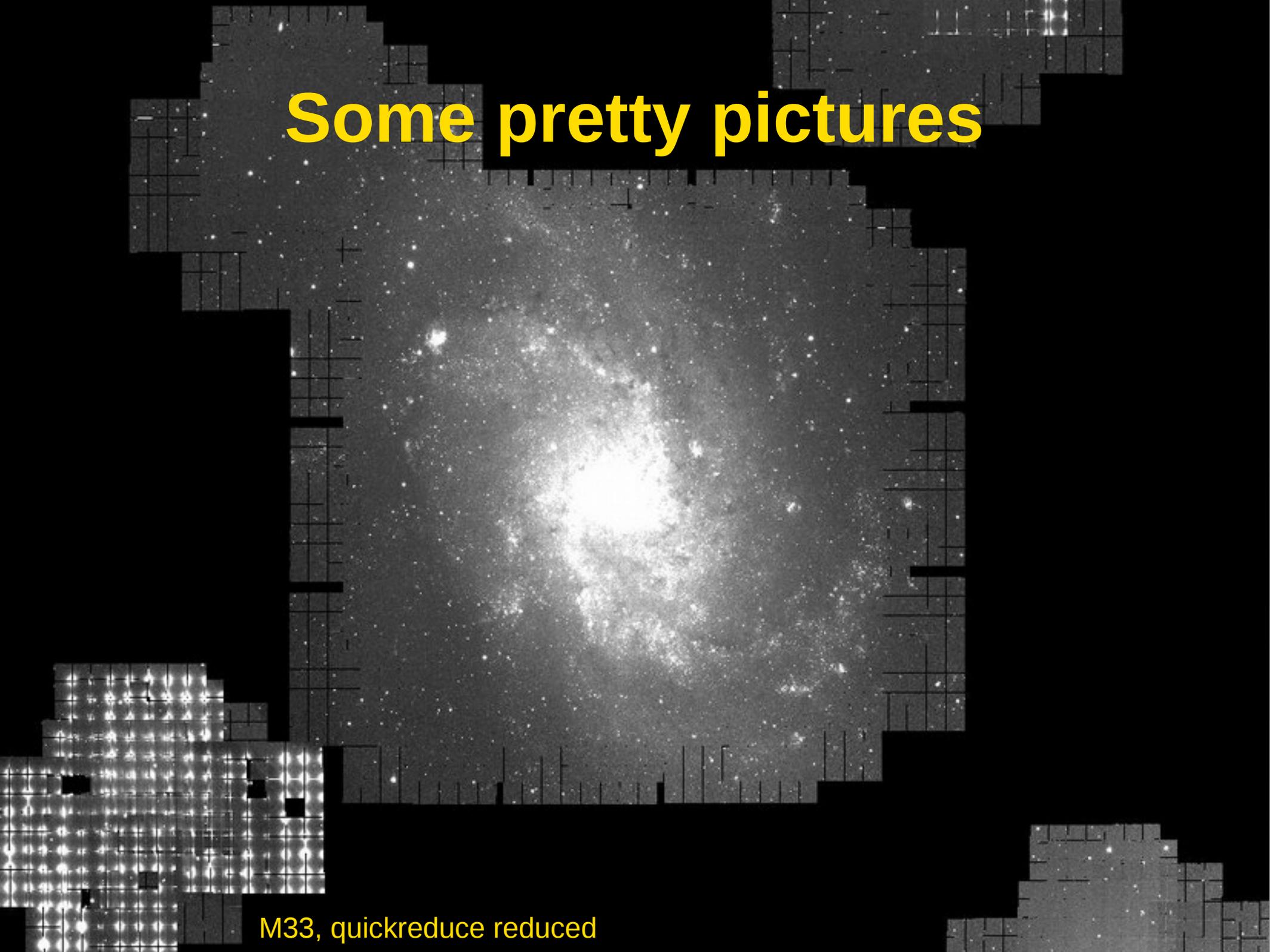


Things that (don't) work (yet)

- Working:
Imaging/Dithering, guiding, data reduction,
most GUIs, ADC
- Kinda working:
pipeline, OT shifting
- Not working:
Focus sensors



Some pretty pictures



M33, quickreduce reduced

Some pretty pictures

M33, quickreduce reduced



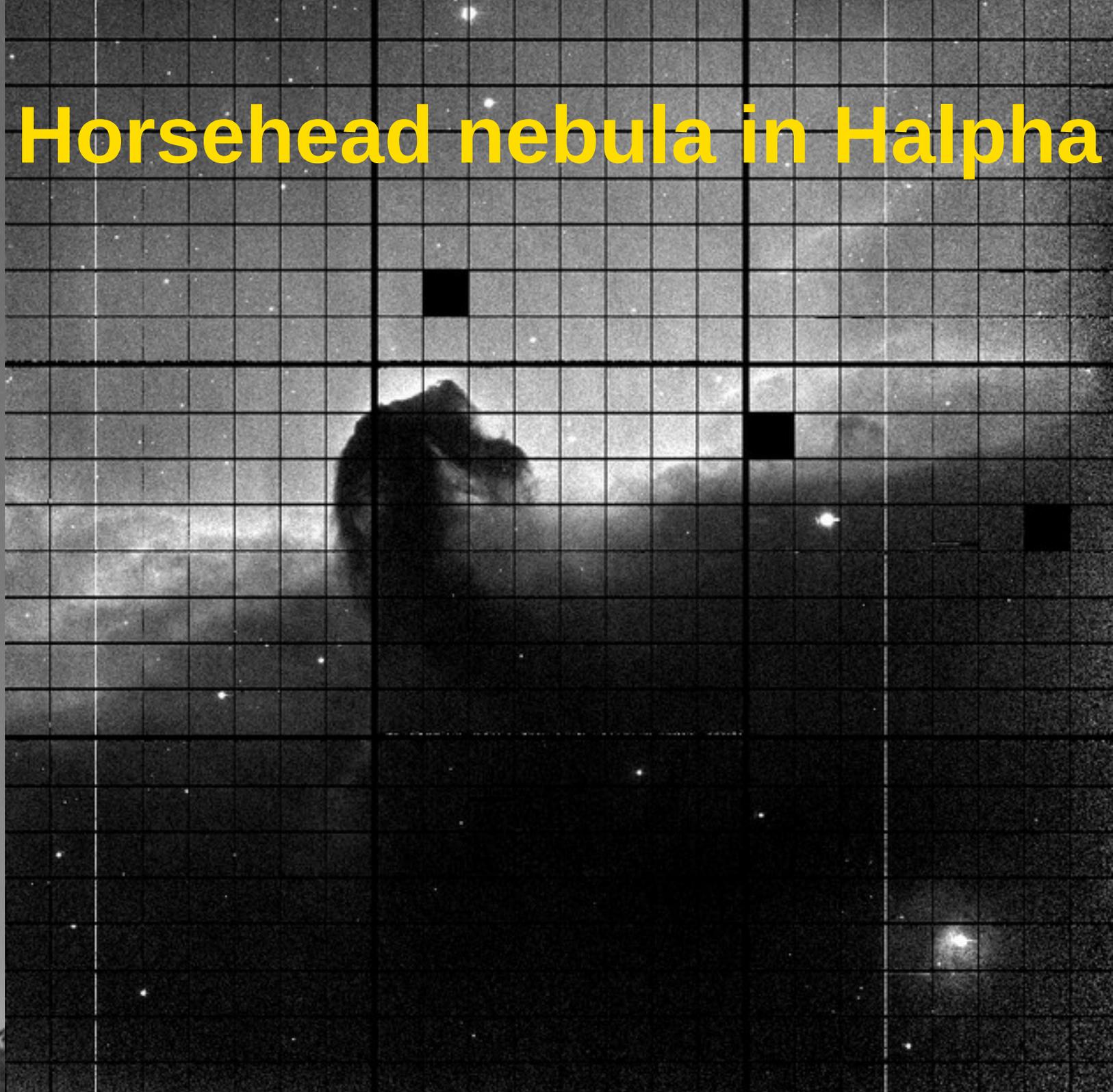


Bubble nebula, pipeline reduced



M15, pipeline reduced

Horsehead nebula in Halpha



Thank you!

