2015 Instrument Talks

The Support Astronomer Group

W. M. Keck Observatory

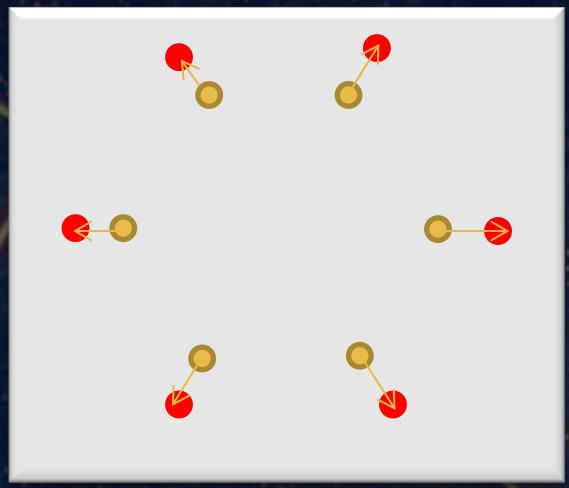
Personnel Changes

- August: Barbara Schaefer retired
  Carolyn Jordan taking over as Lead OA
- October: Greg Wirth moved to NEON
  Currently recruiting a new SA
- March: Bob Goodrich moving to GMTO

Remote Ops Remodel

- New virtual machines running VNC desktops
  - Larger monitors
- New layout
  - Hydraulic tables; sit or stand during your 14-hour observing nights
  - Large monitor with laptop connection

On-demand IQM



- Replacement for MIRA
- Stepping stone for continuous focus
- LRIS: in operational use
  - Run MIRA at the start of each LRIS block
  - Run on-demand IQM (five minutes) each time thereafter

On-demand IQM, NIRSPEC

- Calibration and testing stage
- Performance looks OK, but planning to replace 5-image prism with 6-image prism
- Deployment time unknown

Continuous IQM

- Interleave IQM frames with guiding frames
- Configuring lab setup for testing and development
- Options to interleaving mode being considered.
  - IQM with LRIS offset guider; guide on slit
  - Guide on IQM images (extensible beyond LRIS)

Slitmask design software

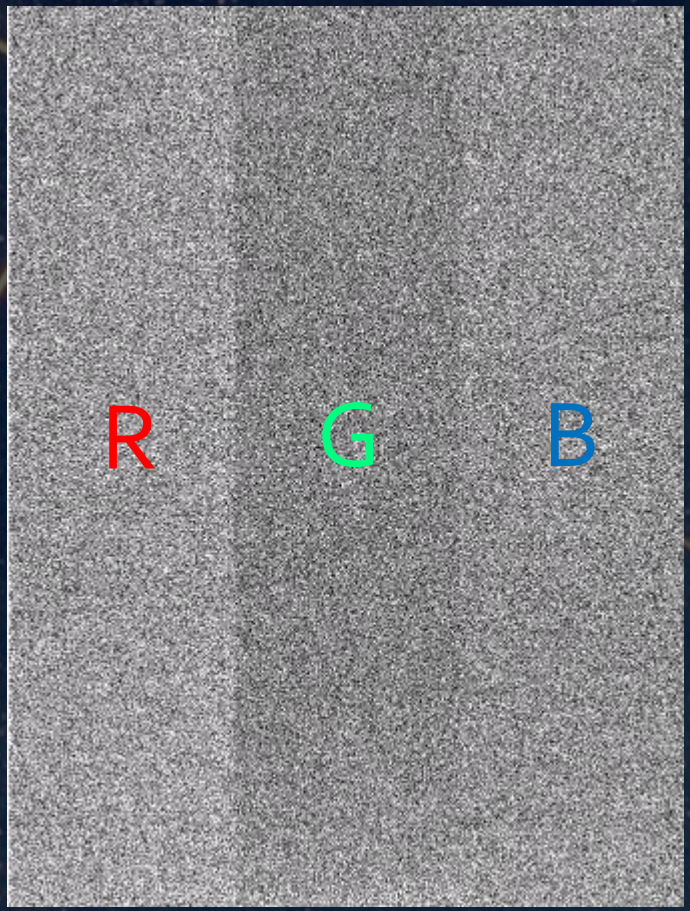
- AUTOSLIT fully "owned" by Keck
- DSIMULATOR "owned," but updates and new release postponed due to lack of resources

HIRES

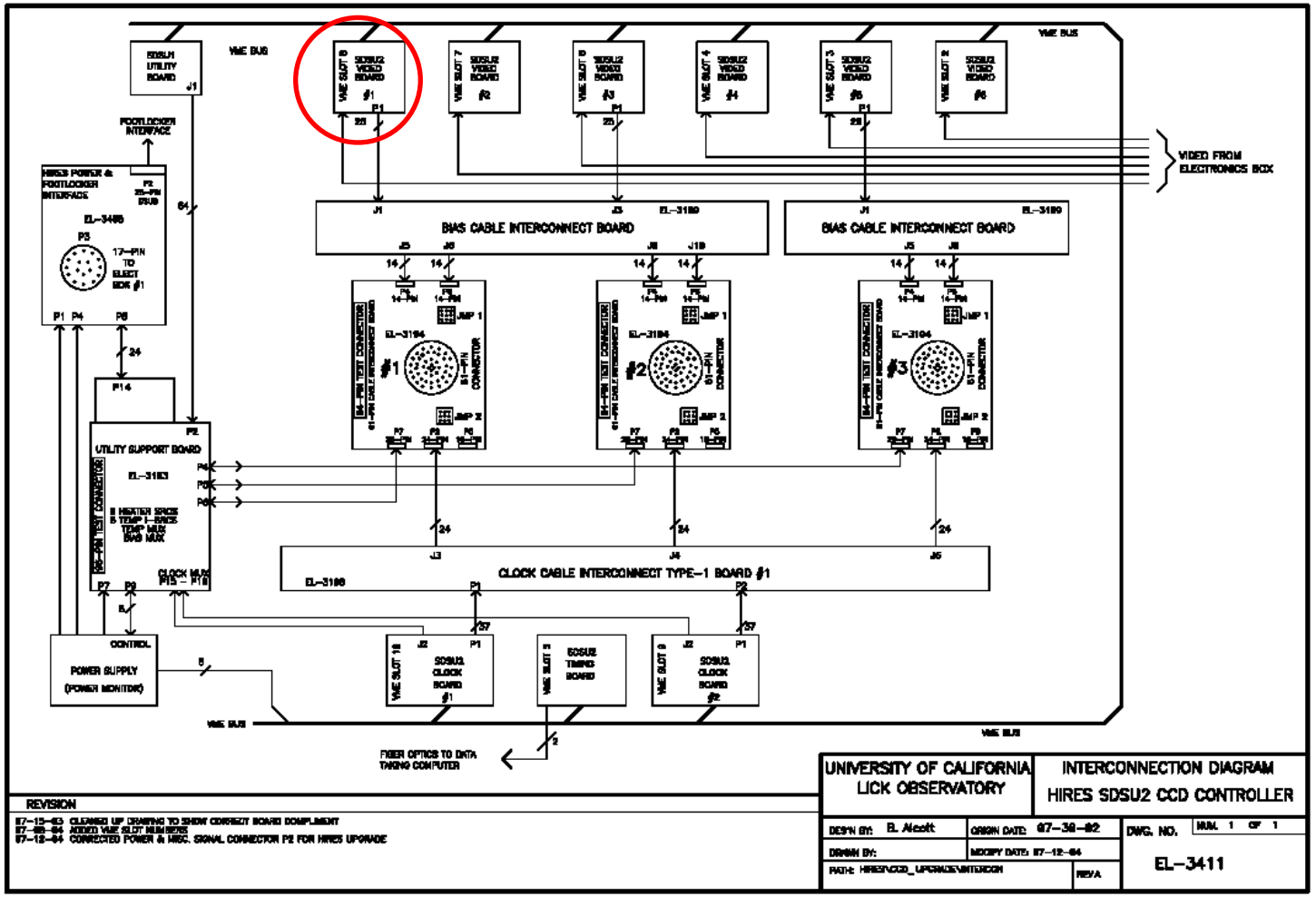
Scott Dahm

HIRES Update

- Stable operations during 2014/2015
- HIRES Issues:
  - Bias level change on CCD 1 (blue).
    - Attributable to one of two SDSU video boards for CCD1 which generates the bias voltage.
    - Plan to exchange the two video boards.
    - Impact: High gain mode is currently unavailable for CCD1.



HIRES Update



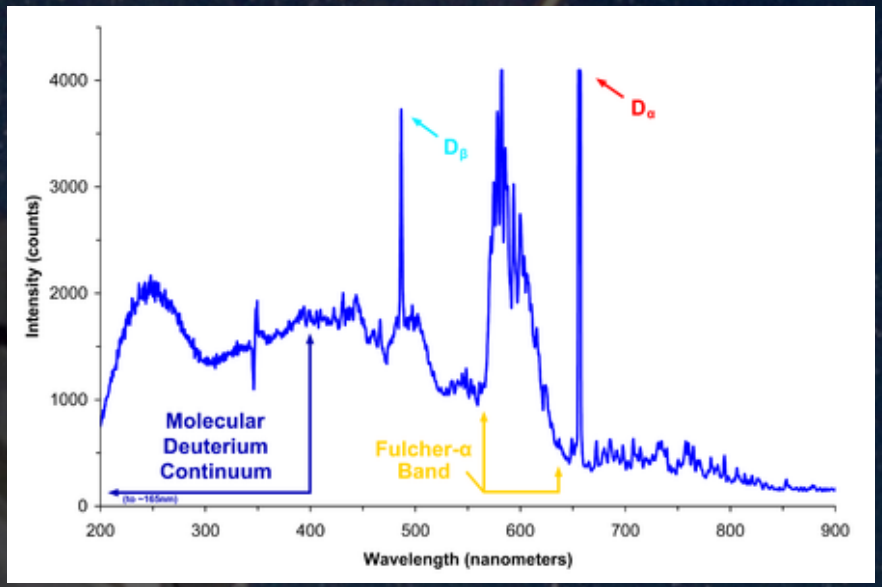
HIRES SDSU CCD Controller Interconnection Diagram

HIRES Update

- HIRES Issues (cont):
  - Failure of the SPARC 5 card (CPU) for the motor crate (04 Jul 2014).
    - Replaced with available spare.
    - Additional spare has been acquired.

HIRES Future Plans

- Submitting FY16 Continuous Improvement project for a blue optimized flat field lamp.
- The deuterium lamp originally installed in HIRES provided little continuum flux.
- A new deuterium lamp will provide continuum emission from 300 – 370 nm.




ESI
Jim Lyke

ESI: Quiet 2014, Noisy 2015

- New ESI Master
- Extensive pre-run checkout
  - Finds problems before nighttime
  - January 2015 unplanned warmup
  - February 2015
    - Dirty fibers
    - Mechanism repeatability

ESI

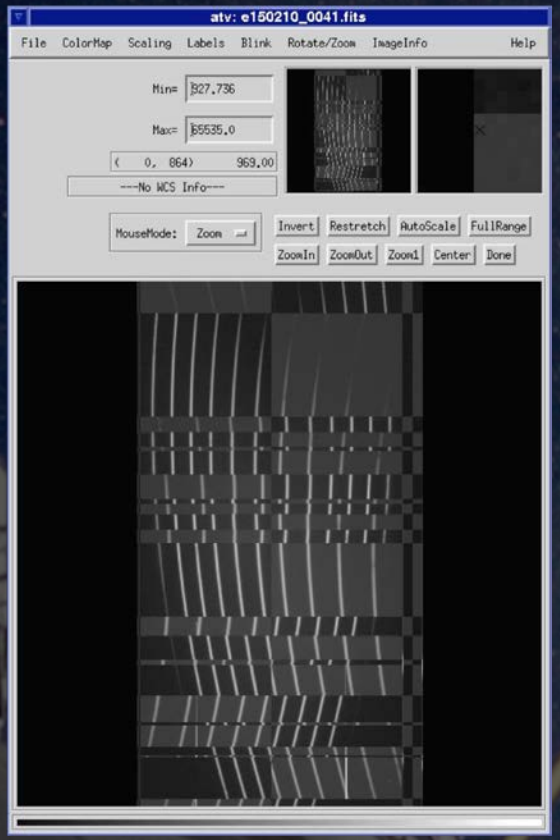
- January 2015
  - Winter storm led to unplanned warmup
  - Vacuum leak led to shortened pump down
  - Soft vacuum and broken ion pump
    - Reduced hold time
    - LN2 fills at night during January

ESI

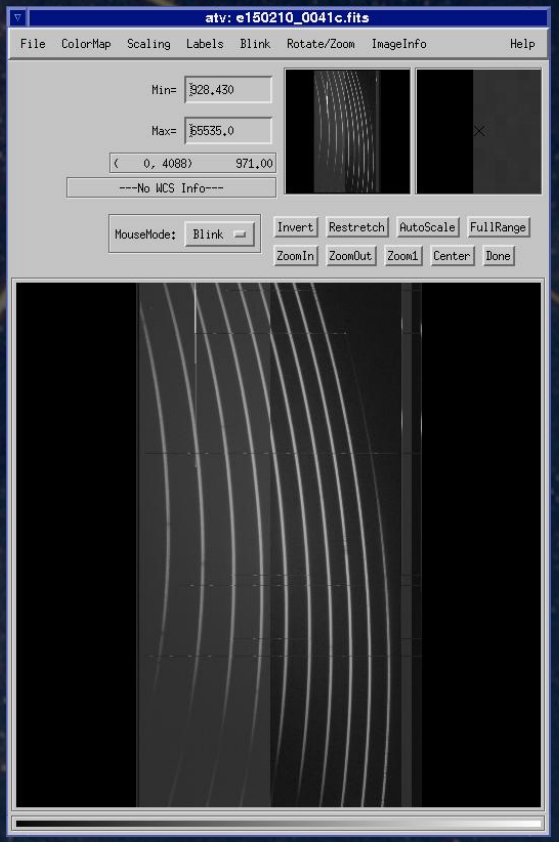
- February 2015
  - Dirty optical fibers mimicked video board problem
  - Analog data were good
  - Interlacing issue in digital transfer

ESI Dirty Fibers

Raw



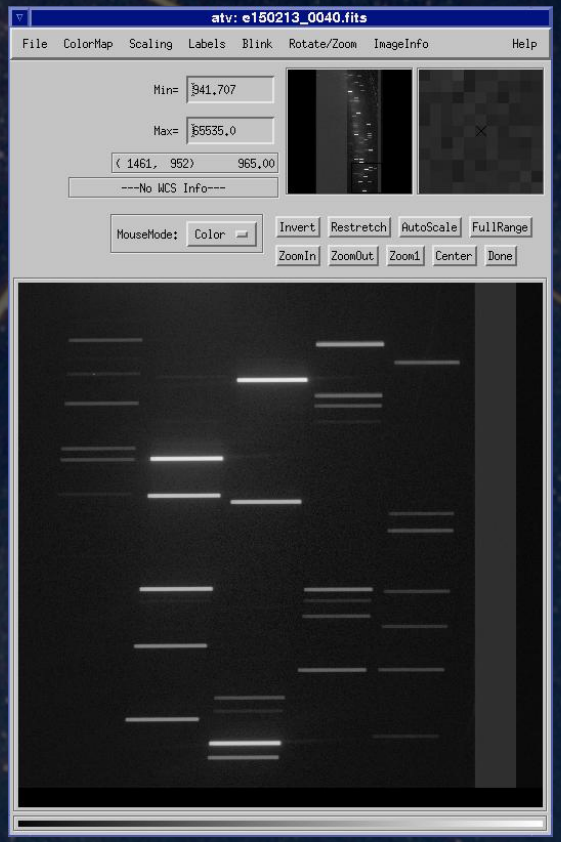
Processed



ESI Mechanism Repeatability

Echellette-Imaging-Echellette

After Re-init

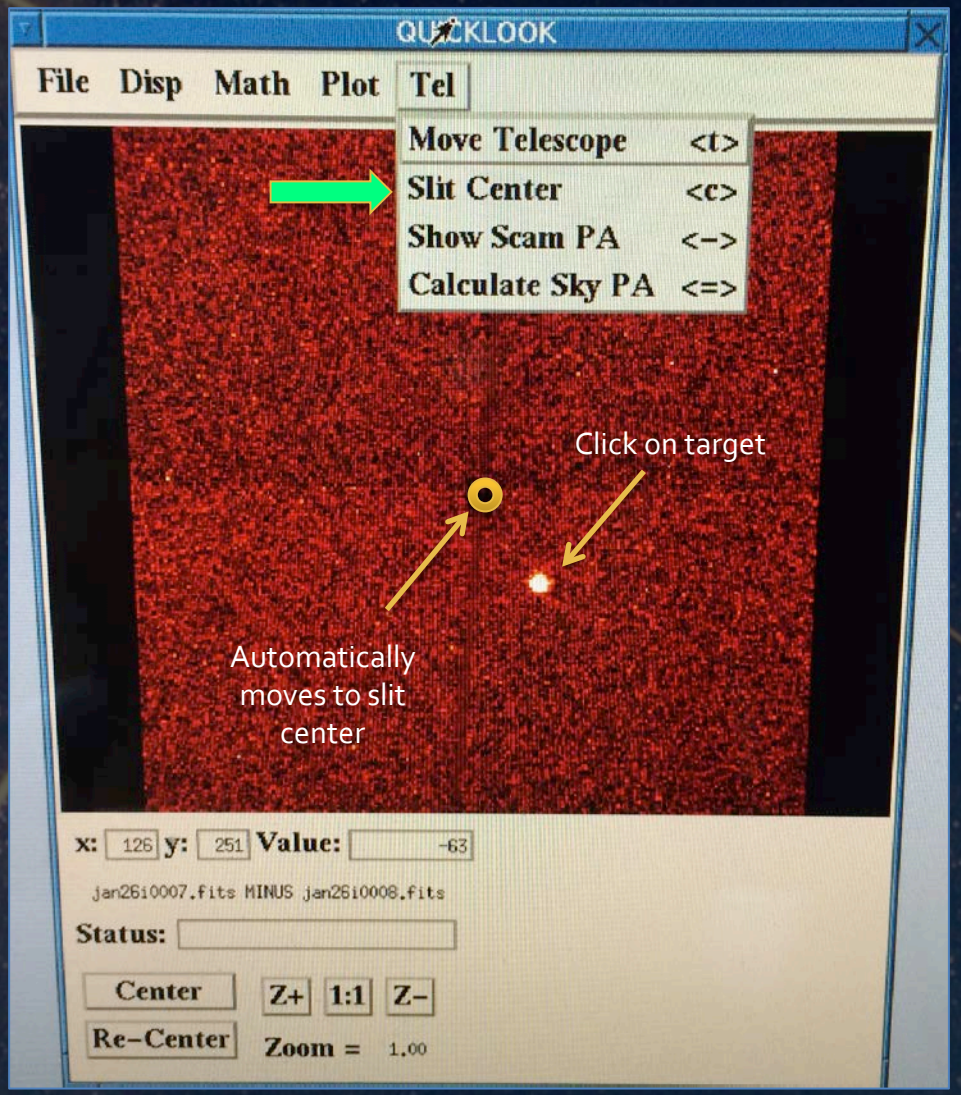


NIRSPEC

Greg Doppmann

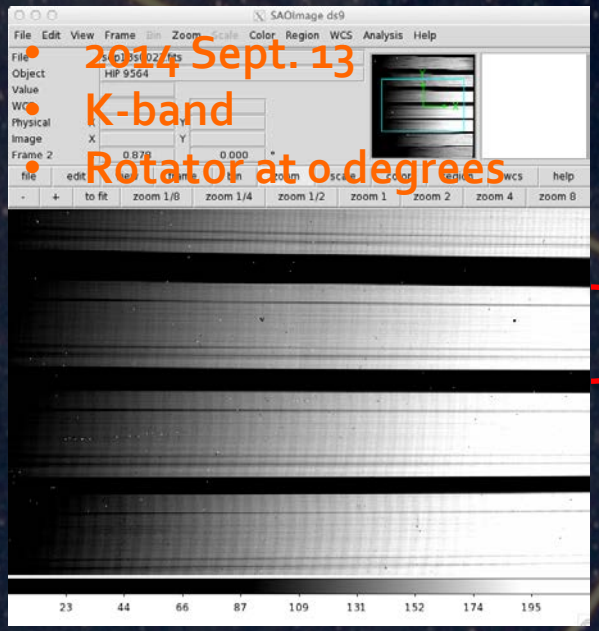
More Efficient Slit Centering Capability

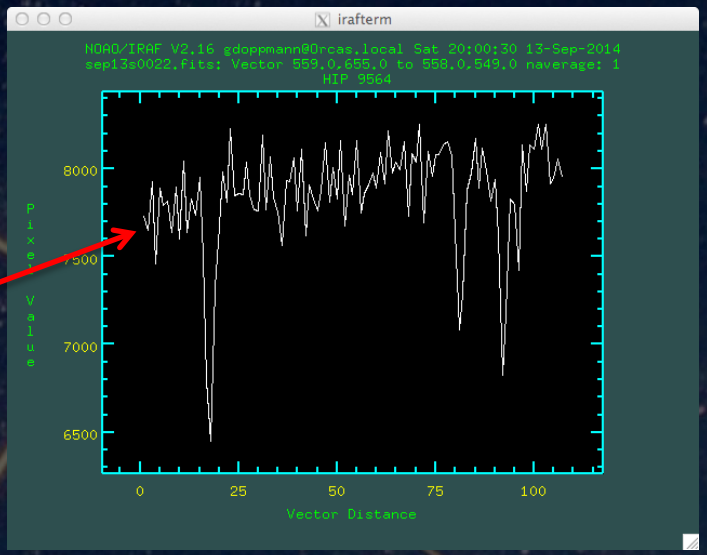
- All NIRSPEC slits have common center position in SCAM (+/- 1 pixel: 131,125 (x,y)
- Faster acquisition: Requires only 1 "click"

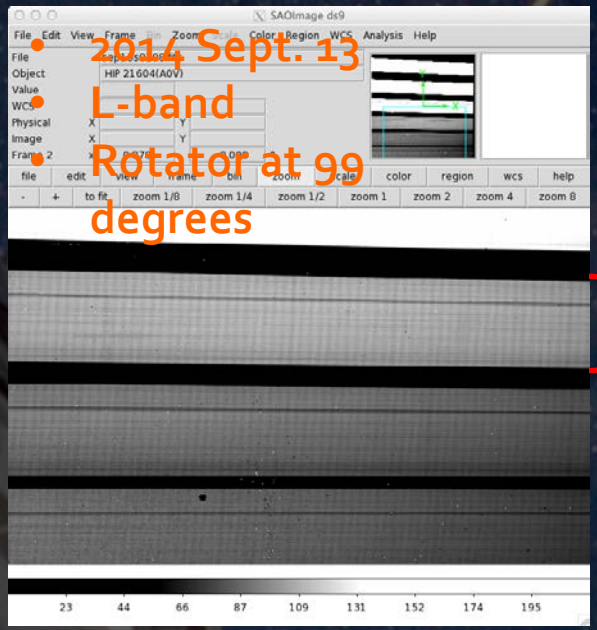


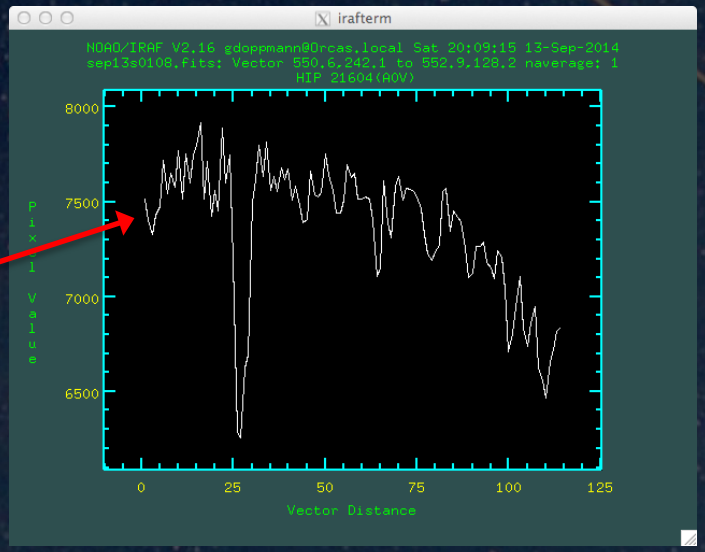
Artifact in Flat fields linked to dust on Cal Unit Optics

- Seen in different filters
- Seen in different slits
- Artifact depends on Rotator Position
- Artifact goes away after cleaning cal unit optics – late Sept. 2014





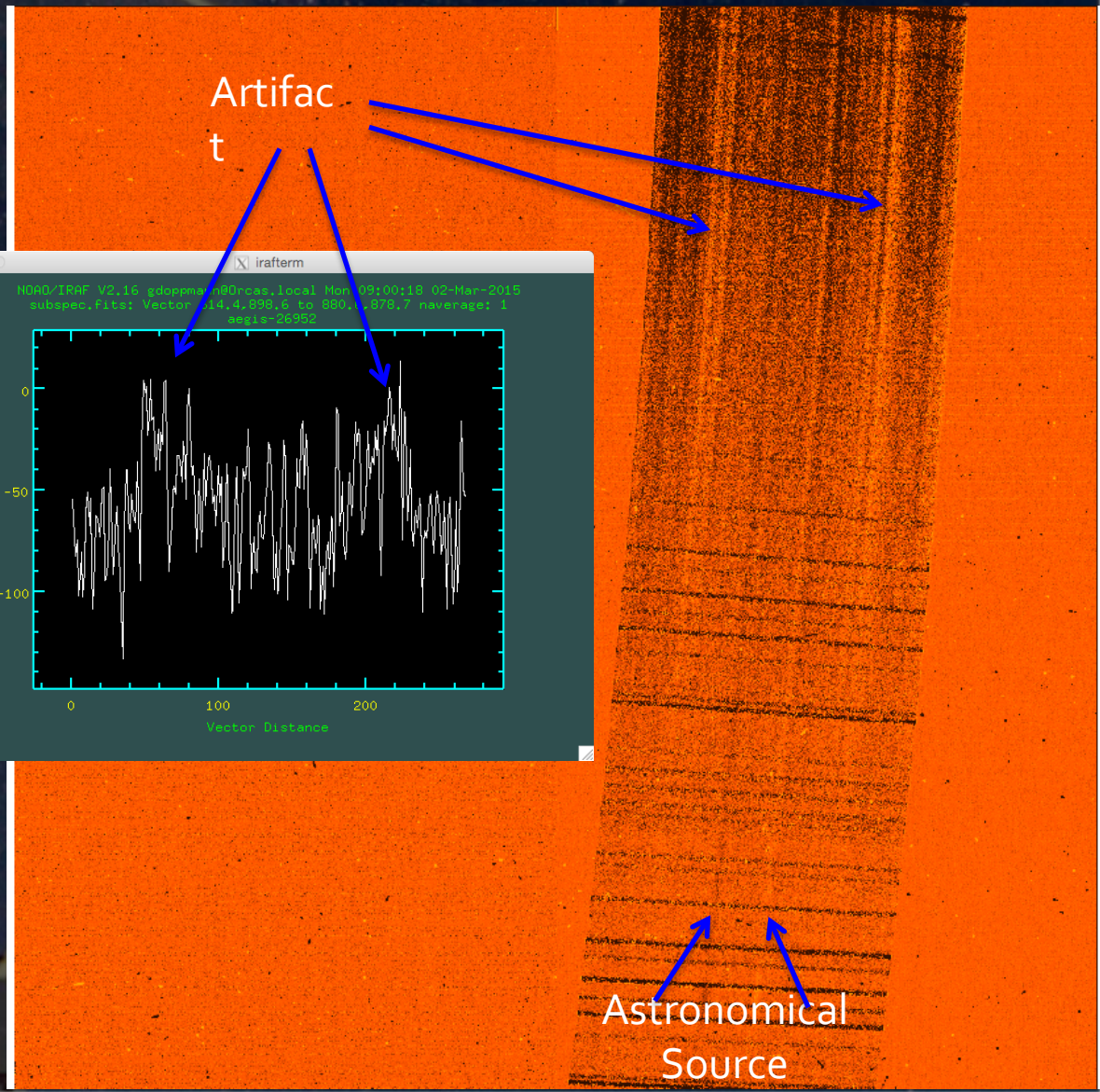




Dust Emission from NIRSPEC Window

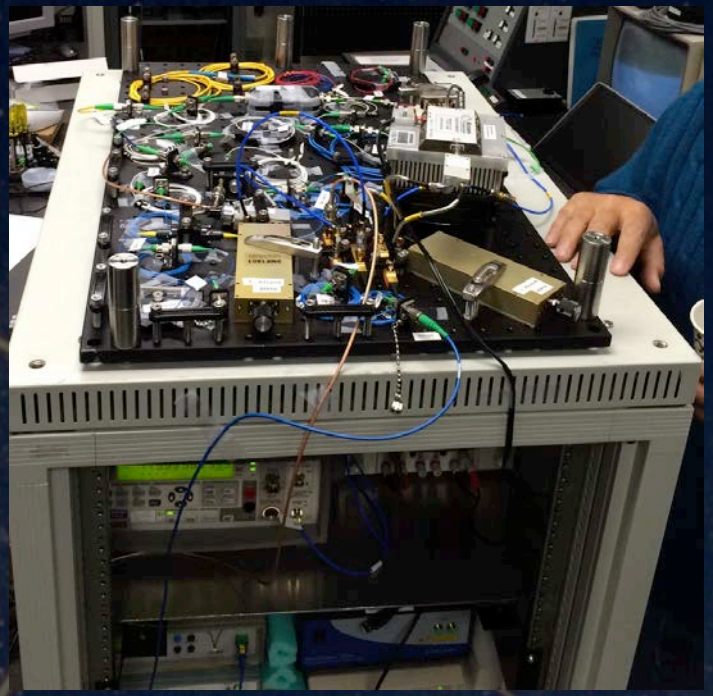
- ✧ Long wavelength emission source
- ✧ Faint
- ✧ Rotator Dependent
- ✧ Confirmed dust on dewar entrance window
- ✧ Attempts to clean window were unsuccessful & introduced cracks

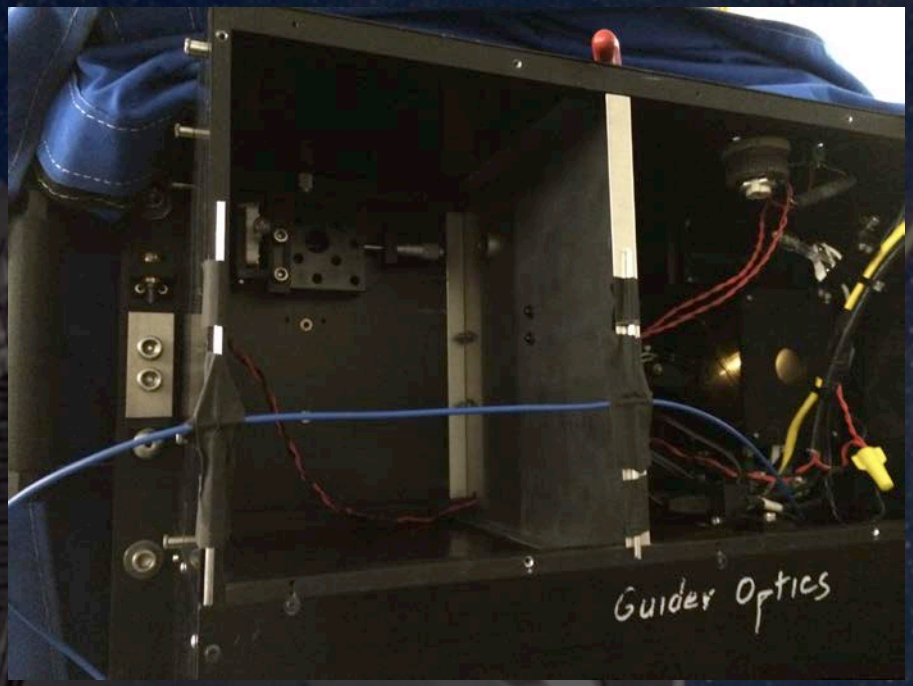
➢ NIRSPEC being serviced to replace window with clean spare

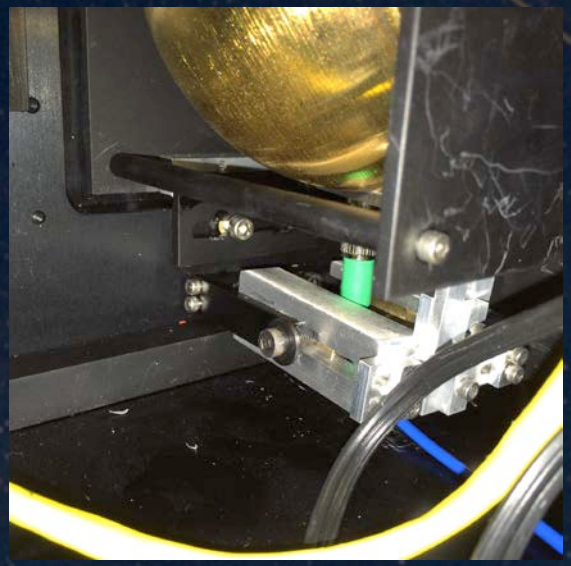


NIRSPEC Laser Comb Tests

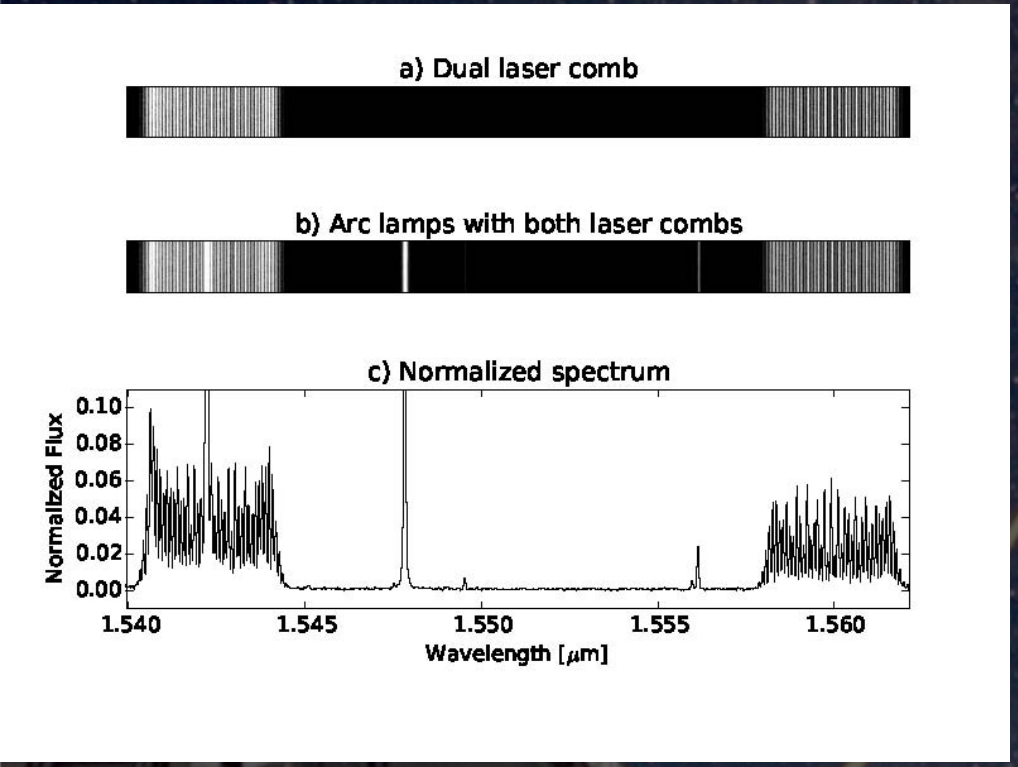
- JPL laser comb signal generated in K2 control room
- Fiber carries signal up to NIRSPEC and into the Cal Unit
- Signal is injected into the Integrating Sphere of NIRSPEC





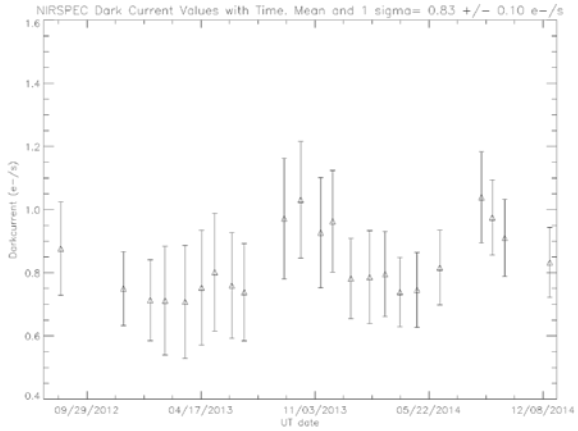


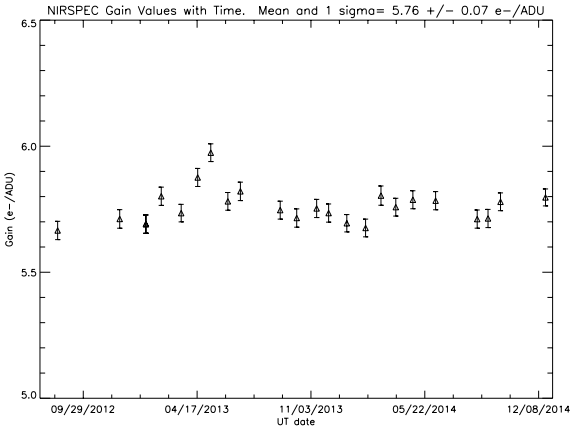
Dual laser comb lines Successfully imaged onto the NIRSPEC Detector

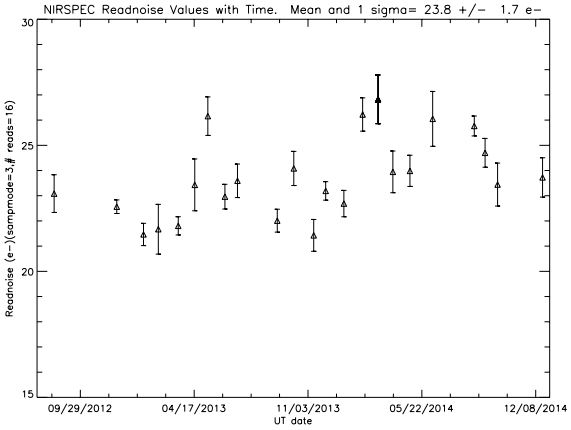


- Comb lines resolved with echelle grating: 1.5 A separation
- Power is balanced across both combs for high precision wavelength calibration
- Arc Lamps can be imaged simultaneously

Science Detector Characteristics continued tracking







Dark Current:
0.83 +- 0.10 e-/s

Gain:
5.76 +- 0.07 e-/ADU

Readnoise:
23.8 +- 1.7 e-

Proposed NIRSPEC Upgrade

- New Science detector (SPEC), H2RG (2048 x 2048)
  - Dark Current reduction (0.8 e-/s -> 0.01 e-/s)
  - Readnoise reduction (23e- -> 4.5e-)
  - Increased QE
  - Smaller pixels (27um -> 18um)
  - ❖ > 6.5 times reduction in time to achieve same SNR
- New Slit Viewing Camera Array (SCAM), H1RG (1024 x 1024)
  - Long λ sensitivity, L & M band on-slit guiding
  - Precise slit positioning at long wavelengths
  - Science quality images with new SCAM
- New Control Electronics
  - Replace obsolete Transputer control with network based control architecture
  - Share common spares pool with MOSFIRE and OSIRIS
  - New Temperature controllers for SPEC and SCAM

LRIS

Luca Rizzi

Red side grating

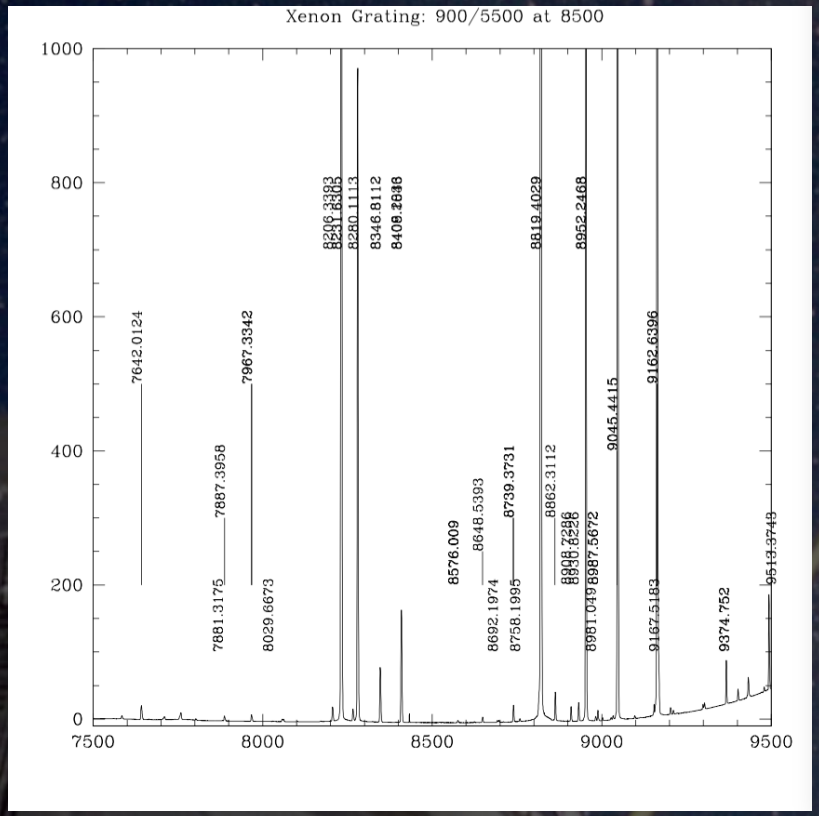
- Observers reported large (> 100 pixels) shifts in the positioning of the red side grating tilt
- The problem was traced to uncertainties in the absolute position of the tilt encoders when the grating is inserted

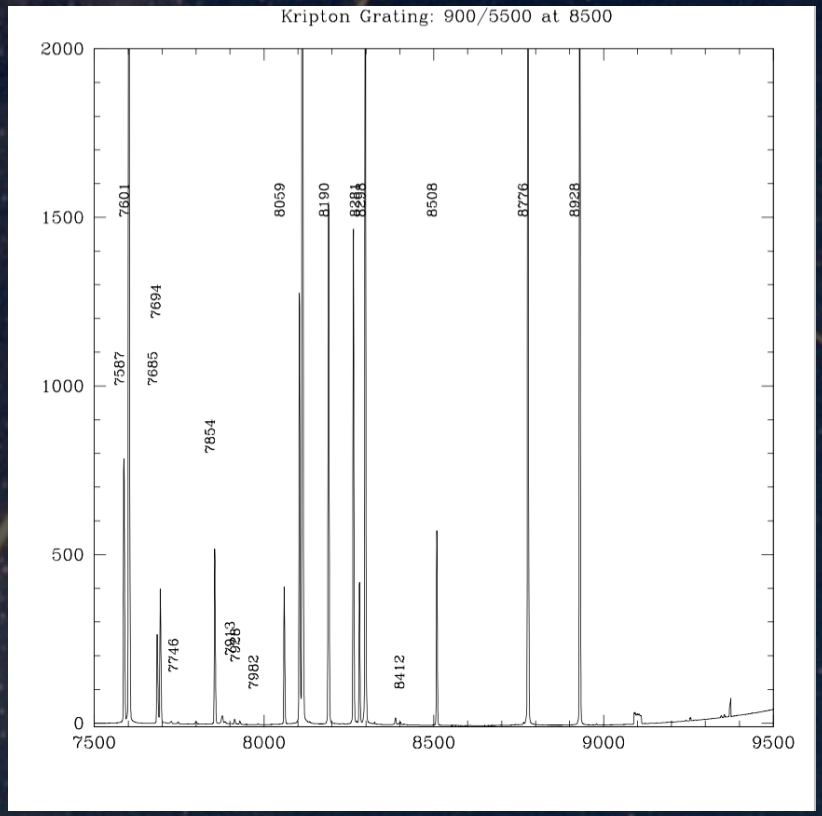
Red side grating

- We fixed the problem by adding a forced homing of the stage when the grating is inserted. Overhead is minimal (about 60 seconds) and only happens on grating changes
- No problems reported since the fix was introduced

New LRIS calibration system

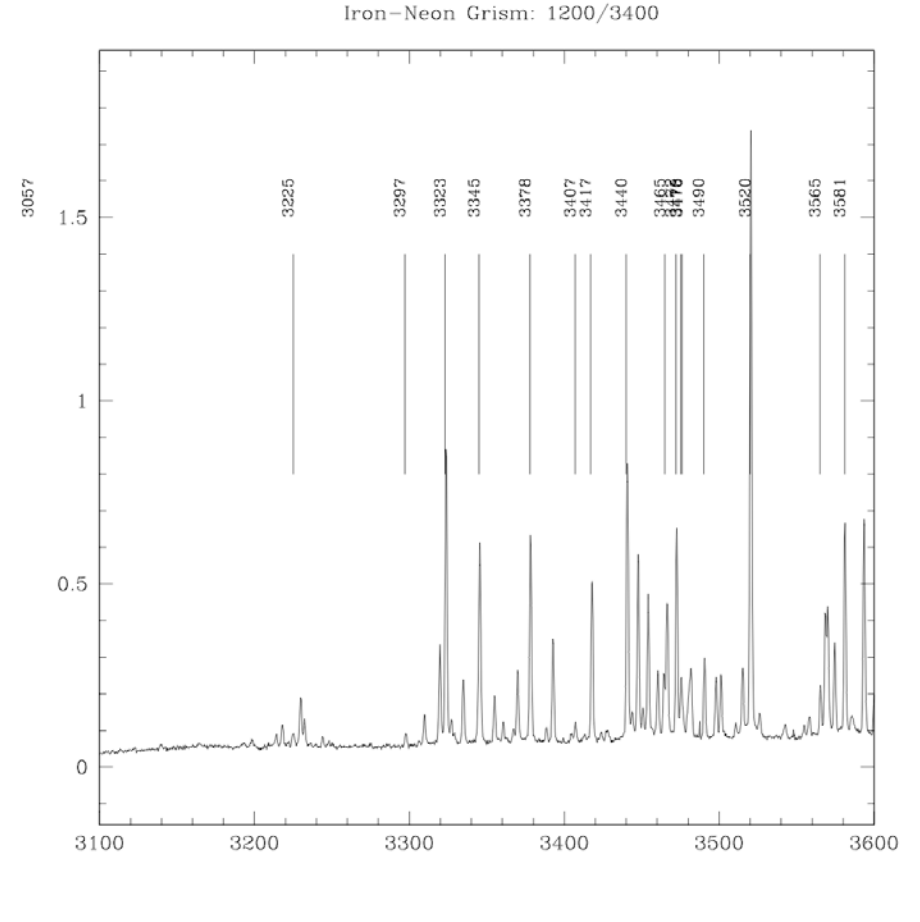
- Calibration available for Kr and Xe





New LRIS calibration system

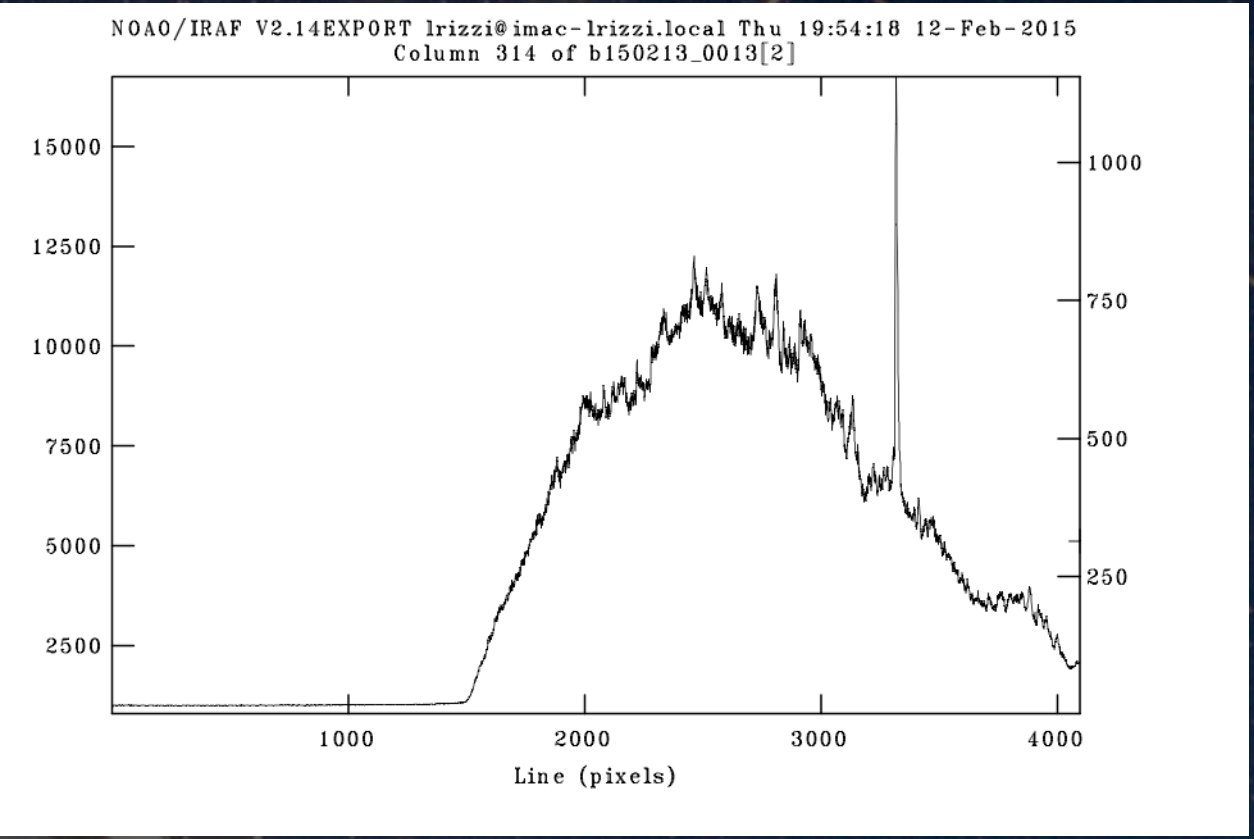
- Calibration available for Fe-Ne



New LRIS calibration system

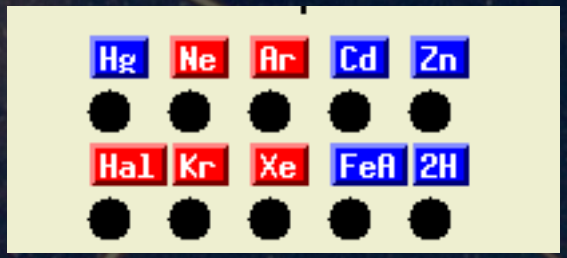
- Flat field spectrum for Deuterium lamp

400/3400
30 seconds



New LRIS calibration system

- New XLRIS
- New Calibration gui



Data Reduction Pipelines

Luca Rizzi

Keck I DRPs

Instrument	DRP/DRT	Author(s)	WMKO support	KOA DRP status
HIRES	MAKEE	T. Barlow	No	Used for processing
	HIRES redux	J. Prochaska	No	
LRIS	Low-Redux	J. Hennawi, S. Burles, J. Prochaska	No	Raw data only
	Starlink+Pamela+Molly	D. Levitan	No	
	Kelsonware	D. Kelson	No	
MOSFIRE	Mosfire DRP	N. Konidaris, C. Steidel	Support and Development	Raw data only
OSIRIS	OSIRIS DRP	OSIRIS DRP team, OSIRIS Keck Support Team	Support and Development	Used for processing

Keck II DRPs

Instrument	DRP/DRT	Author(s)	WMKO support	KOA DRP status
DEIMOS	Deep2 pipeline	DEEP2 team	No	Raw data only
	IDL tools	P. Capak	No	
	Kelsonware	D. Kelson	No	
ESI	ESIRedux	J. Prochaska	No	Raw data only
	MAKEE	T. Barlow	No	
NIRC2	KOA-only tools developed in house	H. Tran, KOA	N/A	Used for processing
NIRSPEC	WMKONSpec	Keck NIRSPEC support team	?	Under development
	REDSPEC	UCLA IR lab	No	

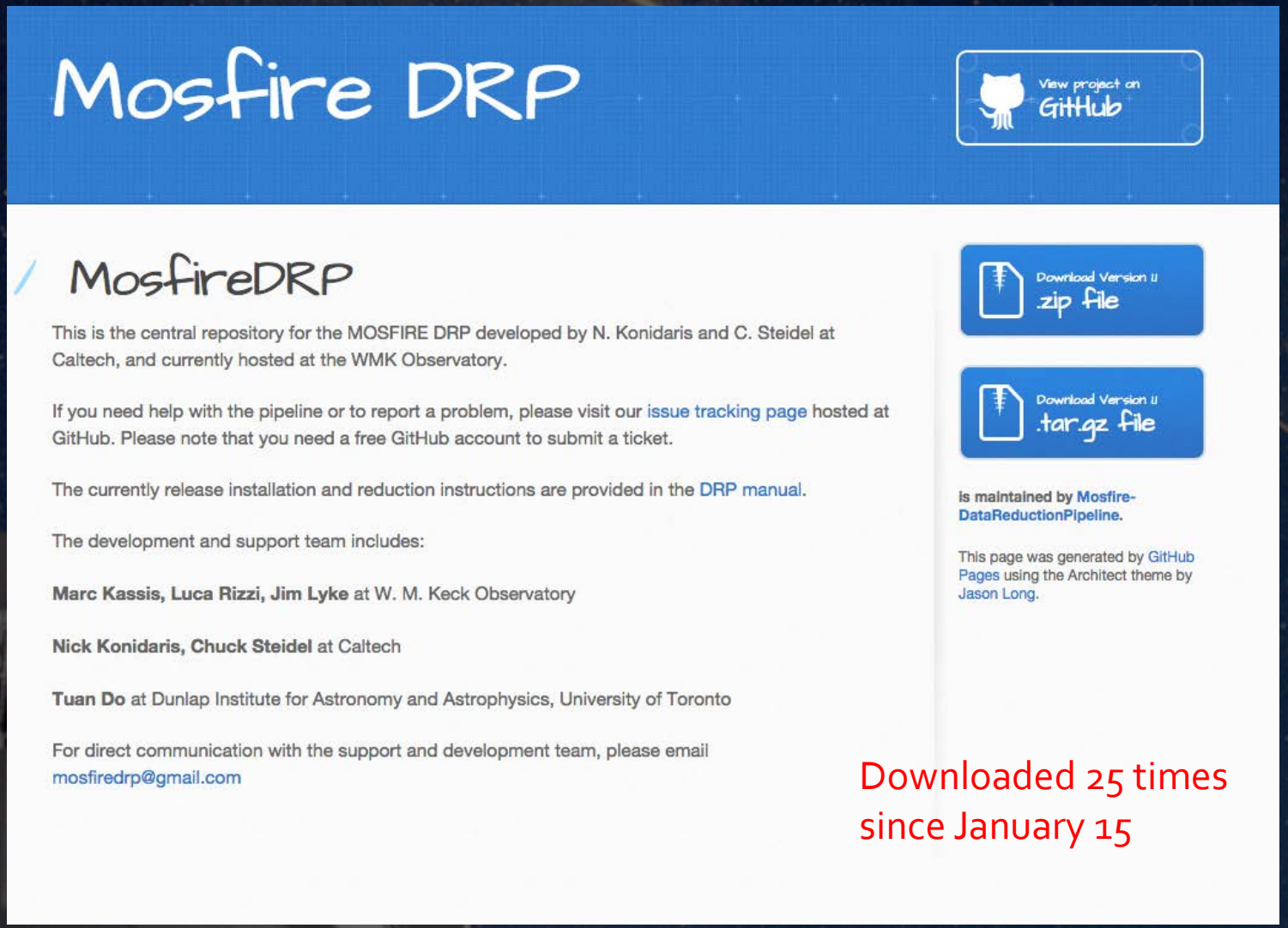
MOSFIRE DRP

Luca Rizzi

MOSFIRE pipeline at WMKO

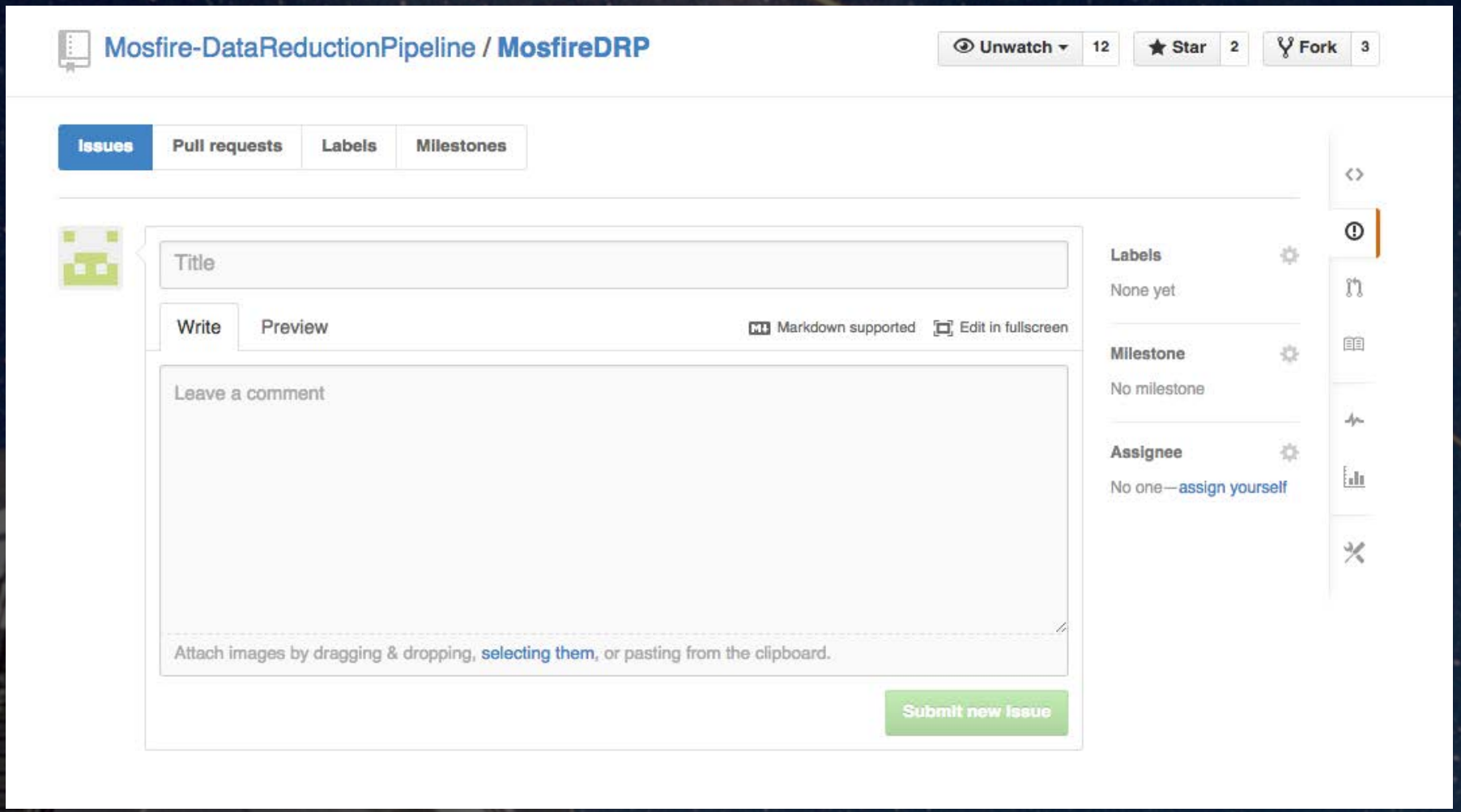
- The transfer of responsibility for the pipeline project to WMKO is complete
- Distribution, support and development are carried out in house, with valuable contributions from the original team and community members

Pipeline distribution

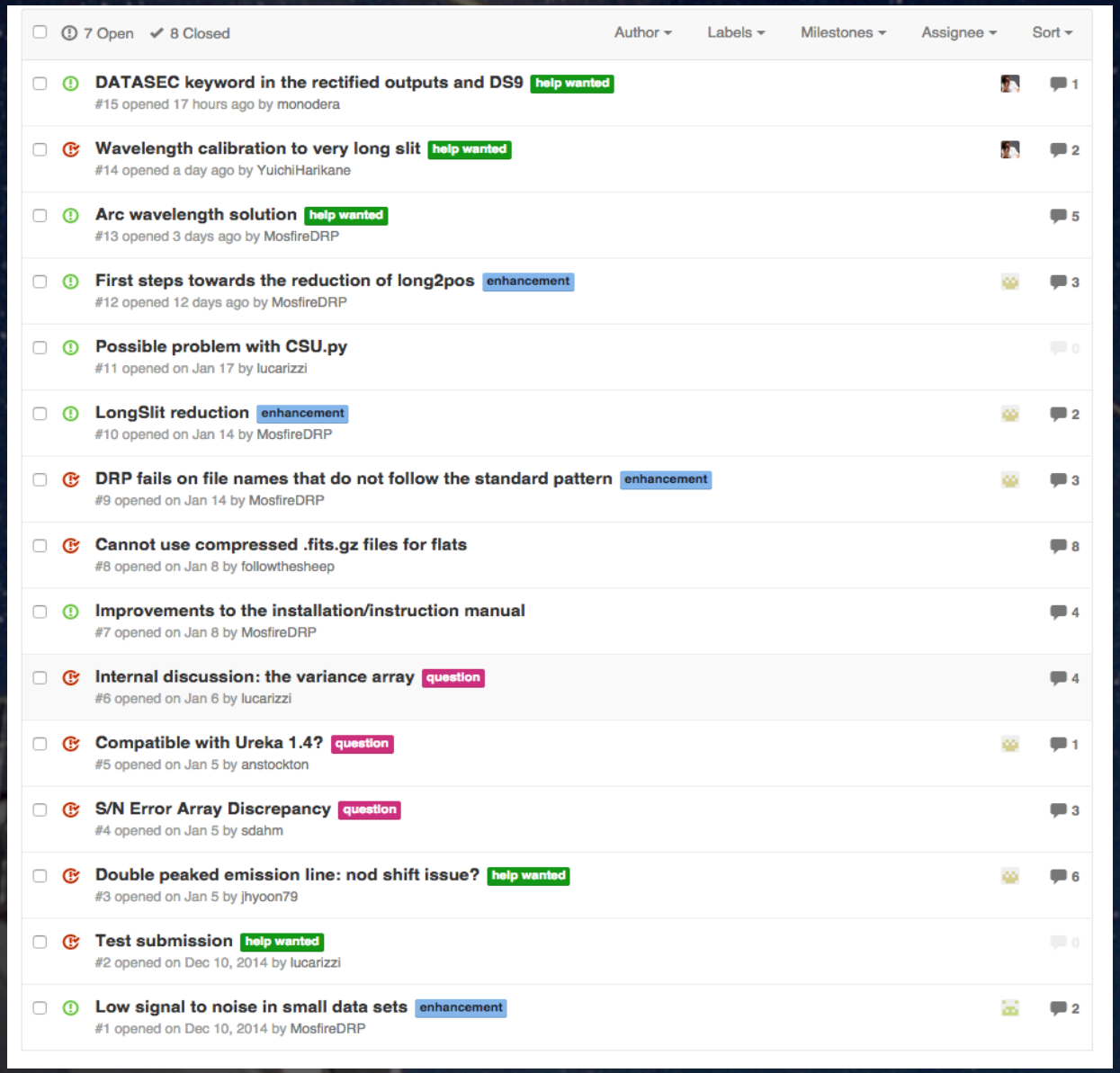


Downloaded 25 times since January 15

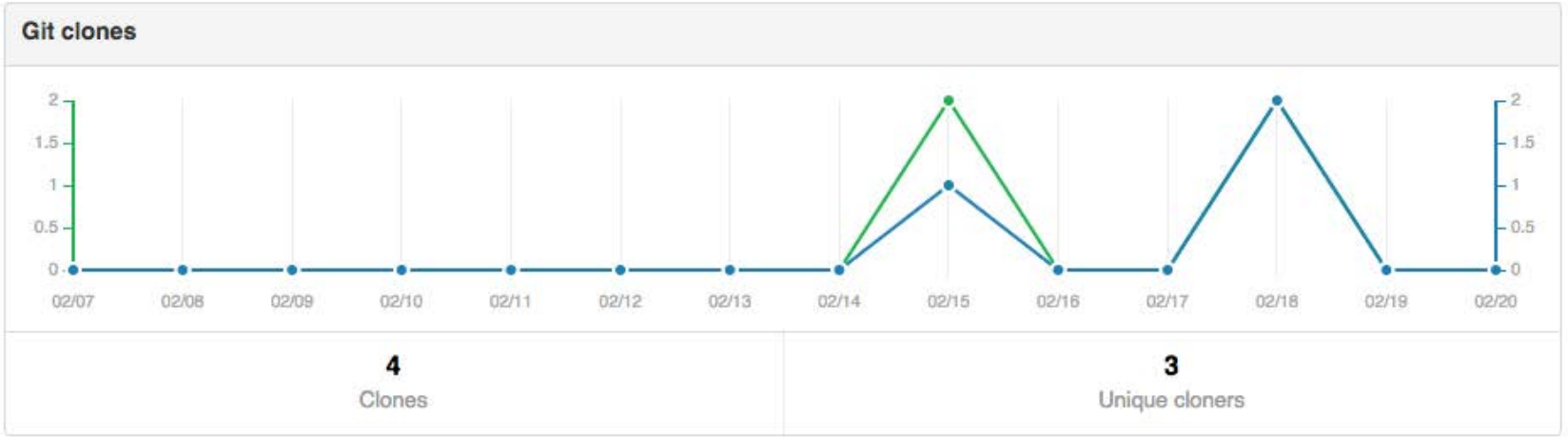
Pipeline support

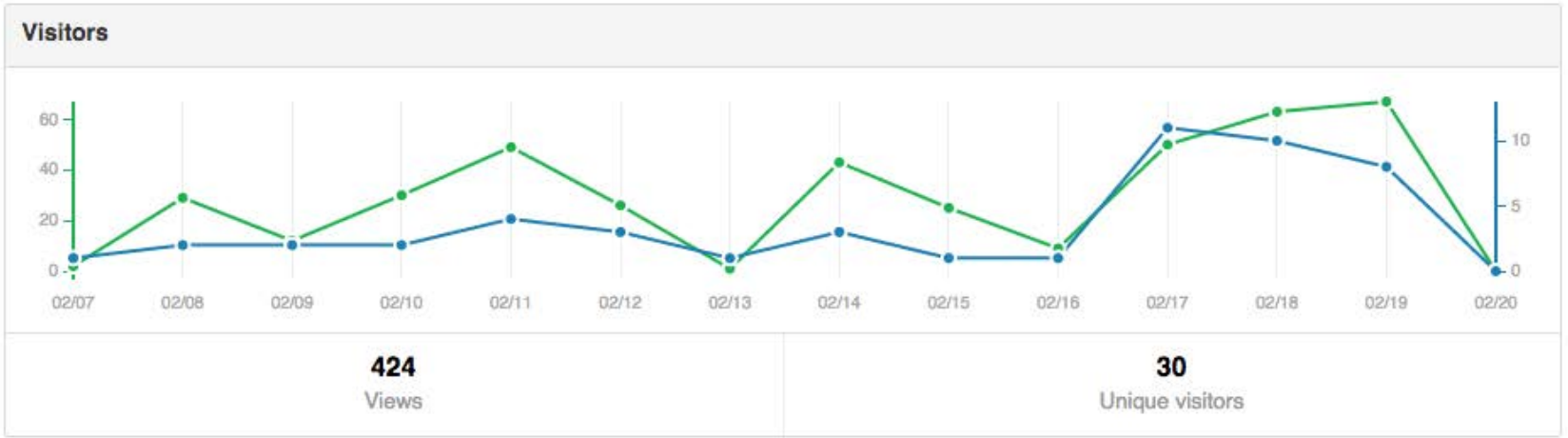


Pipeline support



Pipeline development

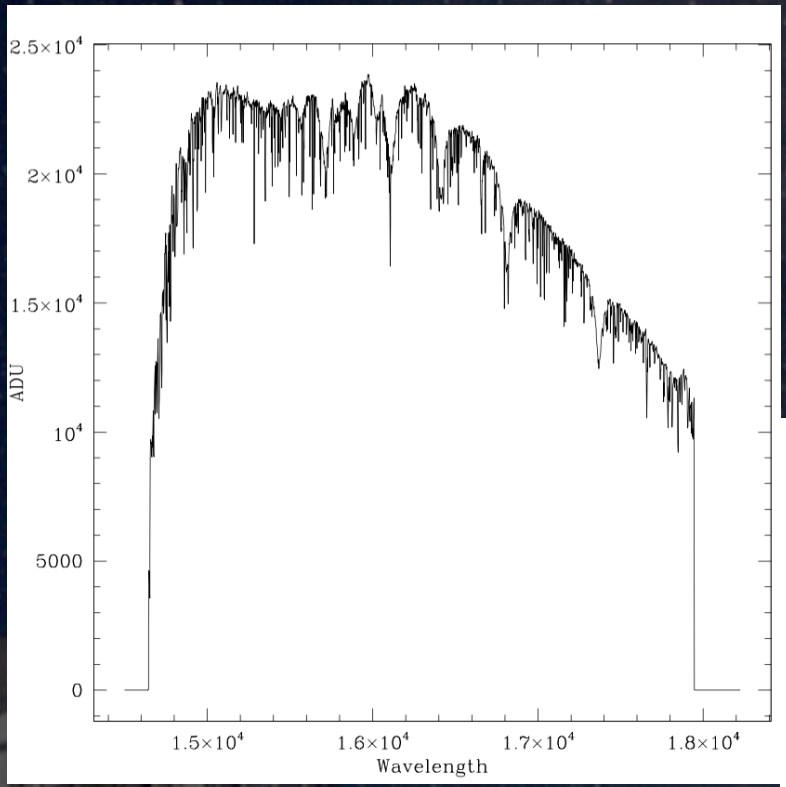




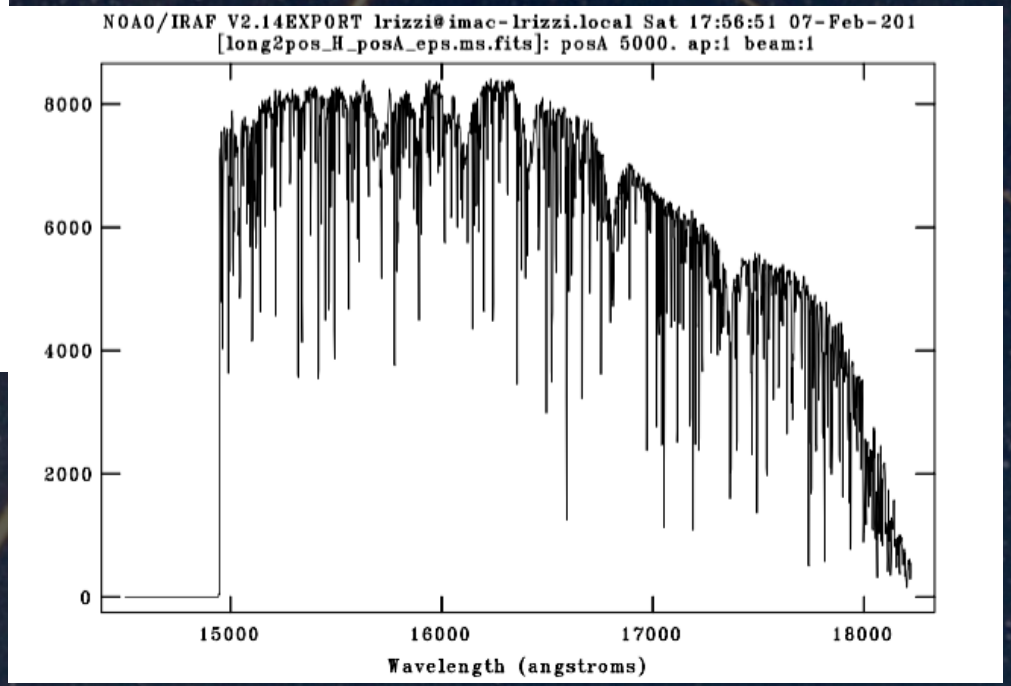
Pipeline development

- Formal Version 1.0 released on December 16
- Longslit reduction developed and being tested
- Long2pos developed for non-spectrophotometric case and being tested
- Expected release date: May 2015

Pipeline development



Longslit observation of HIP13917



Long2pos observation of HIP65210

OSIRIS

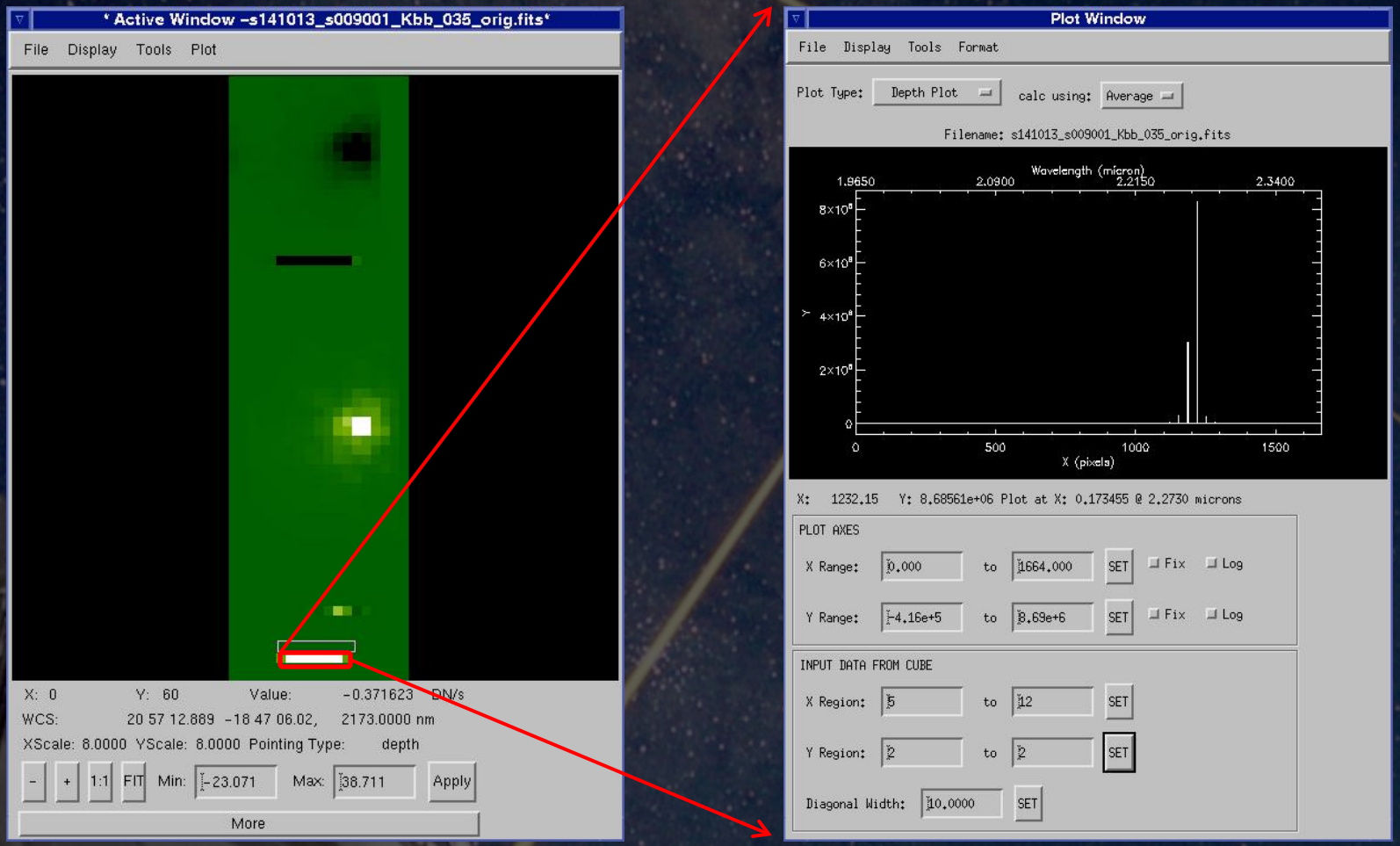
Jim Lyke

OSIRIS DRP Issues

- Bad spaxels appear to be caused by recmats
- Spurious pixel values in recmat spectra
- Two current paths of investigation
  - Poor cosmic ray rejection
  - Remove spurious recmat values
- Other paths
  - “bad” pixel handling when building recmats

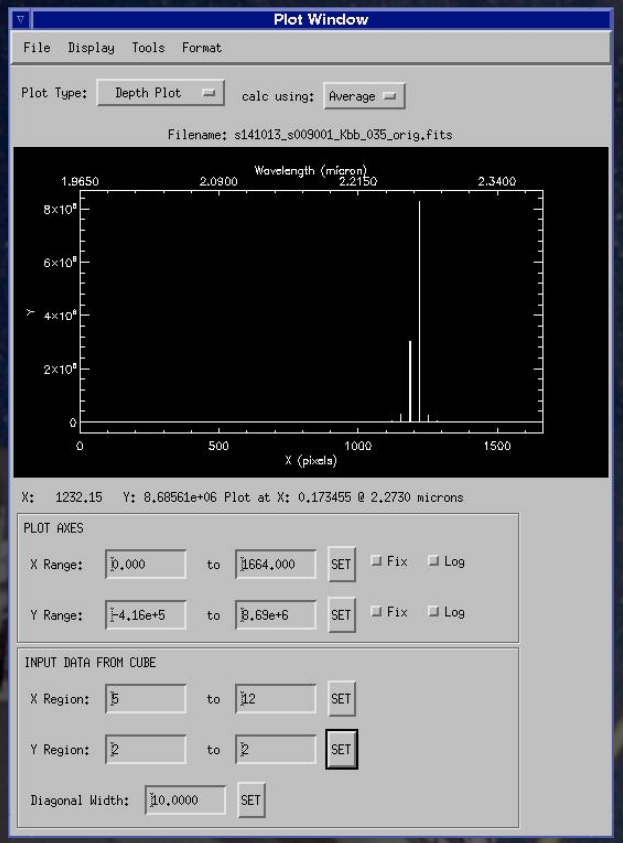
OSIRIS DRP Issues

Bad Spaxel Spectra

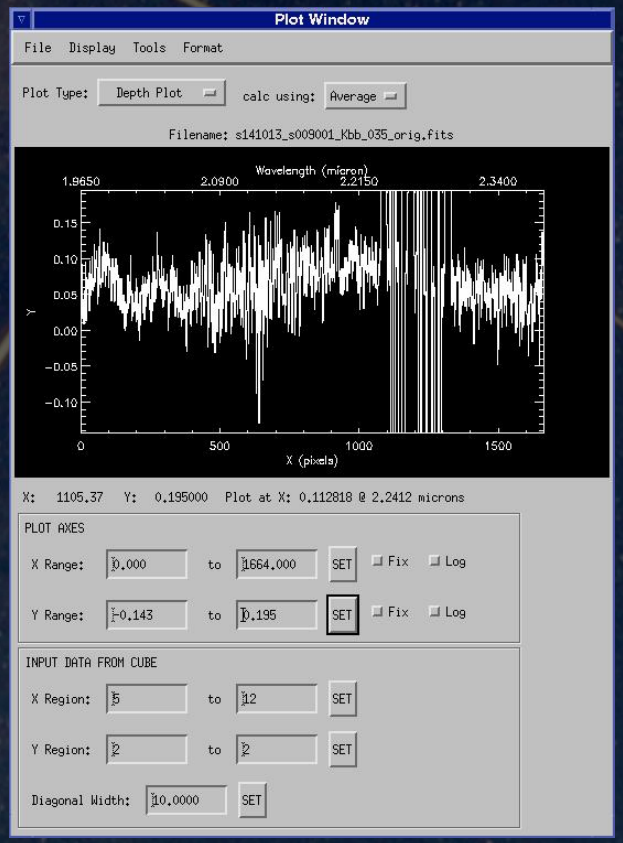


Badness is Localized

Full Scale

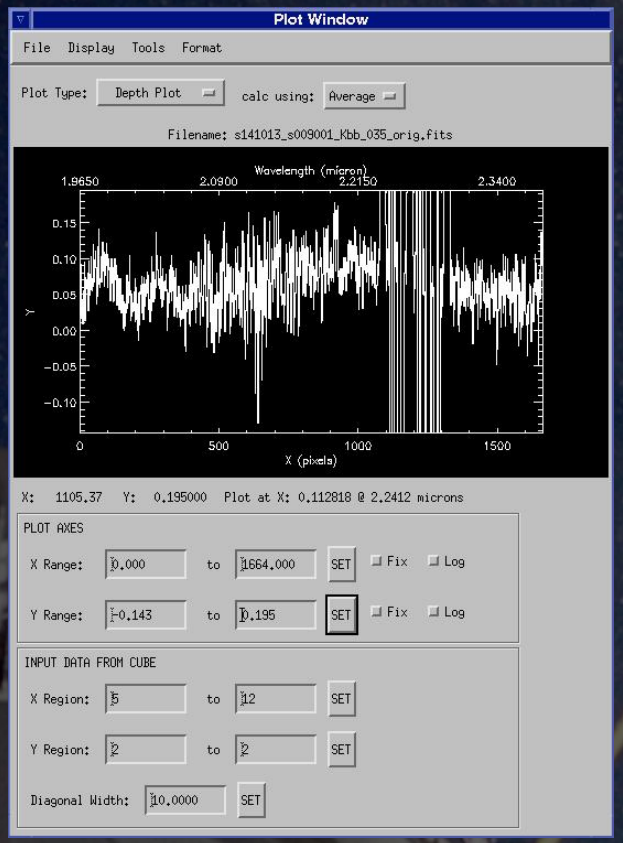


Y-axis zoomed

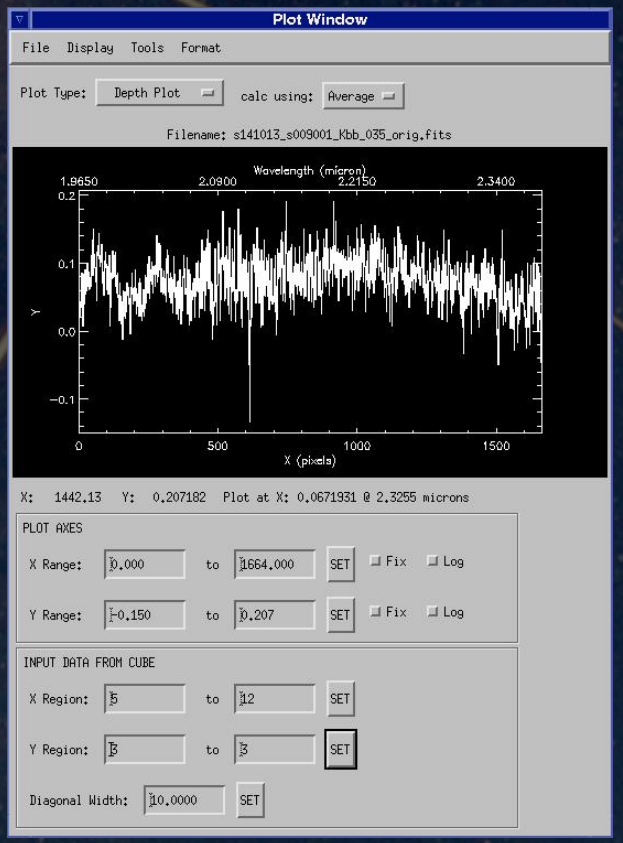


Spectra are Good

Bad Spaxels



Neighboring row

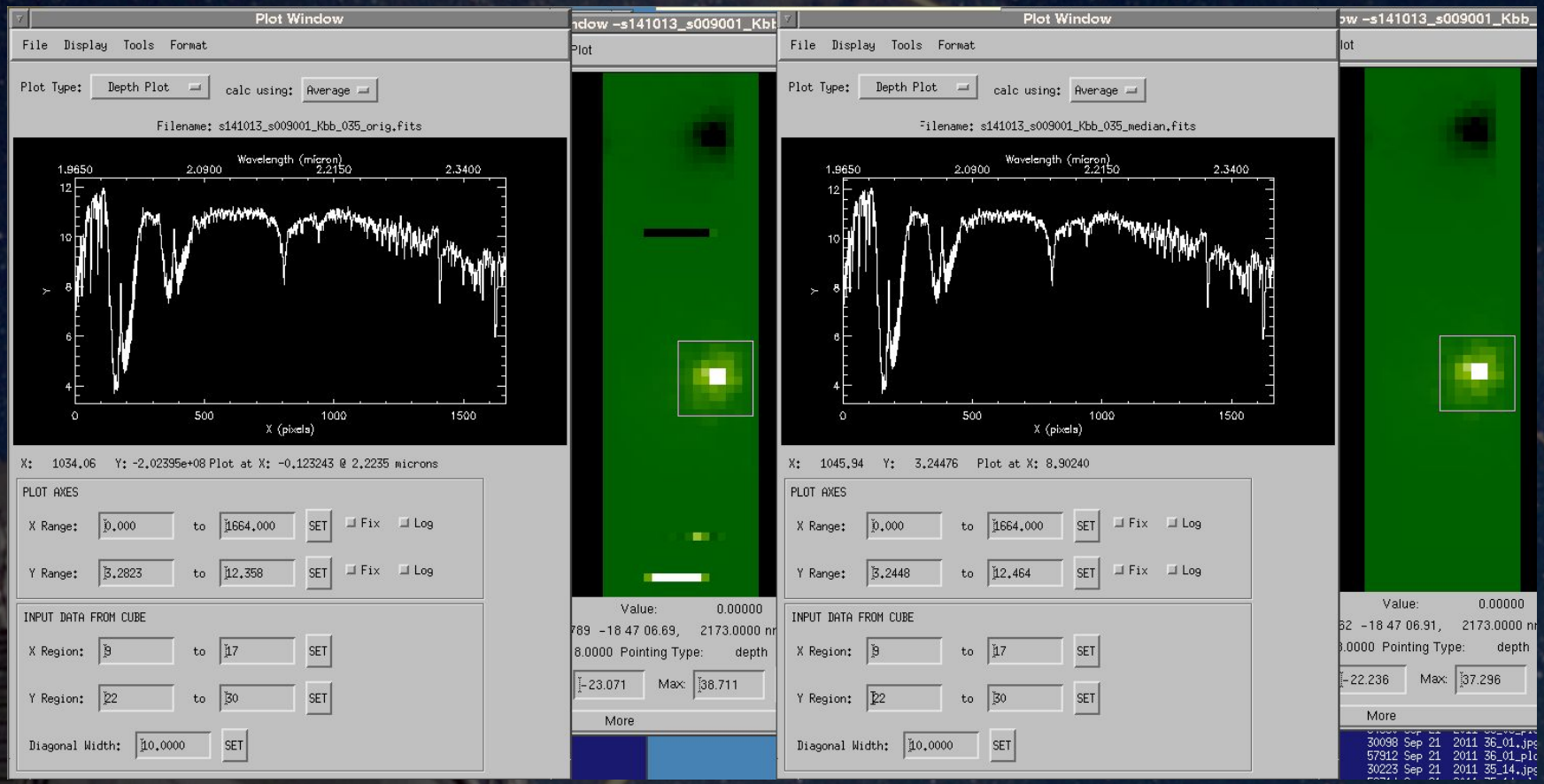


Poor CR Rejection

- Avoid with median of scans
  - Take 5 spectra per lenslet mask position vs. 1
  - Turn off DRP's CR rejection
  - Build Recmat

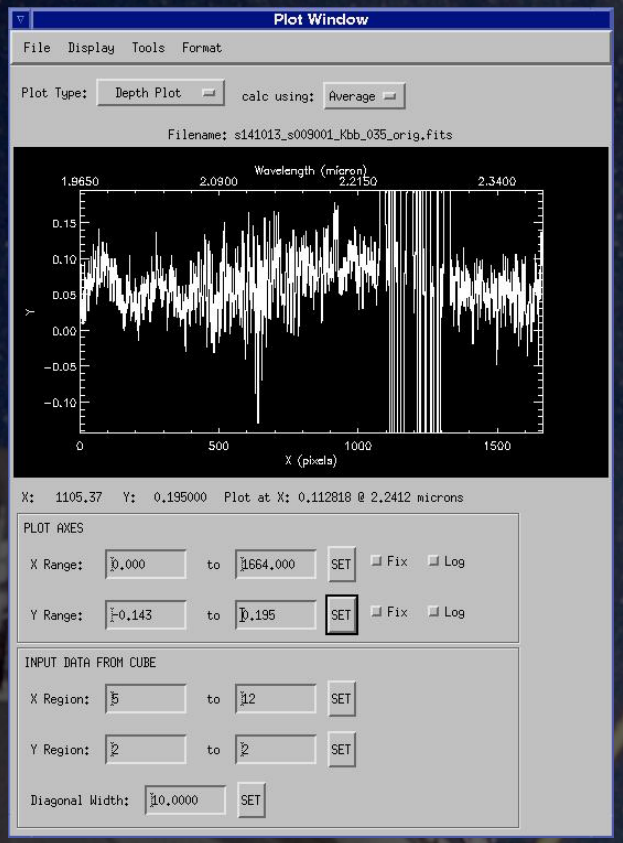
Pros	Cons
• Straightforward • Removes badness before it begins	• Must redo cals • Cannot fix older recmats

Median Scan Method

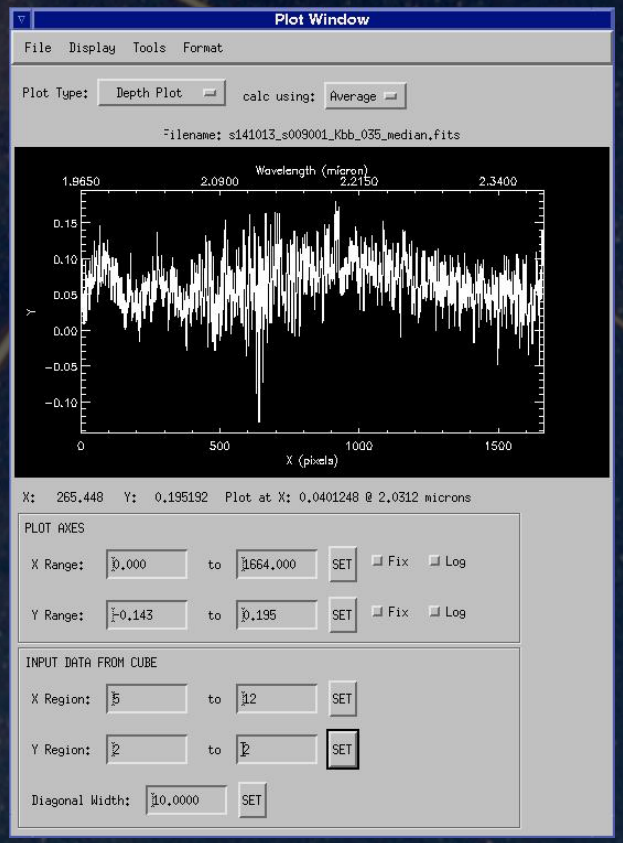


Median Results

Before

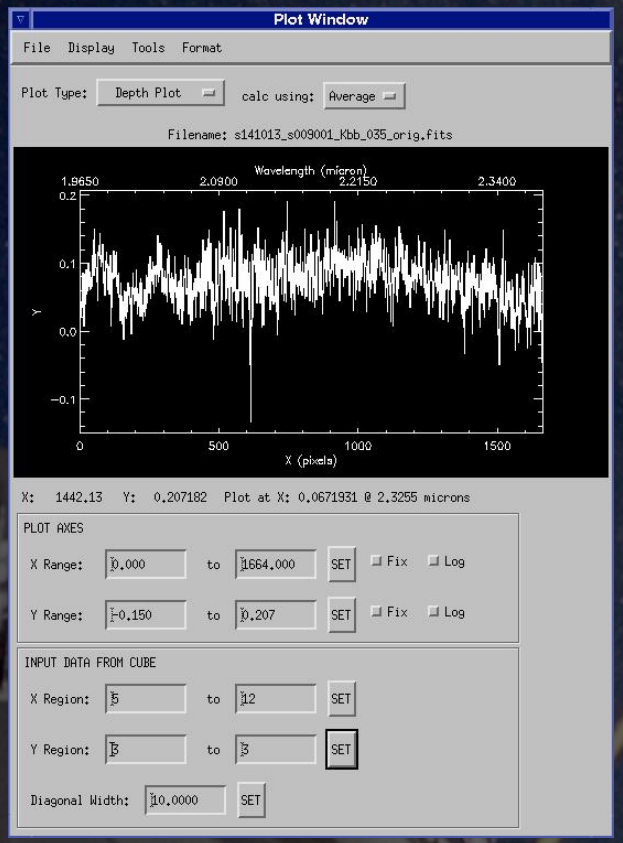


After

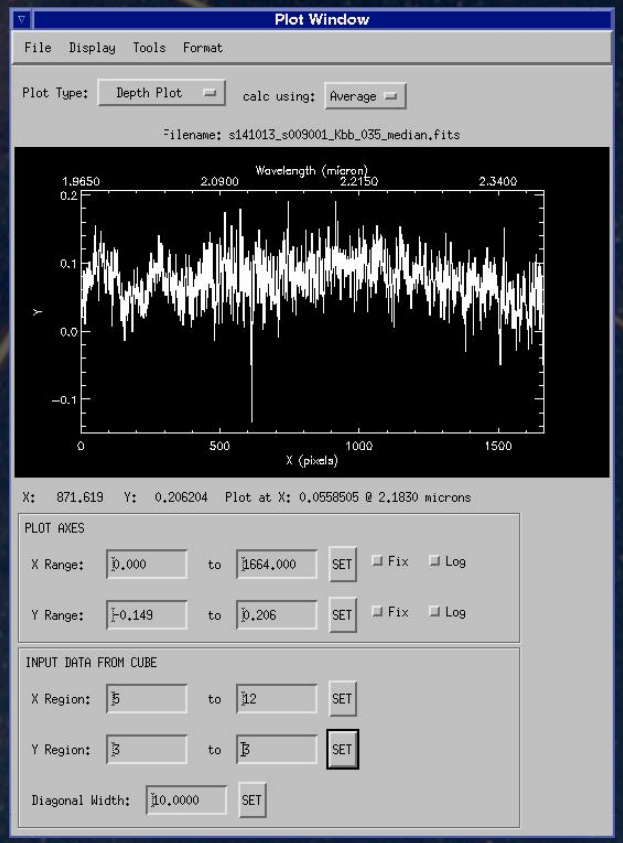


Median Results

Neighbor before



Neighbor after



Remove Spurious Values

- Must define spurious
  - Pixel values above 0.8 (mkrecmatrx_ooo.c)
- Create new (clean) version of recmat

Pros

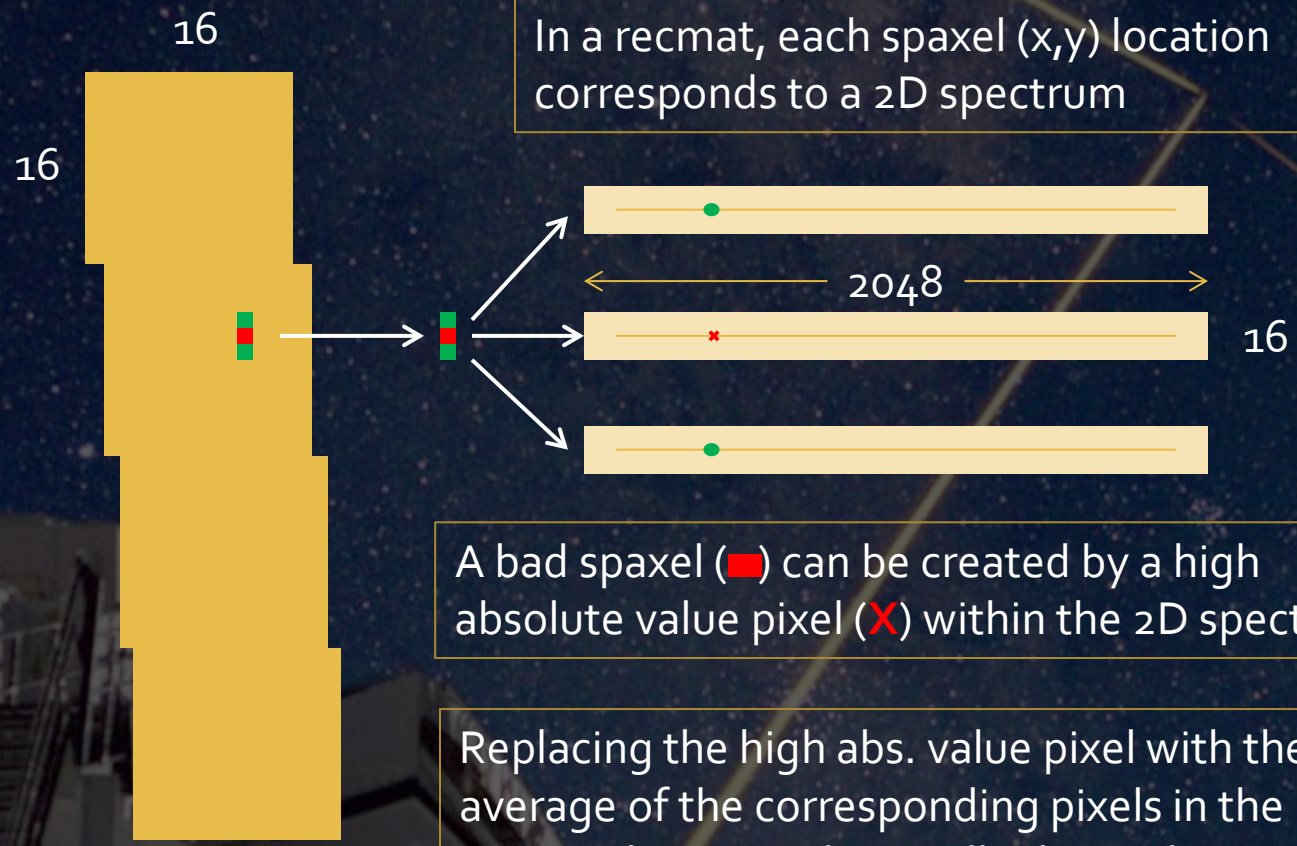
- Fast
- Fixes even old recmats
- Similar to what DRP does now

Cons

- Must be sure recmat pixel is bad

OSIRIS Clean Recmat

Lenslet geometry

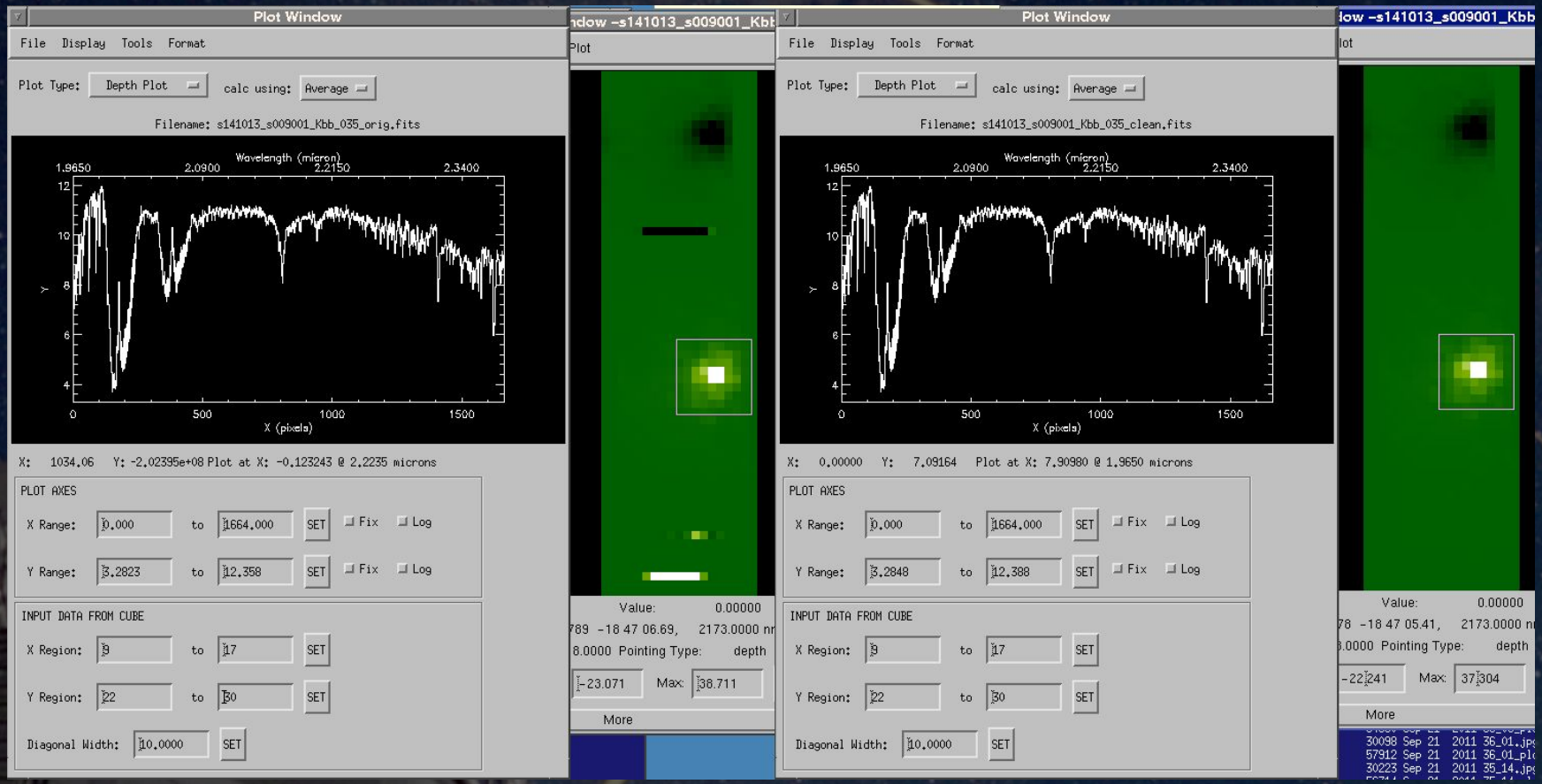


In a recmat, each spaxel (x,y) location corresponds to a 2D spectrum

A bad spaxel (■) can be created by a high absolute value pixel (X) within the 2D spectrum

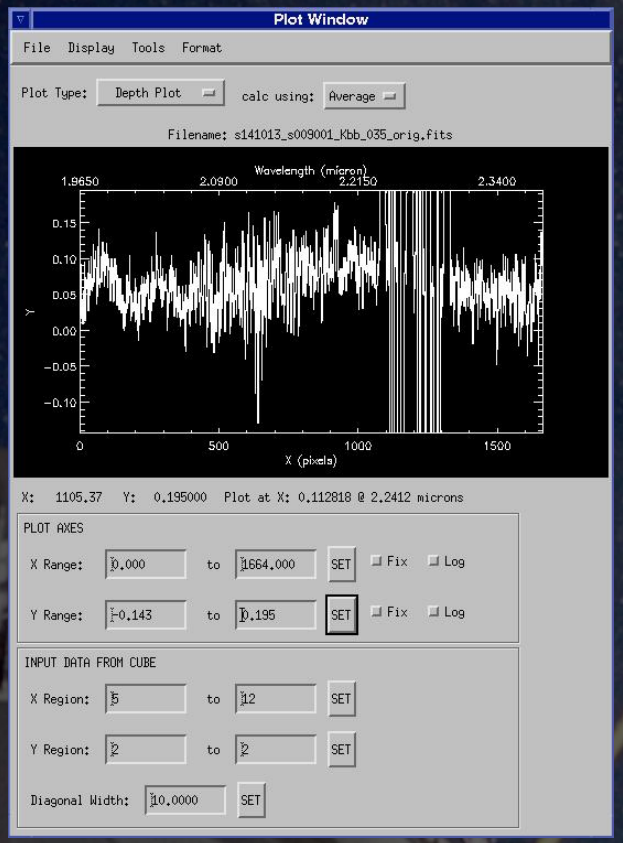
Replacing the high abs. value pixel with the average of the corresponding pixels in the surrounding spaxels (●) will "clean" the recmat

OSIRIS Clean Method

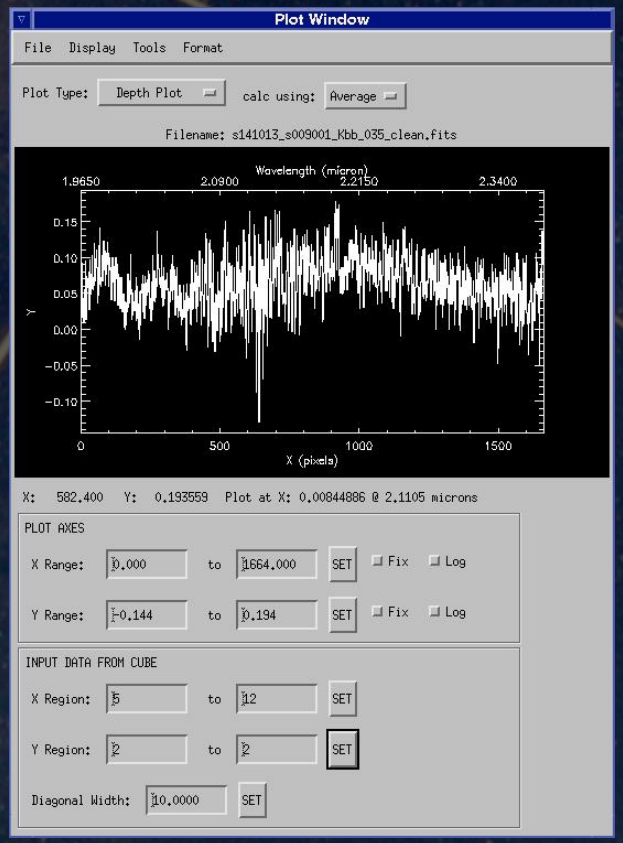


OSIRIS Clean Results

Before

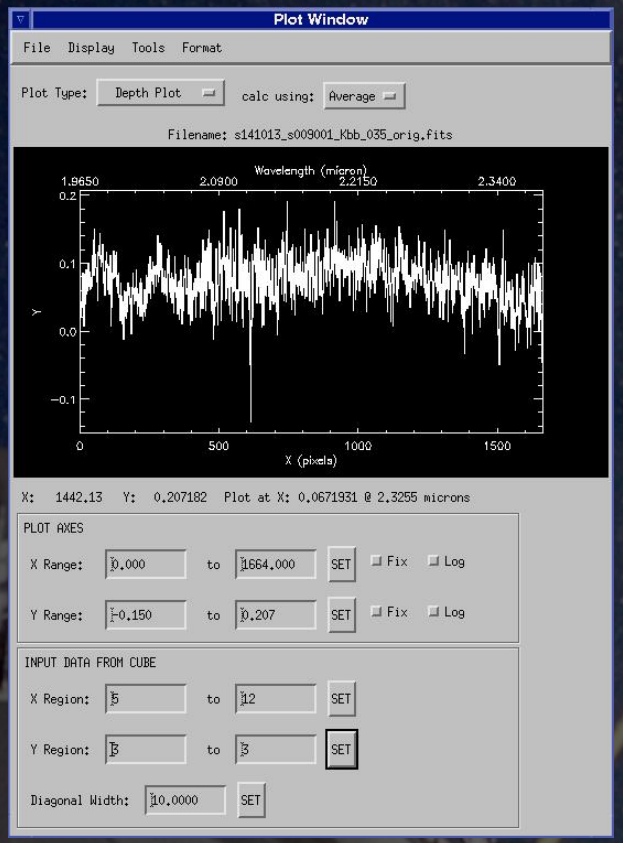


After

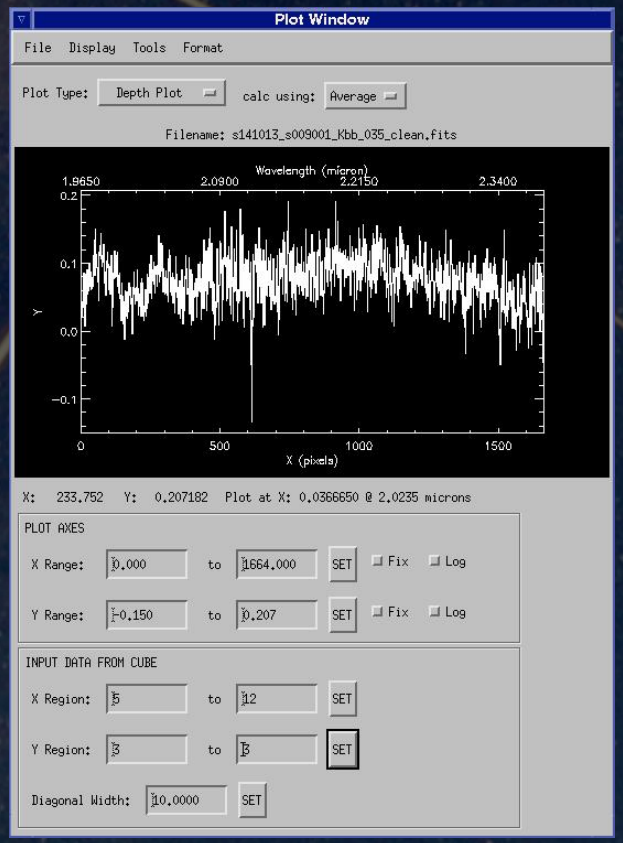


OSIRIS Clean Results

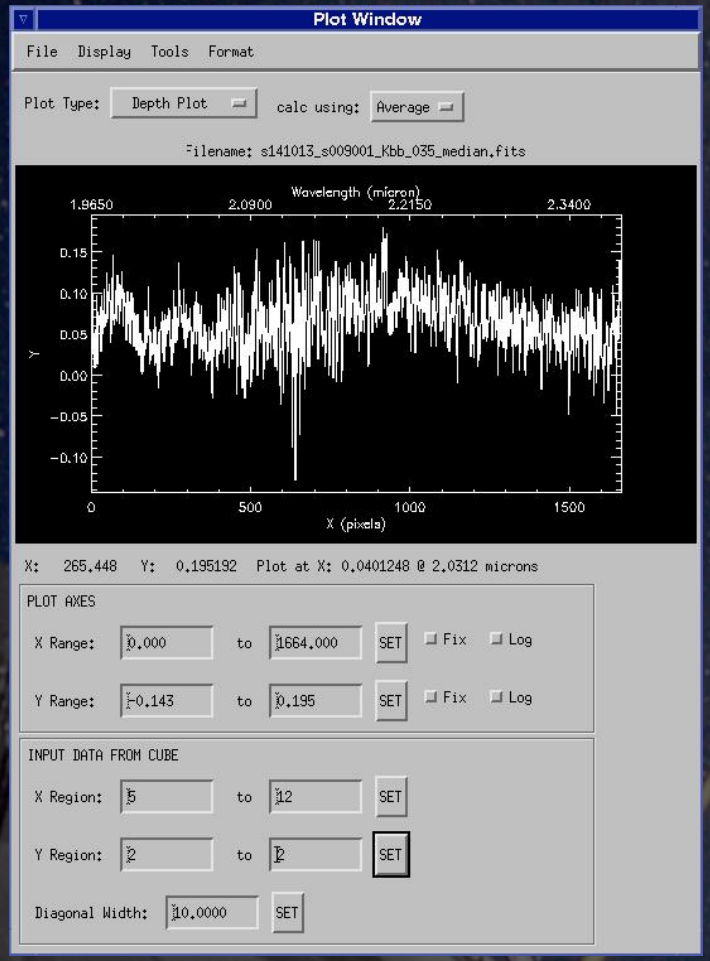
Neighbor before

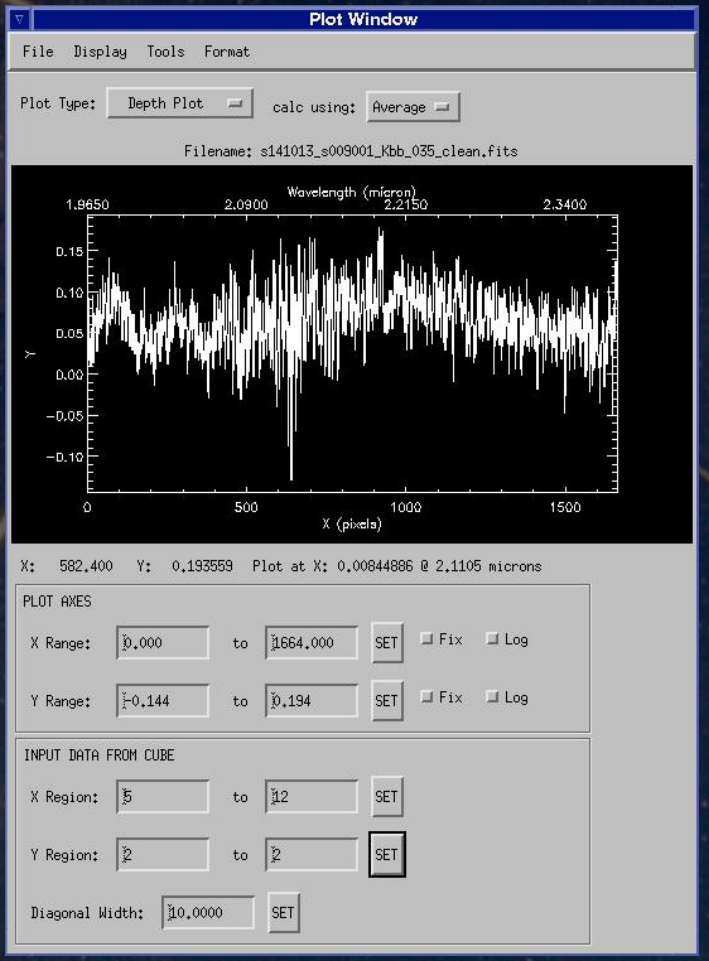


Neighbor after



Median vs. Clean





Next Steps

- Bad pixel handling in building recmats
  - Values outside the "normal"
    - Forced to zero
    - Discontinuities in recmat spectra
  - Try the "clean" method at the beginning
- Median scans for all modes
  - 2 months

OSIRIS Upgrades Update

SPEC: NSF ATI

PI: Larkin, Co-I: Ellis, Adkins

- H2RG in hand at UCLA
- Focus mechanism nearing design completion
- Detector controller and server software in development
- First light Jan 2016

IMAG: Moore Foundation

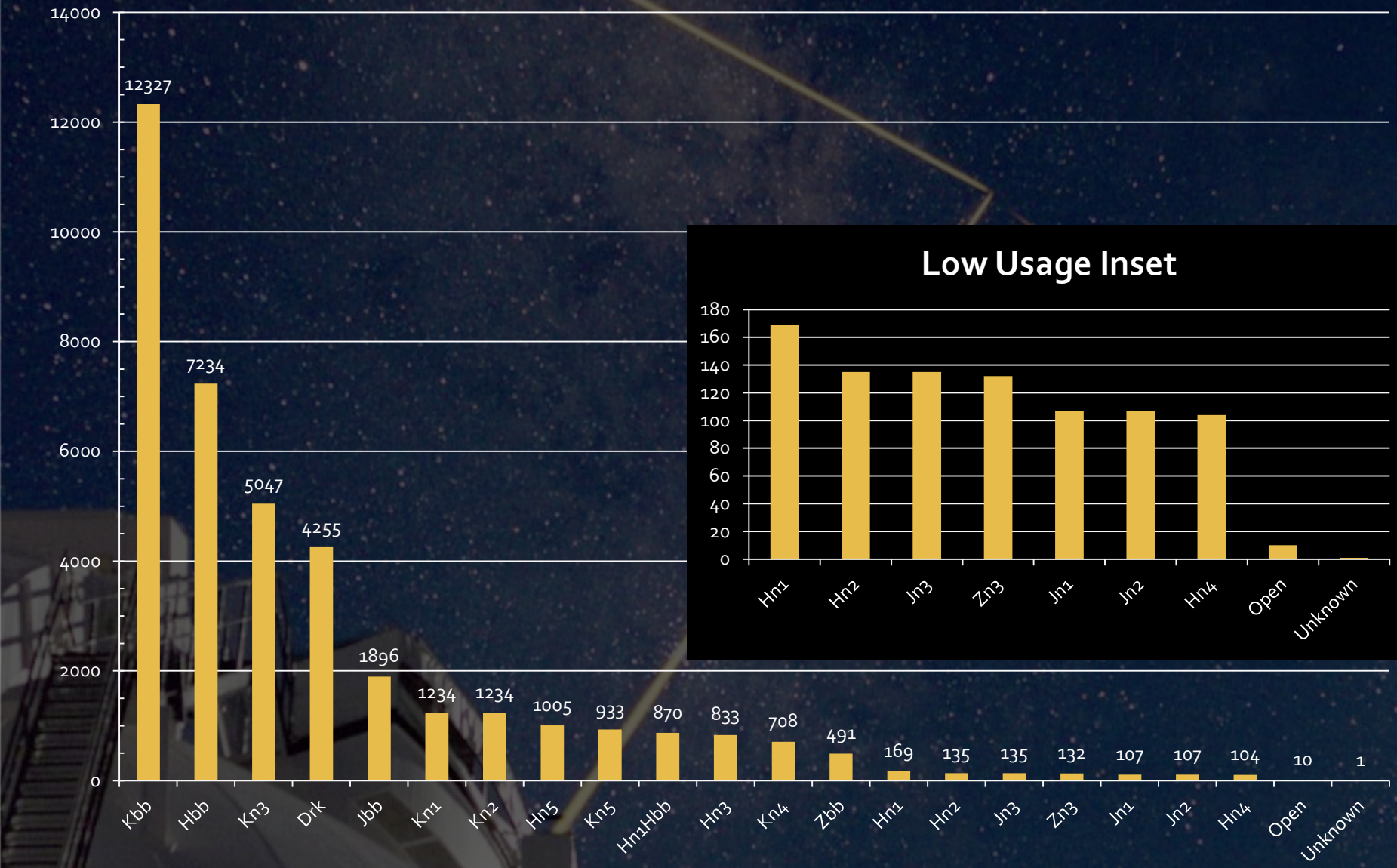
PI: Fitzgerald/Ghez

- H2RG in hand at UCLA
- 10 mas pixels, 20" FOV
- Optical design nearly finalized
- Design review July 2015
- Installation late August 2015

OSIRIS Imager Survey

- Sent to all OSIRIS users since 2010
- Questions
  - Shall we upgrade imager filters?
  - If so, which ones shall we remove?
- Results
  - Ability to observe bright targets (1% filters)
  - Most support MKO broadbands (YJHKs/Kp)
  - Few do not wish to duplicate NIRC2
  - One suggestions to match TMT IRIS filters

OSIRIS Imager Filter Usage
38967 files at night with OSIRIS the selected instrument



Low Usage Inset

NIRC2

Hien Tran

Vor

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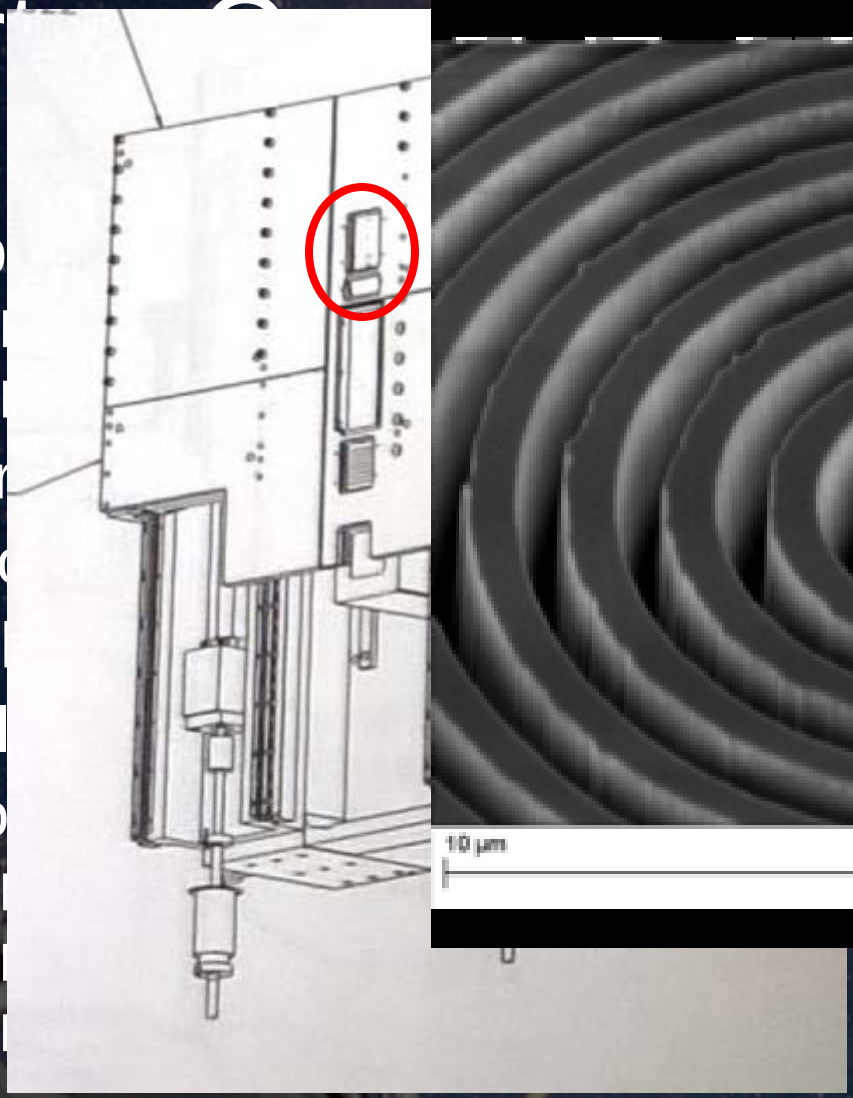
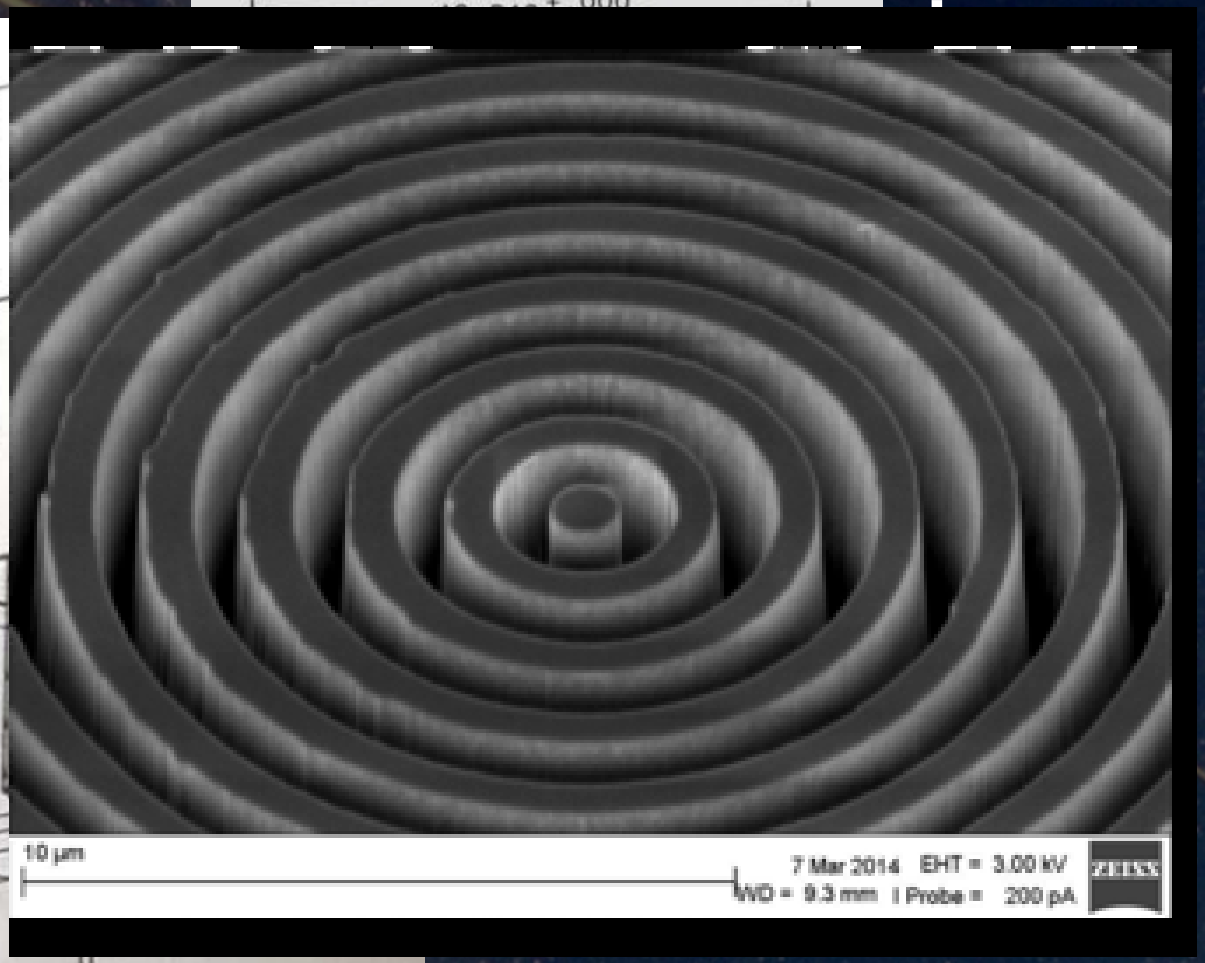


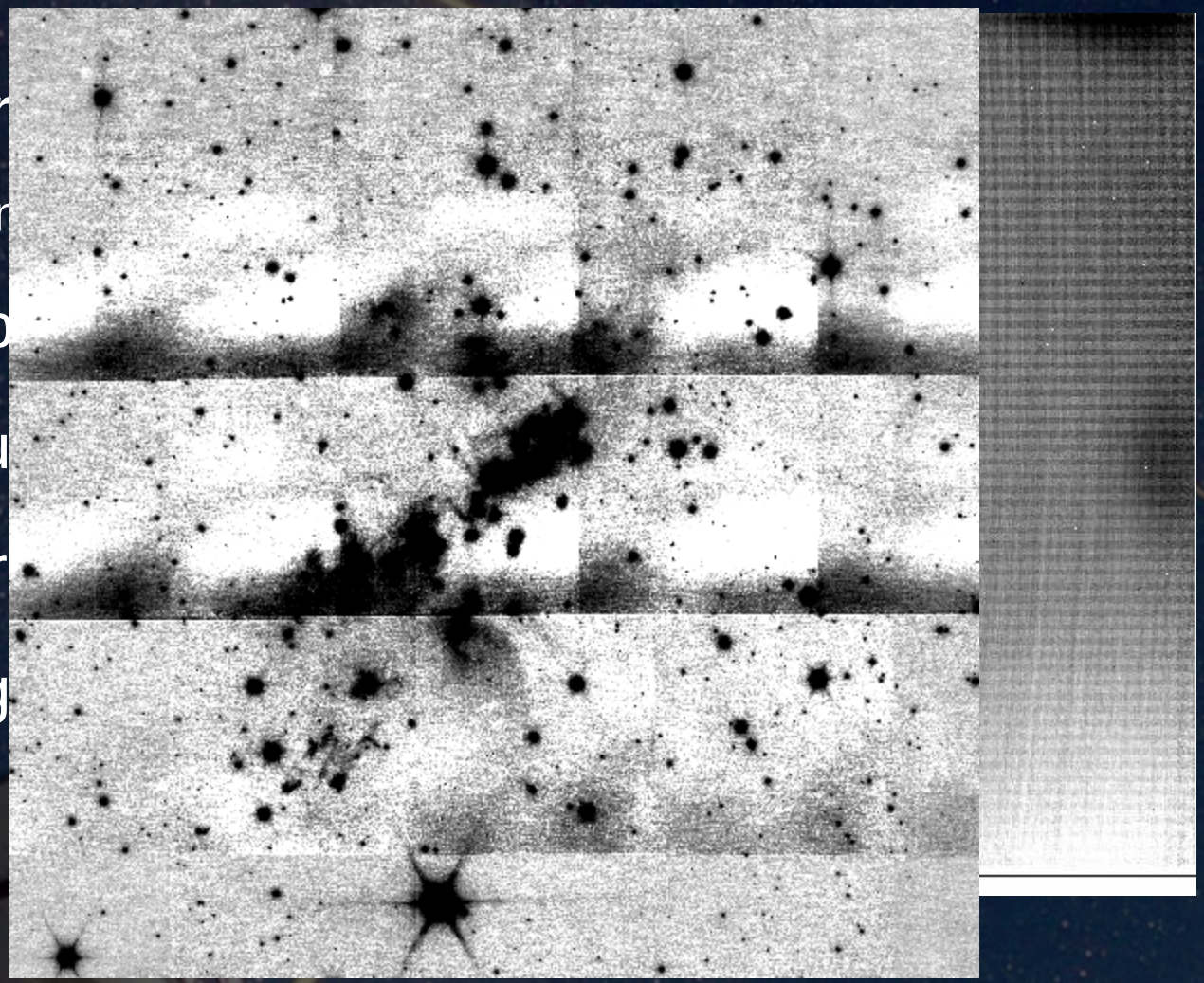


Vortex Coronagraph Installation

- L-band vortex coronagraph
  - Planned for Mar. 17, 2015
  - NIRC2 now being warmed
- Service mission anticipated to take 1 day
- Two new coronagraph masks to replace grids of holes in the slit mask stage (SLS)
- Cold heads to be purged
- Work done on AO bench to support new coronagraph:
  - Pupil realignment
  - Reduce L-band image elongation
  - New L-band calibration source

Other Updates

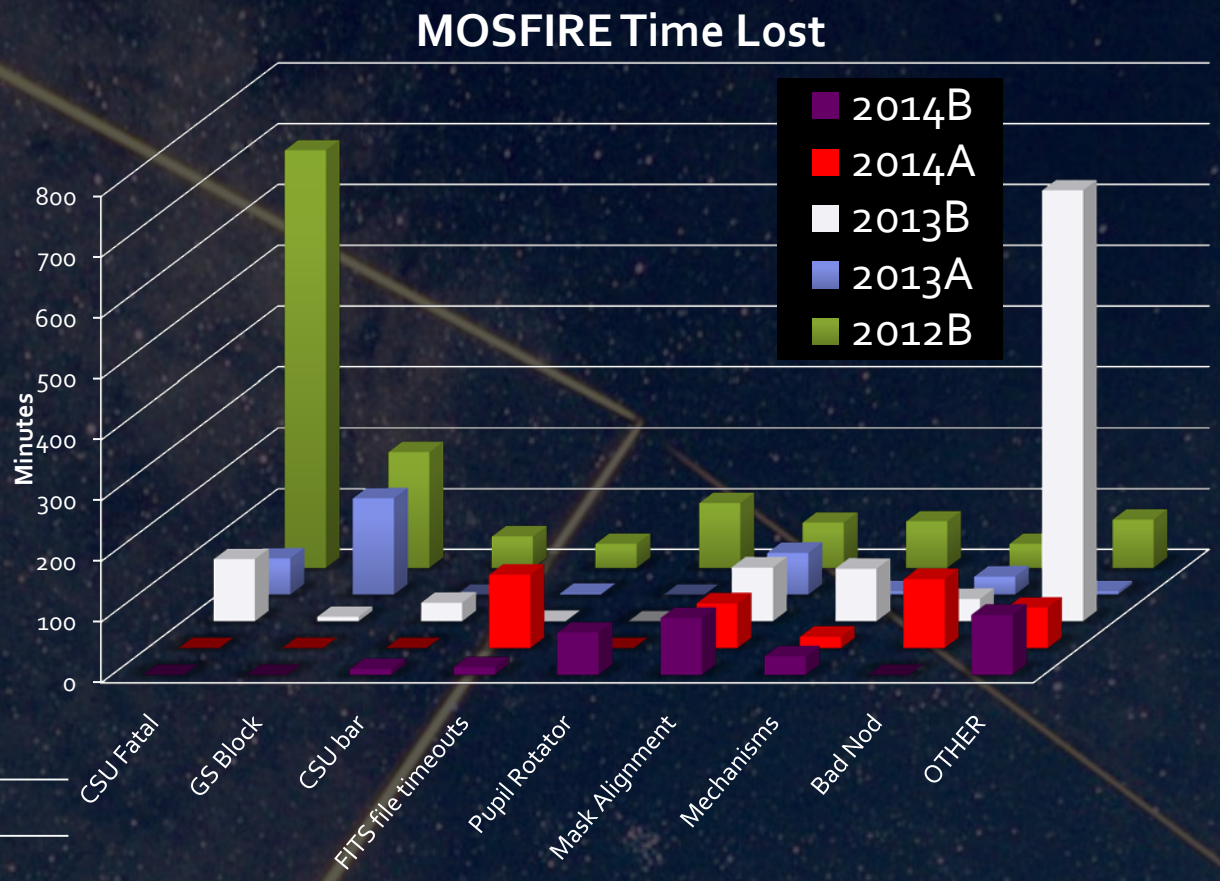
- Improved ***r***
  - Shutdown
- Tklogger p
- Scripts lau
- Source for
- Monitoring
  stage cold

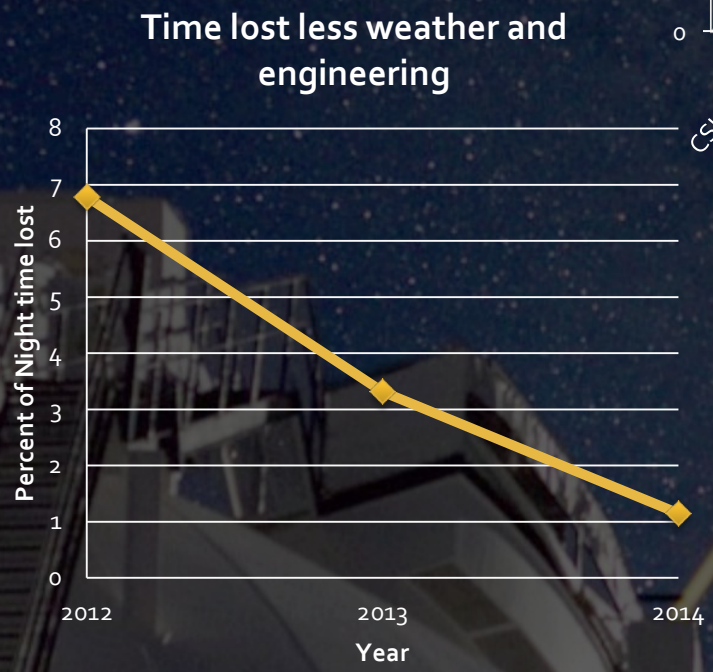


MOSFIRE

Marc Kassis

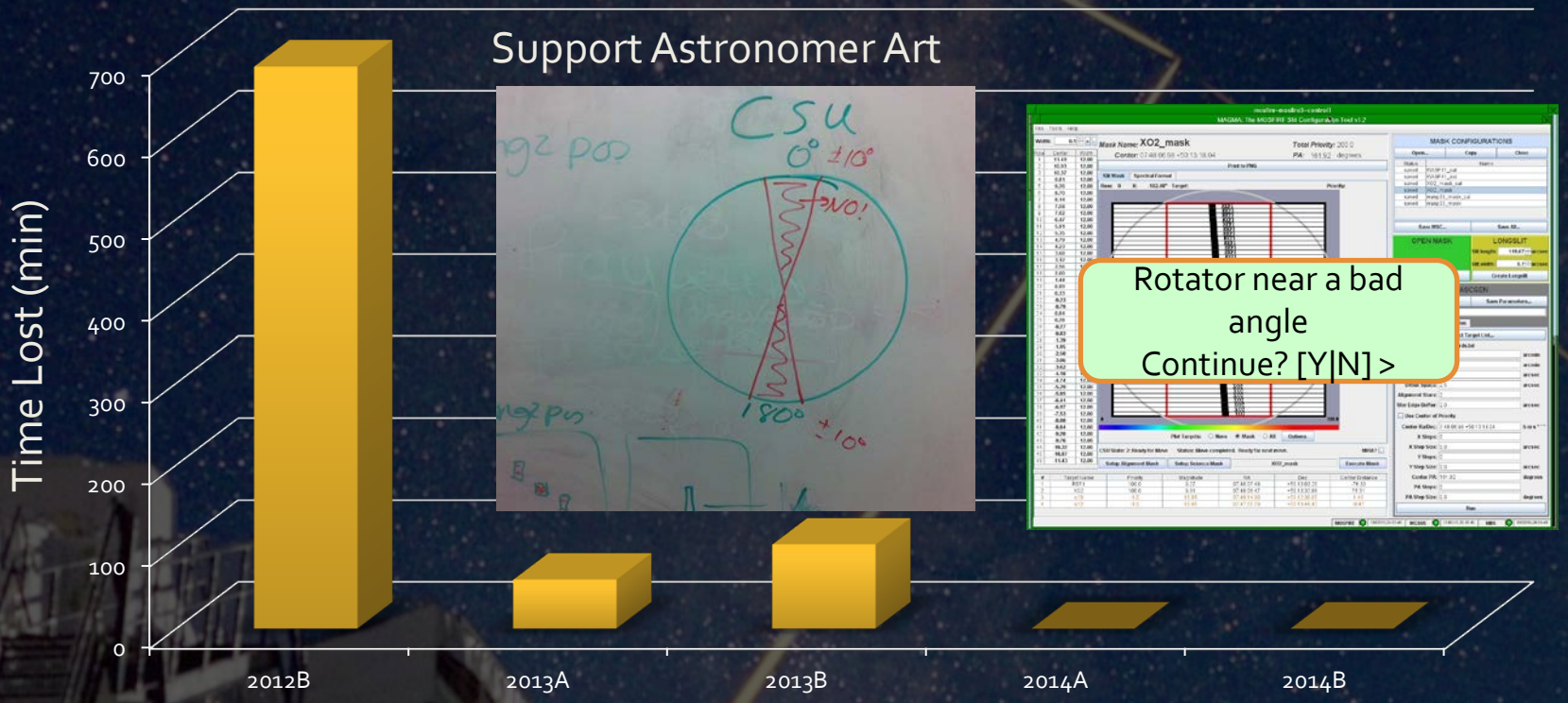
Reduced Fault Times





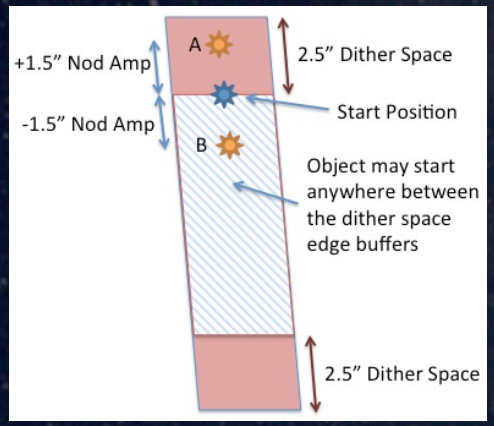
- 148 Nights in 2014
- Time saved:
  ~80 hrs per year

CSU Avoidance Strategies

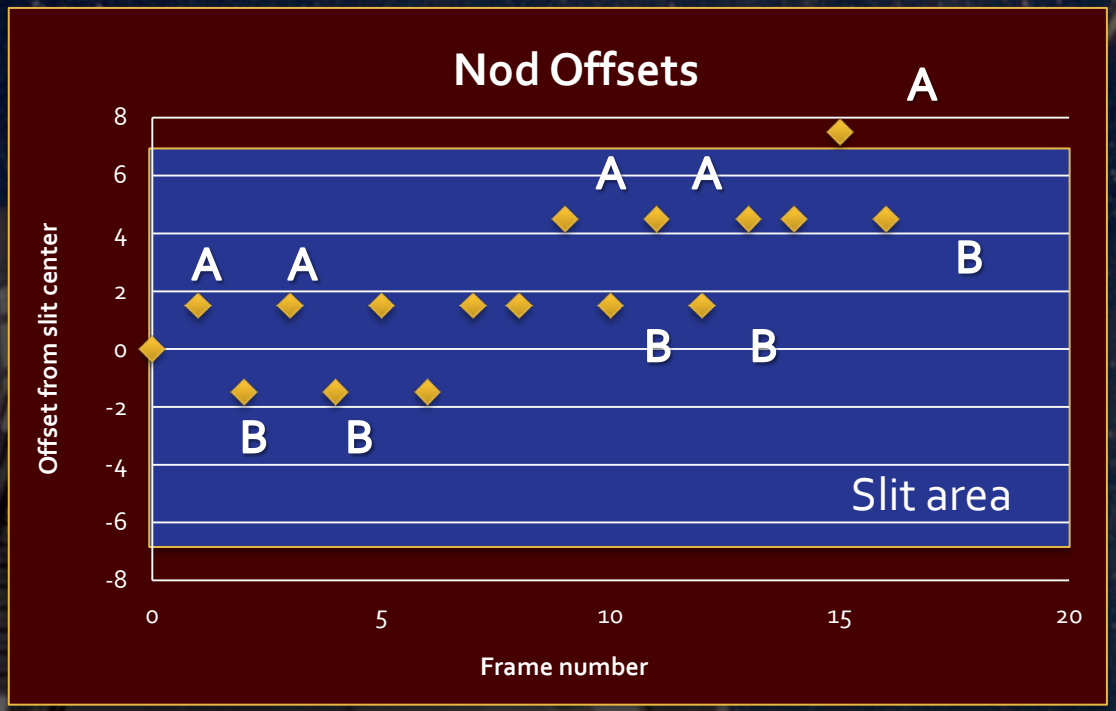


- Moves now in series with telescope slews
- 30 hours lost to CSU moves per year

Missed Telescope moves

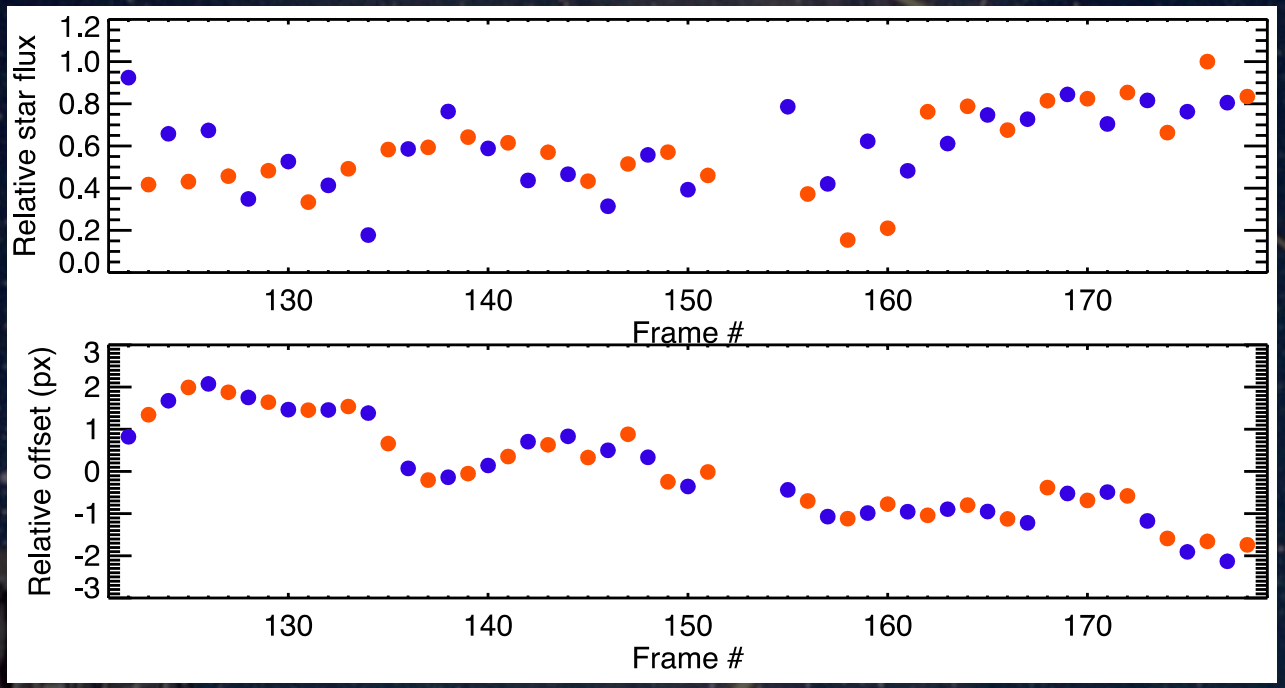


- 1 every 3000 nods
- Communication problem with Keck I



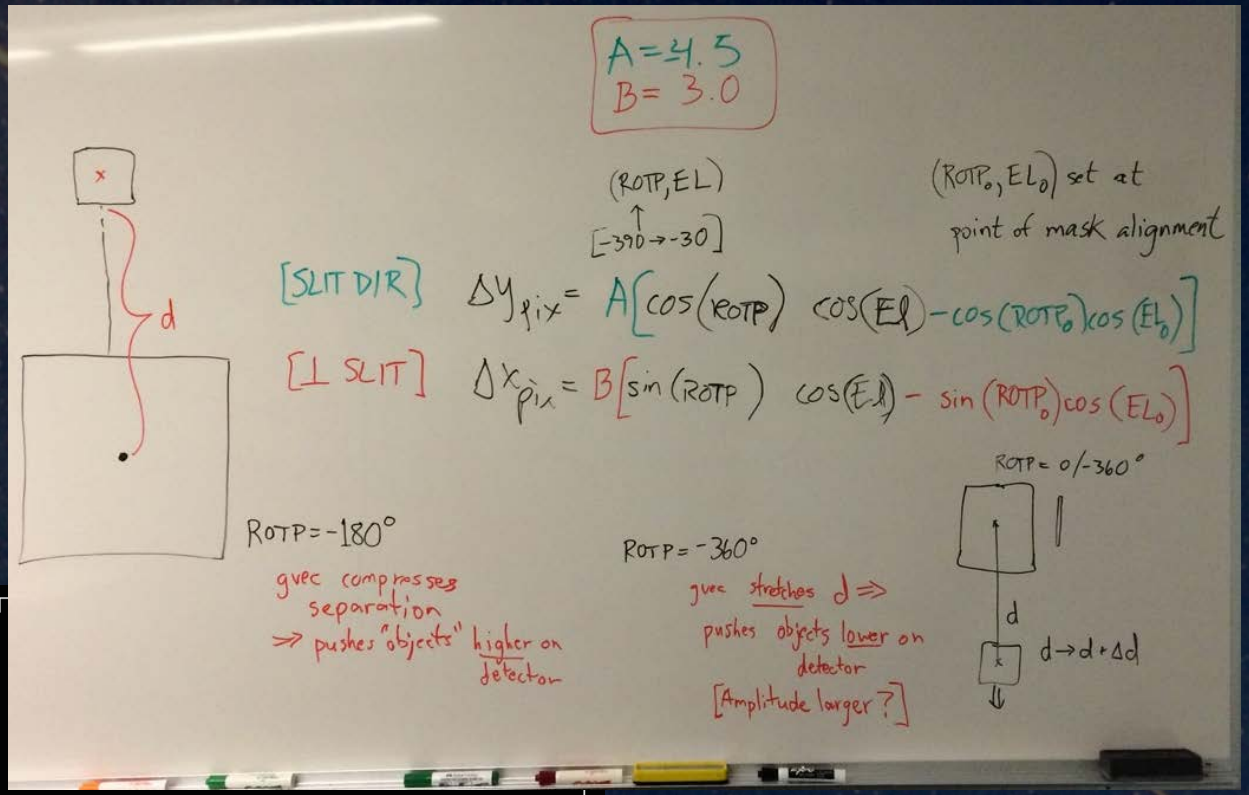
- Keyword Gateway implemented
- Deployed to all instruments

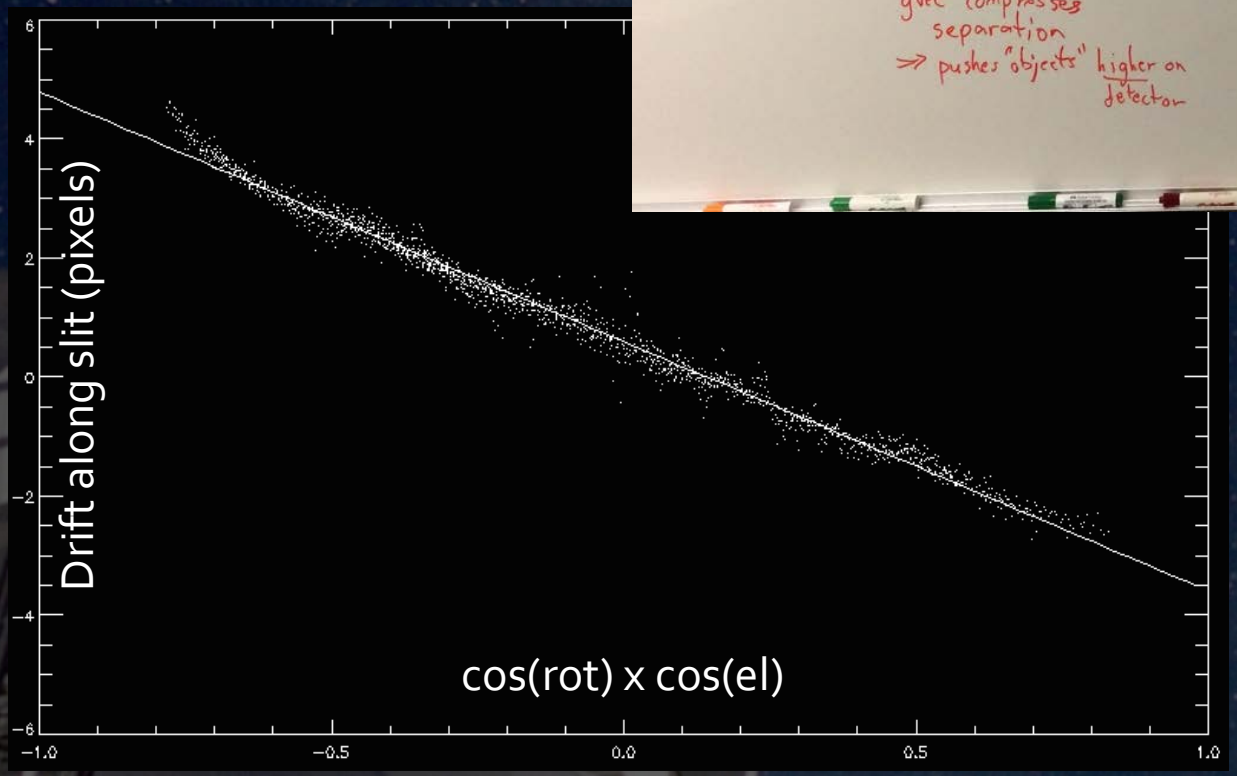
MOSFIRE slit drift



- Observed drift along the slit
- ~ 1 pix per hour

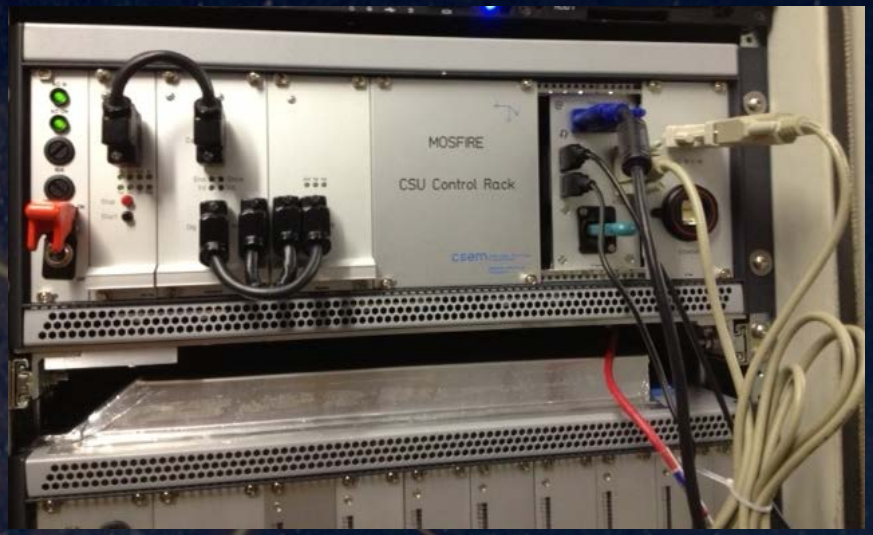
Slit Drift Model





- Diff flexure
- Function of elevation and rotation

CSEM collaboration



- Sparing:
  - IMCU board spare repaired and functioning
  - Spares for all but one board: MACU driver
- Problems we are addressing
  - Fix amplifier board cold sensitivity (ongoing)
  - Identify cause of "Fatal Errors"

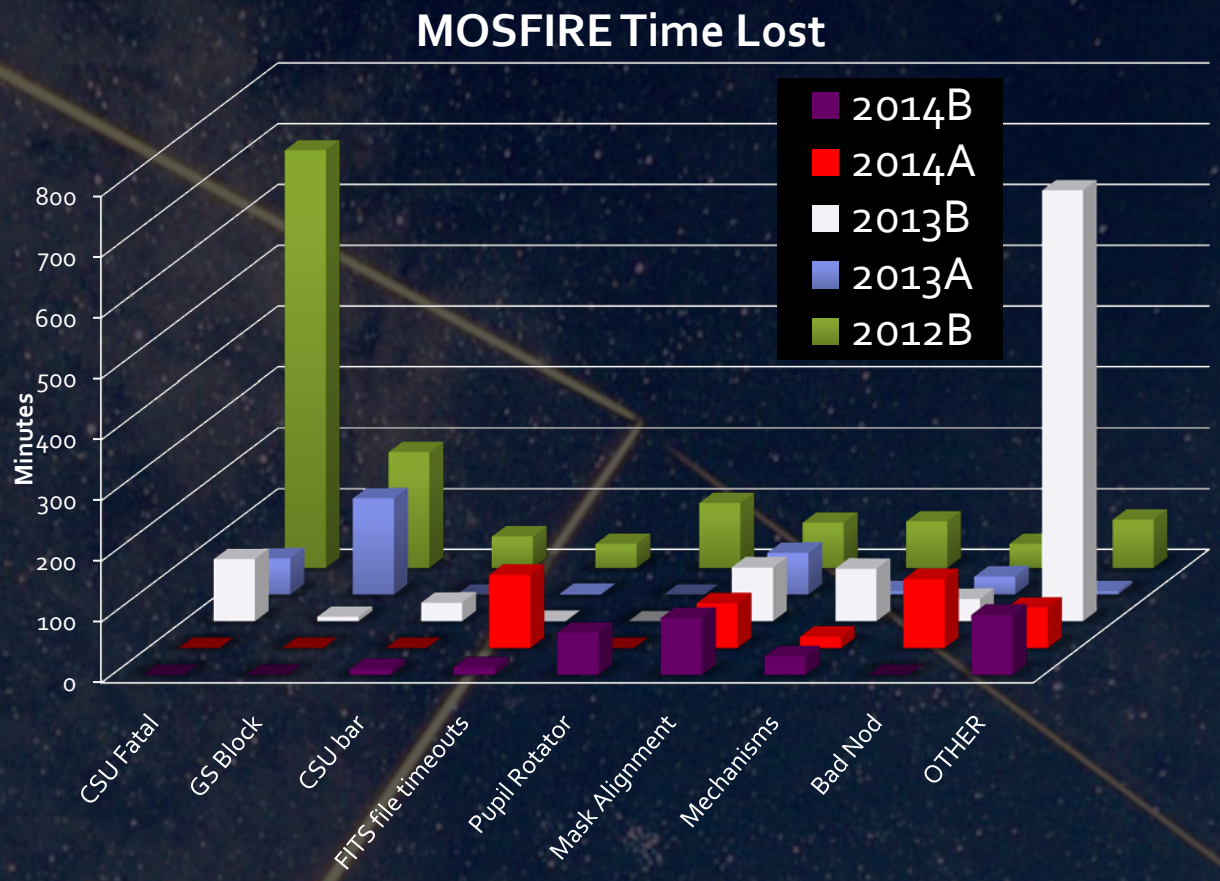
2015 Tasks

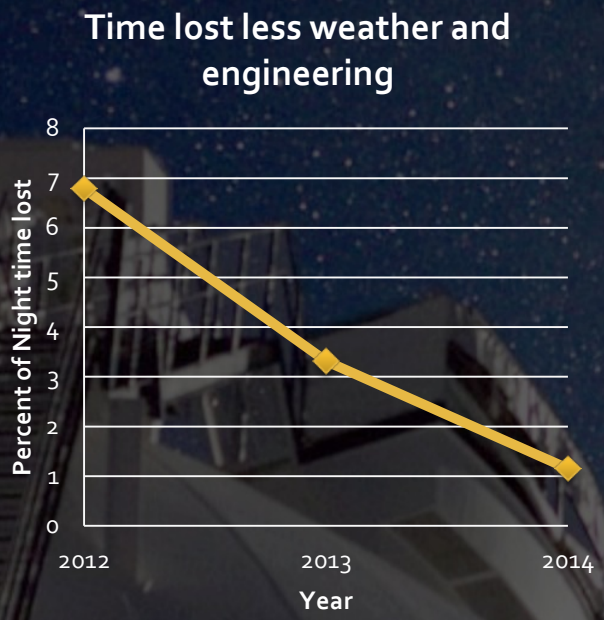
- Slit drift
  - Update guiding software
  - Possible first test at the end of April
- Work with CSEM
  - diagnose the electronics temperature dependency
  - Modify all 92 boards
- Slitmask design software updates

MOSFIRE

Marc Kassis

Reduced Fault Times





- 148 Nights in 2014
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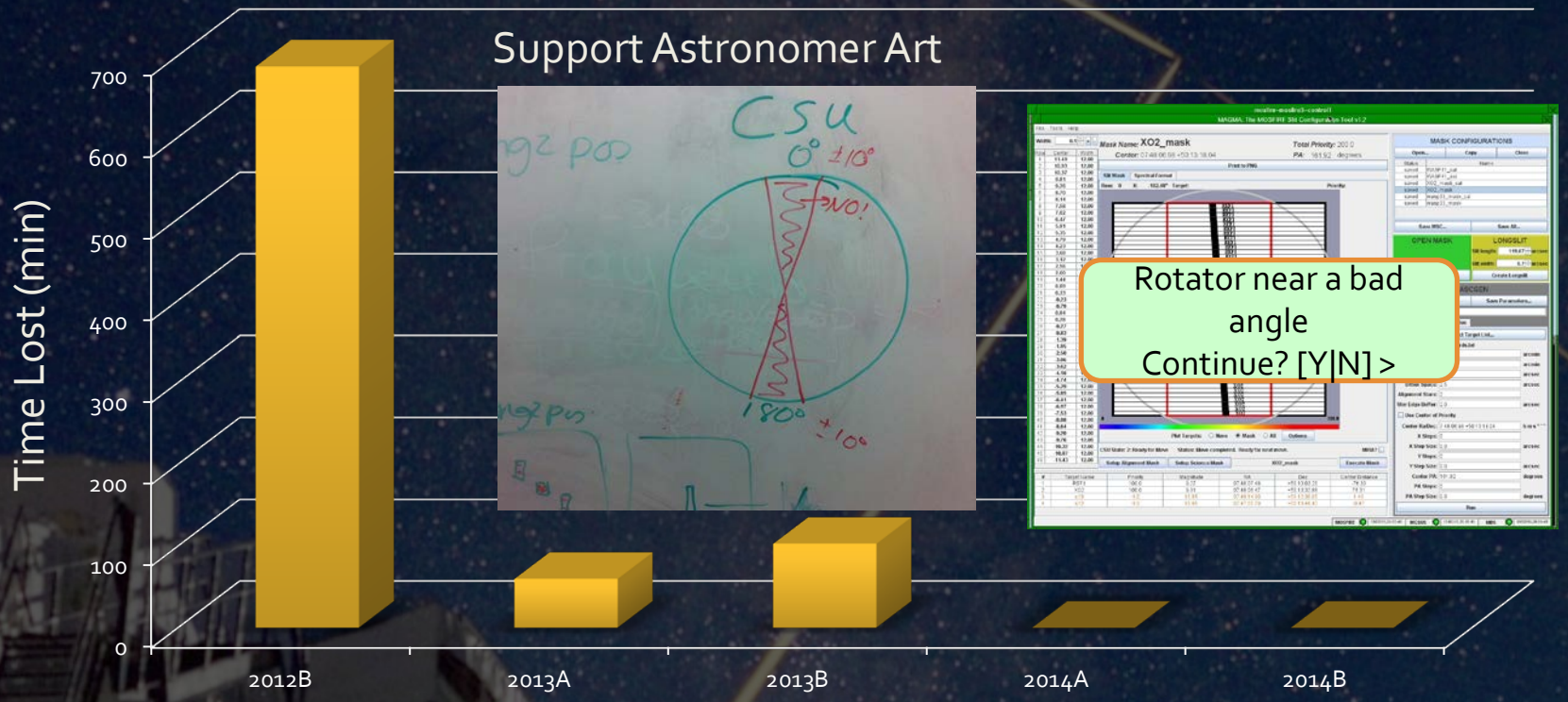

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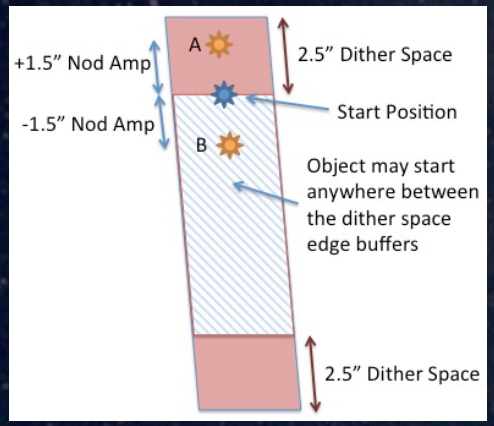

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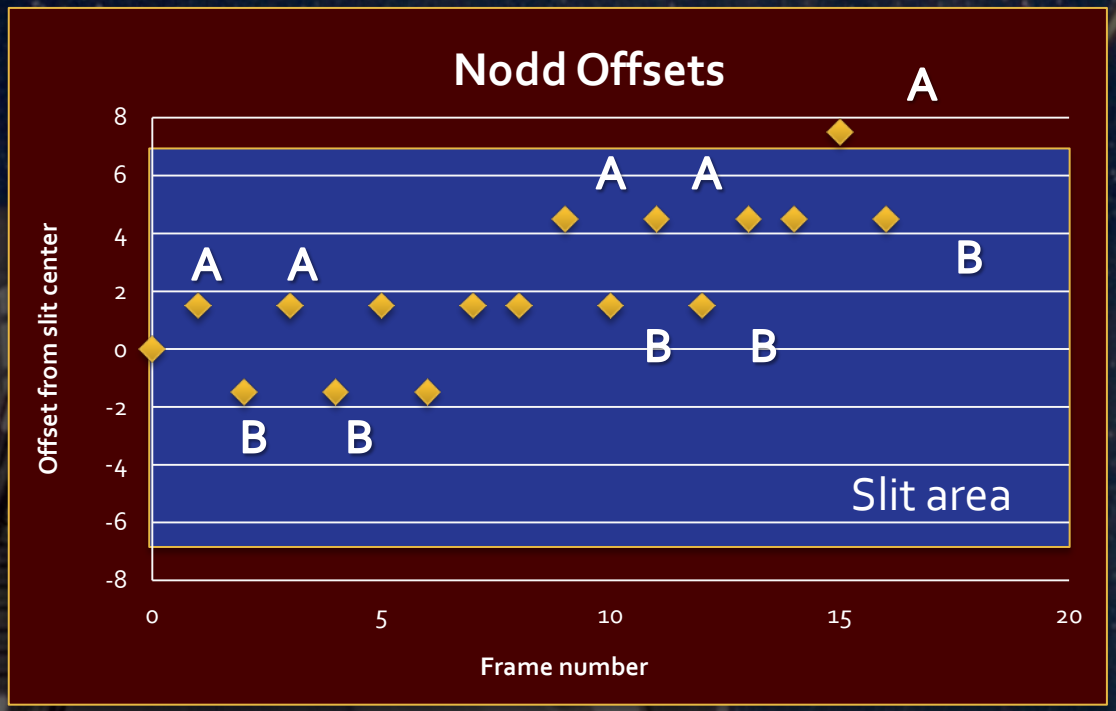
- Communication problem with Keck I



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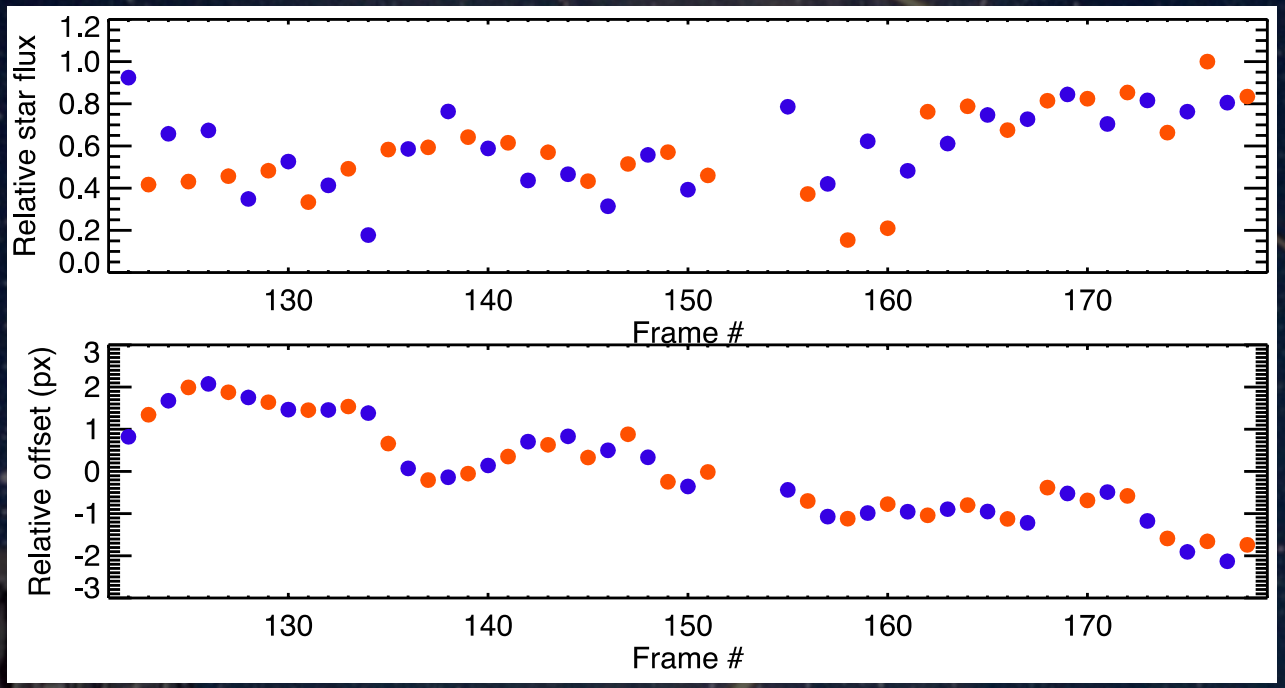
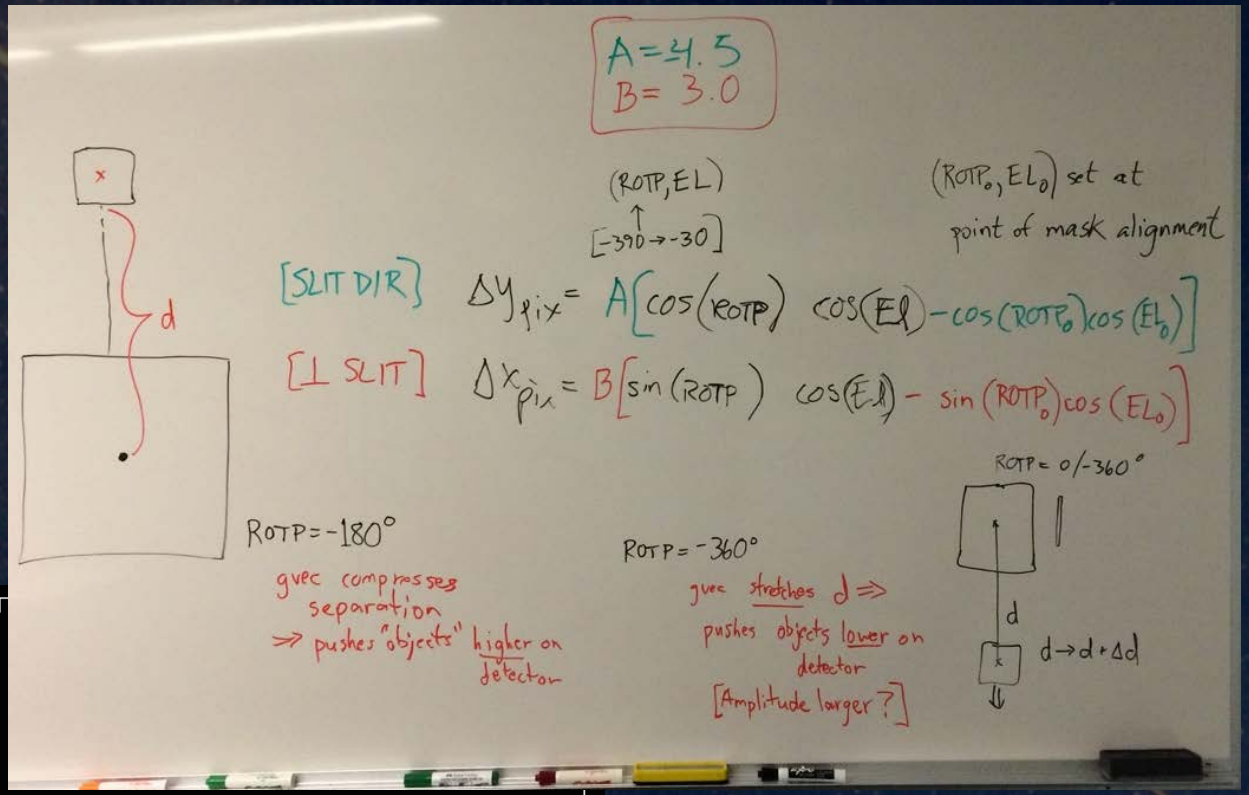
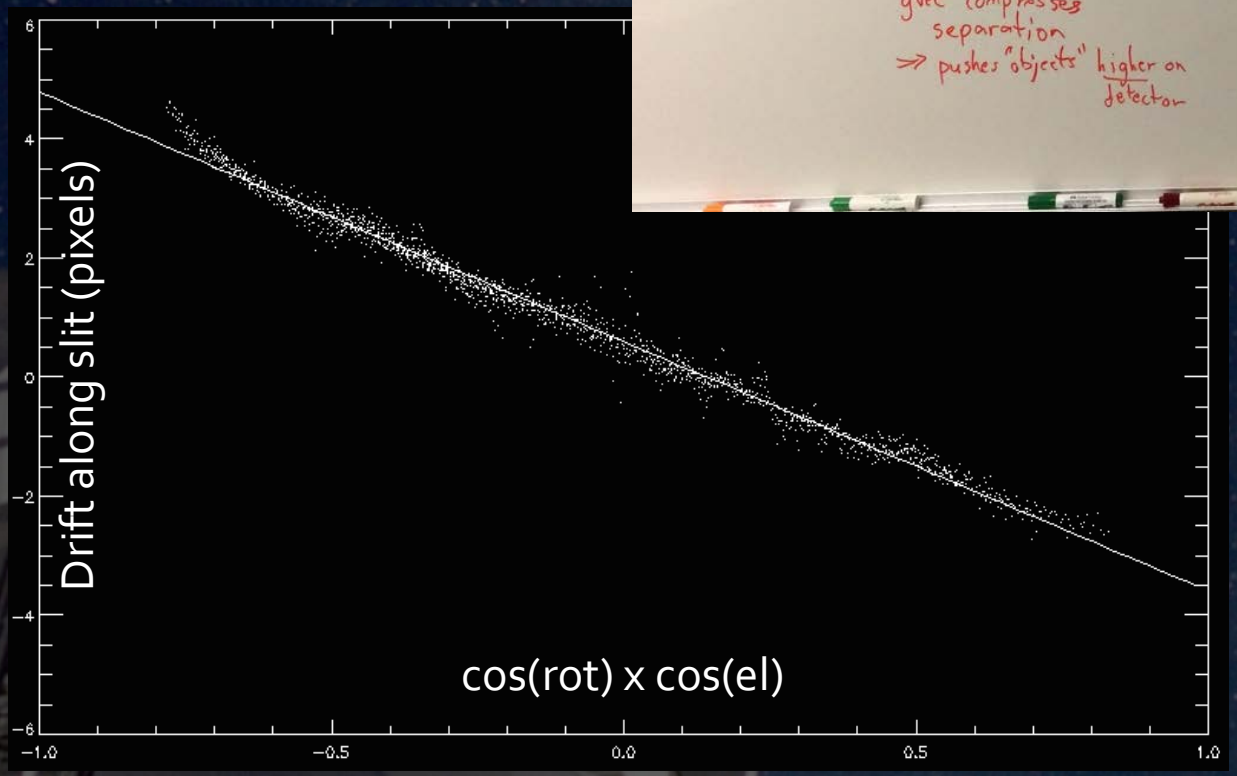
MOSFIRE slit drift



- Observed drift along the slit

Slit Drift Model





- Diff flexure
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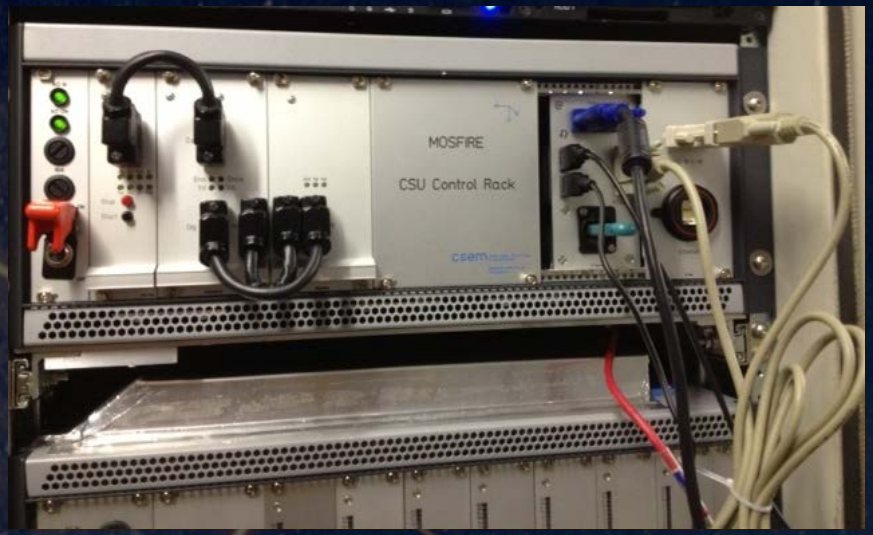
CSEM collaboration



- Sparing:
  - Determined fault with spare IMCU board
  - Spares for all but one board: MACU driver
- Problems we are addressing
  - Fix amplifier board cold sensitivity (ongoing)
  - Identify cause of "Fatal Errors"

2015 Tasks

- Slit drift
  - Update guiding software
  - Possible first test at the end of April
- Work with CSEM
  - diagnose the electronics temperature dependency
  - Modify all 92 boards
- Slitmask design software updates

DEIMOS

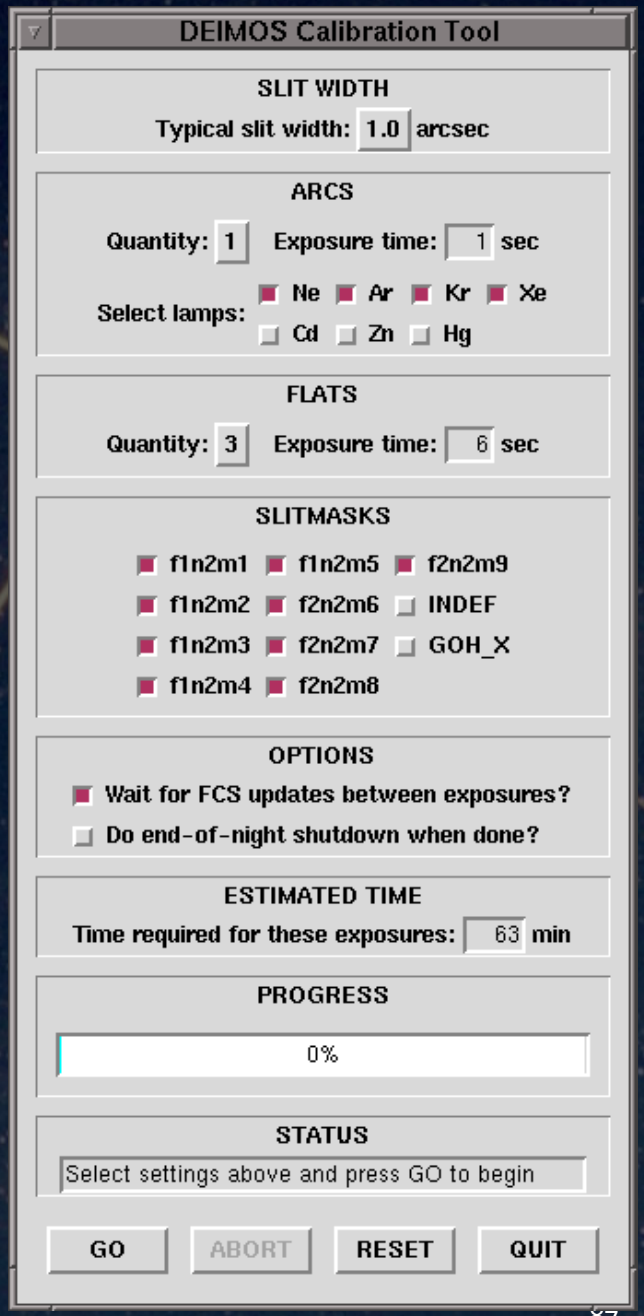
Marc Kassis

DEIMOS Actions in 2014/2015

- Minor software updates
- Replacement of host computer
- Servicing mission to address grating system
- New blue grating

Software Updates

- More flexibility in calibration GUI
- DSIMULATOR served at Keck



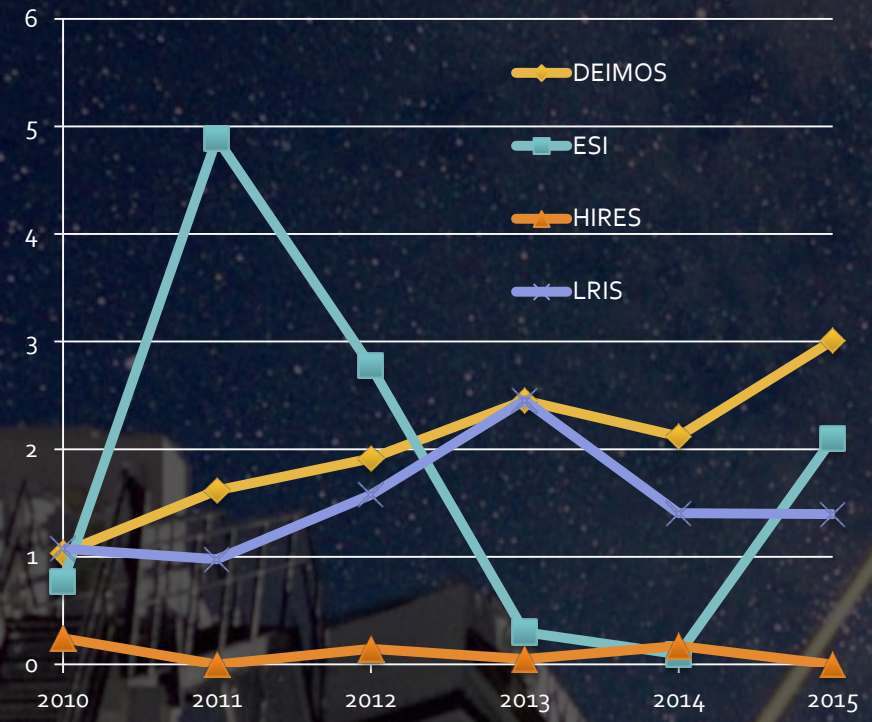
Keamano Upgrade

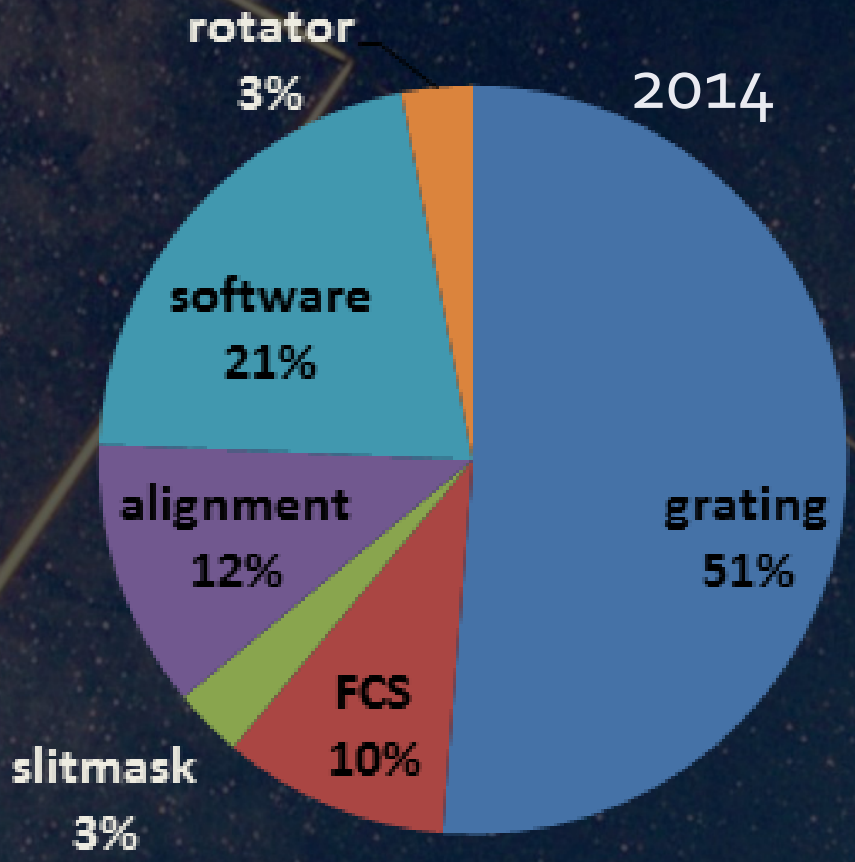
- UCO Lick Scientific Programming Group: Steve Allen, Kyle Lanclos, Will Deich, Bob Kibrick
- Keck Staff: Marc Kassis, Liz Chock, Al Honey
- Goals:
  - Replace host computer with Sun V240 running Solaris 10
  - Update portions of the control software
  - All software now under version control

Grating servicing mission

- UCO Lick Staff: Dave Cowley, Jim Ward, Brad Holden, Steve Allen, Will Deich
- Keck Staff: Luca Rizzi, Steve Milner, Gary Anderson, Nick Souminen, Dwight Chan
- Goals:
  - Replace worn, custom components
  - Grating system is more reliable
  - FCS maintains position with grating clamped at all rotator angles
- DEIMOS out of service 6 weeks starting January

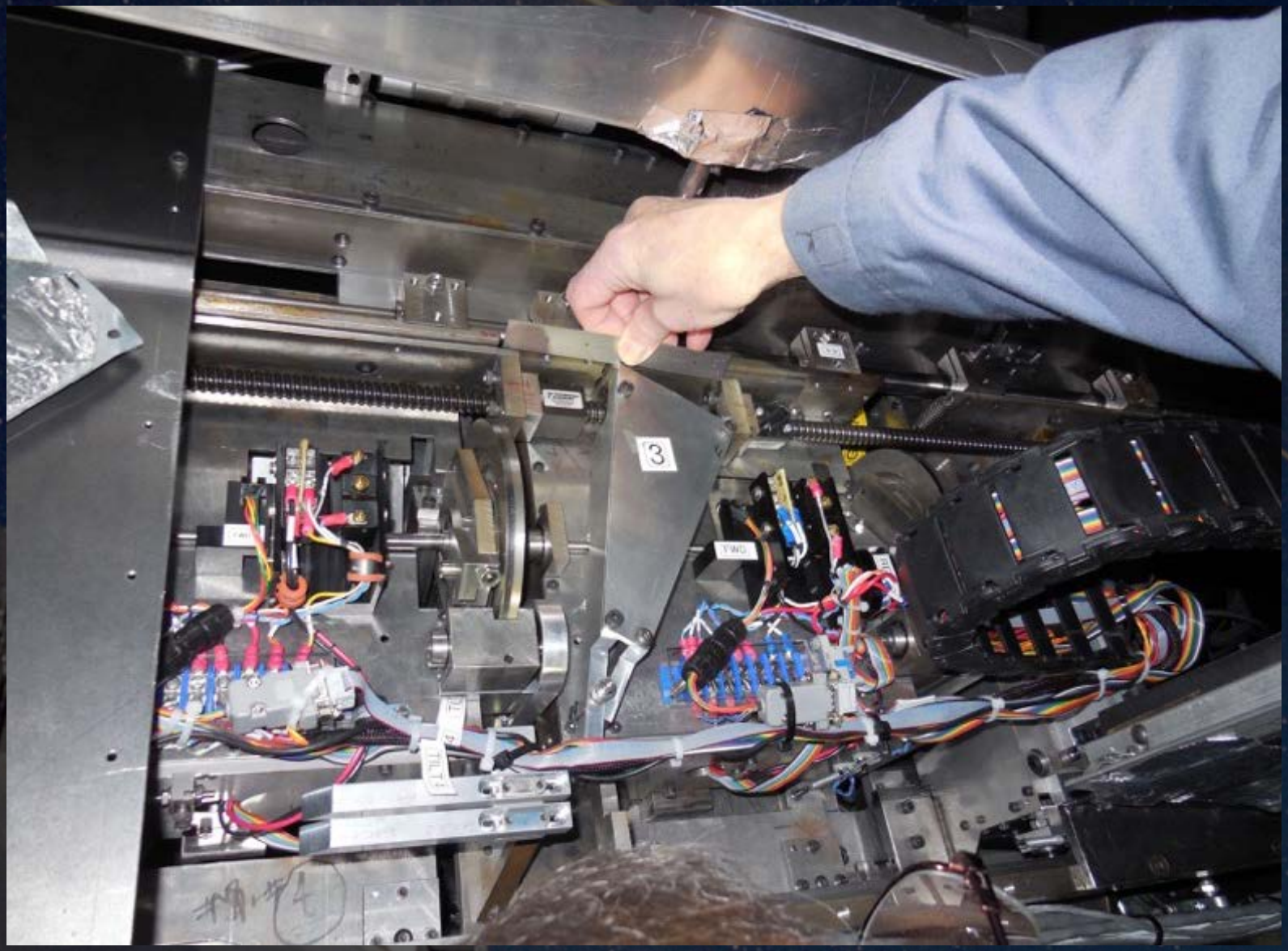
DEIMOS time loss



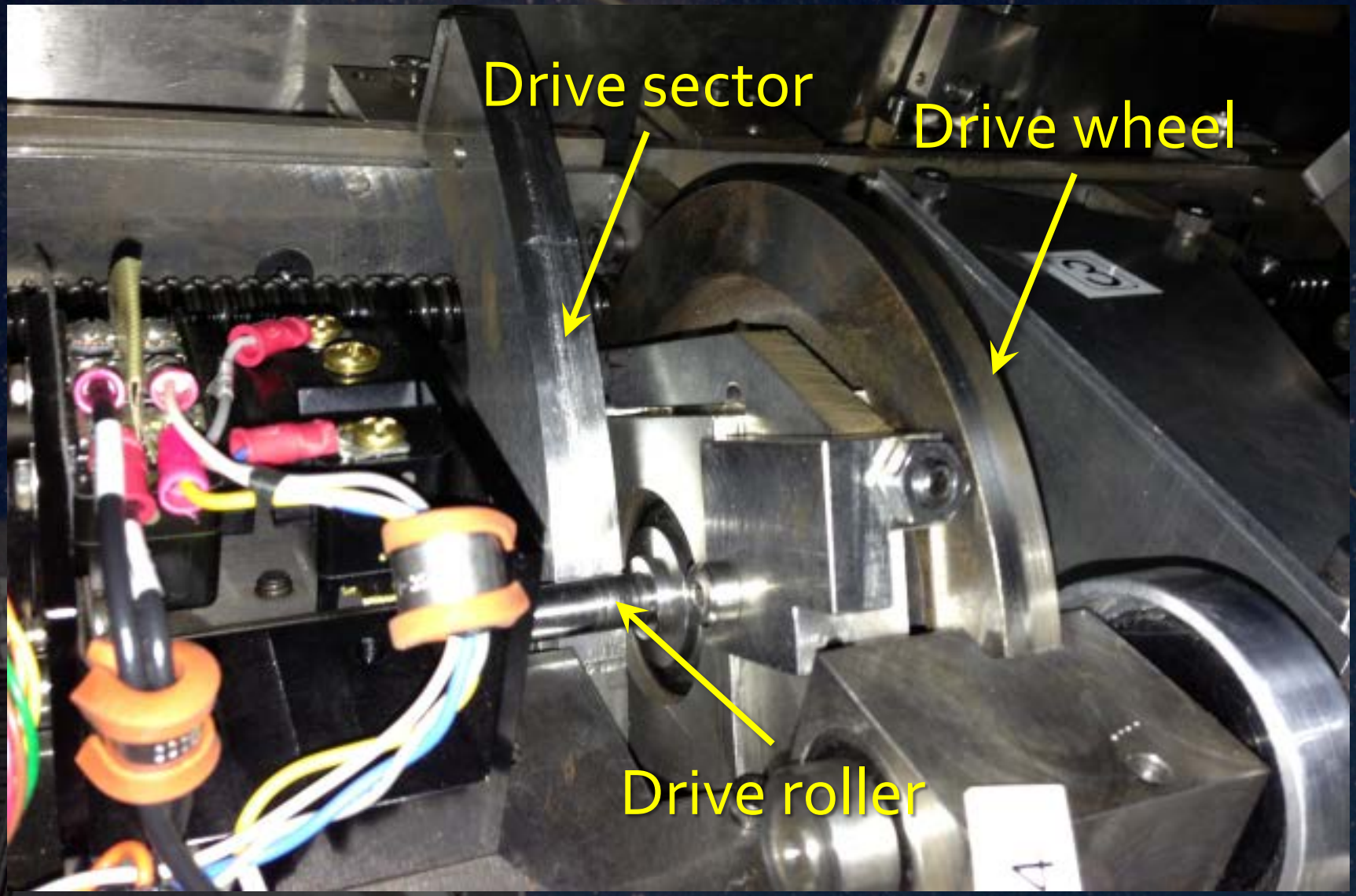


Excludes telescope faults, weather, and engineering

Grating Mechanisms



Critical grating tilt components are worn

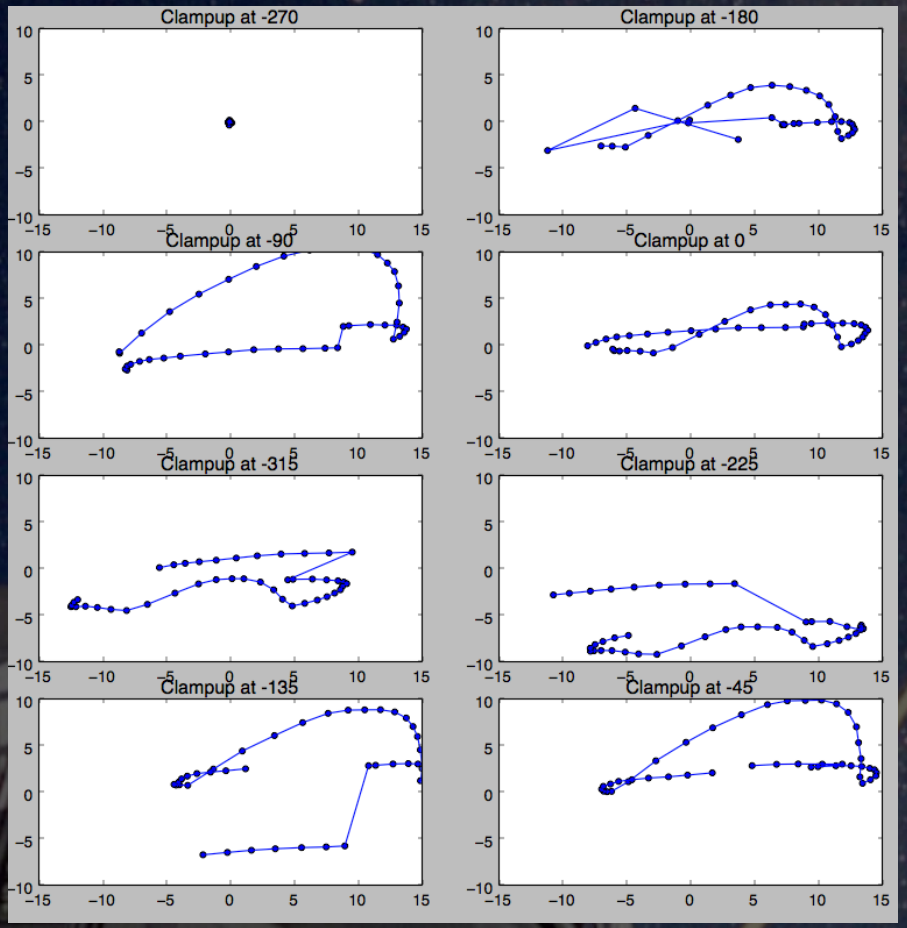


Worn Parts

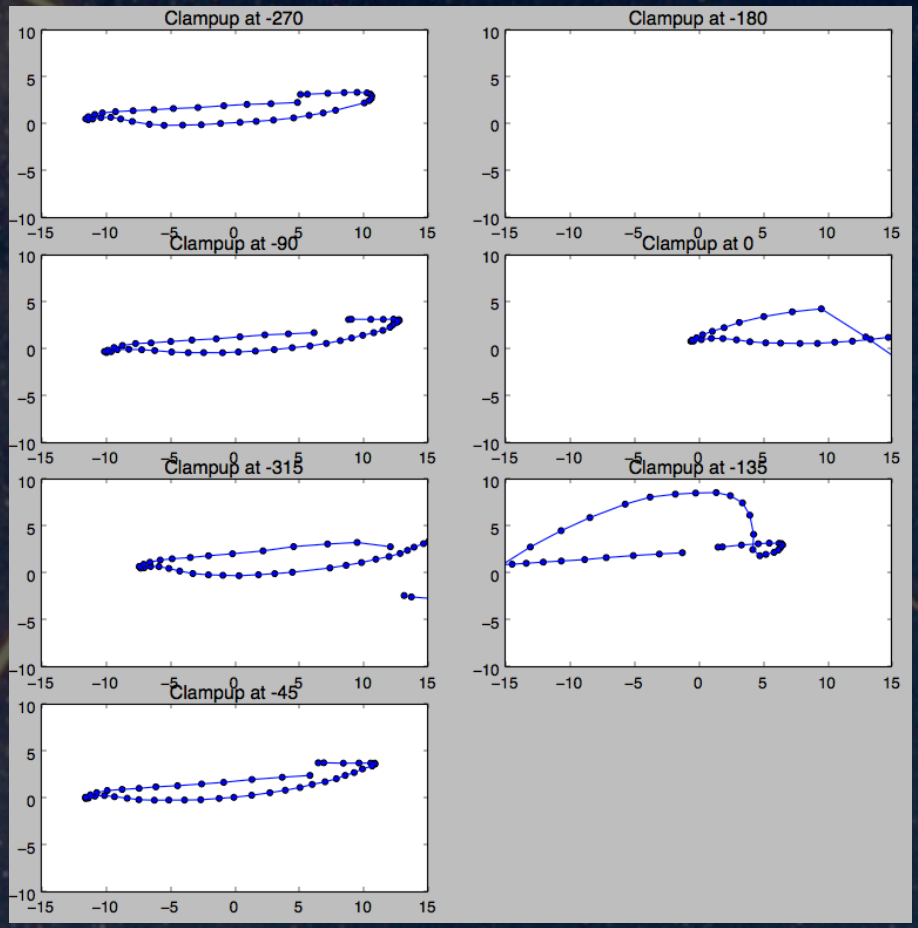
- Bering housing

- Sector Wheel

Grating 3 Flexure

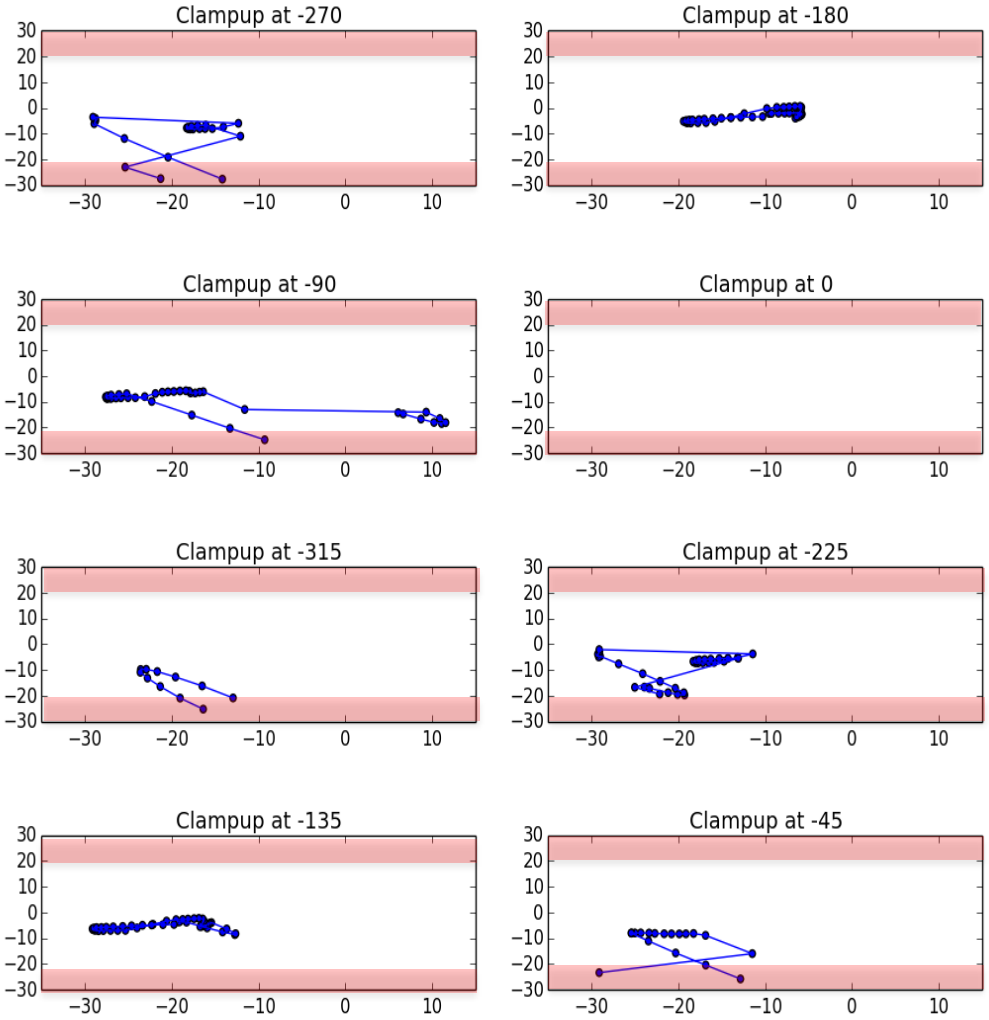


Before



After

Grating 4 Flexure



Believe we can do better

- Grating 3 flexure is good.
- -180 is good for grating 4
- We know we have not optimized the clamp pin position

2015 Tasks

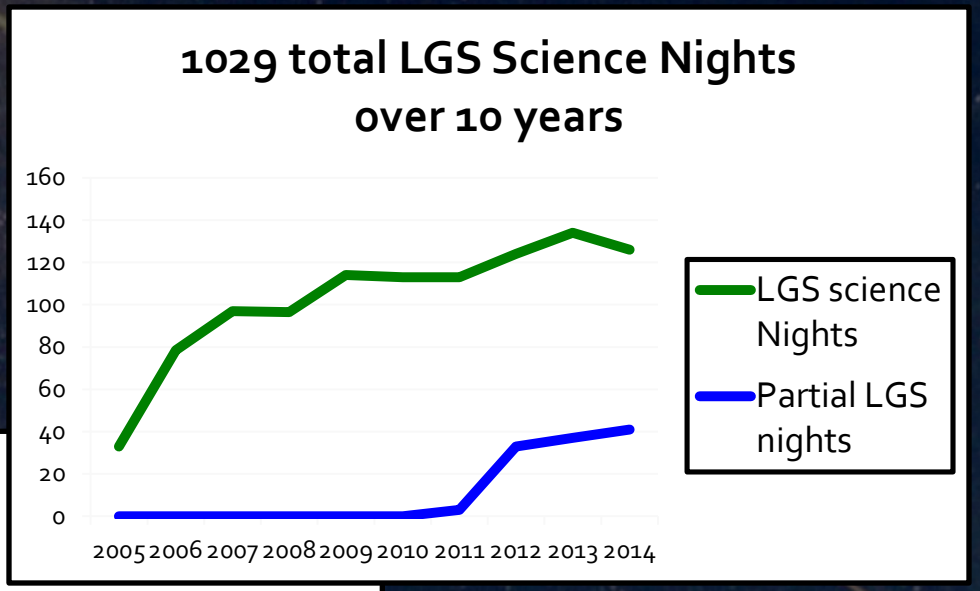
- Grating Service Mission continued effort
  - Tune grating clamp positions
  - Adjust limit switches in tilt mechanisms
  - Update the software with new values
  - Rerun flexure tests
  - Repair damaged video board
- Non-service mission work
  - Diagnose and repair noisy amplifiers
  - Replace a V-band filter
  - Investigate feasibility of commission grating port 5

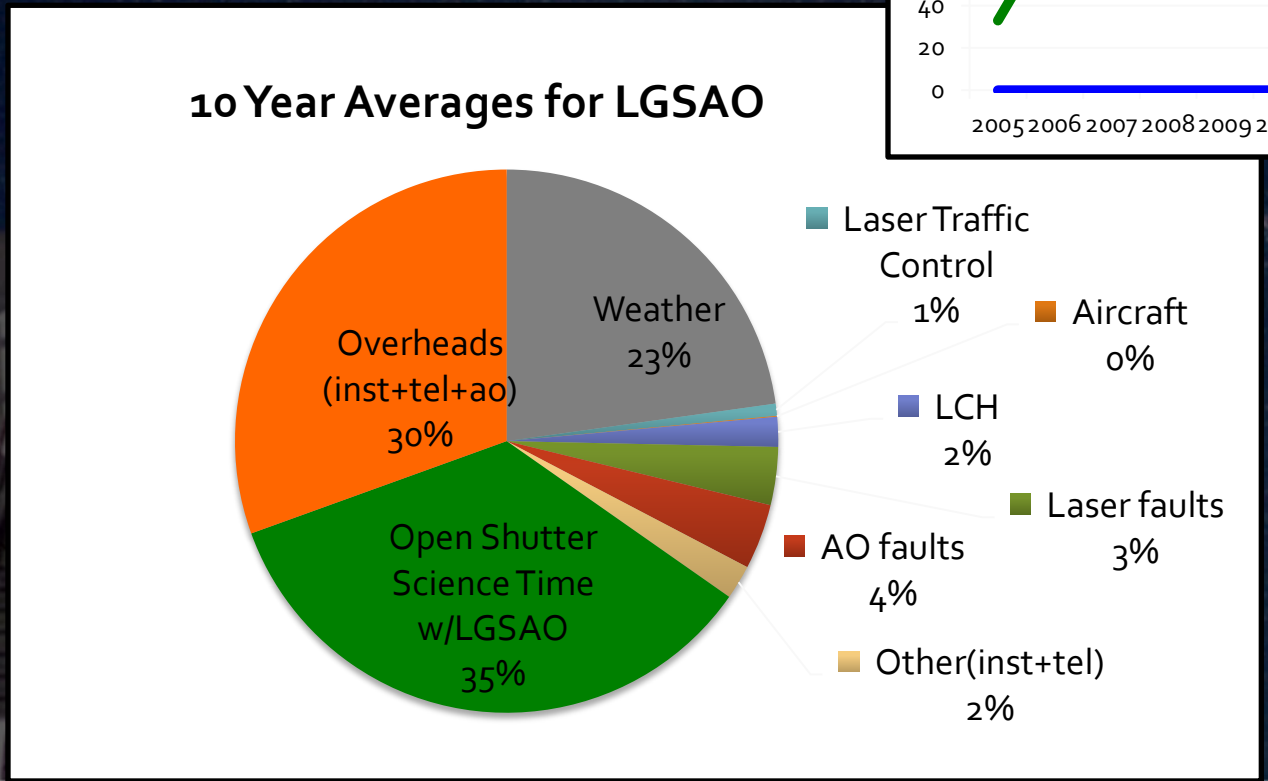
AO Operations

Randy Campbell

LGSAO in 2014

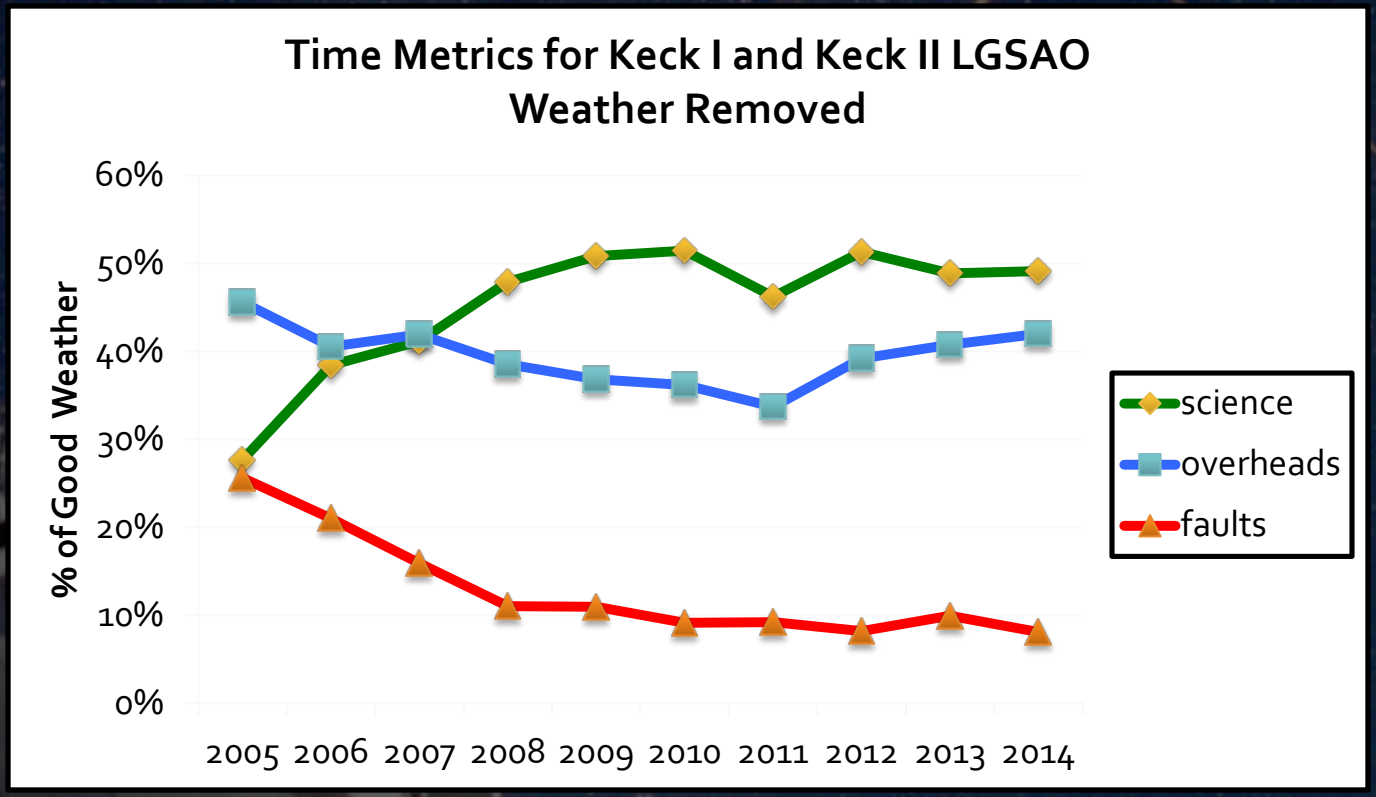
- 10th year of LGSAO Science
  - 126 Science Nights
    - Keck II : 89
    - Keck I : 37
  - 33 Engineering Nights
    - Keck II : 19
    - Keck I : 14



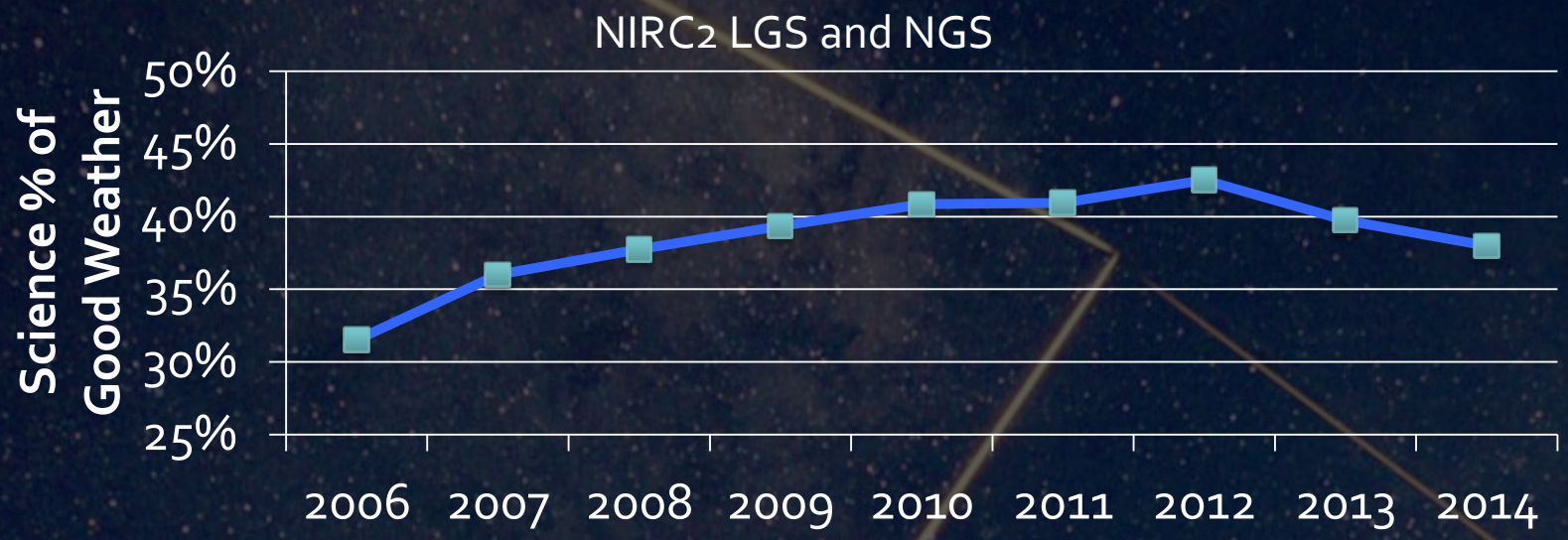


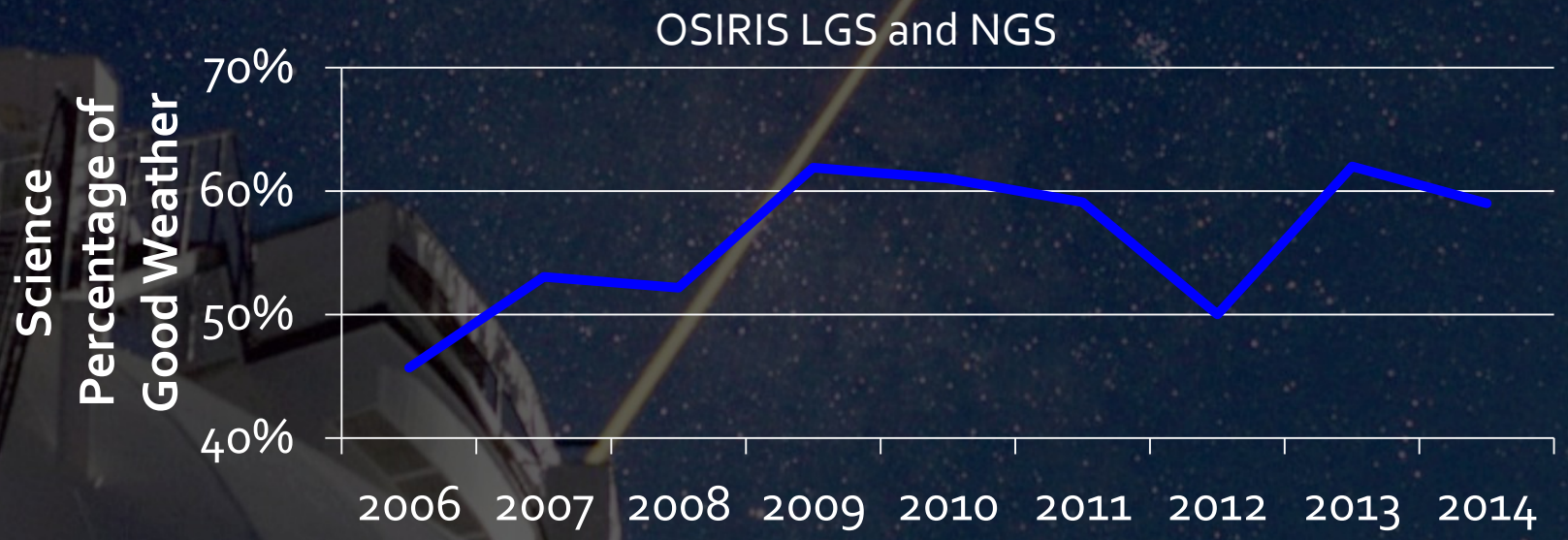
LGS Trends

- Weather loss for LGS in 2014 28%
- Fault loss 8% (AO+laser+other)
- Overheads trending up
  - Perhaps due to increase in partial nights

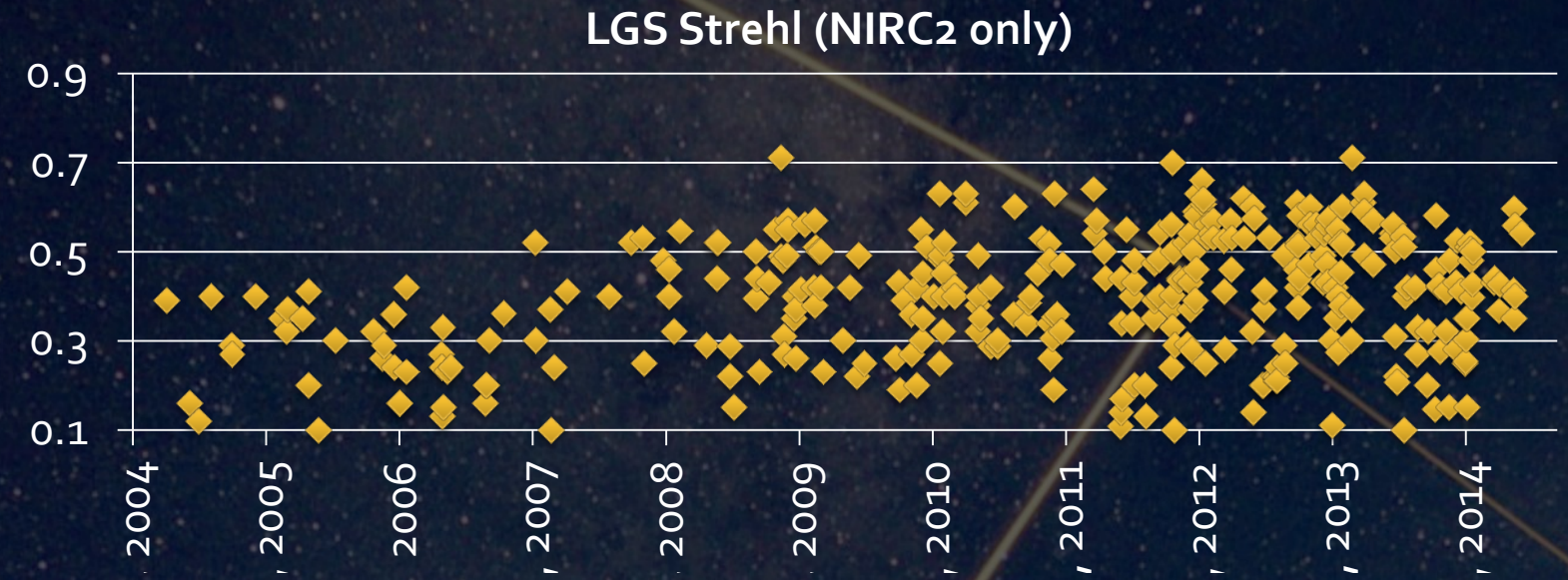


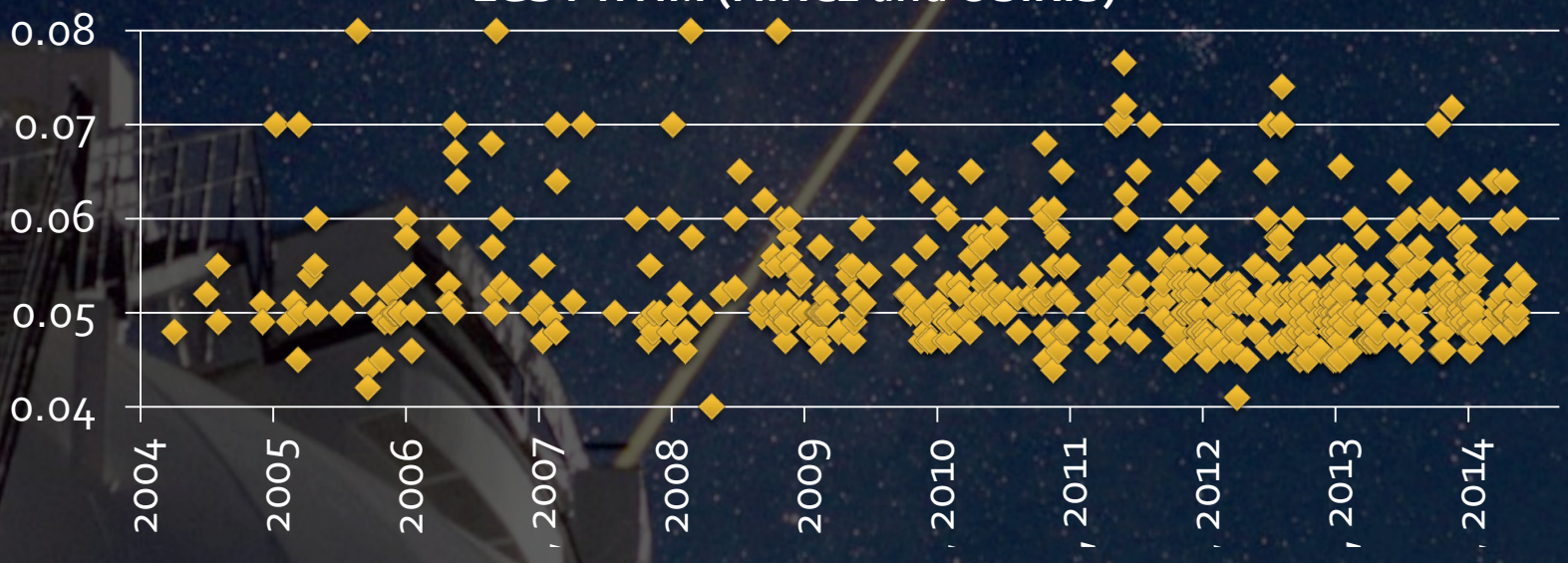
Efficiency


NIRC2 LGS and NGS
Science % of Good Weather
50%
45%
40%
35%
30%
25%
2006
2007
2008
2009
2010
2011
2012
2013
2014

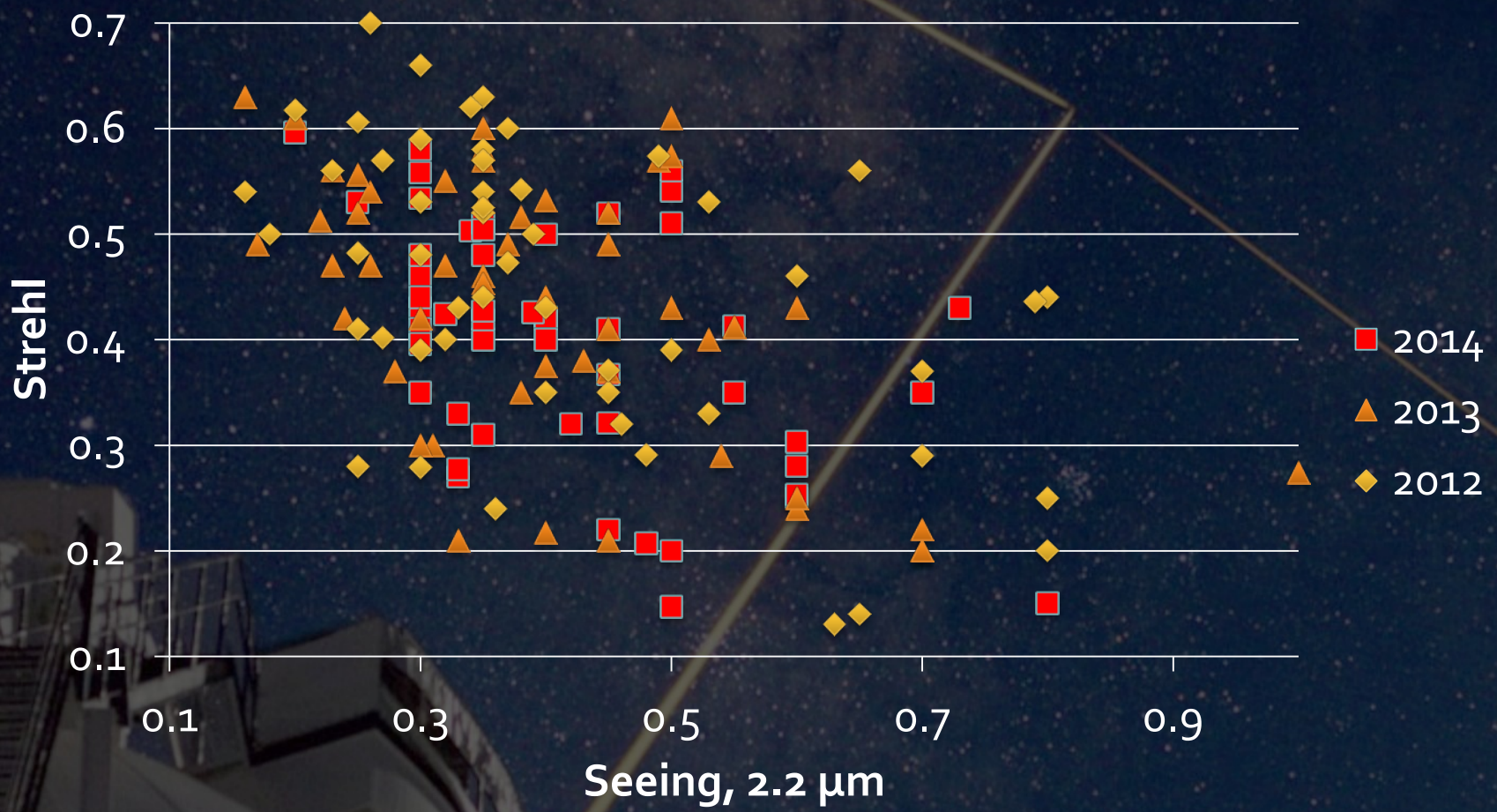

OSIRIS LGS and NGS
Science Percentage of Good Weather
70%
60%
50%
40%
2006
2007
2008
2009
2010
2011
2012
2013
2014

AO Performance Metrics



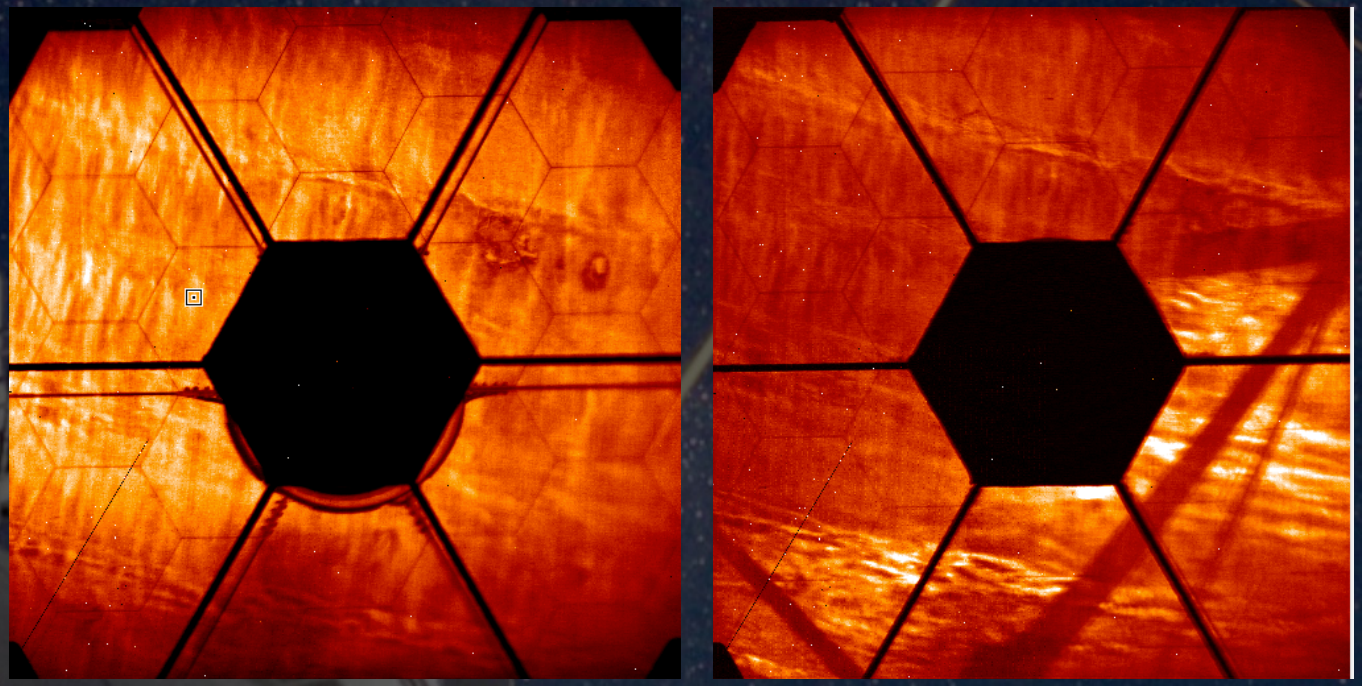


AO Performance Metrics



Keck II AO Bench Tweaks

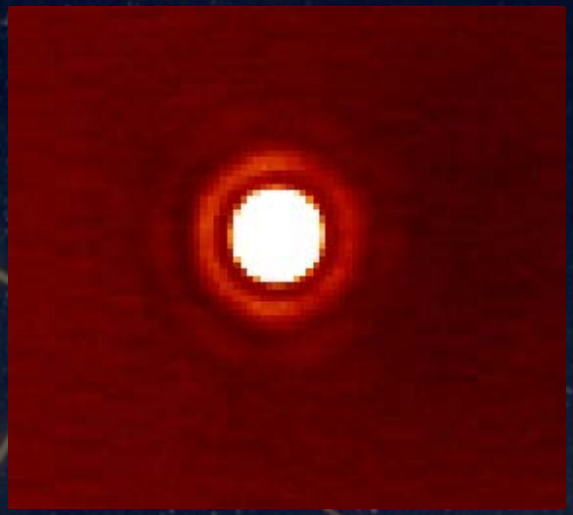
1. Improved pupil nutation (K-mirror)
2. Improved Telescope/NIRC pupil registration (OAPs)
3. Future solution for L-prime elongation (IR Dichroic wedge rotation)
   - Removes lateral chromatic dispersion
   - But introduces a pupil mis-alignment and ~200 nm of astigmatism.
   - Future coordinated adjustments should solve this problem



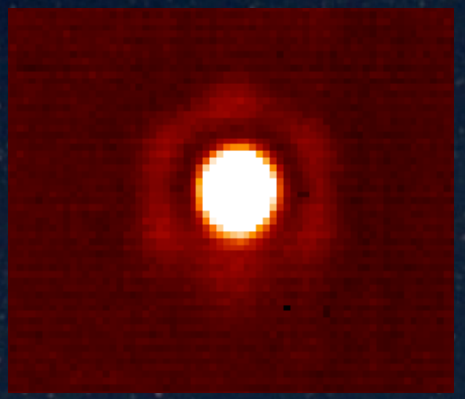
Telescope pupil image before and after alignment with NIRC2 "largehex" mask

2015 Priorities

- Science operations
- Performance improvements
  - AO bench optical alignment
  - Keck I FST efficiency
  - Computer upgrades
- Transition TRICK to operation
- Transition KII CLS to operation
- Transition NGL to operation
- Support PSF reconstruction projects
- Vector vortex coronagraph project
- Fix vignetting (NIRC2 Wide)
- Complete "SkyTiles" project
  - USStratCom coordination
- MLOG coordination
  - LTCS improvements
  - TBAD deployment coordination
- Further develop AO PM program
- Overhaul AO web pages



Sharpened L-prime image of thermal fiber source after dichroic rotation



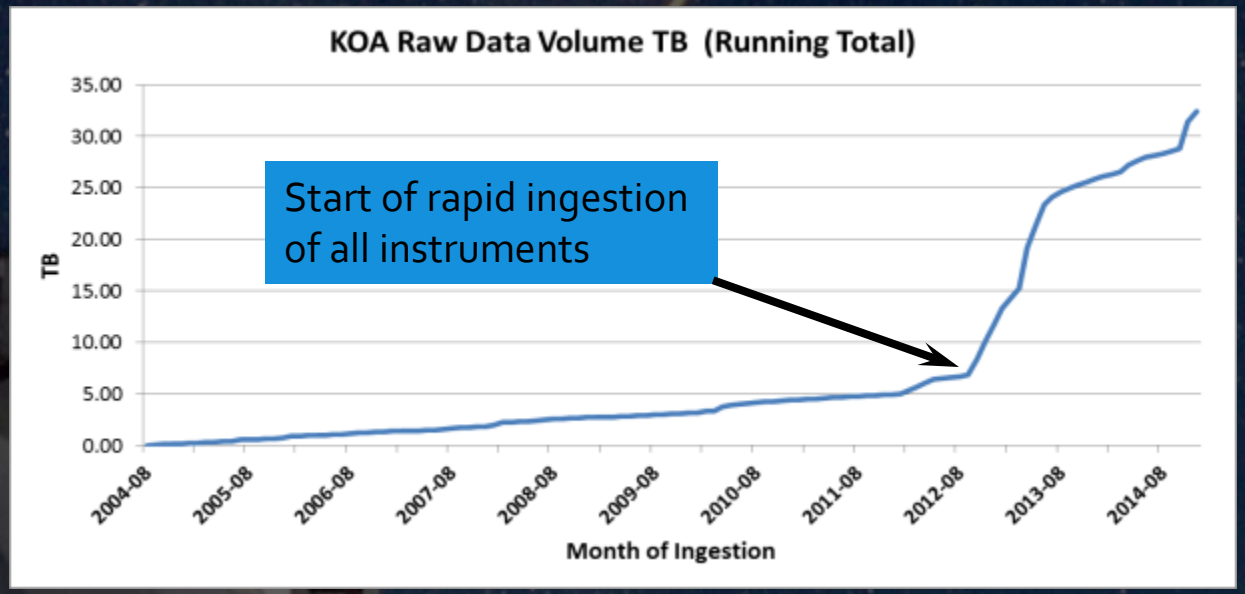
L-prime image of thermal fiber source before dichroic rotation

Keck Observatory Archive

Hien Tran

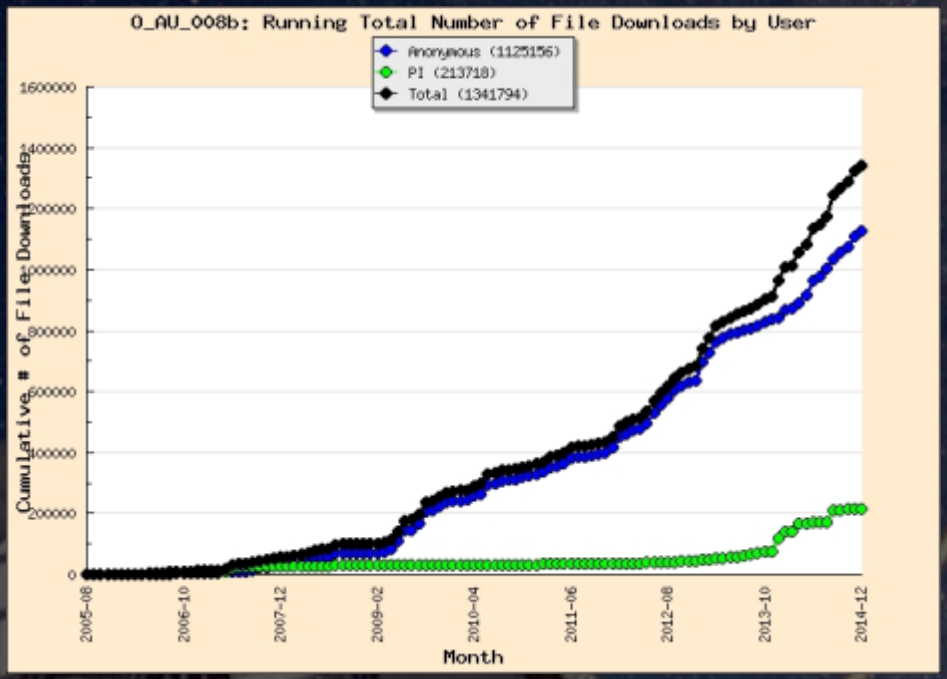
Current Status

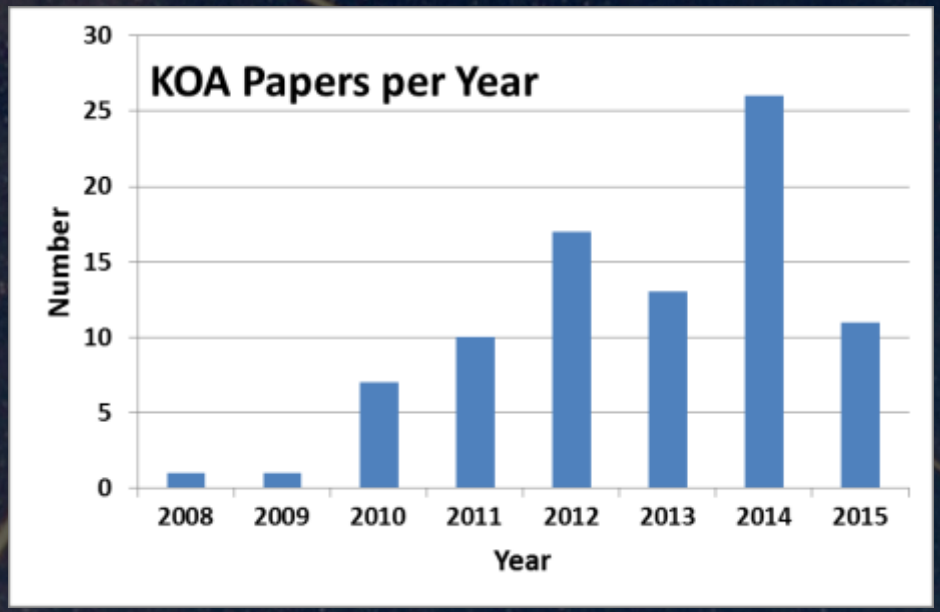
- 10 years of operation this past August
- Archive data from *ALL* 10 past and current instruments
  - Newly acquired data and all previously acquired data
  - Publicly released for all but two (NIRC, LWS)
  - ~70 % of data are public
- Current holding: 35 TB
  - 15,000 program nights, 2.6 million files over 20 years
  - Reduced (level-1) browse products for HIRES, NIRC2, OSIRIS, LWS



KOA Holding & Usage

- Growth in archive queries and data download
- Increased growth in refereed papers citing KOA (86 to date)





- 1.4 Mil queries
- 15.1 TB downloaded (> 1.3 Mil files)

MOWG Findings

- Advertisement of KOA's capabilities and content
  - SPIE, ADASS, KSC, AAS, KSM
- Improved methods of file naming & searching
  - Filename translator script
  - Will implement as download option
- Publish lessons learned from building and operating KOA
  - Presented in two papers at 2014 Astronomical Telescopes + Instrumentation (Montreal)

KOA Future Plans

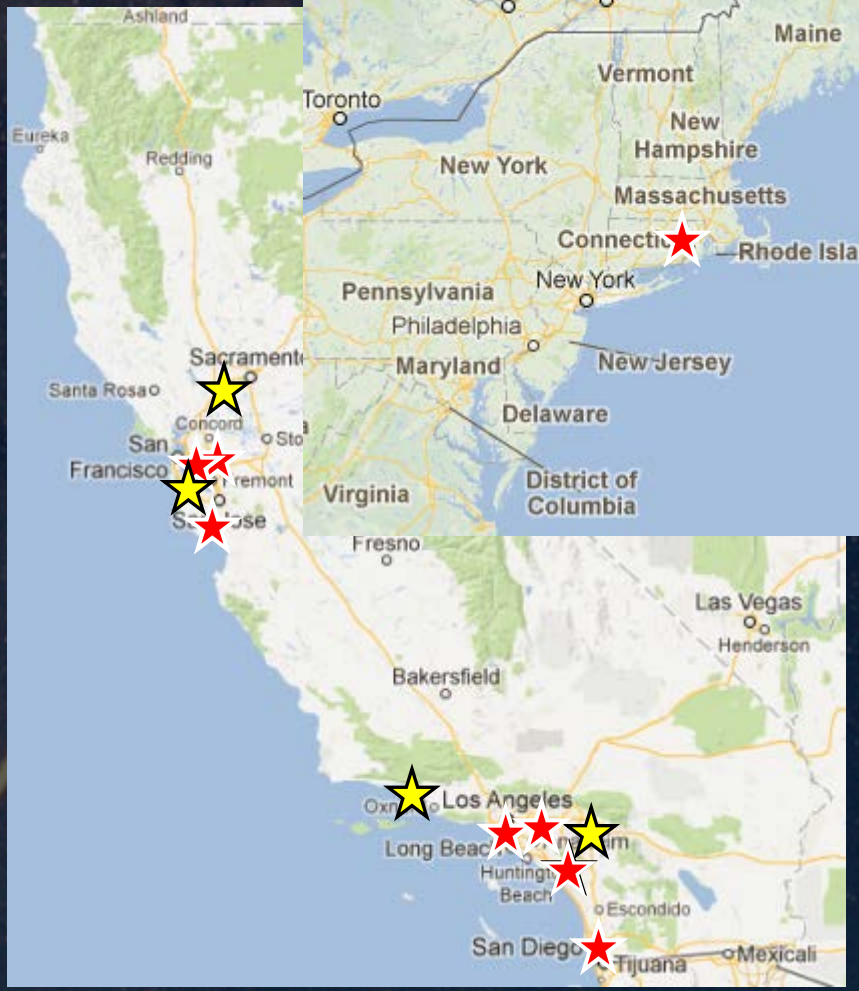
- Public data release for NIRC and LWS (July & Sep. 2015)
- Automated DRPs and level-1 data for all instruments
- Serving full set of keywords for all instruments
  - Better calibration association
  - Improved and more advanced searches (e.g., instrument "modes")
- Interactive viewers for NIRC2 and OSIRIS reduced cubes
- VO compliant services
- Formation of archive users' group
  - Guide priorities for new services

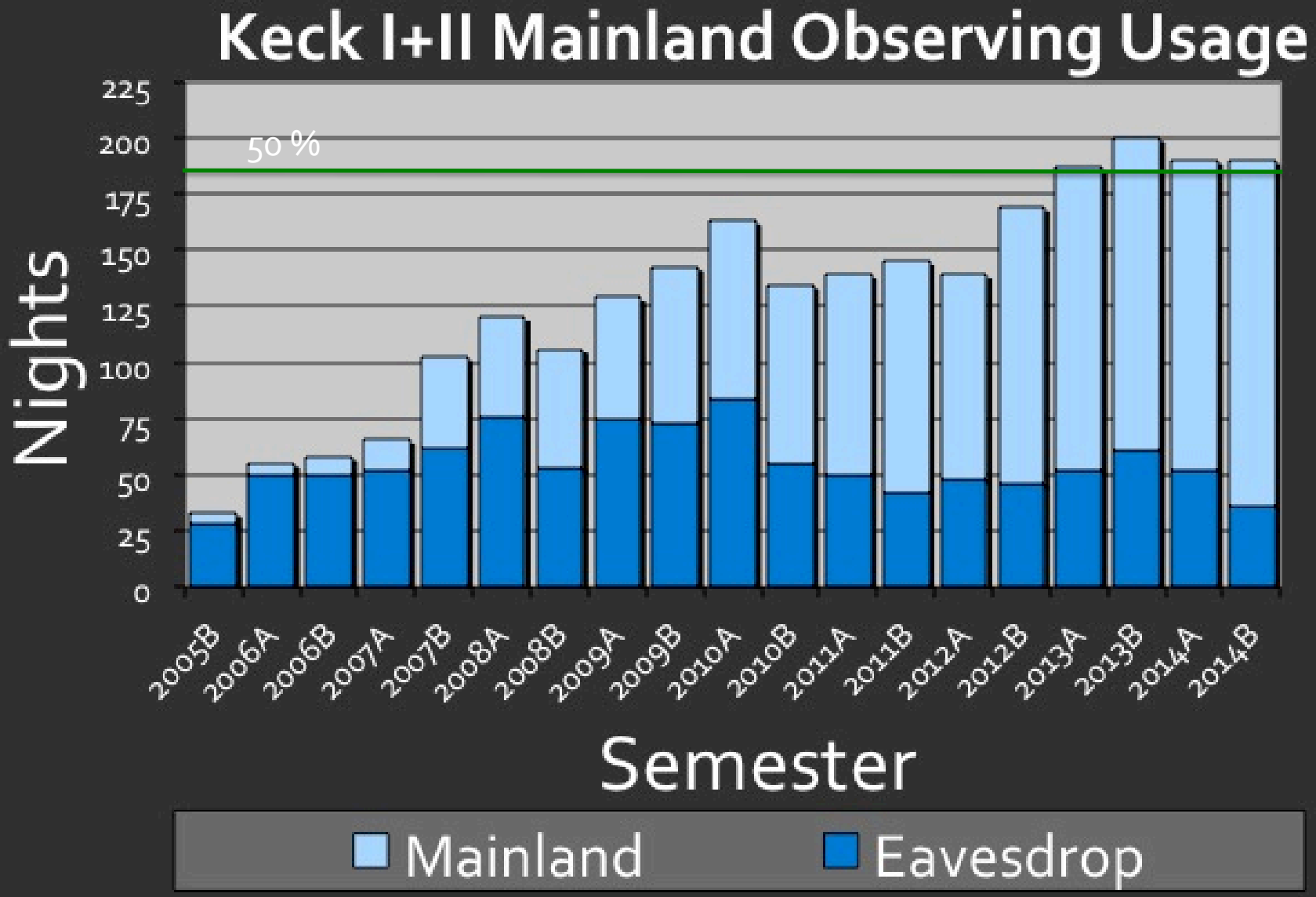
Mainland Observing

Greg Doppmann

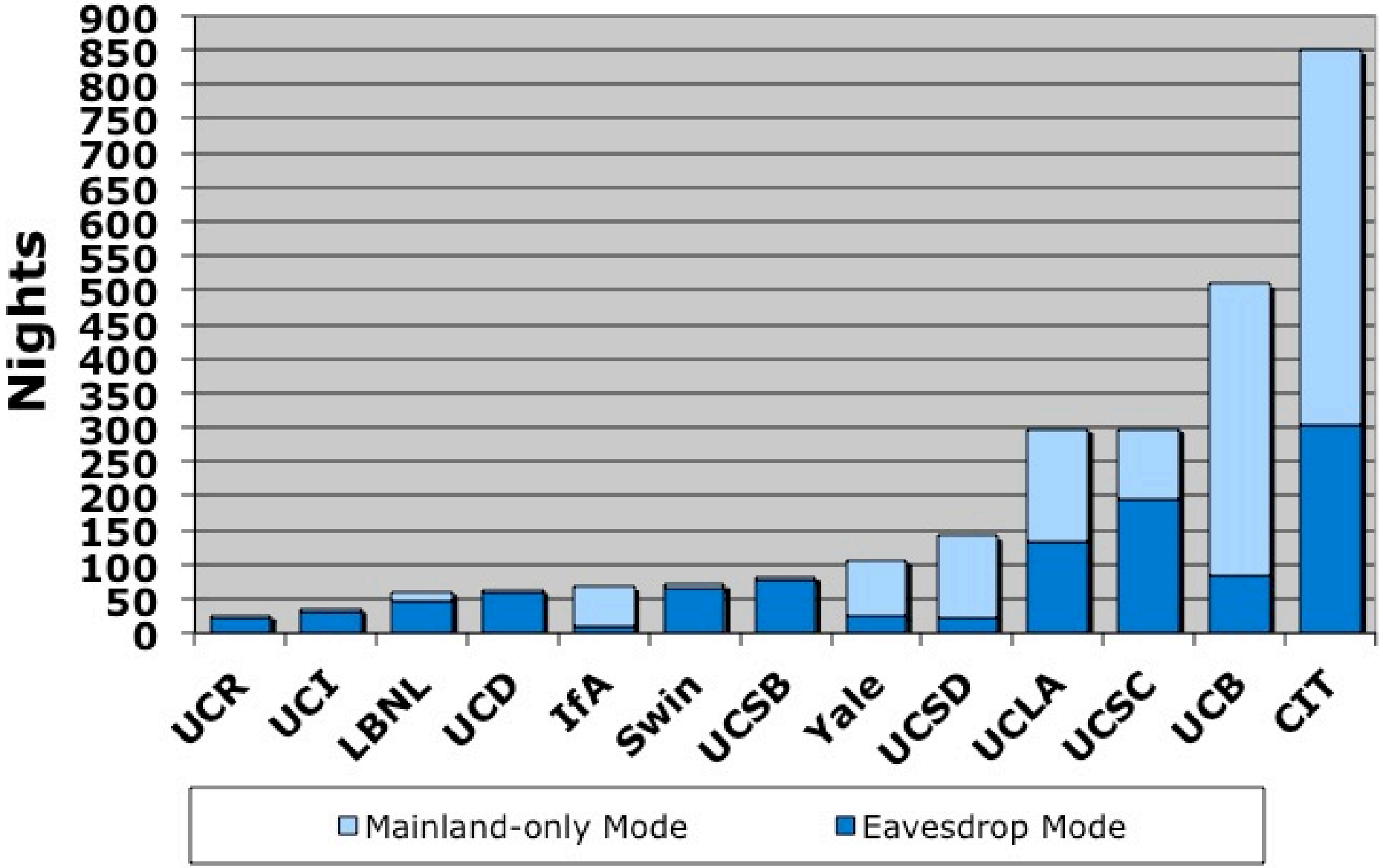
Mainland Observing Sites

- Primary Sites (10 total)
- Secondary sites (4 total)

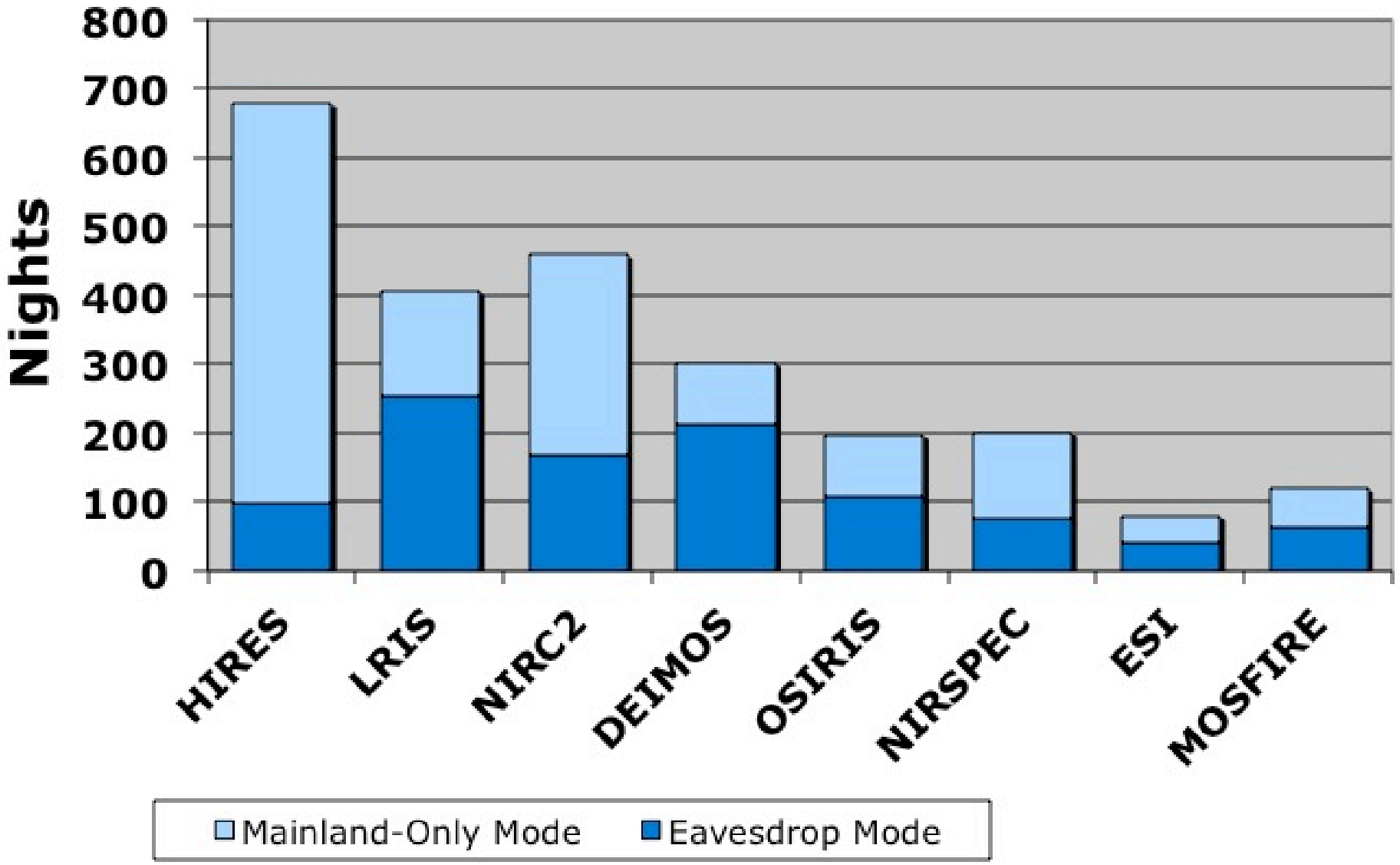



Keck I+II Mainland Observing Usage
Nights
225
200
175
150
125
100
75
50
25
0
50 %
2005B
2006A
2006B
2007A
2007B
2008A
2008B
2009A
2009B
2010A
2010B
2011A
2011B
2012A
2012B
2013A
2013B
2014A
2014B
Semester
Mainland
Eavesdrop

WMKO Remote Usage by Site



WMKO Remote Usage by Instrument



Mainland Observing Updates

- UCB remote observing site relocated to new campus (2 stations operational)
- Stanford now operational as a secondary remote site
- UCSD second remote station coming on-line soon