



# Science Steering Committee Meeting

## Staff Astronomer and Adaptive Optics Presentations

Virtual Meeting via Zoom

November 11, 2020

A cosmic background image featuring several bright, colorful galaxies and nebulae. The colors range from deep purple and blue to bright yellow and white, set against a dark, black space. The galaxies are scattered across the frame, with some appearing as distinct, bright spots and others as larger, more diffuse clouds of light. The overall effect is a rich, multi-colored celestial scene.

# Instrument Reports



Group 2  
KCWI, DEIMOS, NIRC2, ESI

# Keck Cosmic Web Imager

- Bench mounted IFU at K2 Nasmyth
- Range from 3500 to 5600 Angstrom
- Seeing limited
- Resolution from 1,000 to 20,000
- FOV 20" x (8, 16, or 33)"
- Efficiency > 20%



# KCWI Risk Matrix

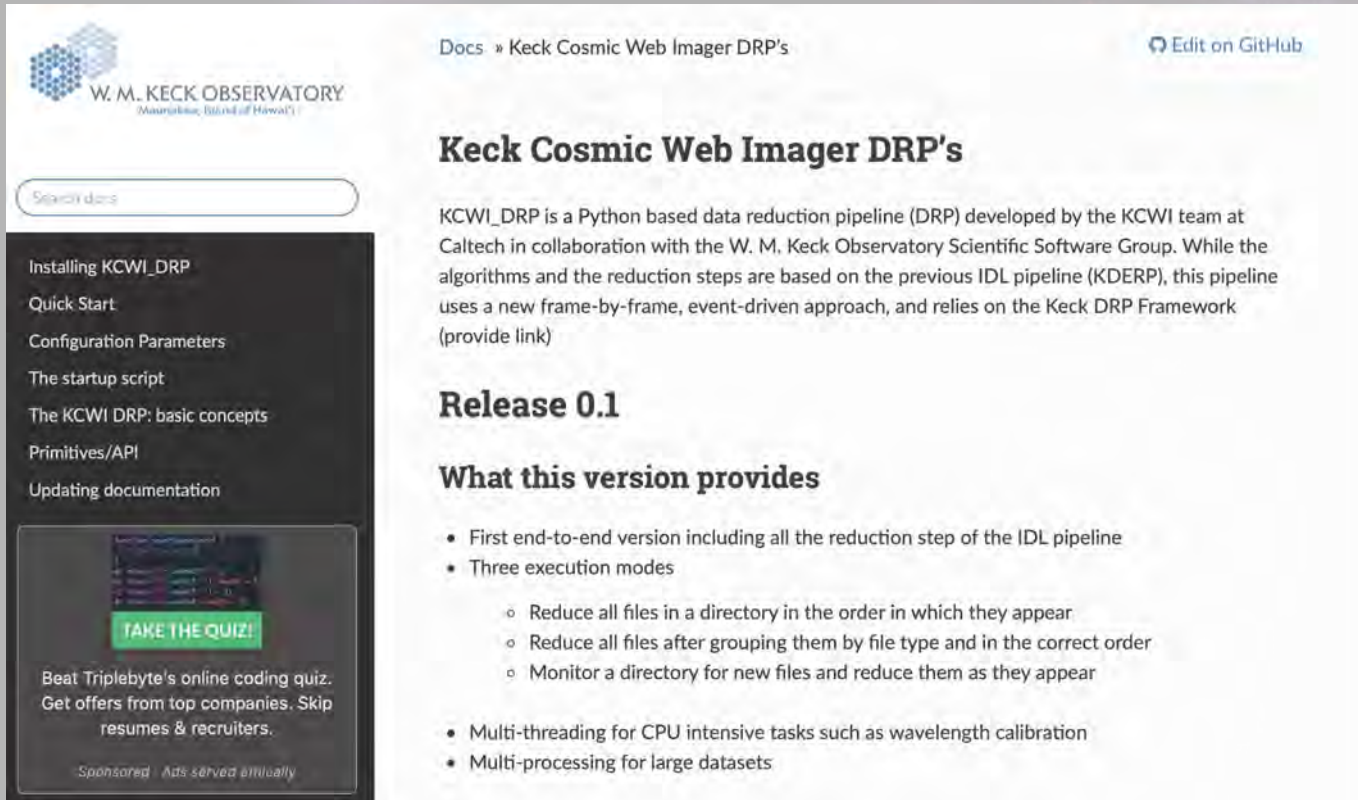
Likelihood of Occurrence	Very Likely >70% within year					
	Probable >35% within year	Minor dewar leak				
	Possible >5% within year	Software issues	Mechanisms problems			Extended loss of power causes overcooling of detector
	Unlikely <5% within year				Mechanism failure	Major dewar leak
	Very unlikely <1% within year					Damage to instrument during KCRM installation. Spill during cryo fill.
		Negligible: Little to no impact on Observation	Minor: Observation Compromised	Moderate: Observation Interrupted	Serious: Instrument Down one Night	Major: Instrument Down Indefinitely
<b>Risk Severity, Impact</b>						

# Activities

Project	Description	Status
Pipeline	Conversion to Python and adoption of Keck DRP Framework	Complete
Startup	Complete automation of the startup procedure	Complete
Autofill	Overhaul and upgrade of autofill system	Complete
Dewar fix	Repair or replacement of leaking dewar	Awaiting KCRM
BH1	Delivery of BH1 grating	Awaiting KCRM
Charge on detector	Fix for excessive charge injected in the detector after a binning switch	Deferred / Addressed in software
Polarimeter	Commissioning of polarimeter	Scheduled for December
Pipeline	Deployment of new pipeline and prototype of DSI end-to-end data flow	Scheduled for December

# New KCWI pipeline

- Event driven
- Reproduces the previous pipeline
- Python: easy to maintain
- Open developed
- Continuous integration
- Same infrastructure as KPF and HISPEC pipelines
- Runs in real time at the telescope and offline for an entire night
- Integral part of DSI
- Currently testing simulated KCRM images



The screenshot shows the documentation page for the Keck Cosmic Web Imager DRP's. The page header includes the W. M. Keck Observatory logo and a search bar. The main content area is titled "Keck Cosmic Web Imager DRP's" and includes a "Release 0.1" section. A sidebar on the left contains navigation links for "Installing KCWI\_DRP", "Quick Start", "Configuration Parameters", "The startup script", "The KCWI DRP: basic concepts", "Primitives/API", and "Updating documentation". A "TAKE THE QUIZ!" button is visible in the sidebar, along with a promotional message: "Beat Triplebyte's online coding quiz. Get offers from top companies. Skip resumes & recruiters." The main text describes the pipeline as a Python-based data reduction pipeline (DRP) developed by the KCWI team at Caltech, which uses a new frame-by-frame, event-driven approach and relies on the Keck DRP Framework. The "Release 0.1" section lists features such as being the first end-to-end version, supporting three execution modes (reducing files in order, by file type, and monitoring for new files), multi-threading for CPU-intensive tasks, and multi-processing for large datasets.

W. M. KECK OBSERVATORY  
Maunakea, Island of Hawaii

Docs » Keck Cosmic Web Imager DRP's [Edit on GitHub](#)

## Keck Cosmic Web Imager DRP's

KCWI\_DRP is a Python based data reduction pipeline (DRP) developed by the KCWI team at Caltech in collaboration with the W. M. Keck Observatory Scientific Software Group. While the algorithms and the reduction steps are based on the previous IDL pipeline (KDERP), this pipeline uses a new frame-by-frame, event-driven approach, and relies on the Keck DRP Framework ([provide link](#))

### Release 0.1

#### What this version provides

- First end-to-end version including all the reduction step of the IDL pipeline
- Three execution modes
  - Reduce all files in a directory in the order in which they appear
  - Reduce all files after grouping them by file type and in the correct order
  - Monitor a directory for new files and reduce them as they appear
- Multi-threading for CPU intensive tasks such as wavelength calibration
- Multi-processing for large datasets

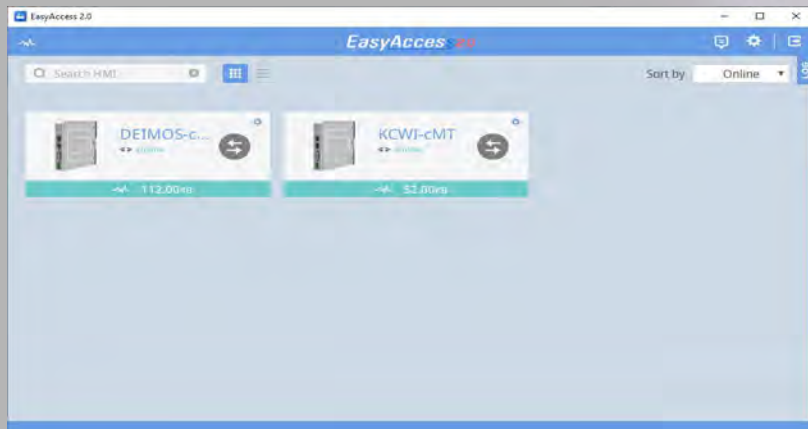
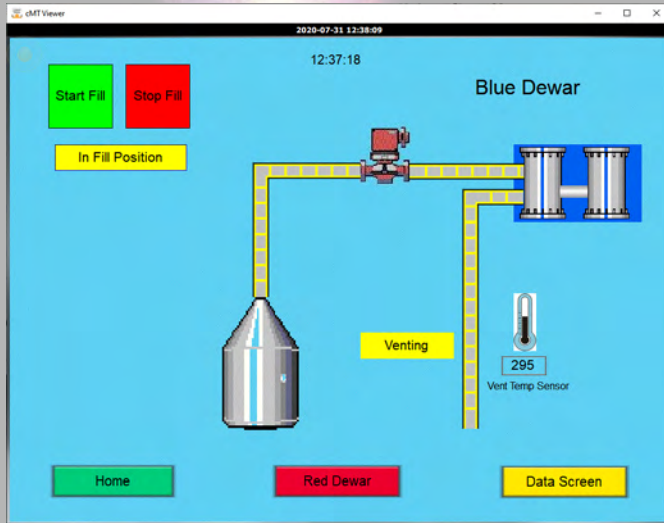
Installing KCWI\_DRP  
Quick Start  
Configuration Parameters  
The startup script  
The KCWI DRP: basic concepts  
Primitives/API  
Updating documentation

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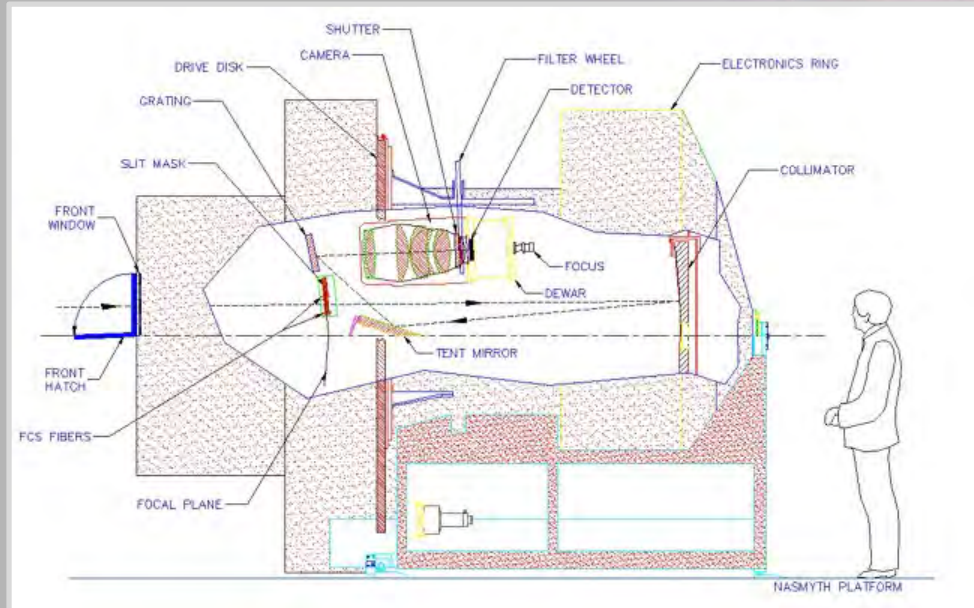
# Autofill upgrade



- PLC moved outside of the instrument
- Shared procedure and controls with DEIMOS
- Software and hardware interlocks to prevent spills
- Ready to accommodate KCRM



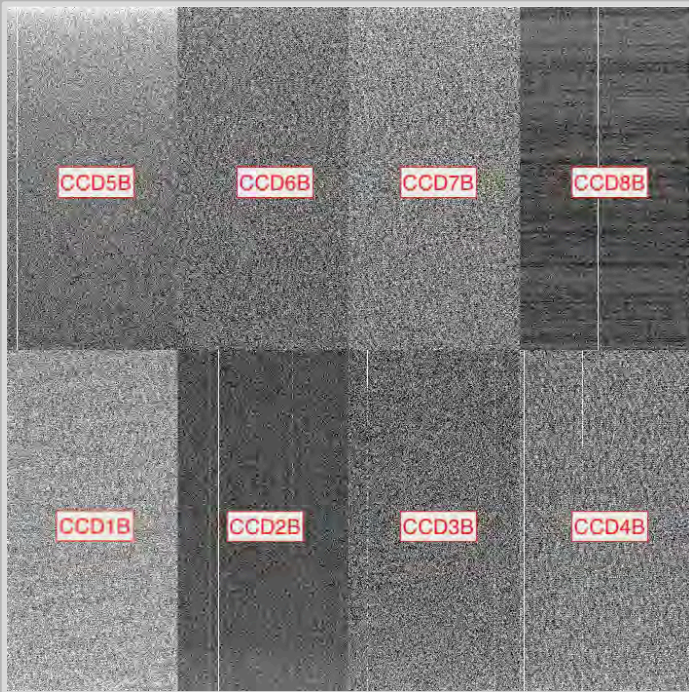
# DEIMOS (DEep Imager and Multi-Object Spectrograph)



- Institution: UCO/Lick
- PI: Sandy Faber
- First Light: June 3, 2002
- Capabilities: Imaging, MOS and long-slit spectroscopy
- Coverage: 0.4 to 1.0  $\mu\text{m}$
- Detector: 8x2048x4096 (4x2 mosaic) MIT/LL CCDs (15  $\mu\text{m}$  pix)
- Pixel scale: 0.1185"
- FOV: 16.7'x5'
- Spectral resolution: 1,200 – 7,600
- Closed-loop flexure compensation system

# DEIMOS Risk Matrix

Likelihood of Occurrence	Very Likely >70% within year				Detector (CCD2, CCD5, CCD8)	
	Probable >35% within year					
	Possible >5% within year				Rotator drive	
	Unlikely <5% within year			Optomechanical components	Cryogenics	
	Very unlikely <1% within year					
		Negligible: Little to no impact on Observation	Minor: Observation Compromised	Moderate: Observation Interrupted	Serious: Instrument Down one Night	Major: Instrument Down Indefinitely
<b>Risk Severity, Impact</b>						

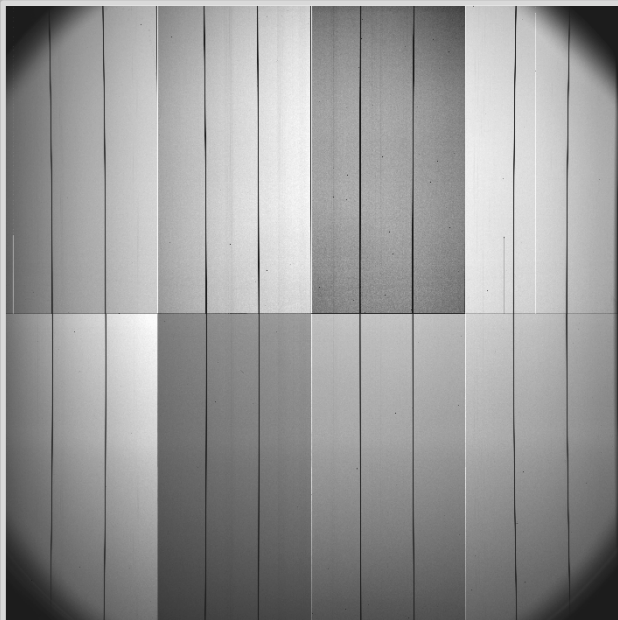


- **Detector electronics:**

- Serious issues with CCD2, CCD5 and CCD8 in the last year
- Current issues: CCD3A, CCD5A, CCD5B, CCD6A and CCD8A
- Full mosaic is currently operational

- **Rotator drive degraded performance:**

- High servo error mitigated by tracking PID.
- Harmonic drive replaced with a new one on November 2, 2020



November 11, 2020



WMKO Report, Science Steering Committee

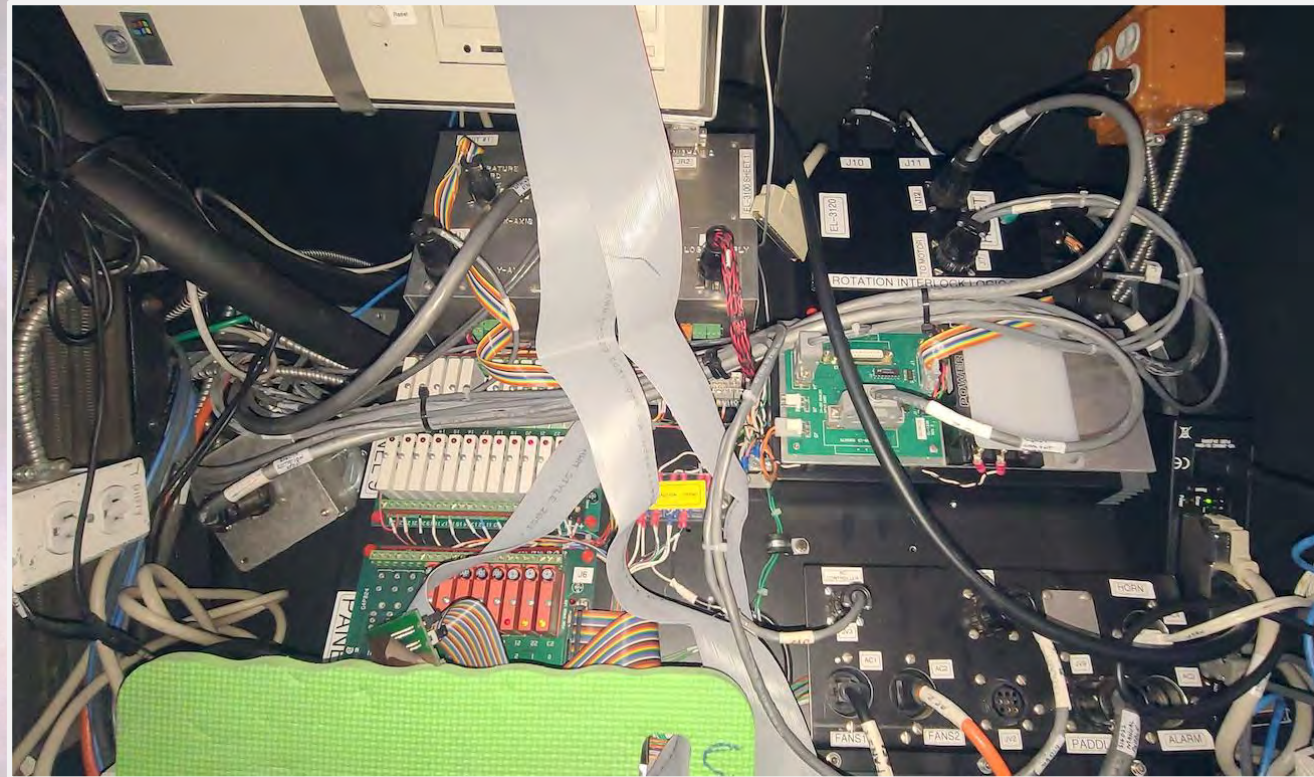


# DEIMOS Rotator Control System Upgrade

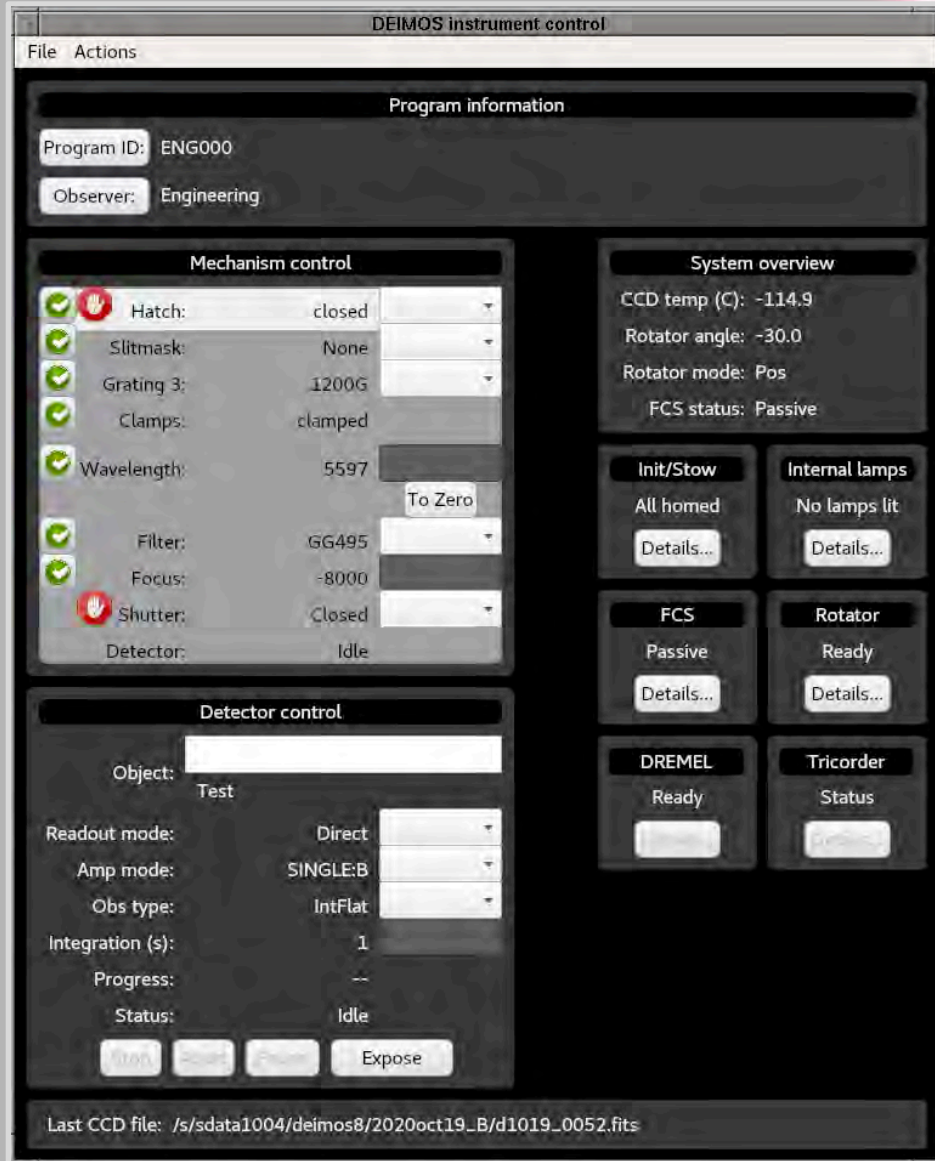
## Motivation:

- To replace Dell Optiplex 110x PC (Red Hat 6.1, 32b.)
- To replace Galil DMC-1840 controller and obsolete kernel driver.

Status: **Completed**



# DEIMOS Instrument Host Upgrade

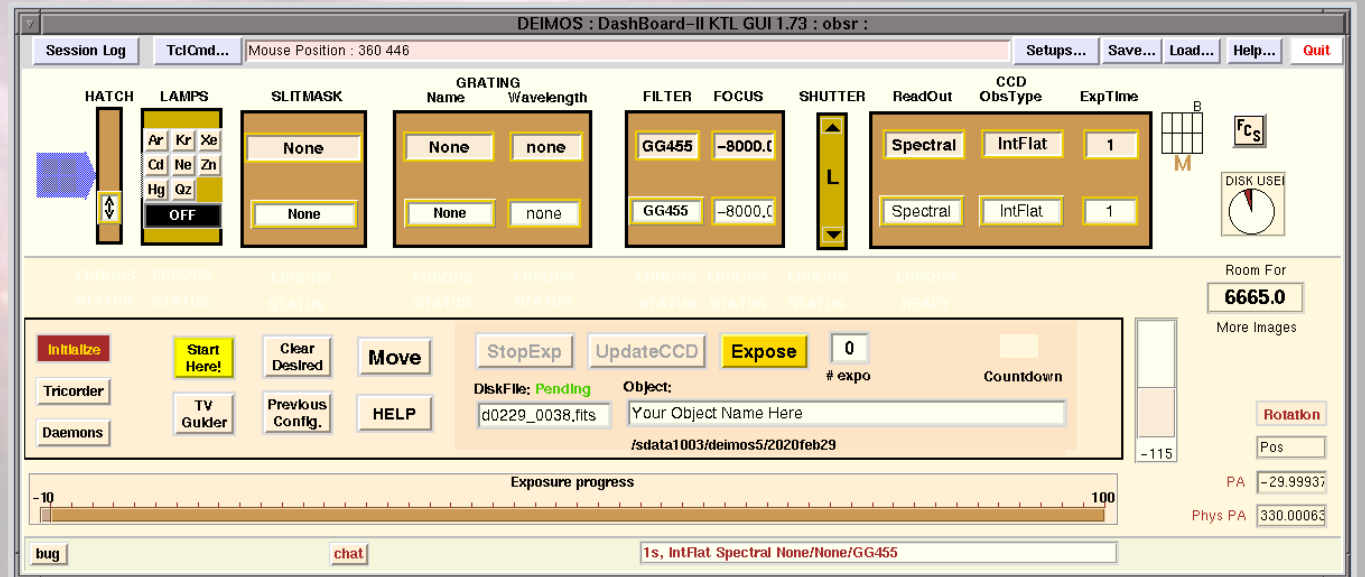


## Objectives:

- To replace obsolete host (polo)
- To eliminate dependency of obsolete software

## Status:

- Used for science operations since July 2020
- Pending web docs and update a few scripts used for operations

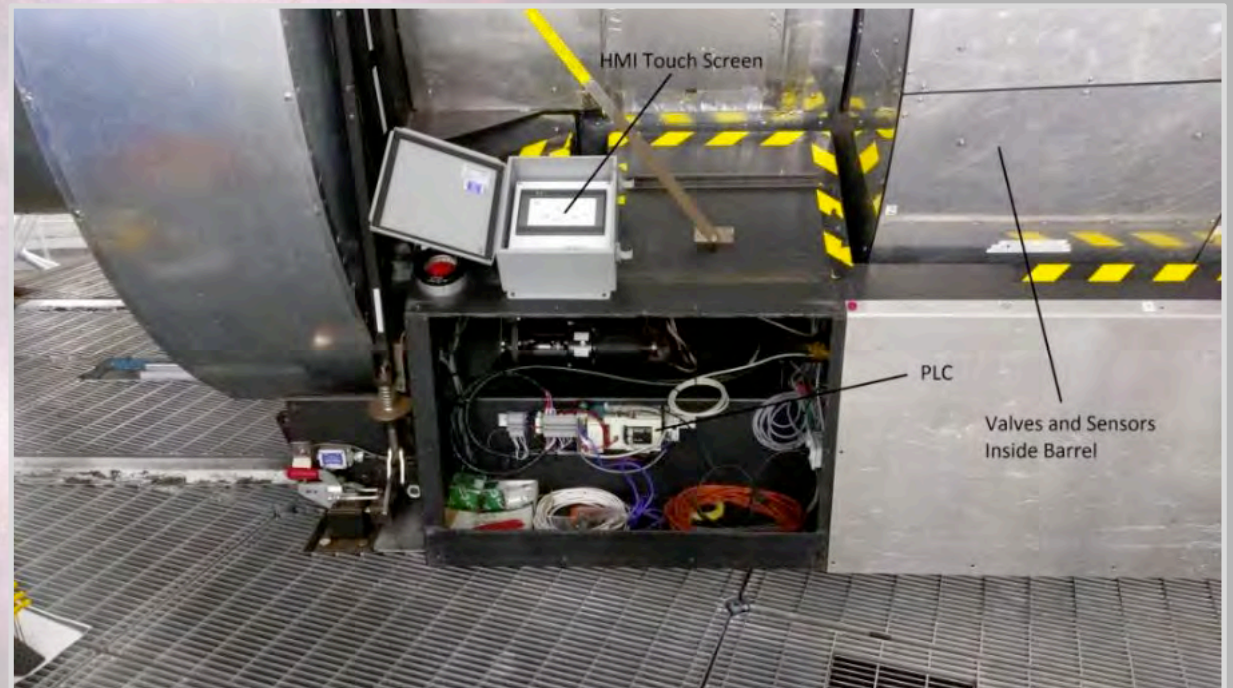
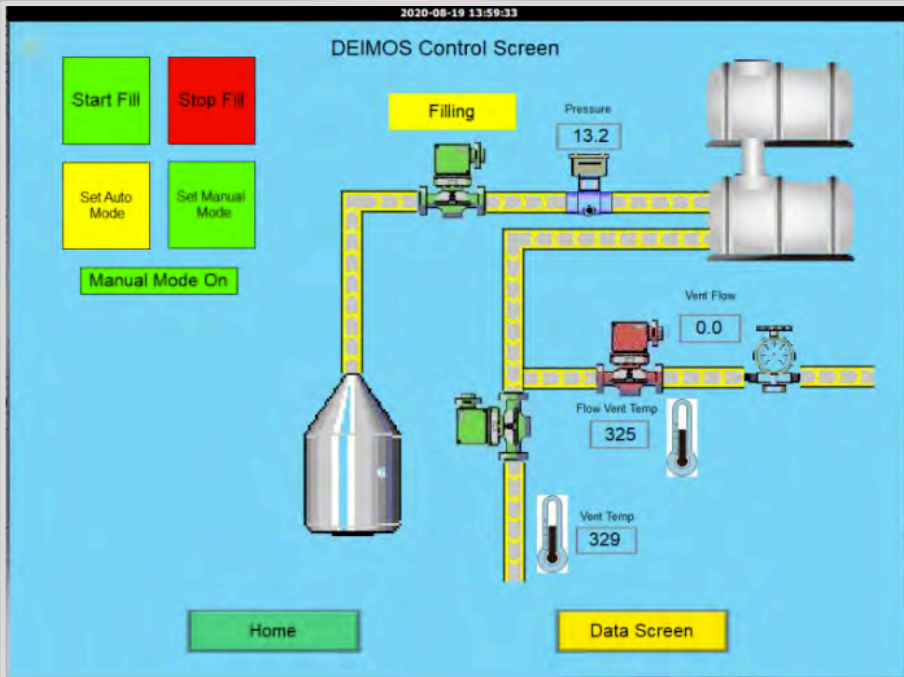


# DEIMOS Autofill Upgrade

## Objectives:

- To eliminate complexity of previous autofill
- To easy access to data, which can be read into keywords
- To simplify operation
- Commonality with KCWI autofill

Status: **Completed**



# Pre-observing software upgrades

## Slitmask database migration:

- **Main motivation:** To eliminate dependency of UCO/Lick (master database on UCO computer).
- **Status:** Most of the work still pending (Steve Allen focused on KCRM.)

## Slitmask design tool replacement:

- **Motivation:** To replace dsimulator, which is based on obsolete IRAF code.
- **Status:**
  - Web interface needs debugging.
  - Currently testing comparison between masks created with new and old design tool.
  - Pending on-sky testing.

Slitmask Design Tool Prototype

Target List:

Status: maskBase=0.00, north=0, scale=0.72, posAngle=-52.00 slitBase=308.00 bx=180.00, compass=218.00, slitRe2Mask=128.00

Reset Display

Min. Priority: 0

Show all targets  Show selected  Show by priority

Show align box

use DSS (needs reload)

Enable navigation  Lock navigation  Enable selection

Show preview  Show slit pos

RA hrs= 02:05:29.73 DEC deg= -04:22:23.94 x=-495.23 y=161.85 skyX=0.0 skyY=0.0

+ Selected target, — Target, □ Alignment box,  
Mouse-Left: pan, Ctrl-Left: rotate view, Mouse-Right: move field, Ctrl-Right: rotate field;  
Alt-Left: scale, Dbl-click: reset  
Moves: h: left, l: right; j: move up; k: down Zoom: x: zoom in; <: zoom out.

Name	RA	DEC	Prior	Slit	In	Slit Pk	Magn	Band	Len1	Len2	SlitWidth
1	02:05:05.80	-04:15:20.30	50	1	1	-45	20.01	R	5.0	5.0	1.5
2	02:05:17.10	-04:16:15.10	50	1	1	-45	20.20	R	5.0	5.0	1.5
3	02:05:07.90	-04:18:58.80	50	1	0	-45	20.84	R	4.0	4.0	1.5
4	02:05:22.80	-04:18:23.90	50	1	1	-45	21.27	R	5.0	5.0	1.5
5	02:05:24.20	-04:16:25.50	40	1	1	-45	21.73	R	7.9	2.1	1.5
6	02:05:21.50	-04:16:50.00	40	1	1	-45	21.75	R	5.0	5.0	1.5
7	02:05:08.30	-04:18:27.70	40	1	0	-45	21.77	R	4.0	4.0	1.5
8	02:05:05.00	-04:17:29.00	40	1	0	-45	21.93	R	4.0	4.0	1.5
9	02:05:13.00	-04:16:02.10	30	1	1	-45	22.07	R	0.5	9.5	1.5
10	02:05:13.40	-04:18:31.50	30	1	1	-45	22.19	R	1.8	8.2	1.5
11	02:05:14.30	-04:15:46.70	30	1	1	-45	22.24	R	5.0	5.0	1.5
12	02:05:07.30	-04:13:00.60	30	1	1	-45	22.27	R	5.0	5.0	1.5
13	02:05:02.50	-04:14:00.30	30	1	1	-45	22.48	R	5.0	5.0	1.5
23	02:05:29.30	-04:21:03.70	5	1	0	-45	19.86	R	4.0	4.0	1.5
42	02:04:41.70	-04:12:02.30	5	1	0	-45	19.07	R	4.0	4.0	1.5
62	02:04:48.00	-04:12:36.90	5	1	1	-45	19.24	R	5.0	5.0	1.5

Selected target: None

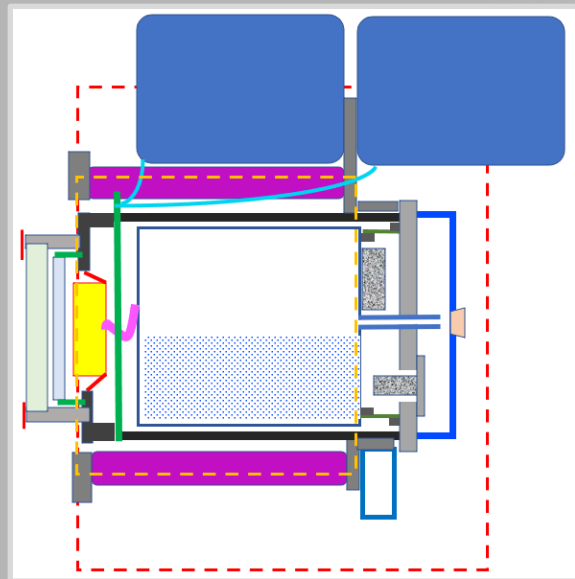
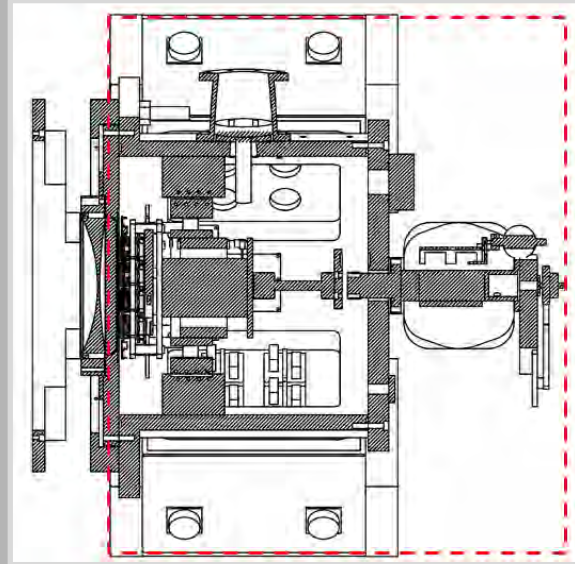
RA [hrs]:  DEC [deg]:

Priority:  Select:

Slit Pk:  Slit Width:

Length1:  length2:

# DEIMOS throughput upgrade

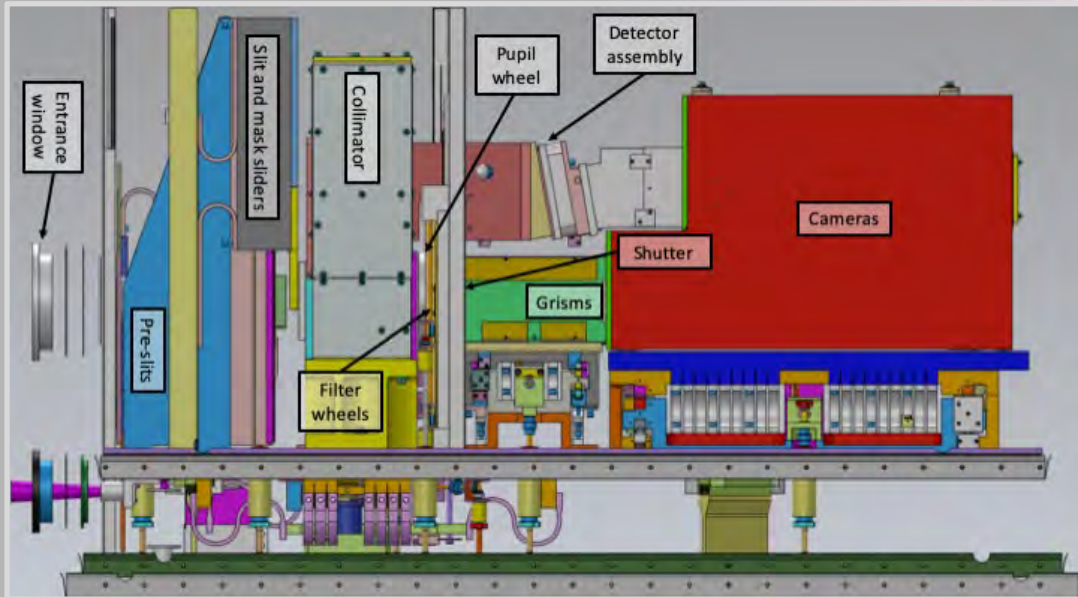
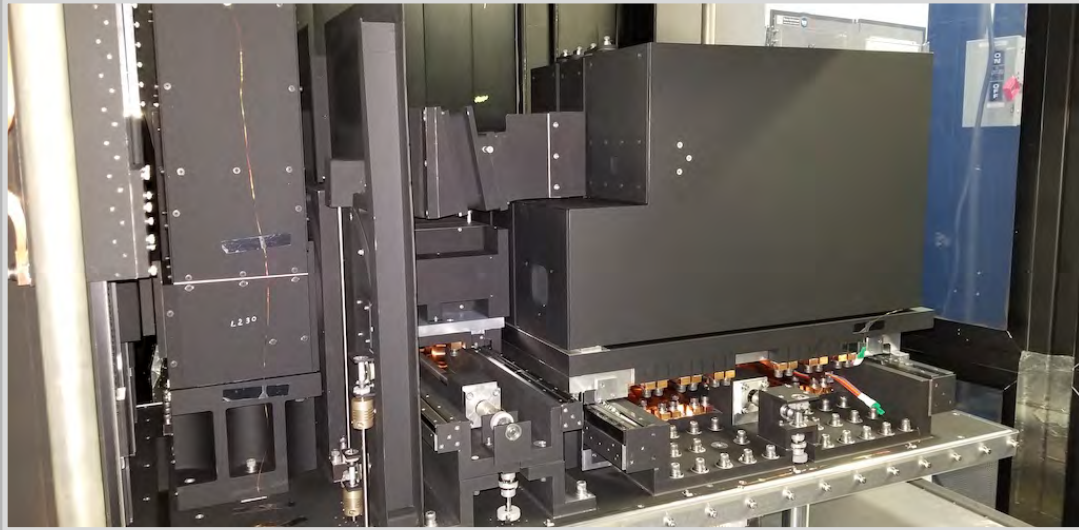


- Project led by E. Kirby (CIT).
- Objectives are to upgrade:
  - Science CCD mosaic
  - FCS CCDs
  - Detector dewar
  - Flexure compensation mechanism (hexapod)
- Currently working with the CIT team in preparing NSF MRI proposal for January 2021





# NIRC2 (Near-IR Camera 2)



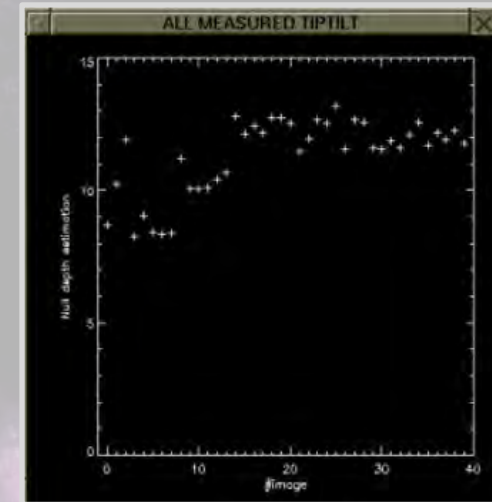
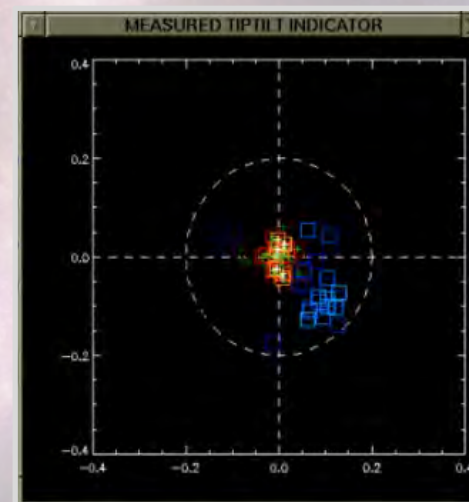
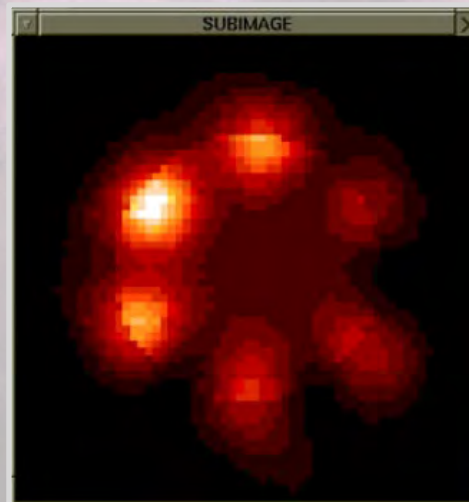
- Institution: Caltech
- PI: Keith Matthews
- First Light: July 29, 2001
- Keck-II AO-fed instrument
- Capabilities: Imaging, coronagraphy and long-slit spectroscopy
- Coverage: 0.9 to 5.5 micron
- Detector: 1024x1024 InSb Aladdin-3
- Pixel scale: 10mas, 20mas, 40mas
- FOV: 10"x10", 20"x20" and 40"x40"
- Spectral resolution: 1200 – 9700

# NIRC2 Risk Matrix

Likelihood of Occurrence	Very Likely >70% within year					
	Probable >35% within year					
	Possible >5% within year				Instrument host	
	Unlikely <5% within year			Other detector electronics	Detector transputers	
	Very unlikely <1% within year					
		Negligible: Little to no impact on Observation	Minor: Observation Compromised	Moderate: Observation Interrupted	Serious: Instrument Down one Night	Major: Instrument Down Indefinitely
<b>Risk Severity, Impact</b>						

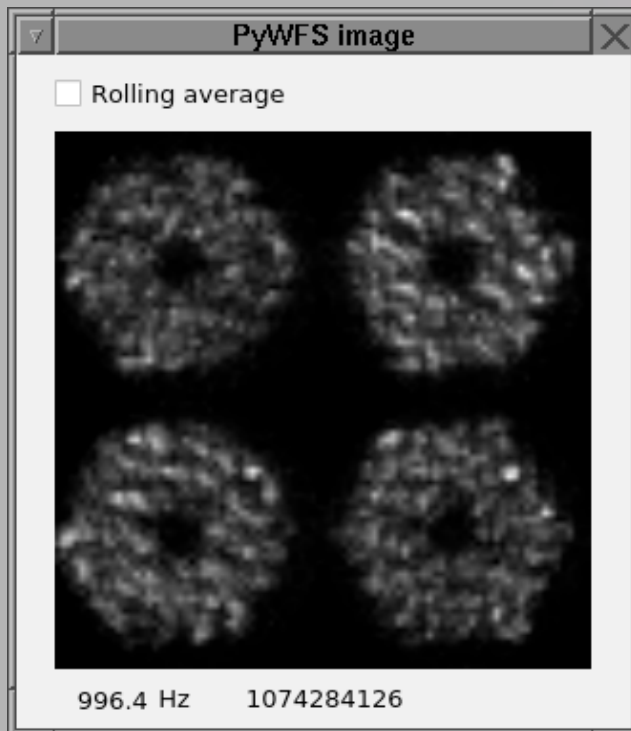
# Issues

- **Detector (alad) server crashes on NIRC2 host (waikoko):** Occur almost every night but hardly any time lost. Unknown cause. RPC issue.
- **NIRC2 host used to suffer spontaneous reboots.** Hardware partially replaced last November. No issues since then.
- **Low efficiency of operations with the VVC.**

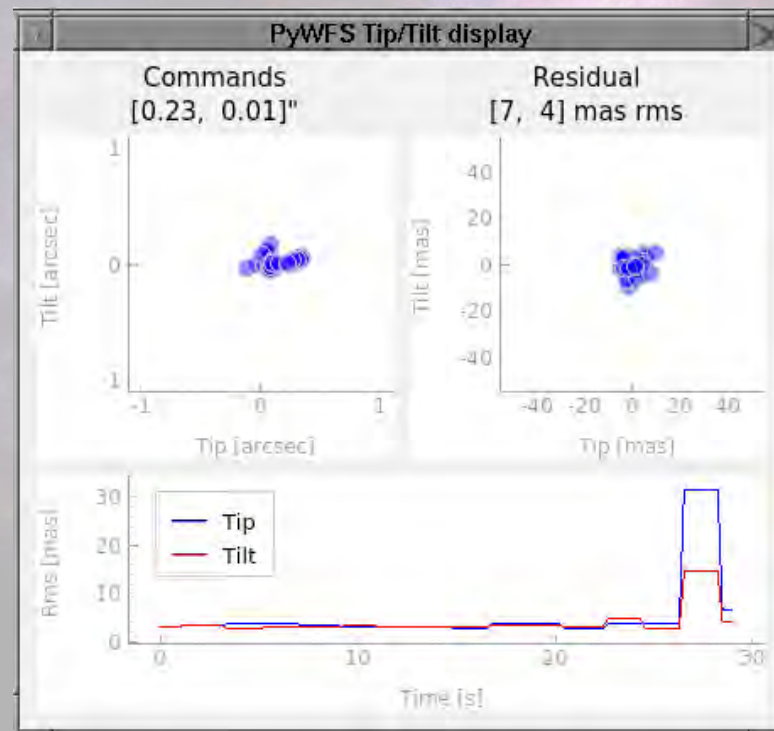


# NIRC2 operations improvements

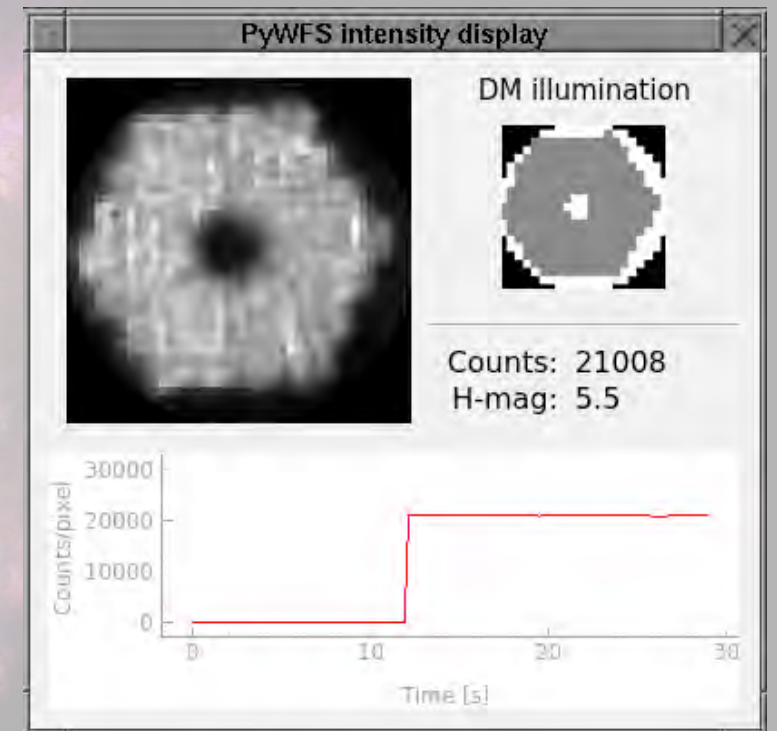
- Updated image writing software:
  - Increased FITS header size to include PyWFS keywords.
  - Fixed long-standing issue with the FITS header END card.
- PyWFS monitoring GUIs available on NIRC2 VNCs.



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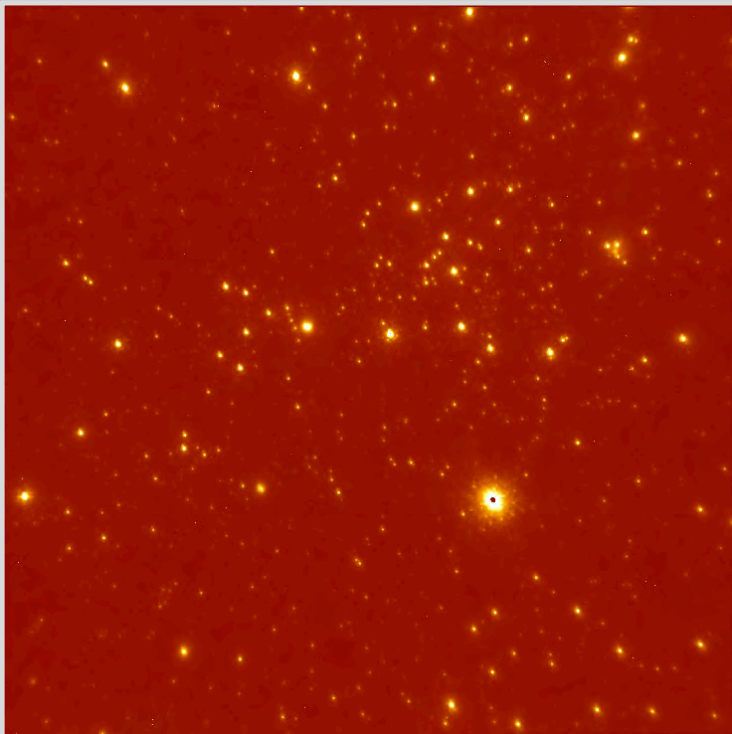
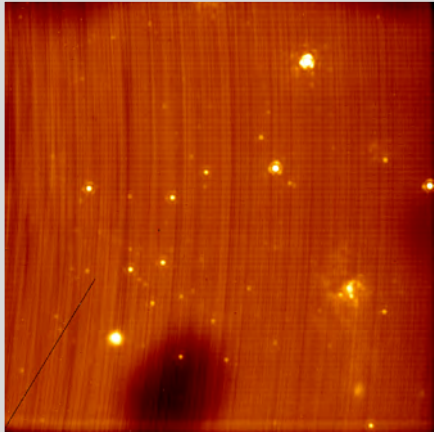


WMKO Report, Science Steering Committee



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# NIRC2 vs. OSIRIS imager



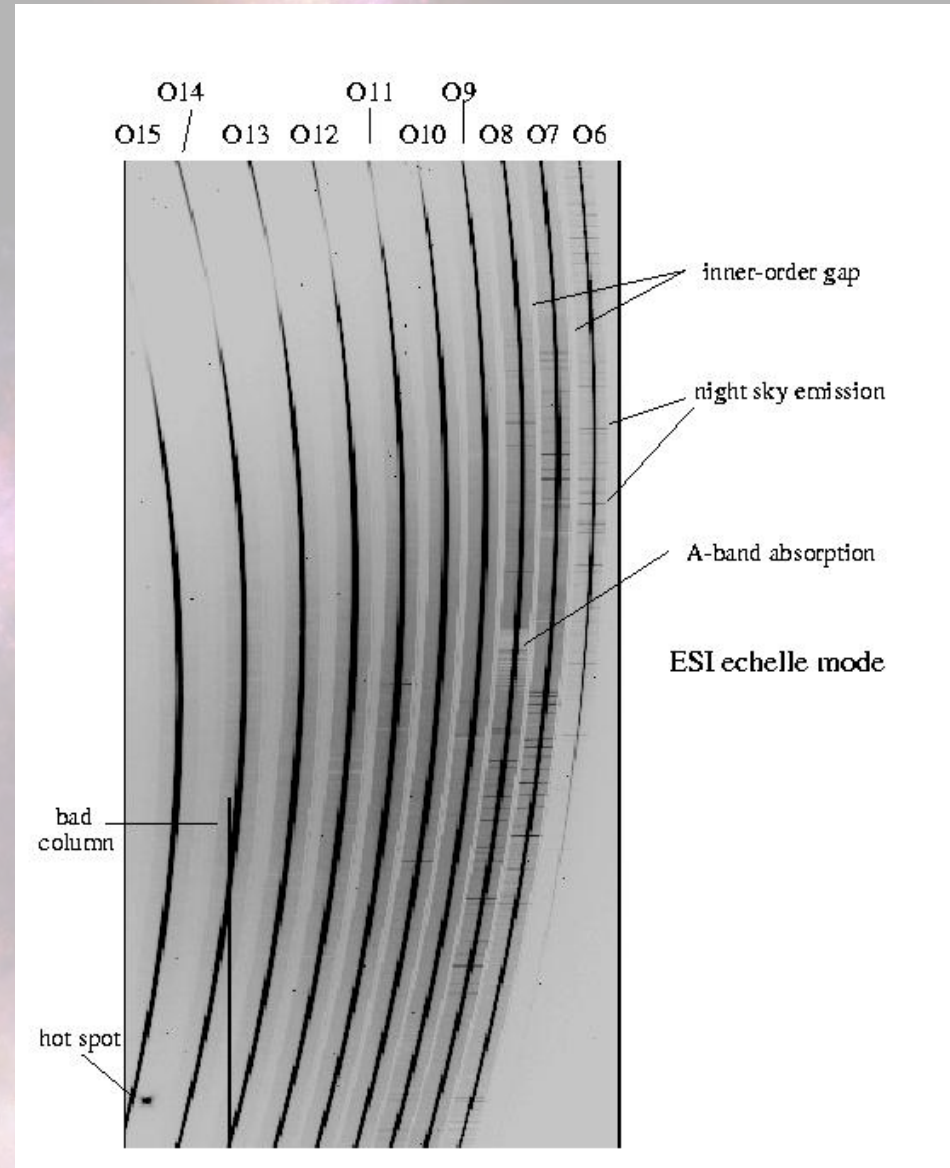
	NIRC2	OSIRIS imager
Detector	1Kx1K Aladdin-3 InSb	2Kx2K Teledyne H2RG HgCdTe
Wavelength ( $\mu\text{m}$ )	0.9 – 5.3	0.9 – 2.5
Pixel scale (mas)	10, 20 and 40	10
FOV ( $\text{arcsec}^2$ )	10x10, 20x20, 40x40	20x20
Sub-windowing	Yes	No
T_exp min (full frame)	0.18s	1.5s
RON per CDS (e-)	60	23
Gain (e-/DN)	4	2.2
1% linearity (DN)	10,000 (40,000 e-)	20,000 (44,000 e-)
AO Capabilities	PyWFS	TRICK

# ESI

Jim Lyke



Keck II: Cassegrain  
20" slit, Cross-dispersed  
3900-11,000 Å , R=13,000



# ESI Risk Matrix

Likelihood of Occurrence	Very Likely >70% within year					
	Probable >35% within year				Cryo Shortage	
	Possible >5% within year				Guider Failure	Detector System Failure
	Unlikely <5% within year					Mechanism or Encoder Failure
	Very unlikely <1% within year					
		Negligible: Little to no impact on Observation	Minor: Observation Compromised	Moderate: Observation Interrupted	Serious: Instrument Down one Night	Major: Instrument Down Indefinitely
		<b>Risk Severity, Impact</b>				

# ESI Efforts

- **Rotator Incident Report**

- On-sky tracking problem investigation led to instrument shake
- Missed lubrication PM during COVID shutdown
- **FIX:**
  - Lubricated rotator bearing
  - Removed input biases from rotator amplifiers
  - Lowered Amp B error amplifier gain

- **Guider failure**

- Replaced with spare
- Driving guider replacement project