(nu)MOIRCS

Detector and Control System Upgrade 2015

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Overview

- MOIRCS
- Detector Upgrade
- Unexpected Challenge(s)
- (Control System Upgrade)
- Current Status

  preliminary performance estimates

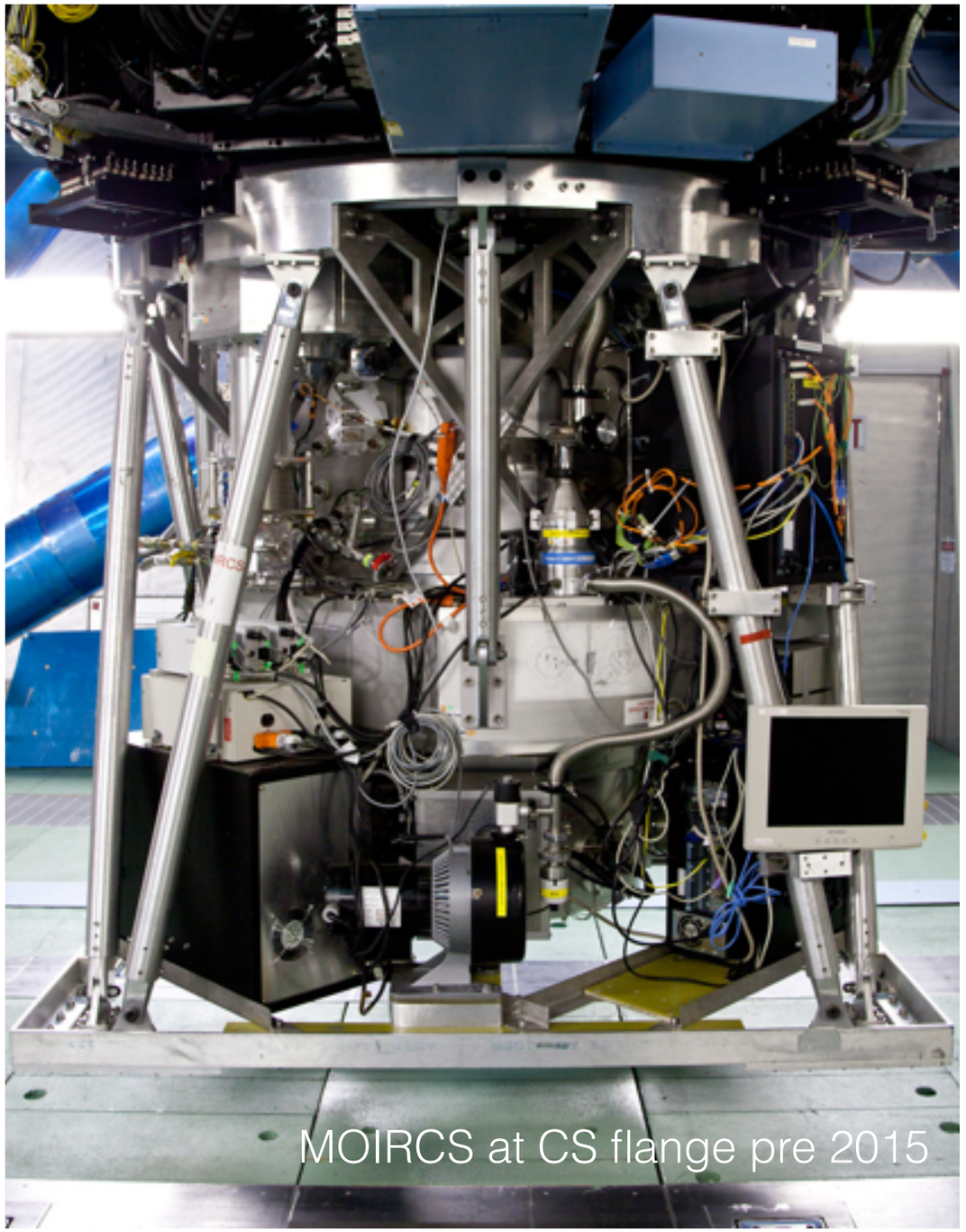
MOIRCS

- MOIRCS [Ichikawa+ 2006, Suzuki+ 2008] is one of Subaru's workhorse near infrared instruments.

- It provides seeing limited imaging (Y,J,H,K[s]) with a FOV of 7' x 4' and MOS spectroscopy through slit masks (R=500-1100/0.5" slit).

- MOIRCS has been one of the earliest instruments of it's kind (first light 2004, open use since 2005), but more recent instruments such as MOSFIRE [McLean+ 2012] offer higher sensitivity.

- As part of nuMOIRCS, in 2015 MORICS has undergone an upgrade of its two science detectors (Hawai'i 2 -> H2RG), housekeeping electronics and instrument control system.

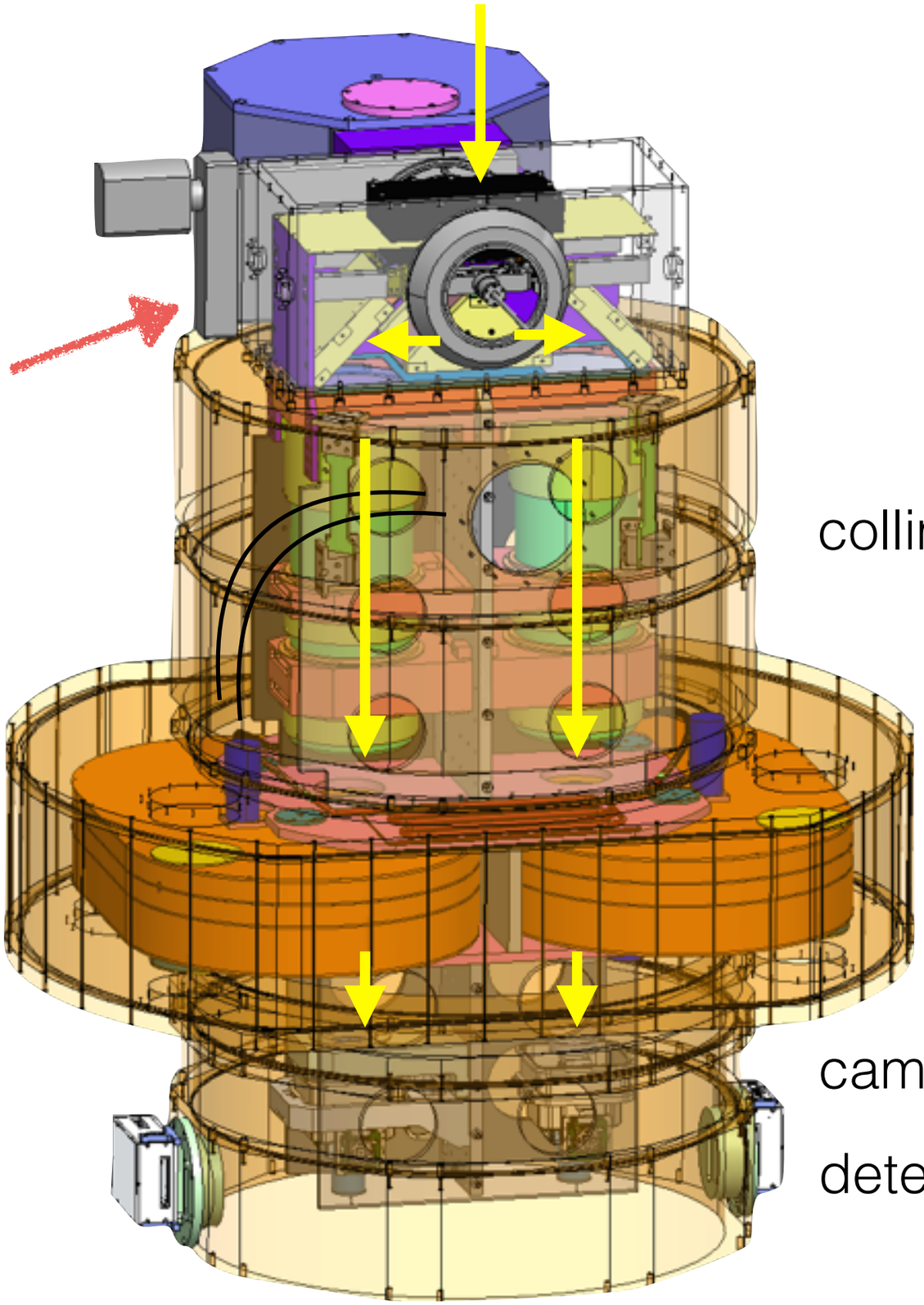


MOIRCS at CS flange pre 2015

MOIRCS

- MOIRCS divides its FOV into two identical channels through the use of a roof mirror system.

- Both channels hold and identical set of optics, filters, GRISMs and detectors.

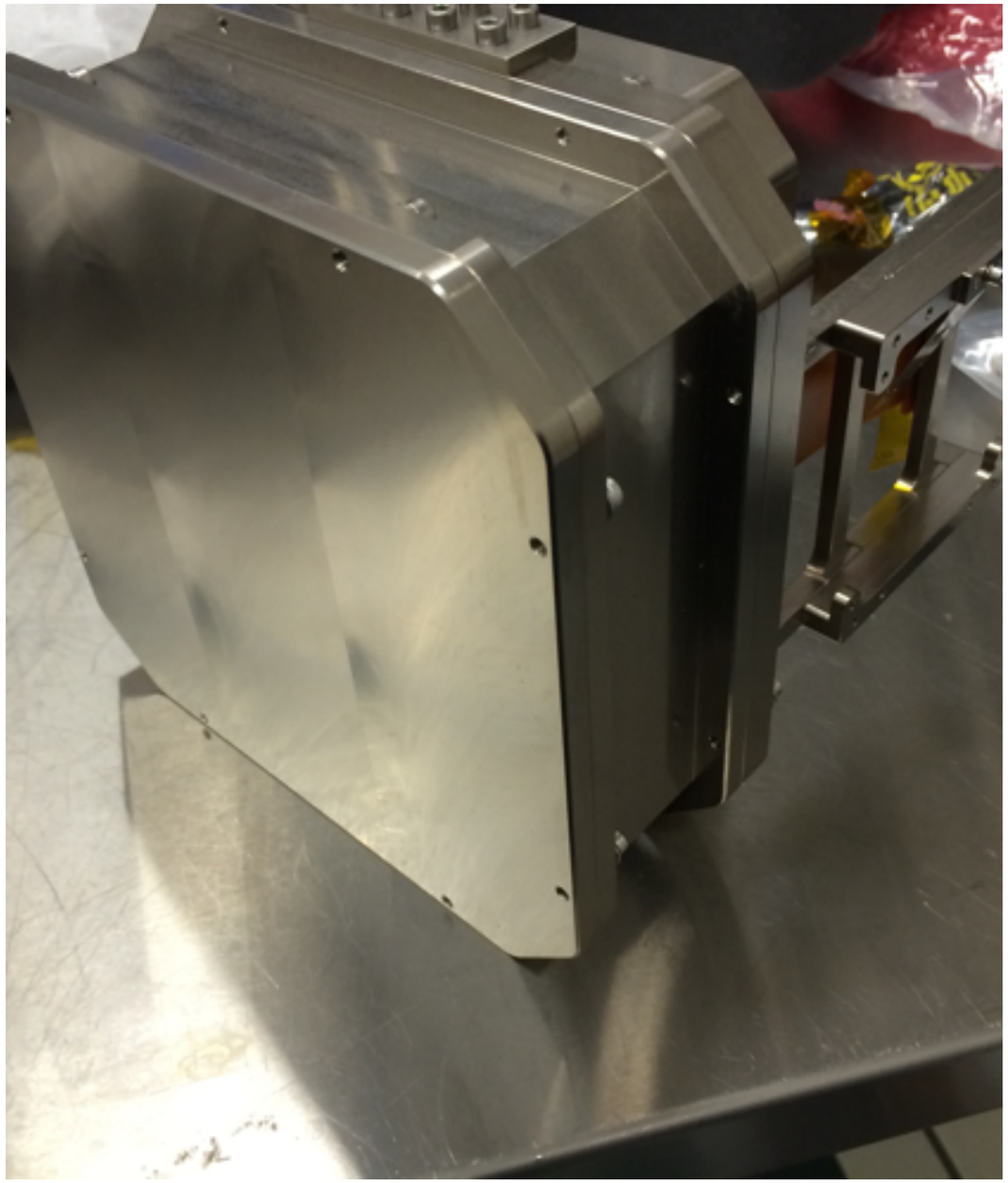


Detector Upgrade

- The new H2RG detectors were purchased from Teledyne Scientific Imaging

- The detector housing and temperature control was purchased from GL Scientific

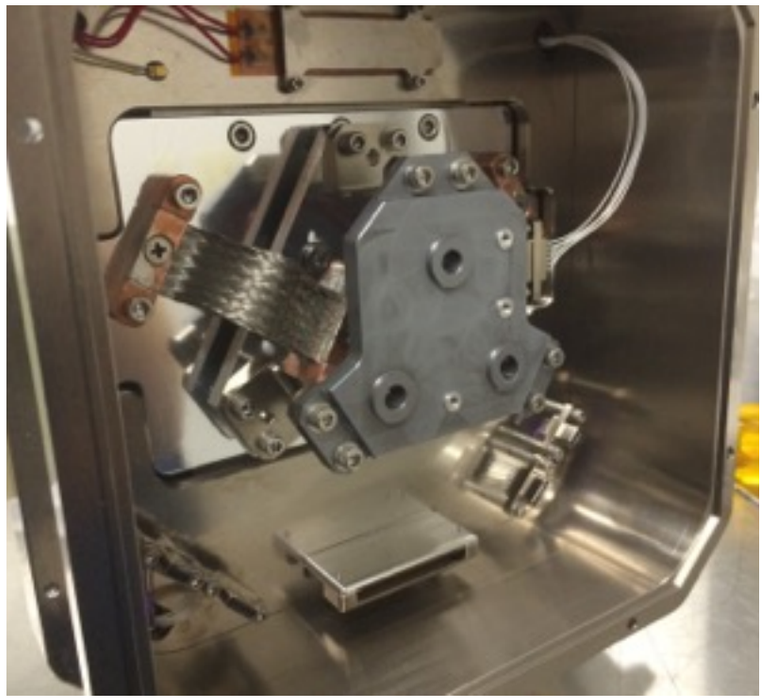
- At Subaru we developed the mechanical interfaces, the detector focus mechanism, characterized and integrated and aligned the detectors into MOIRCS

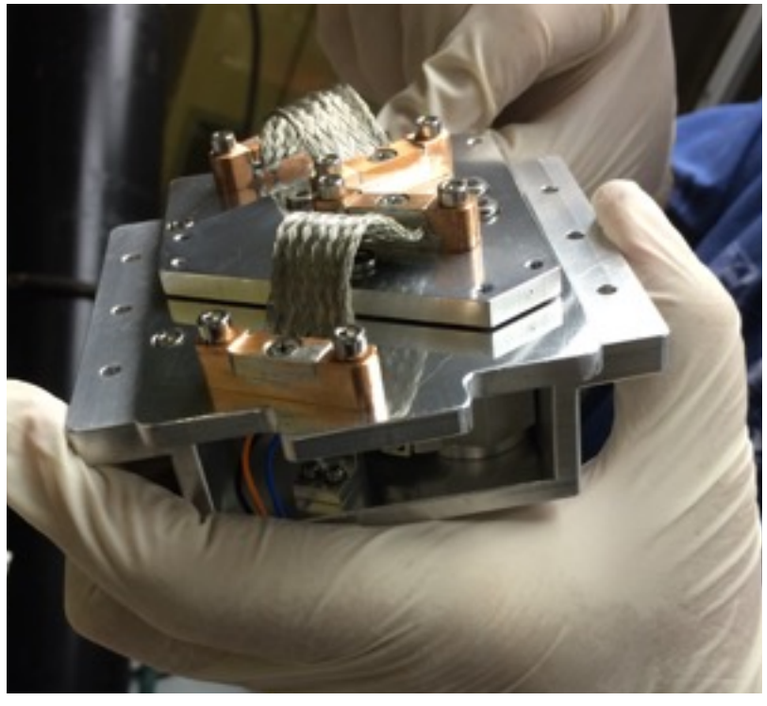


Detector Upgrade

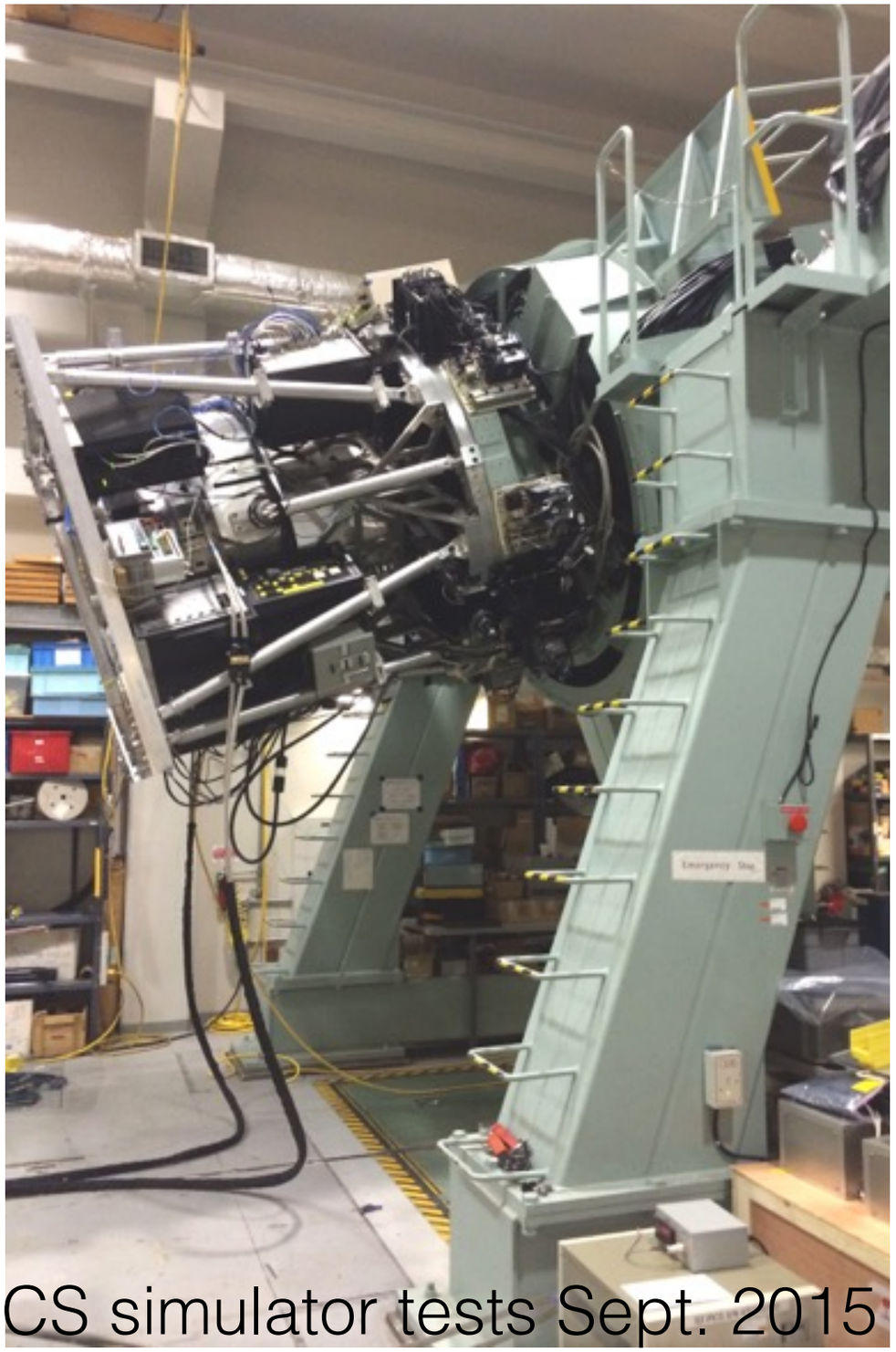
- Mechanically, the most significant task lay in the development of the new focus mechanism

- The mechanism needed to provide in cryogenic conditions:
  - 5 µm step resolution
  - 5 arcmin tip/tilt repeatability



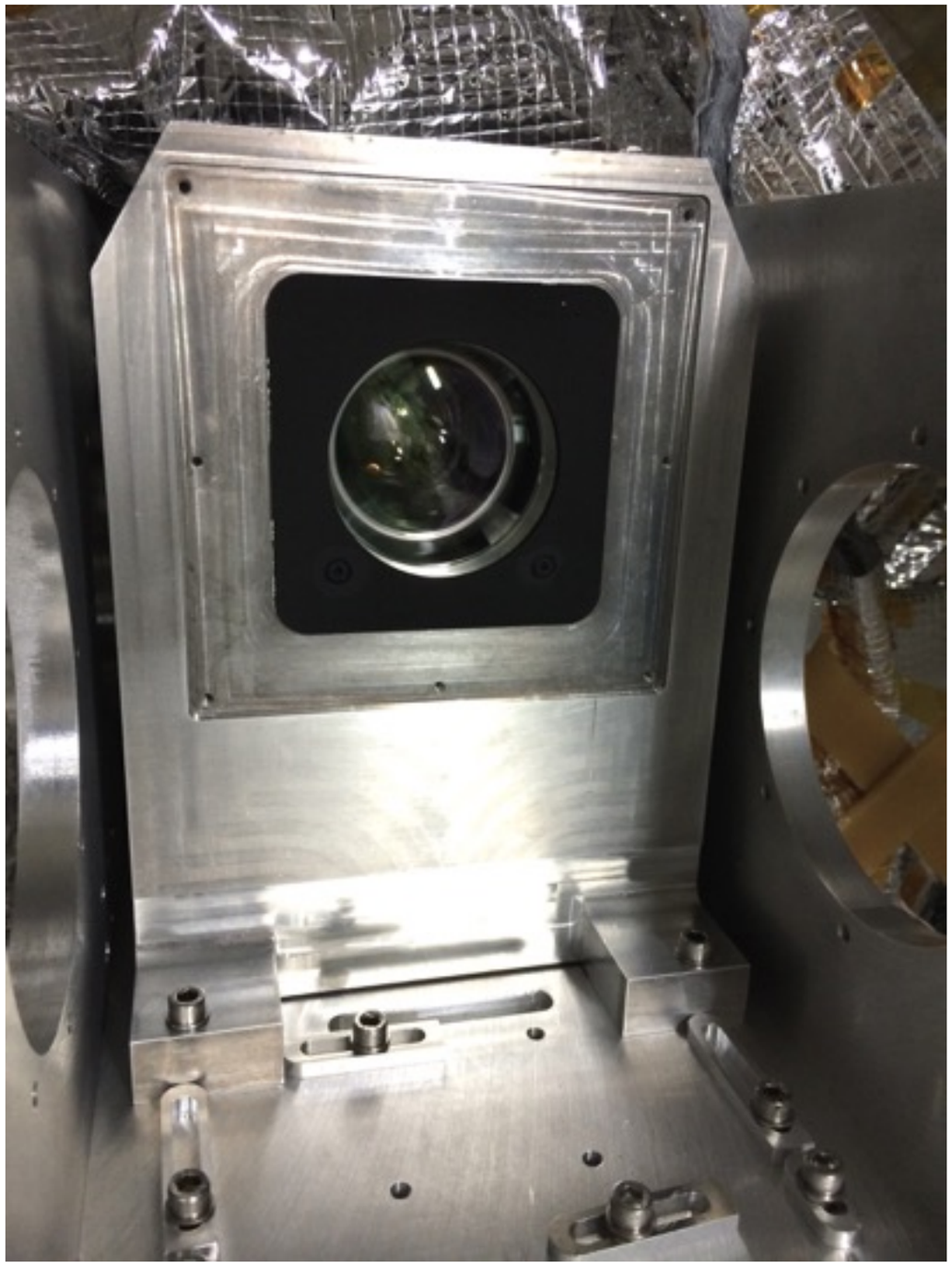


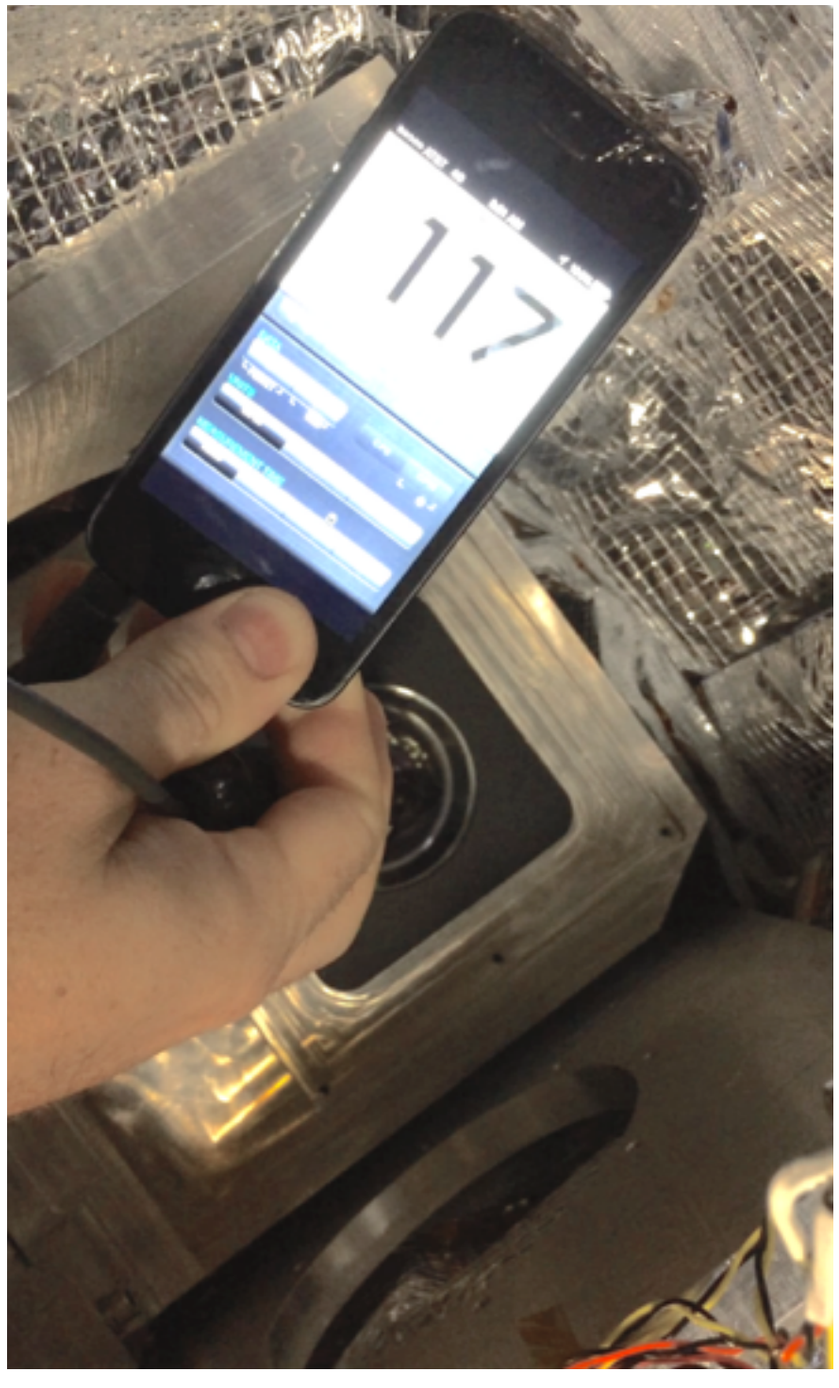
Detector Upgrade



CS simulator tests Sept. 2015

Unexpected Challenges

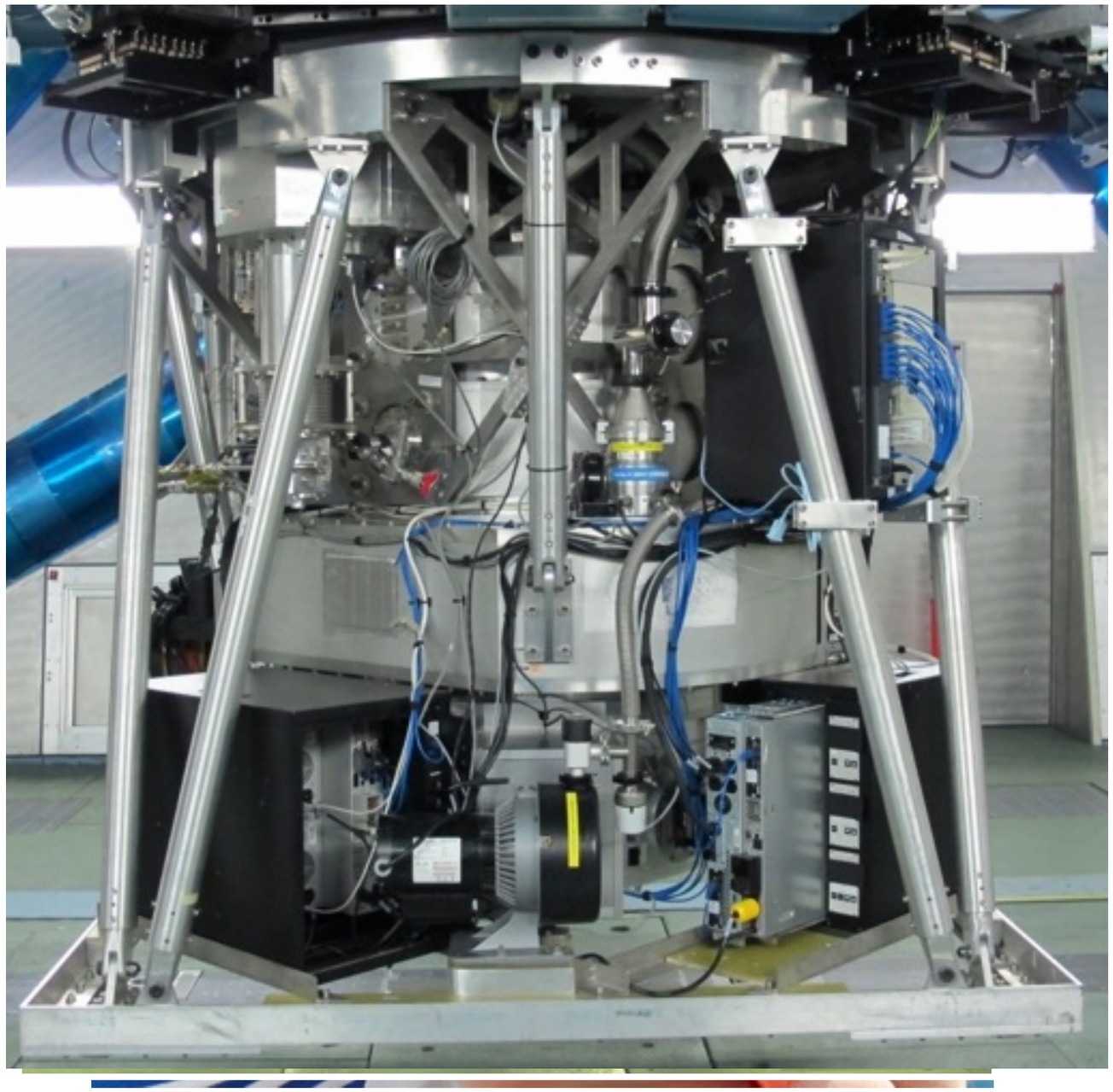




Maximilian Fabricius, nuMOIRCS detector upgrade, Subaru Users Meeting, Atami JP, January 2016

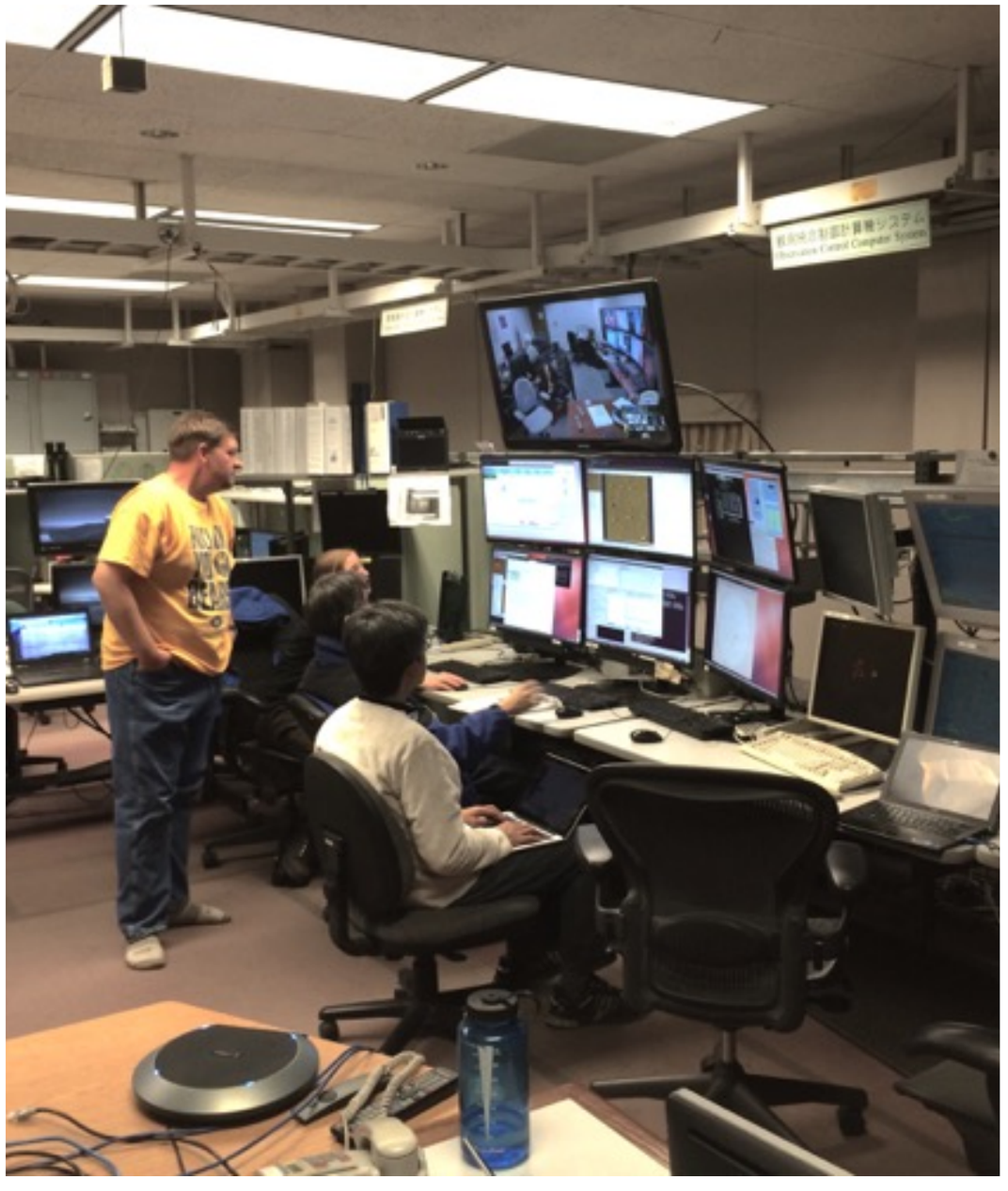
Control System

- Detector electronics (Teledyne Cryo Sidecar + SAM)
- Temperature controllers
- Heater power supplies
- OBE (on board PCs) + KVMs
- Cable management
- **Software (CIAX v2)**



First Light

- First engineering runs on Dec 26/27 (half night)
- Function tests by the new Control software (running skeleton files) in imaging mode
- Basic tests by the new detectors
- Initial throughput measurements
- Demonstration Data



Measured Detector Noise

- Single CDS results are as good as we tested in Hilo in the laboratory.

- NDR=10 would decrease the noise to sqrt(10), and for ch1 the number measured is only slightly larger.

- For ch2, larger noise values might be due to large latent signals observed (after dome-flat data acquisition).

- Single CDS with 10 T=5sec dark data:
  ch1: 6.3ADU = 13.86 e-
  ch2: 6.8ADU = 14.96 e-

- NDR=10 data with 10 T=19.5 sec dark data:
  ch1: 2.32 ADU = 5.6 e-
  ch2: 2.74 ADU = 6.0 e-

Gain = 2.2 is used for calculation

System Throughput from FS128 Observation

System throughput (including the sky + telescope + MOIRCS)

FIL-TER	Mag Zeropoint	Mag Zeropoint	Throughput (ch1)	Throughput (ch2)	TP (OLD, ch2)
Ks	25.203	25.373	**36.0%**	**42.1%**	**37.6%**
H	26.020	26.136	**40.8%**	**45.4%**	**36.7%**
J	25.997	26.064	**33.9%**	**36.0%**	**26.1%**
Y	26.021	25.913	**36.8%**	**33.3%**	**23.4%**

Significant Increase in Sensitivity, especially for blue bands!

Overhead, Survey Efficiency

- The measured overhead is confirmed be calculated as 1.45*2*NDR+EXPTIME+12.
- In the actual observation, the time for telescope dither (10-15sec, depending on the dither width: no AG=ON case) is the additional overheads (we can't control).

	EXPTIME [s]	NEXP	DITHER	Efficiency	old Eff.
Ks	50	3	10	**74%**	**63%**
H	21	4	10	**57%**	**43%**
J	90	1	10	**77%**	**65%**

- The staying time at a dither position is now ~50% reduction for H and K!
- New overhead calculator will soon be available on the Subaru website.
- Future upgrade of detector software should improve this further.

Maximilian Fabricius, nuMOIRCS detector upgrade, Subaru Users Meeting, Atami JP, January 2016

Next steps …

- Installation of alpha blocking filters.
- Fine-tuning of detectors to optimal dynamic range/read noise and minimal crosstalk.
- Engineering run on April 17 and June 14.
  - Test MOS functionality.
  - Confirmation of the system throughput after the installation of the alpha particle window.
  - What else?
- Open use starting June 18

Thank you!

Please see today's Subaru website for web release!

http://subarutelescope.org/Topics/2016/01/19/index.html

HH211 H2,[Fe2],Ks 2015