



# PS2 Status Report

Nick Kaiser

Pan-STARRS, Institute for Astronomy, U. Hawaii

Durham Workshop 2013/01/08

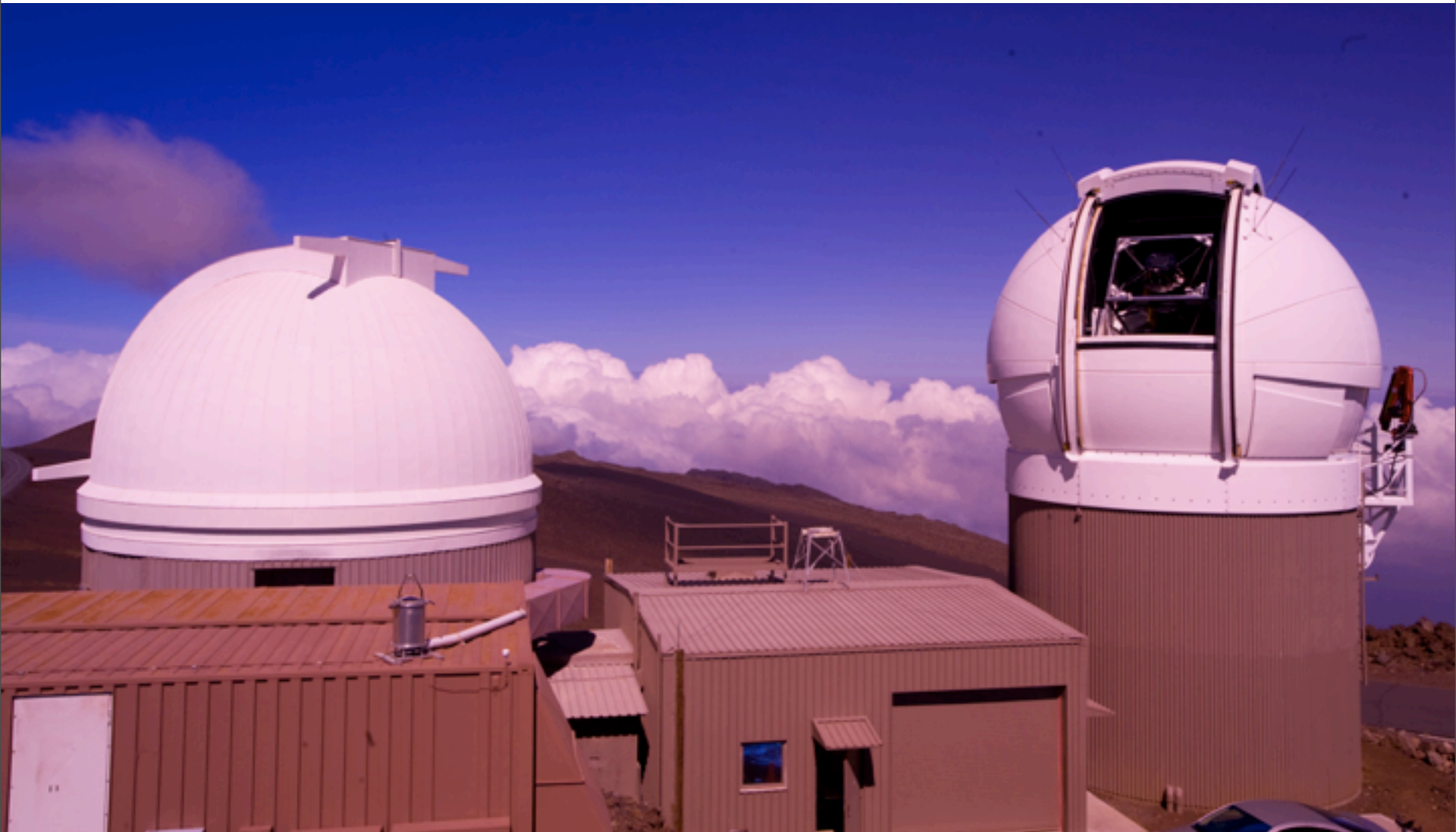
# The near term future for Pan-STARRS: PS1+2

- PS1 survey mission to end 12/2013
- PS2 telescope delivery 03/2013
  - - PS1+2 full operations to start early 2014
- Improved detectors for GPC2
- Improved optics
  - - possibility to upgrade GPC1, replace PS1 L2, L3 & M2 support
- Etendue (light grasp) of PS1+2 similar to Blanco/DECam
  - -  $2 * 1.8\text{m}$  vs  $4\text{m}$ ;  $7 \text{ squ deg}$  vs  $2.2$
  - - PS1 delivers FWHM  $1.1''$  vs DECam goal of  $0.9''$
  - - PS1+2 100% dedicated to surveys vs shared facility (500 nights for DES survey)
- Mission:
  - 7 years @ 50% Euclid photo-z support (g,r,i,z)
  - 7 telescope years over  $7,500 \text{ squ dev}$  vs 2 ty over  $30,00$   
=> 1.4 mag deeper than PS1 3-pi
  - complement to DES, VST in South
  - + NEO searches
  - rest is TBD - but strong synergy with eRosita, ASKAP, ....

# UH-IfA Primary PS2 Construction Goals for 2012

- Observatory renovations
- Complete PS2 telescope (pass FAT), complete LCC, UCC, FM
- Construction of camera cryostat, mechanical sub-assemblies, and read-out/control system
- Delivery of first MITLL CCID71 devices and device IfA testing
- Development of observatory control system to allow dual telescope operations
- Coating of mirrors
- Power and network infrastructure upgrades

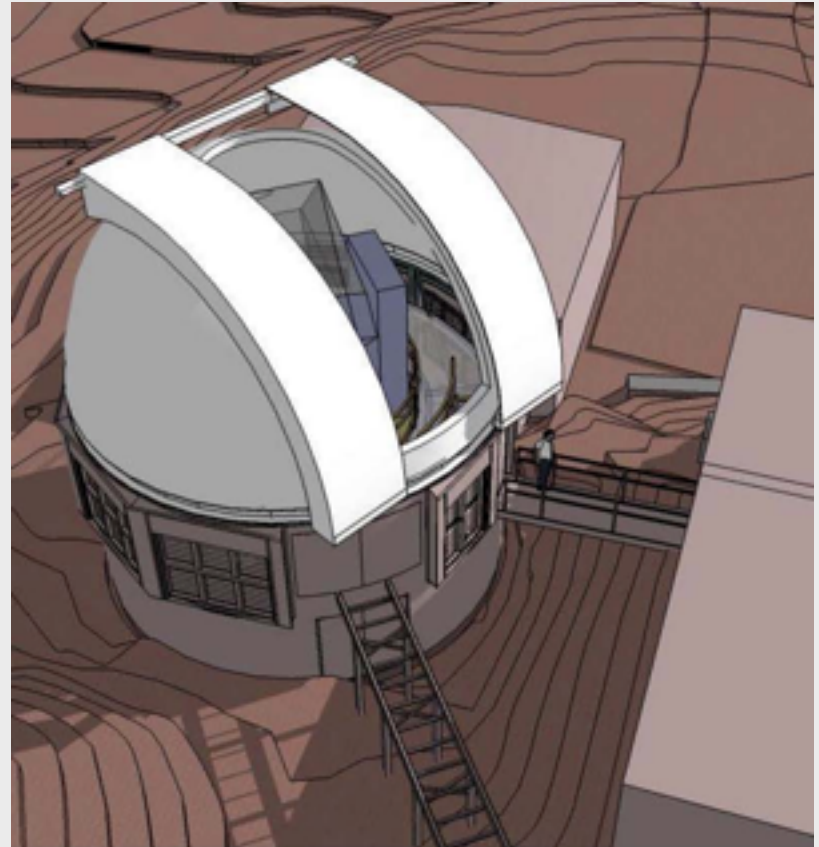
# PS1+2



# PS2 Observatory

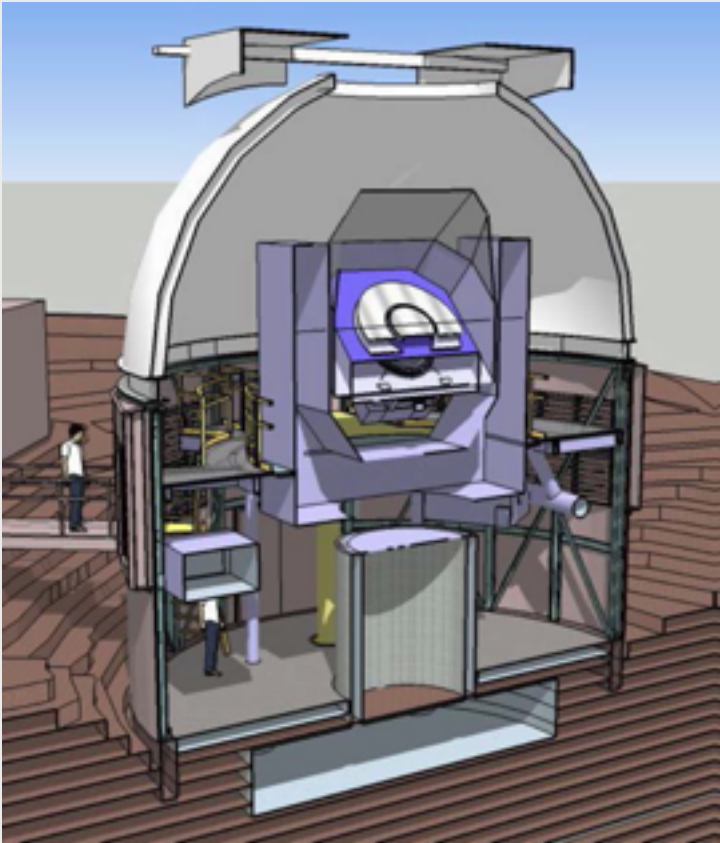
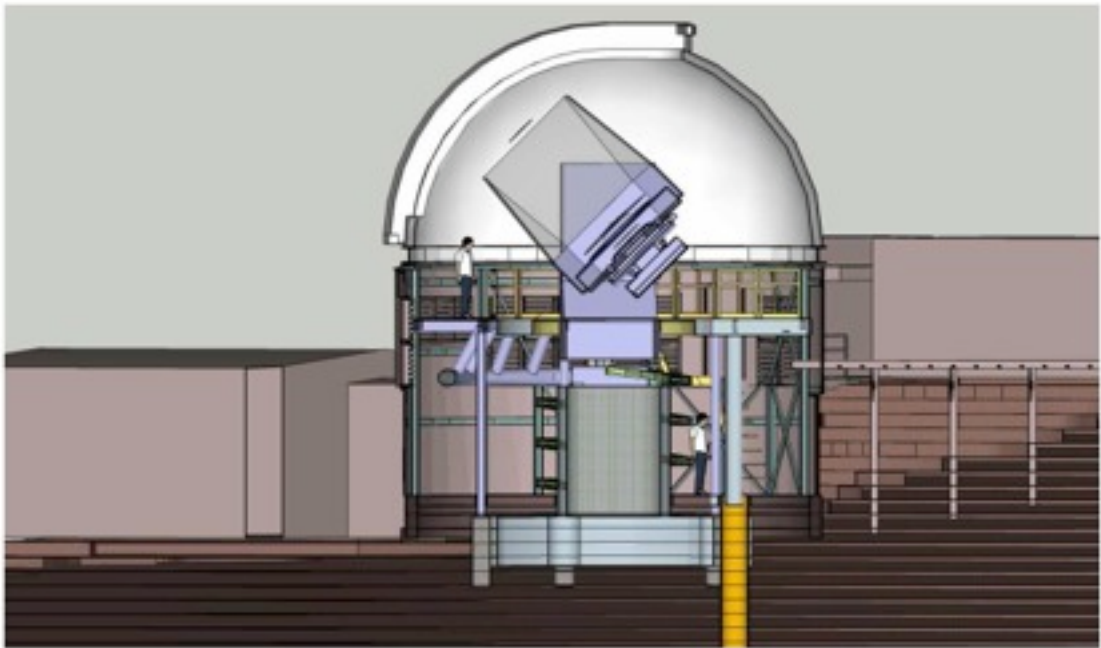


December 2012

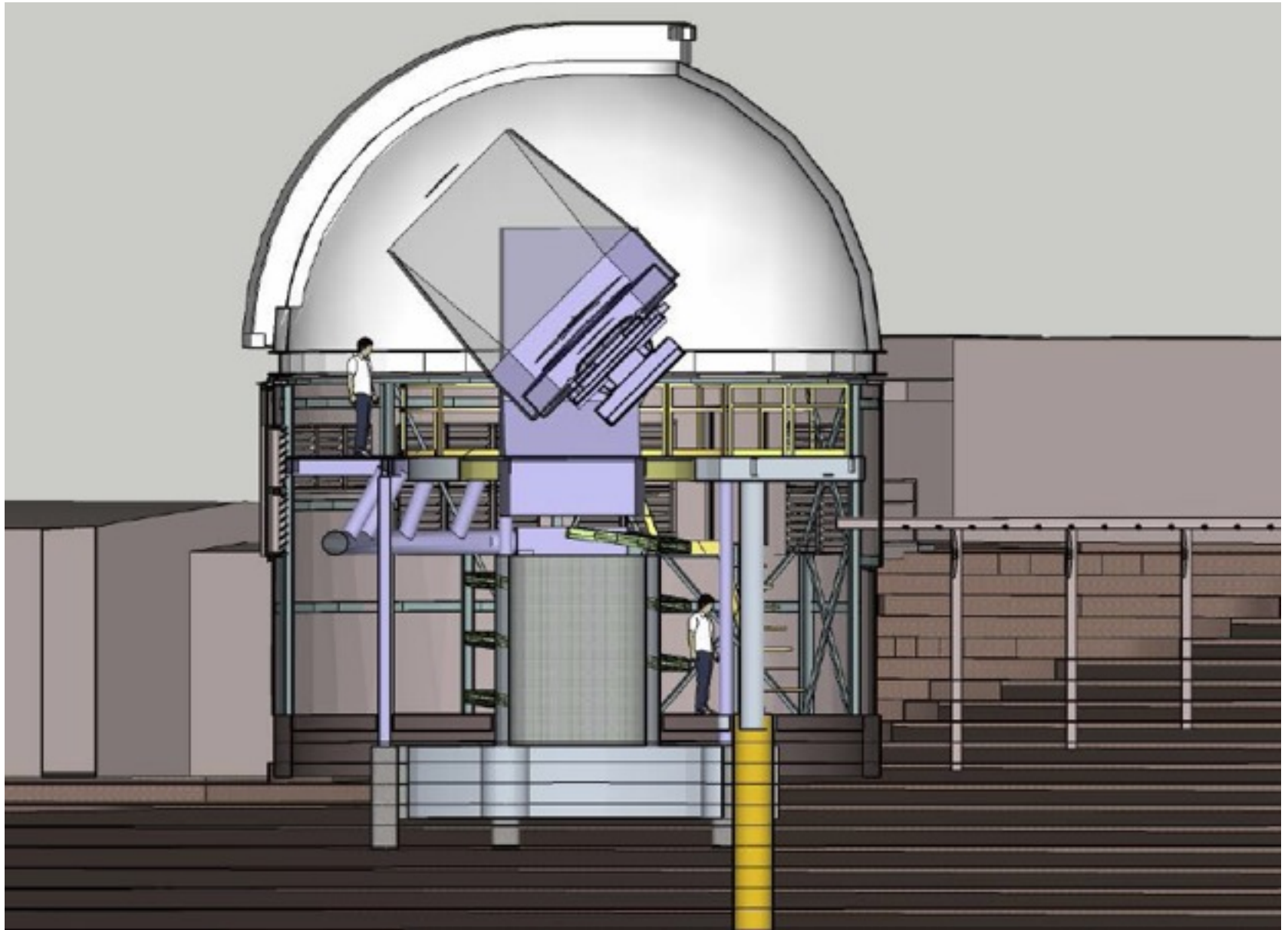


March 2013

# PS2 Observatory Renovations: Cross Section



# Dome Cross Section



# PS2 Observatory Renovations

Caisson for hydraulic lift



Bases of support columns  
for new mezzanine

The start of the pier footing rebar installation is shown. Only the lower grid of rebar has been installed as of 26 Dec 2012.



## PS2 Observatory Renovations



The pier footing rebar installation is shown from the tramway door (26 Dec 2012).

## PS2 Observatory Renovations



The pier footing rebar installation is shown from the walkway. The pier connection rebar is now in place (2 Jan 2013).

## PS2 Observatory Renovations



This is at the end of the pier footing concrete pour (3 Jan 2013). The poured concrete has been smoothed and is beginning its set. The anchor rebar for the pier is now plainly obvious.

## PS2 Observatory Renovations: Cross Section



Installation of 17-ft steel caisson to house hydraulic lift cylinder



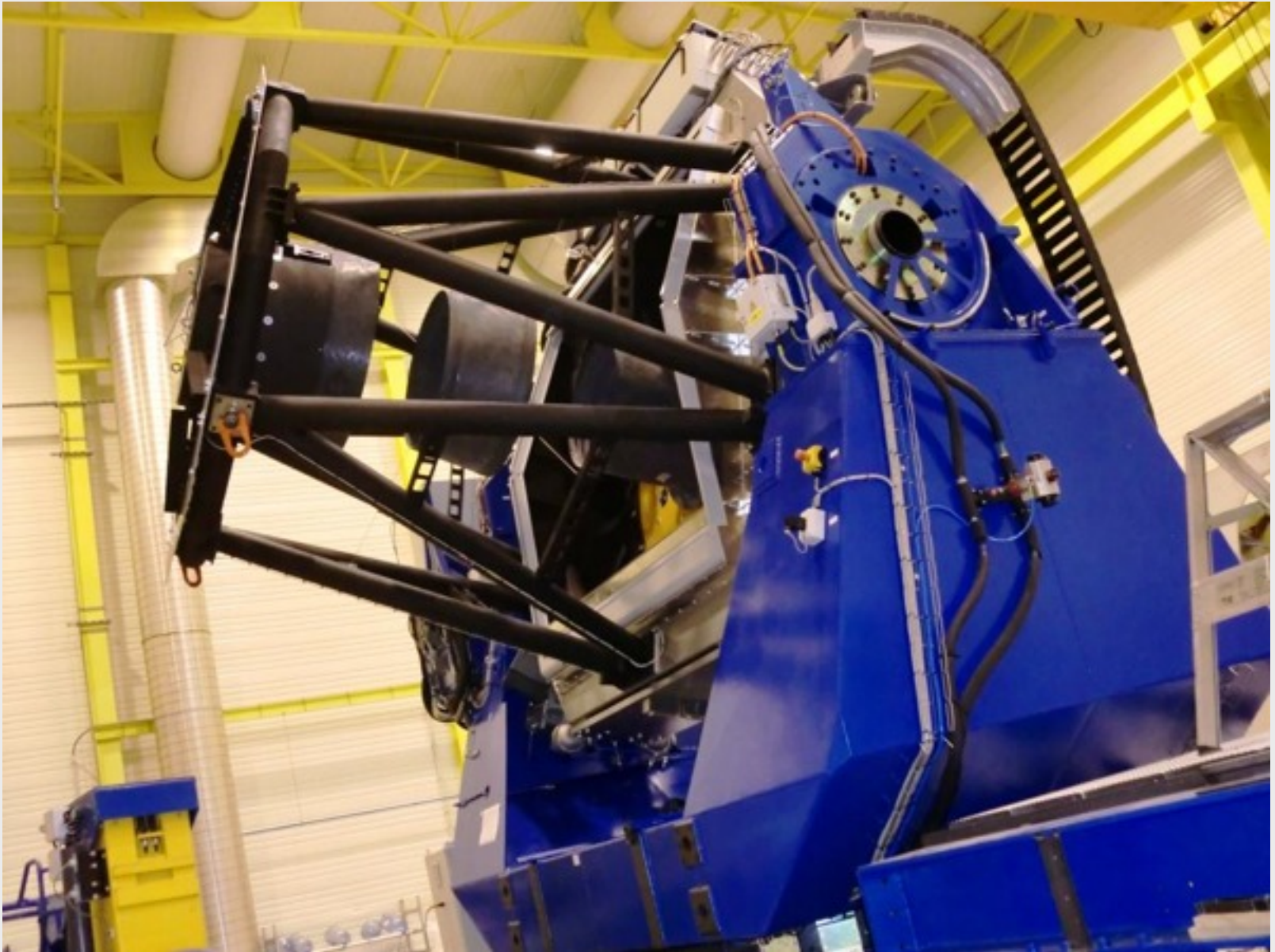
Flowable fill completed around caisson



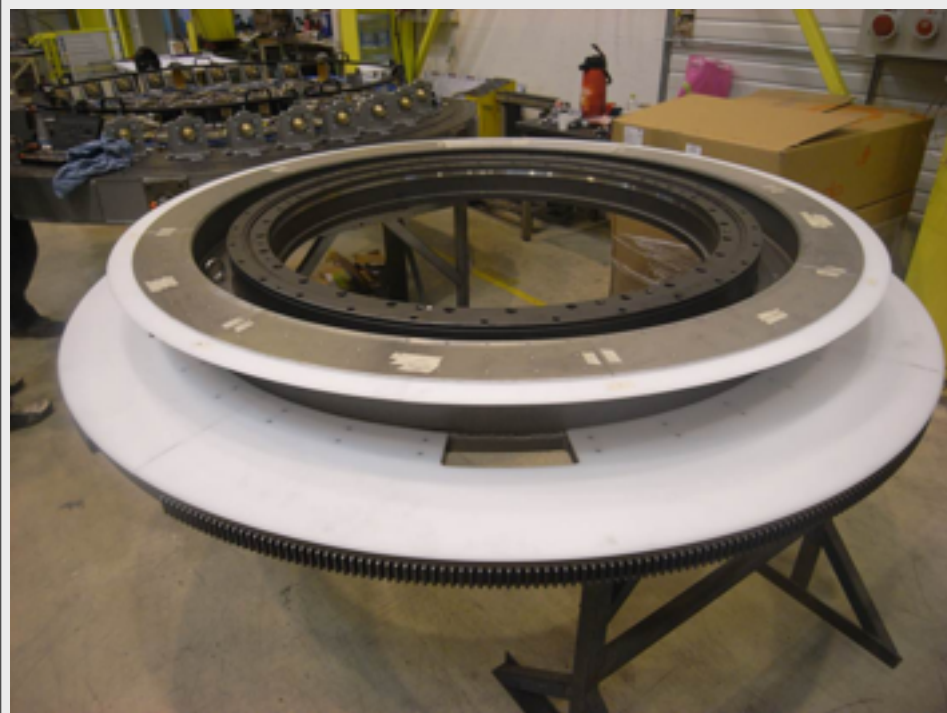
Interior surface compaction complete, ready for form work and pier footing pour



## PS2 Telescope after FAT at AMOS



# Rotator

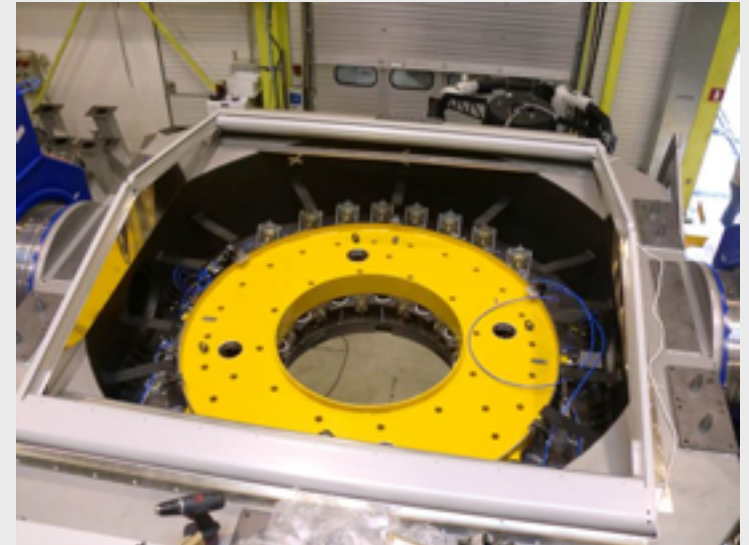
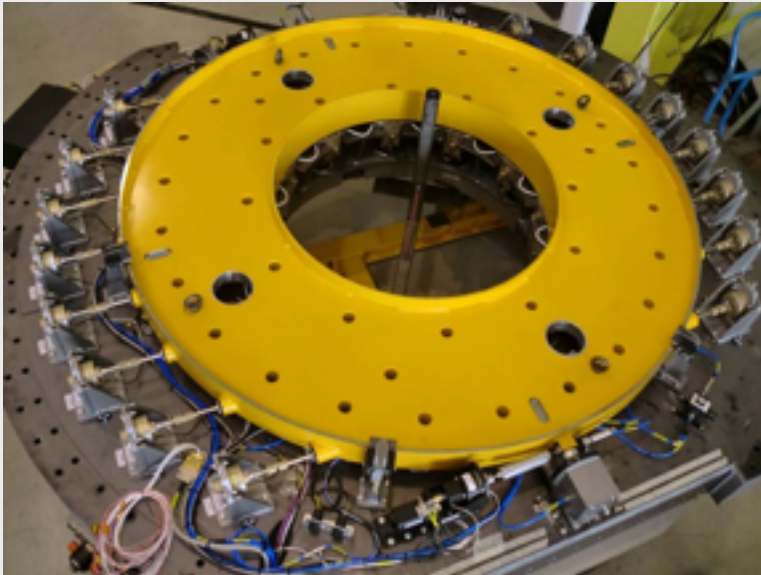


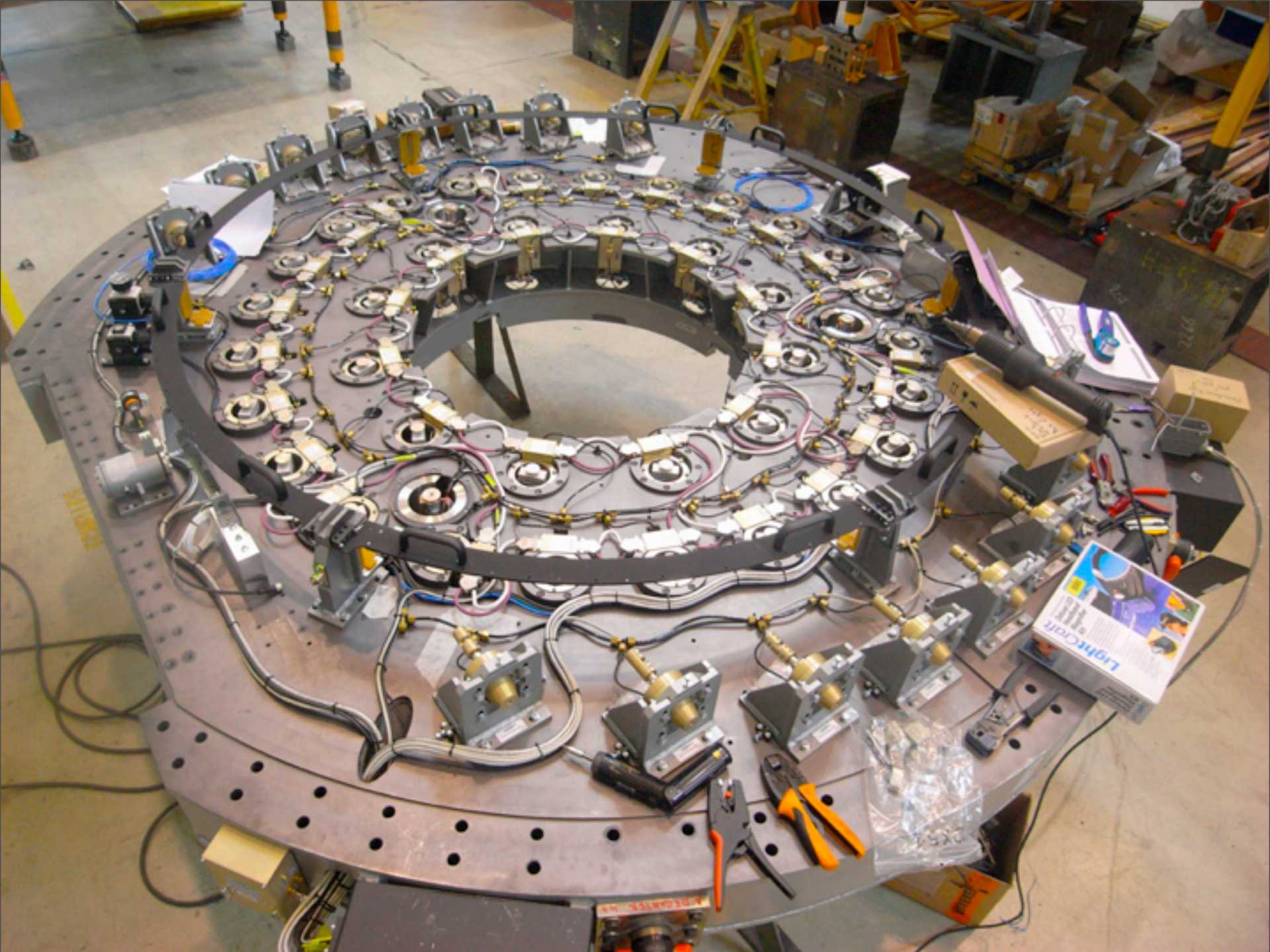
# Actuators in Primary Mirror Assembly (PMA)





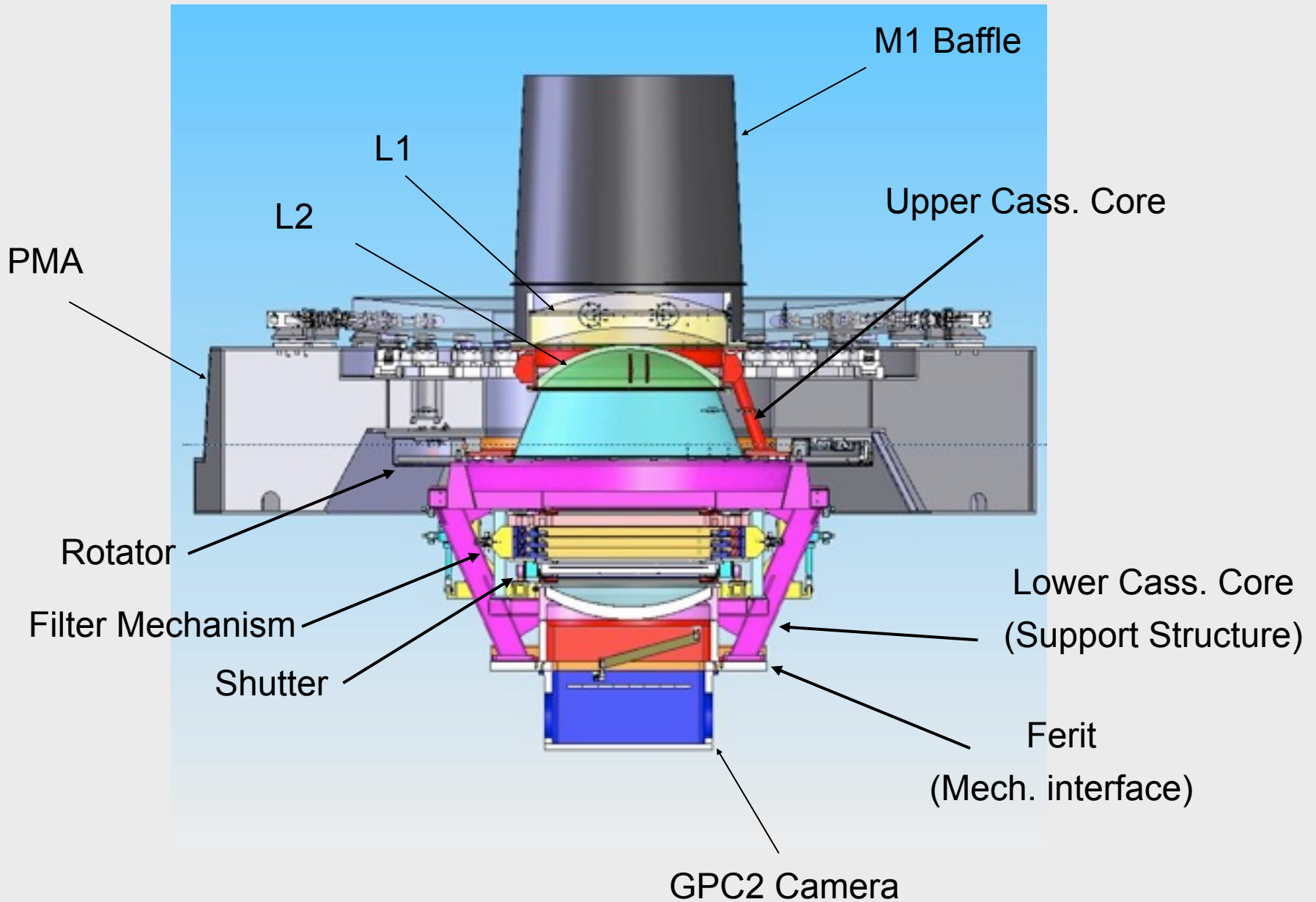
# Final Assembly/Integration of PMA and Test with Dummy M1





Monday, January 7, 13

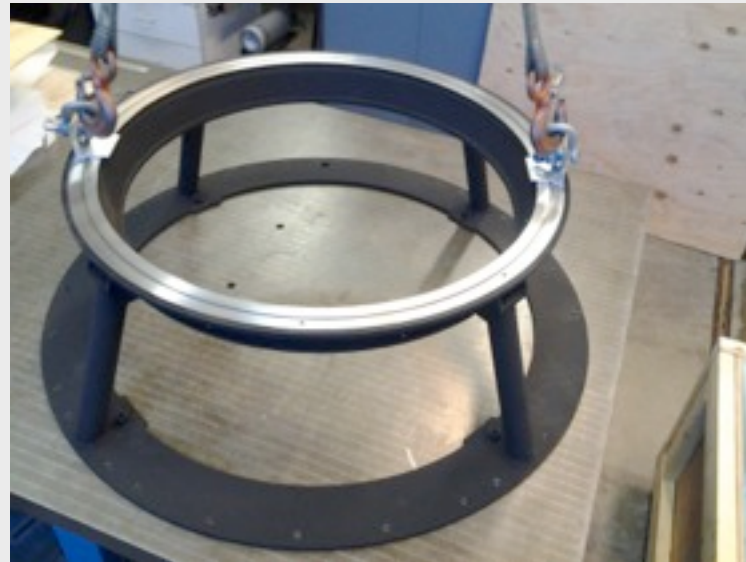
# Instrument Package: The Cassegrain Core design



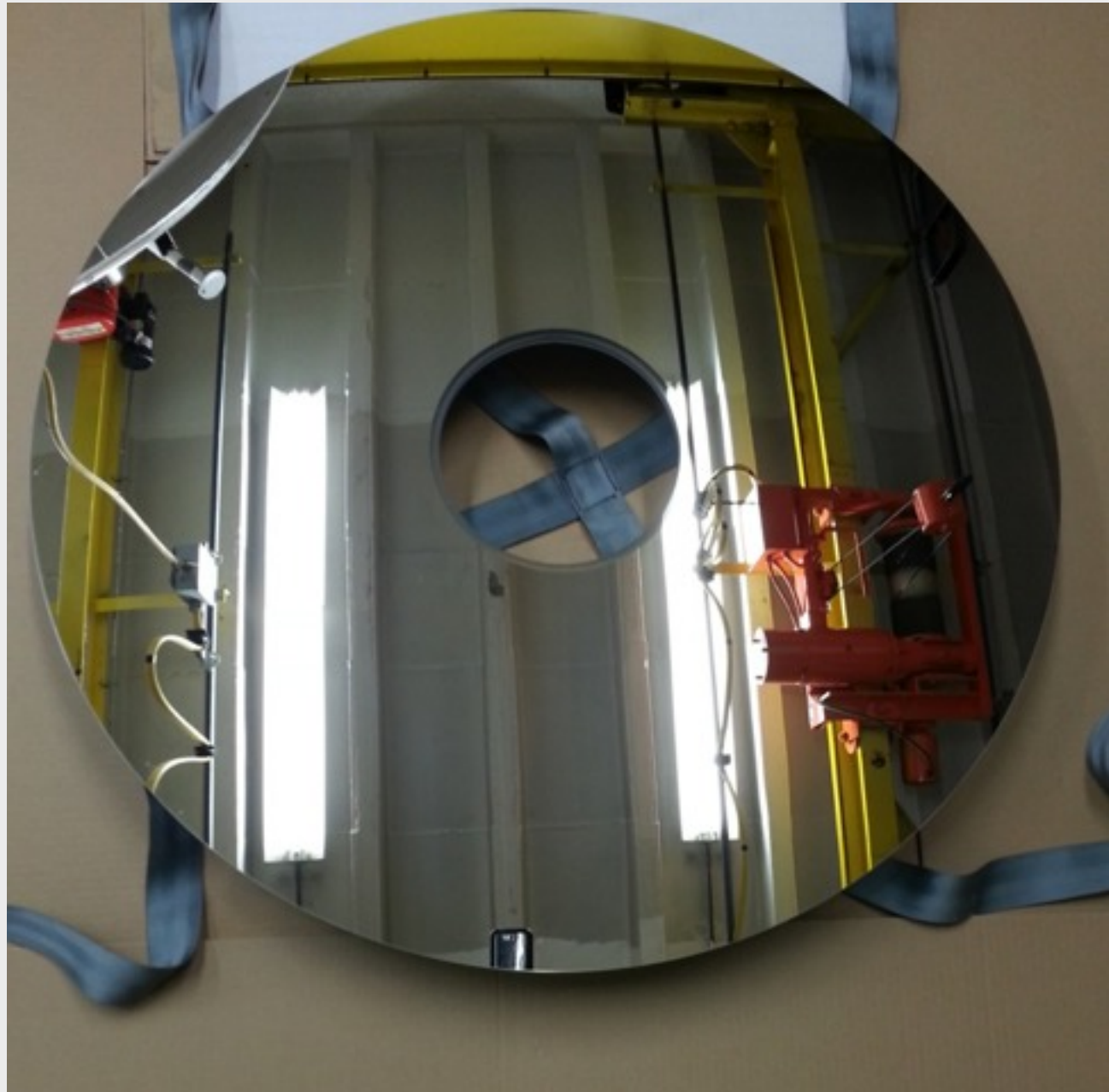
# LCC and Filter Mechanism



# L1, L2, and the UCC

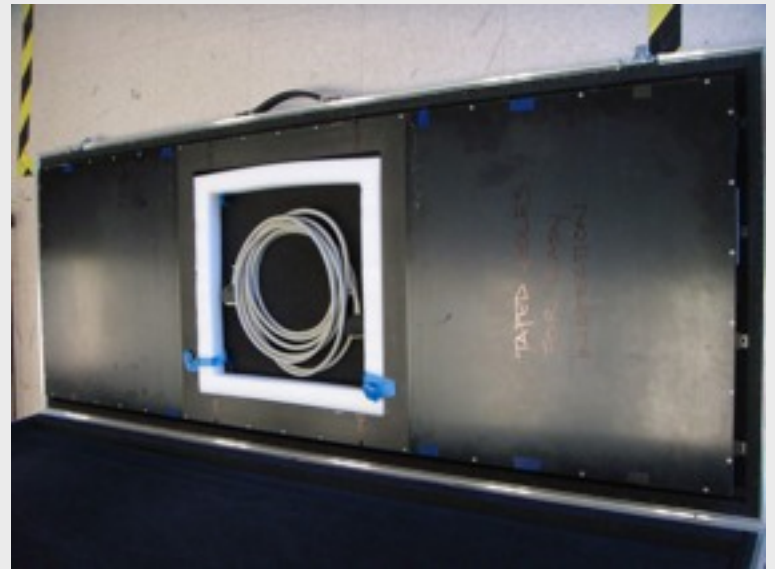


## PS2 M2 - post coating



Monday, January 7, 13

# The LCC, Ferit, Filter Mechanism, and the Shutter

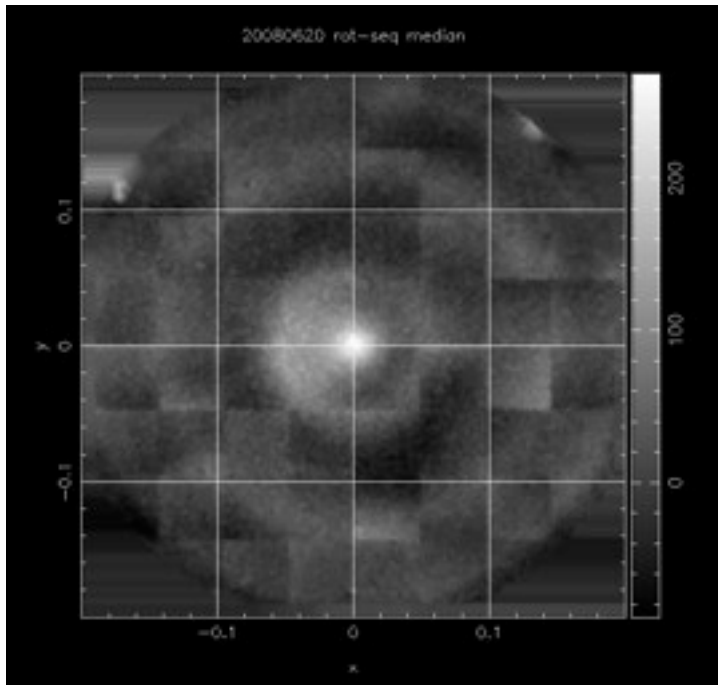


## PS2 Improvements Relative to PS1 - telescope

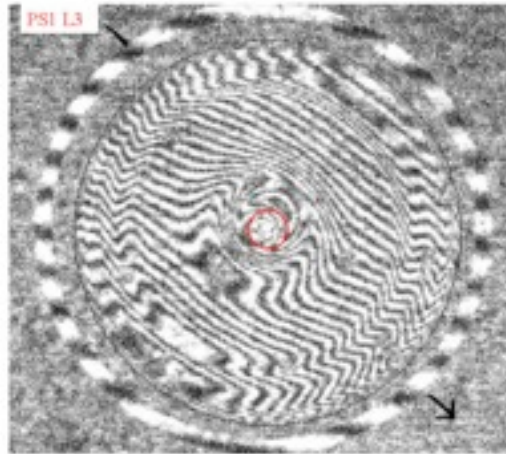
- Better telescope (provided by AMOS of Liège, Belgium)
  - Actively cooled drives with increased performance margin,
  - Cooled primary mirror assembly (PMA)
  - Better M2 support
  - A stiffer truss providing increased margin against vibration
  - Better M1 figure control utilizing 36 active figure controllers (PS1 has 12)
  - Improved cable wrap
  - Better overall reliability not only due to intrinsic design but better quality control of as-built components
- Better optics
  - Full aperture interferometry confirms improved figure
- Better filters
- Significant reduction of ghosting and scattered light
  - though enclosure does not have PS1 style upper/lower dome shutters for moon-shading



# Improvements in the polishing of the optics: L2, L3



**PS1 Focal Plane Distortions**

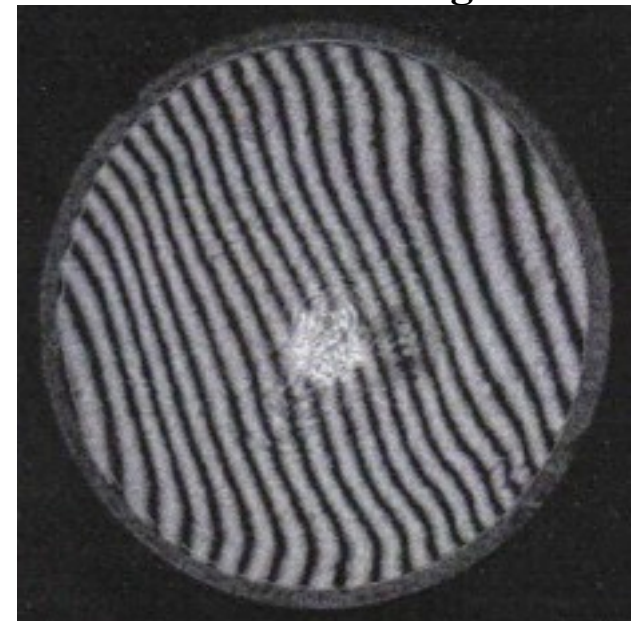


**PS1 L3 Interferogram**



**PS2 L3 Interferogram**

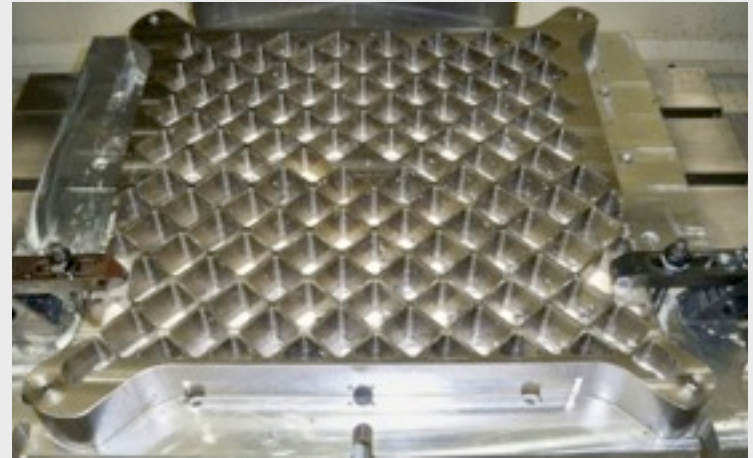
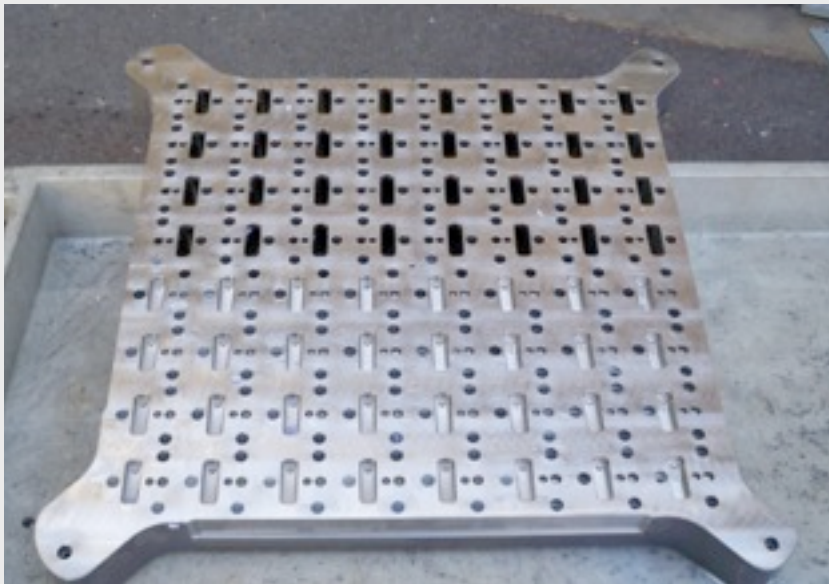
**PS2 L2 Interferogram showing only  $0.11 \lambda$  RMS (specification was for  $0.31 \lambda$  RMS)**



## PS2 Improvements Relative to PS1 - Detectors

- Better CCDs (provided by MIT Lincoln Laboratory)
  - Reduced “burn trails/persistence”
  - Reduced defects
  - Improved CTE
  - Reduced/eliminated amplifier glow
  - Eliminated corner problem
  - Reduced device cross talk
  - Better AR coatings
  - Increased full well
  - Improved linearity
- Better package and mounting to FP
- Better camera electronics
  - Reduced cross talk with new cable routing
  - Reduced read noise
  - Improved thermal control

# GPC2 Mechanical

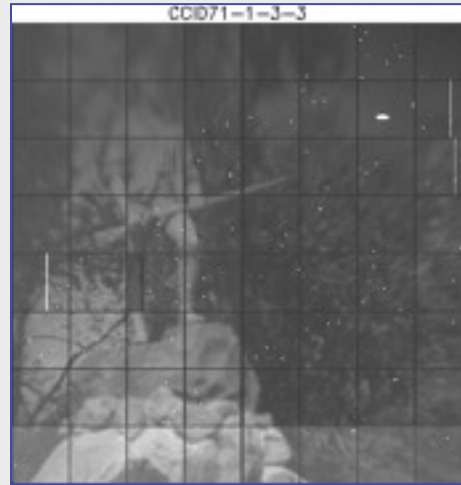
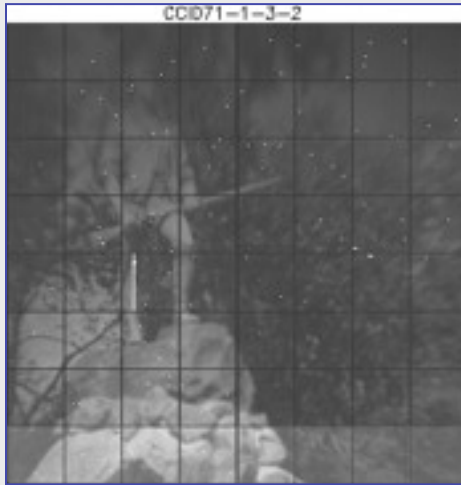


# GPC2 Electronics



## MITLL CCID71 150mm OTAs

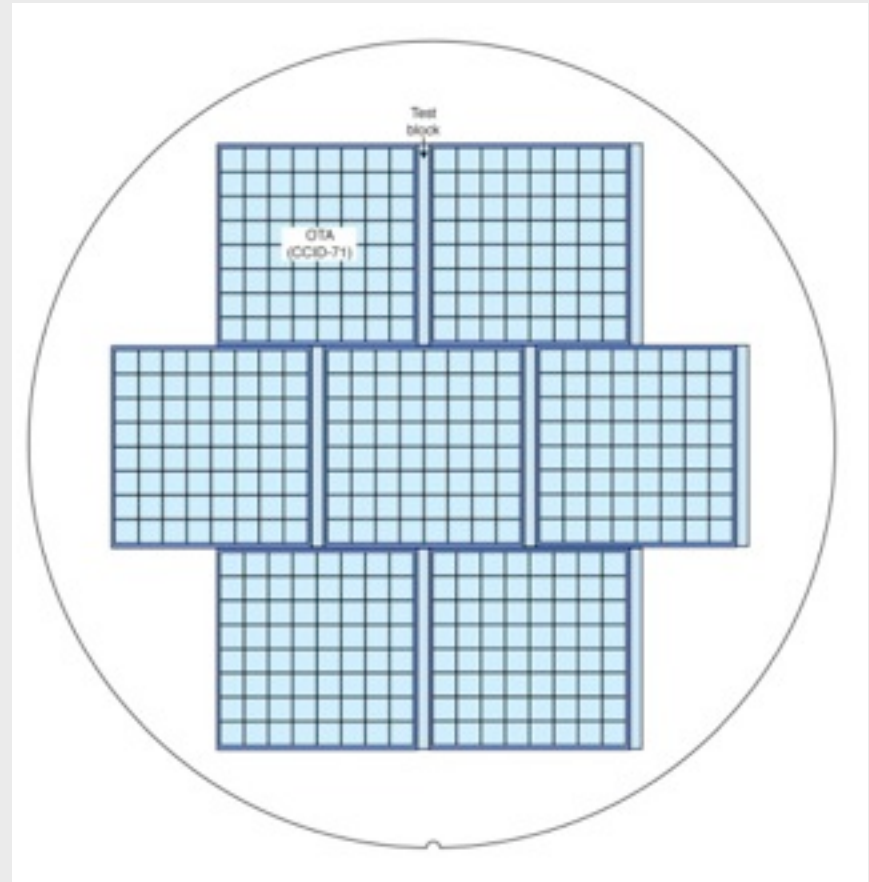
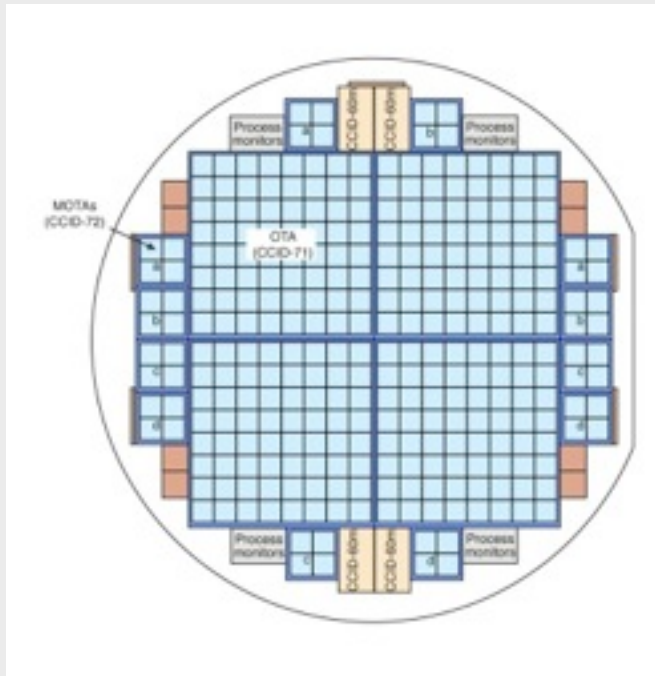
- bi71lot1b Wafer 3 Images, packaged devices sent to IfA this week



- bi71lot1b Wafer 9 Image, package go ahead given



# MITLL CCID 150mm and 200mm wafers



# CCD Development on 200-mm Wafers

- First CCD wafers (frontside) in March 2012
  - Large frame-transfer OTCCD
  - Die size =  $17 \text{ cm}^2$  (vs.  $25 \text{ cm}^2$  for PS OTA)
  - Cosmetically excellent,  $\text{CTE} < 10^{-5}$ , dark current same as 150-mm process
- First back-illuminated wafers (2) under evaluation



**Image from first CCD (front illuminated)**

## PS2 Milestone Schedule

- Telescope FAT in Belgium (passed) Dec 2012
- The on-site delivery of the telescope structure Mar 2013
- The on-site delivery of the 16-OTA TC3 camera Mar 2013
- Completion of the optics & instrument integration with the telescope Apr 2013
- The Site Acceptance Testing (SAT) of the telescope May 2013
- The start of post-SAT telescope commissioning, i.e., testing that does not involve direct participation by the telescope vendor Jun 2013
- The on-site delivery and integration of GPC2 Jul 2013
- The return of GPC2 Oahu for final tuning early Oct 2013
  - Includes focal plane metrology to match the physical detector surface to the actual optical focal surface determined from the preliminary collimation and alignment
  - Possible replacement of some devices, if necessary
- Subsequent return of GPC2 to the summit mid Nov 2013
- Final collimation and alignment Nov-Dec 2013
- The successful simultaneous operation of PS1+PS2 using OTIS2 Dec 2013
- Beginning of science operations Jan 2014



## Wide-Field Imaging Surveys in Next Decade(s)

- PS1+2: 2\*(D=1.8m; 7 squ deg; 1.4bn pix), 100% survey
- PTF: D=1.25m; 7 squ deg; 100m pix; 100% survey
- DES: D=4m; 2.2 squ deg; 570m pix; 500 nights
- VST: D=2.6m; 1 squ deg; 268m pix; ??? nights
- Skymapper: D=1.35m; 5 squ deg; 268m pix; 100%
- HSC: D=8m; 1.5 squ deg; 900mpix; 300 night
- LSST: D=8m; 9 squ deg; 2bn pix; 100% survey
  
- Synergistic surveys
- eRosita - all-sky X-ray Russian/German; launch 2013
- Euclid - 15,000 squ deg dark energy; launch 2019
- ASKAP (esp. Wallaby)