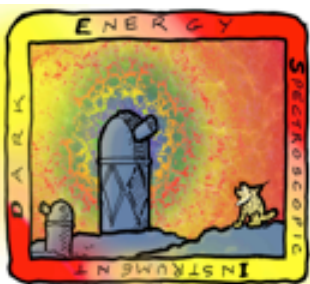
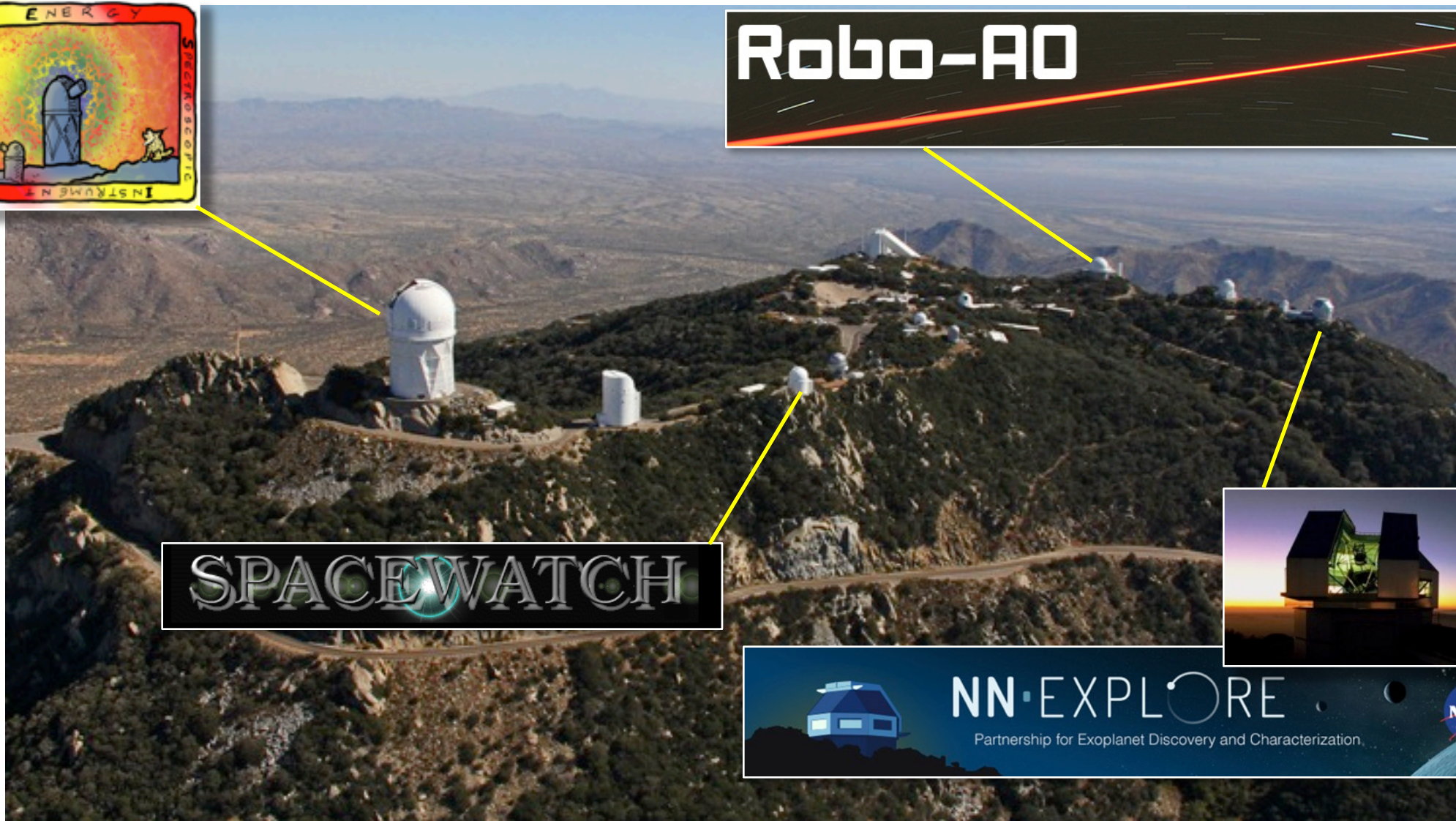


Kitt Peak Report

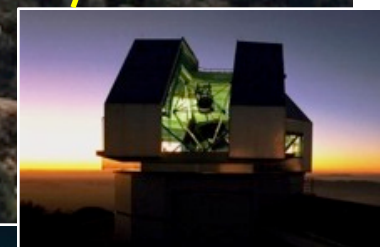
Lori Allen, AD for KPNO



Robo-AO



SPACEWATCH





KPNO 2017 Headlines

- Science highlights
- Mayall-4m & WIYN-3.5m status
- Major projects at Mayall and WIYN, status
 - DOE+NSF Dark Energy Spectroscopic Instrument (DESI)
 - NASA+NSF Exoplanet Observational Research (NN-EXPLORE)
- Infrastructure improvements



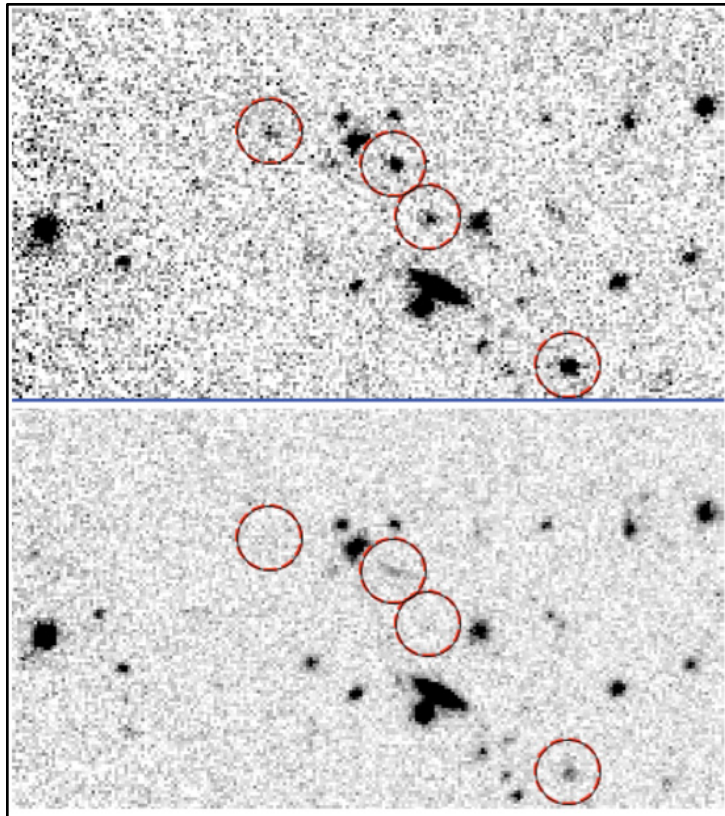


Recent visit by members of Heising-Simons Foundation

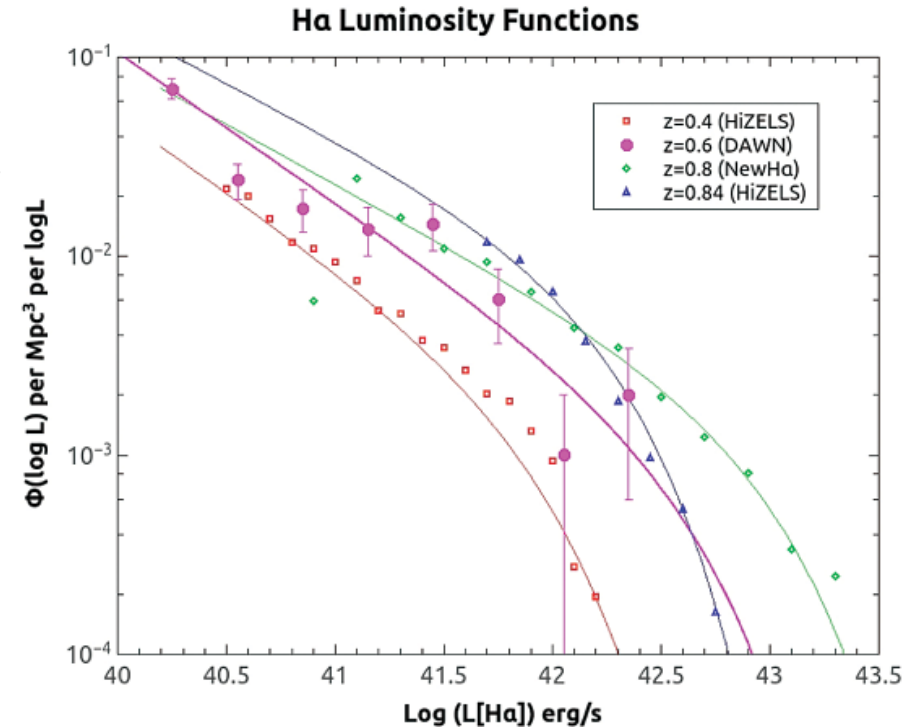
The Deep and Wide Narrowband (DAWN) Survey

J. Rhoads (ASU)

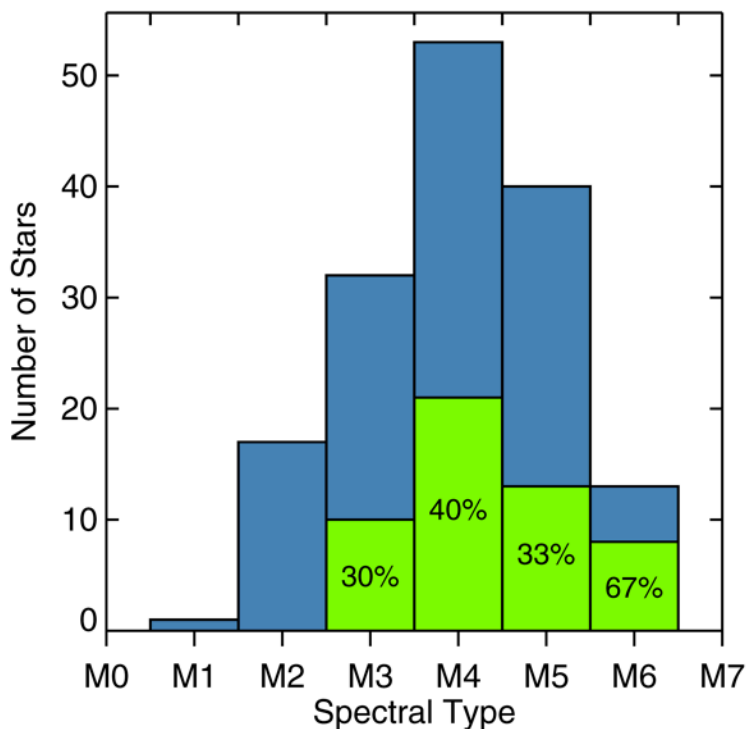
- 1.066 μm detection of Lyman- α emission lines from galaxies at $z=7.7$
- Also detects ELG at $z=0.6$ using Balmer $H\alpha$
- Improve our understanding of reionization history



Left: Comparison of a small region of the DAWN survey's narrowband image of the EGS field (upper), and the corresponding DAWN J-band image (lower). Emission line sources are circled. The emission line source farthest left (east) is the $z = 7.73$ Ly- α emitting galaxy first identified by Oesch et al. (2015).

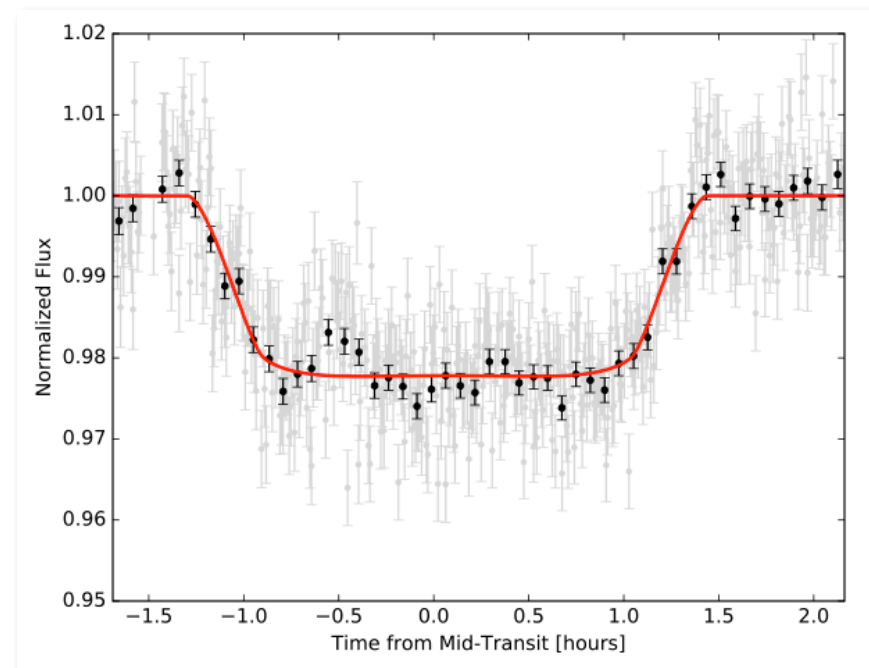


Right: H- α luminosity function for the DAWN survey (from Gonzalez et al. 2017) compared to the HiZELS (Sobral et al. 2013) and New H α (Ly et al. 2011) surveys



Left: Hardegree-Ullman (U. Toledo). *M-Dwarfs in Kepler field with chromospheric activity (to assess habitability) detected through high S/N Hydra spectra.*

Right: Nicole Colon (NASA ARC). *WHIRC data (2mmag precision) to confirm and characterize K2 exoplanet transit.*

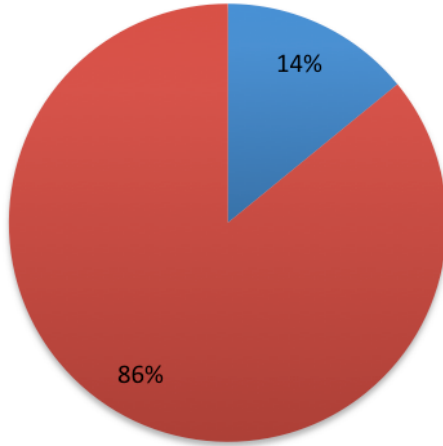


NN-EXPLORE Publications:

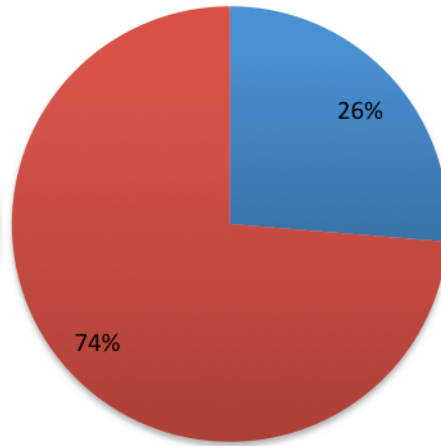
- Hartman, J. D., et al. “HAT-P-65b and HAT-P-66b: Two Transiting Inflated Hot Jupiters and Observational Evidence for the Reinflation of Close-in Giant Planets, 2016, AJ, 152, 182H [WIYN 3.5m +WHIRC]
- Cauley, P.W., et al., “A Search for H-alpha absorption around Kelt-3 b and GJ 436 b”, 2017, AJ, 153, 81C [WIYN + HYDRA]

Down time, Mayall

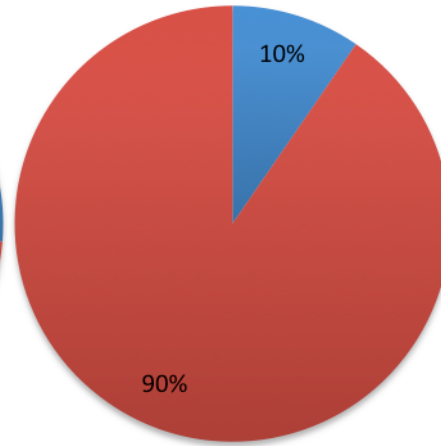
FY15



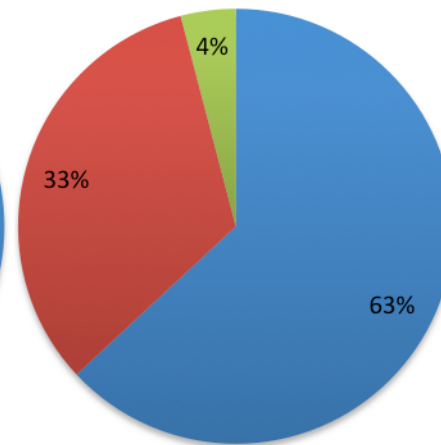
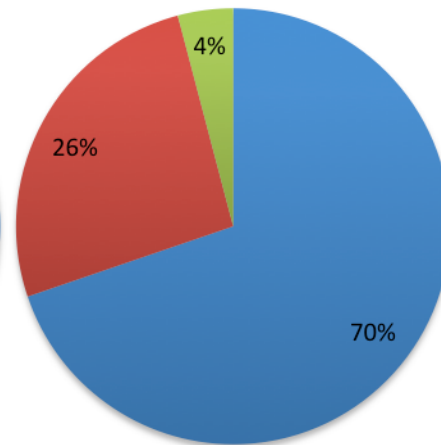
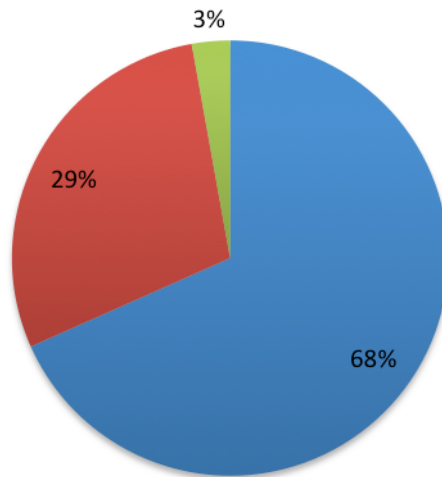
FY16



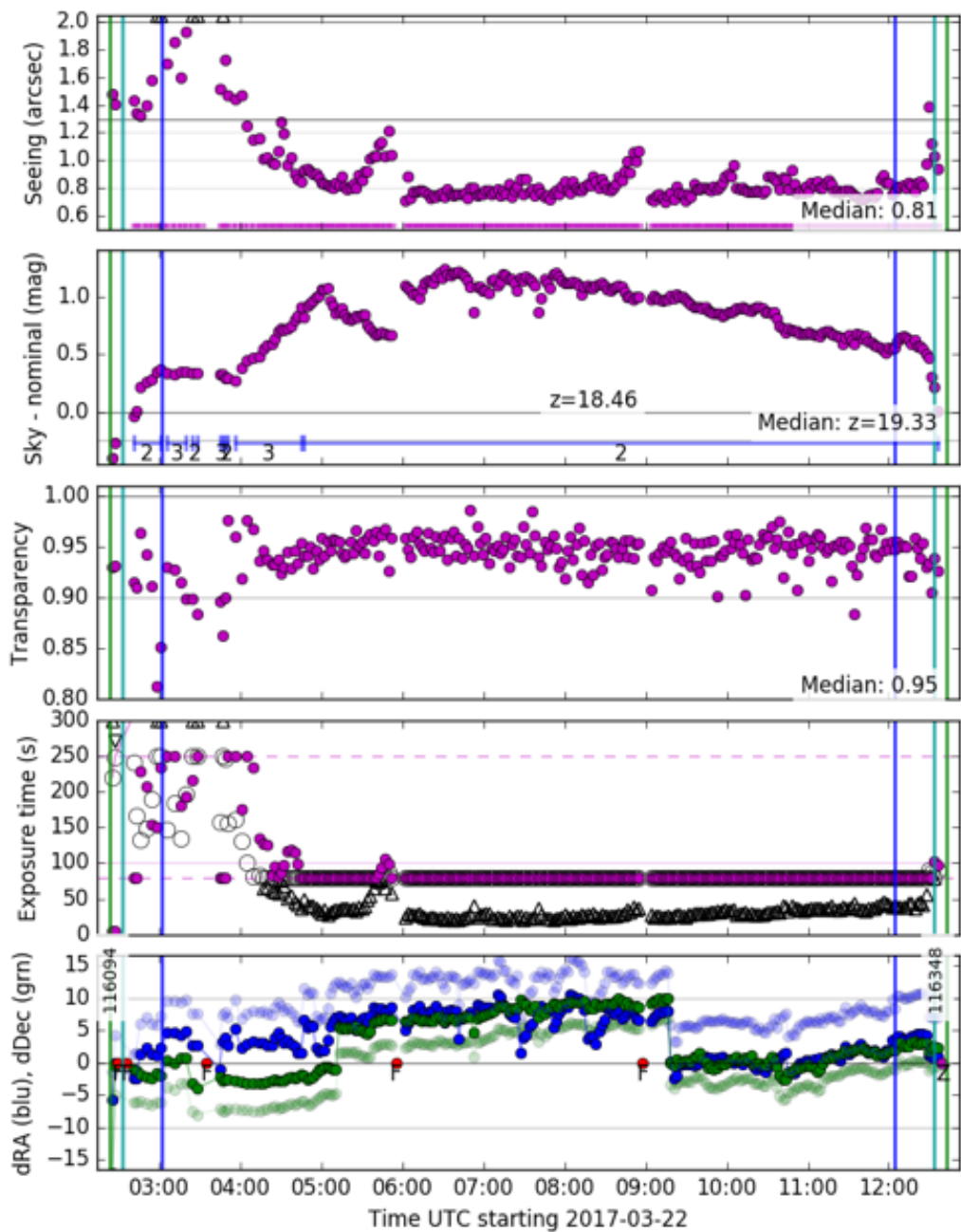
FY17*



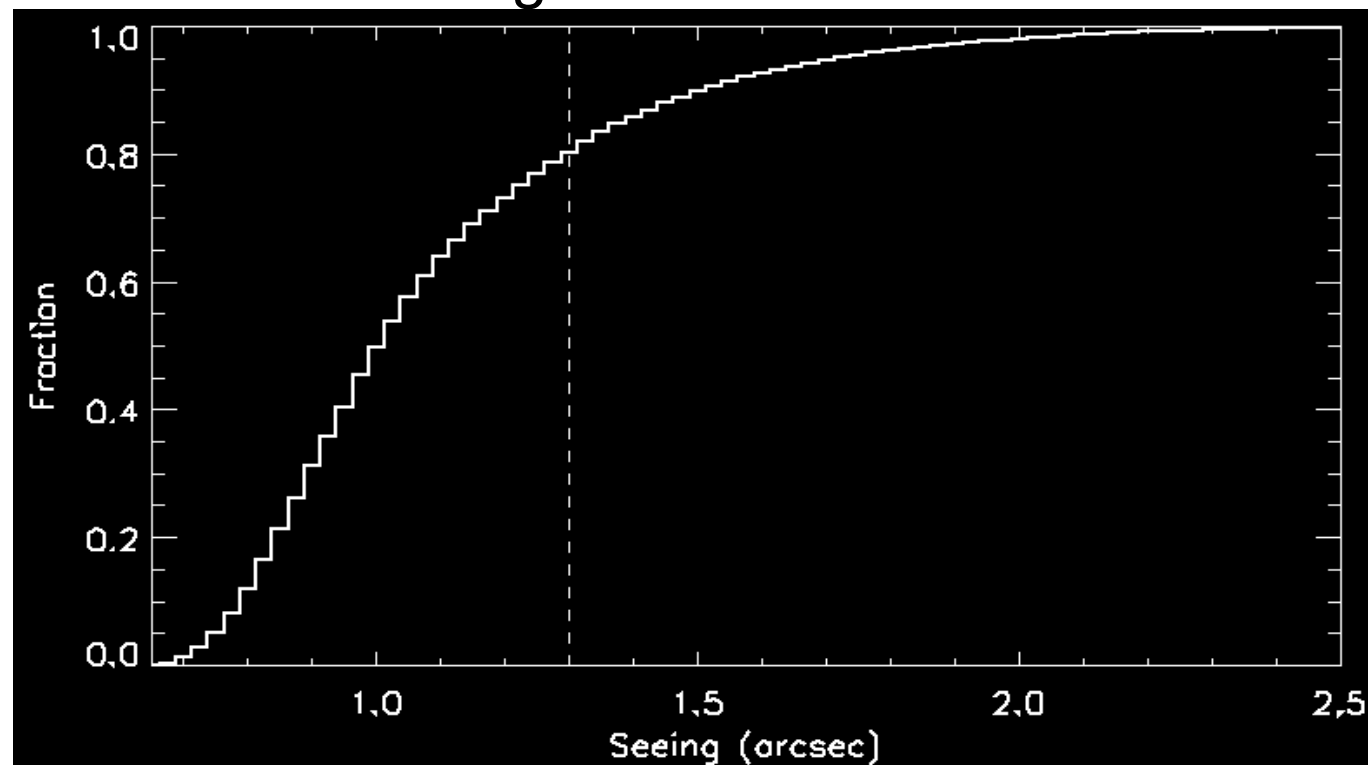
% of ALL time scheduled for science
% of ALL time scheduled for MT&E



% of scheduled science time
% used for science
% lost to weather;
% lost to unscheduled technical downtime



MzLS through 04/20/2017





New U-floor Control Room Nearly Done

- Need work space for min 12 people
- Room for 15
 - 5 along inner wall
 - 10 in two “bays” along outer wall
- Also have kitchen and conference table for 8 in adjoining room
 - With videoconf ability
- Now have 8 screens up high for general interest displays +2 in conf room (cables will be stowed)
- Furniture arriving (tables are in)
- Used in ProtoDESI
 - Led to improved layout





Coming 2019 → DESI @ KPNO Mayall 4-m

Dark Energy Spectroscopic Instrument (DESI)

5000-fiber spectrometer

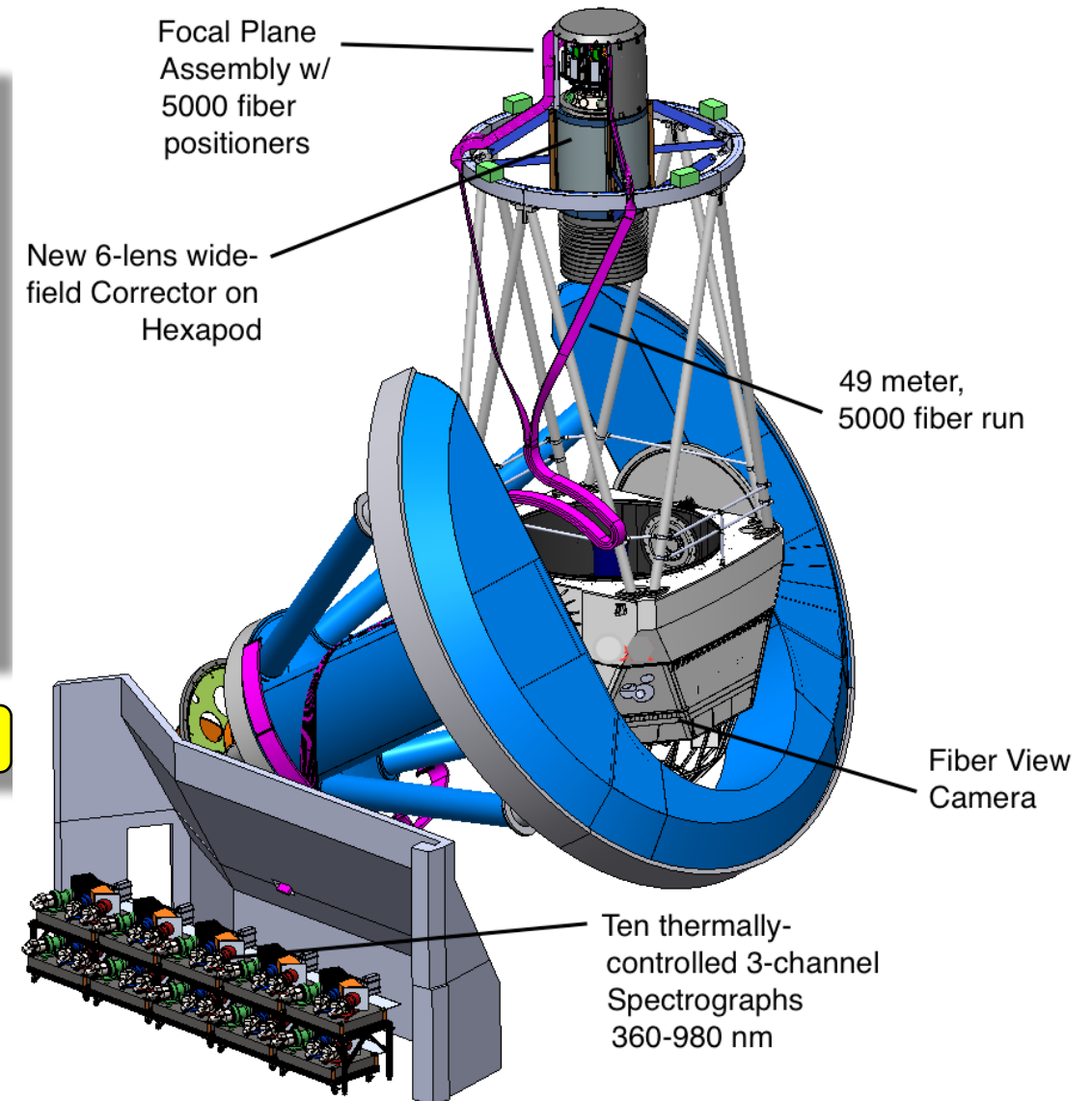
5000 fiber positioner robots @ prime focus

New prime focus corrector (creating an 8 sq deg FOV)

New top ring and cage, barrel and hexapod assembly

Ten 3-arm spectrographs (cf., BOSS spectrographs)

Images: M. Levi, DESI Project Director





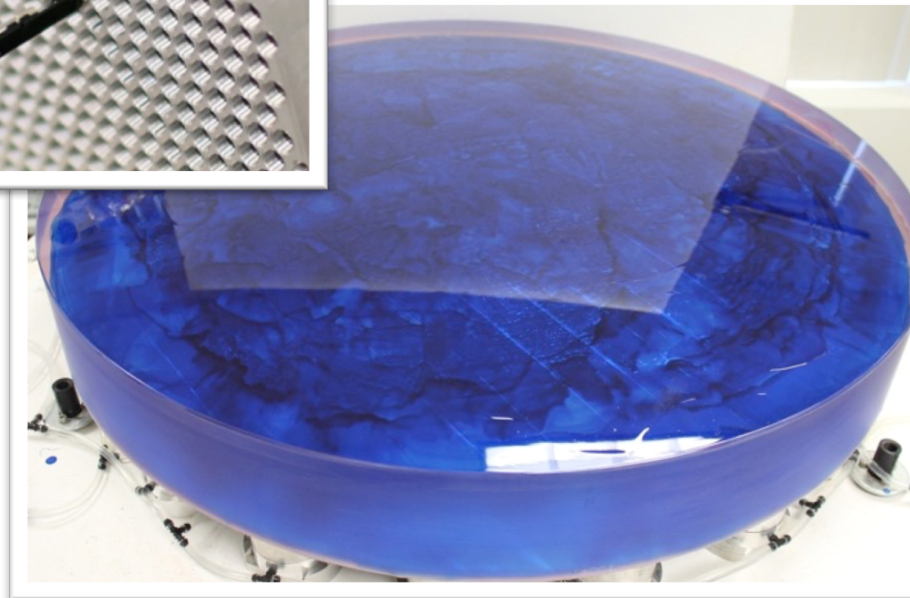
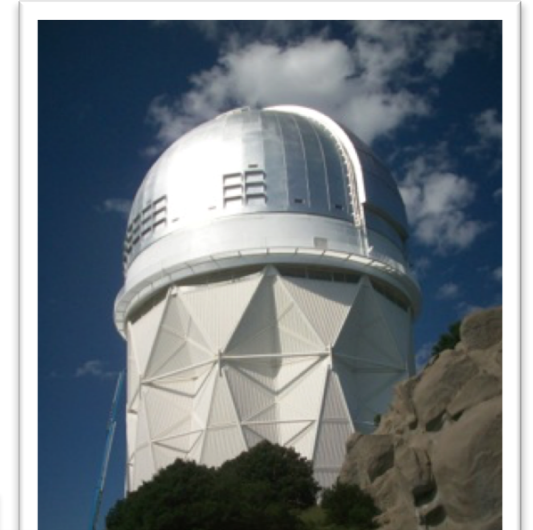
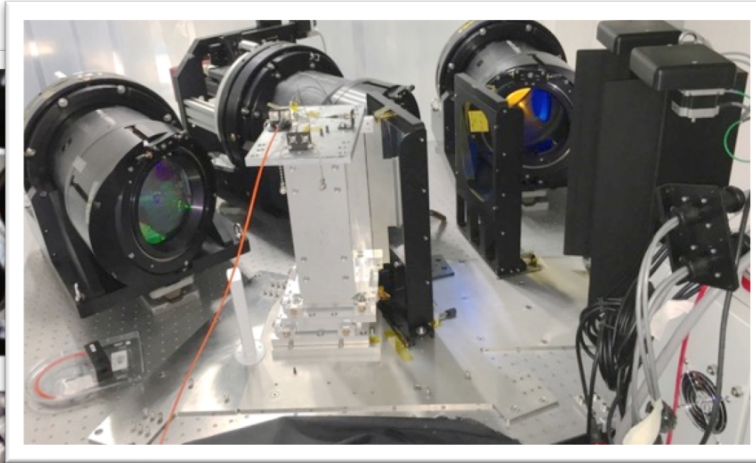
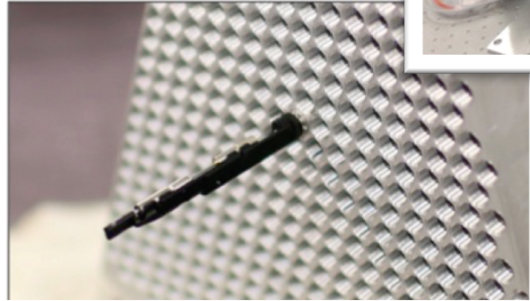
- Recent & upcoming DESI milestones
 - WBS 1.9 FDR (28 Feb-1Mar): AIT&C
 - Mayall shutdown starts 13 November 2017
 - Mayall ready for DESI h/w install 23 March 2018
 - Corrector installed 24 May 2018
 - Focal plane assembly installed 13 Dec 2018
 - Start of commissioning 8 Feb 2019
 - Commissioning complete 28 May 2019



KPNO engineer Derek Guenther (left) and safety officer Tammie Lavoie(right) studying process for stringing fiber optic cables from prime focus down the telescope truss.

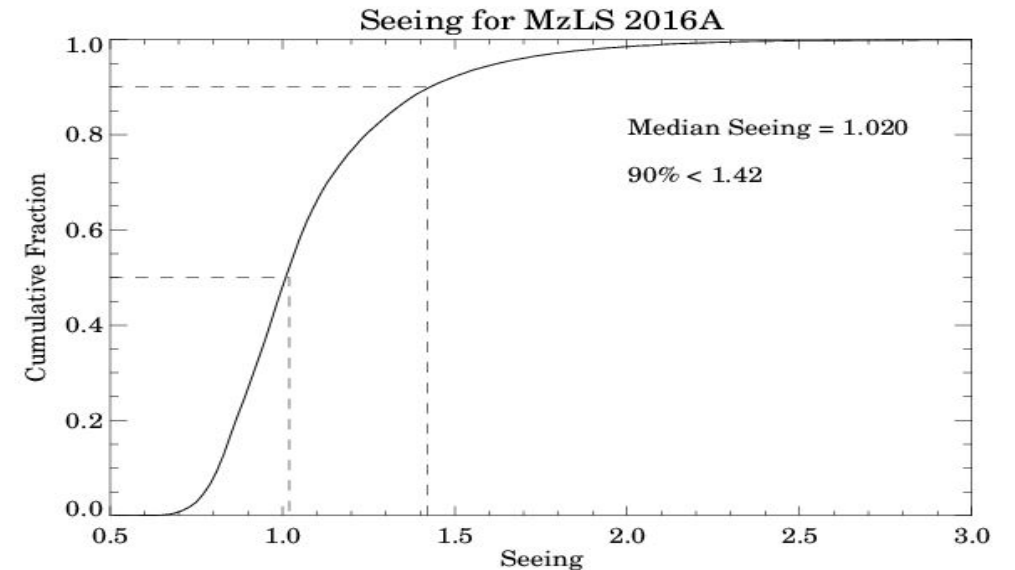
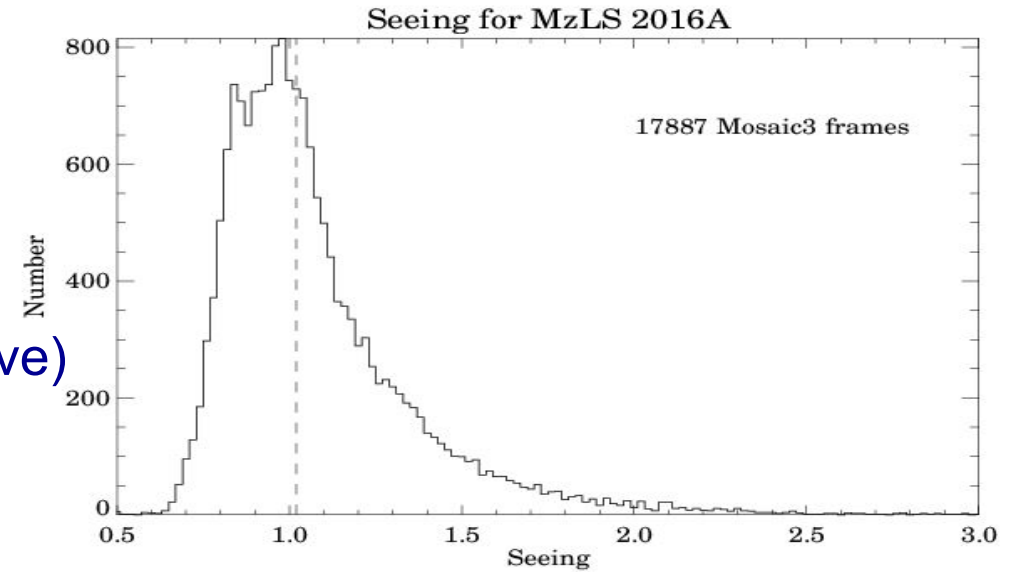
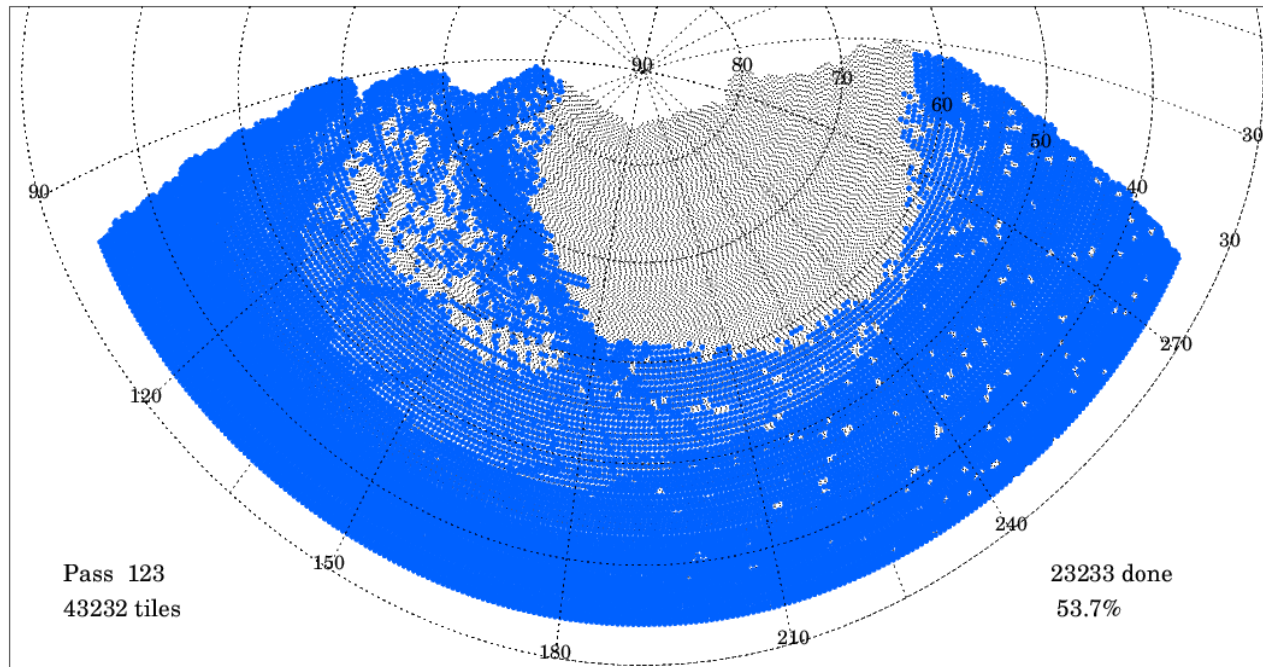


DESI hardware



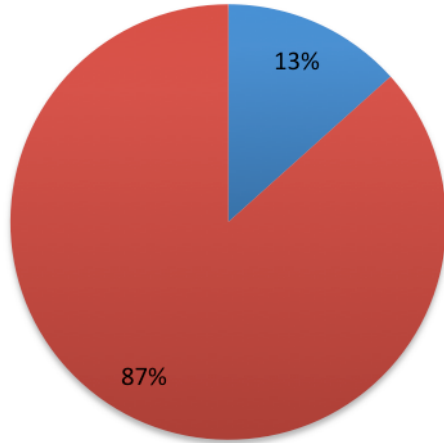
Imaging survey for DESI targeting: MzLS

- DESI footprint at DEC > +30 deg
- Depth: z=23.0 5-sigma point source
- Coordinate footprint with Bok g/r survey
- ~220 nights total with Mayall in 2016A and 2017A
- MzLS data public immediately (NOAO Science Archive)

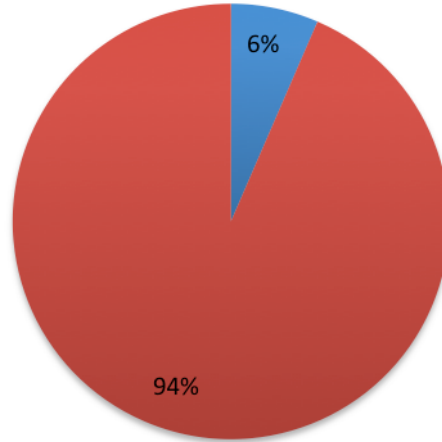


Down time, WIYN

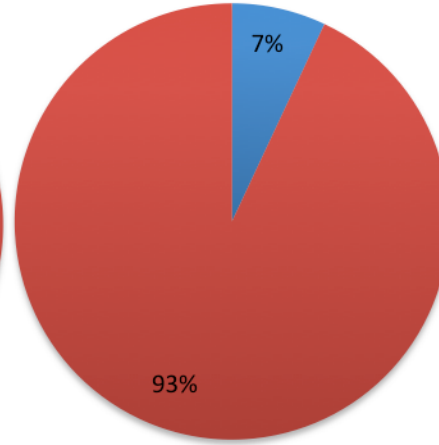
FY15



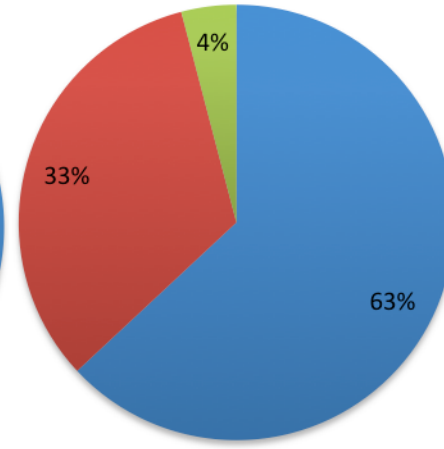
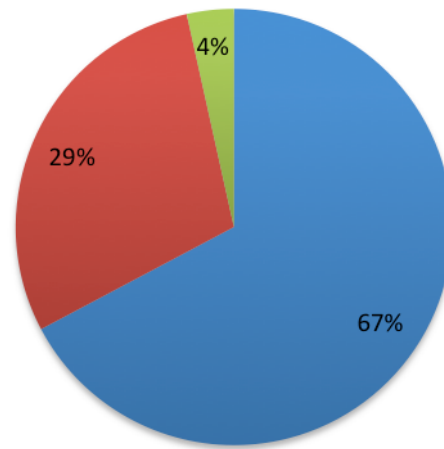
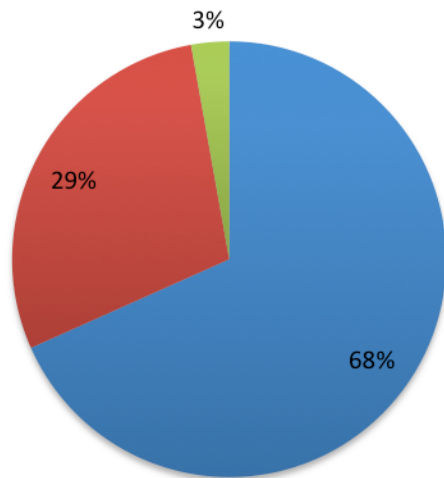
FY16



FY17*



% of ALL time scheduled for science
% of ALL time scheduled for MT&E



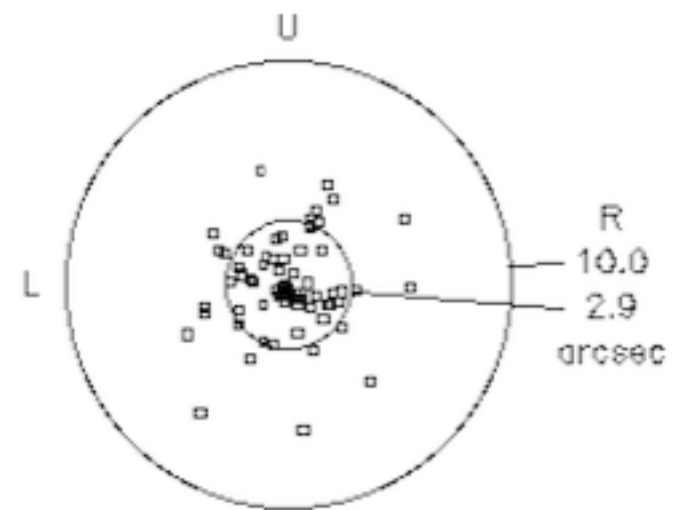
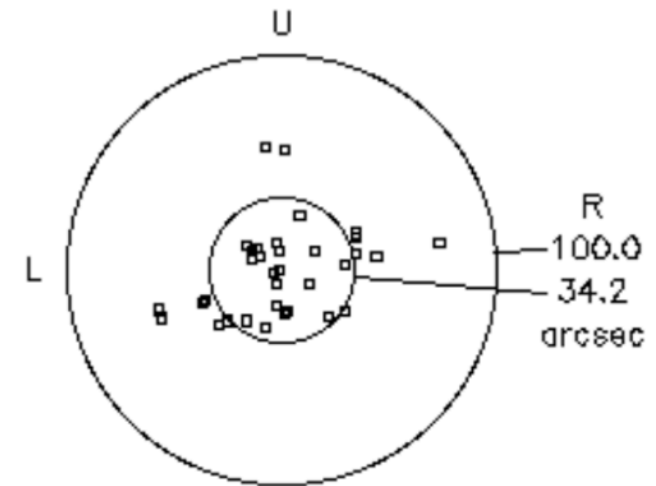
% of scheduled science time
% used for science
% lost to weather;
% lost to unscheduled technical downtime

- Balancing and re-alignment of mount (July 2016) resulted in significant improvement in telescope pointing and tracking

Pointing residuals: Figure at right shows measured pointing performance in January 2015 (top) and September 2016 (bottom).

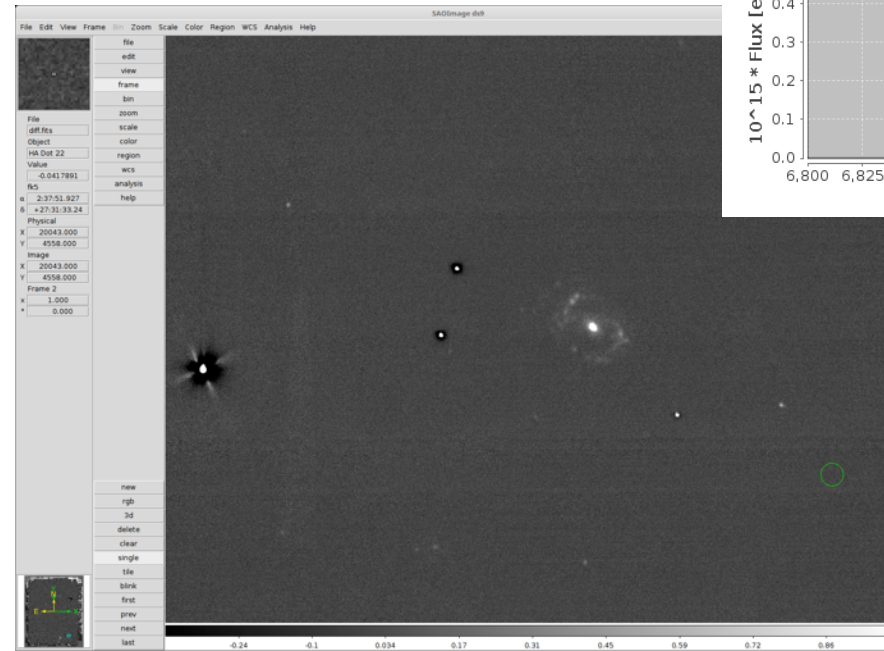
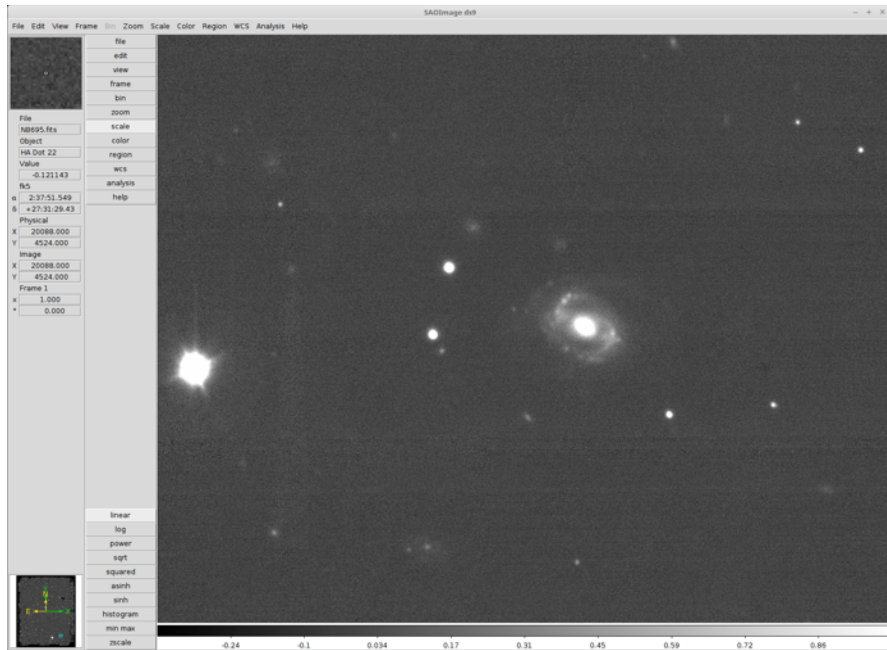
Top: Inner circle is 34" RMS

Bottom: Inner circle is 3" RMS

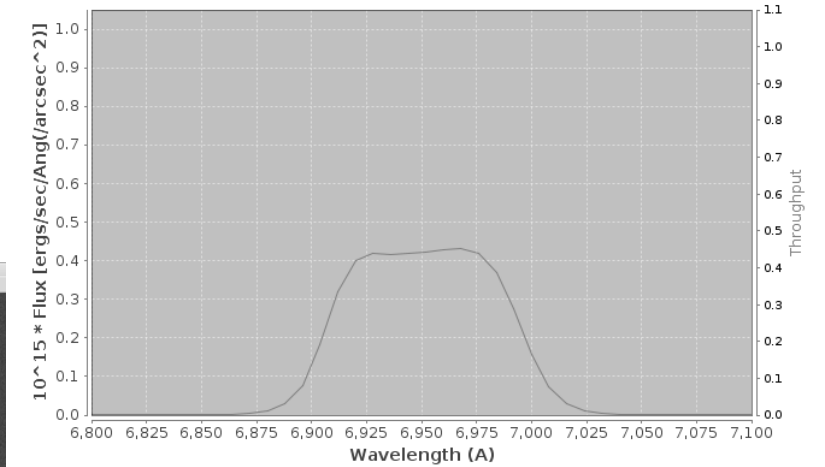


POINTING RESIDUALS, W/RESPECT TO MOUNT COORDINATE

New narrow band filter @ 695 nm for emission-line surveys

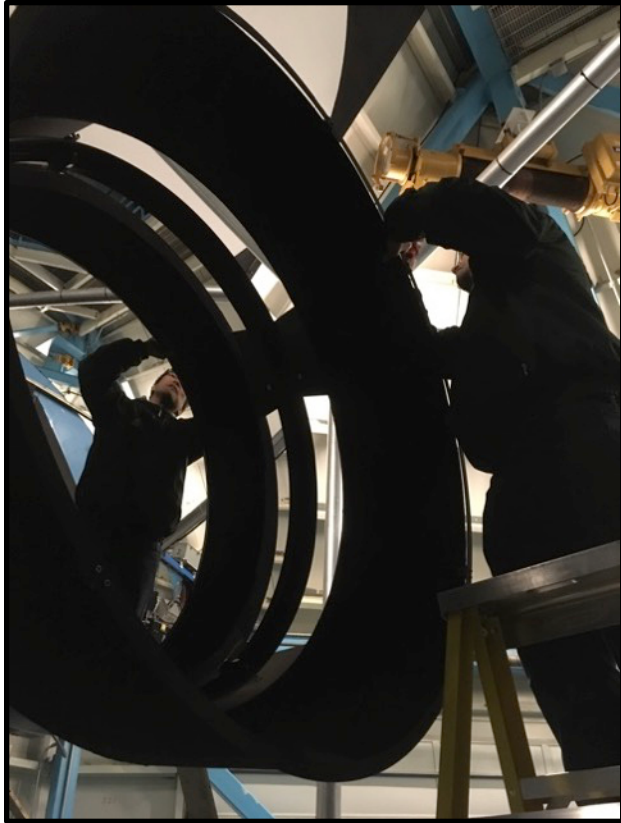


WIYN + ODI + NB695 system throughput



Left: Narrow band filter. Right: Narrow band - continuum (r'), quicklook reduction

Stray Light Mitigation at WIYN



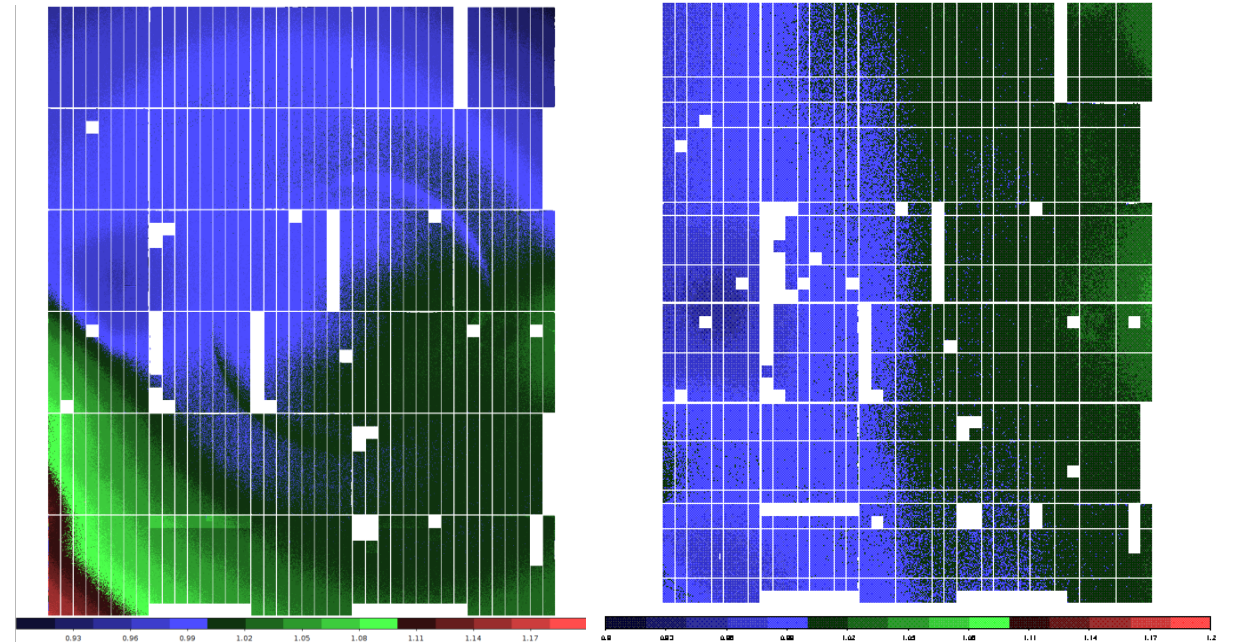
Clockwise from above:
installing new ring on
secondary baffle,
tertiary baffle, tertiary baffle



Below Left: no baffles, strong straylight in
LL corner, 20% effect.



Below Right: w/ new baffles, some internal
reflections / gradient left, <4% level,
average out w/ rotation.



Coming 2019 → **NEID @ KPNO WIYN 3.5-m**

Derived from Tohono O'odham word "to see"



Extreme Precision Doppler Spectrometer

Motivation: TESS, K2, etc.

Mission: determine masses of Earth-like planets

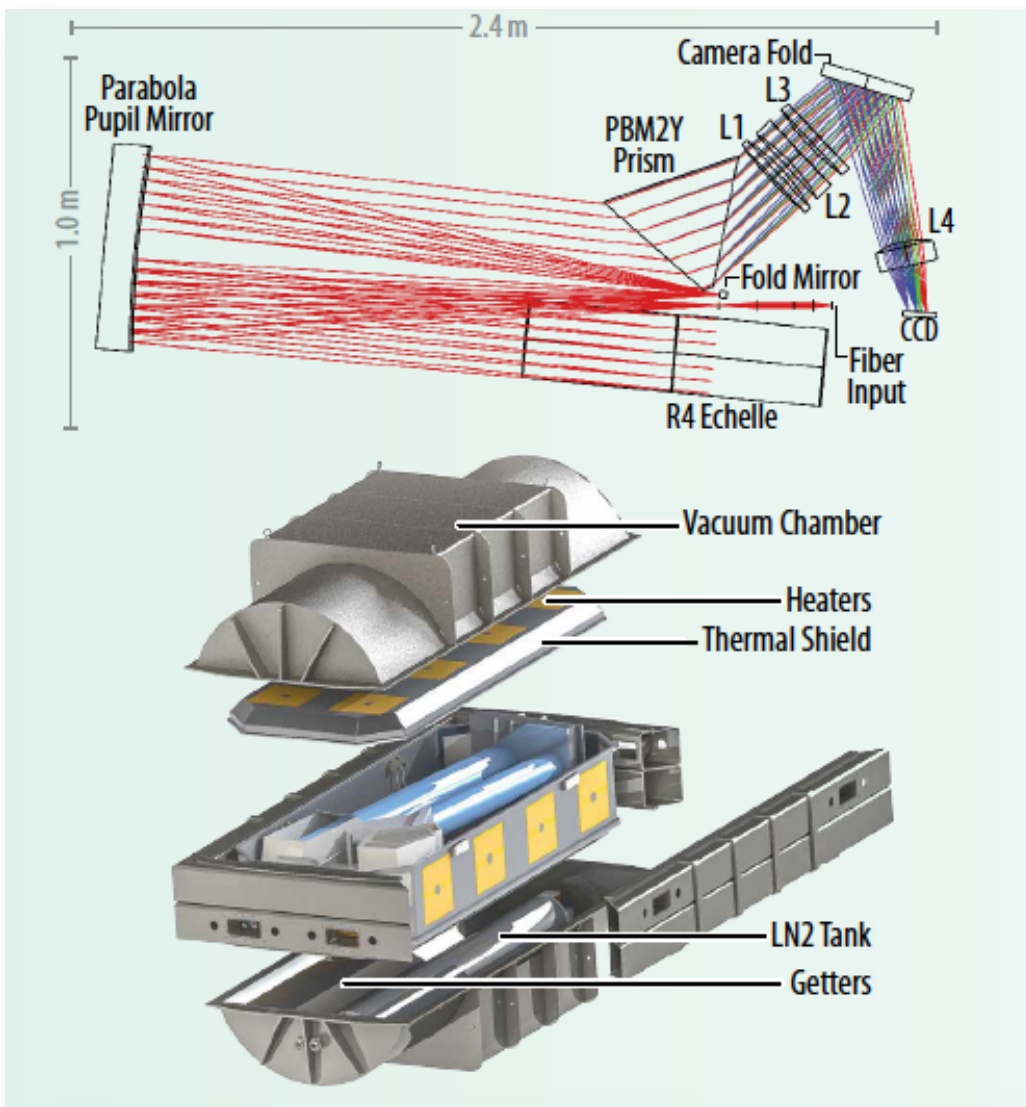
Requirement: $< 50 \text{ cm/s}$

Goal: $\sim 10 \text{ cm/s}$

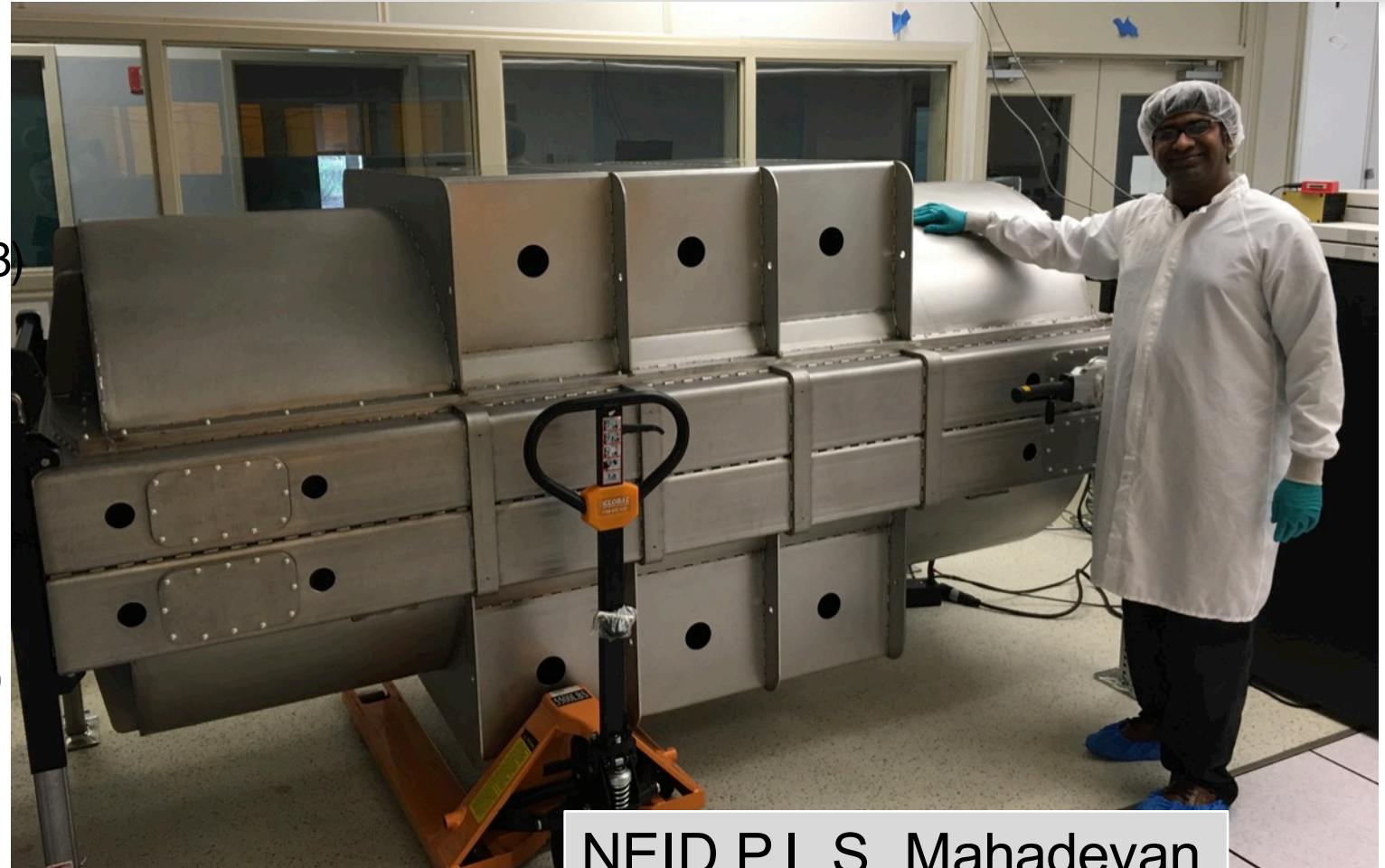
Instrument for the community

Operations start 2019 Q2

PI: S. Mahadevan (PSU)



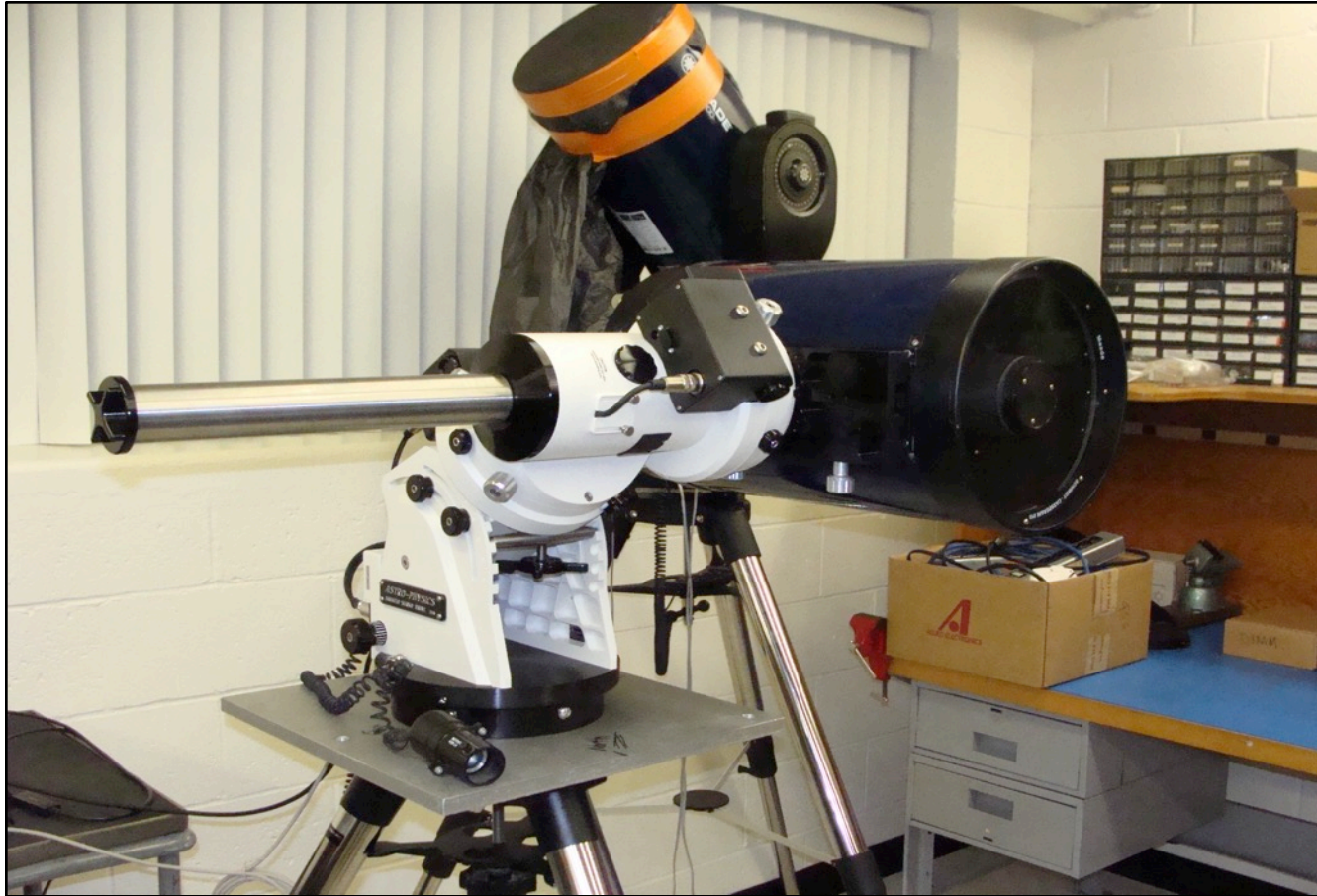
- NEID milestones
 - **Spec DDR November (passed)**
 - Port, Facilities DDR (Jun 2017)
 - Facility mods complete (Jan 2018)
 - Port Adaptor install (May 2018)
 - PA commissioned (Aug 2018)
 - **Spec arrives (Sep 2018)**
 - Spec installed (Oct 2018)
 - Spec commissioned (Jan 2019)
 - Spec LB comm / ORR (Apr 2019)
 - **NEID operations (Apr 2019)**



NEID P.I. S. Mahadevan
with vacuum chamber

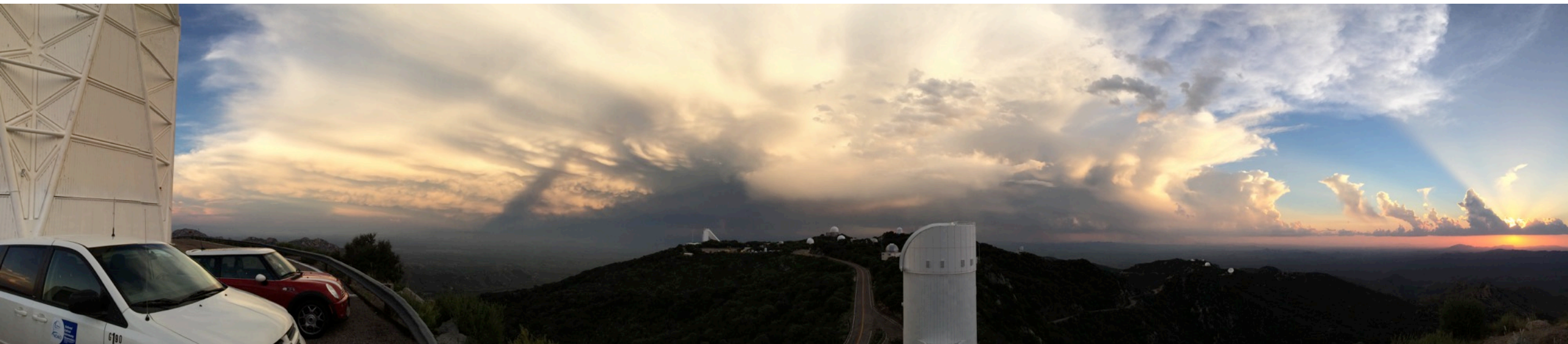
New DIMM (seeing monitor) going in, Spring 2017

- DIMM telescope and mount, initial testing in Tucson lab
- Dome already installed and waiting





End of Presentation





Background Slides

- Remaining slides chronicle improvements to the Mayall facility over last 2 years
 - Some improvements in preparation for DESI
 - Others to ensure long-term viability of telescope and dome

Infrastructure improvements

- Electrical system upgrade scheduled (21-25 August)
 - Second half of mountain-wide power distribution system upgrade
 - Will replace 50-year old switch gear
 - Power outage for much of mountain (generator power for essential staff functions)
 - Tenants notified in mid-February



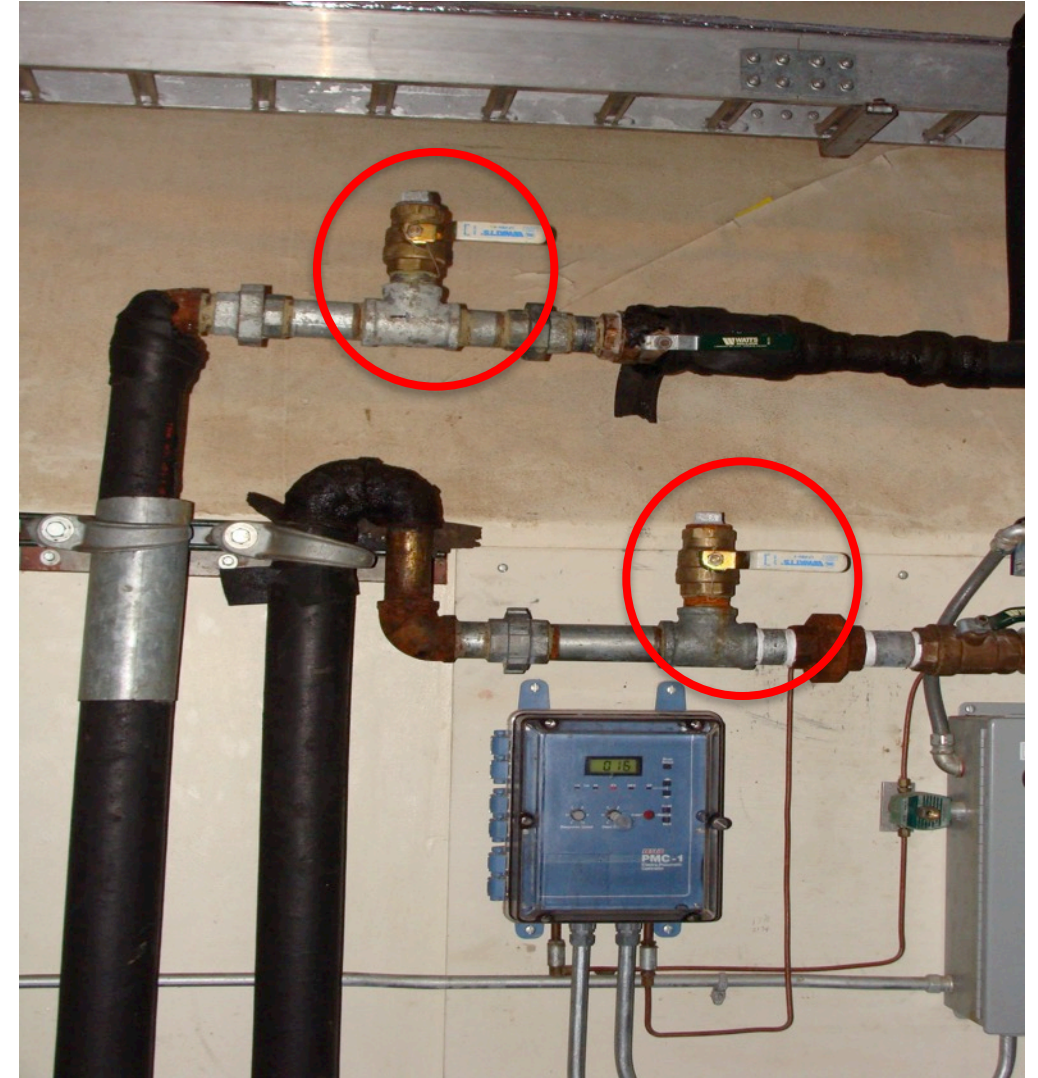
The first half of the electrical system upgrade, completed last year, includes new switch gear in “rock house” below Mayall

- New 80kW UPS
- Serves 3 existing, 4 new panels
 - Coudé room (incl PF and telescope top end, for ADCs, Cal lamps, hexapods)
 - U-Floor
 - Computer
 - Main Floor
- Wiring and UPS done Summer 2016



David Sprayberry / WBS 1.9 FDR

- Glycol System: 3 lines needed inside Coudé room
 - Spectrograph “shack” climate control
 - LPT chiller
 - Prime Focus cooling loop (backup only)
- Mirror cooling lines just on dome side of Coudé room wall
- Taps installed there (1.5-inch) will serve 3 x 1-inch taps inside room
 - Install 1-in taps in room when equipment locations determined
- TCS Interface: DESI-0473 gives requirements:
 - DESI-1132 describes implementation
 - DESI-1949 describes results of successful on-sky tests 21-22 Jan 2016
 - Used throughout ProtoDESI campaign (DESI-2561)



David Sprayberry / WBS 1.9 FDR



- 10Gb/s backbone on fiber
- Nodes in Computer room, Coudé room, U-floor annex, telescope
 - Telescope node for PF, Cass, and top ring (cal lamp control)
- Each node
 - Receives 10Gb/s via fiber backbone
 - Distributes 1Gb/s via Cat 5/6 and RJ-45 to use points
- Equipment will be ordered “just in time” to maximize price vs. performance
- First node needed: Coudé room before “early shack” goes in
 - Will do whole network at once, “early shack” is pacing item
 - Aiming for completion Aug 2017

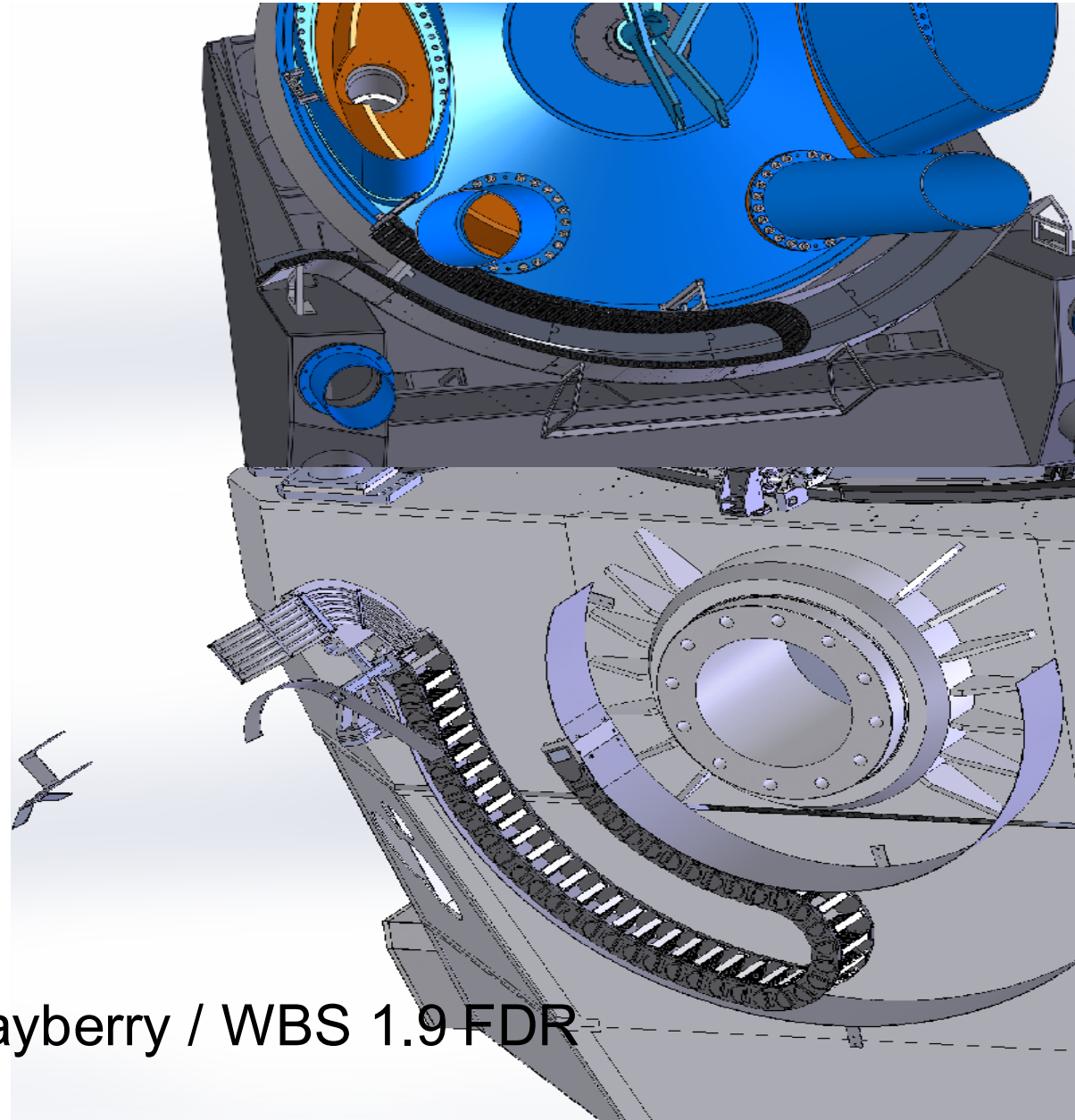


- Added to 1.09.02 after PDR
- Design Complete
- Parts Made
- Installation underway
 - Fixed components being done



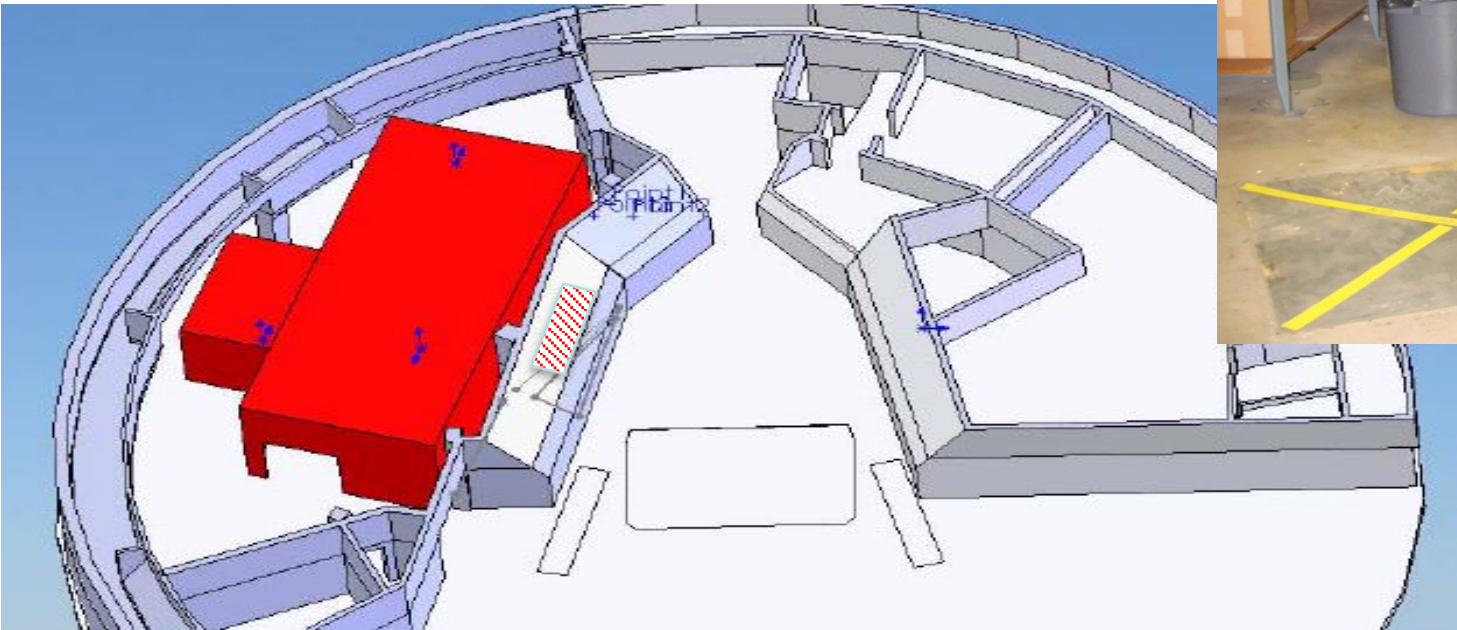
David Sprayberry / WBS 1.9 FDR

KP-9010: Underway



Other DESI Prep Tasks: Large Coudé Room Preparation Underway

- Cut out obstructions (*safely*)
 - e.g., 2100-AD-015-0051, and JHA (see DESI-2666, 2667)
- Cut hole for fiber pass-thru
- Clear space for “shack”



David Sprayberry / WBS 1.9 FDR

Garage Prep In Hand

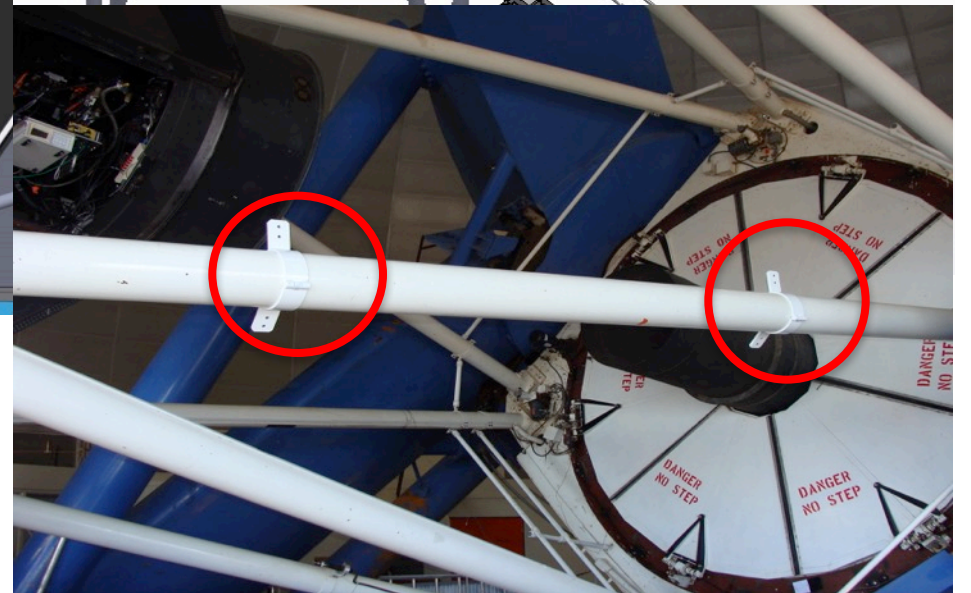
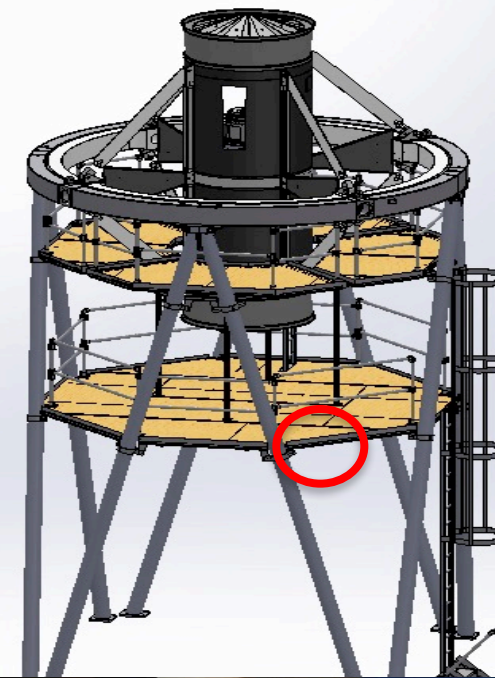
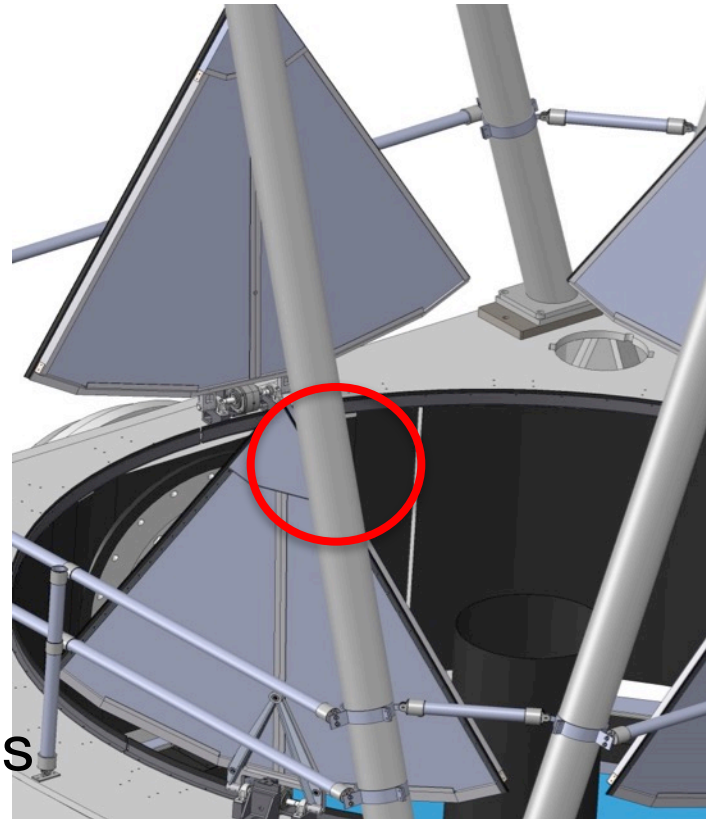
- Corrector re-assembly, alignment
 - Same process for DECam
 - Frame from FNAL, rotary table from UCL
- NOAO provides
 - Tent to enclose it (spec'd out, will be ordered in March 2017)
 - Paint floor
 - Adequate crane (small mobile crane)
 - Electric power, air (present already)



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M1, Cooling, Platforms

- M1 Cover extensions: designed, materials ordered
- Top End Cooling (up to new top ring): designed, parts ordered
- Zenith Work Platforms: designed, materials ordered and custom parts made



David Sprayberry / WBS 1.9 FDR

Mirror Lift Upgrade



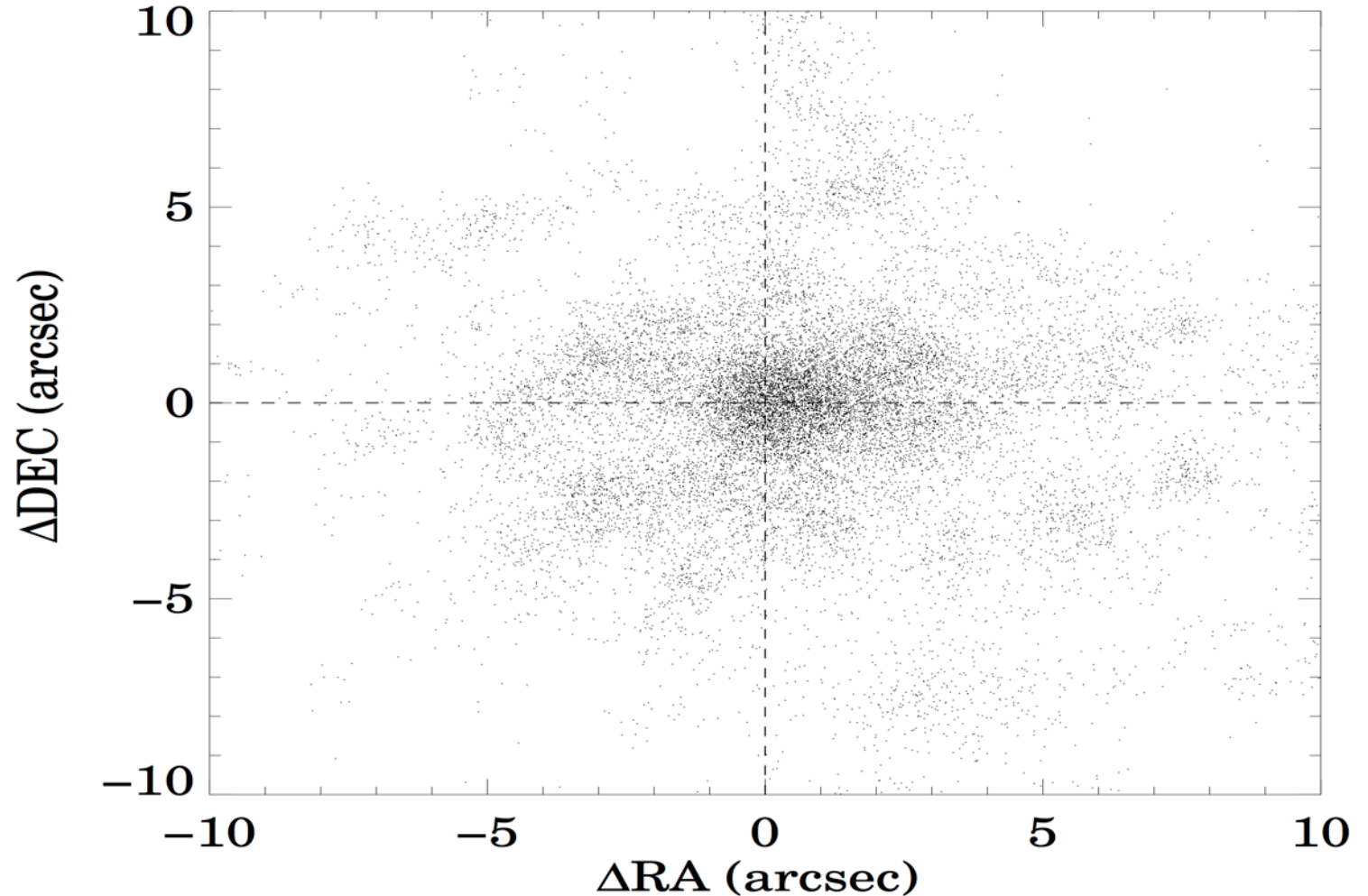
David Sprayberry / WBS 1.9 FDR



TCS Modernized: Encoders, Servos, Software

- Finished Summer 2015
- In full-time use since then
- All-sky pointing errors < 3 arcsec rms (was 18" rms)
- Open-loop tracking similarly good (< 1mas/s)
 - Allowed for reduction in DESI guider update rate req't
- Used for:
 - TCS-ICS testing
 - MzLS Semester 2016A
 - ProtoDESI

Position Offsets from MzLS



David Sprayberry / WBS 1.9 FDR

Upper Dome Shutter Drive Gearbox

- Old unit was under-rated, badly worn, likely to fail soon

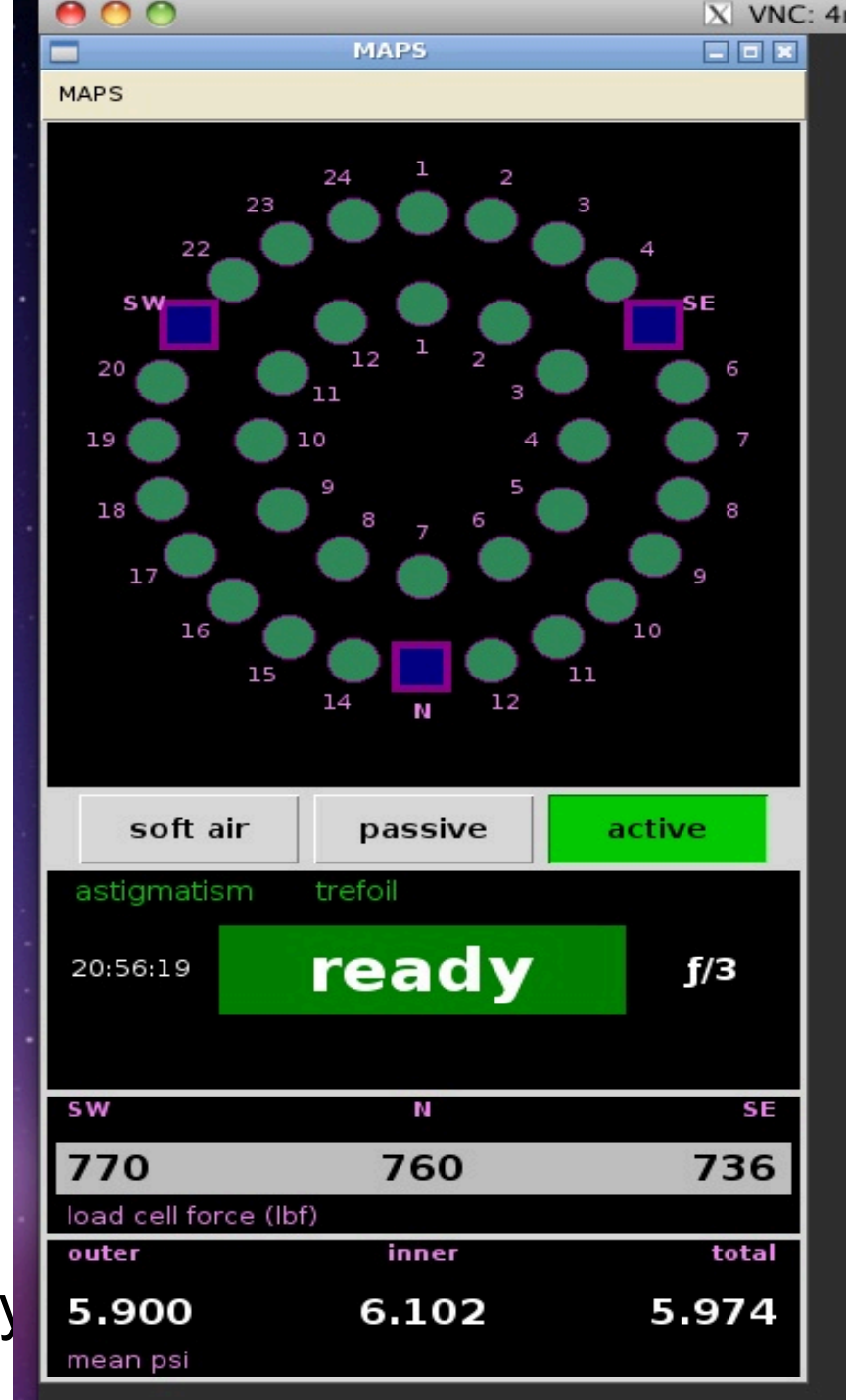


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- 4MAPS Before
 - 40s to settle
- 4MAPS Now
 - < 5s to settle
- Significant reduction in telescope overheads during DESI inter-exposure sequence
 - Average exposure 20min
 - Reconfiguration time:
 - Reqt 2 minutes
 - Goal 1 minute
 - This is ~ 2.5% gain in efficiency or survey duration margin
- Finished Summer 2016

David Spray



4MAPS

E-Stop System Upgrade

- Extended
 - To places previously not properly covered, e.g. mirror lift
 - To places not covered at all, e.g. U floor
- Brought up to modern safety and engineering standards
- Fully tested
- Implements all required power cuts and telescope brake applications



David Sprayberry / WBS 1.9 FDR

- Same 45T capacity
- Same dual-circuit flexibility
- Same control software
- Will be plumbed for quick switchover



David Sprayberry / WBS 1.9 FDR

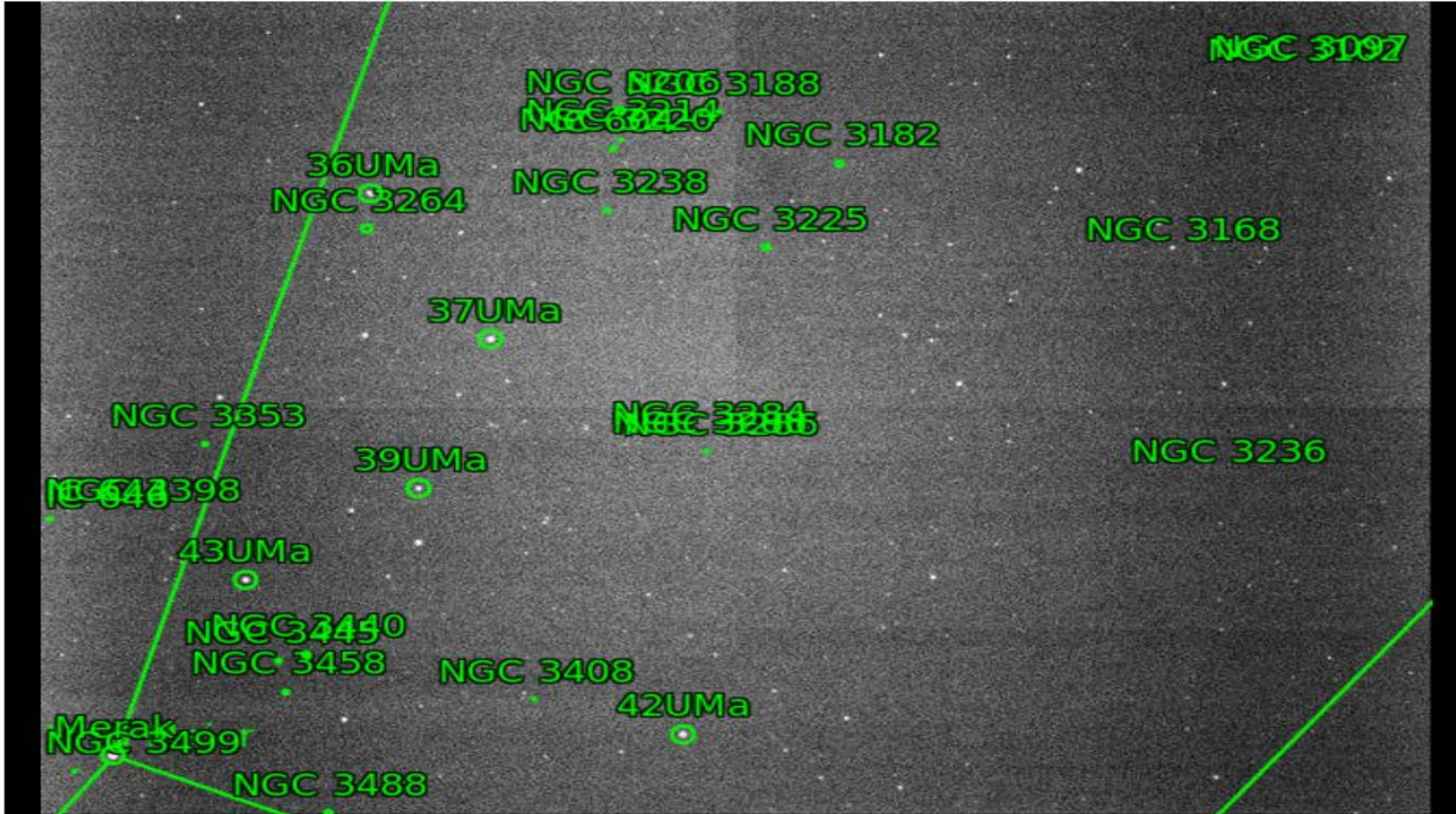
Astrometry Camera will be available for DESI

- Mounts to top ring, 8 deg x 6 deg FOV
- Initial tests got solutions from Astrometry.net in < 0.2 sec average (next slide)
- Can help shorten initial pointing tests for DESI, also do ongoing real-time checks



David Sprayberry / WBS 1.9 FDR

Sample Camera Image as processed by Astrometry.net



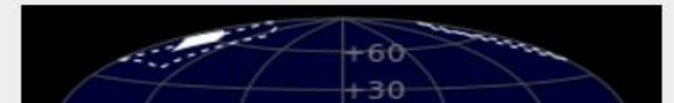
Submitted by Behzad Abareshi (8411)
 on 2017-02-14T18:54:48Z
 as "img_001_tap4_bin1_exp...2.fits" (Submission
 1453724)
 under Attribution 3.0 Unported

Job Status

Job 1946319:
 Success

Calibration

Center (RA, Dec):	(158.420, 58.556)
Center (RA, hms):	10 ^h 33 ^m 40.807 ^s
Center (Dec, dms):	+58° 33' 20.150"
Size:	7.93 x 5.95 deg
Radius:	4.957 deg
Pixel scale:	8.66 arcsec/pixel
Orientation:	Up is 62.4 degrees E of N
WCS file:	wcs.fits
New FITS image:	new-image.fits
Reference stars nearby (RA,Dec table):	rdls.fits
Stars detected in your images (x,y table):	axy.fits
Correspondences between image and reference stars (table):	corr.fits
KMZ (Google Sky):	image.kmz

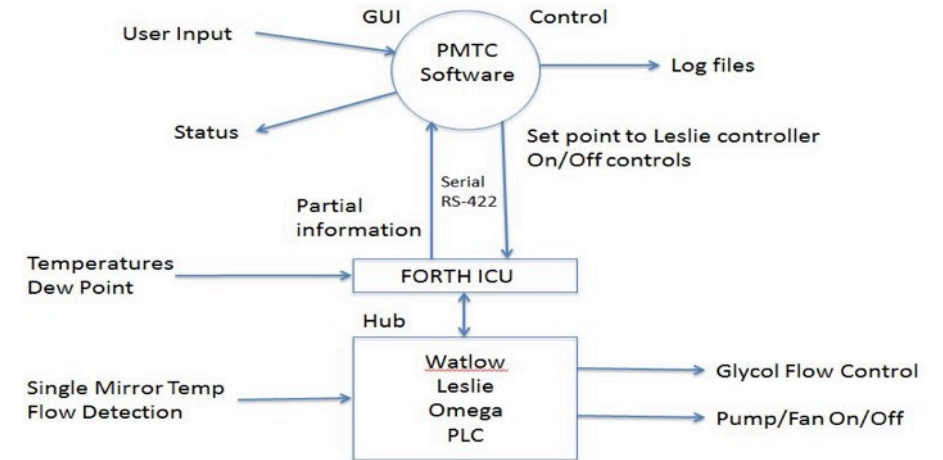


Primary Mirror Temperature Control Upgrade Underway

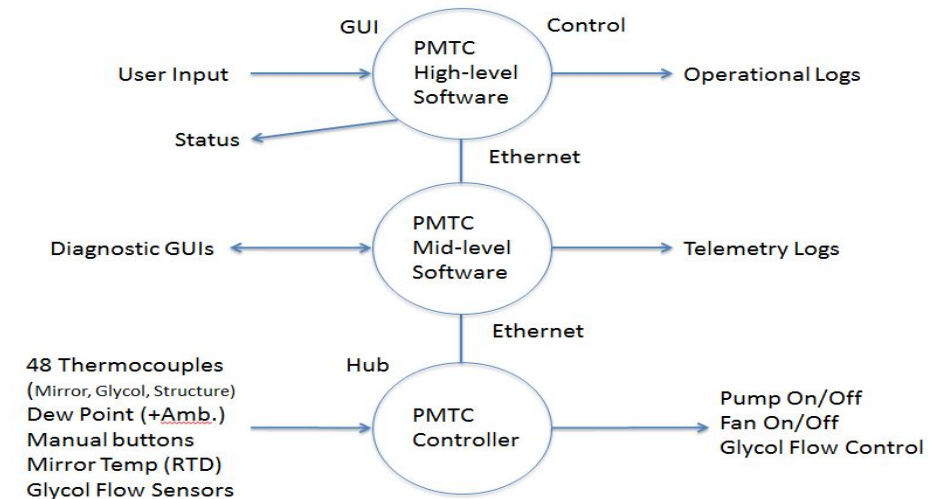
- Goals:

- Replace old electronics
- Retain existing infrastructure where possible
- Minimize downtime
- Complete before DESI installation starts (end of Summer 2017)
- Provide full control and status to user software
- Improve status displays and logging
- Add sensors for redundancy and analysis
- Provide platform for improvements in cooling

Current PMTC Architecture



New PMTC Architecture



David Sprayberry / WBS 1.9 FDR

The Mayall has been rejuvenated!

- We repainted the dome Summer 2016
 - Lo-mit coating for improved thermal performance
 - Addressed long-term maintenance need



David Sprayberry / WBS 1.9 FDR