The Blanco Telescope & DECam

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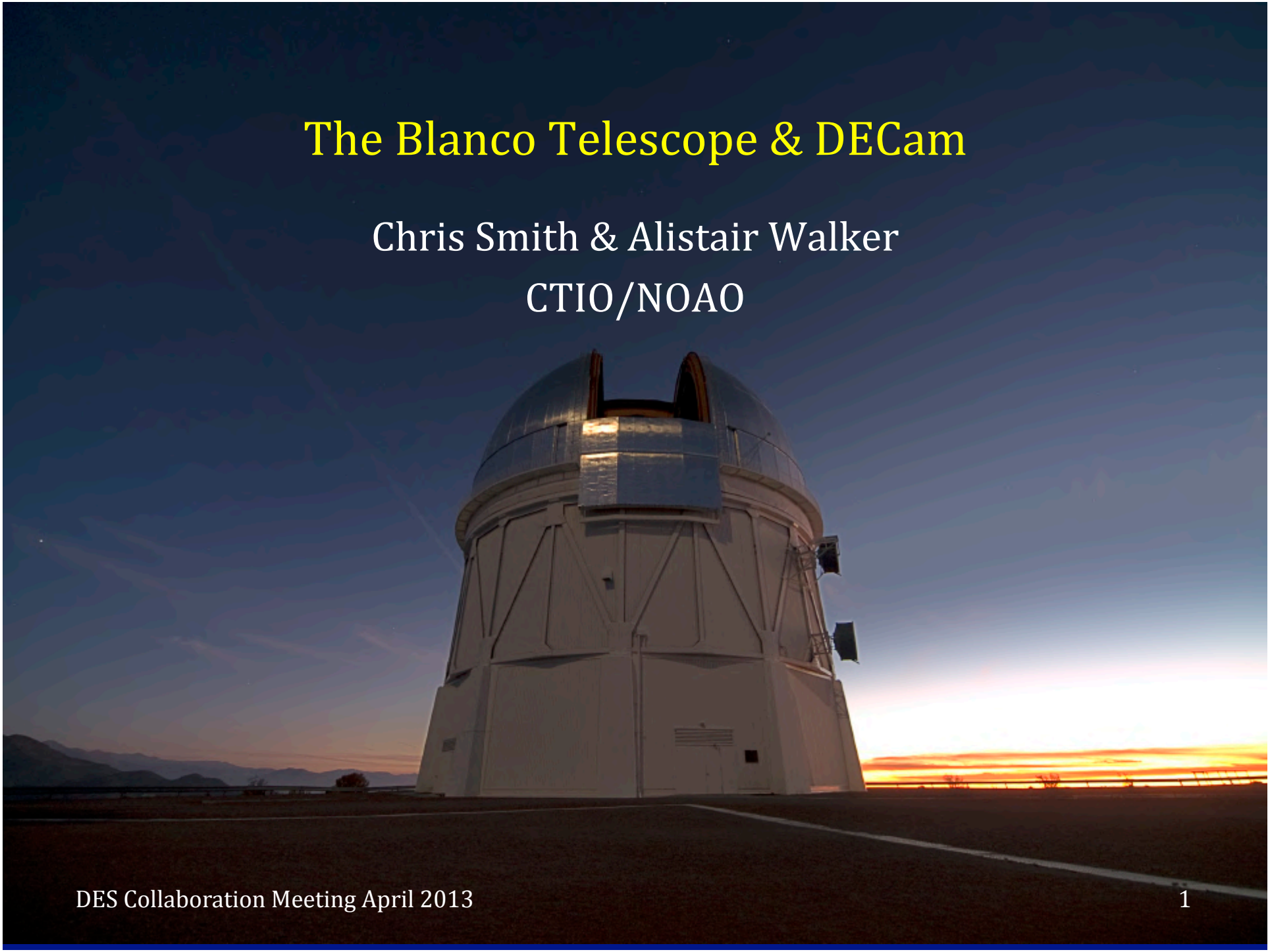
CTIO/NOAO



Executive Summary

- To date (7 months in) DECam has proven to be mature and reliable; DES-SV and Community observations have had outstanding on-sky time fraction for a new instrument.
- Telescope tracking/guiding issues resulting in degraded image quality have been fixed, after effort on several fronts.
- The focus of effort now turns to understanding the telescope opto-mechanical properties, and to improving the thermal behavior of telescope and dome.
- CCD performance meets the specifications, but work will continue on both device characteristics and pipeline calibrations with a goal of reducing photometric errors

Contents

- Evolution from Commissioning to the Present
- The Next 6 Months (March-September 2013)

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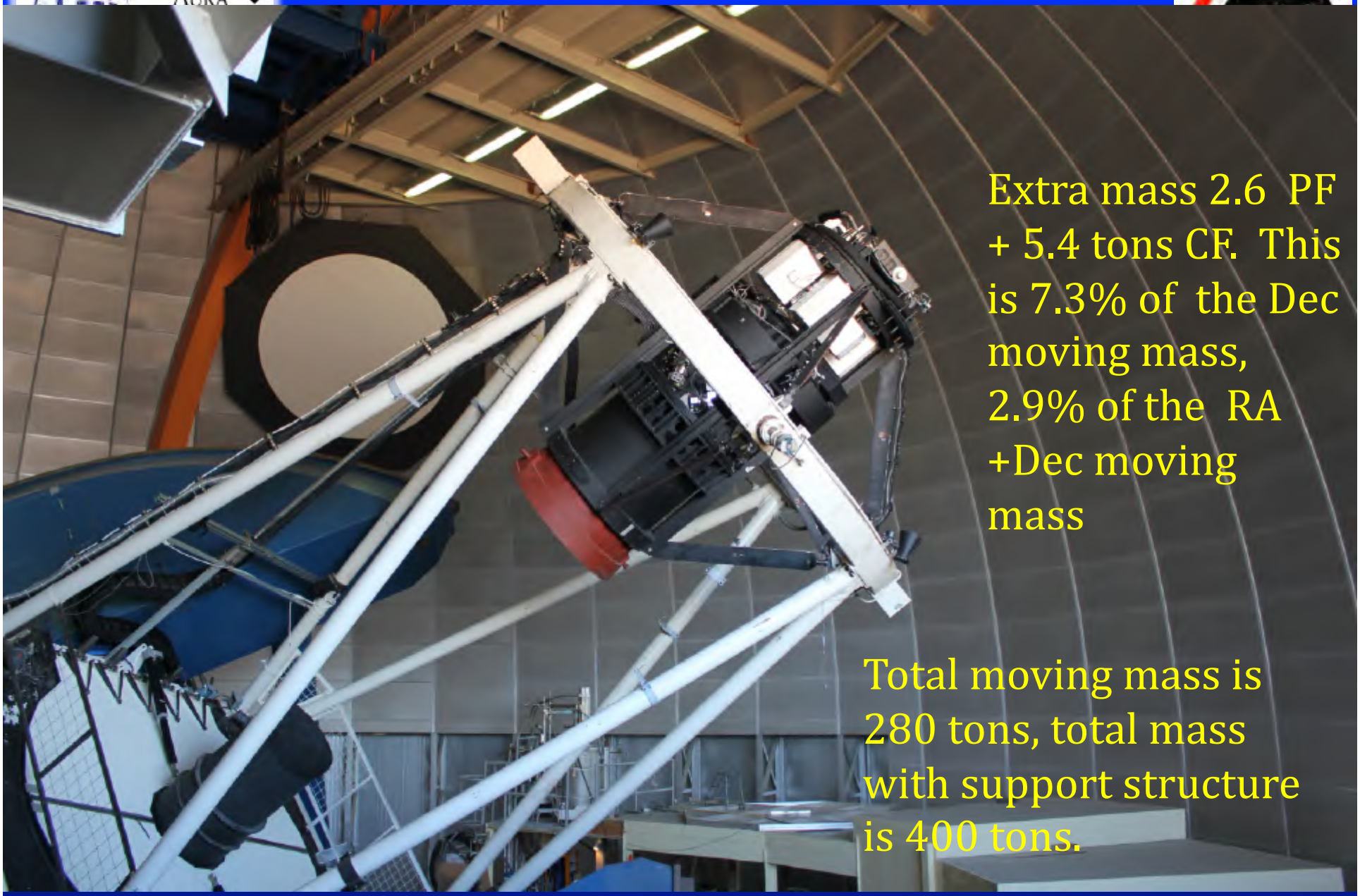
We are ~8 months from this

- New Camera
- New Corrector
- New PF cage
- Modified Telescope
- New Telescope Control System



Extra mass 2.6 PF + 5.4 tons CF. This is 7.3% of the Dec moving mass, 2.9% of the RA +Dec moving mass

Total moving mass is 280 tons, total mass with support structure is 400 tons.

How to gauge progress?

One way is from the Requirements Matrix –

- 196 technical requirements
- 4 not met yet (all being worked on)
  - Telescope+instrument image quality
  - Image whisker spec
  - Slew time (2 degrees in 17 secs?)
  - Flat field to better than 0.5%
- ~20 pending (many relate to the Community Pipeline and to the f/8 installation)

Another way

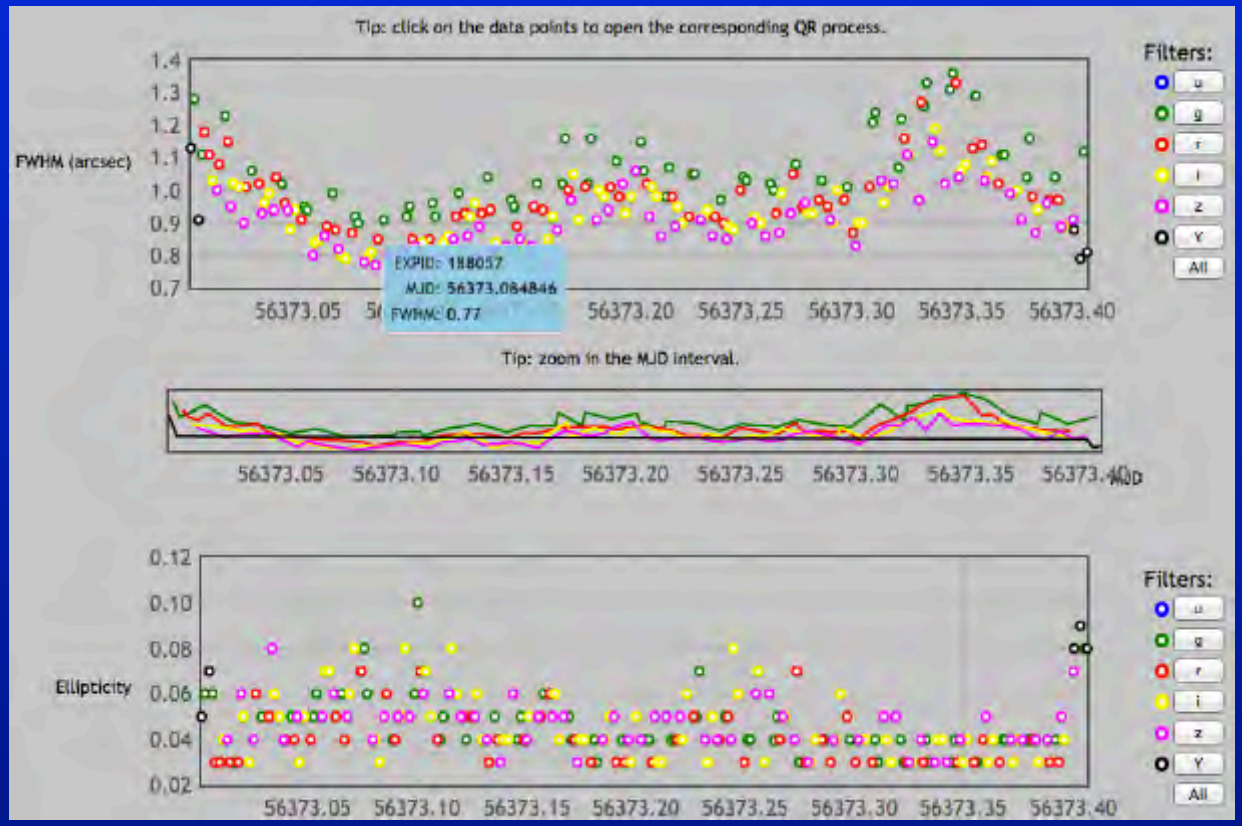
In last 30 nights of scheduled observing up to March Review:

- 260 night-time hours
- 11 hours lost, ~ 8 hours telescope, ~ 3 hours DECam
- 4.5 hours in 2 events (both involving re-booting multiple computers)

This is 4%.

Another way

- Observing is often now "boring"
  - Well prepared observers, with scripts for most of night
  - QR running smoothly, producing good immediate feedback



And Another Way

- Total Data Collected (as of April 1, 2013)
  - >55,000 images taken
  - >63 TB of uncompressed data, >26 TB compressed
- All Automatically transported via DTS
  - To either NCSA and/or Tucson (depending on queue)
  - Average nighttime shutter close to delivery is ~2 min
- Record setting nights (Bloom et al.) in March 2013
  - >700 images in a single night
  - >0.8 TB collected (uncompressed), >0.3 TB transferred

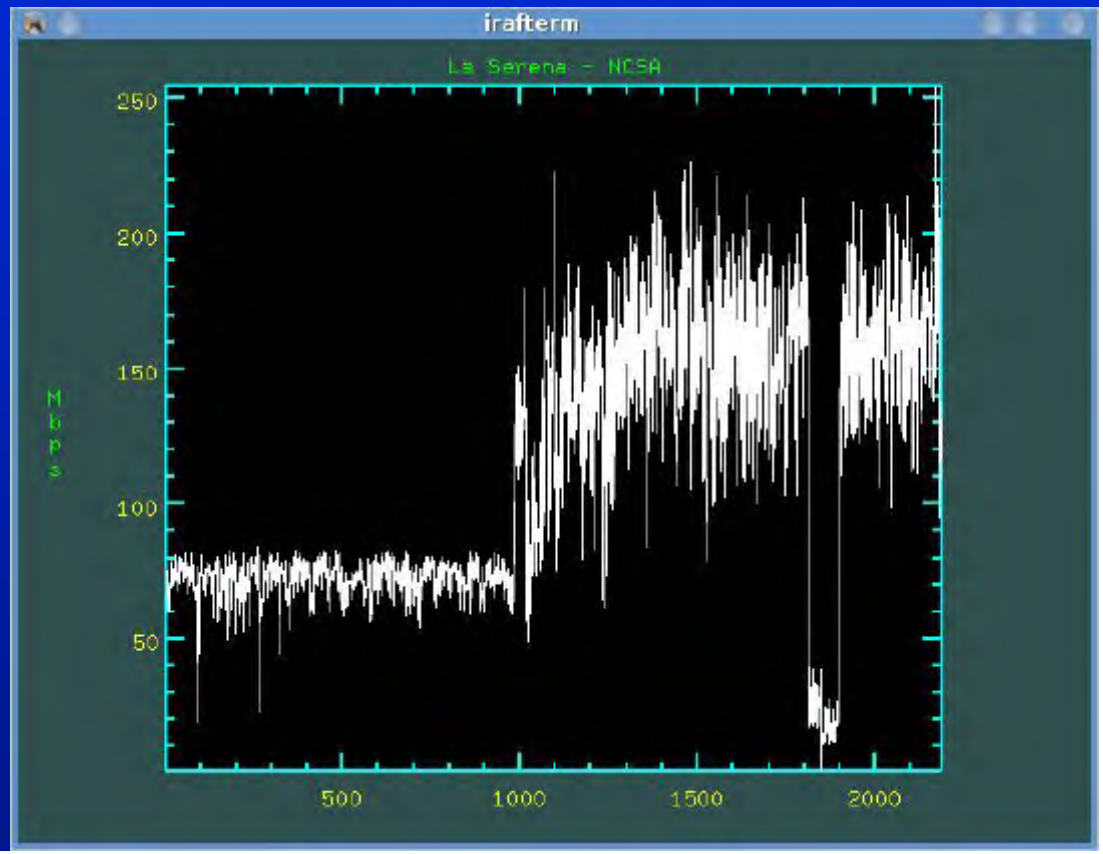
And Another Way

- First call for proposals: Deadline 30 Sep 2012
  - Call went out before first light, deadline soon after first light
  - Disappointing results, not a big response
- Second call for proposals: Deadline 31 Jan 2013
  - Oversubscription of ~4.5 !
  - Community is now VERY interested in using DECam
- Third call for proposals: Deadline 28 Mar 2013 for 2013B
  - DES starting, limited community time
  - Oversubscription ~4, pending scheduling

Data Transport: Recent improvements

- Cadence settling down (Jan-Mar)
  - Average of 9200+/-400 images per month
  - Average of >4.4 TB+/-0.2TB (compressed), ~10TB (uncompressed)

- Firewall upgraded
  - Now regularly achieving 150Mbps to NCSA



Post Commissioning Engineering

- Regular engineering time planned, 2-4 days+nights per month for 2013A (and through start of DES 2013)

- Major shutdowns planned for June, July, Aug/Sep 2013
  - June 2013 = f/8 practice
  - July 2013 = DECam: LN2 pump and related
  - Aug/Sep 2013 (to be scheduled) = f/8 installation

- Regular maintenance and minor tests may be scheduled during the day time, not affecting scheduled night time observing (only as approved by CTIO instrument scientist) – err on side of stability for observers

f/8 status

- The mirror has been successfully repaired

- Shipment planned for next week
- First (re)light is planned for August

What we have been working on

- Fixing problems with the telescope & DECam as they arose, identifying issues for study and resolution
- Telescope tracking, guiding, pointing
  - New Control system (both hardware and software)
  - DECam + counterweights adds 8 tons to the telescope tube
  - Cable wraps – including two vacuum-jacketed LN2 hoses
- "Hardening" the system
  - More reliable utilities
  - Redundant systems, available spares
- Training the operations staff
  - Much through solving problems as they come up

1. Fixing Problems as they Arise

- LEDs inside the Filter Change Module (fixed by a week stand-down during commissioning)
- NESLAB failure on Dec 26. Replaced by spare
- Monsoon crate fan sensors disabled
- Acquisition software bug fixes, interface issues, improvements
- Vacuum jacket leaks near the cold tank are being continuously pumped, fix in July
- Utilities – learning from failures, make system more robust
- Telescope Control System
  - Fine Tuning with new weight characteristics a long process
  - Understanding opto-mechanics + hexapod interactions still work in progress

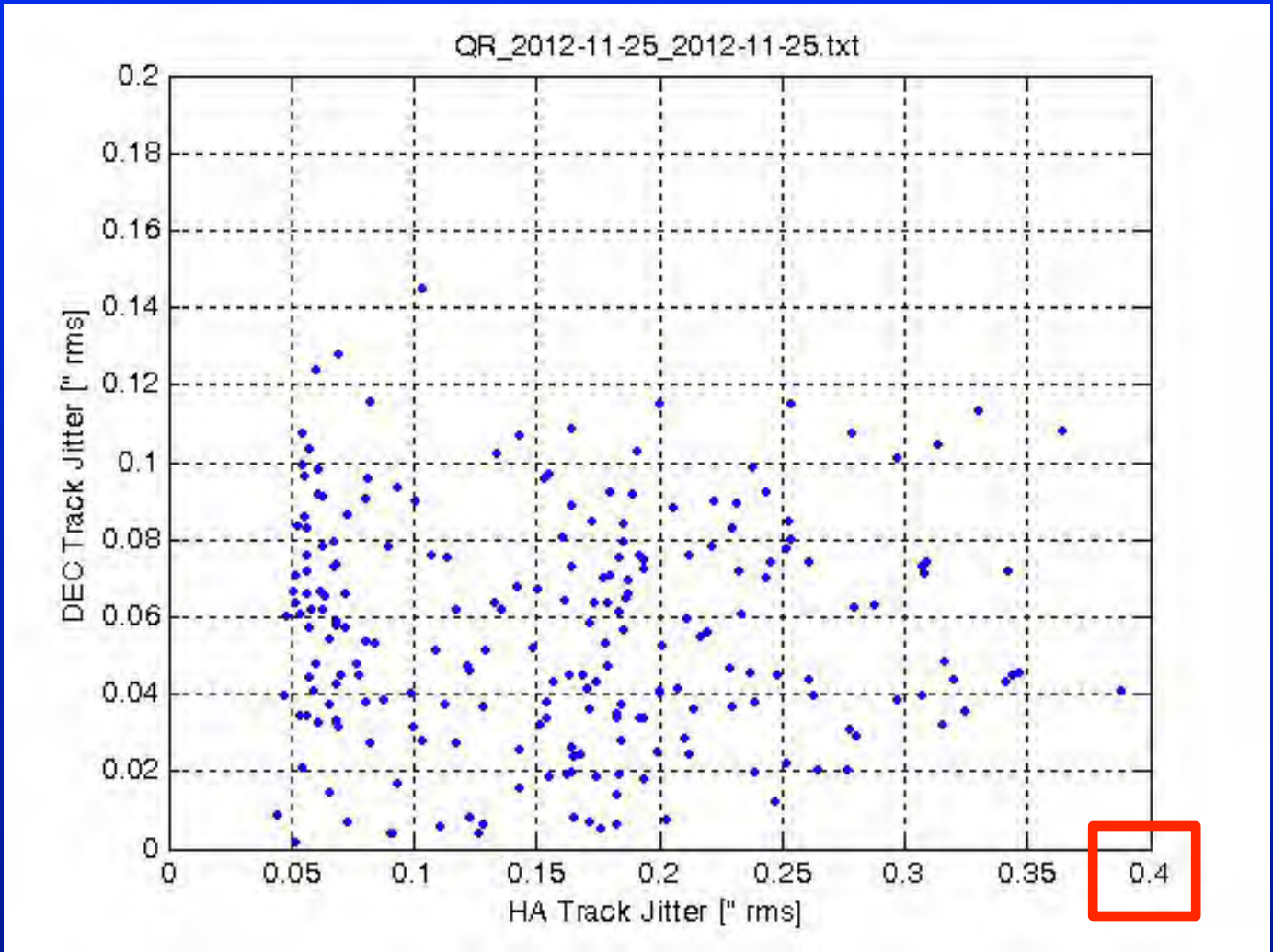
2. Telescope tracking, guiding, pointing

- Improving the telescope tracking has been top priority since the recognition that tracking was sub-standard in late October/early November
- Vibration damper - Major improvement on November 30 2012 when the RA axis vibration damper was reconnected. But at times, the resonant frequency seemed nearer 0.7 Hz than the expected 1.05 Hz.
- Oil wipers were found to be touching the RA bearing
  - Cleaned and adjusted on Jan 30 2013.
  - RA tracking improved dramatically but not everywhere.
  - On February 25 2013 the secondary oil wipers were removed.
  - Now we have good tracking performance everywhere.

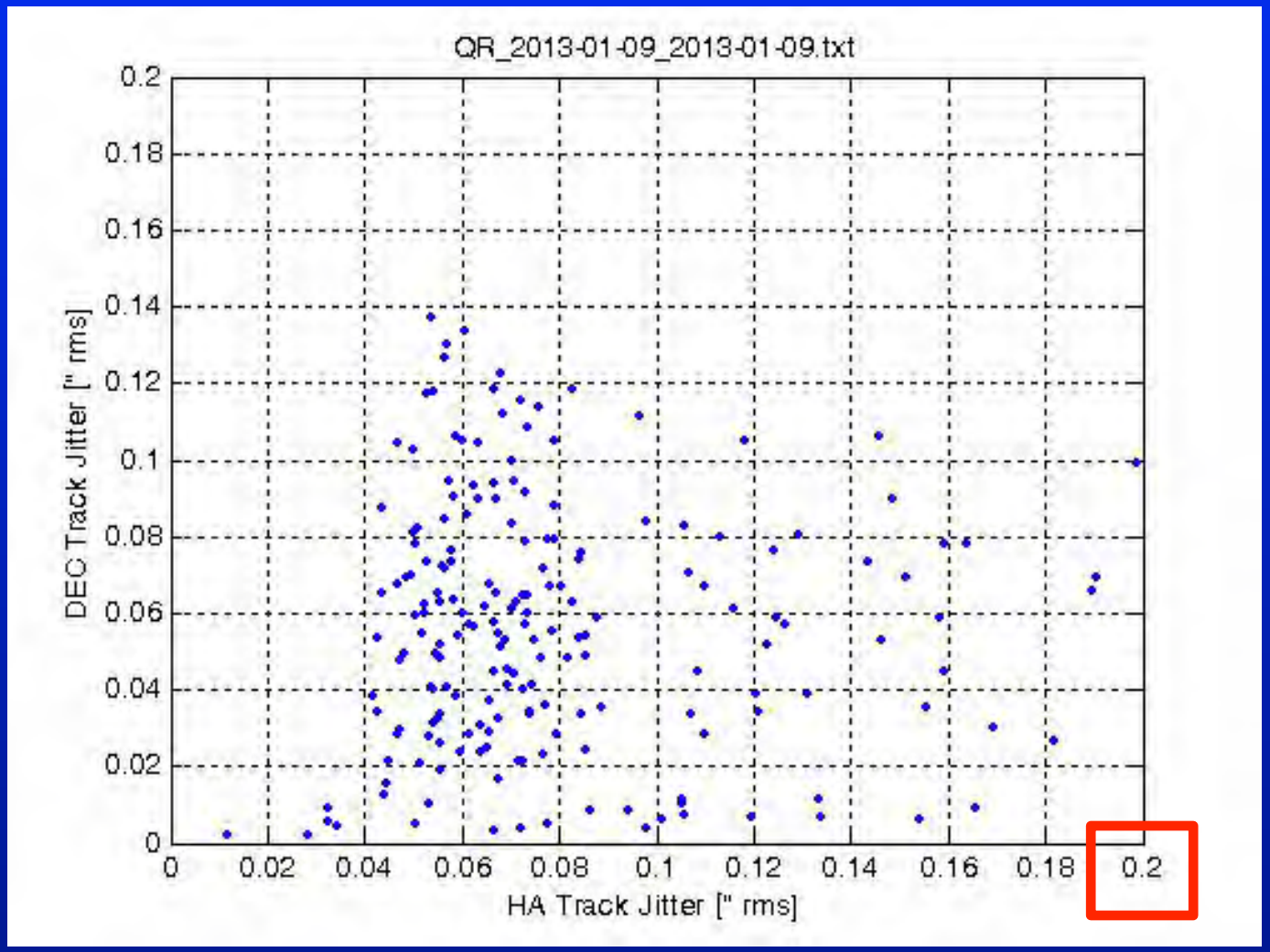
And…

- Cable wraps: The cable runs consist of both flexible link units and fixed trays that run across and up the telescope to the prime focus cage
  - They contain two vacuum-jacked LN2 hoses, glycol-water lines, cables, fibers
  - Modifications since delivery includes massaging of the individual links to remove high spots, pick-off support added to both the RA and DEC regions of travel, and the "great wall" modified with a teflon sheet surface

Tracking Jitter before HA Horseshoe Damper was activated (Data from 25Nov2012)

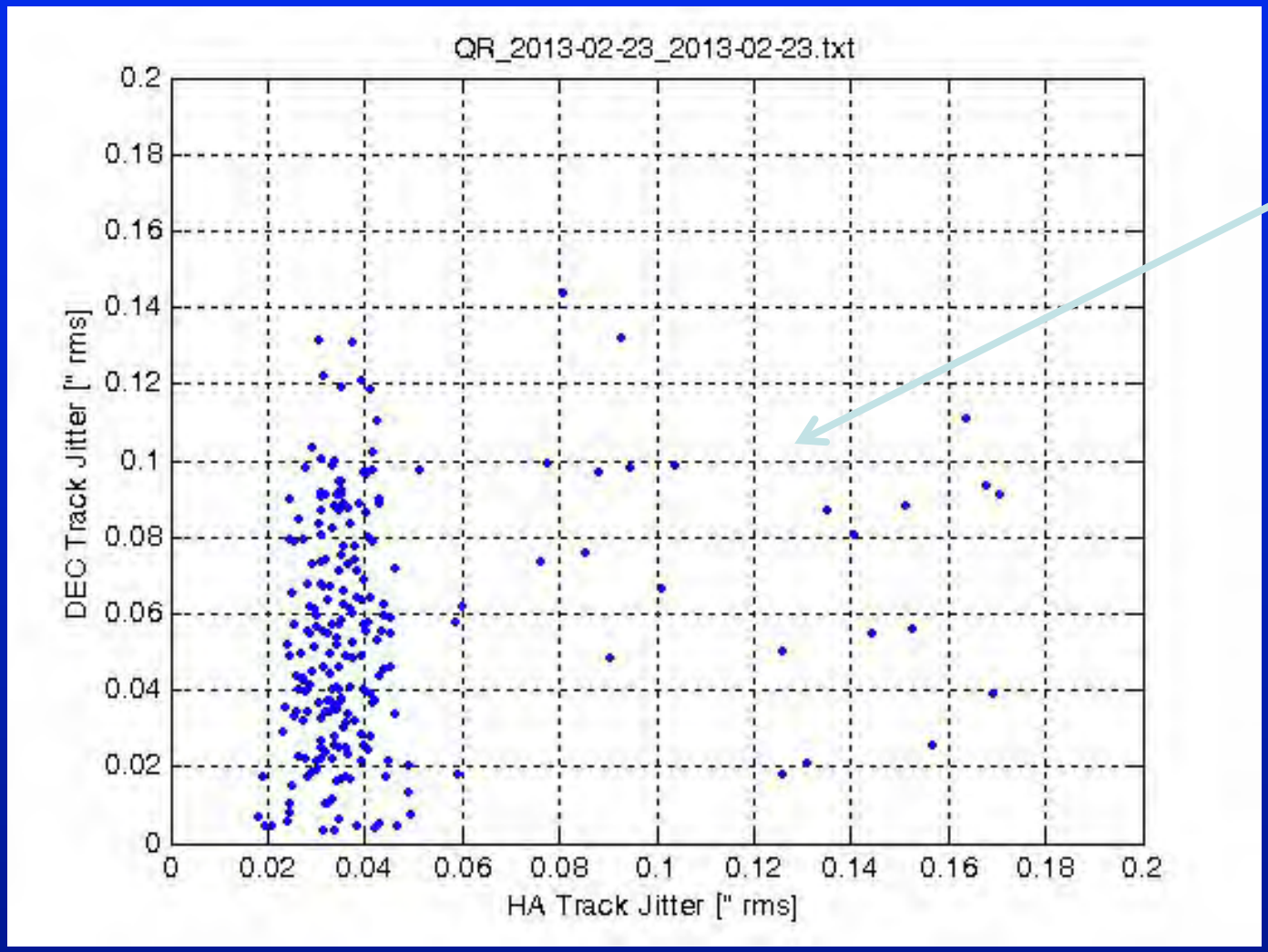


Tracking Jitter after HA Horseshoe Damper activated, and before Oil Sweepers where cleaned (Data from 09Jan2013)



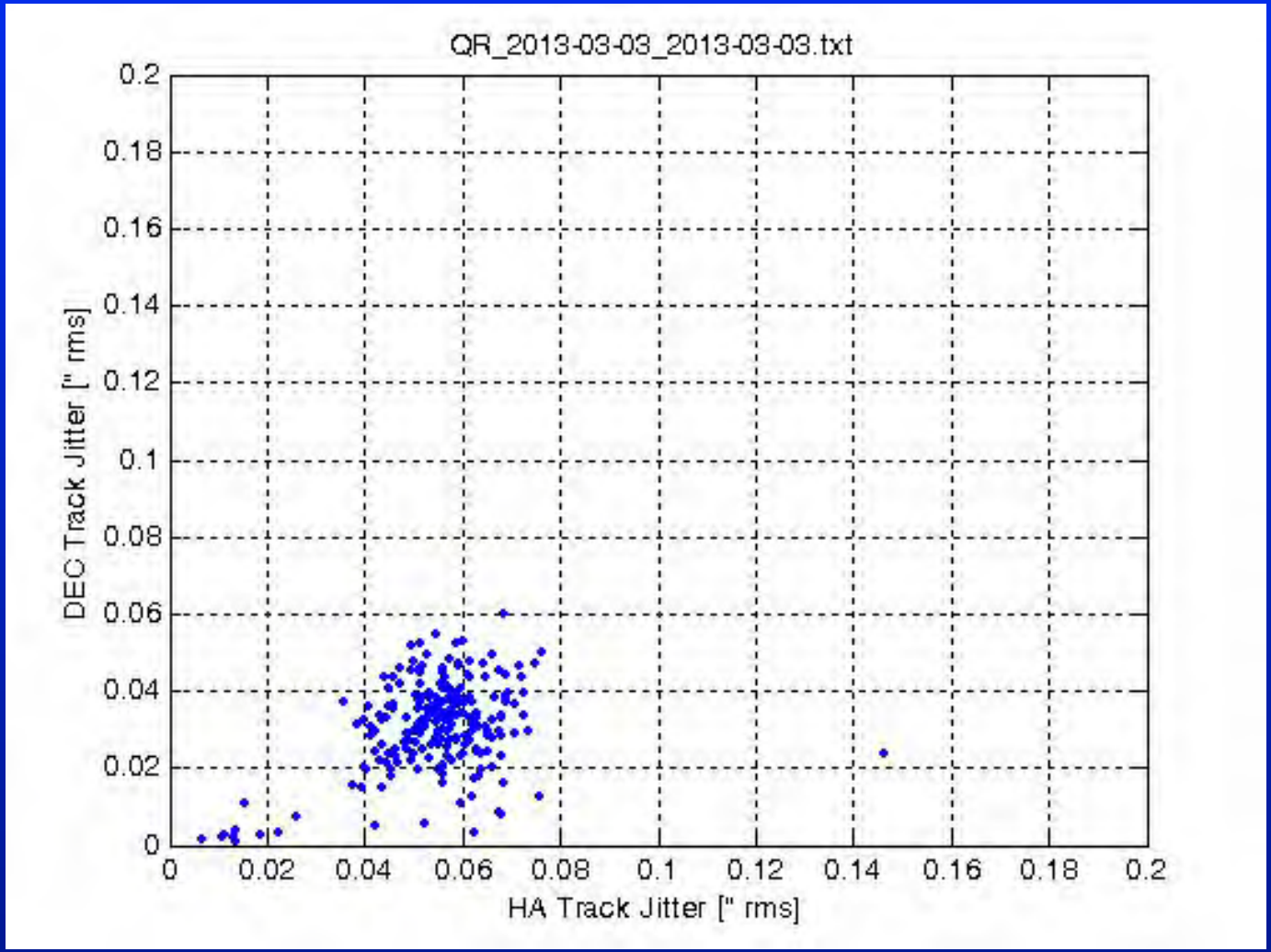
HA tracking improved by a factor of >2

Tracking Jitter after Oil Wipers were cleaned & re –positioned; loop track gains HA=2, DEC=1 (Data from 23Feb2013)



Note:
Scattered poor HA tracking, at some HA positions

Tracking after Oil Wipers removed, with position loop track gains HA=1, DEC=4 (Data from 03Mar2013)



TGP Summary

- Tracking & Guiding are now no longer issues for the delivered image quality
- We'll be optimizing the guider algorithm to improve star selection in crowded regions, guide star recovery in clouded conditions, etc. Use of guider "auto" mode depends on having good pointing
- Pointing – there has been some improvement with bug fixes and new pointing models.
  - But RMS across the sky is still ~ 60 arcsec, goal is 10 arcsec.
- The telescope seems more sensitive to wind buffeting, we are revising protocols for use of the wind blind and closing the windows.

Contents

- Evolution from Commissioning

- The Next 6 Months (March-September 2013)
  - Image Quality – optics
  - Image Quality – facility
  - Observing efficiency

1. Image Quality - Optics

- Is the Active Optics System working optimally?
- Why does the present hexapod LUT behave anomalously in the South-East?
- Why do the BCams not agree well with the Donut analysis?
- How much hysteresis is there?
- How important is it to have a primary mirror supports LUT that varies with sky position?

- These questions bear directly on the delivered image quality
- Also bear on the pointing accuracy and observing efficiency

How to answer these questions?

- More tests with the CTIO laser target system
  - Larger 30 mm SBIG CCD camera to be able to measure to 30 deg elevation
  - Sturdier mount for the new camera
  - Scheduled for April engineering run
  - Purpose: Diagnose why the two systems do not agree

- Analysis of donut sets of measurements
  - e.g. Data set of out-of-exposure images on the focal plane to determine a primary mirror LUT
  - Purpose: See whether the primary mirror figure correction (by the support system) needs tweaking, and whether we need a LUT to apply different corrections around the sky

2. Image Quality – Telescope & Facility

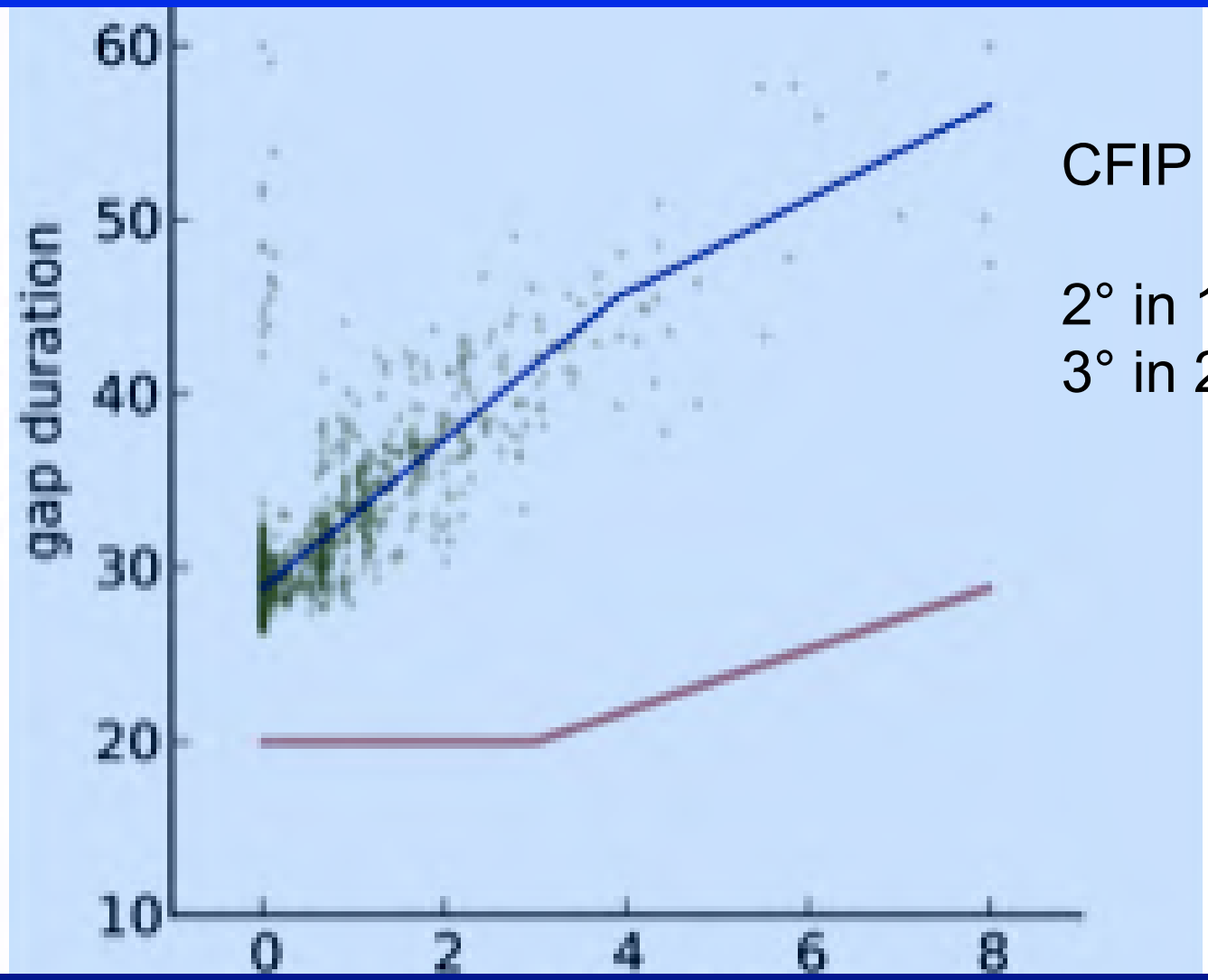
- *See CFIP Blanco Environmental Control System Report,* DES-doc 4337
- Almost all the short-term recommendations have been implemented
- A longer-term recommendation, better control of the daytime dome temperature, is in the planning phase

- The primary mirror daytime cold-air blower was off-line during much of the SV period
- The hydraulic oil cooler is still off-line

Image Quality - Telescope & Facility

- Tune the control algorithm for the primary mirror daytime-cooler, nighttime-sucker system
- Install the PF cage covers and ascertain whether the cage cooler does any good
- Complete the study for installing a large (~10T) air conditioner on the C floor in the Blanco dome
  - Powered from the 40T chiller #2.
  - Purpose is to reduce the rise in air temperature in the dome during the daytime.
- The Tololo Differential Image Motion Monitor (DIMM) will be repaired or replaced.

3. Efficiency



CFIP TDR:

2° in 17s req'd
3° in 20s goal

Can we improve this?

- The early estimates of the telescope drive parameters acceleration, jog were optimistic. We cannot change this.

- The telescope is now settling quicker with the recent (Feb 25) changes in servo gains.

- We should fire the BCams when the telescope is finally settling (18 arcsec/mm so 0.5 arcsec = 28 microns)

- We have recently saved 5s by eliminating TCS delay.
- Further work on tuning planned

Ahead: More fixes, More tuning,
More clear skies, and More TBs of great data!

Reliable Utilities

- DECam requires reliable utilities – electricity, dry air, glycol/water, LN2, vacuum

Need:

- Redundant critical systems, and spares readily available
- Good telemetry so as to recognize failing systems
- In conjunction with regular scheduled maintenance

Two new 40 Ton facility chillers

More improvements

- Second new 40 ton facility chiller - runs the mirror coo and the cooled floor, and backs up 40T#1 that runs computer room AC, DECam cryocoolers, NESLAB
- Improvements to the powerhouse – both technical & personnel. Investigating a devoted small backup generator
- Second NESLAB, that cools the electronics crates in the PF cage
- Parallel pumping - ion pump, and a turbo+backing pump. Install a second backing pump in the Cassegrain cage.
- Two air-compressors, plumbed together. Bottled N2 for LN2 valvebox
- Improvements to telemetry, alarms, displays, & training