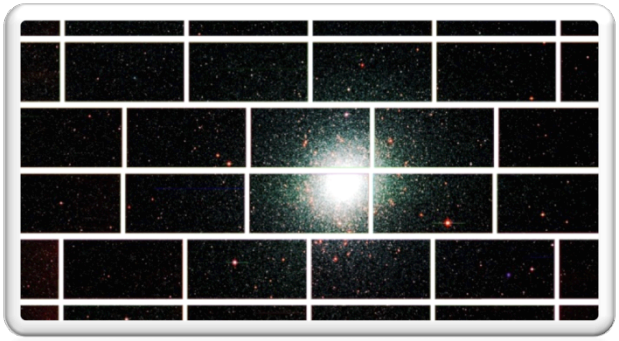
DES: Status and Plans



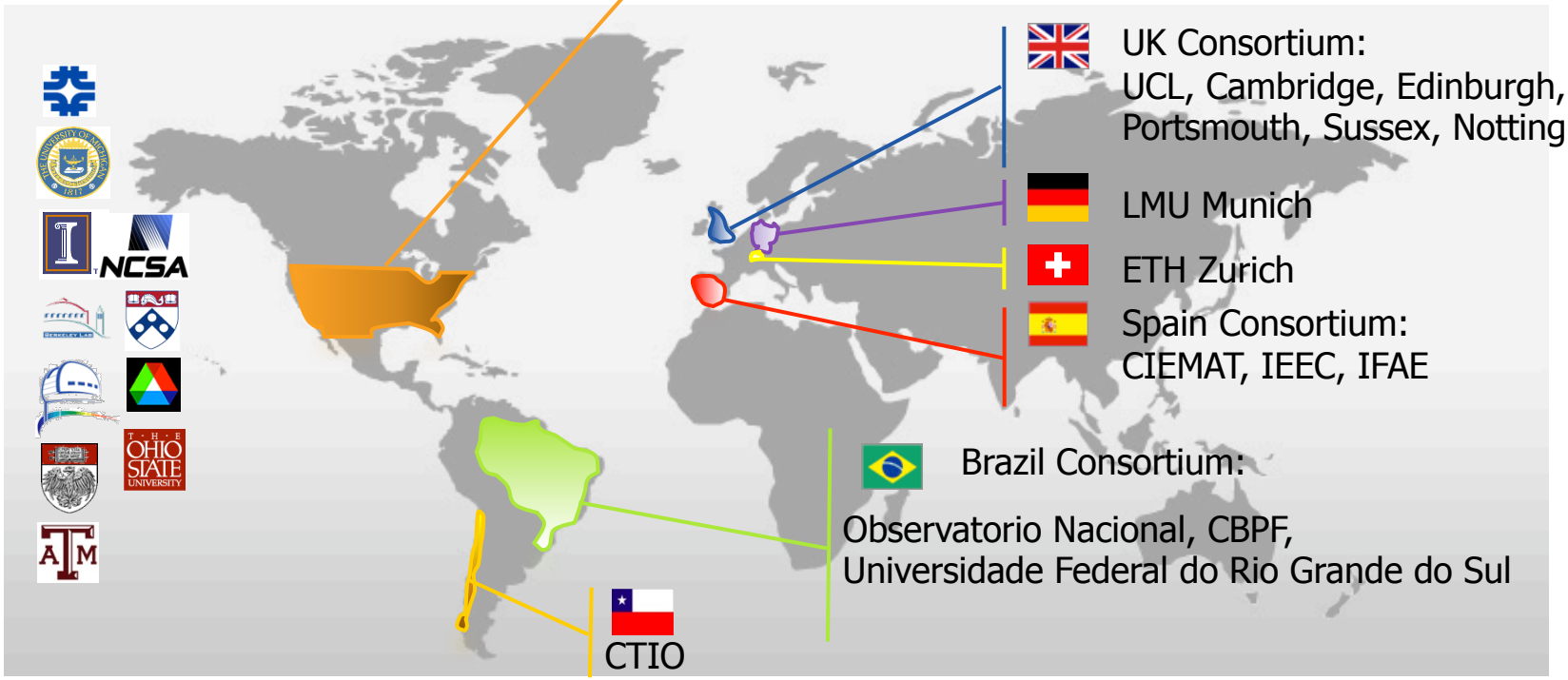
K. Honscheid
Ohio State University
Fermilab PAC Meeting, October 2012

The DES Collaboration

The Dark Energy Survey

is an international collaboration of
>200 scientists from ~26 institutions

US Groups:
Fermilab, UIUC/NCSA, University of Chicago, LBNL, NOAO, University of Michigan, University of Pennsylvania, Argonne National Laboratory, Ohio State University, Santa-Cruz/SLAC Consortium, Texas A&M



UK Consortium:
UCL, Cambridge, Edinburgh, Portsmouth, Sussex, Nottingham

LMU Munich

ETH Zurich

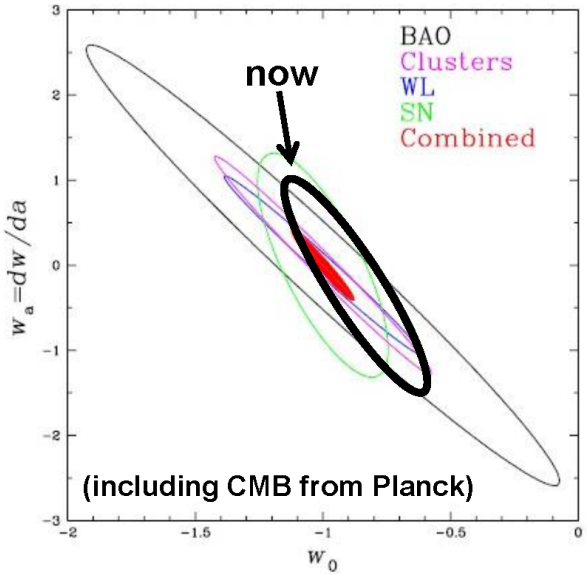
Spain Consortium:
CIEMAT, IEEC, IFAE

Brazil Consortium:

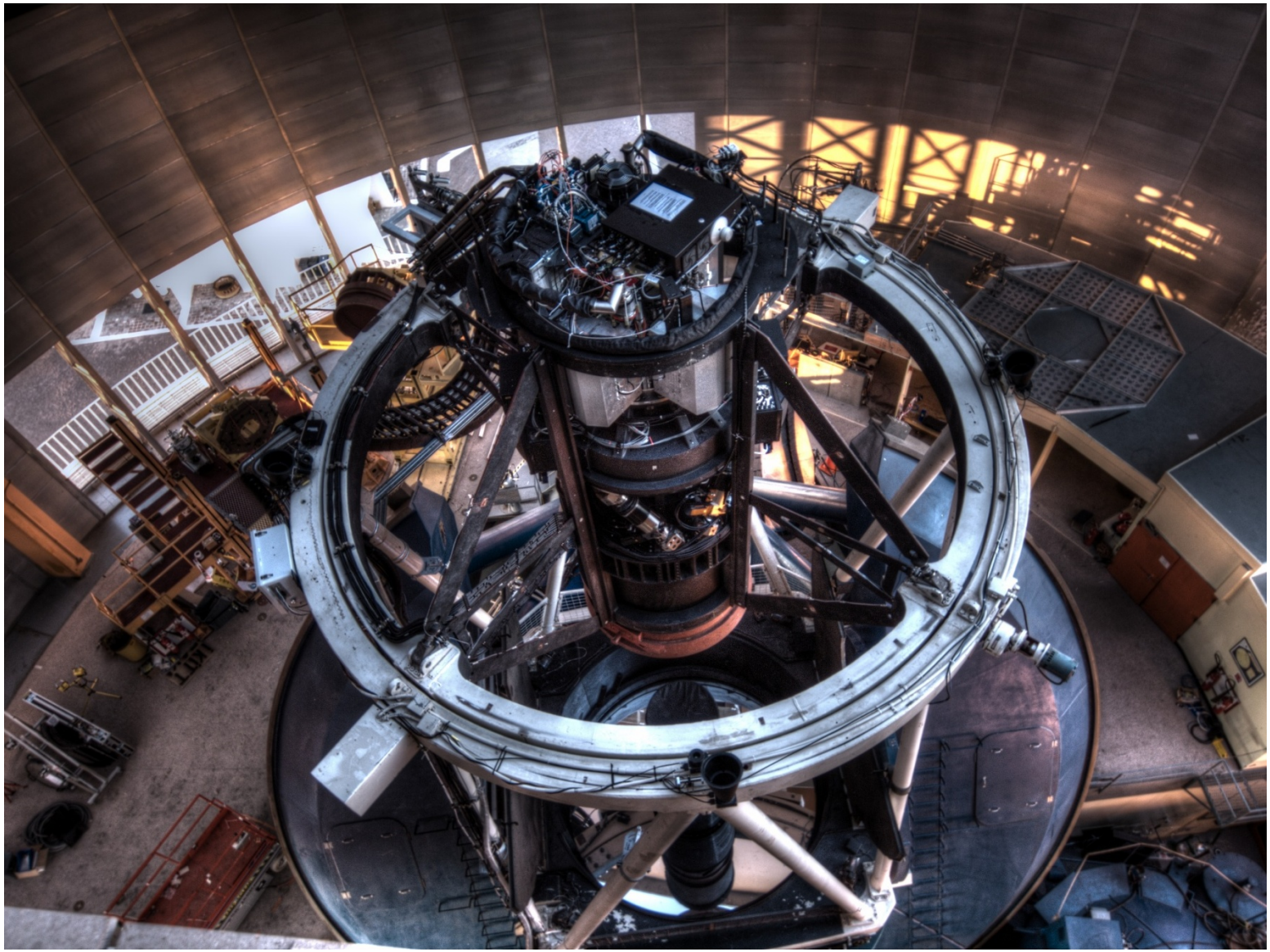
Observatorio Nacional, CBPF, Universidade Federal do Rio Grande do Sul

The Dark Energy Survey

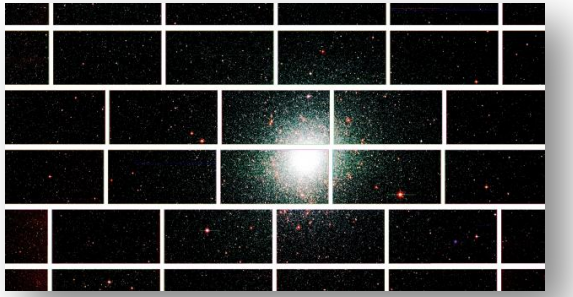
- Project:
  - Perform a 5000 sq. deg. survey of the southern galactic cap using the CTIO Blanco 4-m telescope.
  - Measure dark energy with 4 complementary techniques
    - Galaxy clusters
    - Weak lensing
    - Baryonic acoustic oscillations
    - Type 1a Supernovae
- New Instrument (DECam):
  - Replace the PF cage with a new 2.2 deg FOV, 570 Mega pixel CCD camera and optics
- Time scales:
  - Instrument Construction 2008-2011
  - Installation and Commissioning 2012
  - First Light Sep. 2012
  - Survey: 525 nights during Sep.–Feb. 2012-2017
  - 30% of the telescope time, 70 % community use

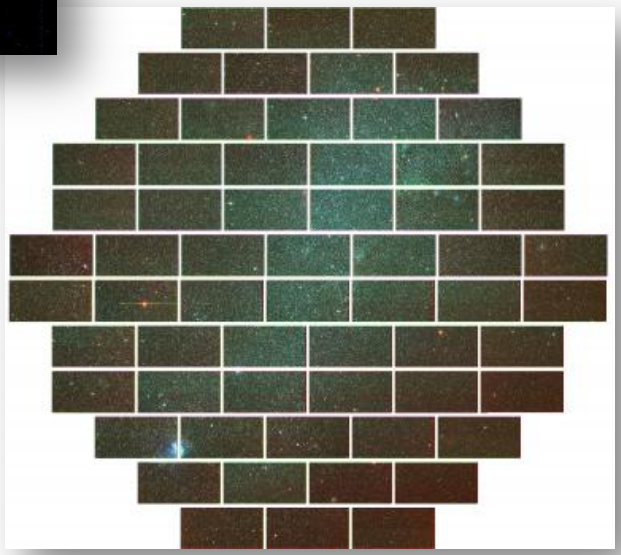


DECam Installed on the Blanco 4-m



DECam First Light September 12, 2012





5 Ways The Brand New Dark Energy Camera Will Utterly Change Our Understanding Of The Universe

The world's most sensitive digital camera has begun peering into deep space

The most powerful sky-scanning camera yet built has begun its quest to pin down the mysterious stuff that makes up nearly three-quarters of our Universe.

258 publications in 36 countries

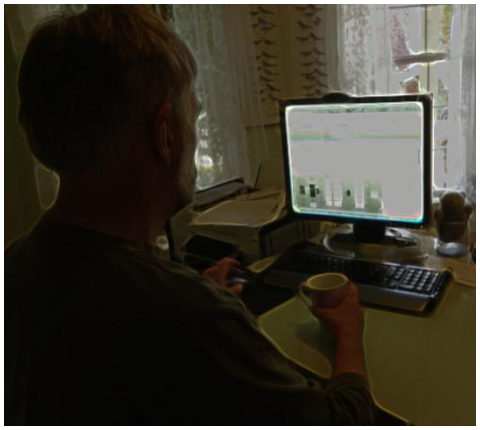
DES/DECam Schedule

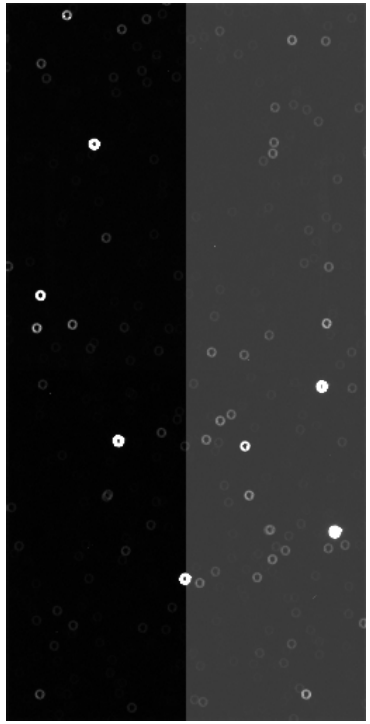
Activity	Lead Institution	Status	Date
DECam Construction	Fermilab	**Complete** (on budget + on schedule)	**Jan. 2012**
DECam Installation	CTIO/NOAO	**Complete**	**Sept. 1**
DECam Commissioning	CTIO/NOAO (Walker)	**Ongoing**	**Oct. 31**
DES Science Verification	DES (Bernstein, KH)	**Planned**	**Nov 1 - 26**
DES Survey, Year 1 500 sq deg, full depth	DES	**Planned**	**Dec 1 – mid Feb.**

Scenes from CTIO (and some location in Ohio)

After working with SISPI more than ever before, I have to tell you I am impressed

Much better than flying 4400 miles

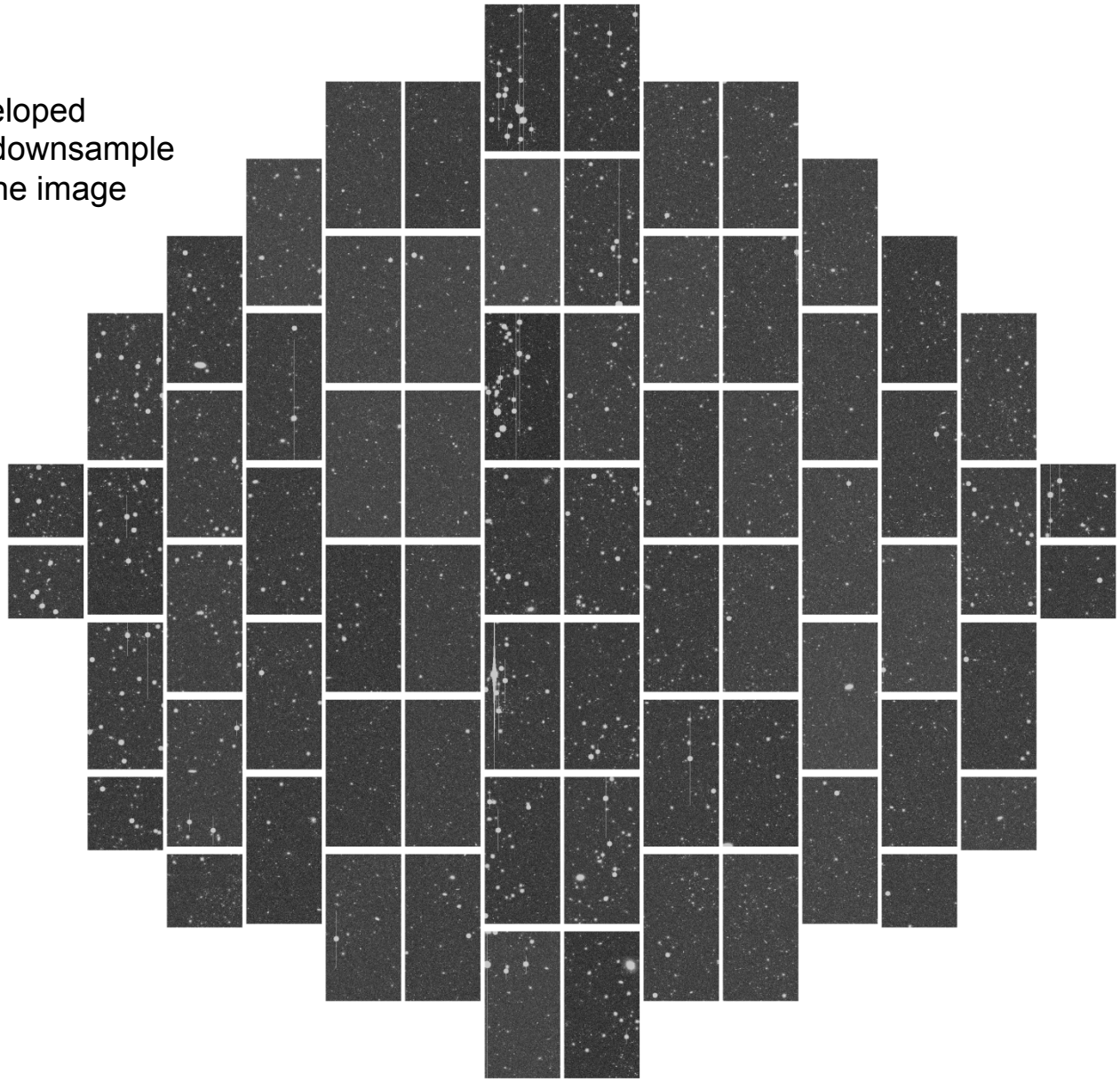




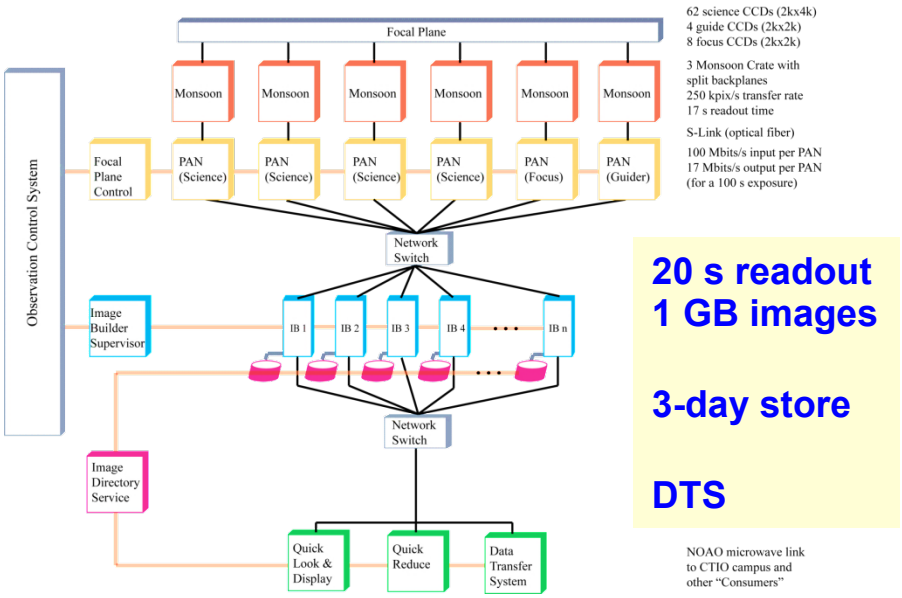
One of the very first CCD images
Just needs a little bit of focus

Our Event Display

Ken Patton developed
an algorithm to downsample
the full focal plane image
in ~ seconds



DECam Commissioning: SISPI

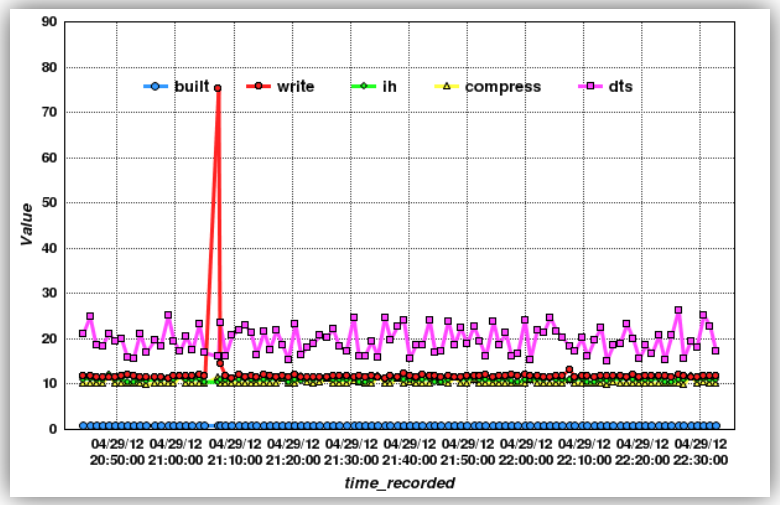


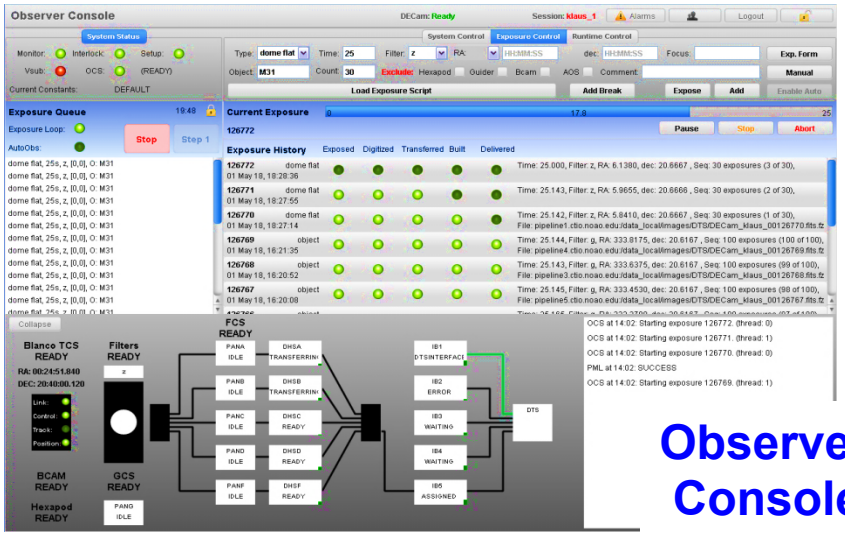
20 s readout
1 GB images

3-day store

DTS

Monitoring and Telemetry



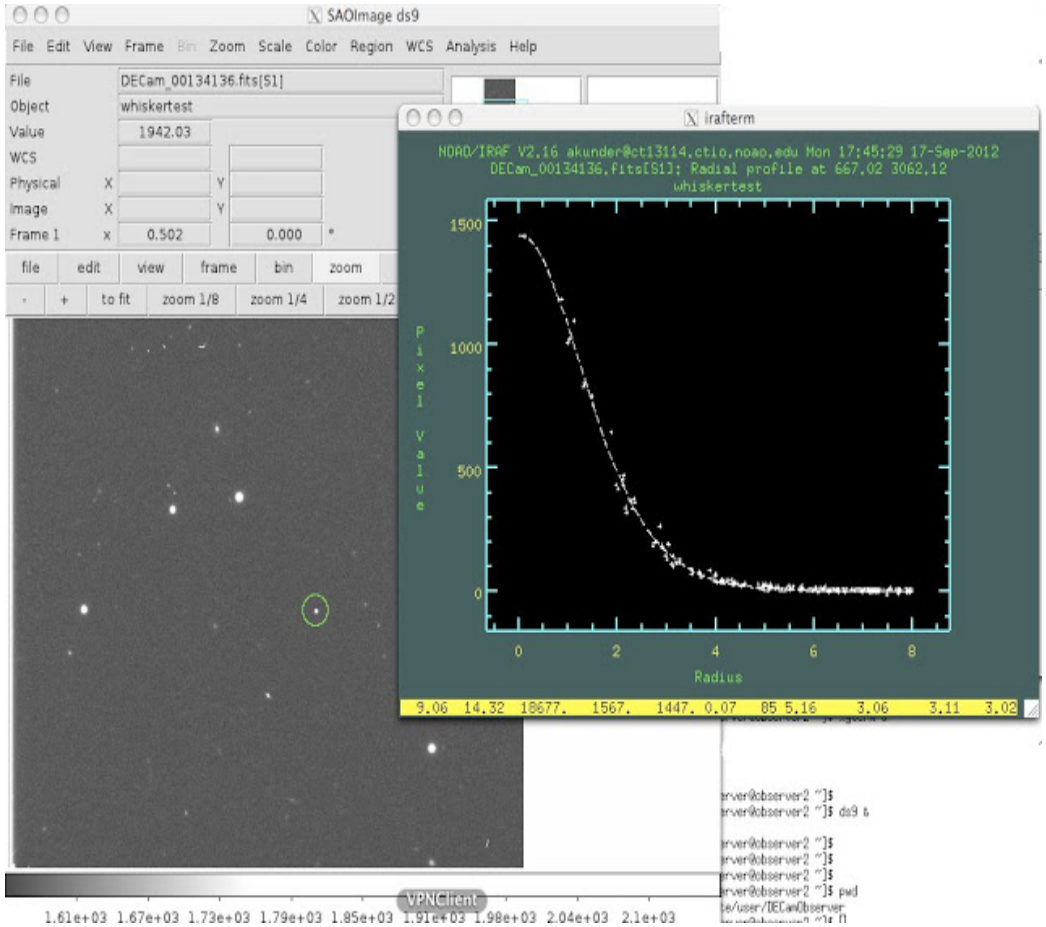


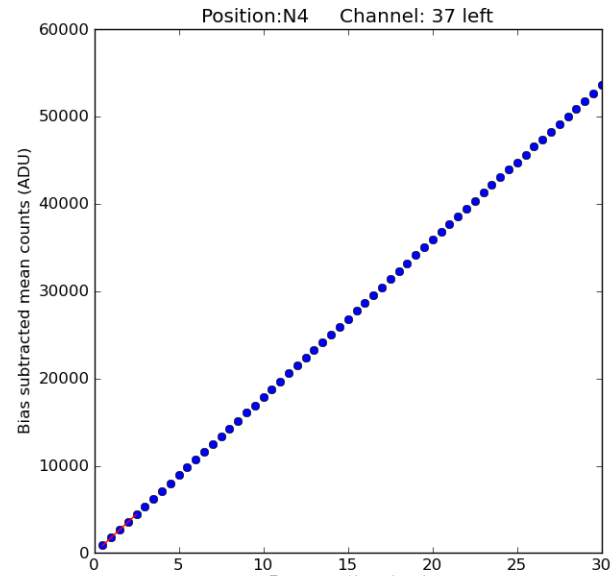
Observer Console

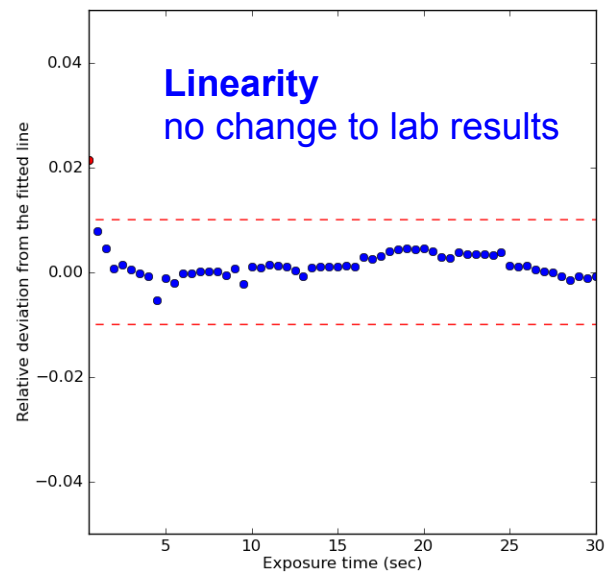
Realtime Image QA

DECam Commissioning

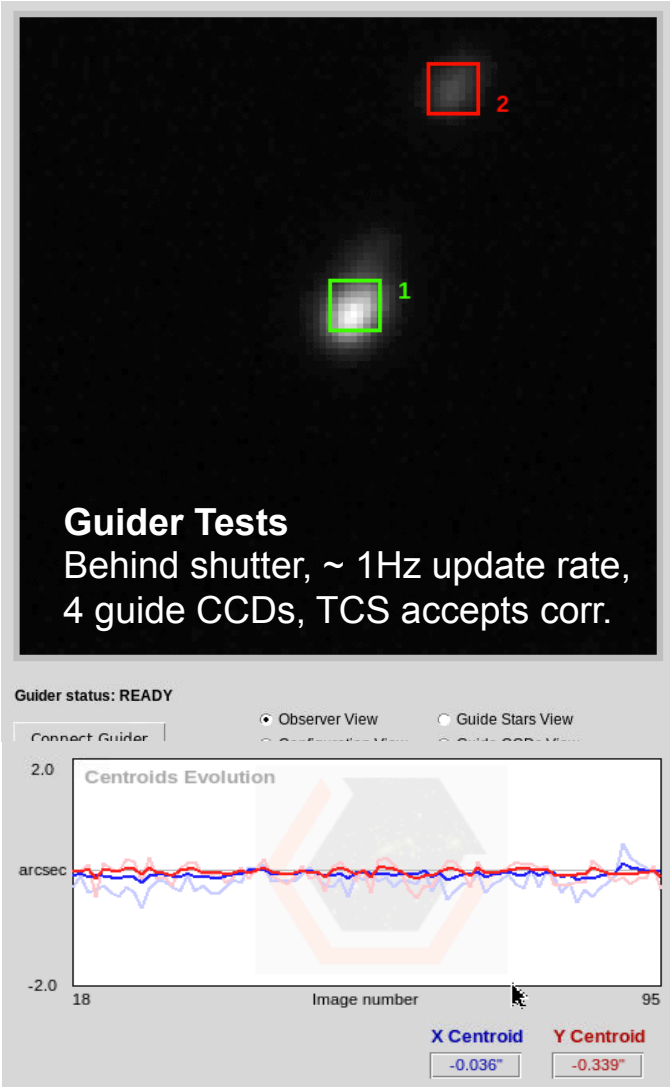
Excellent seeing during the first part of commissioning
Pixel scale: 0.26”/pixel

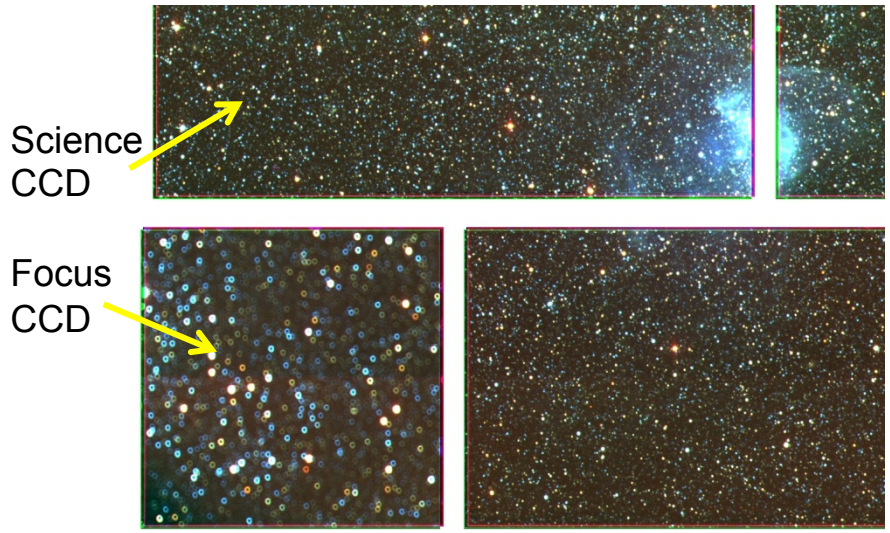


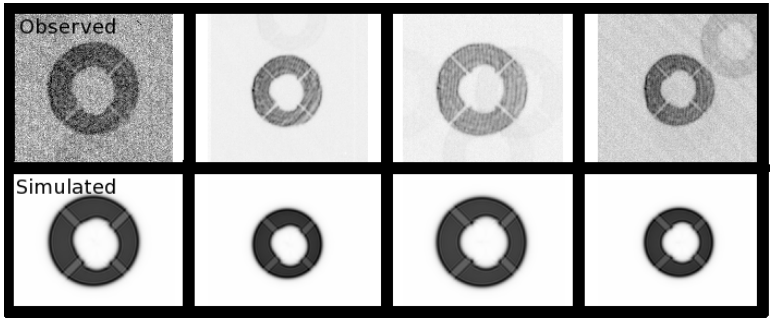




DECam Commissioning

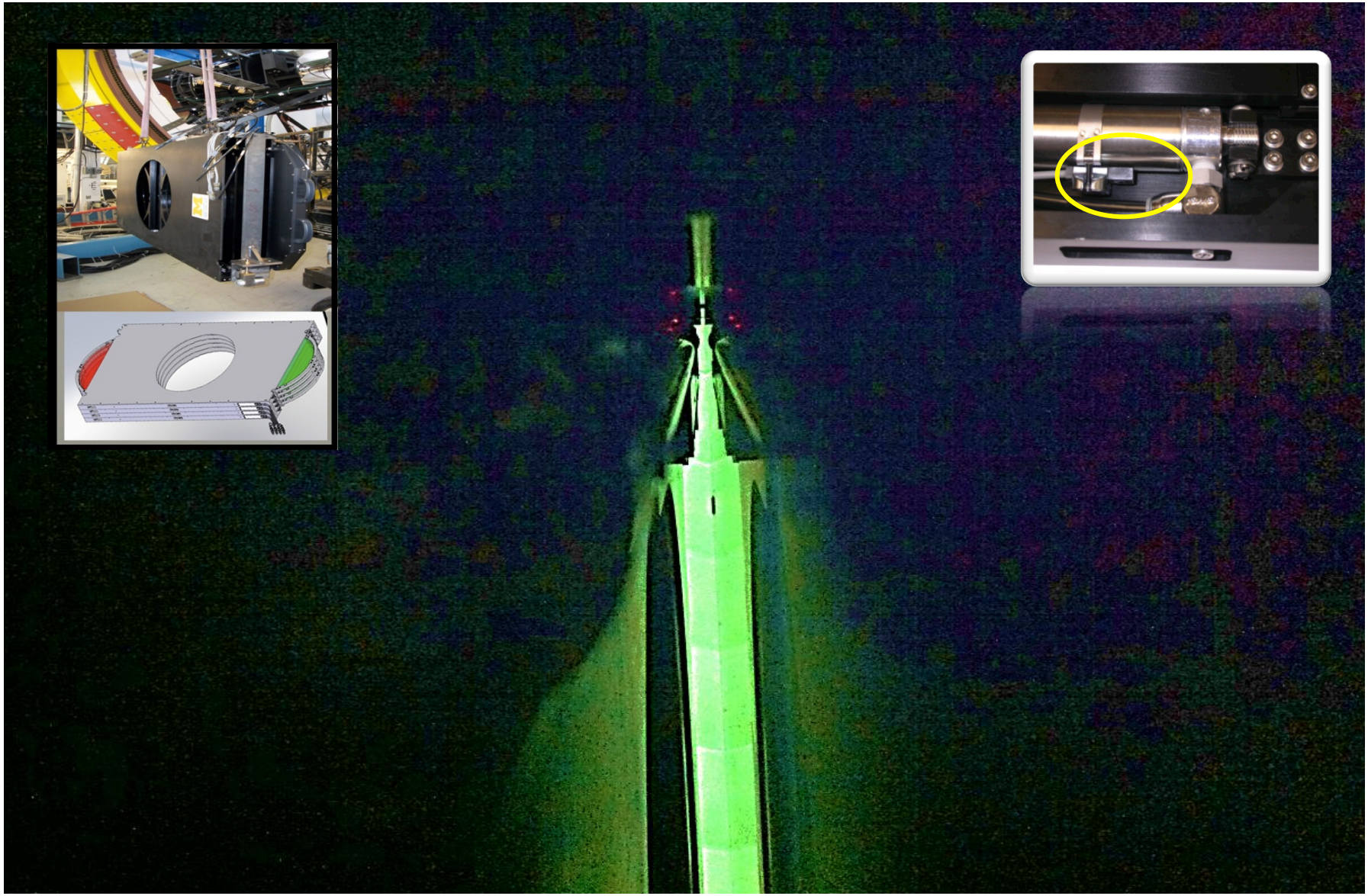






Focus and Alignment System (8 CCDs)
Donut algorithm tested
Successfully closed feedback loop

DECam Commissioning: LEDs are bad…



DECam Commissioning

- Follow detailed commissioning plan with day-by-day (night) schedule. Adjusted as needed
- Experienced observers + DECam experts scheduled to be at CTIO
- Daily planning meetings; weekly reports to EX-COM
- Ongoing activities:
  - Reinstall Filter Changer
  - Install Hexapod lookup table
  - Complete telescope pointing model and evaluate performance
  - Commission spectrophotometric calibration system
  - Guider/Tracking/Pointing studies
  - Test DES observation strategy tool
- Scheduled completion date: Oct 31

DES Science Verification

- Validate that DECam produces images of survey quality
- Demonstrate operational readiness
- Co-chaired by G. Bernstein (Penn) and K. Honscheid (OSU)
- 24 Half-Nights in November
- Activities:
  - Formed SV squad (17 members)
  - Assigned observers for SV period
  - Defined 46 SV requirements
  - Defined 50 SV goals
  - Weekly meetings
  - Test DES DM data access
  - Test DES DM Standalone software
  - Developing operational procedures
  - Documentation
- Final report to DES Management

Science Verification Requirements

Sig-R1	Sig-R2	Sig-R3	Sig-R4	*	Ast-R1	Ast-R2	Ast-R3
Untested	Untested	Untested	Untested	*	Untested	Untested	Untested

Cal-R1	Cal-R2	Cal-R3	Cal-R4	Cal-R5	Cal-R6	Cal-R7
Untested	Untested	Untested	Untested	Untested	Untested	Untested

IQ-R1	IQ-R2	IQ-R3	IQ-R4	IQ-R5
Untested	Untested	Untested	Untested	Untested

Point-R1	Point-R2	Point-R3	Point-R4	Point-R5
Untested	Untested	Untested	Untested	Untested

Anom-R1	Anom-R2	Anom-R3	Anom-R4	Anom-R5	Anom-R6
Untested	DONE PASSED	Untested	Untested	Untested	Untested

Ops-R1	Ops-R2	Ops-R3	Ops-R4	Ops-R5	Ops-R6	Ops-R7	Ops-R8	Ops-R9
Untested	Untested	Untested	Untested	Untested	Untested	Untested	Untested	Untested

SN-R1	SN-R2	SN-R3	SN-R4	SN-R5	SN-R6	SN-R7
Untested	Untested	Untested	Untested	Untested	Untested	Untested

Gal-G1	Gal-G2	Gal-G3	Gal-G4	Gal-G5	Gal-G6	Gal-G7	Gal-G8	Gal-G9	Gal-G
Untested	Untested	Untested	Untested	Untested	Untested	Untested	Untested	Untested	Untes

SG-G1		SG-G2		SG-G3		SG-G4		SG-G5	SG-G6		SG
DONE	Untested	Coding	Untested	Coding	Untested	Coding	Untested	Untested	Coding	Untested	Coding

Cal-G1	Cal-G2	Cal-G3	Cal-G4	Cal-G5	Cal-G6	Cal-G7	Cal-G8	Cal-G9	Cal-G
Untested	Untested	Untested	Untested	Untested	Untested	Untested	Untested	Untested	Untes

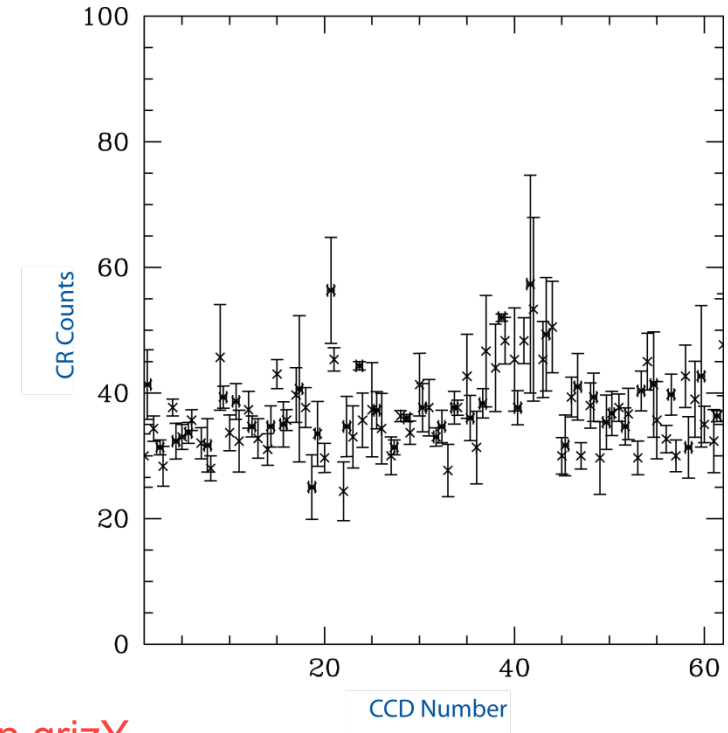
PSF-G1	PSF-G2	PSF-G3	PSF-G4	PSF-G5
Untested	Untested	Untested	Untested	Untested

SN-G1	SN-G2	SN-G3	SN-G4	SN-G5	*	Mask-G1	Mask-G2
Untested	Untested	Untested	Untested	Untested	*	Untested	Untested

PZ-G1	PZ-G2	PZ-G3	PZ-G4	*	Tools-G1	Tools-G2	Tools-G3	Tools-G4
Untested	Untested	Untested	Untested	*	Untested	Untested	Untested	Untested

DES Science Verification: Requirements

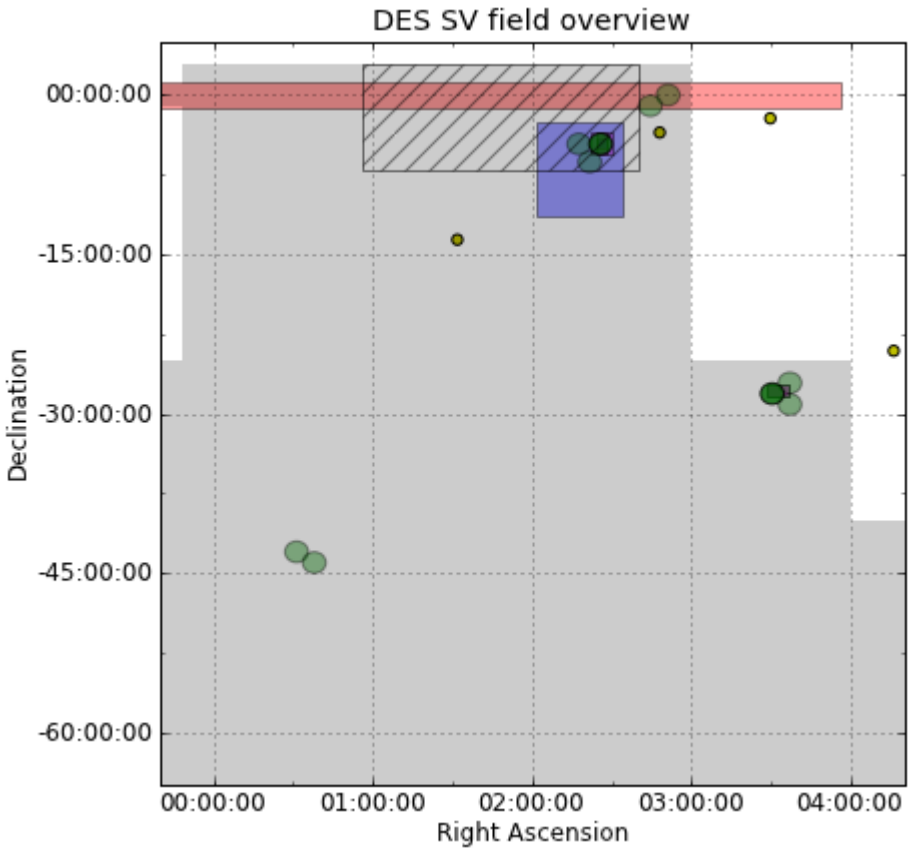
- Anom-R2: Cosmic ray rate should be less than 10 cm^{-2} min^{-1}
  - Procedure
    - Take 5 dark frames
    - Correct for bad pixels
    - Run SExtractor
    - Should find only cosmic ray hits
  - Results: Passed

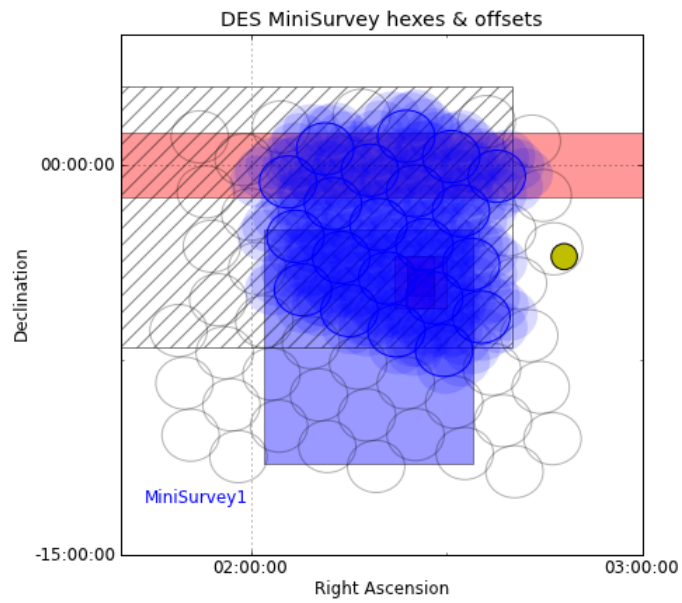


- Sig-R2: grizY zeropoints are within 0.05 mag of expectations
  - Procedure
    - Observe spectrophotometric standard star in grizY
    - Process images with DES DM tools
    - Measure standards with aperture photometry
- For each requirement
  - Procedure, owner, pre-requisites

DES SV Observing Plan

Melchior (OSU)





Legend: **DES main survey footprint (gray),**
SV spectroscopic training field (hatched),
DES SN fields (green, dark is deep),
Stripe 82 (red),
CHFTLS W1 & D1 (blue),
VVDS fields (magenta)
CLASH clusters A209, A383, MACSJ0329, MACSJ0416
(yellow circles, from left to right)

For each observation:

RA, DEC
Filter
Exposure time

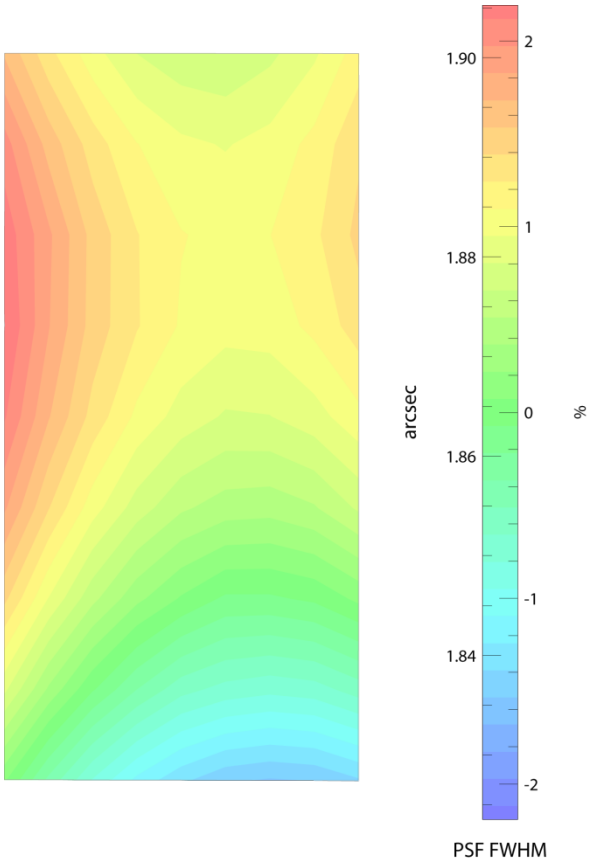
DES Science Verification: Operational Readiness

- Run Manager
  - Responsible for DES operations at CTIO
    - Observer training
    - Daily meeting (with DM, observers)
    - First Responder, SISPI expert
    - Liason to CTIO
  - ~ 3 week terms, 2 per season
- Check lists
- Standard calibration scripts
- Call lists and email distribution lists
- DES observation strategy tool (OBSTAC)
- Observing shifts for year 1

DES Stand-Alone Software

- Nightly Processing done by DES DM
  - Receive image data from CTIO
  - Create calibration frames
  - Detrending and Reconstruction Pipelines
  - Uses grid computing

- Different needs for SV
  - Stand-alone processing using DES DM codes (B. Yanny (FNAL))
  - Code restructured by Fermilab
  - Installed at CTIO + additional scripts to support observer
  - Installed at OSU, Penn, Fermilab …
  - Fully operational
  - Already very useful to study DECam images



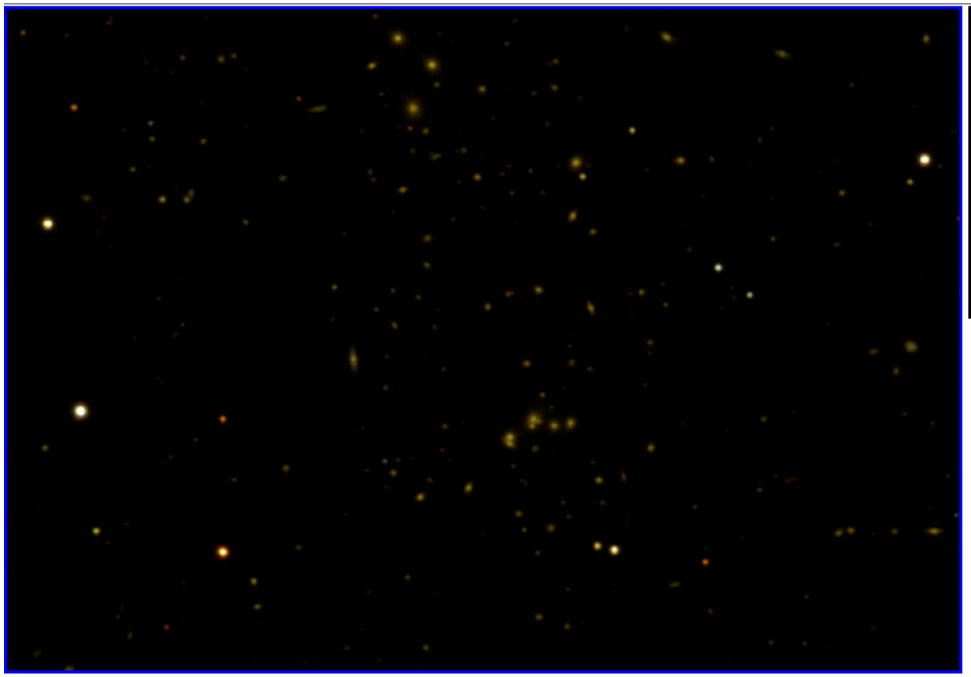
Sample output:
PSF variation across a CCD

DES Science Verification: Cross Checks

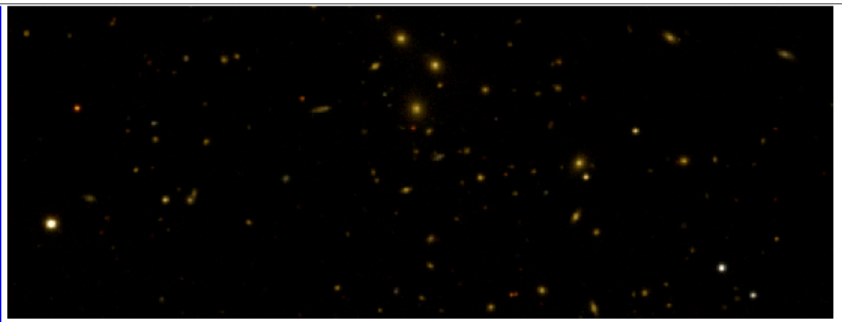
Abell 142 Cluster (25 galaxies) at z = 0.25, 1 sq degree
21 exposures in griz (100 seconds)
10 exposures in u (300 seconds)
Poor seeing conditions (1.5” – 1.9”)

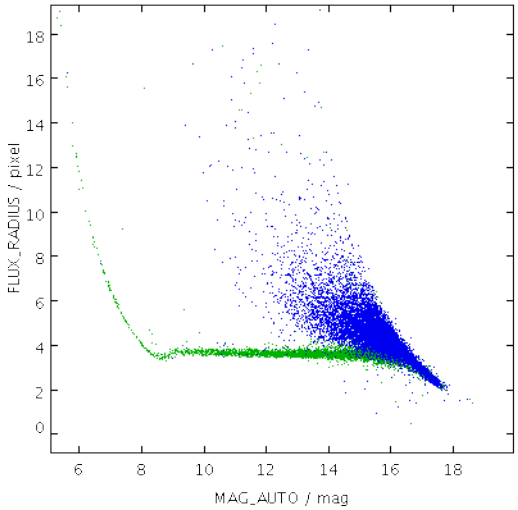
Soares Santos
Lin (FNAL)

DECam



SDSS



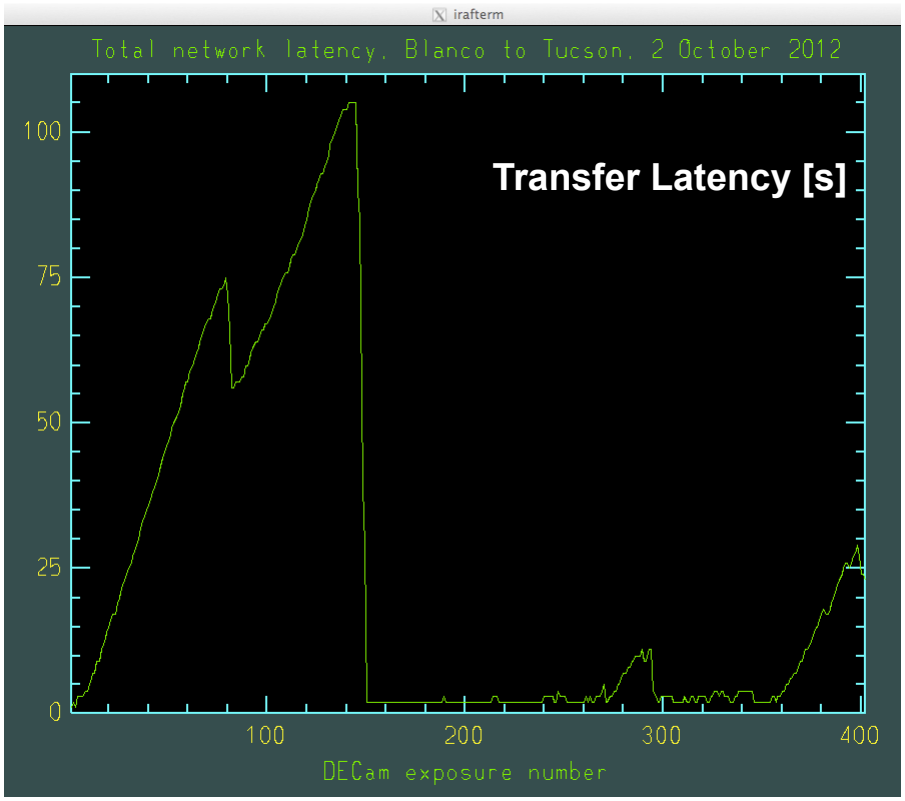


Sevilla
(Spain)

Stars
Galaxies

DES Science Verification: Operational Readiness

- Data Transfer System (NOAO)
  - Transfer DECam image data from SISPI to NCSA and NOAO
  - Transferred so far
    - 4441 images
    - About 2 TB
  - Transfer Latencies (October 2nd, 2012)
    - 402 images or 209 GB
    - 1st image about 2-3 min to NOAO
    - Last image arrived at NOAO 24 min after the shutter closed
  - Reliable and robust



- DES DM Data Ingest
  - Raw image data available to SV team via http/ftp access
  - Daily reports

Data Management: Data Challenge 7

- Designed to test “data readiness” of DM systems
- End-to-end test
  - DECam – SISPI – DTS – NCSA (- NOAO)
  - Copied ~500 GB of image data to CTIO (zero, flats, objects)
  - Ran SISPI in simulation mode, transferred data to NCSA
  - Worked out some issues and successfully ingested into DM DB
- DES DM processing
  - Successfully processed “a night” (400+ images) with DES pipeline (First Cut)
  - SN pipeline processed deep and shallow fields
  - 50 sq deg through First Cut and Final Cut. Working on co-adds

Data Management Status

- Received $8M from NSF ($14M requested)
- Additional help from FNAL CD and ETH Zurich and collaboration scientists
- Science codes are being tested by collaboration in stand alone (DES) and community pipelines (NOAO)
- SN pipeline and Final Cut pipeline will be available for the start of the survey.
- Refactored system will be available in early 2013 to reprocess DES 1st year data
- Data quality effort was started (E. Neilsen, FNAL)
- Small supplement request to NSF grant being prepared
- New DESDM Project Scientist B. Yanny (FNAL) tasked with organizing collaboration effort on science codes

Summary

- DECam was successfully installed on the Blanco 4-m telescope at CTIO
- First Light Sep 11-12, 2012
- Commissioning on schedule, all systems operational
- DES has organized a significant science verification effort scheduled for November
  - Validate science requirements
  - Assess image quality
  - Operational readiness
- On track to begin the survey early December

Additional Transparencies

Expected DECam Performance

Blanco Effective Aperture/ f number @ prime focus	4 m/ 2.7
Blanco Primary Mirror - 80% encircled energy	0.25 arcsec
Optical Corrector Field of View	2.2 deg.
Corrector Wavelength Sensitivity	<350-1050 nm
Filters	SDSS g, r, i, z, Y (400-1050 nm)
Effective Area of CCD Focal Plane	3.0 sq. deg.
Image CCD pixel format/ total # pixels	2K X 4K/ 520 Mpix
Guide, Focus & Alignment Sensor CCD pixel format	2K X 2K
Pixel Size	0.27 arcsec/ 15 μm
Readout Speed/Noise requirement	250 kpix/sec/ 10 e
Survey Area SPT overlap SDSS stripe 82 Connection region	5,000 sq. deg. total RA -60 to 105, DEC -30 to -65 RA -75 to -60 , DEC -45 to -65 RA -50 to 50, Dec -1 to 1 RA 20 to 50, Dec -30 to -1
Survey Time/Duration	525/5 (nights/years)
Median Site Seeing Sept. – Feb.	0.65 arcsec
Median Delivered Seeing with Mosaic II on the Blanco	0.9-1.0 arcsec (V band)
Limiting Magnitude: 10σ in 1.6” aperture assuming 0.9” seeing, AB system	g=24.7, r=24.2, i=24.4, z=23.9
Limiting Magnitude: 5σ for point sources assuming 0.9” seeing , AB system	g=26.1,r=25.6, i=25.8, z=25.3