



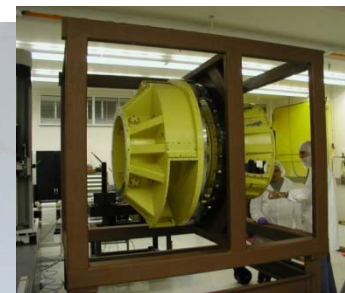
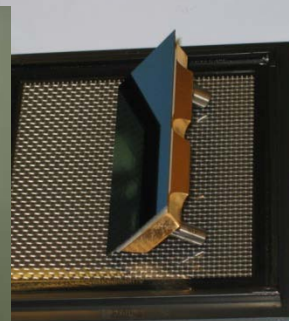
# Dark Energy Camera Status

DARK ENERGY  
SURVEY

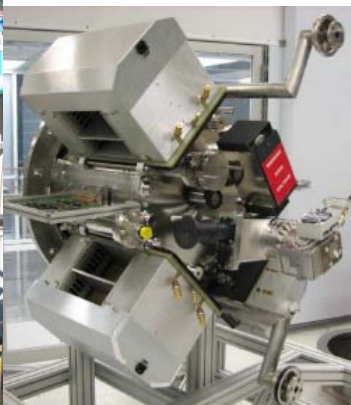
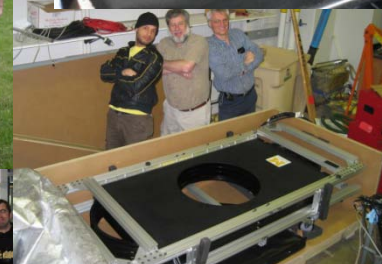
All Experimenters' Meeting January 24, 2011

## Outline

- DECam
- Integration & Testing in Lab A on the Telescope Simulator
- Optical Train Ass'y
- The Timeline & Shipping to CTIO



SISPI GUI Interfaces



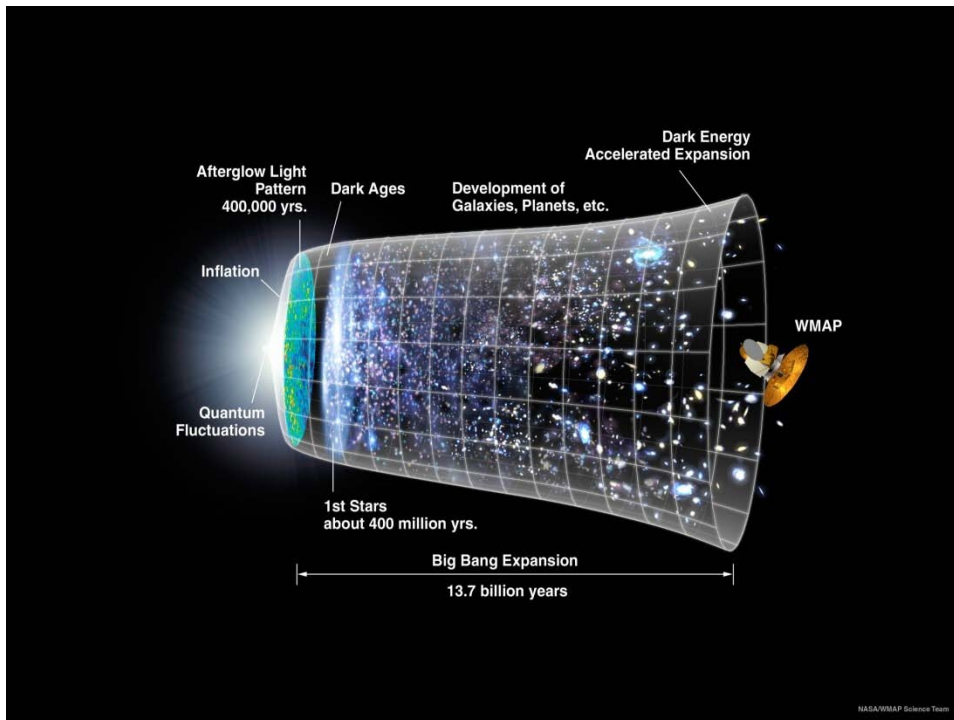
Tom Diehl  
FNAL 1



# Dark Energy Survey

DARK ENERGY  
SURVEY

- Dark Energy: Our name for the cause of the observation that the expansion rate of the Universe is increasing
- DES Science: To measure the expansion rate of the Universe and the growth of massive structures over the previous ~8 B.Y.



- Four Techniques with independent systematic uncertainties:
  - Baryon Acoustic Oscillations as seen in the galaxy distribution
  - Weak Gravitational Lensing
  - Galaxy Cluster Formation
  - Type 1A Supernovae



# Dark Energy Survey

DARK ENERGY  
SURVEY

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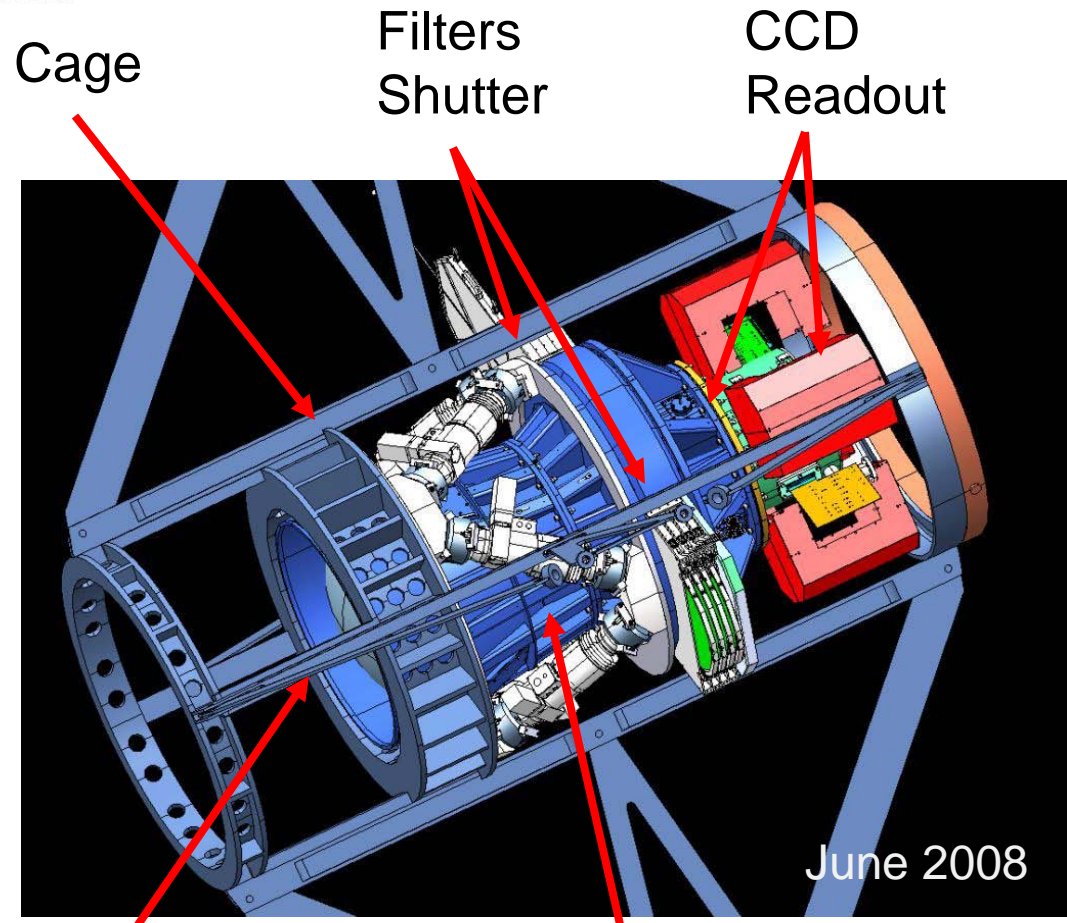
- DES is an international collaboration with ~120 scientists from USA, UK, Spain, Germany, Chile, Brazil.
- The Survey will use 525 nights to map 5000 sq-deg ( $\sim 1/8^{\text{th}}$  of the whole sky) in the direction away from the Galactic center
  - Position and redshift of 300M galaxies
  - >30,000 clusters





# DECam => the Blanco Telescope @ CTIO

DARK ENERGY SURVEY



Cage

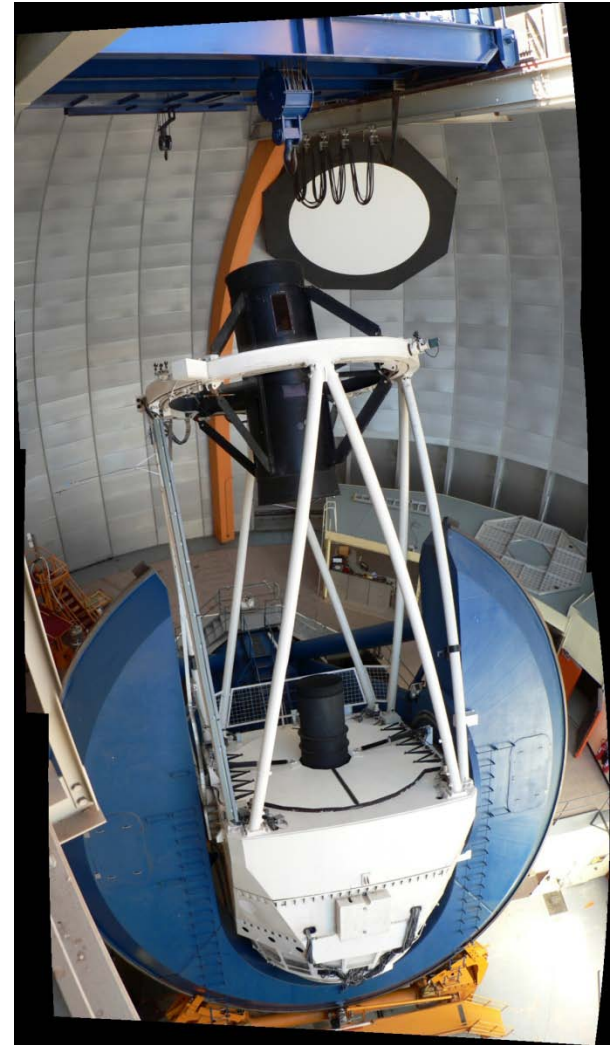
Filters  
Shutter

CCD  
Readout

5 Optical  
Lenses

Hexapod  
For alignment & focus

June 2008

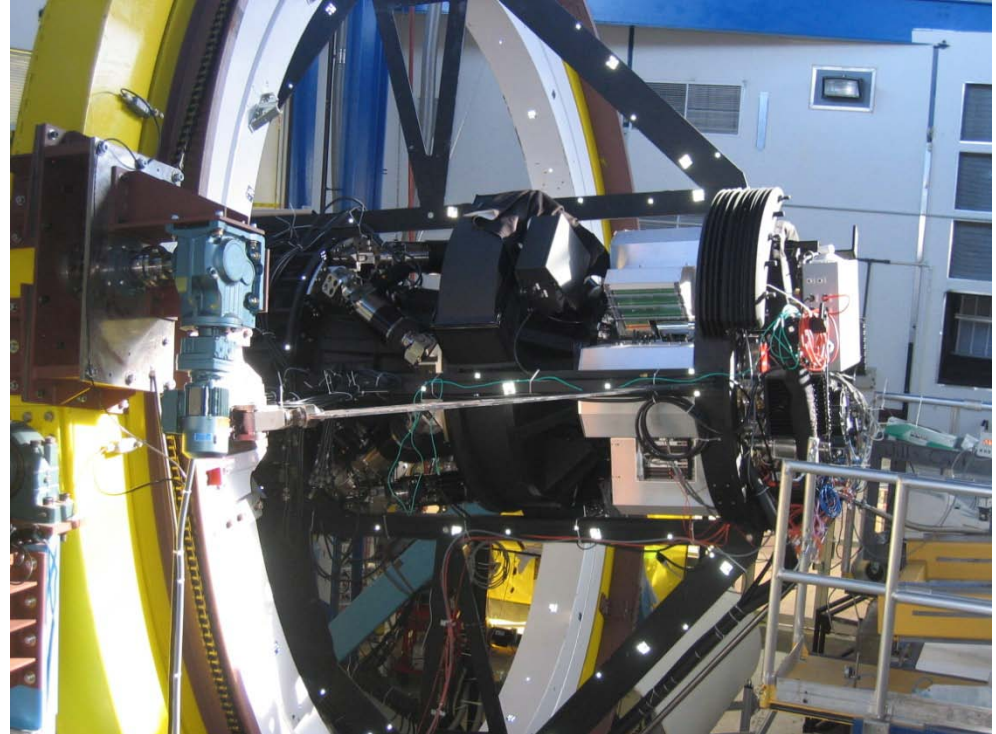




# Integration and Pre-Commissioning @ FNAL

DARK ENERGY  
SURVEY

- Most economical to perform these system tests at FNAL
- Test and verify Infrastructure
  - Mechanical Components
  - Dewar vacuum, Camera Cooling (2-phase N<sub>2</sub>), Electronics Crate Cooling, etc ...
- Imaging Cadence (Mock Observing)
  - Read out CCDs, Move Telescope, Adjust hexapods according to the focus determination, Change Filters (17s)
  - Expose (typically 100s)

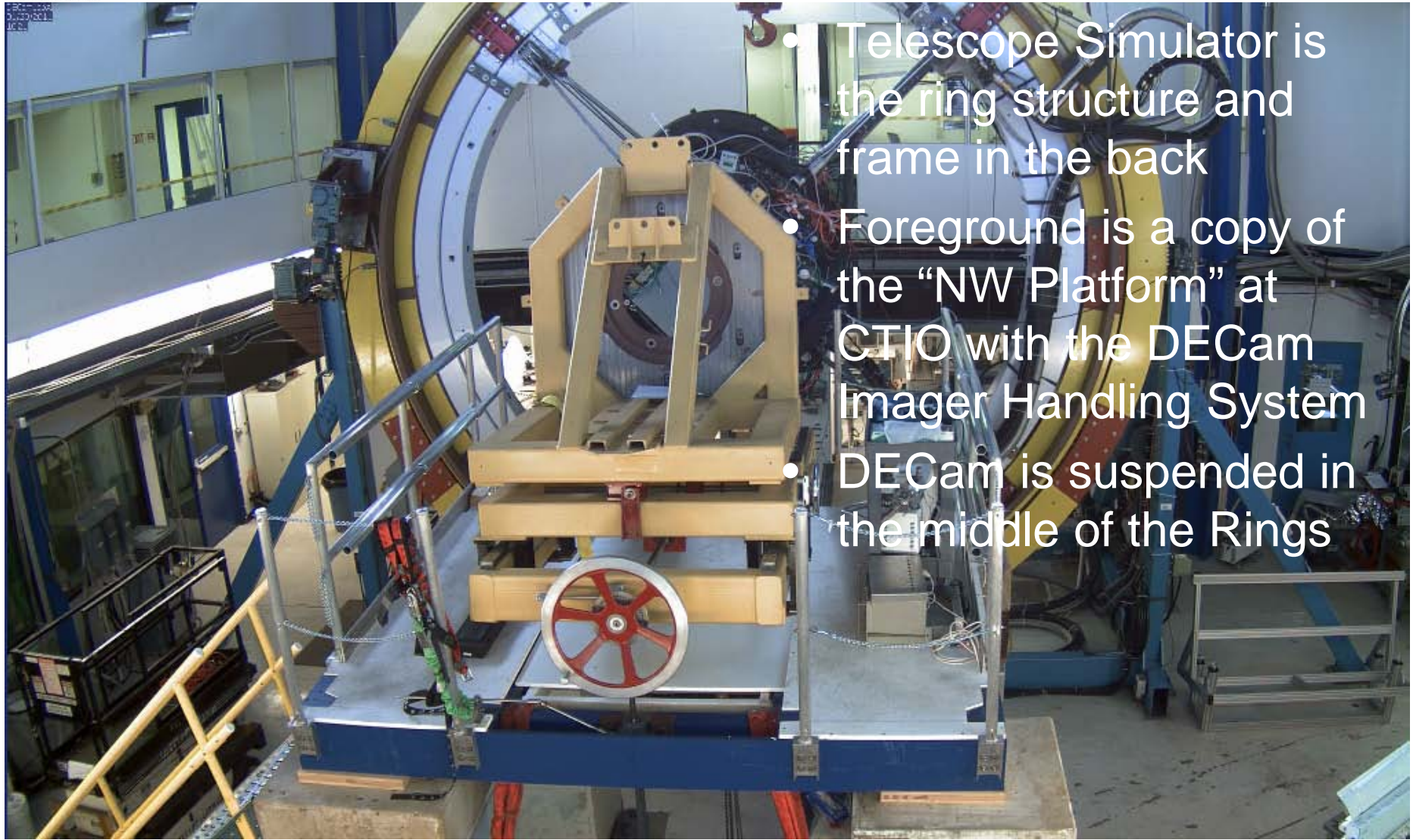




# Telescope Simulator in Lab A

## 01/20/11

DARK ENERGY  
SURVEY



- Telescope Simulator is the ring structure and frame in the back
- Foreground is a copy of the “NW Platform” at CTIO with the DECAM Imager Handling System
- DECAM is suspended in the middle of the Rings



# Examples: Mechanical Infrastructure

DARK ENERGY  
SURVEY



- Secondary Mirror (f/8) Handling System, tested at FNAL, is now installed at CTIO

- DECam Imager Handling System being used to install the imager into the Cage





# In-Progress DECam Tests on T.S.

DARK ENERGY  
SURVEY

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## Using Various Diagnostics

- The functionality of software controls of various parts (SISPI)
- Focal Plane (CCD) temperature stability both with time and camera orientation
- Filter Installation Speed
- Hexapod Motions measured with BCams

## Using Images

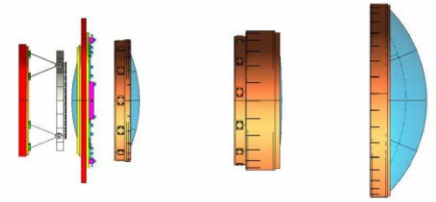
- Shutter open/close precision & filter placement accuracy
- Light leaks (dark current)
- Hexapod (focus) control
- Readout Noise including while exchanging filters and moving the hexapod
- Focal plane (CCD) position stability

All of this in several camera “pitch” and “roll” orientations as if the camera were operating on the Blanco Telescope

Special Thanks: SISPI Team including FNAL Post-Docs  
Jiangang-Hao and Marcelle Soares-Santos

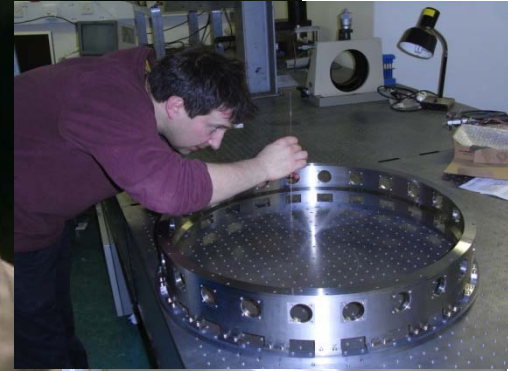


# Optical System & Filters



DARK ENERGY  
SURVEY

- Lens polishing has finished. Most lenses are at UCL. Some of the cells.
- Next:
  - Finish cell alignment in the better barrel (FNAL) & ship to UCL
  - Mount lenses in the cells (UCL)
  - Mount cells in the barrel (UCL)
  - Test & Ship to CTIO
- Filters are being manufactured at Asahi Optical, near Tokyo.





# Timeline

DARK ENERGY  
SURVEY

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- On Feb. 21, 2011: Imager tests on the are TS complete
- During March: remove cage, hexapod, shutter, FCM, cooling systems, etc ... off the TS and ship to Chile. Arrive in May and we begin to build assemble the infrastructure there
- Load the Imager (still at FNAL) with science grade CCDs and test. Arrives at CTIO ~ June 7, 2011.
- Meanwhile, the optical corrector is assembled and aligned at UCL. Arrives in CTIO in July.
- Now at CTIO starting in ~July 2011:
- Cooling system is ready by this time to retest the imager.
- Test f/8 handling system.
- Build up the cage, barrel, and optics
- CTIO Director decides when to remove the old instrument and begin DECam installation.
- This will be the 1<sup>st</sup> time the imager is tested with the optical train – test that before we put on the imager
- 1<sup>st</sup> Light ~ sometime in October 2011



# Shipping DECcam

DARK ENERGY  
SURVEY

- Components will be shipped by air or by boat depending on their value, size, and fragility.
  - Probably By Air: the hexapod, shutter, filter in their own shipping containers, the imager and CCDs
  - Probably By Boat: Mechanical components, cage, fins, cooling system
  - Some consideration will be given to schedule requirements



f/8 handling  
9/17/10  
Left FNAL  
for NYC

10/8/10  
through  
Panama  
Canal  
to SFO



Somehow,  
by boat,  
10/17/10  
Arrived in  
Chile.



10/19/10  
At CTIO



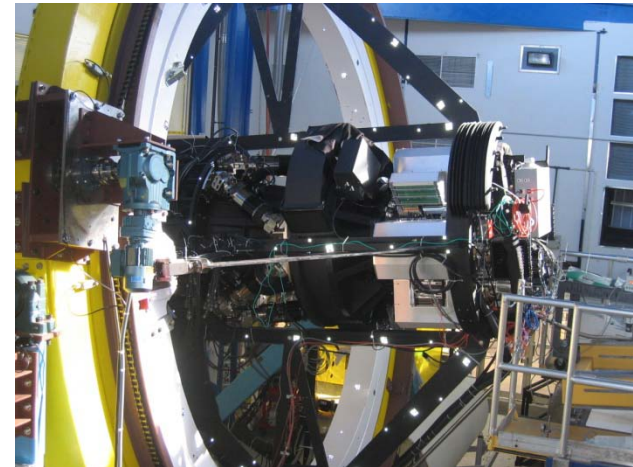
# Summary

DARK ENERGY  
SURVEY

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- The Dark Energy Camera systems integration, testing, and “pre-commissioning” has been going on at SiDet in Lab A. Some parts are already shipped and installed at CTIO
- Tests are going well.
- We are planning to begin taking the camera apart by the end of February.
- 1<sup>st</sup> Light expected in October 2011
- “Video” 1 picture/day since Jan. 2010:





# Extra Slides

DARK ENERGY  
SURVEY

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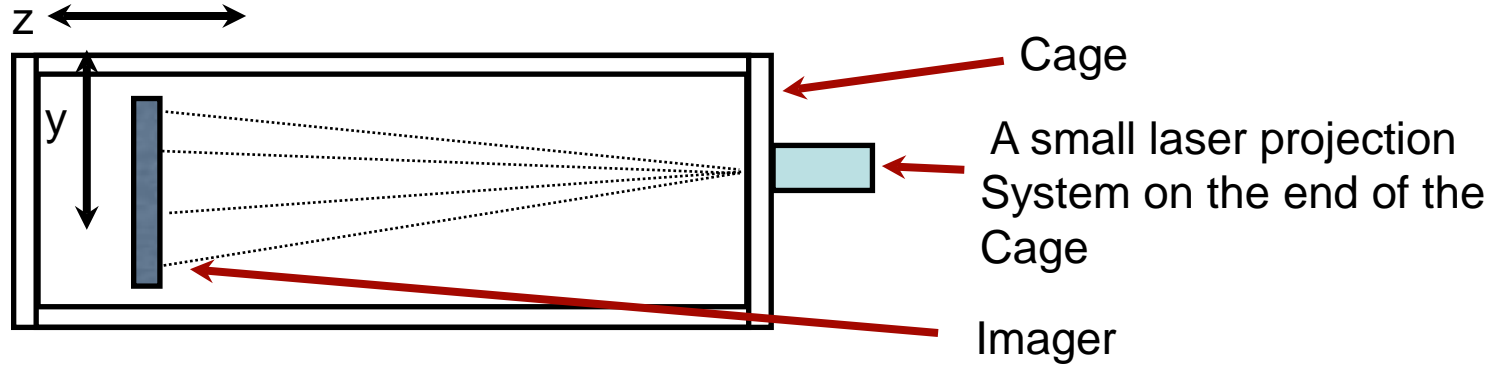
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# DECam Tests on T.S.: “Star Projector”

DARK ENERGY  
SURVEY



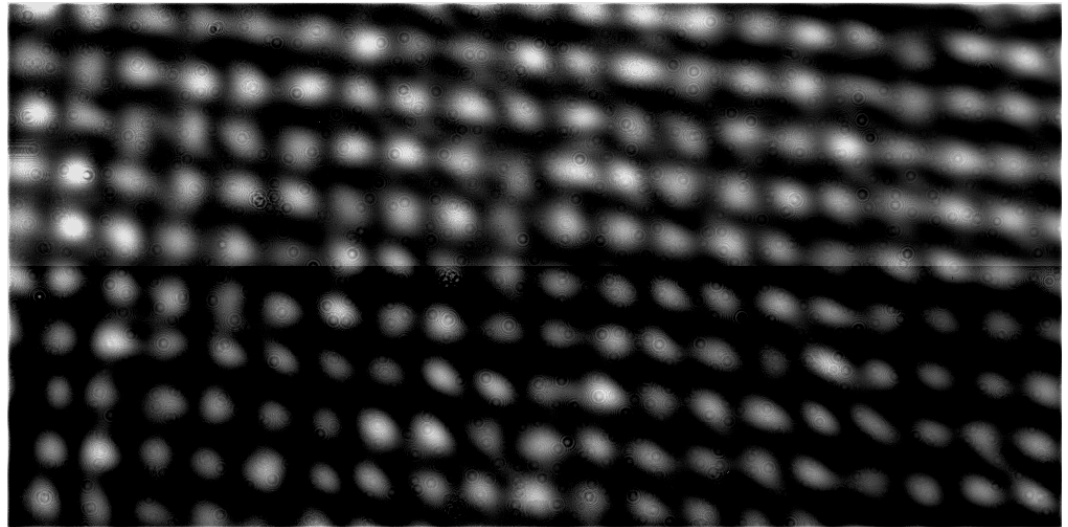
Special Thanks:

SISPI Team including

FNAL Post-Docs

Jiangang-Hao

Marcelle Soares-Santos



This is our basic tool. We project on the CCDs a diffraction pattern that is attached to the end of the cage. When the hexapod moves, the dots in this image move. We can locate the dots here with a precision of a few microns.