



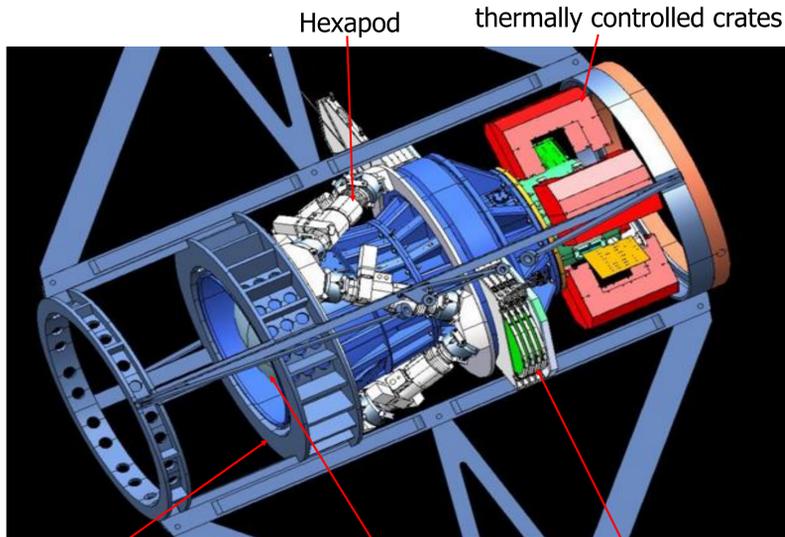
DARK ENERGY SURVEY

The Dark Energy Survey Camera (DECam)

Brenna Flaugher, Fermilab, for the Dark Energy Survey Collaboration

The Dark Energy Survey (DES) will investigate the expansion rate of the universe using four complementary methods: weak gravitational lensing, galaxy cluster counts, baryon acoustic oscillations, and Type Ia supernovae. To perform the survey, the DES Collaboration is building the Dark Energy Camera (DECam), a 3 square-degree, 520-Megapixel CCD camera which will be mounted at the prime focus of the Blanco 4-meter telescope at the Cerro Tololo Inter-American Observatory (CTIO). Construction of DECam is well underway and integration of the major system components will begin in 2010 at Fermilab. A description of the plans for construction of a telescope simulator and the full system testing prior to shipment to CTIO is presented.

The DECam Instrument



Hexapod

Readout electronics in thermally controlled crates

Cage includes hexapod ring

5-element fused silica corrector

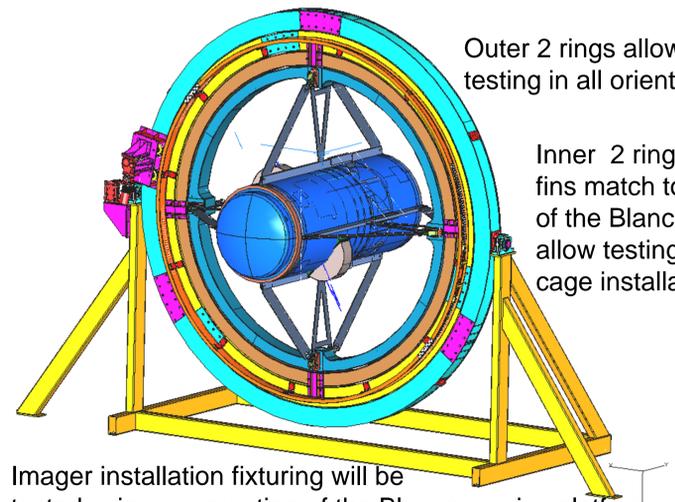
g,r,i,z,Y filter set and shutter

The DECam instrument will replace the entire prime focus cage of the Blanco. The major components are a 520 megapixel CCD camera, a low noise readout system, a combination shutter-filter system, a wide field optical corrector (3 sq. deg. field of view) and a hexapod for focus and lateral alignment.

DECam has over 100 technical requirements and an intensive testing program to verify performance

Opto-Mechanical Requirements		Single Component tests	Telescope Simulator Before Imager	Telescope Simulator with Imager
TOM 1	Focal plane temp range spec	✓		
TOM 2	Focal plane temp stability spec	✓		
TOM 3	Focal plane temp stability spec	✓		
TOM 4	Dewar vac spec before cooling	✓		
TOM 5	Dewar vac during ops spec	✓		
TOM 6	Manual intervention period			
TOM 7	Long term vacuum and FP temp spec	✓		
TOM 8	Focal plane should come to op. temp in < 8 hours			✓
TOM 9	Dewar should warm up in < 12 hours			✓
TOM 10	Focal plane xy distortion due to vac/cooling system	✓		
TOM 11	Focal plane z distortion due to vac/cooling system	✓		
TOM 12	Vibration spec due to vac/cooling system			
TOM 13	Precision for setting focus		✓	
TOM 14	Full range of focus is 30 mm (hexapod movement)		✓	
TOM 15	Speed of focus mechanism		✓	
TOM 16	Range of lateral movement of the hexapod		✓	
TOM 17	Precision of lateral movement of the corrector		✓	
TOM 18	Range of corrector tilt		✓	
TOM 19	Tolerance of corrector tilt		✓	
TOM 20	Stability of tilt angle		✓	
TOM 21	Stability of horizontal translation		✓	
TOM 22	Focus stability over the tilt/translation range		✓	
TOM 23	Rotation stability of focus range		✓	

DECam will be assembled and tested as a system on a telescope simulator at Fermilab prior to shipping to Chile



Outer 2 rings allow testing in all orientations

Inner 2 rings and fins match top end of the Blanco, and allow testing of cage installation

Imager installation fixturing will be tested using a recreation of the Blanco service platform

Imager on handling cart



Barrel Fabrication



Bonn Shutter



Filter coating chamber at ASAHI

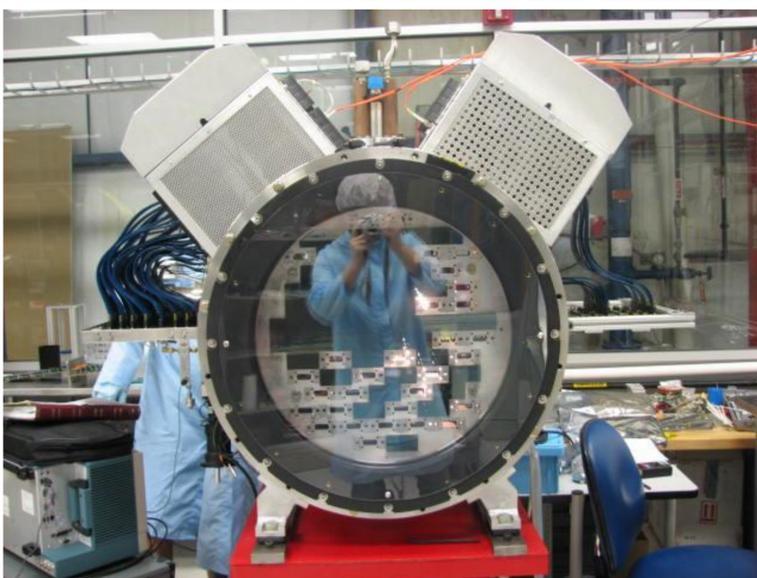
DECam filters are 620 mm diameter



Fabrication of the Blanco top-end rings



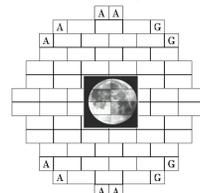
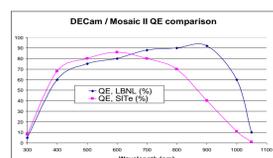
Fins redesigned to allow insulating bushings around cage pins



44 CCDs installed in full size prototype for system tests

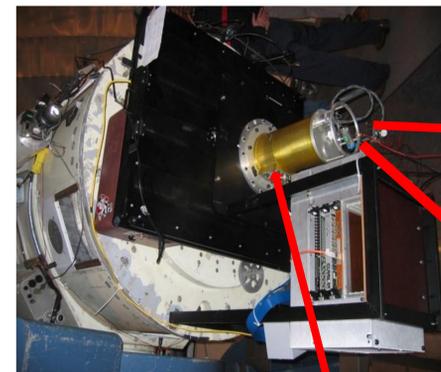


Pin-hole camera picture of the production imager using 18 CCDs in the prototype imager



On-Sky testing Nov. 2009

One 2kx2k DECam CCD on the 1m at CTIO with preproduction DECam electronics (redesigned Monsoon system to have higher form factor)



Focal plane has 62 2kx4k image CCDs, plus 8 2kx2k for focus/alignment and 4 2kx2k for guiding

DES Collaboration: Fermilab, U of Illinois at Urbana-Champaign, U of Chicago, LBNL, U of Michigan, U of Pennsylvania, The Ohio State University, Argonne National Laboratory, NOAO/CTIO, CSIC/Institut d'Estudis Espacials de Catalunya (Barcelona), Institut de Física D'Altes Energies (Barcelona), CIEMAT (Madrid), University College London, U of Cambridge, U of Edinburgh, U of Portsmouth, U of Sussex, Observatorio Nacional, Centro Brasileiro de Pesquisas Físicas, Universidade Federal do Rio de Janeiro, Universidade Federal do Rio Grande do Sul.

DES Funding: DOE, NSF, STFC (UK), Ministry of Education and Science (Spain), FINEP (Brazil), and the Collaborating Institutions