Dark Energy Survey

HEPAP Summer Meeting
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DARK ENERGY SURVEY

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Dark Energy Survey Concept

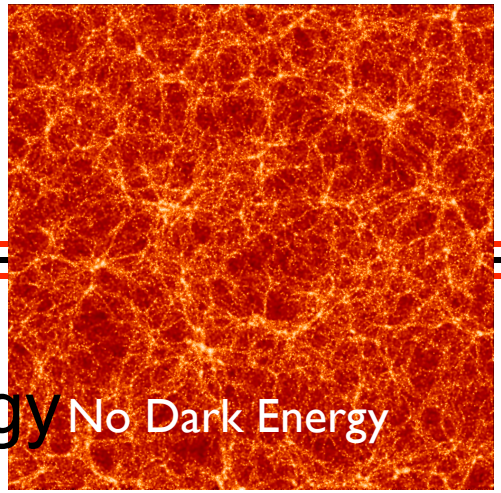
DARK ENERGY SURVEY

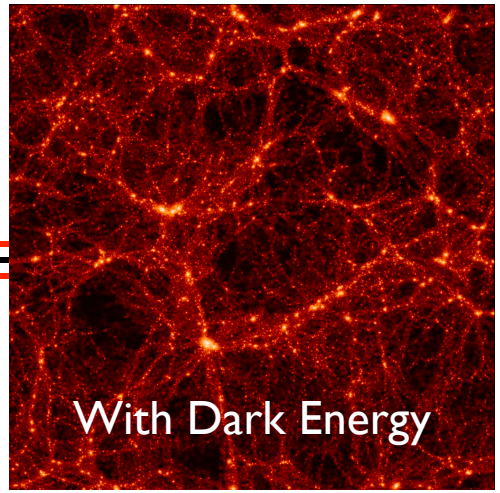
- Survey concept:
  - Perform a 5000-square-degree, 5-band, ~24th magnitude survey of the southern sky
- New instrument:
  - Replaced this prime focus cage with a 2.2 degree FOV, 570 Megapixel red-sensitive CCD imager and optics
- Time scale:
  - Preparation and reviews 2003-2008
  - Instrument construction 2008-2011
  - Delivery to CTIO 2011-2012
  - Installation Feb.- Aug. 2012
  - Commissioning Sept. 2012
- 525-night survey:
  - 105 nights per year (Sept.-February)

Use the Blanco 4-m Telescope at the Cerro Tololo Interamerican Observatory (CTIO)

DES Science Summary

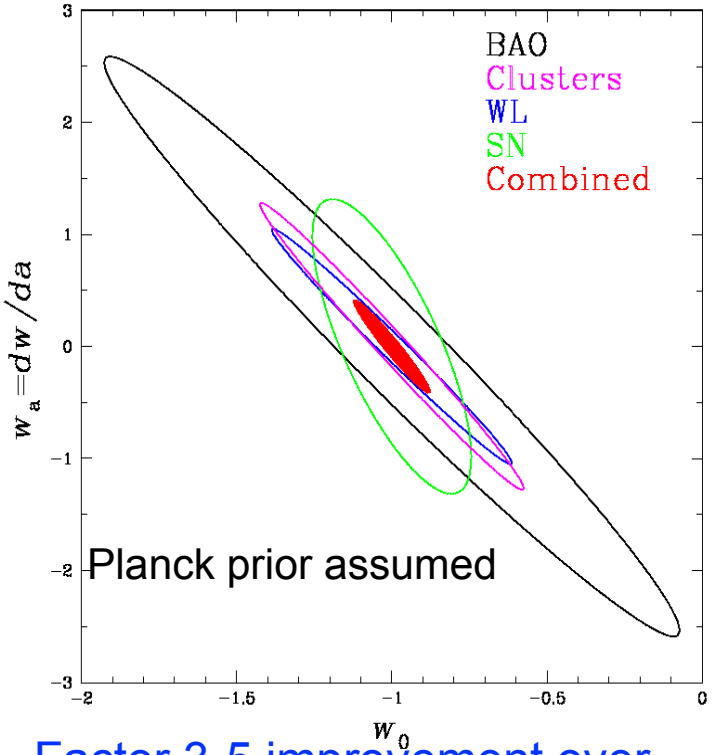
DARK ENERGY SURVEY





Four Probes of Dark Energy

- Galaxy Clusters
  - ~100,000 clusters to z = 1 and beyond
  - Synergy with South Pole Telescope
  - Sensitive to growth of structure and geometry
- Weak Lensing
  - Shape measurements of 200 million galaxies
  - Sensitive to growth of structure and geometry
- Large-scale Structure (BAO)
  - 300 million galaxies to z = 1 and beyond
  - Sensitive to geometry
- Supernovae
  - 30-square-degree time-domain survey
  - ~4000 well sampled Type Ia to z ~ 1
  - Sensitive to geometry



Factor 3-5 improvement over Stage II DETF Figure of Merit

DES Collaboration

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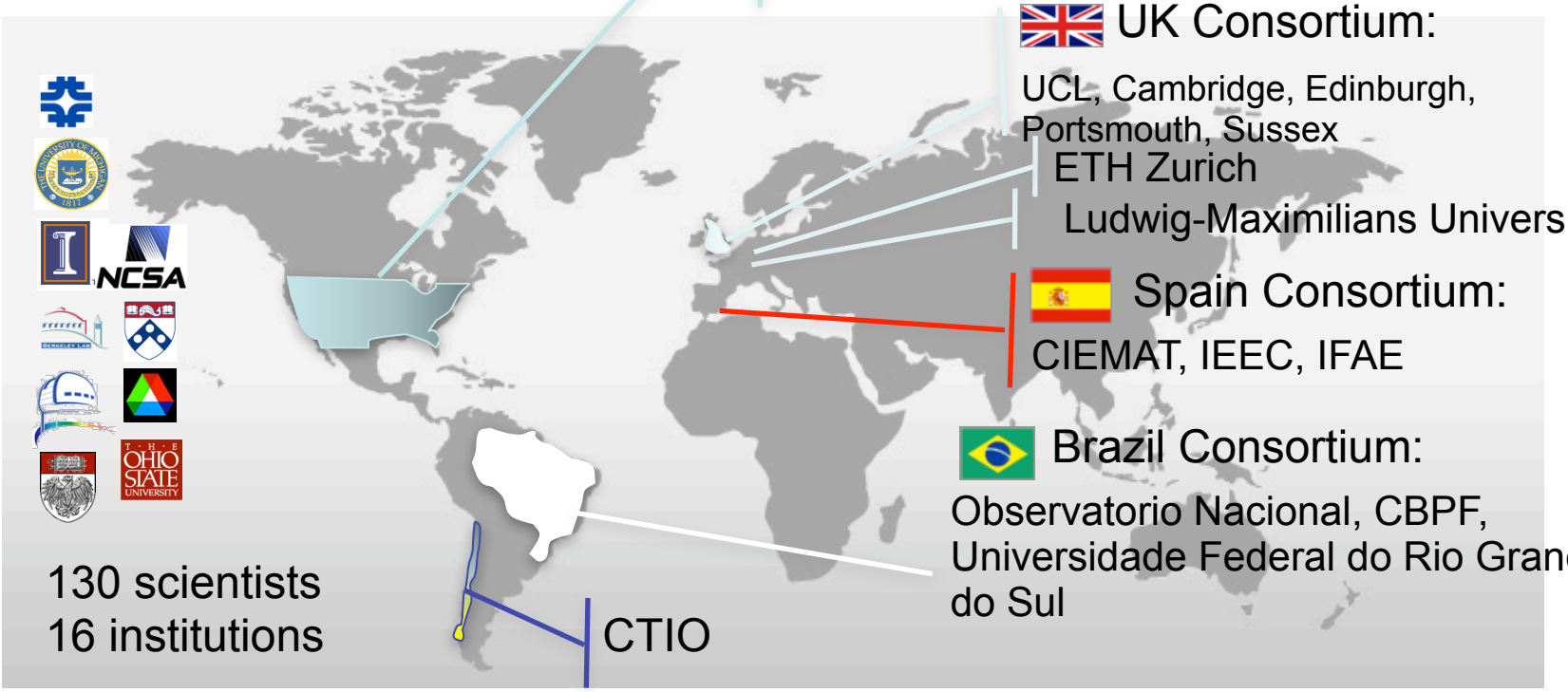
The DES is an international project to measure cosmic acceleration.

Funding from DOE, NSF, and collaborating institutions.

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

ETH Zurich

Ludwig-Maximilians Universität

Spain Consortium:

CIEMAT, IEEC, IFAE

Brazil Consortium:

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

Cerro Tololo Interamerican Observatory

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- Blanco Telescope primary mirror support upgraded
- New clean room & control room
- New Telescope Control System
- New Data Transport System

Data Management

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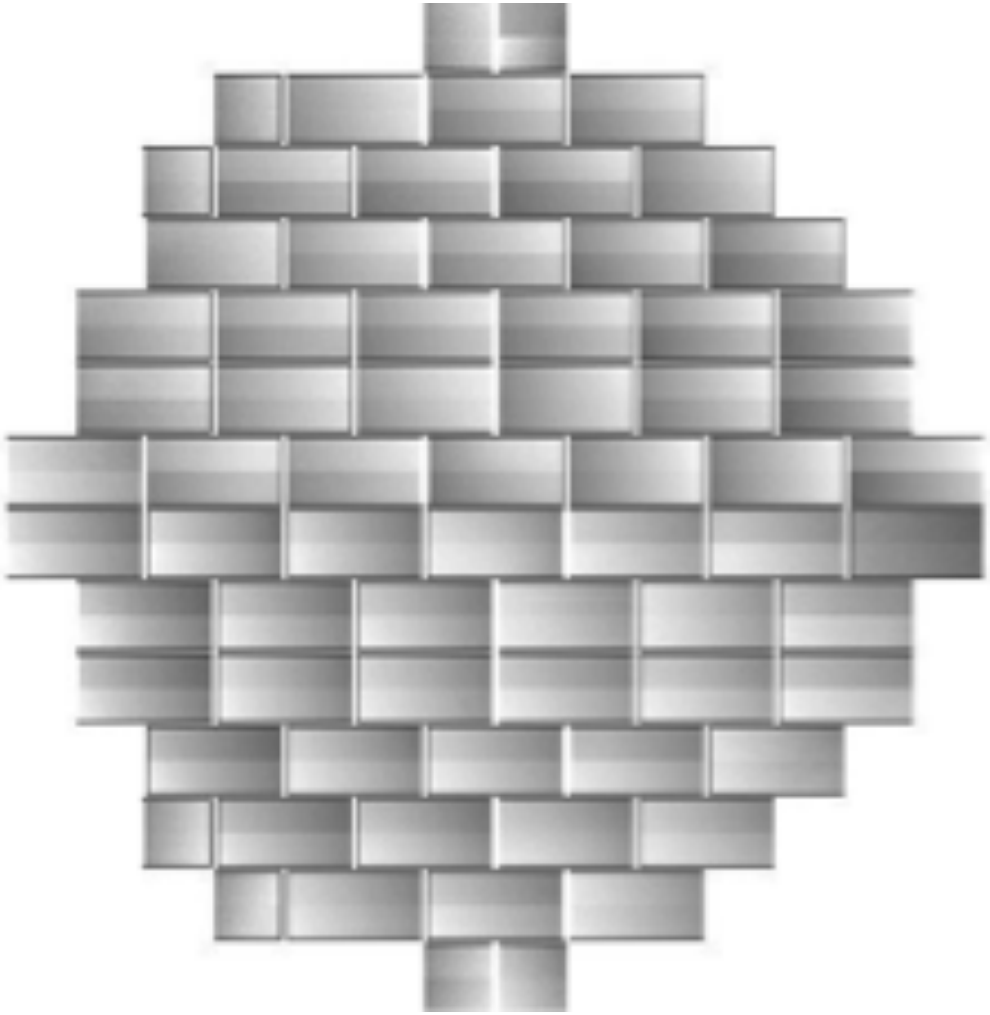
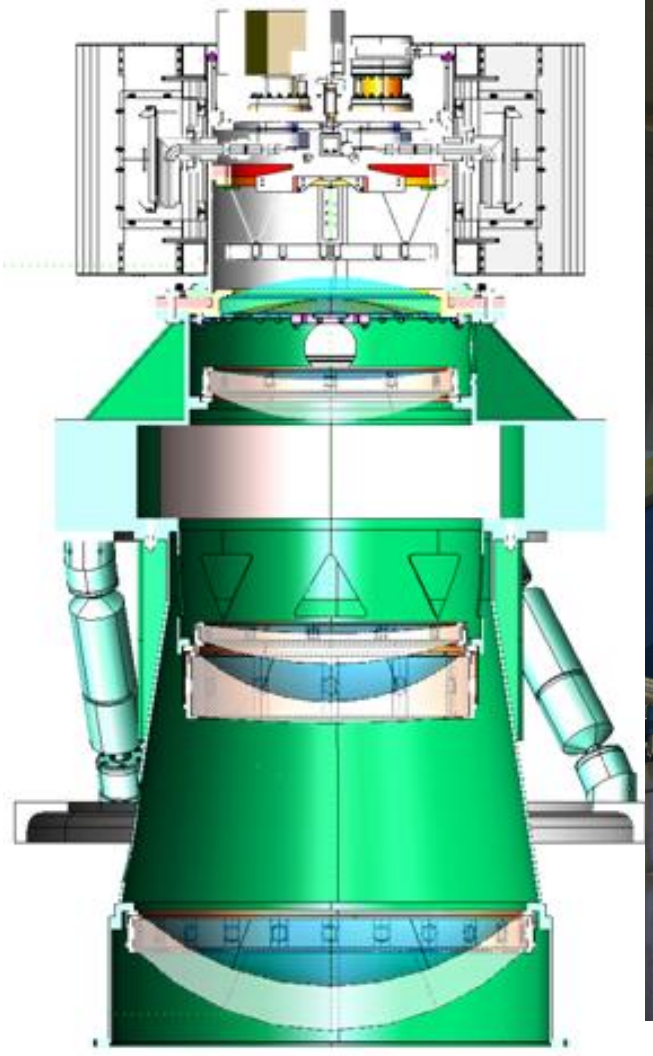
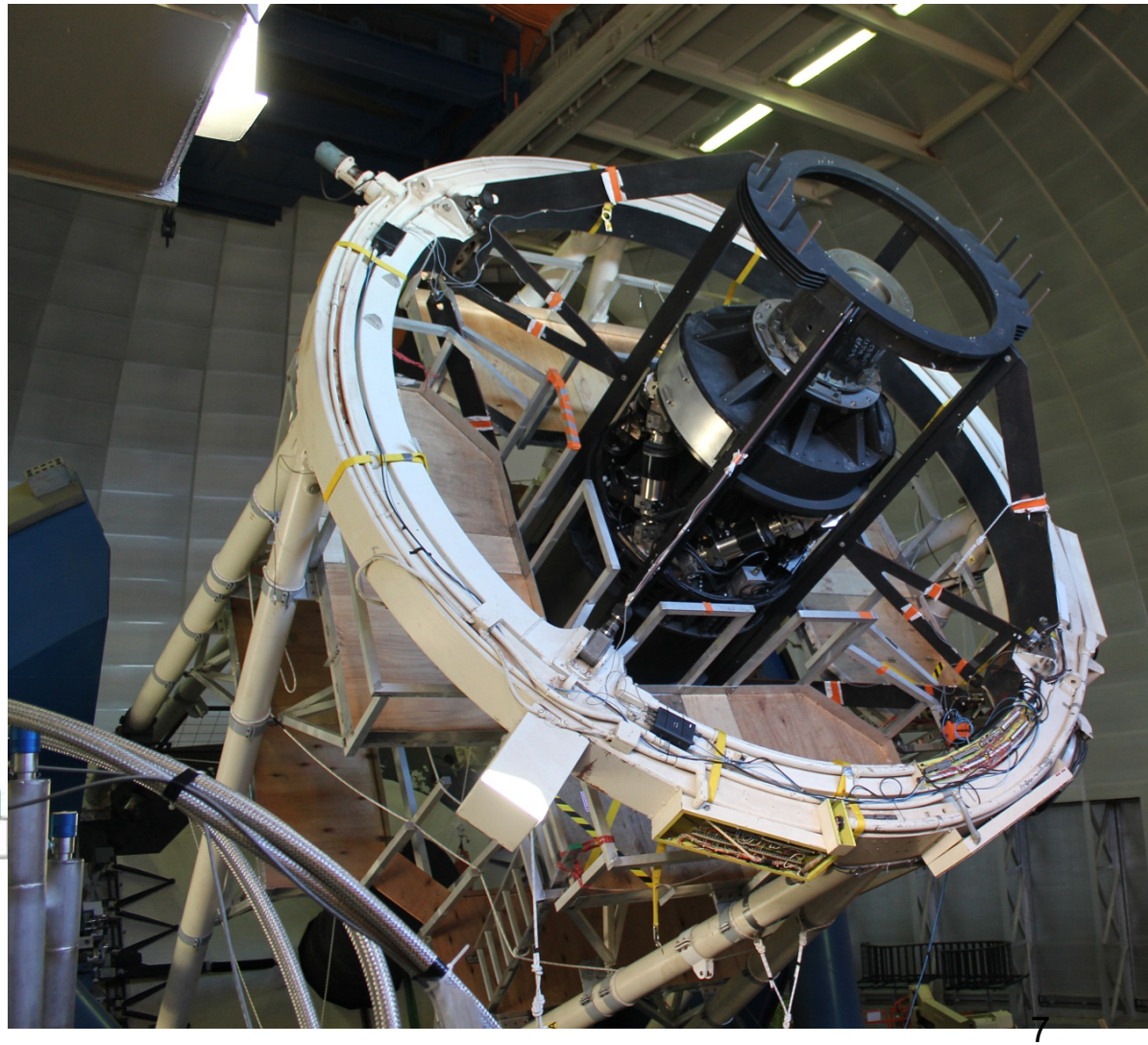
- Each night produces 300 Gby: sent to National Center for Supercomputer Applications for processing
  - galaxy colors (*photometric redshifts*)
  - galaxy shapes (*weak lensing*)
  - identification of Type Ia supernovae (*accurate fluxes*)
- Pipelines tested using simulated data & Data Challenges
- Collaboration actively engaged in data quality testing and analysis, code development and testing



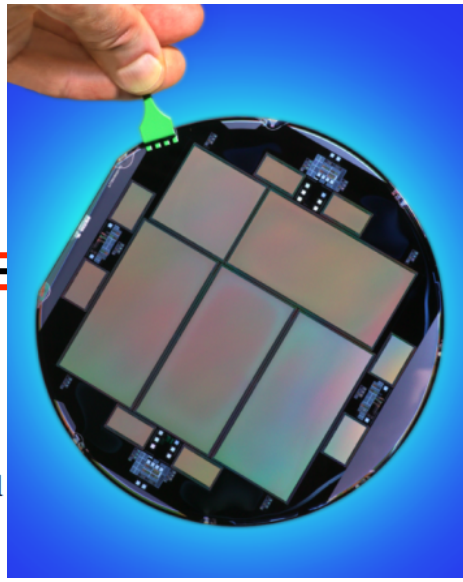
Dark Energy Camera (DECam)

DARK ENERGY SURVEY





DECam CCDs



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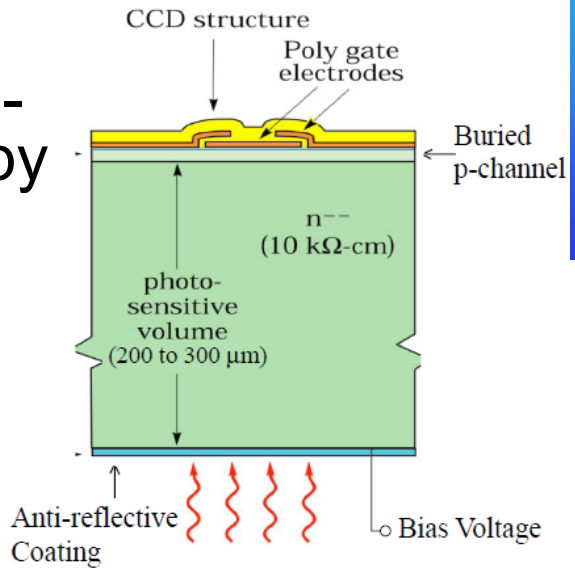
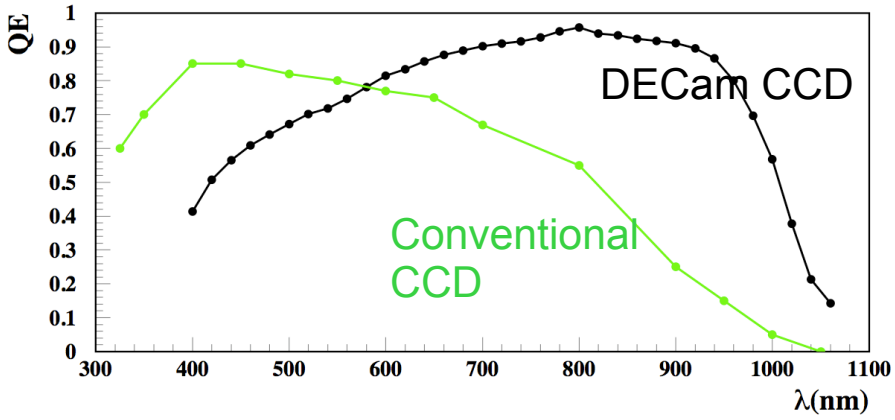
- The CCDs are thick, back-illuminated, fully-depleted p-channel devices designed by LBNL and manufactured at Dalsa+LBNL
  - thinned to 250 microns for DECam
  - higher QE over broader wavelength range



- ~500 packaged and tested at Fermilab
  - ~120 science-grade devices, 62 in the imager (15-micron pixels ⇒ 0.27 seconds of arc)
  - leverages FNAL silicon vertex detector construction for the collider programs



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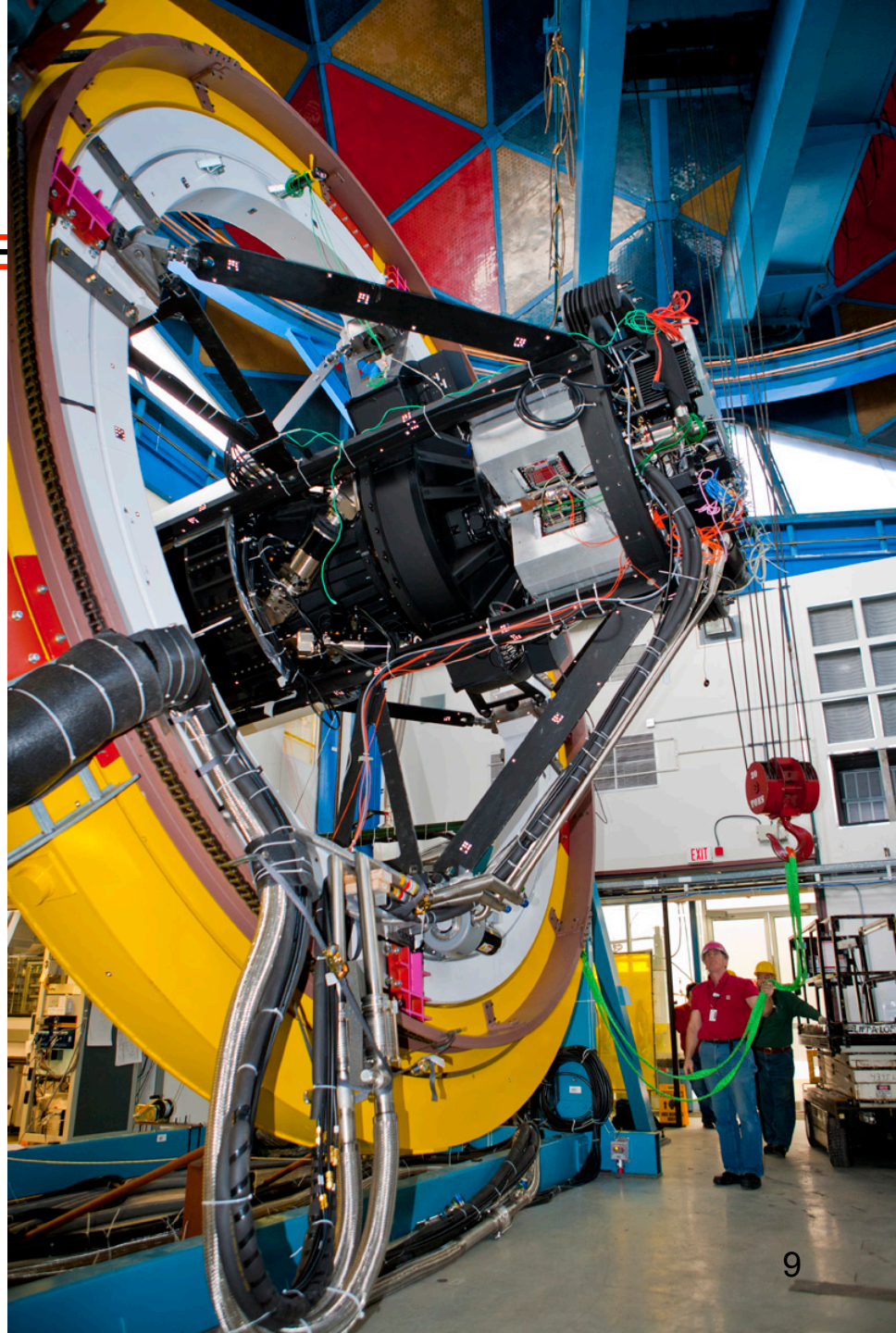
2011

- Telescope Simulator at Fermilab: DECam systems integration
- Essential for testing and debugging all systems prior to shipping; critical for DOE technical reviews
- Devise and practice procedures for actual installation on the Blanco Telescope



DECam at CTIO

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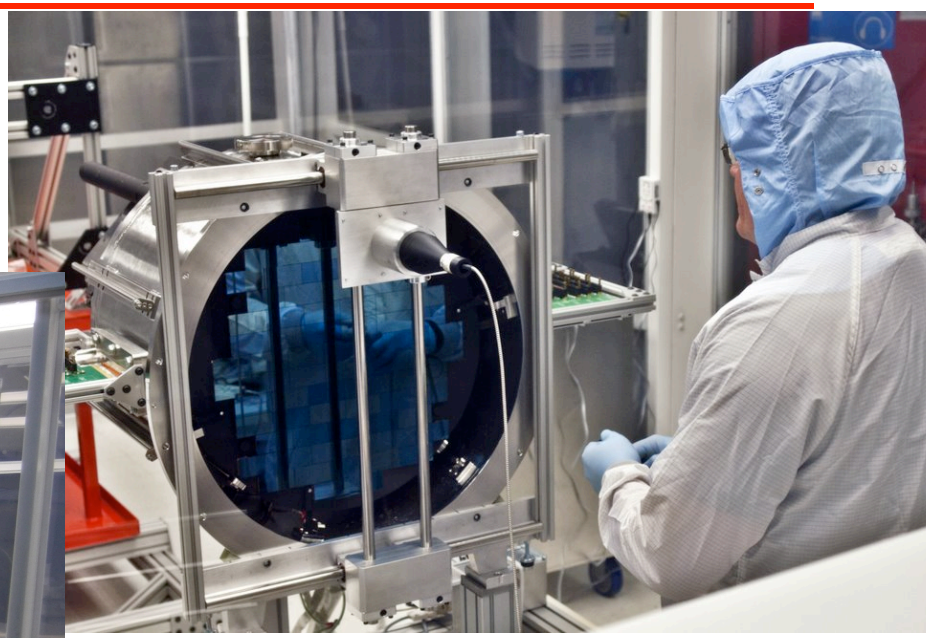

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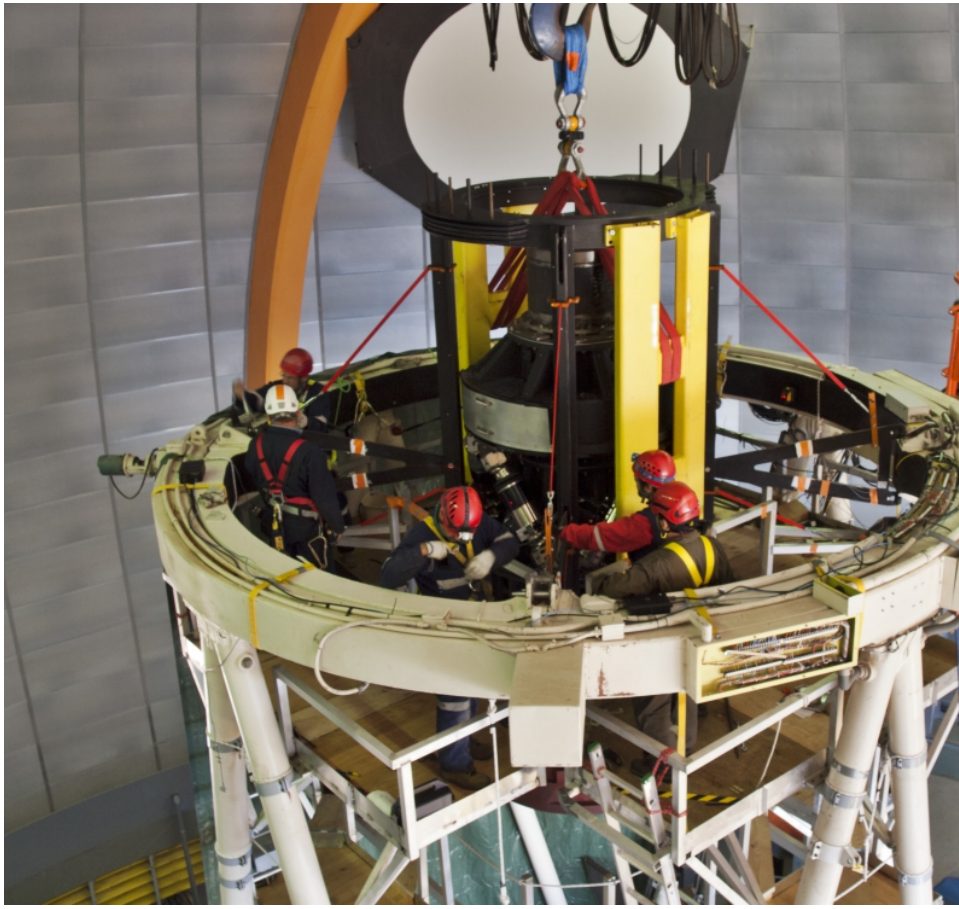
2012

- Old cage removed, new installed (April/May)
- Primary mirror, Cassegrain cage with additional counterweights reinstalled (June)
- Cabling and cryogenics lines (July/ August)
- Installation of imager (tomorrow!)
- First light for the imager on the telescope (September)
- Commissioning (Sept. - October)
- Science Verification (November)
- Start of Survey Operations (Dec.)



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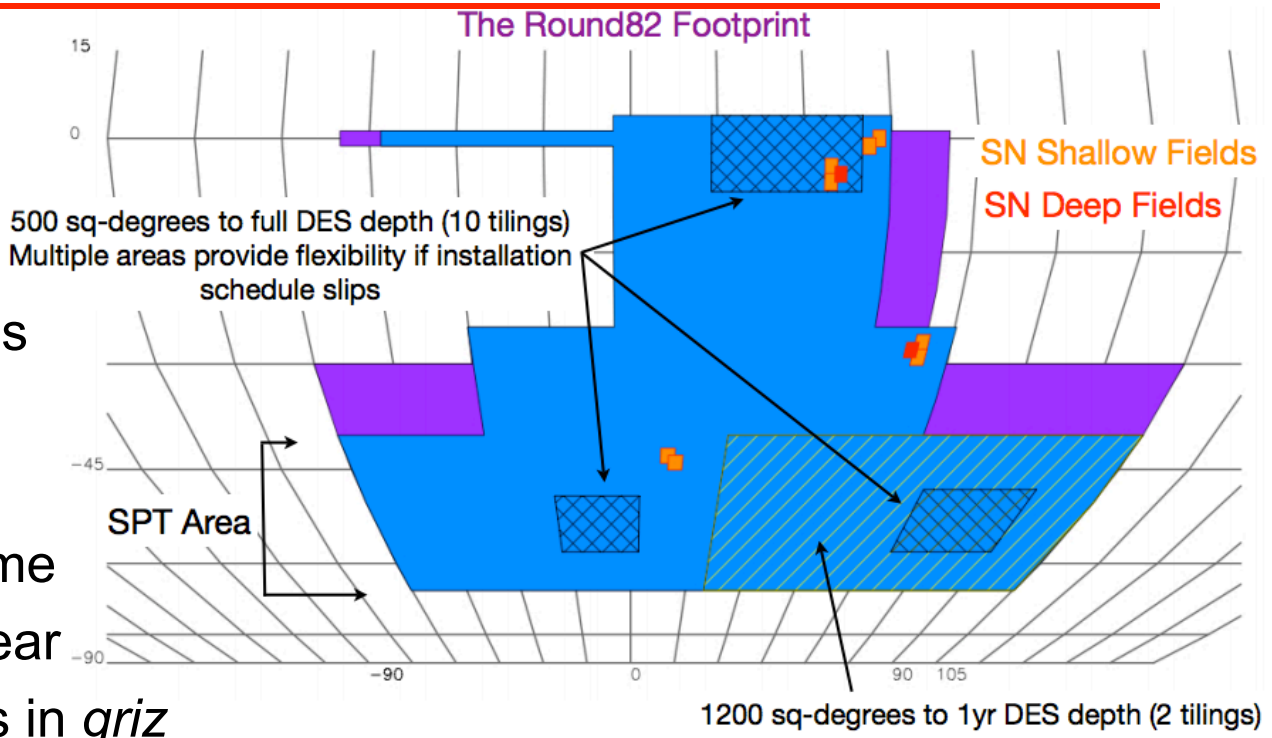
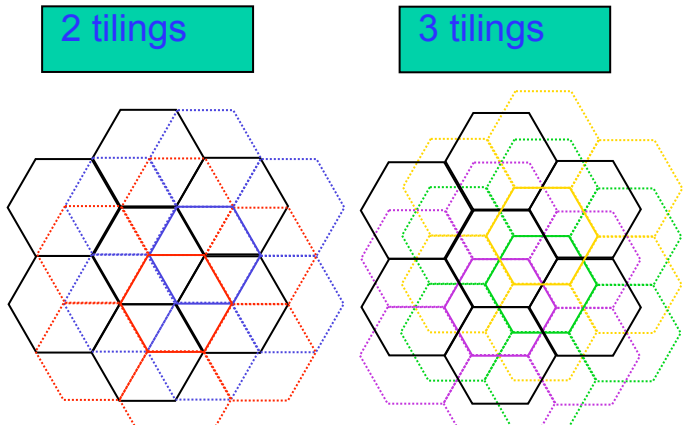
DES Collaboration Scientists

- Finalized survey strategy and evaluated contingency options for first season
- Evaluated Data Challenge 6B quality *vs* Science Requirements
- Organizing first-season science analysis projects
- Developing spectroscopic follow-up plans for the near and long terms
- Involvement in DECam commissioning and leading DES Science Verification (verify the system is producing survey-quality data prior to operations)

Survey Strategy



- 80 - 100 sec exposures
- 2 filters per pointing
  - *gr* in dark time
  - *izy* in bright/grey time
- 2 survey tilings/filter/year
- Interleave 10 SN fields in *griz* if poor seeing or time gap (aim for ~5 day cadence)



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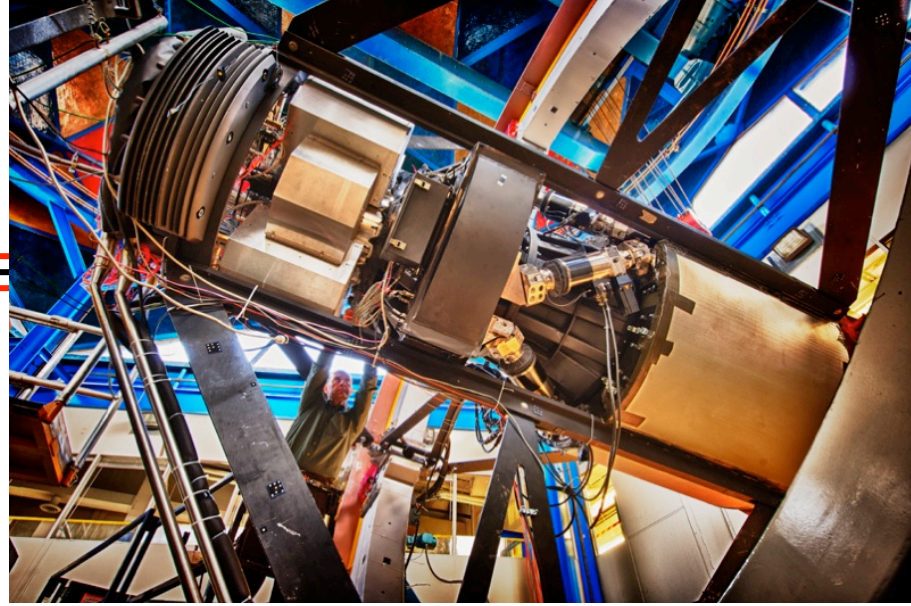
Summary



- DECam is complete, on budget, and on schedule
- Data Management will be ready for first on-sky data; architecture is being revamped for better operational efficiency, will be phased in after first season
- Successful DOE-NSF partnership, with US and foreign institutional support
- Dark Energy Survey will use DECam to take the next step in constraining Dark Energy
- NSF Astronomy Portfolio Review supports DES and community access to DECam+Blanco