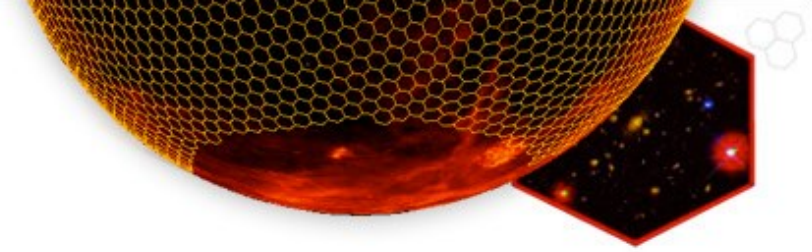




THE DARK ENERGY SURVEY



The Dark Energy Survey (DES)

Eusebio Sánchez
(for the DES-Spain Collaboration)

COSMOPHENATA

Valencia

May 2013



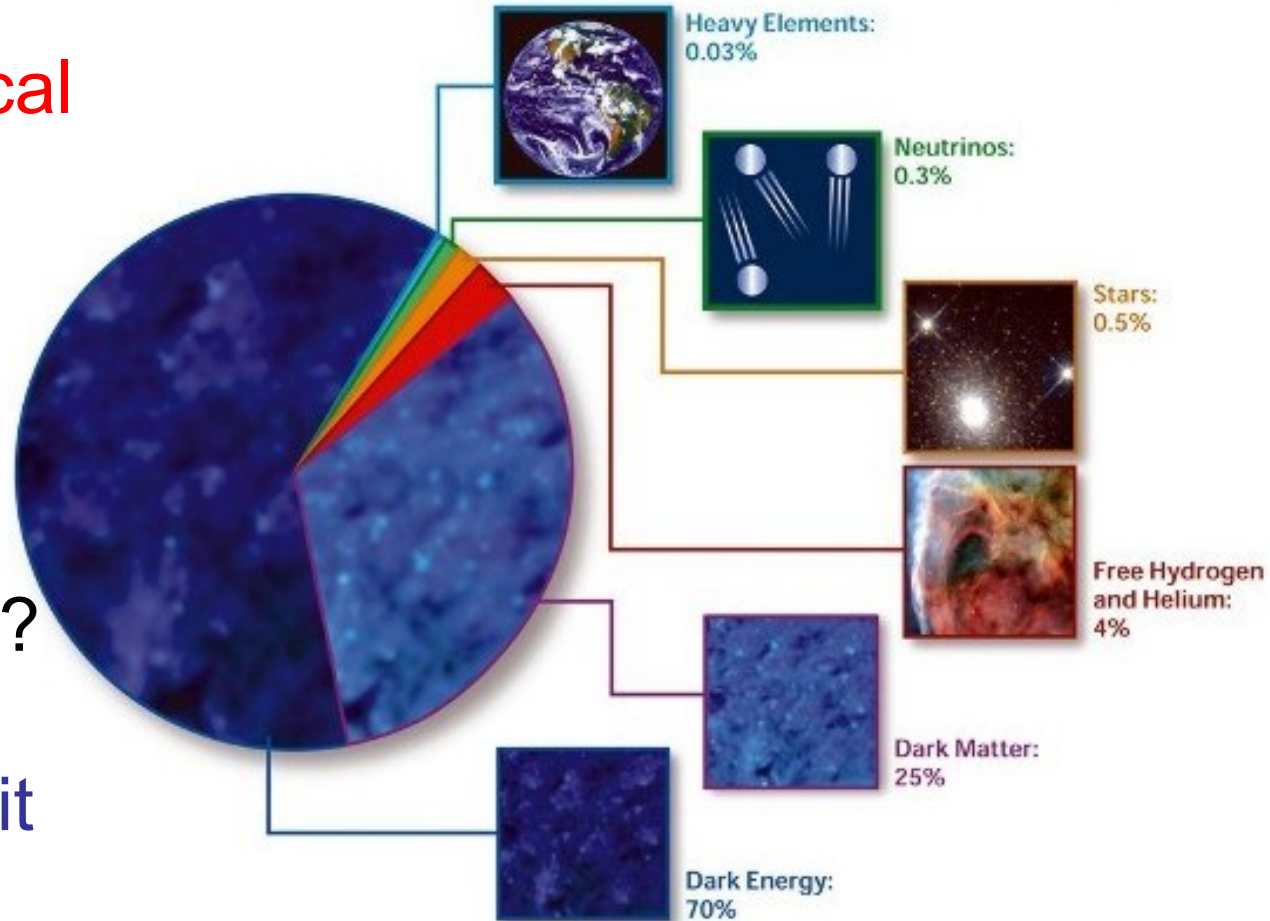
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SURVEY

Dark Energy

What is the physical
cause of cosmic
acceleration?

Dark Energy or
modification of
General Relativity?

If Dark Energy, is it
 Λ (the vacuum) or
something else?





Four Cosmological Probes

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Galaxy Clusters

100000 Clusters to $z > 1$, SZ from SPT

Weak Lensing

Shape of 300M galaxies

Large-Scale structure

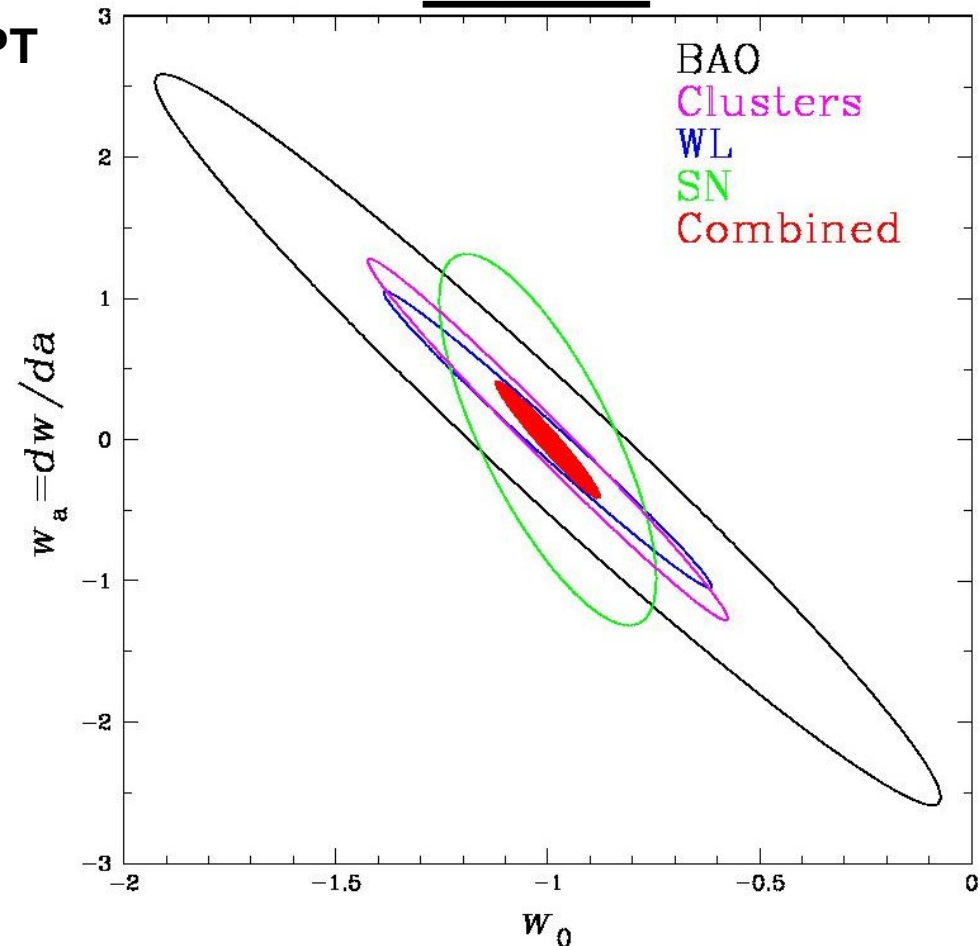
300M galaxies to $z \sim 1.4$
Angular BAO tomography

Supernovae

~ 4000 well-sampled SNIa to $z \sim 1$

Plus QSOs, Strong Lensing, Milky Way, Galaxy Evolution

Forecast on DE equation of state





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DES Collaboration

~150 scientists from
27 institutions

facebook.com/darkenergysurvey
<http://darkenergysurvey.org>



USA: 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 University



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



Germany: Munich



Switzerland: Zurich



Spain Consortium: CIEMAT, IEEC, IFAE



Brazil Consortium: Observatorio nacional, CBPF, Universidade Federal do Rio de Janeiro, Universidade Federal do Rio Grande do Sul



Chile: CTIO





The Dark Energy Survey

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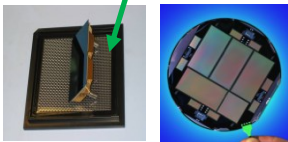
- Optical/IR imaging survey with the **Blanco 4m telescope** at Cerro Tololo Inter-American Observatory (CTIO) in Chile
- **5000 sq-deg (1/8 of the sky) in *grizY* bands (2500 sq-deg overlapping with SPT) + 30 sq-deg time-domain *griz* (SNe)**
- **570 Mpx camera, with 3 sq-deg FoV, DECam**
- Up to 24th magnitude ($z \sim 1.5$)



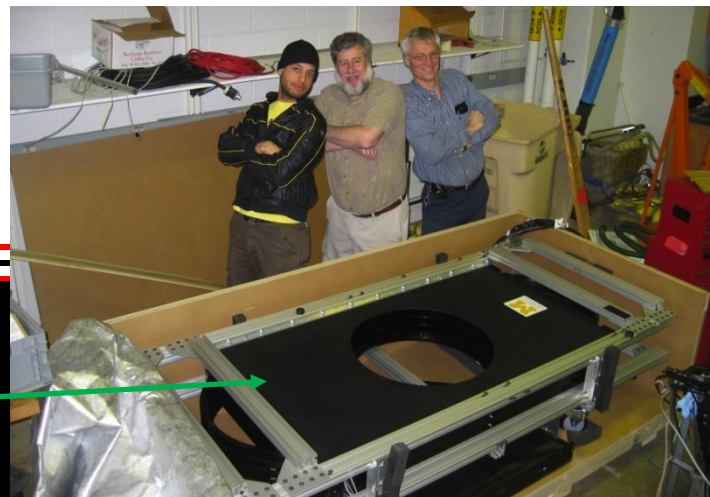
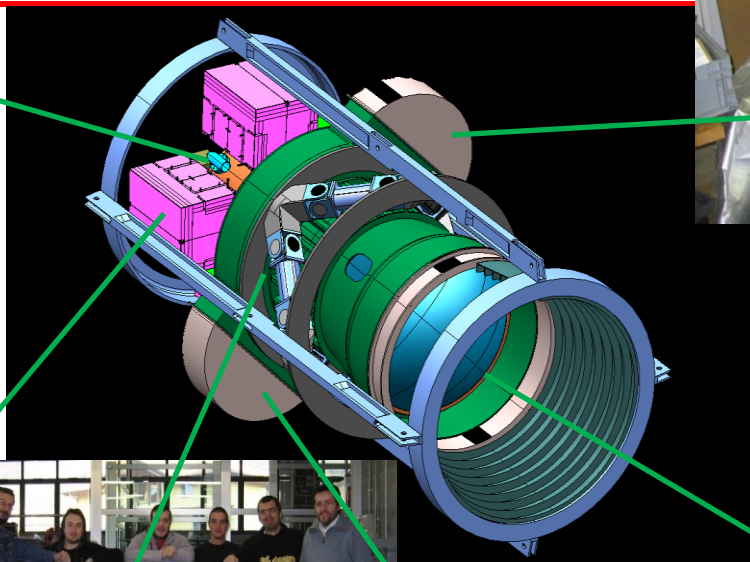
Dark Energy Camera - DECam



Imager, FNAL



CCDs, wafer from LBNL, packaged at FNAL



Filter changer, Univ. of Michigan



Barrel and Cage (FNAL, no lenses)



Hexapod, Italy



Shutter, Germany

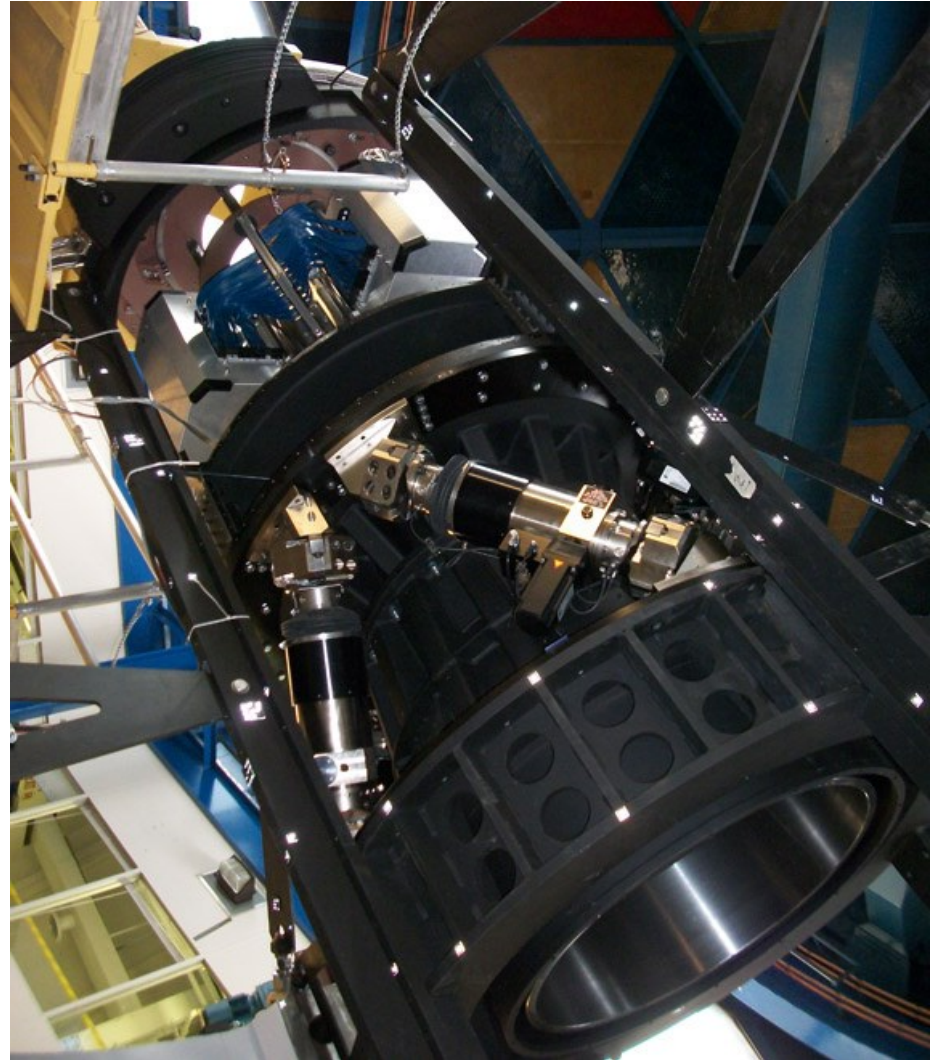
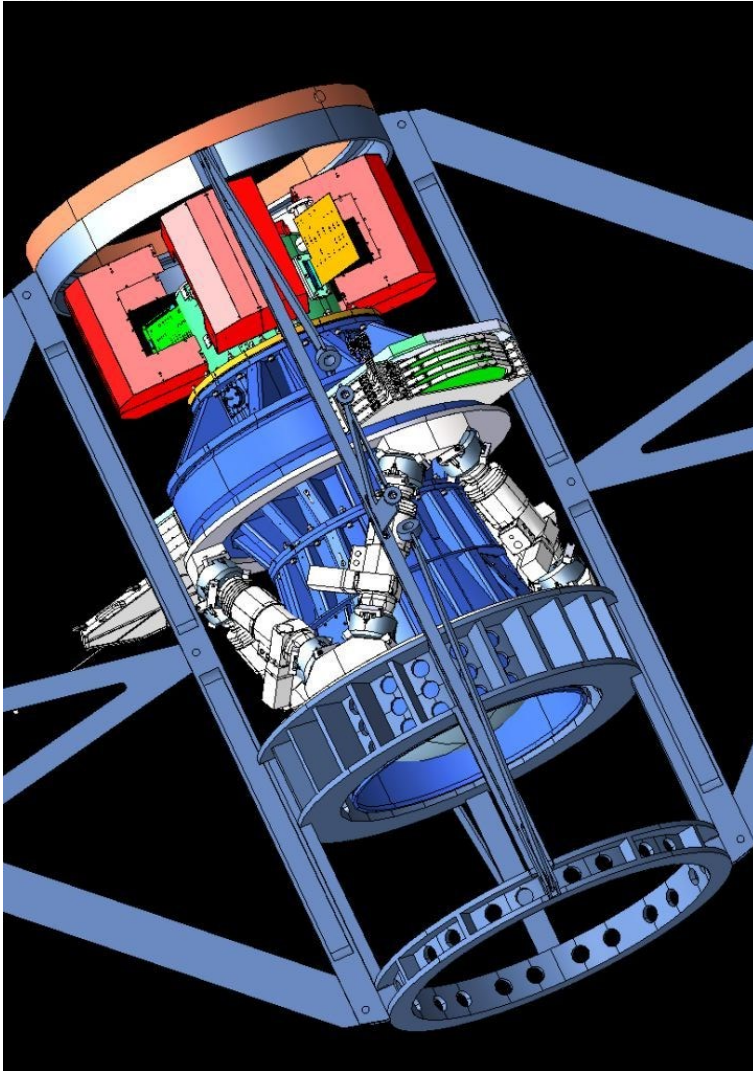


Electronics, Spain and FNAL



DECam

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Installed on Blanco since august 2012

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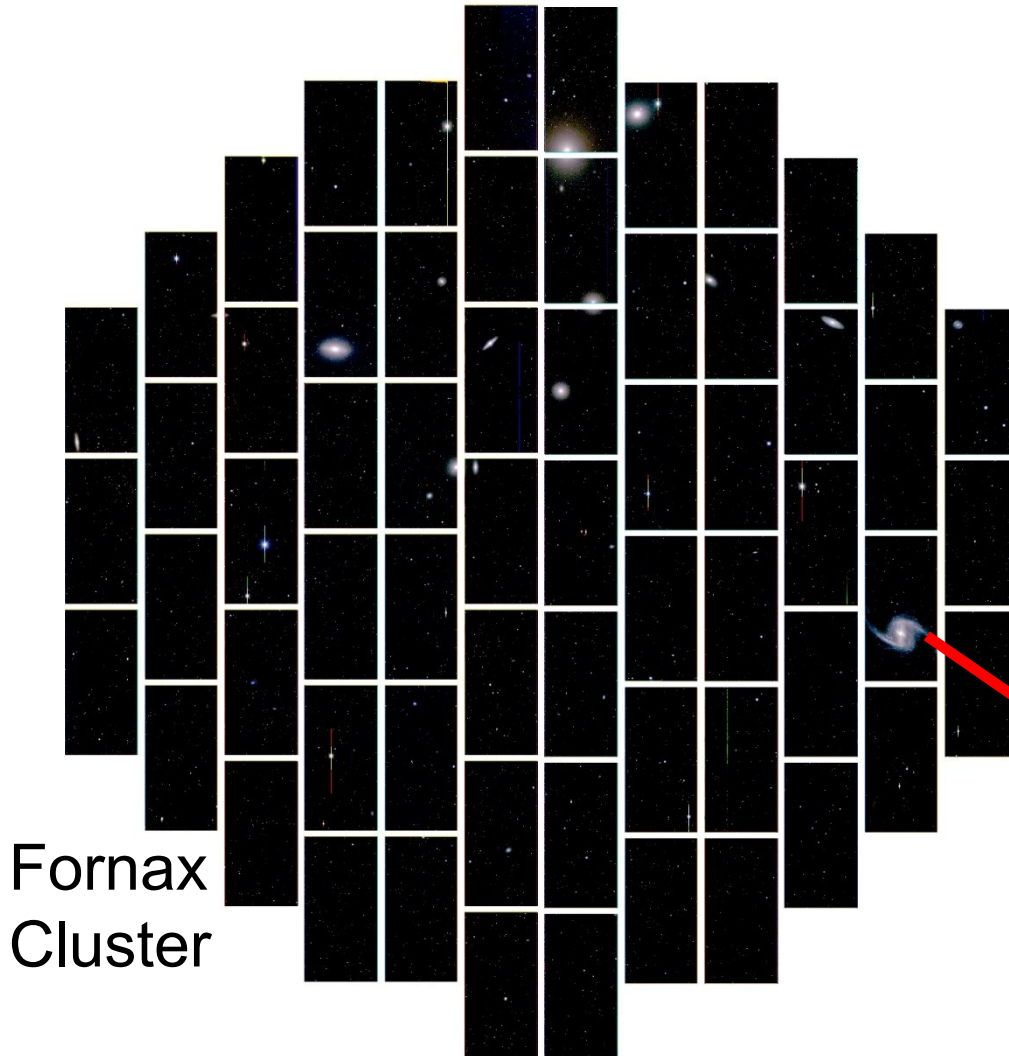


First Light: 12 september 2012

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Covered in 258 publications
in 36 countries

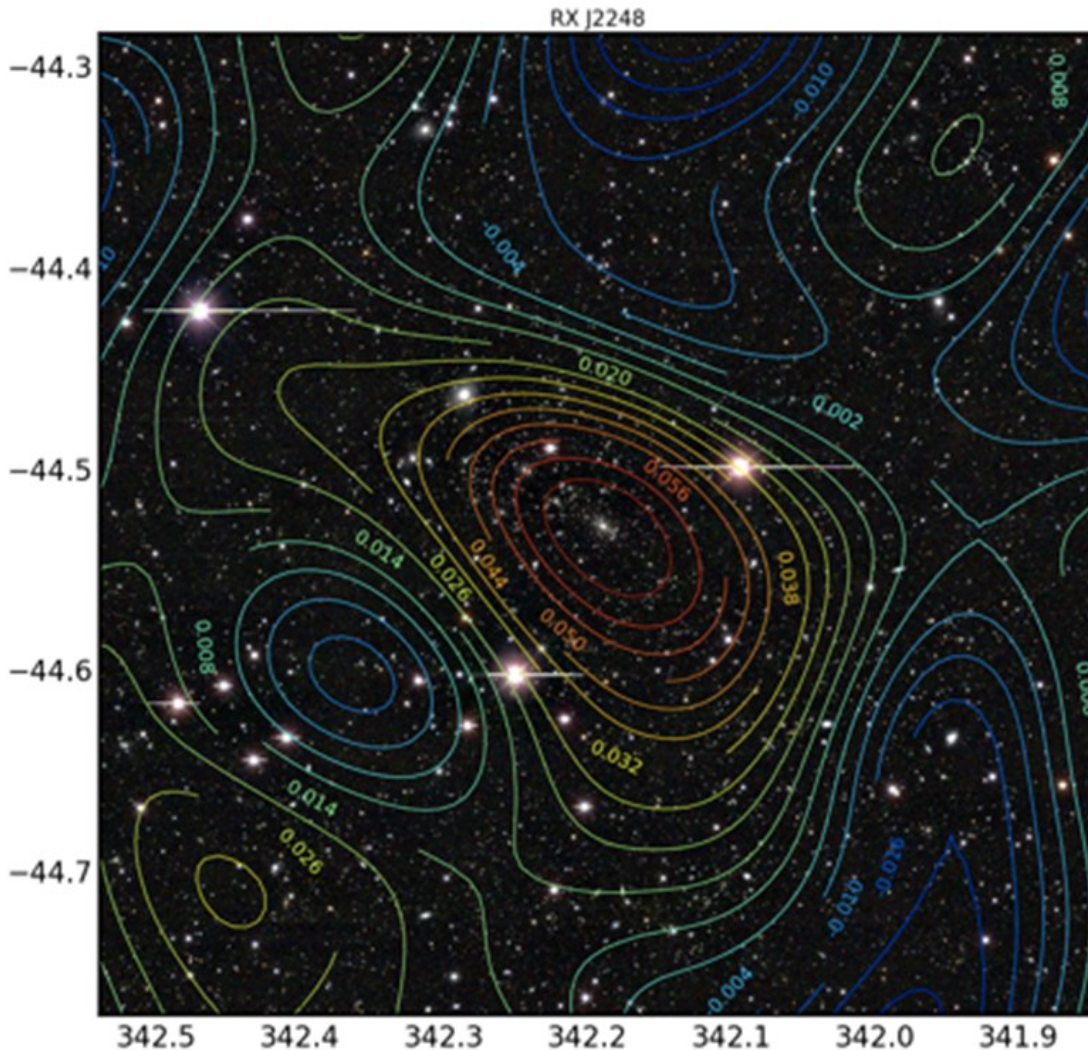
Science verification data up
to february 2013 → Check
data quality and verify the
camera-telescope system





Data from Science Verification

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Cluster RXJ2238 at
 $z=0.35$

Preliminary cluster
mass map from
DES SV data



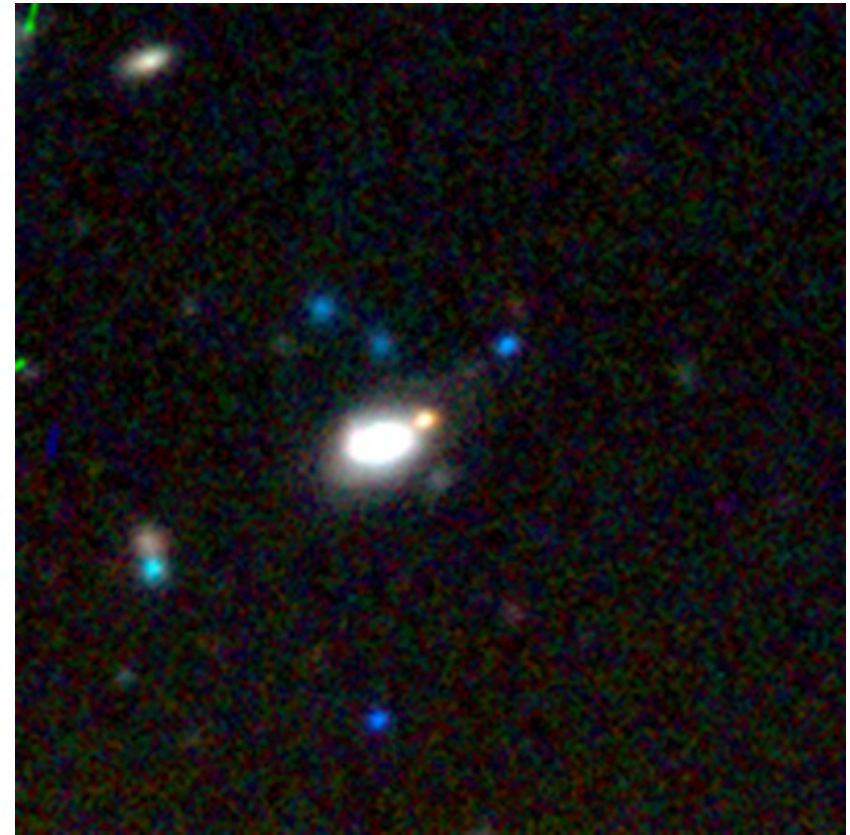
Data from Science Verification

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07 november 2012



15 december 2012



Type Ia supernovae at redshift 0.2 confirmed at AAO



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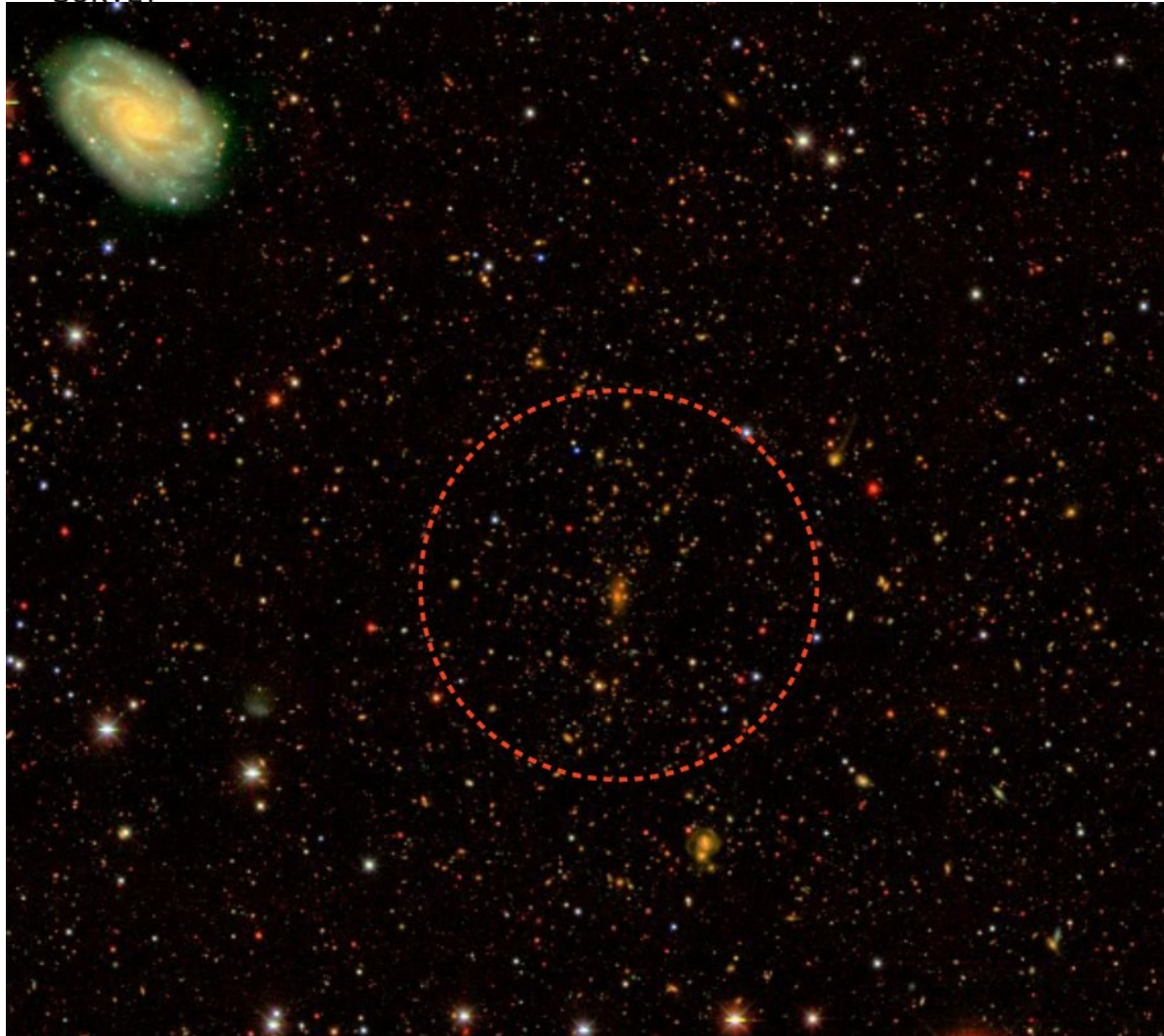
Data from Science Verification: Galaxy Cluster Abell3151





Data from Science Verification: Galaxy Cluster SPT-CL J2332-5385

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South Pole Telescope (SPT) detects galaxy clusters using the SZ effect in microwave band

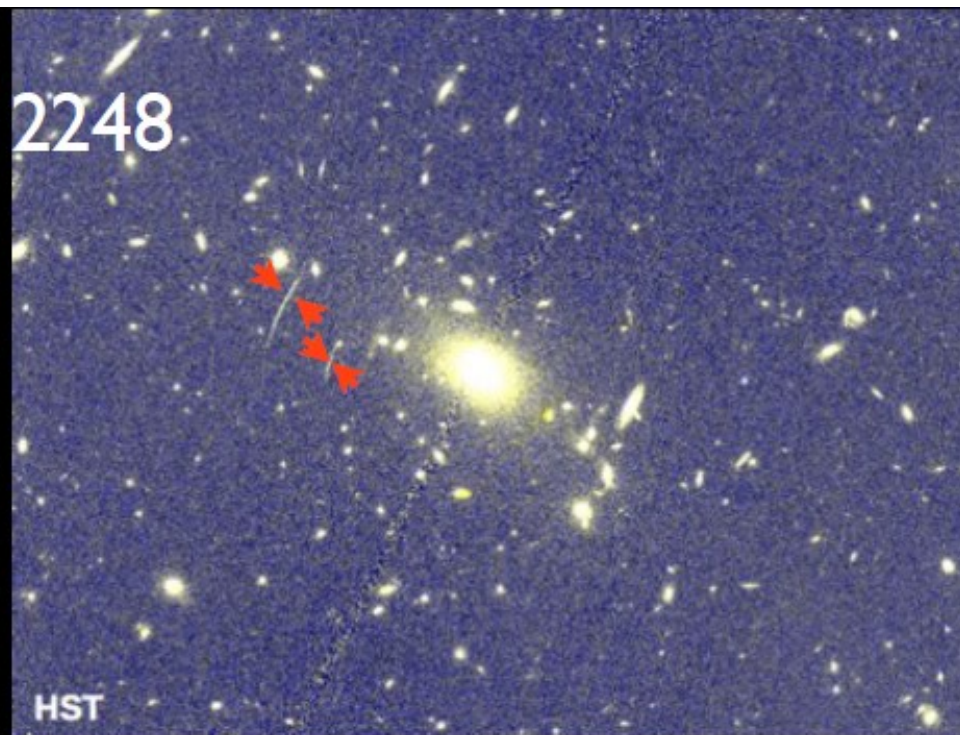
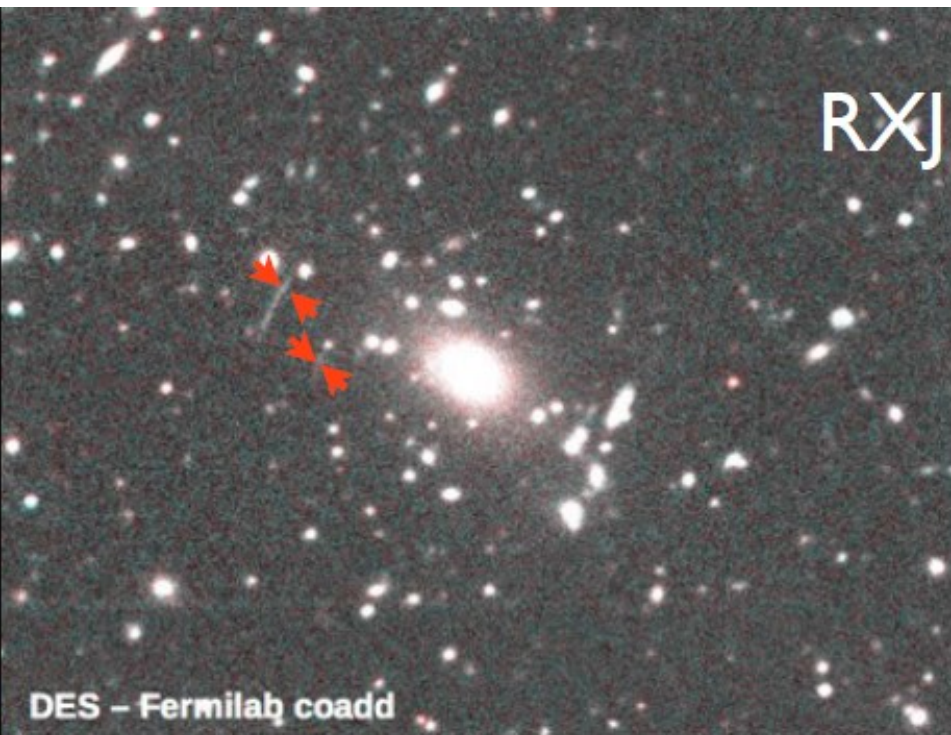
DES follows up SPT clusters in optical band.

SPT-CL J2332-5385



Data from Science Verification: Strong Lensing Arcs

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Summary

DES has taken its first data!

DECam installation and commissioning went smoothly

Science Verification observations have been completed and are being analysed. We hope to have scientific results this year

Instrument performed very well

Telescope performance improved substantially

DES system has been exercised, tested and improved



Main Spanish Contributions to DES

DES-Spain Collaboration:

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CIEMAT (Madrid), IEEC/CSIC and IFAE (Barcelona)

+ collaborators at PIC and UAM/IFT



CIEMAT: *E. Sánchez, I. Sevilla, R. Ponce, F. J. Sánchez, G. Martínez, J. de Vicente, J. Castilla*

IEEC/CSIC: *E. Gaztañaga, F. J. Castander, P. Fosalba, M. Crocce, A. Bauer, S. Jouvel, C. Bonnett, S. Farrens, M. Eriksen, J. Asorey, S. Serrano*

IFAE: *R. Miquel, E. Fernández, P. Martí, C. Sánchez, L. Cardiel, O. Ballester, C. Arteche, J. Gaweda*

IFT: *J. García-Bellido, D. Alonso*

PIC: *J. Carretero, C. Neissner*

Color code:
Senior
Post-doc
Engineer
Student
Technician



Main Spanish Contributions to DES

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- **Electronics:**

- Design of the Clock & Bias (CIEMAT), Transition (IFAE/CIEMAT) and Master Control (IFAE) Boards
- Production and commissioning of the whole read-out electronics for the camera: 108 boards, finished in fall 2010 (IFAE/CIEMAT)
- CCD characterization (CIEMAT/IFAE/IEEC/CSIC)

- **Simulations, data quality and software:**

- Large scale simulations of the universe (IEEC/CSIC)
- Data management (PIC, IEEC/CSIC, IFAE)
- Data quality checks and data reduction (CIEMAT, IEEC/CSIC)
- Guiding (IEEC/CSIC)



Main Spanish Contributions to DES

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• **Science Working Groups:**

- Large scale structure (IEEC/CSIC, CIEMAT, IFT)
- Weak Lensing (IEEC/CSIC, IFAE, CIEMAT)
- Photo-z (IEEC/CSIC, IFAE)
- Theory and Combined Probes (IEEC/CSIC, IFT)
- Supernovae (IFAE)

Scientific topics we are working on:

Photoz calibration, BAO and RSD with photometric surveys, all sky weak lensing maps, magnification and galaxy bias from cross-correlations, cross-correlation LSS-CMB, modeling errors and covariance matrices for LSS and WL, star-galaxy separation and photometric characterization, production of mock galaxy catalogs, fast computation of correlations, theoretical forecasts...



DES/Spain in DES Governance

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- **Two voting members in Management Committee (EG, RM)**
- **Two members in Science Committee (EG, FC)**
- **Science Working Group coordination:**
 - **Large-scale structure (including BAO) (EG)**
 - **Photo-z (FC)**
- **Speakers bureau, Chair (RM)**
- **Publication board (RM, ex-officio)**
- **Membership committee (ES)**
- **Data Management users coordinator (IS)**
- **Builders committee (EF, RM)**
- *Publication policy committee (RM)*
- *Membership policy committee (ES)*
- *Search committee for new DES director (RM)*
- *Front-end electronics panel (ES, GM, LC, FC, MM (Chair))*



DES Schedule

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Science Verification: September 2012 – February 2012

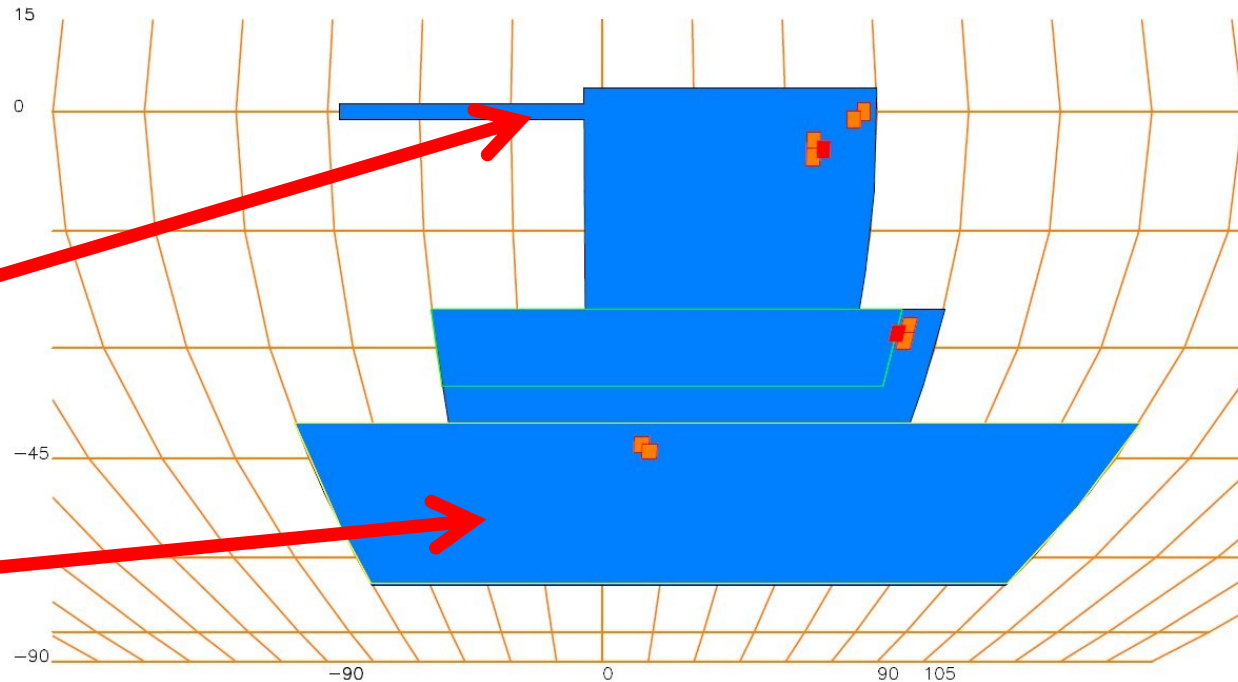
Survey Start: September 2013

Survey Complete: February 2018 (525 nights in 5 years)

  SN Fields

SDSS Stripe 82

SPT Area





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Concluding Remarks

DES Science Verification observations completed

Instrument performing well

Telescope performance improved substantially

DES SV data products being analysed

Around 200 sq-degrees data taken

Plans for first science papers based on SV data for this year

Plan to start survey operations in September

Survey from 2013 to 2018 to complete 5000 sq-deg