

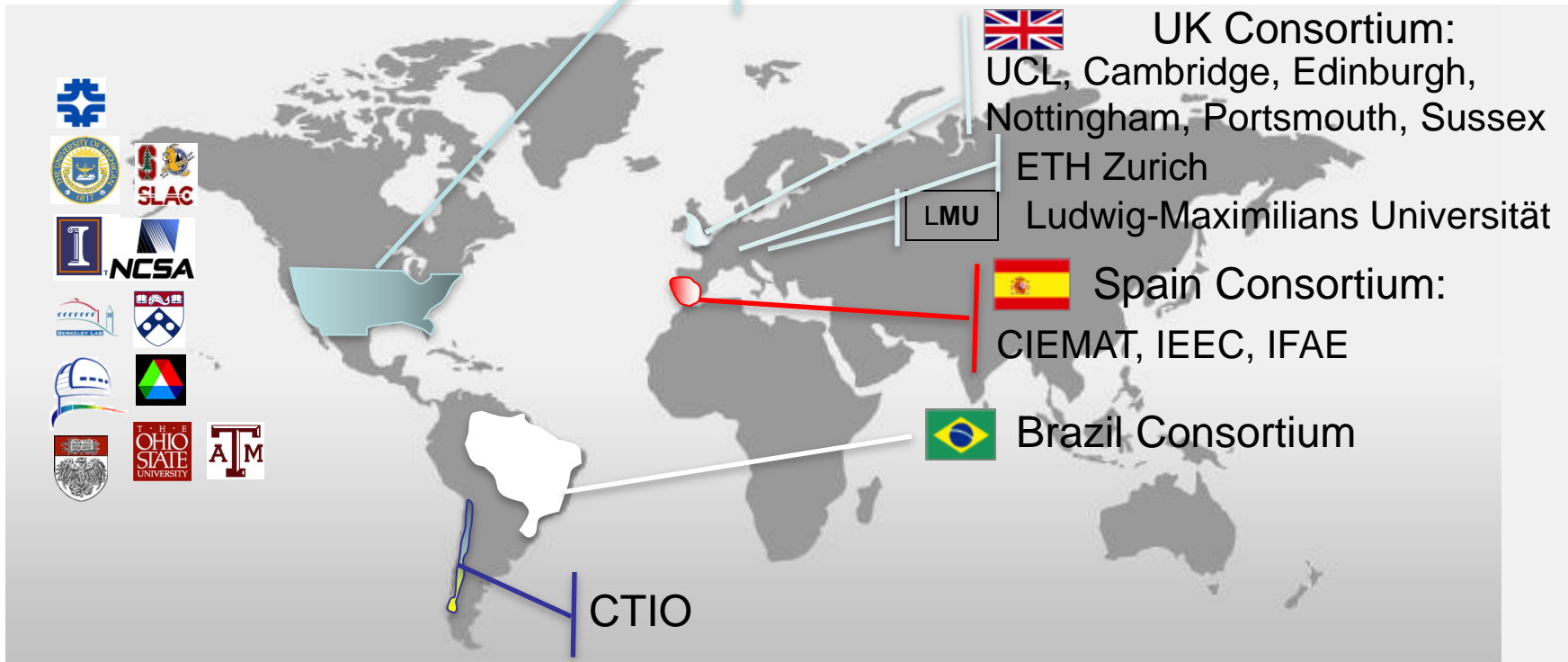


The Dark Energy Survey Collaboration

DARK ENERGY
SURVEY

~300 scientists
US support from DOE+NSF

Fermilab, UIUC/NCSA, University of Chicago, LBNL, NOAO, University of Michigan, University of Pennsylvania, Argonne National Lab, Ohio State University, Santa-Cruz/SLAC/Stanford, Texas A&M

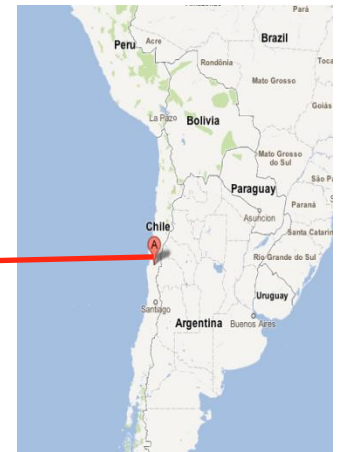
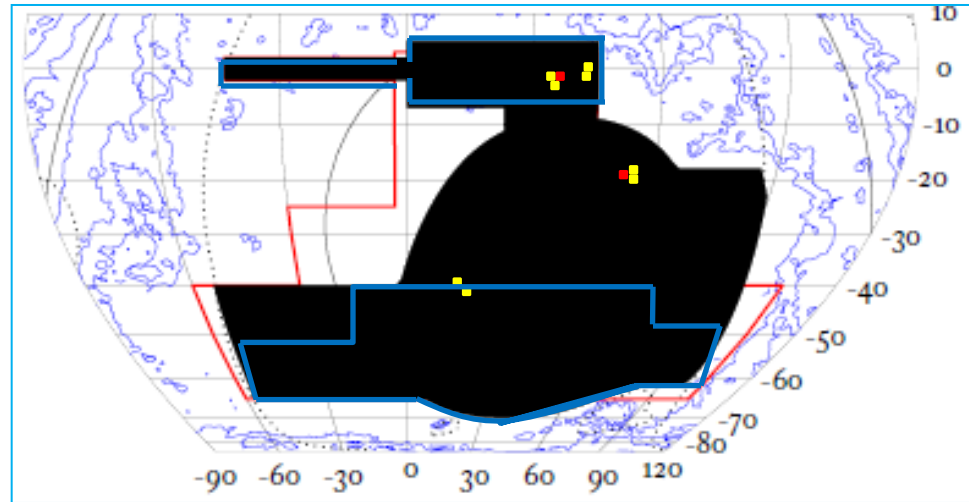




The Dark Energy Survey

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- DES uses 4 complementary techniques to measure acceleration of the Universe
 - I. Cluster Counts
 - II. Weak Lensing
 - III. Large-scale Structure (BAO)
 - IV. Supernovae
- Two multiband imaging surveys:
 - 5000 deg² *grizY* to 24th mag
 - 30 deg² repeat *griz* (SNe)
- Built DECam, a 3 deg² FOV camera for the Blanco 4m telescope at CTIO
 - Survey 2013-2018 (525 nights)
 - Facility instrument for astronomy community (DES uses 30% time).

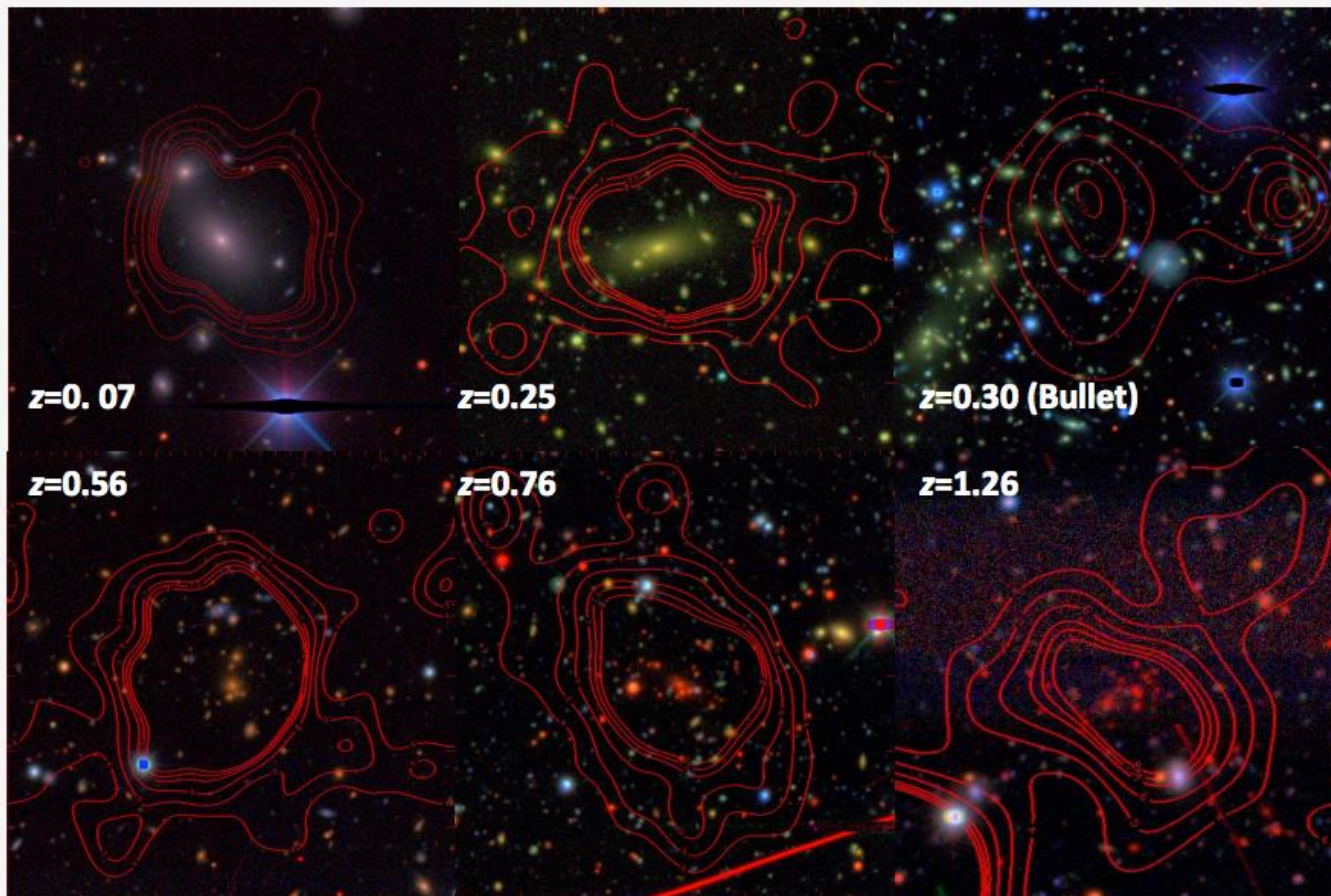




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The Dark Energy Survey: Galaxy Cluster Counts

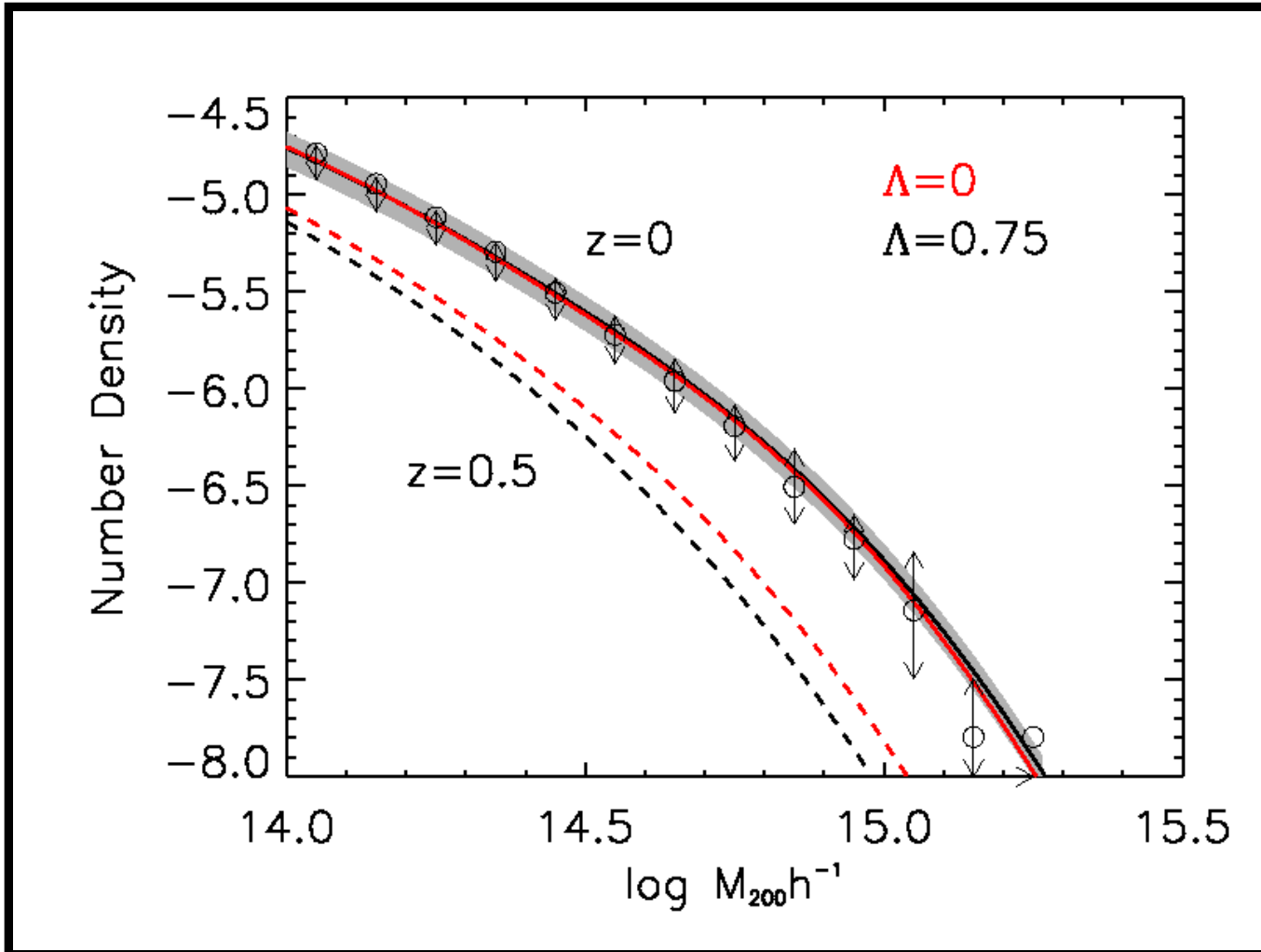
X-ray Cosmology in DES





The Dark Energy Survey: Cluster Counts

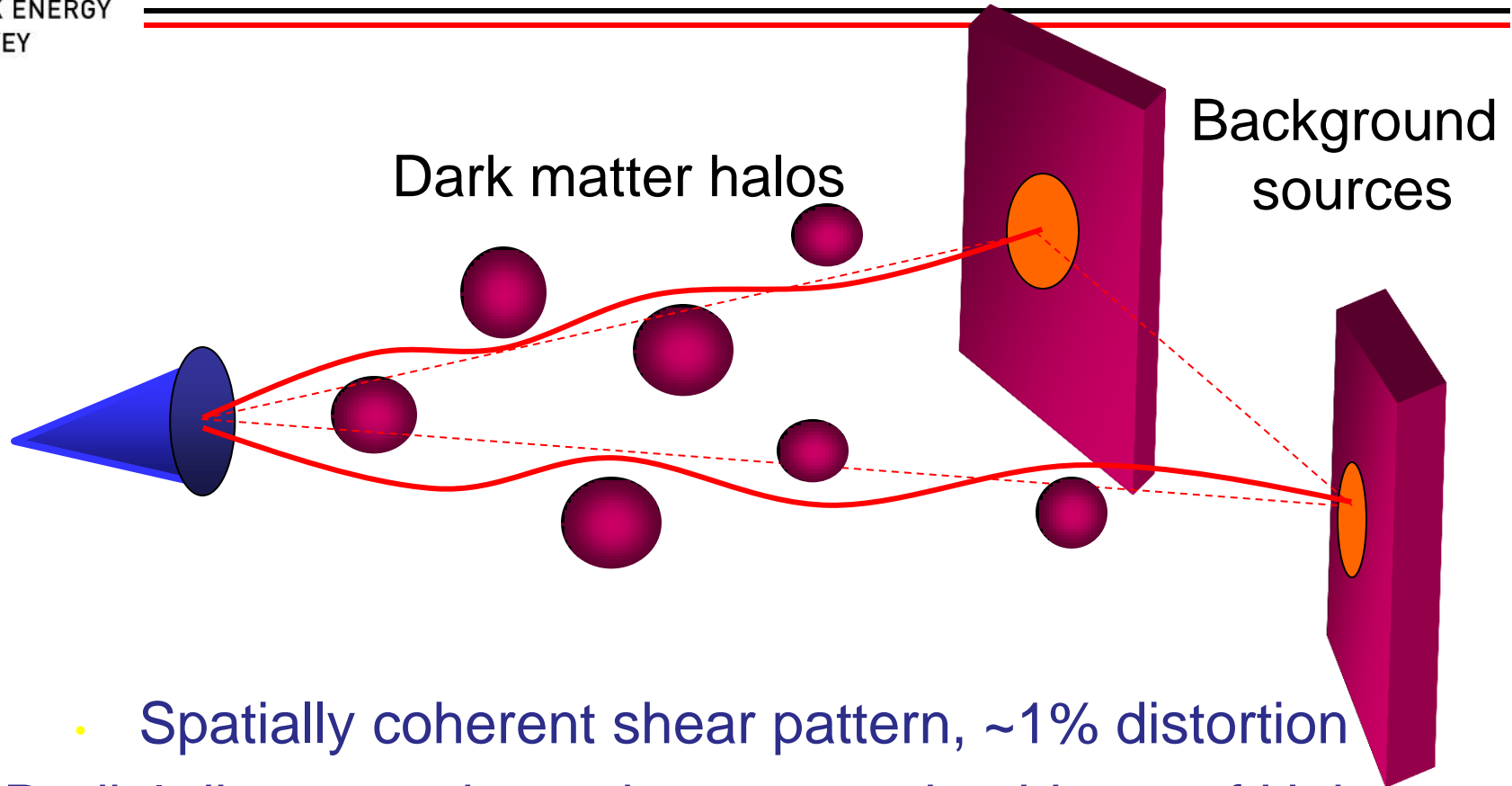
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The Dark Energy Survey: Galaxy Weak Lensing Shear



- Spatially coherent shear pattern, $\sim 1\%$ distortion

- Radial distances depend on *expansion history* of Universe

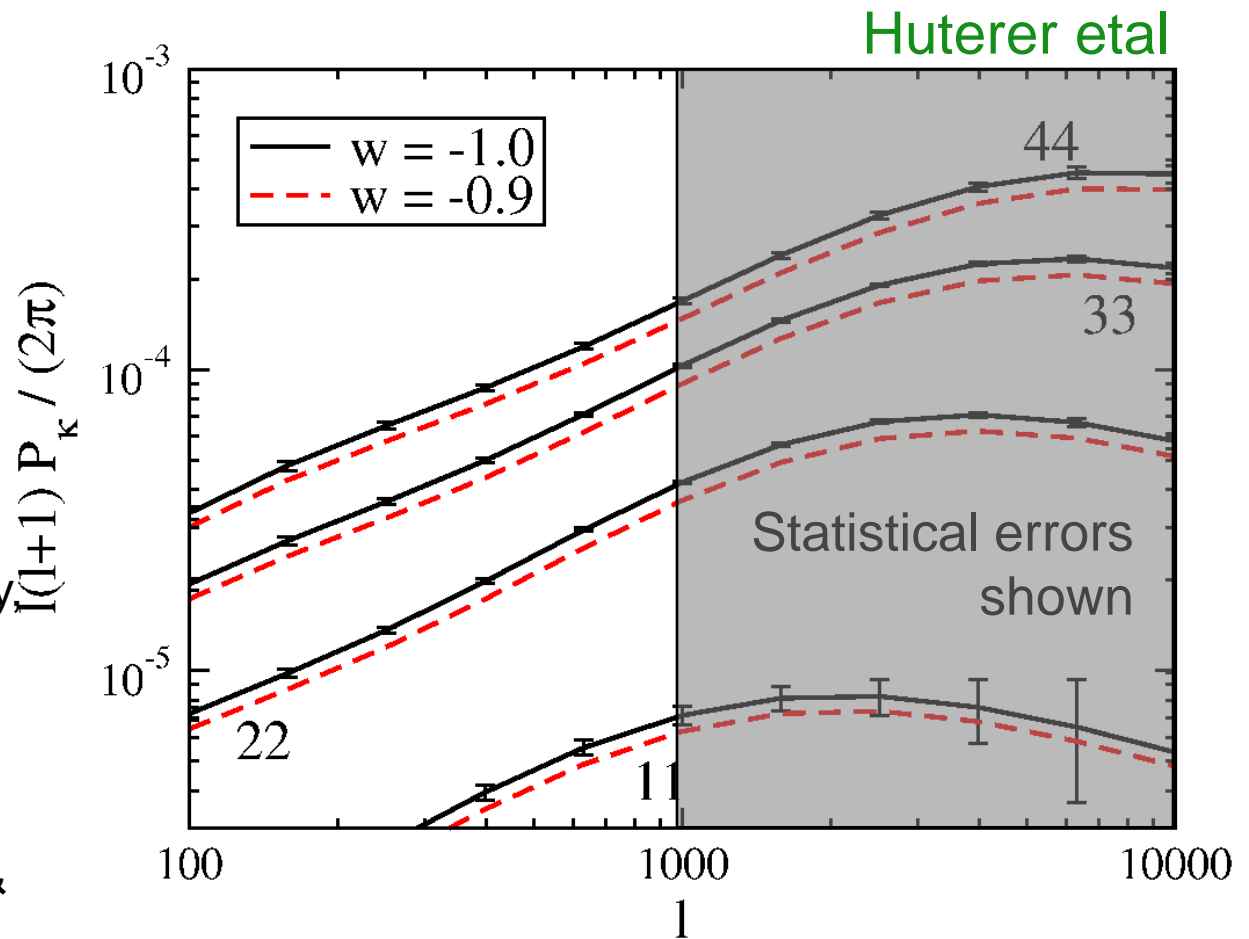
- Foreground mass distribution depends on *growth* of structure



DES: Weak Lensing Shear Tomography

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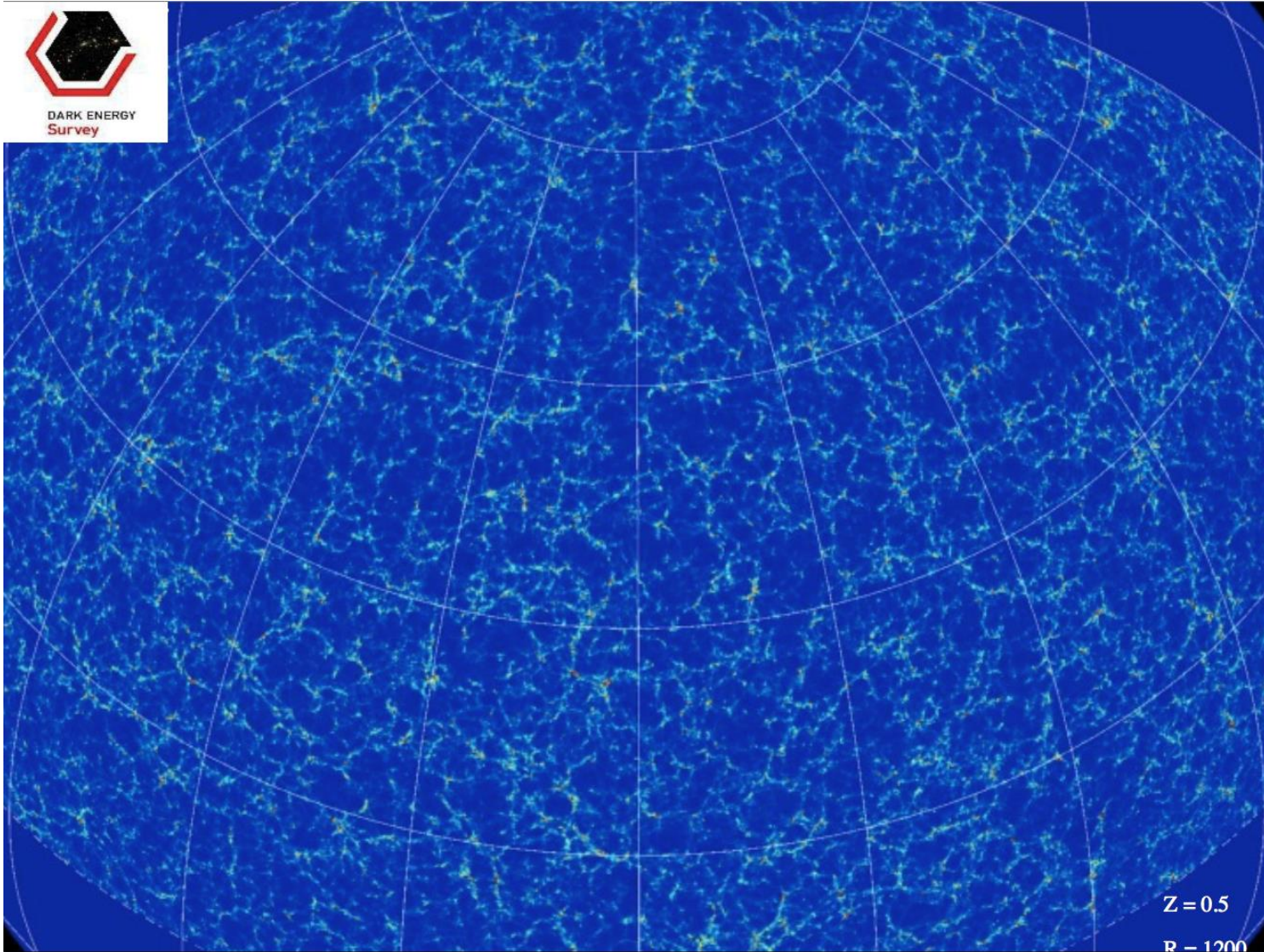
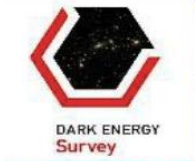
- Cosmic Shear Angular Power Spectrum in Photo-z Slices
- Shapes of ~200 million well-resolved galaxies, $\langle z \rangle = 0.7$
- Challenges: photo-z's, intrinsic alignments, PSF anisotropy, shear calibration, nonlinear+baryon $P(k)$ effects
- Extra info in bispectrum & galaxy-shear: robust





DES: Large Scale Structure

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Z = 0.5

R = 1200



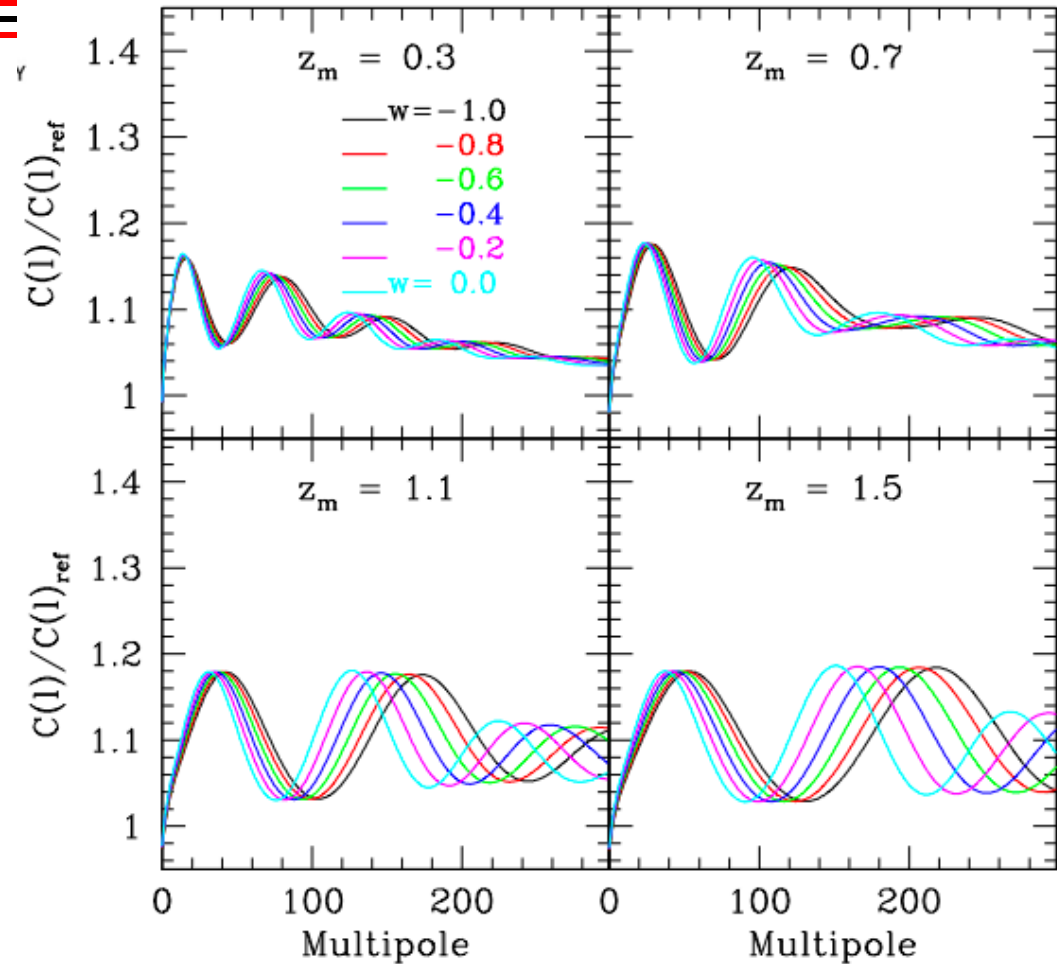
The Dark Energy Survey: BAO and Large-Scale Structure

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Galaxy angular
power spectrum
in photo-z bins
(relative to model
without BAO)

Photometric
surveys provide
angular measure

Radial modes
require
spectroscopy
(MS-DESI)

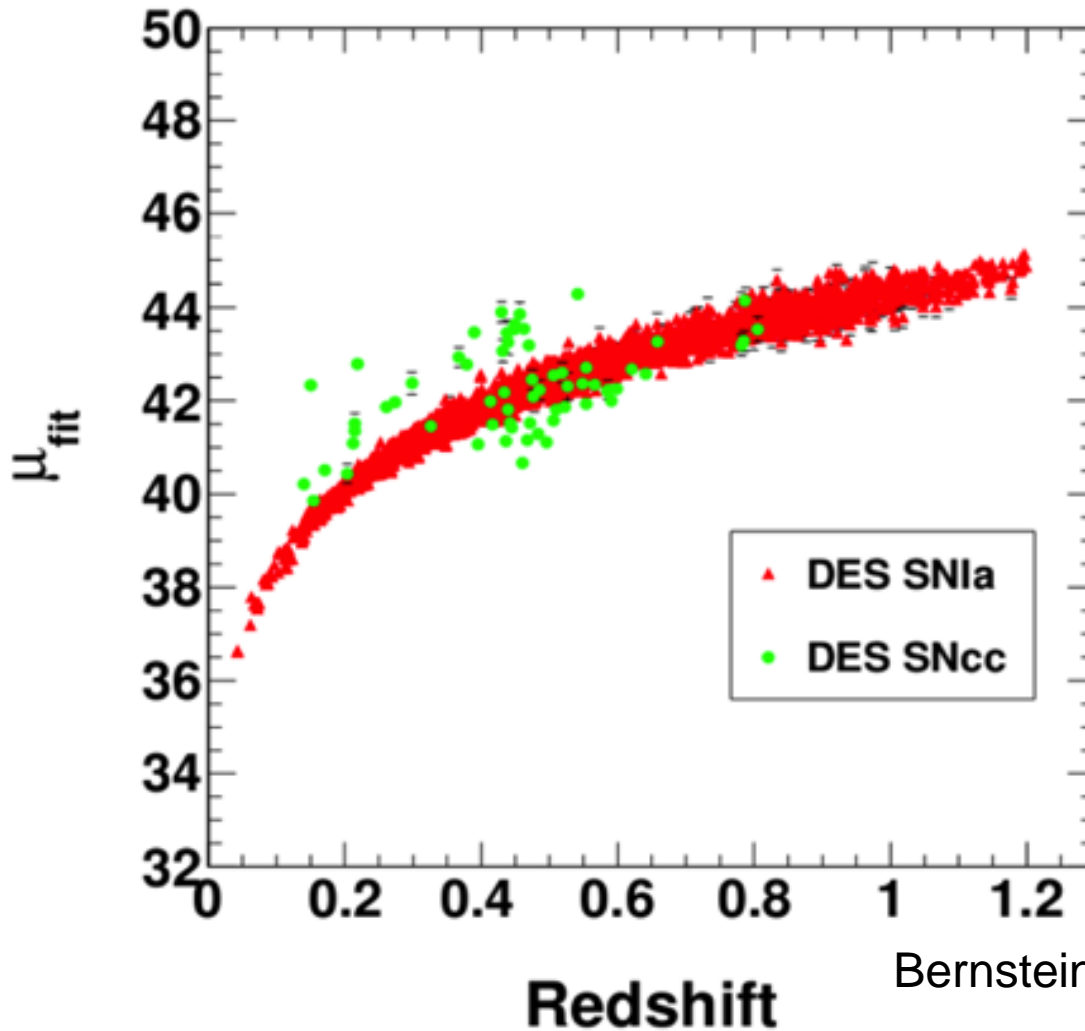


Fosalba & Gaztanaga



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DES: Type Ia Supernovae Light-curves

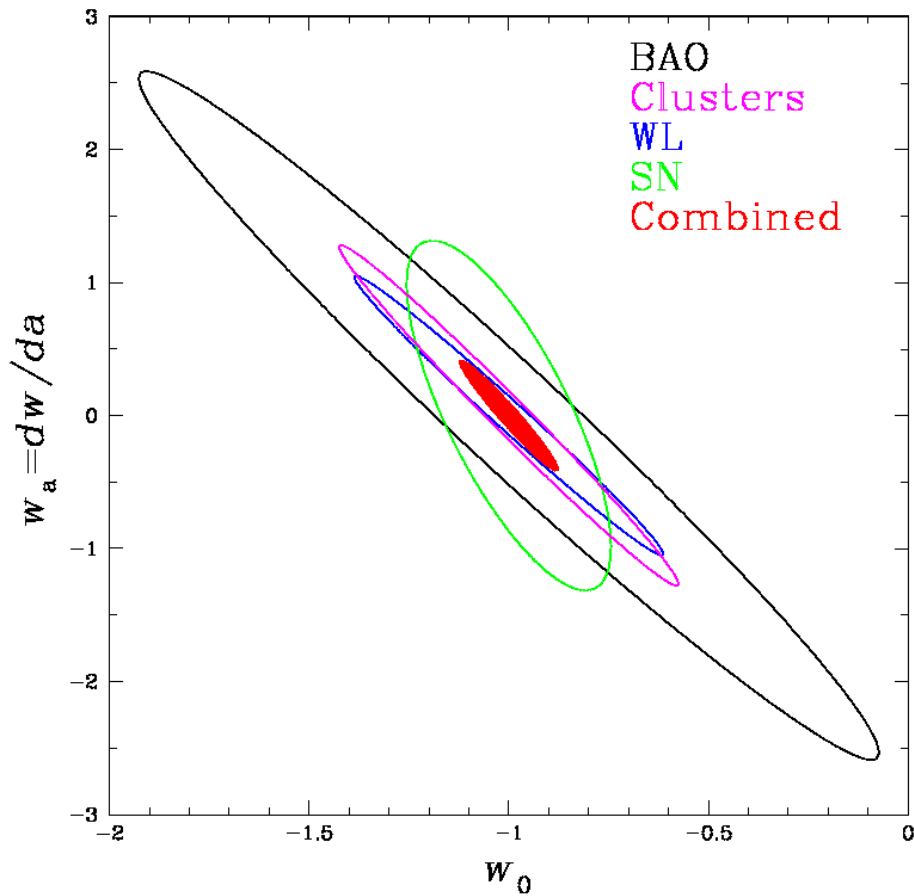


Bernstein, et al



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DES: Cosmological Goals Combined Probes

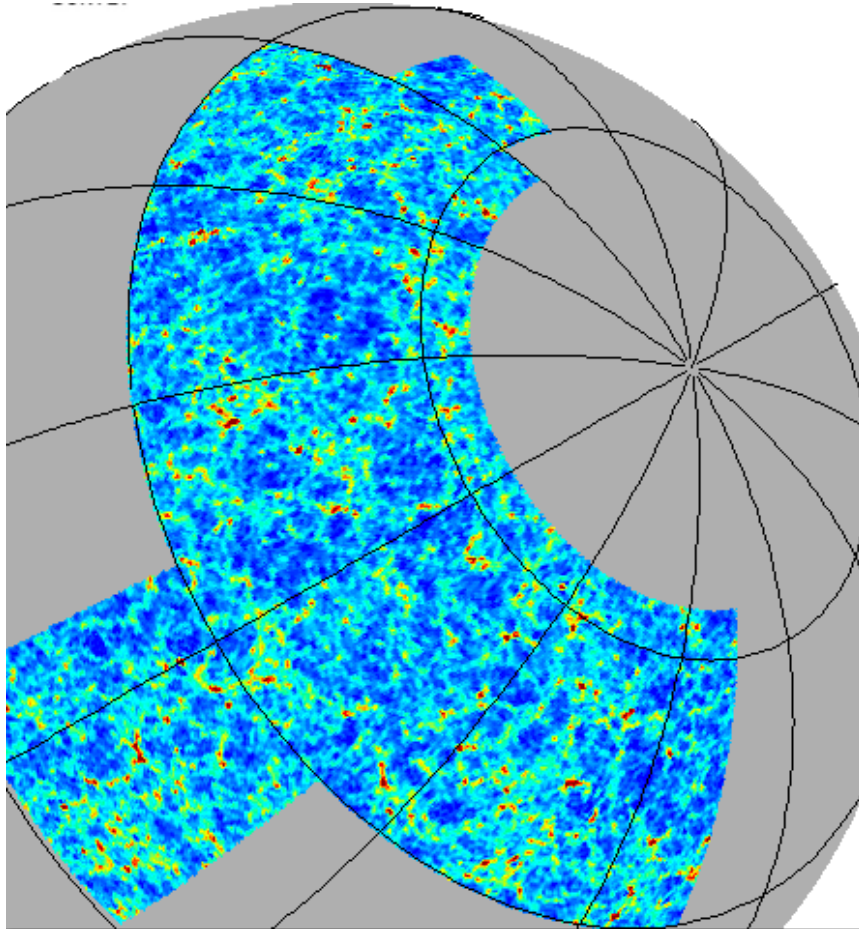




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DES: Affiliated Surveys

South Pole Telescope Survey(s)



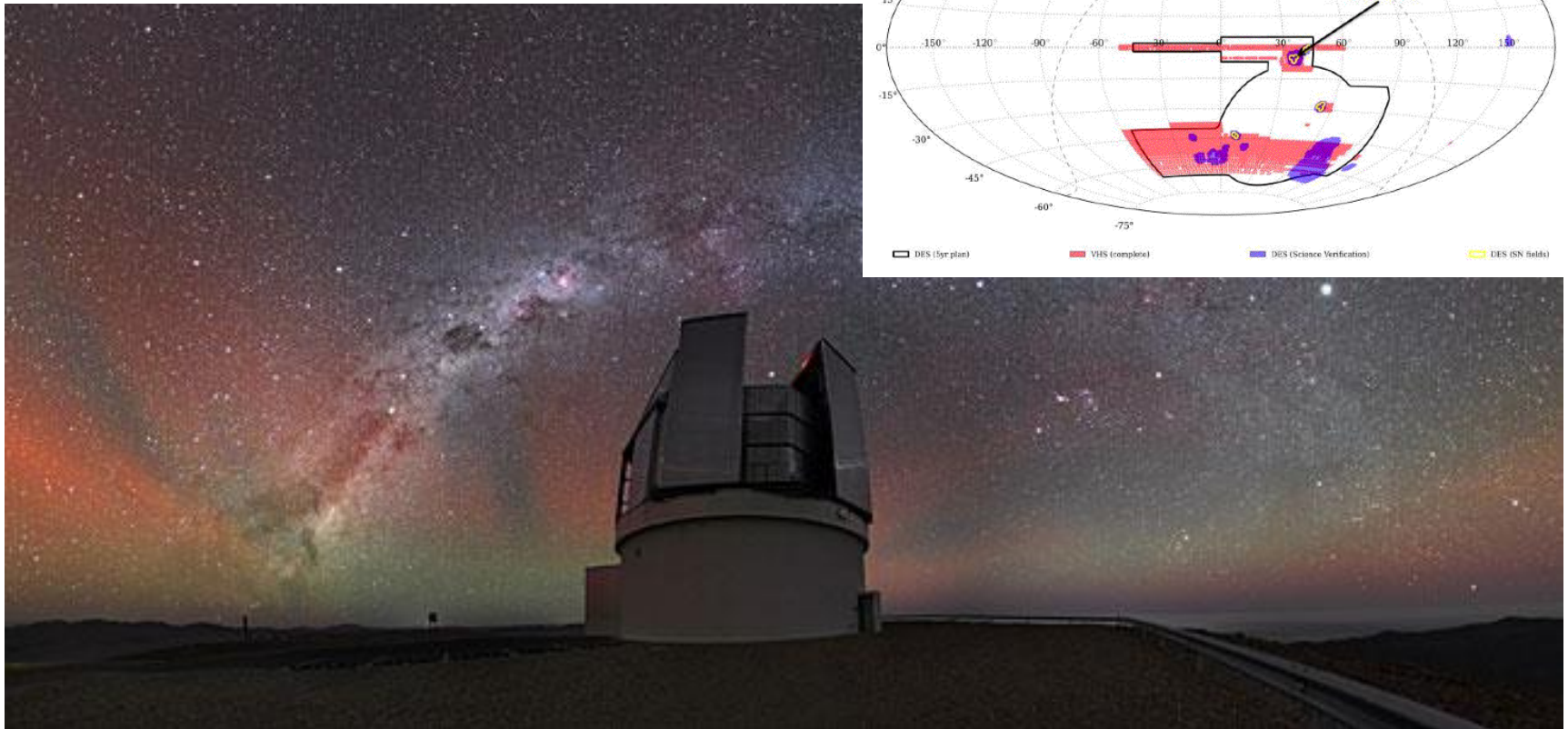
DES survey area encompasses SPT Sunyaev-Zel'dovich Cluster Survey 11



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DES: Affiliated Surveys

VISTA Hemisphere Survey





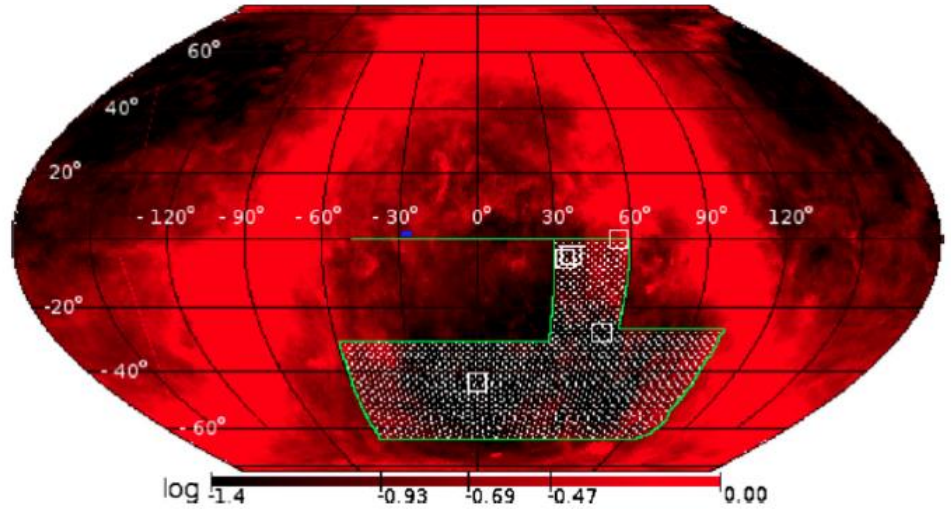
DARK ENERGY

DES: Affiliated Surveys

OZDES



zDES

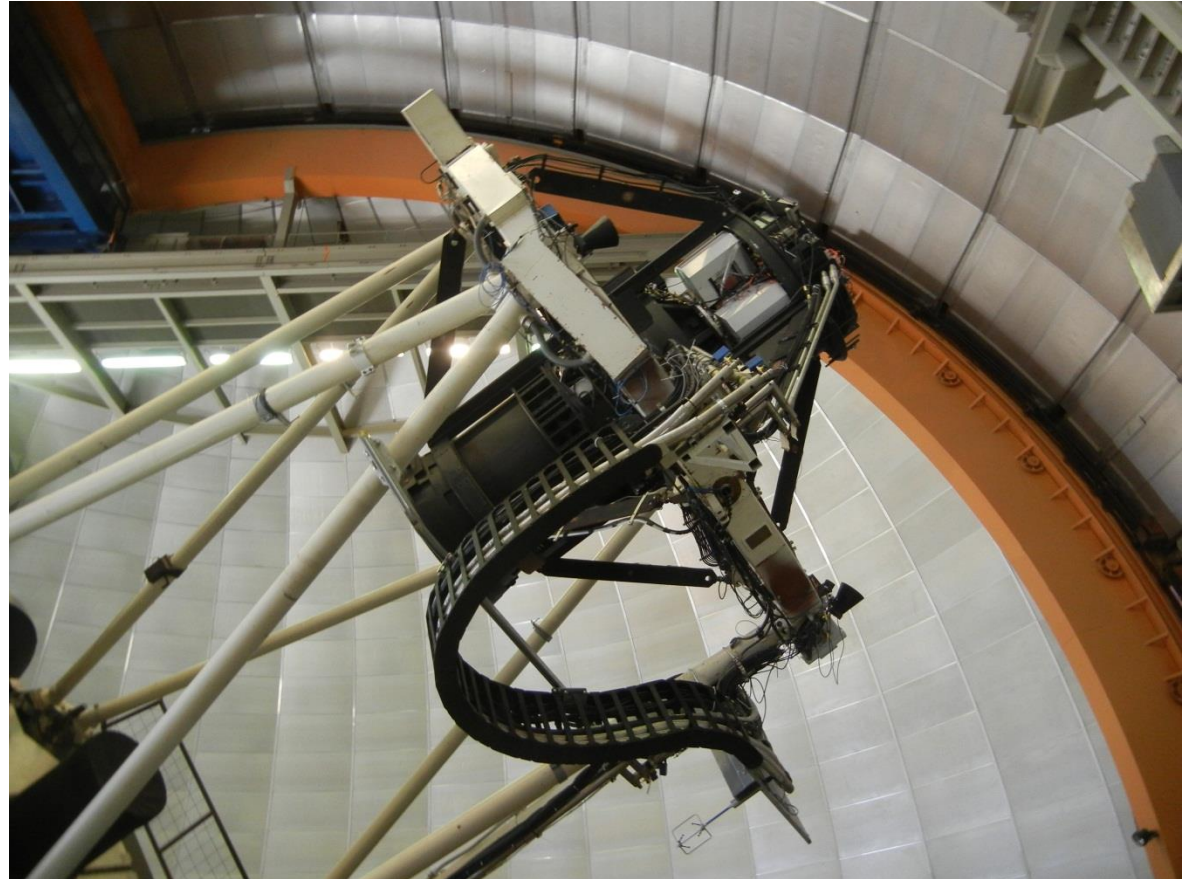




DES Timeline and DECam

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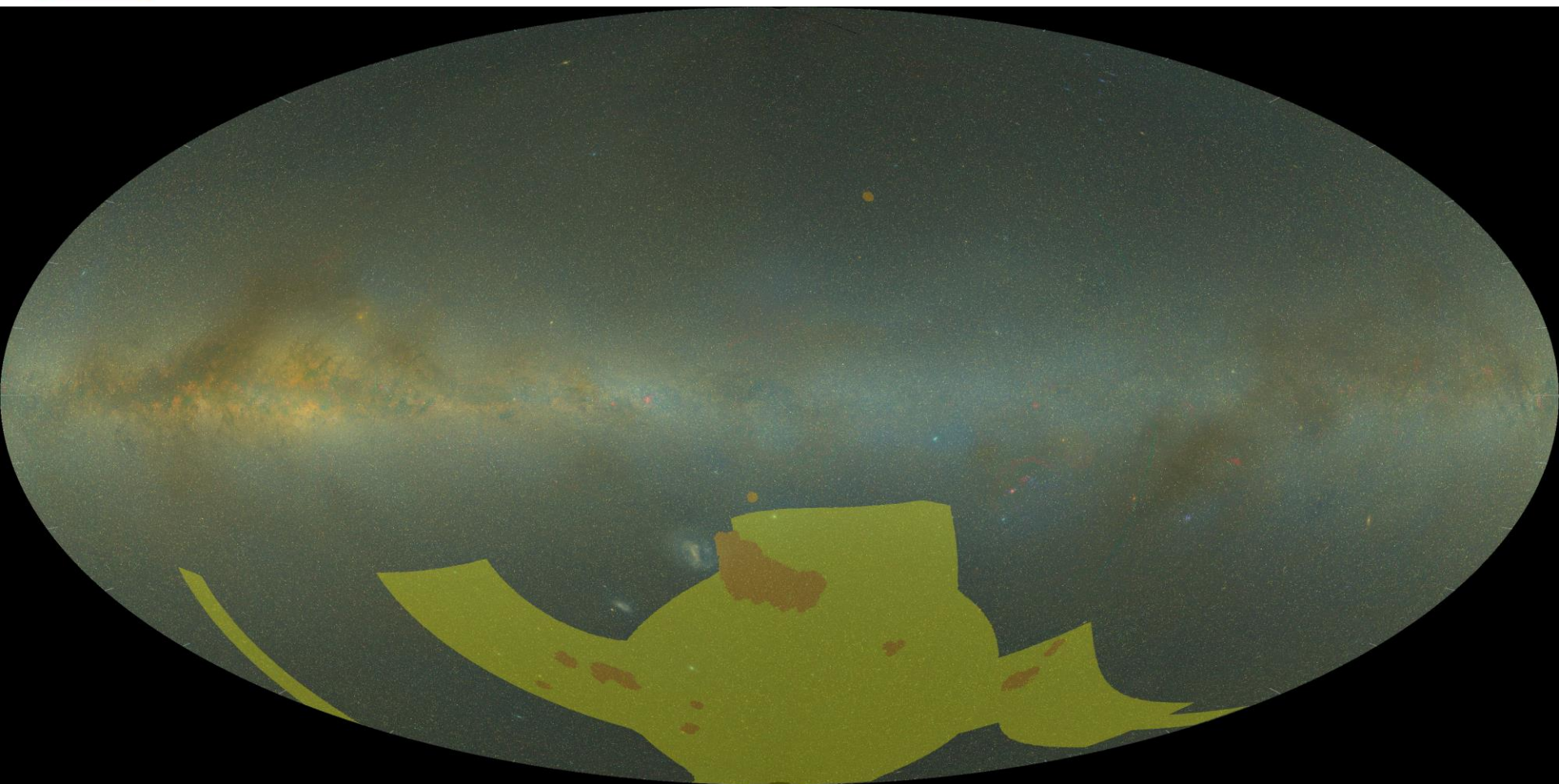
- 2003 – 2007 planning
- 2008-2011 construction & testing
- 2011-2012 Installation at CTIO
- Sept. 2012 “1st Light”
- Oct. 2012 – Feb. 2013 commissioning and “Science Verification”
- August 2013 – Feb. 2014 “Year 1”
- Sept 2014 “Year 2” begins
- Sept 2015 “Year 3” begins



The Dark Energy Camera on the
Blanco Telescope



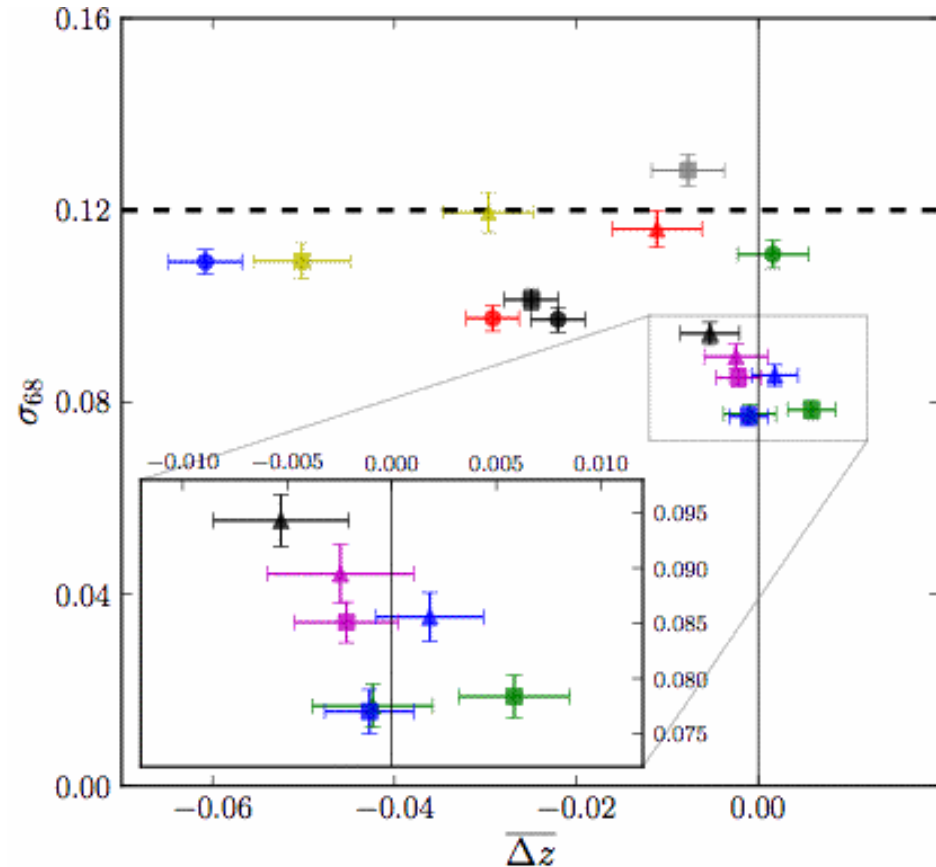
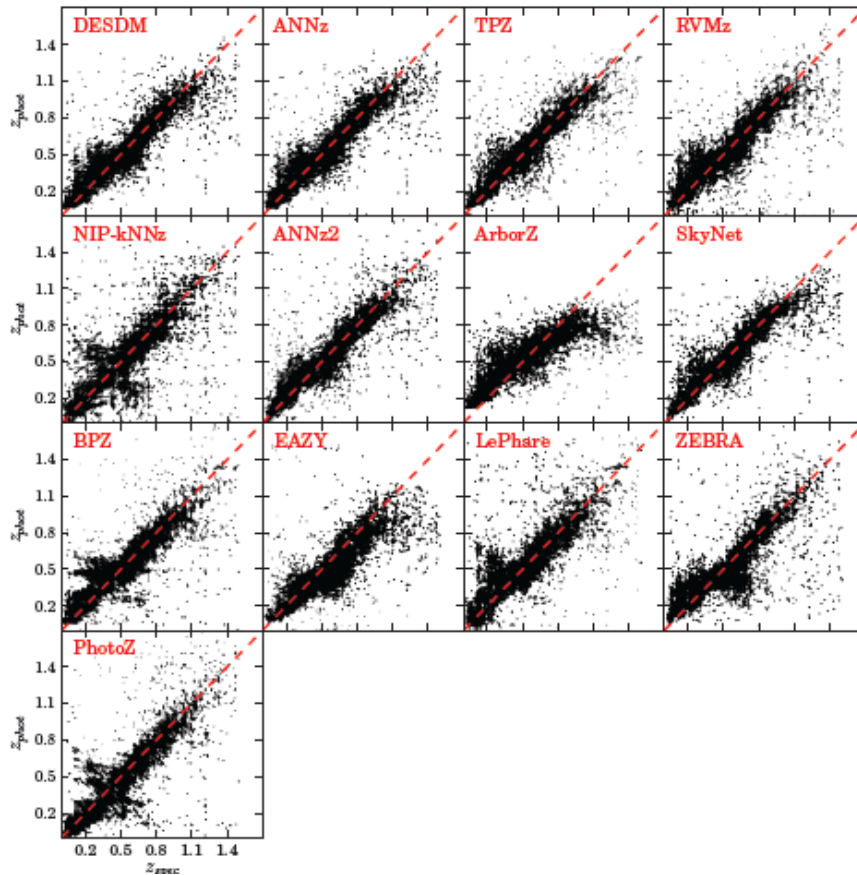
Dark Energy Survey: Early Science





DES Early Results: Photometric Redshifts: Sanchez et al. 1406.4407

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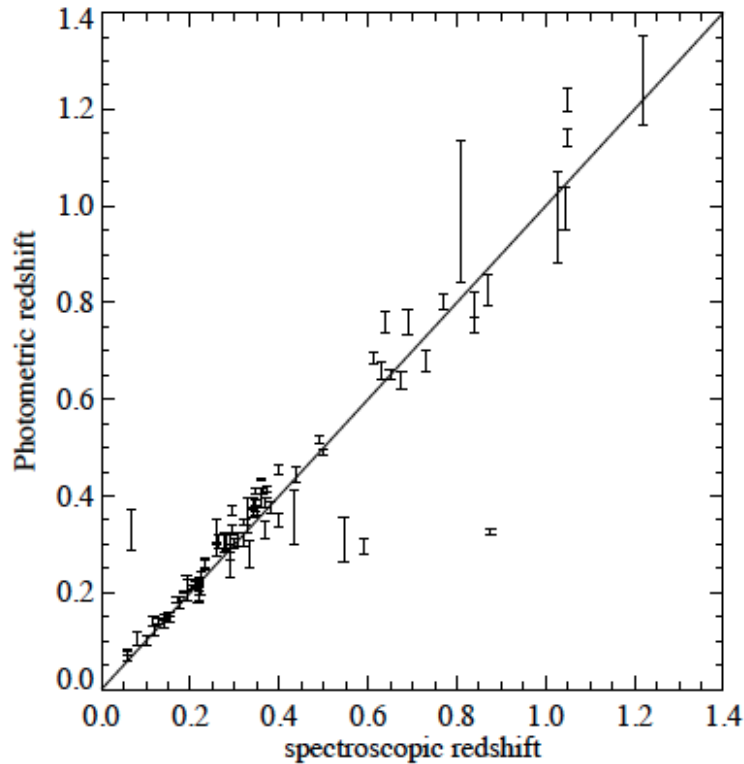




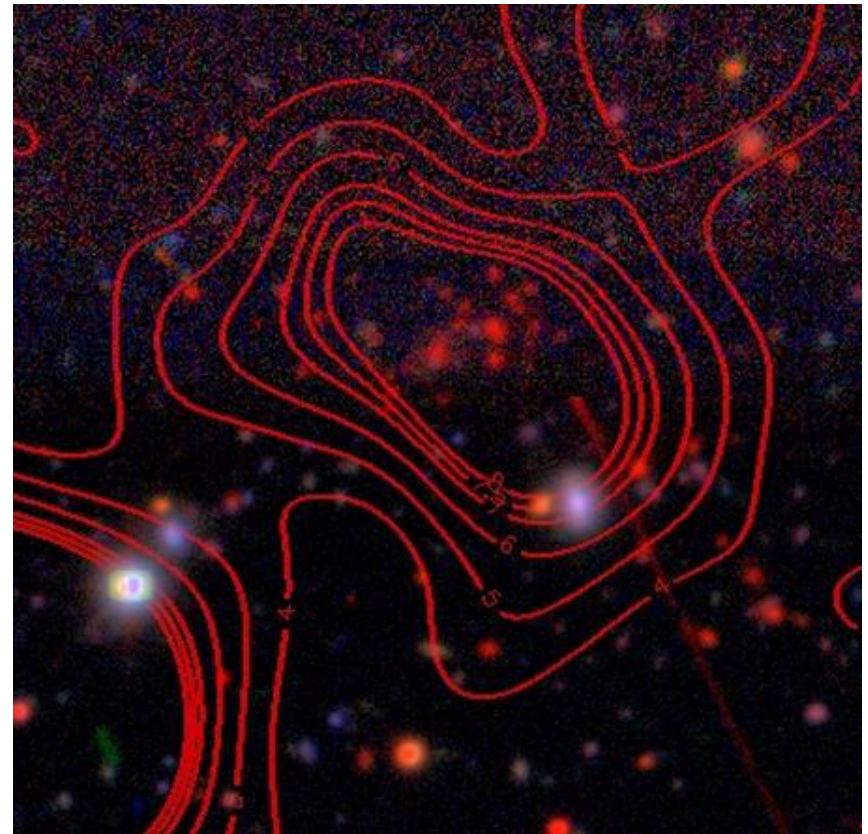
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DES Early Results: Galaxy Clusters: Preliminary

**Red-sequence photo-z's are
unbiased with ~1-2% scatter**



**Sensitivity: $z=1.26$ X-ray cluster
is easy to see in DES-SV data**

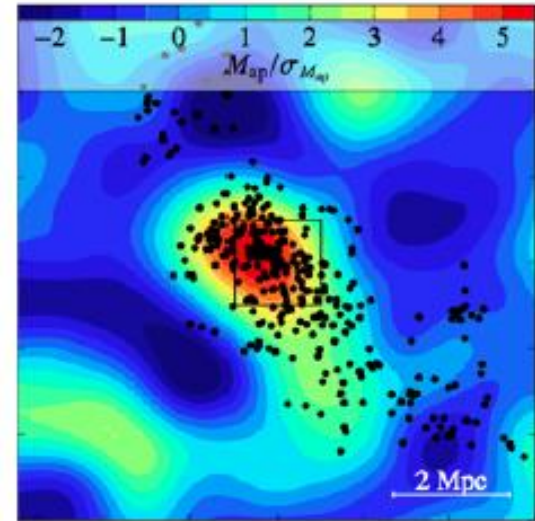
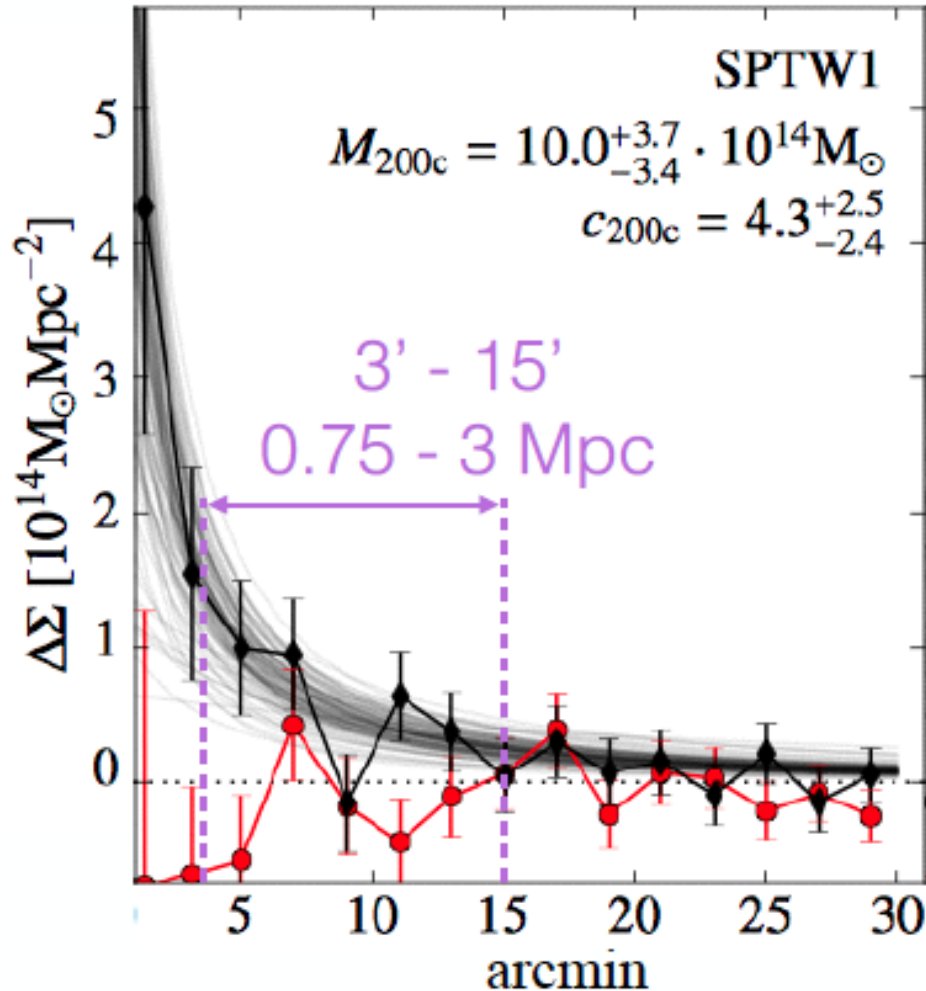


Miller et al., under DES review



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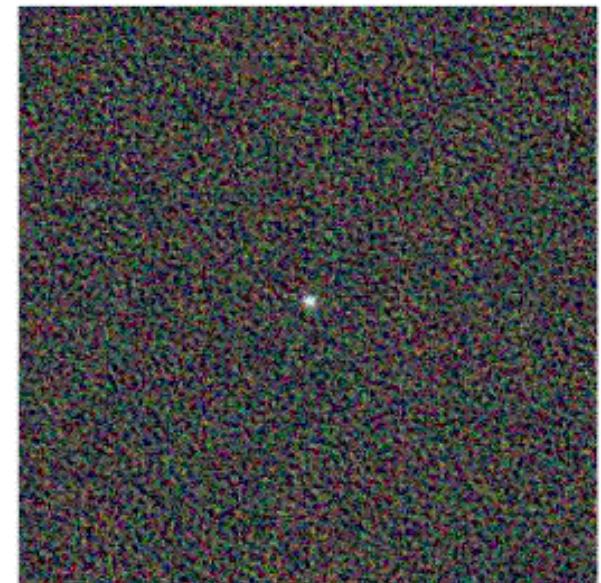
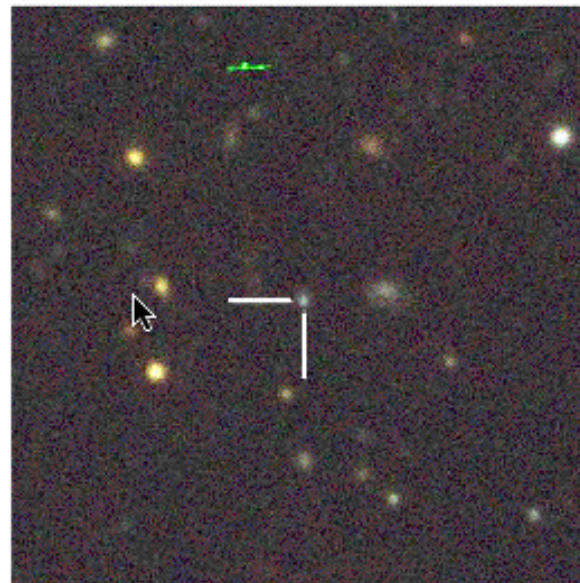
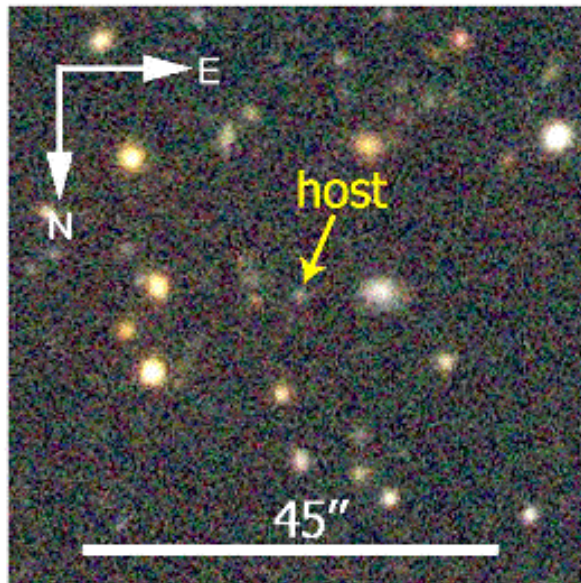
DES Early Results: Cluster Weak Lensing: Melchior et al. 1405.4285



Cluster name	M_{200c}
RXC J2248.7-4431	$17.6^{+4.5}_{-4.0}$
1E 0657-56	$14.2^{+10.0}_{-6.1}$
SCSO J233227-535827	$10.0^{+3.7}_{-3.4}$
Abell 3261	$8.6^{+8.6}_{-3.9}$

DES Early Results:

Super-luminous Supernova: Papadopoulos et al 1501.07232

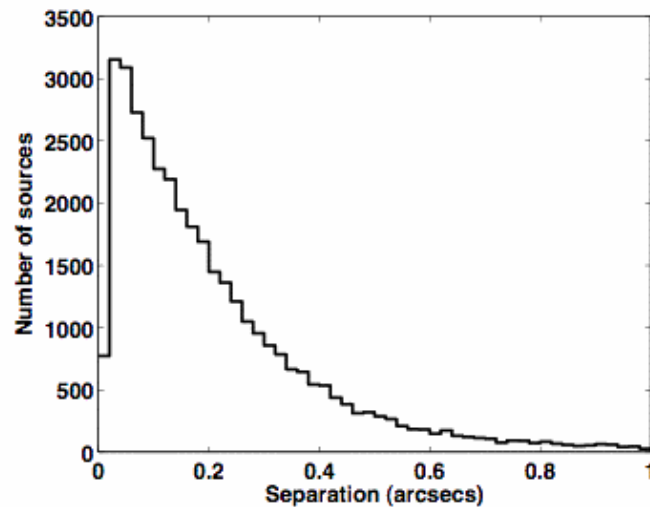
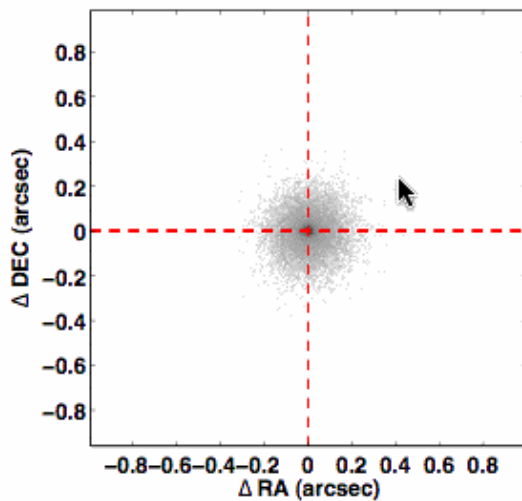
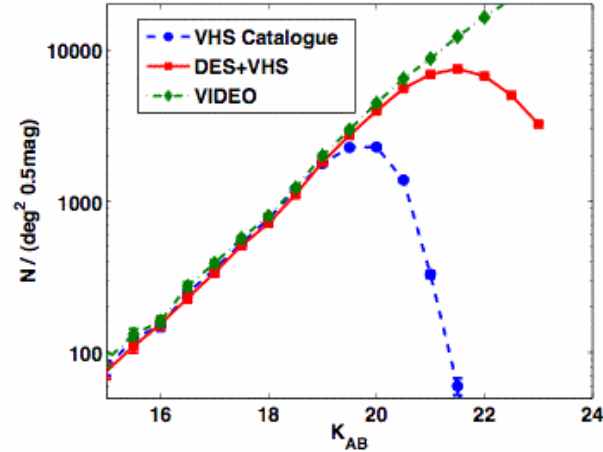
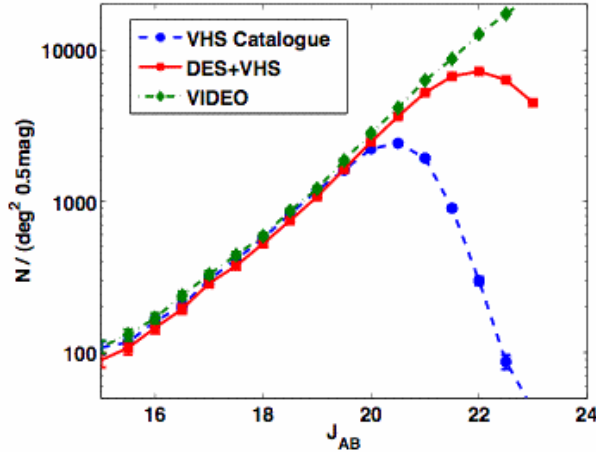


Radioactive decay of ^{56}Ni ? Or Magnetar?



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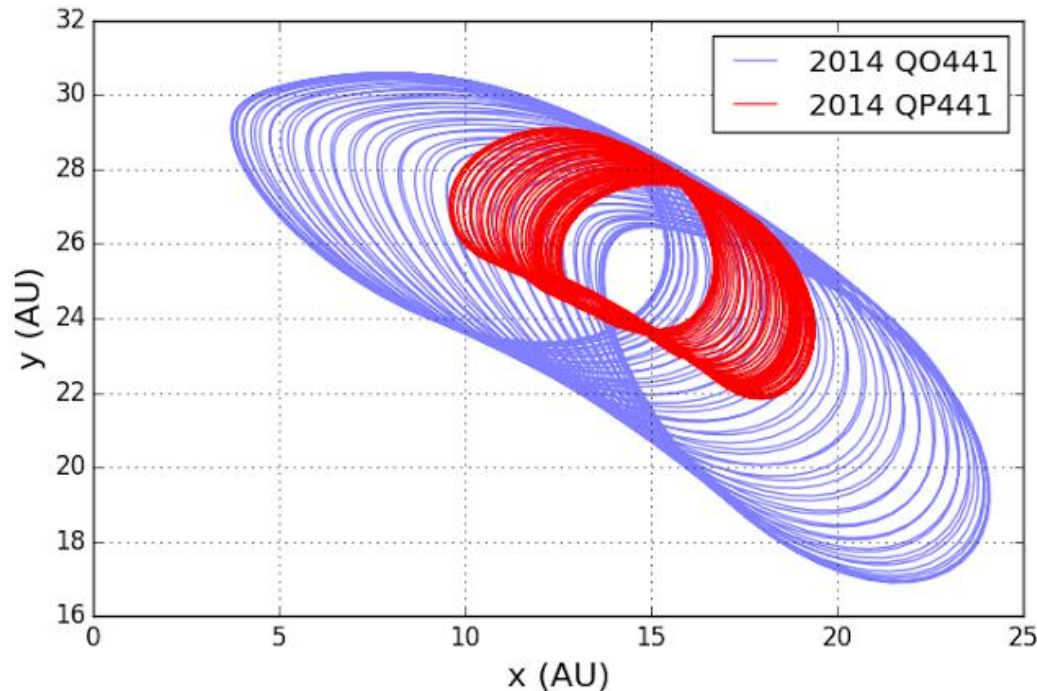
DES Early Results: Synergy with VHS: Banerji et al 1407.3801





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DES Early Results: Trans Neptunian Objects: Gerdes et al. in prep

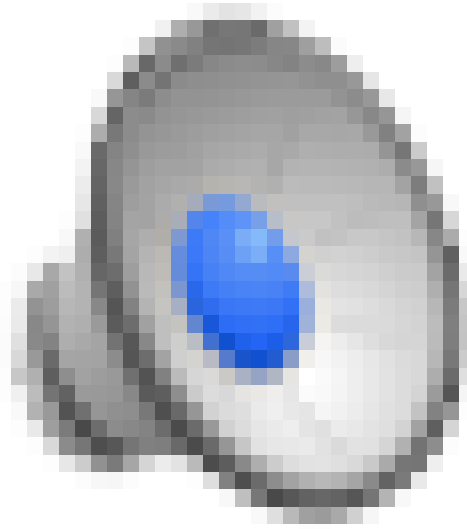


TNOs live in the Lagrange points at Neptune
First discovered in 2001. Could be 10x greater in
number than Jupiter Trojans
Might help explain Solar System formation



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SURVEY

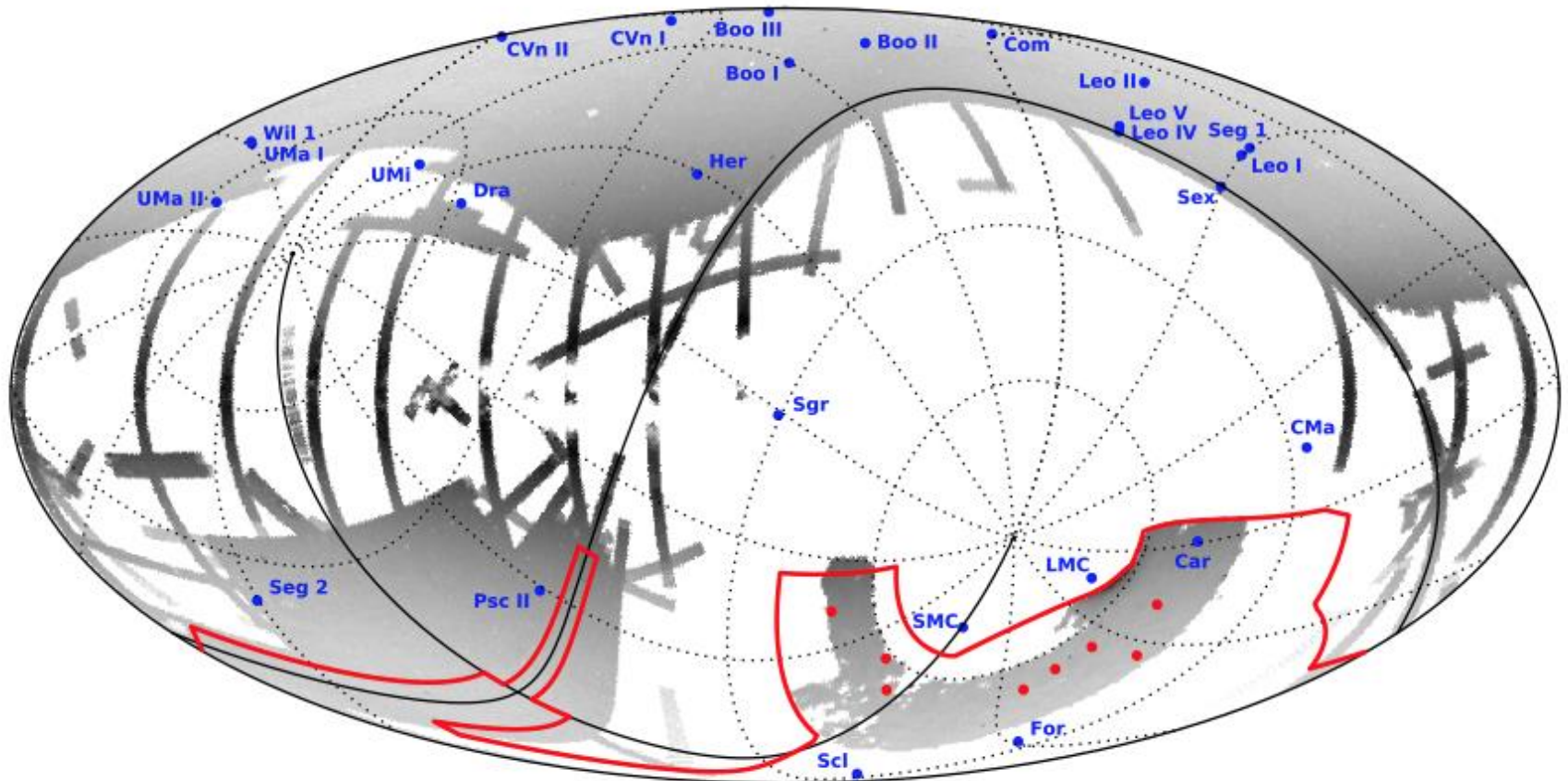
DES Early Results: Trans Neptunian Objects





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DES Early Results: 9 New Milky Way Dwarfs: Bechtol et al. 1503.02584



- DES has just started!
- Science analysis of DES Science Verification data and Y1 data underway
 - first results are coming out NOW
- Raw DES data available after 12 months via NOAO
 - Planned public releases of processed/coadd data/catalogs from 1st 2 seasons and from full survey

