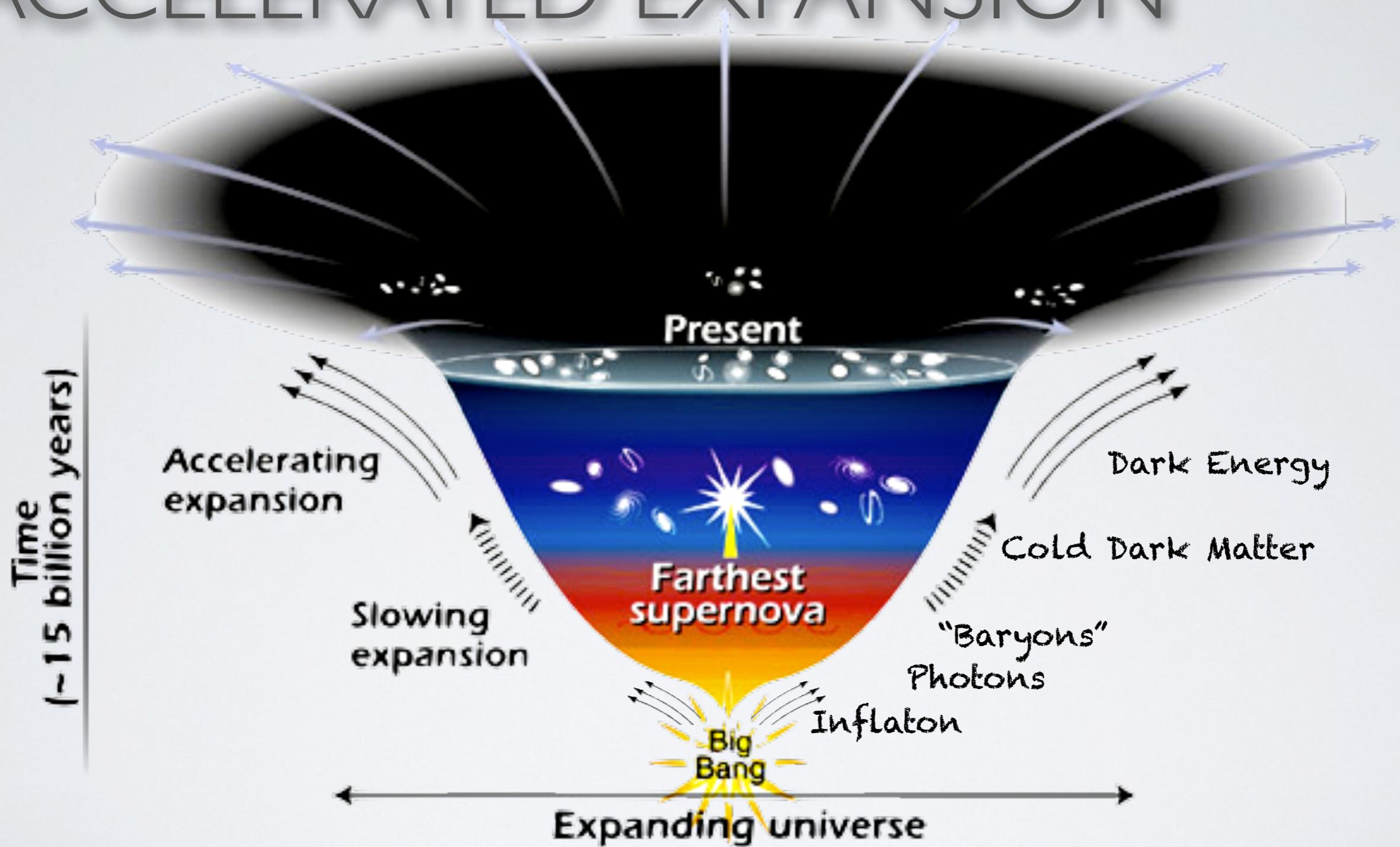


DARK ENERGY SURVEY GALAXY CLUSTERS

Marcelle Soares-Santos
Fermilab
DES Collaboration

ICHEP 2016, Chicago — August 05, 2016

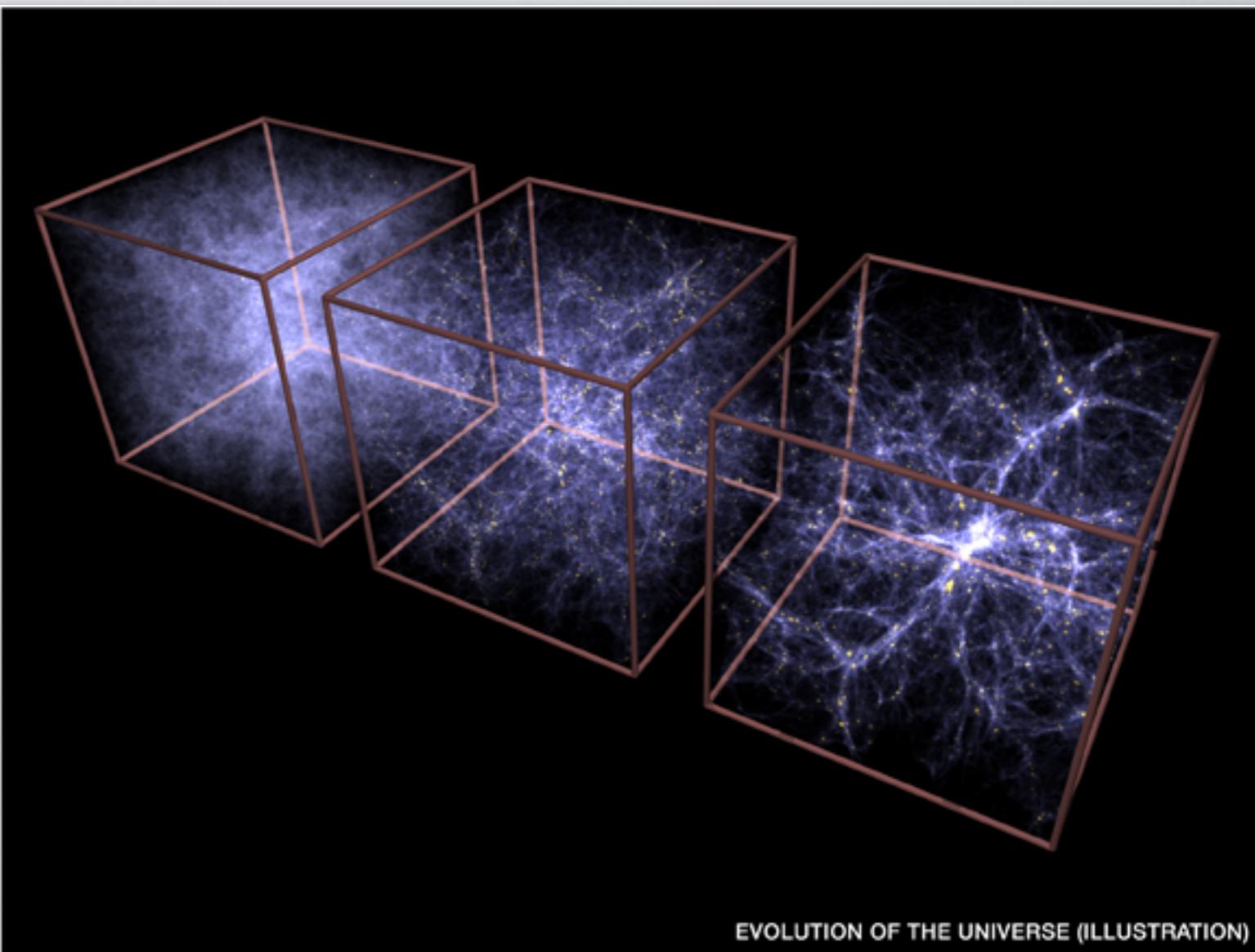
DARK ENERGY & ACCELERATED EXPANSION



GROWTH OF STRUCTURE



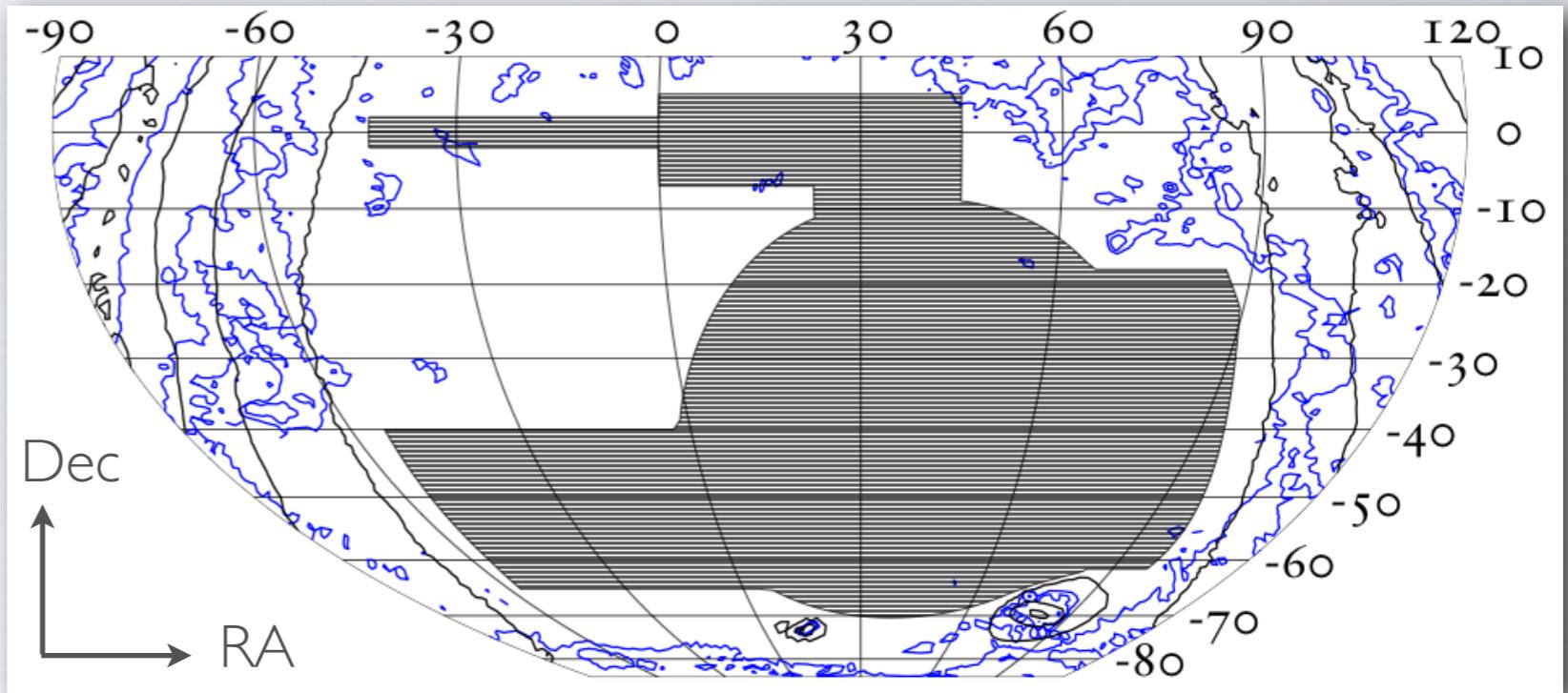
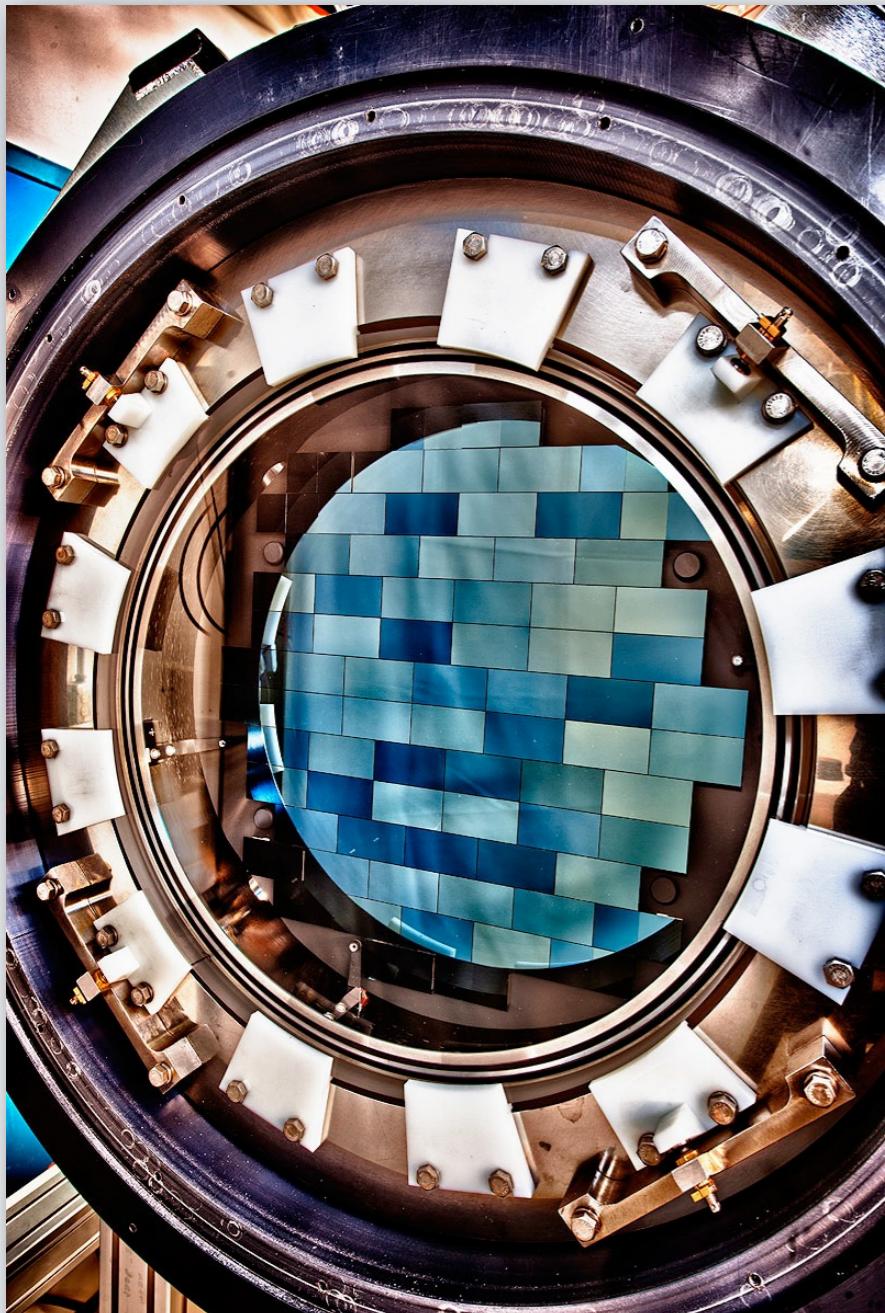
X-RAY/OPTICAL



EVOLUTION OF THE UNIVERSE (ILLUSTRATION)

The **growth** of the largest structures in the universe,
clusters of galaxies, is inhibited by **dark energy**.

DARK ENERGY SURVEY



DEcam

3 sq deg FOV, 570 Mpix
optical CCD camera

Facility instrument at
CTIO Blanco 4-m
telescope in Chile

First light: Sep 2012

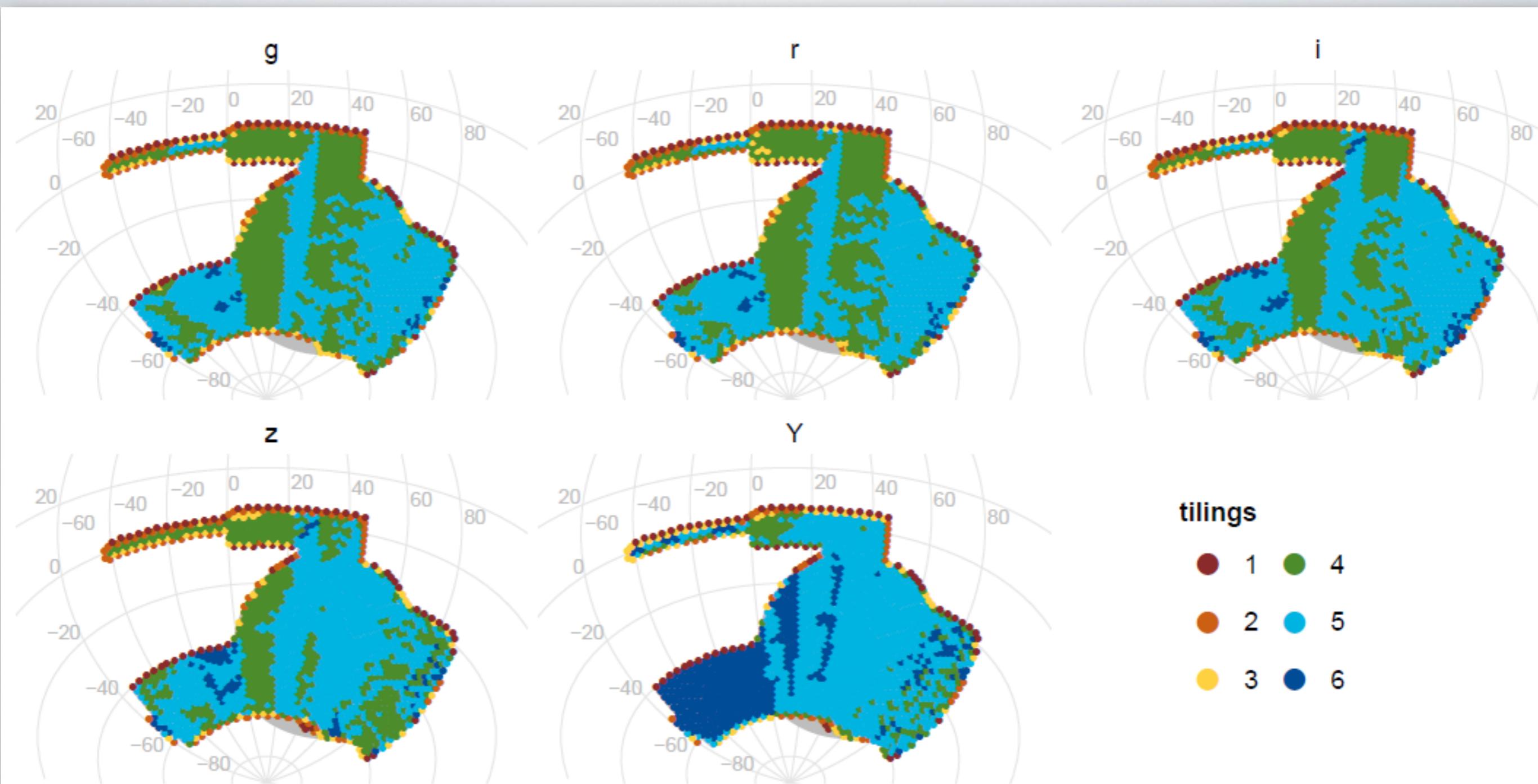
Survey

5000 sq deg grizY to 24th mag
overlapping with SPT and VISTA

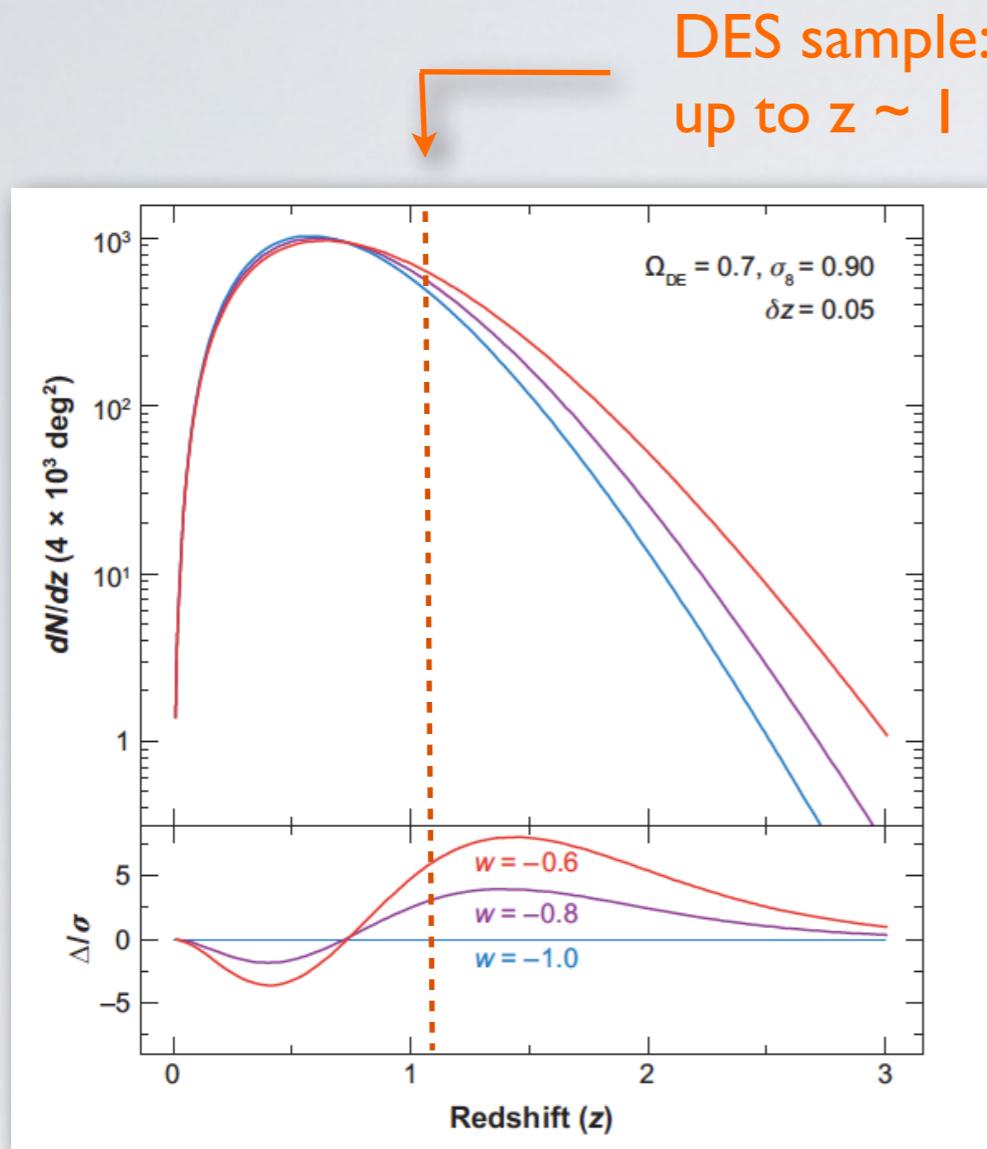
30 sq deg SNe survey
0.9 arcseconds seeing

525 nights: 2013-2018

DES — STATUS AS OF 10 FEB 2016



CLUSTERS AS DE PROBES



Number of clusters above $10^{14.5}$ solar masses as a function of z , for a 4000 sq-deg survey in 3 different cosmologies.

The number of clusters as a function of **mass** and **redshift** is a **dark energy** probe.

Reliable **detection** of clusters, and accurate mass **calibration** are required.

Systematics can be controlled by understanding the **astrophysics** of clusters.

DES RESULTS: CLUSTERS

Mass and galaxy distributions of four massive clusters from DES Science Verification data

Melchior et al. 2015, MNRAS, 429, 2219

Constraints on the richness–mass relation and the optical-SZE positional offset distribution for SZE-selected clusters

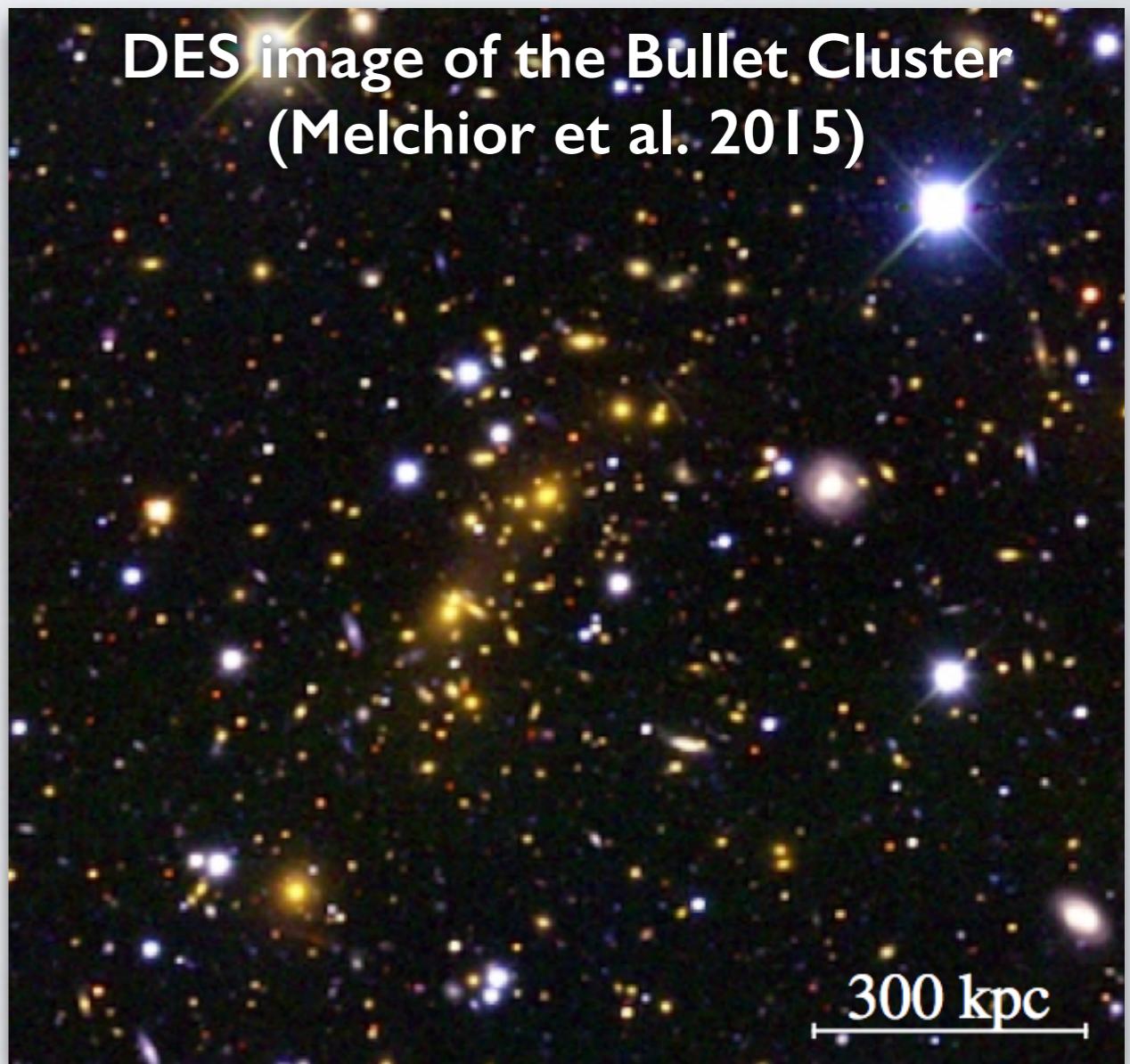
Saro et al. 2015, MNRAS, 454, 2305

Optical-SZE Scaling Relations for DES Optically Selected Clusters within the SPT-SZ Survey

Saro et al. 2016, arXiv:1605.08770

The RedMaPPer Galaxy Cluster Catalog From DES Science Verification Data

Rykoff et al. 2016, ApJS, 224, I



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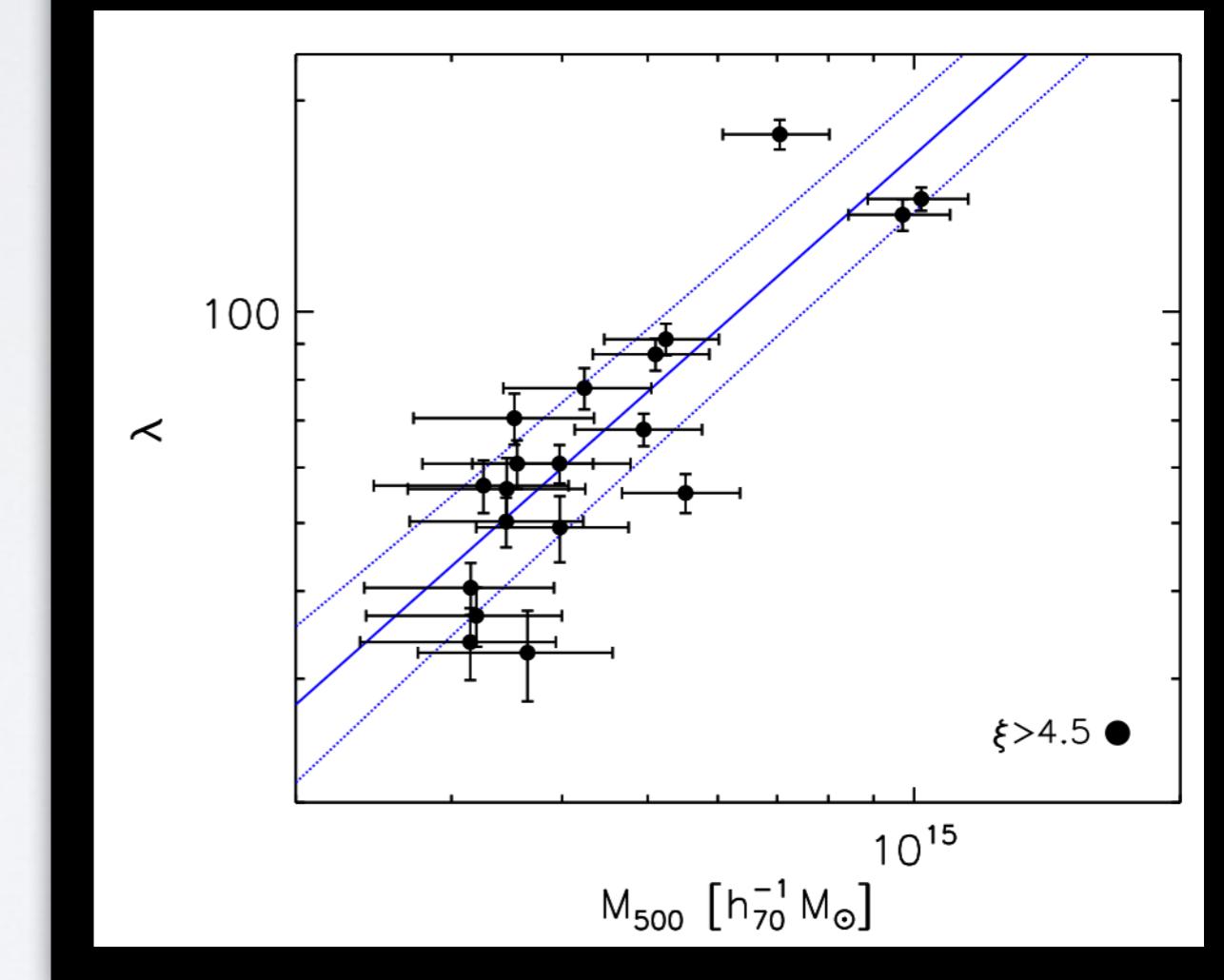
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DES mass calibration of SZ-selected clusters
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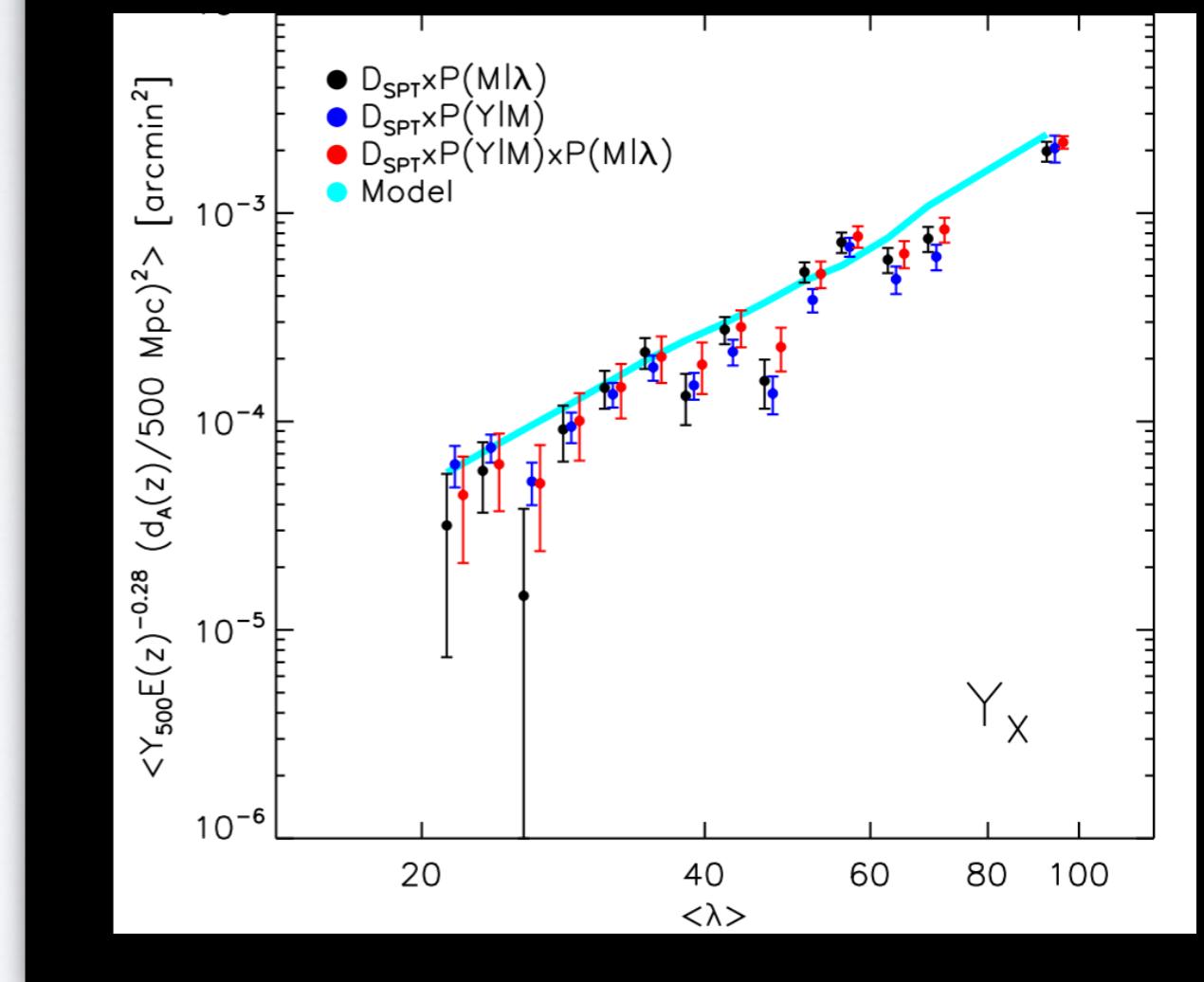
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DES mass calibration of
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DES RESULTS: CLUSTERS

Galaxy Populations in Massive Galaxy Clusters
to $z = 1.1$

Henning et al. 2016, arXiv:1604.00988

The Evolution of Active Galactic Nuclei in
Clusters of Galaxies from
the Dark Energy Survey

Bufanda et al. 2015, MNRAS, 454, 2305

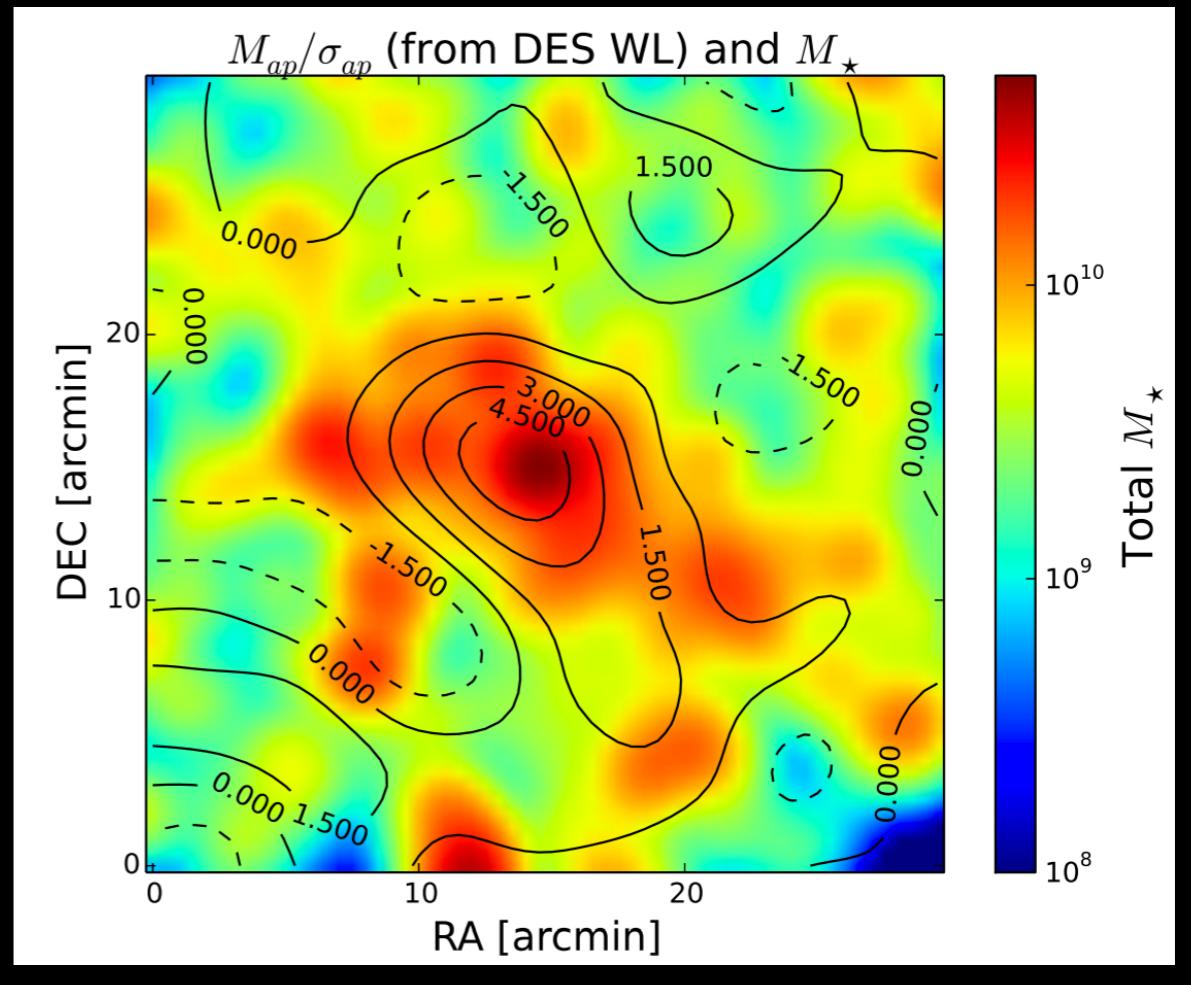
Comparing DES and HST–CLASH
observations of the galaxy cluster
RXC J2248.7–4431

Palmese et al. 2016, arXiv:1601.00589

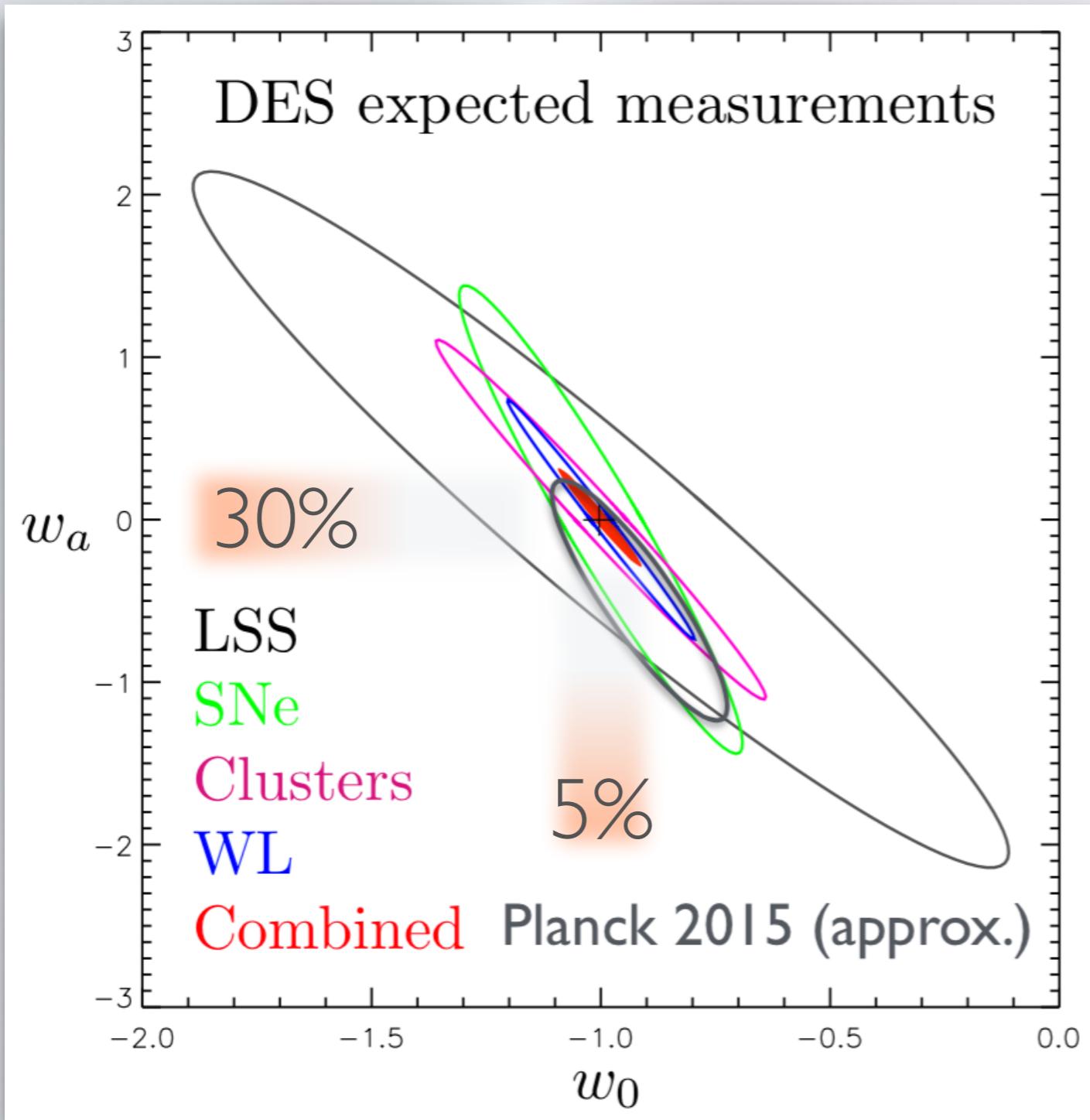
Galaxies in X-ray Selected Clusters and
Groups in DES Data I: Stellar Mass Growth of
Bright Central Galaxies Since $z \sim 1.2$

Zhang et al. 2015, ApJ, 816, 98

DES stellar mass map and dark
matter mass distribution for
RXC J2248.7–4431
(Palmese et al. 2016)



DES PROJECTIONS



5000 deg², 0.9" seeing,
24th mag (redshift~1.4)

300M galaxies, shapes,
100K clusters, 4K SNe

4 combined probes

3-5x improved Dark
Energy measurement

These are exciting times for **Dark Energy** science,
and more, with DES. Stay tuned for more results soon!



The DES site at Cerro Tololo Inter-American Observatory, Chile