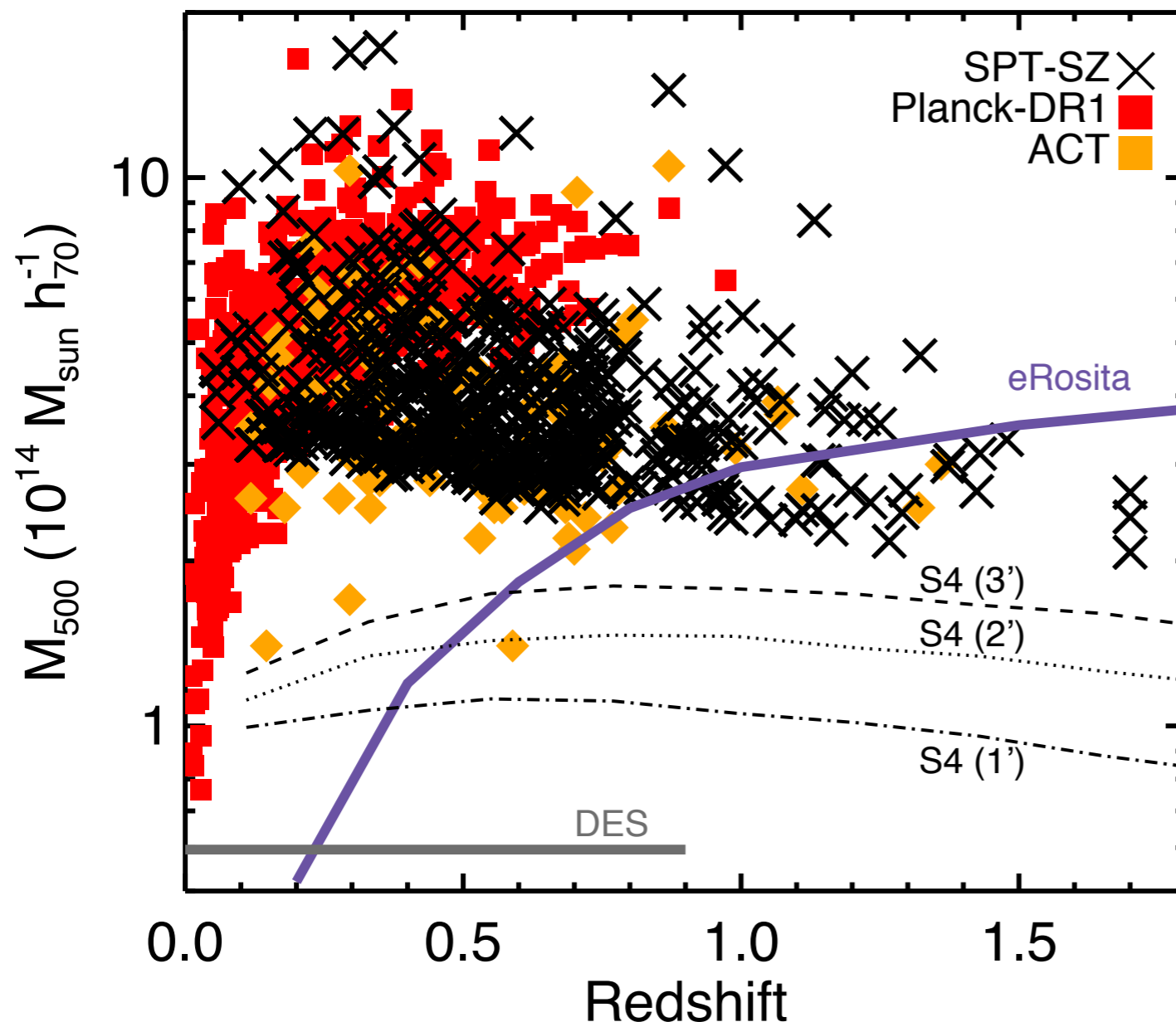


# Cross-Correlation Science from SPTxLSST

LSST x CMB-S4	CMB Lensing Convergence ( $\kappa$ ) Map	SZ Thermal	CMB Polarization	Small-scale CMB Lensing
<b>Galaxy Map</b>	Measure galaxy bias; the relationship between galaxy stellar and halo mass	<b>Joint cosmology from SZ+Optical Cluster Survey</b>	Gravitational potential from LSST galaxies convolved with E-modes to estimate their B-mode contribution	<b>CMB cluster lensing of LSST galaxies</b>
<b>Shear Map</b>	Constrain systematics in galaxy shape measurements (e.g., linear and magnification bias)	<b>Probes baryonic pressure as a function of distance from halos</b>	Gravitational potential from LSST shear convolved with E-modes to estimate their B-mode contribution	Measure CMB lensing around LSST shear peaks, tomographic measurement of large-scale structure
<b>Tangential Shear</b> [galaxy-galaxy or cluster lensing]	Measure tangential shear of LSST galaxies around SZ-selected lensing peaks	<b>SZ cluster survey cosmological constraints using LSST WL mass calibration</b>		

# CMB-S4 Cluster Survey



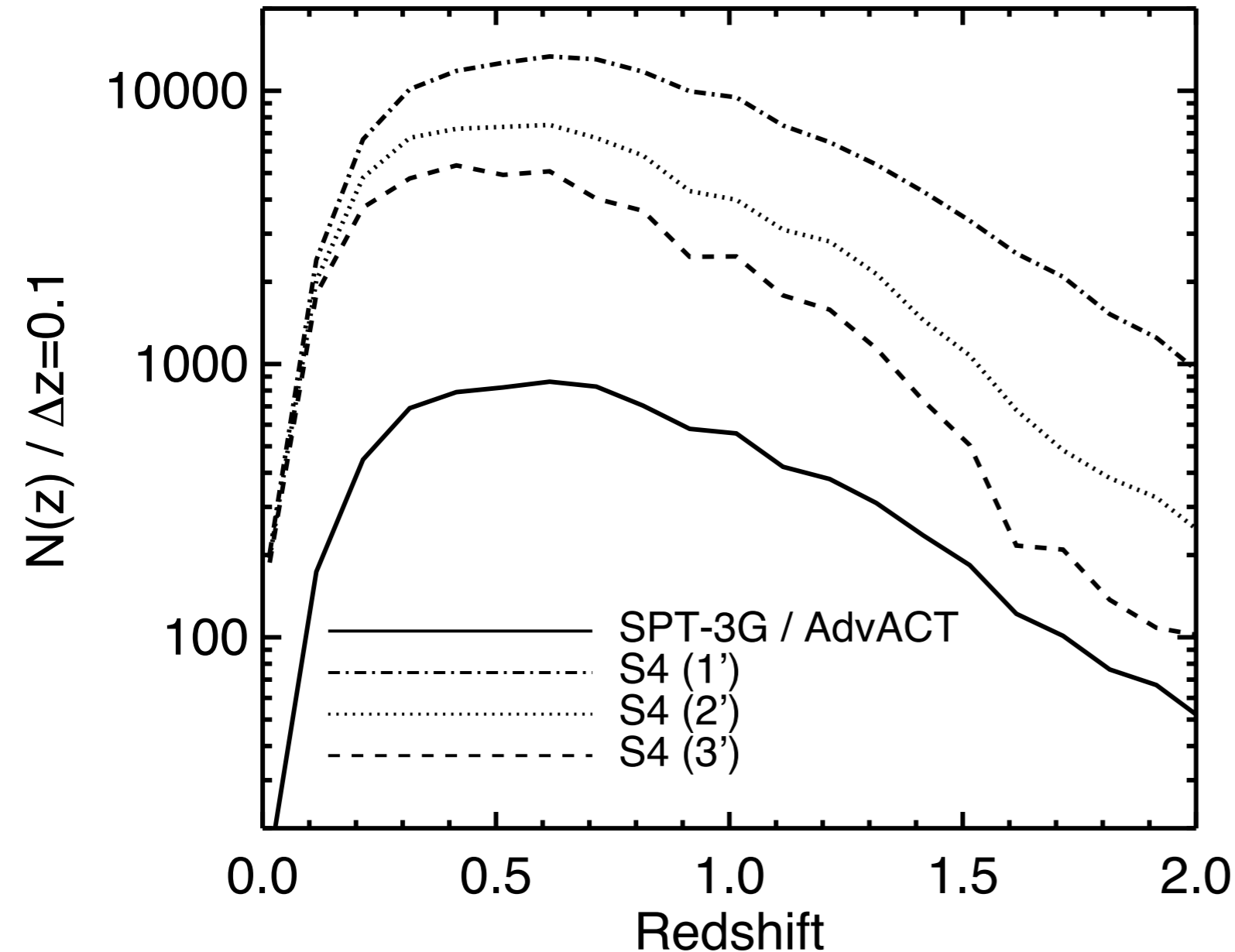
## General Parameters of Cluster Survey:

- Estimated 50% mass-completeness of S4 survey
- Assumed  $f_{\text{sky}}=0.5$  and 95, 150, 220 GHz bands at depths of 2, 1, 2  $\mu\text{K-arcmin}$ , respectively
- Used old Shaw+08 sims, re-scaled SZ amplitude to match SPT-SZ cluster counts
- ***Mass limit for CMB-S4 survey will be ~2-3 times less than current SZ surveys***

## Action Items:

- Use new sims (e.g., Battaglia)
- Consider more variations on S4 survey parameters, bands, depths, etc.

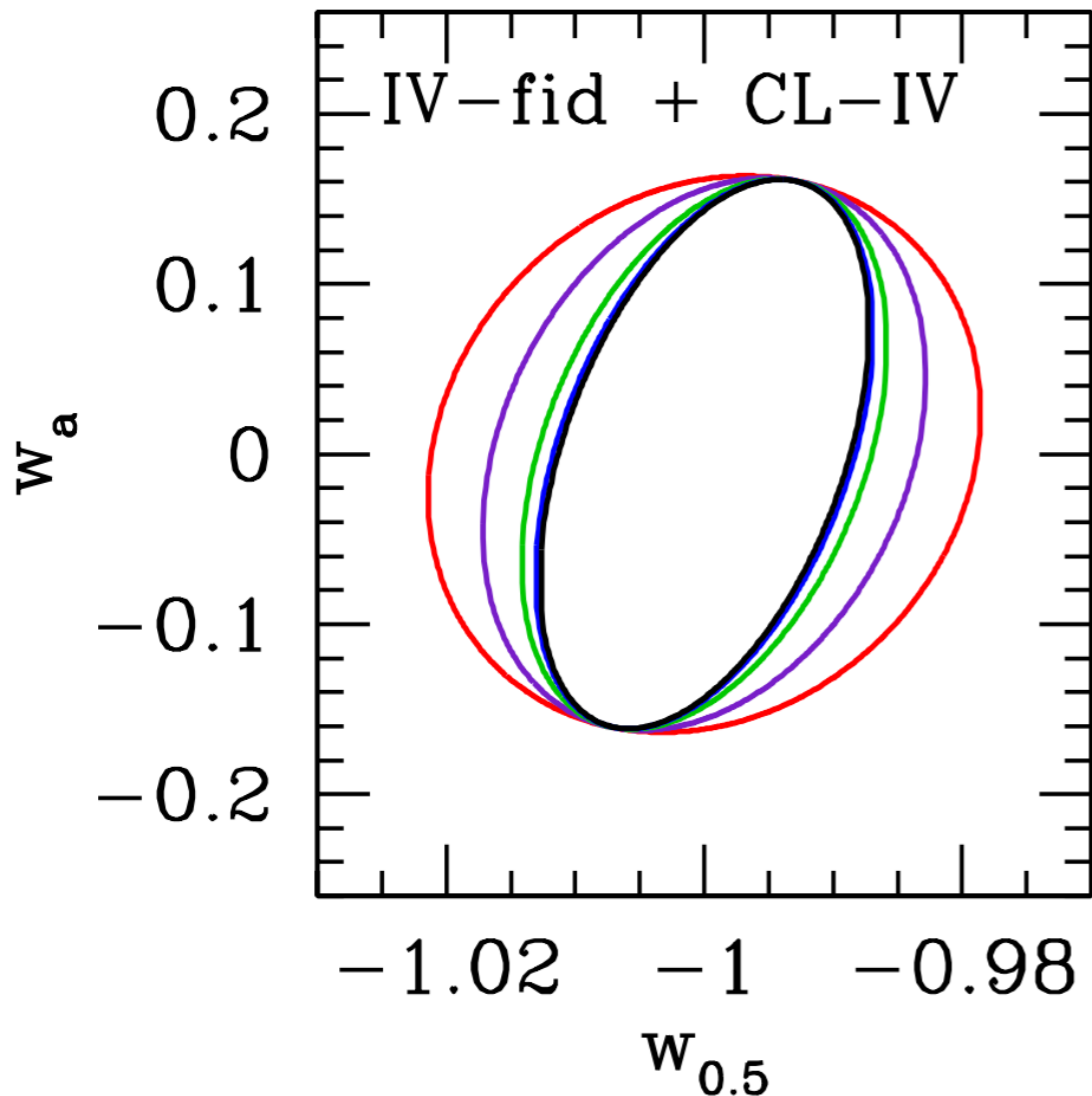
# CMB-S4 Cluster Survey



## General Parameters of Cluster Survey:

- CMB-S4 will find on order 140e3, 70e3, 45e3 clusters for a 1, 2, 3 arcmin beam, respectively
- From cluster abundance, expect a DETF FOM  $\sim 140, 70, 45$ , respectively.

# CMB-S4 Cluster DE Forecasts

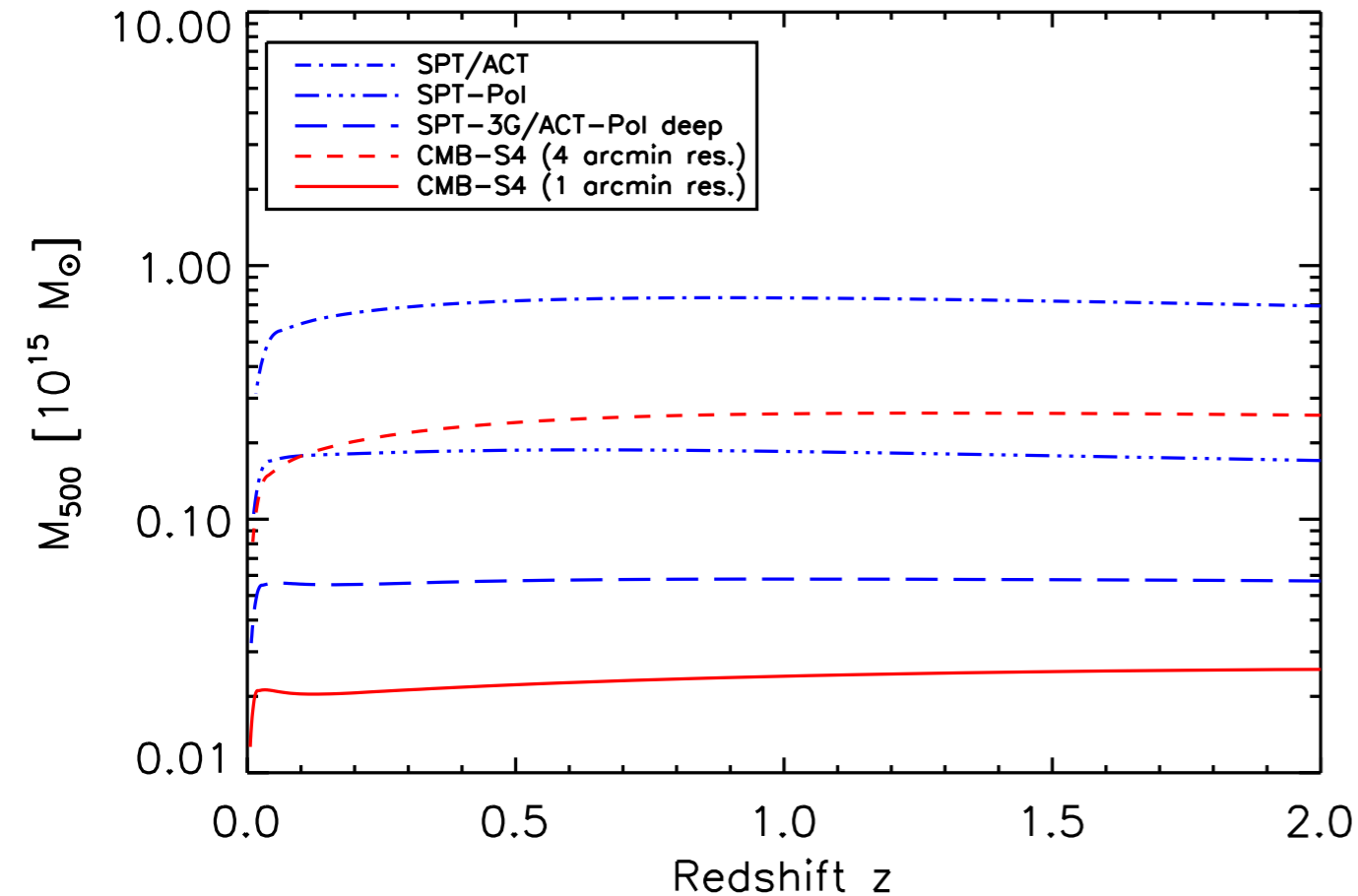


- Weinberg+(2013) found S4-cluster survey could improve DE FOM by factor of  $\sim 2$ , over baseline S4 constraints from BAO, SNe, WL, Planck

## Action Items:

- Need DE projections from cluster counts
  - DE improvement from adding CMB-S4 to other S4 surveys (i.e., DESI, LSST, etc.)
    - Some potential candidates to do this work identified, will talk to Eduardo Rozo this week as well
  - DE constraints from joint LSST+S4 cluster survey
  - ***Incorporate into larger CMB-S4 DE projection framework (not clear who is doing this)***

# CMB-S4 Cluster Ancillary Science



**Case and level of detail in science book is still TBD:**

- CMB cluster lensing
- Cluster astrophysics and evolution
  - Unique sample of  $\sim 10,000$  massive high- $z$  clusters
  - Formation and gas virialization in the “first” clusters
- Cluster profiles
  - Missing baryons
  - Astrophysical feedback history