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Cosmology from Clusters and Joint SPT-DES Analyses of Clusters in the SPT-SZ survey (12' + 3')

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Galaxy clusters—the largest gravitationally collapsed systems in the Universe—are powerful tools with which to constrain cosmological models as their abundance depends upon both the expansion history of the universe and the growth of density fluctuations. In this talk I will highlight cosmological results derived using clusters identified in the 2500-square-degree South Pole Telescope (SPT) SZ Survey. The SPT cluster sample consists of 516 galaxy clusters (>80% new discoveries) selected via the Sunyaev-Zel'dovich (SZ) effect. The sample has a median mass of $M_{500} \sim 3.5x10^{14} M_{sun}/h$, a median redshift of z=0.55, and a maximum spectroscopic redshift to date of 1.47. We have used the high-significance portion (377 clusters at $z > 0.25$, detection significance greater than 5)—in combination with dedicated Chandra X-ray follow up observations for 82 of these systems—to place constraints on base ΛCDM model parameters, the species-summed neutrino mass, the effective number of relativistic species, as well as the equation of state of dark energy. Further constraints from this sample are limited by uncertainties in the mass-SZ observable scaling relation and ongoing efforts to improve this calibration using weak lensing observations will be discussed.

Beyond this high-mass SZ-selected sample, there is a wealth of information that can be extracted from joint analyses of clusters using multi-wavelength data from SPT and the optical Dark Energy Survey (DES). I will highlight several of these efforts including a new $\sim 4\sigma$ measurement of the pairwise motion of DES-identified clusters using CMB survey data. While the first modest-significance detections of this phenomena have only recently occurred, measurements using future CMB and galaxy survey data have the potential to place interesting constraints on both cosmological parameters (esp. dark energy models and the sum of the masses of the neutrino species) as well as to test models of gravity at ∼100 Mpc scales.

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