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Cosmological Constraints from the South Pole Telescope[1]

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The 10-meter South Pole Telescope (SPT) is a millimeter wavelength telescope whose primary goal is to search for clusters of galaxies via their distortion of the cosmic microwave background (CMB), otherwise known as the Sunyaev-Zel'dovich (SZ) effect. The surface brightness of the SZ effect is redshift independent which allows a SZ survey with sufficient angular resolution to provide a nearly mass limited cluster sample out to the earliest epochs of cluster formation. The SPT recently completed a 2500 deg^2 survey that has detected $\sim$500 massive clusters ($M >\sim 2 \times 10^{14} M_\odot$) that span redshifts from $0.0 < z < 1.4$. I will give an overview of the SPT survey, including its current, and projected future, cosmological constraints from measurements of the power spectrum of the CMB and the SPT-SZ cluster survey. I will highlight recent results using the first 18 cluster sub-sample which have additional X-ray measurements. We find that adding the SPT cluster data significantly improves the constraints on the dark energy equation of state, w, and the sum of the neutrino masses beyond those found when using measurements of the CMB, supernovae (SNe), baryon acoustic oscillations (BAO), and the Hubble constant. Considering each independently, we best constrain $w = -0.973 \pm 0.063$ and the sum of neutrino masses to be < 0.28 eV at 95% confidence, a factor of 1.25 and 1.4 improvement, respectively, over the constraints without SPT cluster data. When considering a model with massive neutrinos and a free effective number of relativistic species, $N_{\rm eff}$, which includes the number of neutrino species, we measure $N_{\rm eff} = 3.91 \pm 0.42$ and the sum of the neutrino masses to be 0.34 ± 0.17 eV with a 95% upper limit of 0.63 eV. The full SPT-SZ survey and improved mass calibration will produce constraints on w comparable to current constraints from the combination of CMB+BAO+SNe data, and would represent an independent systematic test of the standard dark energy paradigm by measuring the effect of dark energy on the growth of structure. The combination of CMB+BAO+SNe data with the SPT cluster sample will break degeneracies between the data sets resulting in significantly tighter constraints on dark energy.

[1]The SPT Collaboration