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Probing Cosmology and Particle Physics with ACT

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Over the coming decade, tiny fluctuations in temperature and polarization of the Cosmic Microwave Background (CMB) will be mapped with unprecedented resolution. The Planck Surveyor, the Atacama Cosmology Telescope (ACT), and the South Pole Telescope (SPT) are already making great advances. In a few years, high resolution polarization experiments, such as PolarBear, ACTPol, and SPTPol will be in full swing. While these new arc-minute resolution observations will continue to help constrain the physics of the early universe, they will also be unique in a new way - they will allow us to measure the gravitational lensing of the CMB. This lensing is the deflection of CMB photons by intervening large scale structure. CMB lensing will probe the growth of structure over cosmic time, helping constrain the total mass of neutrinos and the behavior of dark energy. In the first part of the talk, I will review the recent progress made with ACT, especially in constraining the physics of Big Bang Nucleosynthesis and the neutrino sector. In the second part, I will discuss the scientific potential of the CMB lensing signal, its first detection, a new way to constrain dark energy, and its prospects for cross-correlation with other datasets. Finally, I will discuss the upcoming polarized counterpart of ACT – the ACTPol project, which will have greater sensitivity than ACT, and will be a premier CMB lensing experiment. I will describe our plans to extract different flavors of science from the ACTPol data, including the cross-correlations with optical lensing and galaxy surveys, such as SDSS, BOSS, DES and LSST.

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