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Fundamental Physics from Secondary CMB Anisotropies: Dipoles and Dark Sectors

Abstract

As cosmic microwave background photons propagate from the surface of last scattering to us, they interact with the intervening large-scale structure and are imprinted with secondary temperature and polarization anisotropies. In this talk, I will discuss new constraints on fundamental physics from two types of secondary CMB anisotropies. First, I describe how temperature anisotropies induced by electrons in bulk motion, the kinetic Sunyaev Zel'dovich (kSZ) effect, can be used to create high fidelity maps of the radial velocity field through cross-correlations with large scale structure. Using Planck CMB and unWISE galaxy data, I present the tightest existing constraints on the fundamental component of the CMB dipole from such maps. Next, I describe how CMB photon interactions with a dark sector (e.g. through kinetic mixing with a massive vector – a dark photon) mediated by large-scale structure lead to new CMB anisotropies. I present a preliminary analysis of scenarios involving dark photons and axions using Planck data which improve existing constraints by several orders of magnitude.