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Towards testing CMB anomalies using the kinetic and polarized Sunyaev Zel'dovich effects

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Measurements of the CMB temperature anisotropies on large angular scales have uncovered a number of anomalous features of marginal statistical significance: a hemispherical power asymmetry, lack of power on large angular scales, and features in the power spectrum. Because the primary CMB temperature has been measured at the cosmic variance limit, determining if these anomalies are hints of new physics as opposed to foregrounds, systematics, or simply statistical flukes, requires new observables. We highlight the potential contribution that future measurements of the kinetic Sunyaev-Zel'dovich effect (kSZ) and the polarized Sunyaev Zel'dovich effect (pSZ) could make in determining the physical nature of several CMB anomalies. The kSZ and pSZ effects, temperature and polarization anisotropies induced by scattering from free electrons in the reionized Universe, are the dominant blackbody contribution to the CMB on small angular scales. Using the technique of SZ tomography, measurements of these effects can be combined with galaxy surveys to reconstruct the remote CMB dipole and quadrupole fields, providing a 3-dimensional probe of large scale modes inside our Hubble volume. We forecast the additional constraining power that these observables might offer for a representative set of anomaly models and find that the information from CMB temperature, polarization, and the remote dipole and quadrupole fields is complementary, and the full set of observables can improve constraints on anomaly models by a factor of ˜ 2 – 4 using next-generation CMB experiments and galaxy surveys. This could be sufficient to definitively establish the physical origin of several CMB anomalies.

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