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Large-scale structure cross-correlation of the Universe

We present a joint analysis of the power spectra of the Planck Compton y-parameter map and the projected galaxy density field using the WISE all-sky survey. We detect the statistical correlation between WISE and Planck data (gy) with a significance of 21.8σ. We also measure the auto-correlation spectrum for the tSZ (yy) and the galaxy density field maps (gg) with a significance of 150σ and 88σ, respectively. We then construct a halo model and use the measured correlations Cℓgg, Cℓyy and Cℓgy to constrain the tSZ mass bias B≡M_500/M_tSZ500. We also fit for the galaxy bias, which is included with explicit redshift and multipole dependencies as bg(z,ℓ)=b0g(1+z)α(ℓ/ℓ0)β, with ℓ0=117. We obtain the constraints to be B=1.50±0.07(stat)±0.34(sys), i.e. 1−bH=0.67±0.03(stat)±0.16(sys) (68% confidence level) for the hydrostatic mass bias, and b0g=1.28+0.03−0.04(stat)±0.11(sys), with α=0.20+0.11−0.07(stat)±0.10(sys) and β=0.45±0.01(stat)±0.02(sys) for the galaxy bias.

Similarly, We present a joint cosmological analysis of the power spectra measurement of the Planck Compton y-map and the integrated Sachs-Wolfe (ISW) map. We detect the statistical correlation between the Planck tSZ map and ISW data with a significance of 1.7σ , while the significance of the auto-correlation for Planck tSZ data and ISW data are 3.3σ and 2.1σ respectively. The joint auto and cross-power spectra constrain the matter density Ωm = 0.316 ± 0.011, Hubble constant h = 0.723 ± 0.01, and the rms matter density fluctuation σ8 = 0.767 ± 0.014 at 68% confidence level. The derived growth of structure parameter is S8 ≡ σ8(Ωm /0.3)0.5 = 0.788+0.0187 −0.0198. In addition, we obtain the constraint of the product of the gas bias, gas temperature and density as bgas (Te/(0.1 keV)) (ne/1 m-3) = 5.60+0.30
−0.34. We find that this leads to an estimate on the electron temperature for
today to T0e = (4.33+0.232−0.266) × 106 K .

Incoming data sets from future CMB and galaxy surveys (e.g. Rubin Observatory) will allow probing the large-scale gas distribution in more detail.

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