



INSTITUTO DE FÍSICA
DE PARTÍCULAS Y DEL COSMOS

IPARCOS



Preprint Series in Particles and Cosmos Physics

n° IPARCOS-UCM-24-057

Cross-correlating the EMU Pilot Survey 1 with CMB lensing: Constraints on cosmology and galaxy bias with harmonic-space power spectra

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November 2024

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Abstract

We measured the harmonic-space power spectrum of galaxy clustering auto-correlation from the Evolutionary Map of the Universe Pilot Survey 1 data (EMU PS1) and its cross-correlation with the lensing convergence map of cosmic microwave background (CMB) from Planck Public Release 4 at the linear scale range from $\ell=2$ to 500. We applied two flux density cuts at 0.18 and 0.4mJy on the radio galaxies observed at 944MHz and considered two source detection algorithms. We found the auto-correlation measurements from the two algorithms at the 0.18mJy cut to deviate for $\ell \geq 250$ due to the different criteria assumed on the source detection and decided to ignore data above this scale. We report a cross-correlation detection of EMU PS1 with CMB lensing at $\sim 5.5\sigma$, irrespective of flux density cut. In our theoretical modelling we considered two redshift distribution simulation models that yield consistent results, a linear and a non-linear matter power spectrum, and two linear galaxy bias models. That is a constant redshift-independent galaxy bias $b(z)=b_g$ and a constant amplitude galaxy bias $b(z)=b_g/D(z)$. By fixing a cosmology model and considering a non-linear matter power spectrum, we measured a constant galaxy bias at 0.18mJy (0.4mJy) with $b_g=2.32+0.41-0.33$ ($2.18+0.17-0.25$) and a constant amplitude bias with $b_g=1.72+0.31-0.21$ ($1.78+0.22-0.15$). When δ is a free parameter for the same models at 0.18mJy (0.4mJy) with the constant model we found $\sigma_\delta=0.68+0.16-0.14$ (0.82 ± 0.10), while with the constant amplitude model we measured $\sigma_\delta=0.61+0.18-0.20$ ($0.78+0.11-0.09$), respectively. Our results agree at 1σ with the measurements from Planck CMB and the weak lensing surveys and also show the potential of cosmology studies with future radio continuum survey data.

