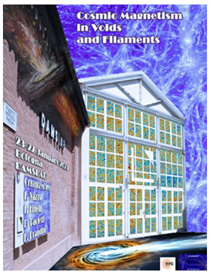
Cosmic Magnetism in Voids and Filaments



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Towards 21-cm intensity mapping with uGMRT (online)

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Post-reionization neutral hydrogen (HI) intensity mapping (IM) offers an efficient technique for mapping large-scale structures in the universe. We apply the Tapered Gridded Estimator (TGE) on a 24.4 MHz bandwidth uGMRT Band 3 data aiming HI IM at z=2.28. TGE allows us to taper the sky response, suppressing the wide-angle foreground contributions. Applying TGE, we estimate the multi-frequency angular power spectrum $C_\ell(\Delta\nu)$ from which we determine the cylindrical power spectrum $P(k_\perp, k_\parallel)$. This method naturally overcomes the issue of missing frequency channels. We introduce the Cross TGE, which cross-correlates two cross-polarizations (RR and LL) to estimate $C_\ell(\Delta\nu)$. The Cross TGE is expected to mitigate several effects like noise bias, calibration errors etc., which affect the 'Total' TGE, which combines the two polarizations. The measured Cross $C_\ell(\Delta\nu)$ is modelled to yield maximum likelihood estimates of the foregrounds and the spherical power spectrum $P(k)$ in several k bins. Considering the mean squared brightness temperature fluctuations, we report a 2σ upper limit $\Delta^2_{UL}(k) \le (58.67)^2\ \mathrm{mK}^2$ at $k = 0.804\ \mathrm{Mpc}^{-1}$ which is 5.2 times tighter than our previous estimate with the Total TGE. Assuming that the HI traces the underlying matter distribution, we have estimated $[\Omega_{HI} b_{HI}]$ where Ω_{HI} and b_{HI} are the HI density and linear bias parameters respectively. We obtain a 2σ upper limit $[\Omega_{HI} b_{HI}]_{UL} \le 0.061$ from this approach. Using their contrasting decorrelation properties, we also use a foreground removal technique to distinguish the foregrounds and the 21-cm signal from the $C_\ell(\Delta\nu)$. We found $[\Omega_{HI} b_{HI}]_{UL} \le 2.17 \times 10^{-2}$ which is although ~ 10 times larger than the expected value, nonetheless, ~ 3 times improved over the foreground avoidance approaches.

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