Contribution ID: **305** Type: **Poster**

Post-reionization HI 21cm signal: A probe of negative cosmological constant

In this study, we investigate a cosmological model involving a negative cosmological constant (AdS vacua in the dark energy sector). We consider a quintessence field on top of a negative cosmological constant and study its impact on cosmological evolution and structure formation. We use the power spectrum of the redshifted HI 21 cm brightness temperature maps from the post-reionization epoch as a cosmological probe. The signature of baryon acoustic oscillations (BAO) on the multipoles of the power spectrum is used to extract measurements of the angular diameter distance $D_A(z)$ and the Hubble parameter $H(z)$. The projected errors on these are then subsequently employed to forecast the constraints on the model parameters (Ω_Λ, w_0, w_a) using Markov Chain Monte Carlo techniques. We find that a negative cosmological constant with a phantom dark energy equation of state (EoS) and a higher value of H_0 is viable from BAO distance measurements data derived from galaxy samples. We also find that BAO imprints on the 21cm power spectrum obtained from a futuristic SKA-mid like experiment yield a $1-\sigma$ error on a negative cosmological constant and the quintessence dark energy EoS parameters to be $\Omega_\Lambda = -0.883^{0.978}_{-2.987}$ and $w_0 = -1.030^{0.023}_{-0.082}$, $w_a = -0.088^{0.162}_{-0.343}$ respectively, which is competitive with other probes reported in the literature.

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Session Classification: Cosmology

Track Classification: Cosmology