10th International Conference on Gravitation and Cosmology: New Horizons and Singularities in Gravity (ICGC 2023)



Contribution ID: 317

Type: Oral

A new method to simultaneously determine the reionization history and power spectrum

The light-cone (LC) effect arises from the cosmological evolution of the redshifted 21-cm signal along an observer's line of sight (LoS), which is the frequency axis. It is particularly pronounced during the Epoch of Reionization (EoR) when the mean neutral hydrogen fraction (x_HI) and statistical properties change rapidly. The 3D power spectrum only quantifies the ergodic part of the signal and fails to capture the variation of the x_HI . The multifrequency angular power spectrum (MAPS), on the other hand, quantifies the entire secondorder statistics of the signal in the presence of the LC effect, including the homogeneous and isotropic statistical fluctuations along the angular directions and systematic variation along the LoS direction due to cosmological evolution. We propose a new method to observationally determine the reionization history along with the power spectrum by assuming a model where the systematic frequency dependence along the LoS direction arises entirely due to the evolution of the mean neutral hydrogen fraction. We validate our method by calculating MAPS from a simulated LC EoR 21-cm dataset and using Markov Chain Monte Carlo (MCMC).

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Session Classification: Cosmology

Track Classification: Cosmology