Abstract

Observation of the redshifted 21-cm signal holds the potential of being a valuable cosmological probe over a large redshift range. However such observations are plagued with the problem of large foreground contaminants. In this thesis we look at the possibility of detecting the signal by a cross-correlation of the 21-cm brightness temperature maps with other cosmological fields. As a biased tracer of the underlying matter distribution, the 21-cm power spectrum probes the clustering property of matter. We first investigate the imprint of primordial gravitational waves on the redshift space matter power spectrum. The effect is seen to be distinct from that due to peculiar velocities. We find that the possibility of detecting the signal is high for large probing redshift. Hence the 21-cm power spectrum from dark ages should, in principle probe this. However we find that the effect is of the order of few percent and on super-horizon scales. The signal is highly suppressed for modes inside the horizon. Hence the signal is cosmic variance dominated.

We have studied the post-reionization 21-cm signal extensively. Here, we have first considered the cross-correlation of the 21-cm maps with CMBR ISW and CMBR weak lensing. The theoretically predicted cross-correlation angular power spectra are presented. The angular power spectra measures the strength of cross-correlation as a function of angular scale. If detected, this would be an independent cosmological probe. However, our SNR analysis shows that the signal is only weakly detectable even in idealized situations.

We have finally considered the cross-correlation of the post-reionization 21-cm signal with the Lyman-α flux fluctuations. Though these signals have different astrophysical sources, they are expected to be correlated on the large scales of our interest. We have proposed an unbiased estimator for the cross-correlation power spectrum and looked at its statistical properties. We have shown that it is possible to detect the cross-correlation signal with futuristic radio observations and quasar surveys. This has been the motivation for investigating the imprint of baryon acoustic oscillation in the cross-correlation signal and study its various properties.