

HI intensity mapping with MeerKAT: cosmology at redshifts 0.4 to 1.3

Abstract

The intensity mapping technique, using the 21-cm line of neutral hydrogen (HI), is opening a new observational window in cosmology, promising to measure the large-scale structure of the Universe over a wide range of redshifts, something that would be extremely challenging with a regular HI galaxy survey. This technique is the main driver for cosmology with the SKA, and a large survey has been proposed in order to probe key cosmological parameters, from the nature of dark energy to inflationary large-scale effects. MeerKAT on its own can achieve enough sensitivity to detect these baryon acoustic oscillations and provide competitive constraints on cosmological parameters. For MeerKAT/SKA, the technique will rely on the use of the single dish data. Building on our recent successful proof-of-concept observations and the availability of the UHF band, we propose a large sky survey ($\sim 500 \text{ deg}^2$) capable of making novel measurements of the HI intensity mapping power spectrum over a wide redshift (z) range ($0.4 < z < 1.3$). With 60 hours on source, we can measure both the auto-correlations and cross-correlations with galaxy surveys over 5 redshift bins with a high signal to noise ratio (SNR) and even detect the redshift space distortions (RSD) with a minimum SNR of 5. These observations will represent a significant advance in the application of the 21cm intensity mapping technique, and will provide crucial insights into system performance and analysis techniques towards our goal of probing cosmology below 1 GHz with MeerKAT and the SKAO.