Title:	HI Intensity Mapping on GMRT Observations with the Tapered Gridded Estimator
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Abstract:	One of the foremost challenges in modern astrophysics and cosmology is to get obser- vational constraints on theories of galaxy formation and evolution in a wide redshift range, ranging from the dark ages to the present epoch. Observing the redshifted 21 cm signal of neutral hydrogen (HI) allows us to probe the large scale structure in these epochs using radio telescopes. In the post reionization era, the HI is expected to be confined in the dense interiors of galaxies and hence, the spatial distribution of HI should trace the galaxy distribution and, in turn, the dark matter distribution. HI Intensity Mapping is a novel technique which uses low angular resolution observations using radio interferometers to measure the 3 dimensional distribution of integrated HI emission from a large number of galaxies. This allows us to build up the signal to noise by averaging the signal in large comoving volumes and get a statistical estimate of the large scale structure distribution. In this project, we perform HI intensity mapping with the upgraded Giant Me- trewave Radio Telescope. For this purpose, we use the Tapered Gridded Estimator [Choudhuri 14] which is a visibility based estimator for the HI power spectrum. In the first part of the project, we use simulations of GMRT observations to implement the estimator and then test its performance in different situations. We see that the estimator is able to recover the input power spectrum from the simulated data at all but the very large scales, possibly because of the lack of very small baselines in the GMRT antenna distribution. Next, the estimator is applied to actual observations of the Extended Groth Strip made using the GMRT at a redshift of 0.028. All point sources above a threshold of 7σ are modelled and subtracted. The Multifrequency Angular Power Spectrum (C ` (∆ν)), the cylindrical power spectrum P (k ⊥ , k k) and the spherical power spectrum (P (k)) are measured using the TGE and the effect of point source subtraction and tapering on these quantities is studied. Both tapering and point source subtraction are seen to have a significant effect in the suppression of foregrounds. We employ a foreground avoidance technique to average the power values in a region outside the foreground wedge in spherical k shells to estimate the spherical power spectrum, which is then used to set the upper limits on the dimen- sionless HI power spectrum (∆ 2 (k)) at z = 0.028 and in the relevant wave modes. The dark matter power spectrum at z = 0.028 is calculated and used to get upper limits on the quantity Ω HI × b HI . We obtain the tightest constraints at k = 20.73 M pc −1 and the estimated 2σ upper limits at this mode are ∆ 2 (k) = (17.14) 2 mK 2 and Ω HI b HI = 0.0179. A similar analysis is then done on EGS observations with the GMRT at z=0.34 and z=0.38. The tightest constraints from this analysis are: ∆ 2 U (k) = (54.28) 2 mK 2 and Ω HI b HI = 6.02 × 10 −2 at k=5.56M pc −1 (for z=0.34) and ∆ 2 U (k) = (71.32) 2 mK 2 and Ω HI b HI = 8.61 × 10 −2 at k=3.60M pc −1 (for z=0.38).
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