Constrainting IGM Heating with the 21 cm Power Spectrum; Predictions and First Observations with the MWA.

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Observations of the 21 cm power spectrum at high redshift will allow us to characterize the sources that heated the intergalactic medium including the first stellar mass black holes (Mirabel 2011) and hot interstellar medium (Pacucci 2014). Current experiments are primarily targeting reionization, however it is likely that the best constraints on heating will come from higher redshifts than the reionization epoch. Using the Fisher matrix formalism and a suite of semi-numerical simulations, we investigate how the information on heating is distributed with redshift and find that 10% constraints on the spectral properties of the heating sources may be obtained if observations are conducted with a next generation interferometer out to a redshift of 20.

Systematics associated with low frequency radio observations such as increased foreground brightness, ionospheric fluctuations, and RFI within the FM band are expected to be worse at pre-reionization redshifts. To investigate these, we also analyze three hours of observations on the MWA between the redshifts of 12 and 18 with variegated ionospheric conditions. After the integration presented here, we do not find ourselves limited by RFI in much of the FM band. In comparing power spectra formed from data with different levels of differential refraction, we also find that the ionosphere does not have a significant effect on power within the region of Fourier space that we aim to detect the 21 cm signal. We are currently limited by foreground leakage due to reflections in our receiver to beamformer cables that we are unable to calibrate out.