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Effect of Earth's Ionosphere on the Simulated HI 21 cm Observations with Radio Interferometers

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The 21 cm line of the neutral hydrogen is the hyperfine transition line of atomic hydrogen (in the ground state), which arises due to the interaction between the electron and proton spins. Observation of the redshifted 21 cm signal from Cosmic Dawn (CD) and Epoch of Reionization (EoR) is a promising probe for the early Universe. These observations are made challenging due to the presence of bright foregrounds that are a few orders of magnitude brighter than the cosmic signal present, Radio Frequency Interference (RFI) and Earth's Ionosphere and Instrumental systematics. In order to understand the effect of each of these corruption terms, it is necessary to set up an end-to-end pipeline. To perform the end-to-end pipeline, we need a global sky model, which includes the foreground and 21 cm signal. To achieve highly sensitive and high-resolution imaging will require a telescope design optimization. To increase the signal to noise ratio for identifying dim or distant sources, telescopes need large collecting areas. The highly sensitive next-generation interferometers Square Kilometer Array are expected to detect the 21 cm signal and characterize the multi-redshift PS. We have done the same and studied the effects of antenna based gain errors and position errors in our previous publications. Here, we use simulations to comprehend and quantify the effect of Earth's ionosphere on the radio interferometric observations at these low frequencies. We study the ionospheric effect on the foreground removal and redshifted 21 cm signal extraction. Here, we present the initial results from simulations involving a static ionospheric model for the entire observing time.

References

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