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Probing the EoR using uGMRT deep field observations in Band-2

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After the cosmic Dark Ages when the first luminous sources started appearing in our universe, the era is termed as the Cosmic Dawn (CD). These luminous sources started to emit high energy photons in all directions to ionize the surrounding Intergalactic Medium (IGM) that was dominated by neutral hydrogen marking the beginning of the Epoch of Reionization (EoR). CD and EoR are the two important epochs in our cosmic structure formation history that remain to be explored. The major probe for this extended epoch is the redshifted HI 21-cm signal, caused by the spin-flip transition seen in neutral hydrogen as a result of hyperfine splitting and the release of a photon of 1420 MHz frequency.

Unfortunately, the 21-cm signal is masked by several bright foreground sources (Galactic and Extragalactic), almost five orders of magnitude brighter than the actual signal. This obscuration of the faint redshifted 21-cm signal makes it quite challenging to probe even with very powerful radio telescopes. Moreover, other factors constrain the signal detection, such as the ionospheric effects on the signal, the incorrect beam modeling, and even the instrumental noise of the detectors.

Several ground-based radio telescopes like the Hydrogen Epoch of Reionization Array (HERA), Murchison Widefield Array (MWA), and Low-Frequency Array (LOFAR) are currently operating to detect the faint 21-cm signal. The upgraded Giant Meterwave Radio Telescope (uGMRT) [1] in Pune, India, aims to look out for the redshifted 21-cm line to study EoR. The upcoming telescope Square Kilometre Array (SKA) has the required sensitivity to be able to directly detect the signal and achieve a higher signal-to-noise ratio in the spatial fluctuations across a broader redshift. Apart from these, there are single antenna telescopes to detect the global "all sky" averaged 21-cm signal (i.e., SARAS, LEDA, EDGES, SciHi, PRIzM, etc) .

This work aims at observations of a well studied part of the sky in other wavelengths, the European Large-Area ISO Survey-North 1 (ELAIS N1) field, using the uGMRT Band-2 (120 - 240 MHz). Our work aims at characterizing the foregrounds at this EoR band and understanding the systematics for these observations. OUr initial results show a radio image of the central field with the RMS noise of ~ 240 μJy beam$^{[-1]}$ at ~ 180 MHz. We will present our initial results constraining the diffuse and compact foreground characteristics of the field at these frequencies. We will also present our way forward to get an upper limit on the redshifted HI 21cm signal from the CD/EoR signal at these redshifts.

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