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Observing the HSC SXDS field with the uGMRT Band-2

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The Epoch of Reionization (EoR) is an important phase transition in the Universe for understanding galaxy evolution. The first luminous objects were formed during the EoR. Such galaxies ionized the hydrogen atom in the intergalactic medium (IGM). While recent observations found lots of high-z galaxies, it is still unknown what type of galaxies mainly reionized the IGM. The 21cm line, emitted from neutral hydrogen atom in the IGM, is one of the most direct probes of the state of IGM. It is expected that the distribution of ionizing sources (i.e. galaxies) at the epoch has an anti-correlation with the 21cm line signal. Therefore, the cross-correlation analysis between the 21cm line and distant galaxies can reveal the properties of galaxies at the epochs and how the galaxies contributed to the reionization. A candidate for cross-correlation is the high-z Lyman-alpha emitting galaxy (LAE). LAEs have already been observed by the Subaru HyperSprime Cam (HSC). On the other hand, an extremely highly sensitive radio telescope is essential for the detection of the cross-correlation signal. The 21cm-LAE cross-correlation should be a unique observable in the SKA era. Toward the future observation with the SKA1 Low, it is demanded to develop software for cross power spectrum analysis. We conducted the uGMRT band2 (120-250MHz) observations of the udSXDS field, which is one of the HSC survey areas. We perform, for the first time, the cross-correlation analysis of the 21cm line observed with the uGMRT and LAEs detected with the Subaru HSC. The radio image at 210MHz shown in Figure 1 is dominated by the foregrounds. Therefore we apply the principal component analysis-based foreground removal method. However, the performance has declined due to RFI flagging. The resultant cross-power spectrum at the udSXDS field is dominated by the statistical error due to the foregrounds.

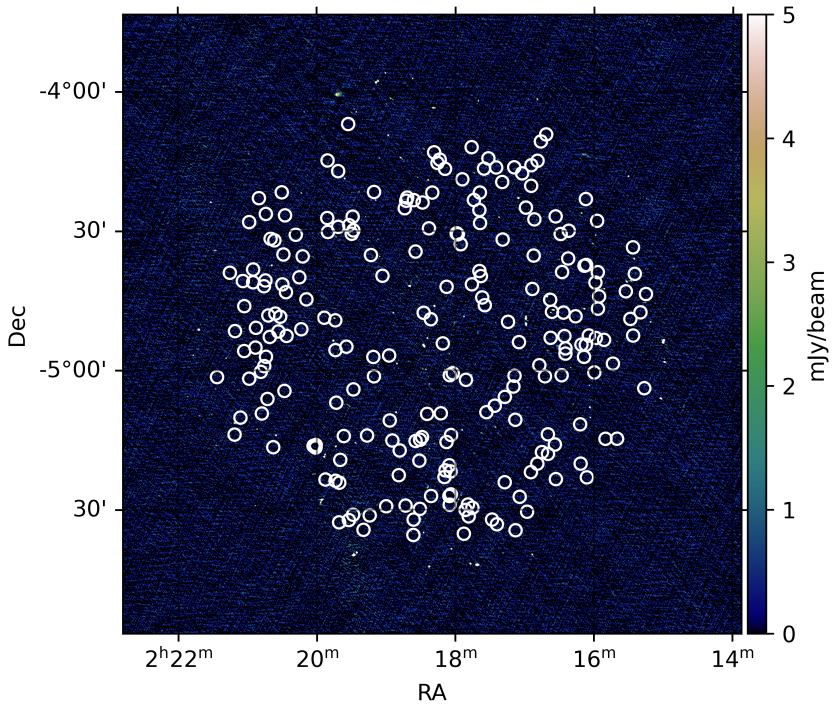

Figure 1. Cleaned radio image of udSXDS field observed by the uGMRT at ~210 MHz. Overlayed circles indicate positions of the LAEs observed by the HSC (LAE data is taken from http://cos.icrr.u-tokyo.ac.jp/rush.html).