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Impact of Realistic Foreground and Telescopic Noise on 21-cm maps from the Epoch of Reionization

Saswata Dasgupta[(1)(2)], Suman Majumdar[(1)], Samit Kumar Pal[(1)], Abhirup Datta[(1)], Sohini Dutta[(1)(3)]
(1) Indian Institute of Technology-Indore, Indore, MP, India
(2) Kavli Institute of Cosmology, Institute of Astronomy, University of Cambridge, Cambridgeshire, United Kingdom
(3) Jodrell Bank Centre for Astrophysics-The University of Manchester, Manchester, United Kingdom

1 Extended Abstract

The Cosmic Dawn (CD) and the Epoch of Reionization (EoR) marks a turning point in cosmic history, creating the emergence of the first luminous objects that ionize the intergalactic medium (IGM). Understanding this period is of great importance for cosmology; and the key probe of this period, the evolving 21-cm line from neutral hydrogen residing in the IGM can provide us with a wealth of information. The upcoming Square Kilometer Array (SKA1-Low) has the potential to create tomographic images of these periods in cosmic time. However, the inherent presence of galactic and extra-galactic foregrounds and instrumental noise poses significant challenges in the detection of the underlying feeble 21-cm field.

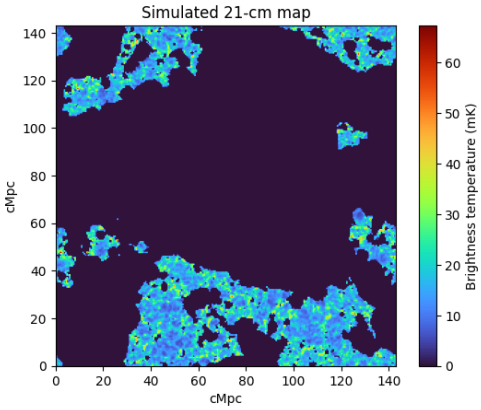

Figure 1. Slice of a simulated 21-cm brighness temperature map at $z = 7.2$

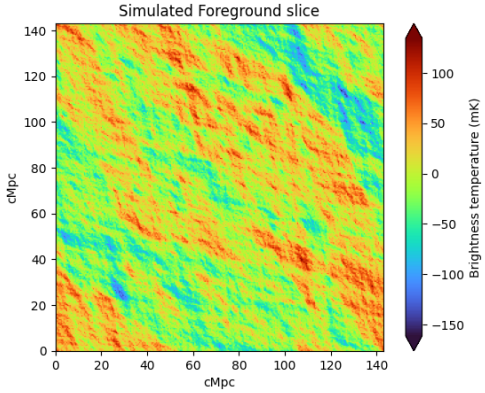

Figure 2. Slice of a simulated Foreground map at a frequency of 150 MHz

Our study delves into the development of reionization by utilizing a novel statistic called the "Largest Cluster Statistics" (LCS)[1], [2]. We put particular emphasis on the morphological and topological development of the ionized regions during EoR, especially at the time of percolation transition. We investigate on the effect of SKA1-Low beam, telescopic noise. Further, we delve into the implications of point source and diffuse foreground emission, by using their simulated models, and creating synthetic 21-cm observations of the EoR. We employ LCS on these observational maps and quantify the bias that these effects introduce in the observation of the morphological development of the ionized regions and draw inferences on the history of reionization.

References

[1] S. Dasgupta, S. K. Pal, S. Bag, *et al.*, "Interpreting the hi 21-cm cosmology maps through largest cluster statistics. part i. impact of the synthetic ska1-low observations," *Journal of Cosmology and Astroparticle Physics*, vol. 2023, no. 05, p. 014, May 2023. DOI: 10.1088/1475-7516/2023/05/014. [Online]. Available: https://dx.doi.org/10.1088/1475-7516/2023/05/014.

[2] A. Pathak, S. Bag, S. Dasgupta, *et al.*, "Distinguishing reionization models using the largest cluster statistics of the 21-cm maps," *Journal of Cosmology and Astroparticle Physics*, vol. 2022, no. 11, p. 027, Nov. 2022. DOI: 10.1088/1475-7516/2022/11/027. [Online]. Available: https://dx.doi.org/10.1088/1475-7516/2022/11/027.