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Probing the Epoch of Reionization with line-intensity mapping technique

Chandra Shekhar Murmu[(1)], Suman Majumdar [(1)], and Kanan K. Datta[(2)]
(1) Indian Institute of Technology Indore, India; e-mail: phd1901121005@iiti.ac.in, chandra0murmu@gmail.com
(2) Indian Institute of Technology Indore, India; e-mail: suman.majumdar@iiti.ac.in
(3) Jadavpur University, India; email: datta.kanan@gmail.com

The Epoch of Reionization is the yet, unknown period in the cosmic evolutionary history that remains to be probed robustly. Upcoming experiments, like the HERA, SKA, etc., will try to detect the redshifted 21cm signal from the early IGM and characterize its evolution through cosmic time. We expect that via the 21cm signal, we will uncover the processes that drove the reionization. This 21cm signal, when combined with the galaxy line emissions such as $[C\ II]_{158\mu m}$, CO, $[O\ III]_{88\mu m}$ etc., probed via intensity mapping, will open up compelling cross-correlations opportunities. These signals will have line-of-sight (LoS) evolution imprinted due to their variation with cosmic time. We have shown, in our work, that this light-cone effect can have a pronounced impact (dependent on the underlying reionization history) on the [C II] x 21cm cross-correlation. Therefore, the light-cone effect needs to be appropriately modelled so that one can interpret beneficial information from these cross-correlation statistics. Various astrophysical factors will introduce line-luminosity scatter in these galaxy line emissions. The ionizing flux from these galaxies, driving the reionization process, will also have scatter imprinted similarly. It, in principle, will have signatures imprinted in the 21cm signal. Although the 2-pt statistics aren't adequate to probe this signature, the 21cm bispectrum might be robust enough for this purpose. The bispectrum is the 3-pt statistic in Fourier-space that correlates three length scales and can probe signatures of non-gaussianity. Our preliminary study suggests that the astrophysical scatter in the ionizing flux significantly impacts the 21cm bispectrum, depending on the various bispectrum-triangle shapes. Whether this impact is robust enough is yet to be checked with higher bin resolutions of the bispectrum.