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Detecting the cross-correlation between 21cm signal and line intensity mapping during reionization

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The distribution of neutral hydrogen mapped by SKA-Low through the 21 cm signal provides a unique and powerful probe of the cosmic reionization process. However, this method faces significant challenges due to severe foreground contamination, which can exceed the cosmological signal by up to five orders of magnitude. Cross-correlating 21 cm and line intensity maps such as [CII] and CO offers a promising strategy to mitigate foregrounds and other systematics, as the dominant contaminants in these two surveys are largely uncorrelated. Detecting the cross power spectrum would verify initial claims of a detection with SKA. Moreover LIM and 21cm synergies very nicely as [CII] and CO lines originate from the interstellar medium while cosmic 21cm is sourced from the intergalactic medium. Together, they draw a complete view of the reionization process in the high-redshift Universe.

We develop a pipeline for simultaneously forward modeling 21cm, LIMs as their cross-correlation. We demonstrate that high signal to noise detection of 21cm-[CII] is possible with SKA-low AA* combined with LIM from several upcoming telescopes. Our study highlights the advantages of multi-tracer approaches in overcoming observational challenges and giving more physical insight into the epoch of reionization.

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