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21 cm signal from cosmic dawn

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Observations of redshifted 21 cm radiation from the epoch of reionization promises to provide information on the physical processes during that epoch. Many low frequency interferometers are trying to provide statistical measurements of this signal, such as its power spectrum. Beside observations numerical simulations are essential to derive tight constraints on different aspects of reionization like the nature of first sources, relative level of emission from UV and X-ray sources etc. We present a formalism for generating the δT_b distribution using dark matter simulations and an one-dimensional radiative transfer code. Our analysis is able to account for the spin temperature $T_{\rm S}$ fluctuations arising from inhomogeneous X-ray heating and $Ly\alpha$ coupling during cosmic dawn. The δT_b power spectrum amplitude at large scales ($k \sim 0.1$ Mpc^{-1}) is maximum when $\sim 10\%$ of the gas (by volume) is heated above the CMB temperature. The power spectrum shows a "bump"-like feature during cosmic dawn and its location measures the typical sizes of heated regions. Also, one need to consider the effect of peculiar velocities of gas (redshift space distortion) while generating δT_b distribution. We find that the effect of peculiar velocities on the power spectrum is negligible at large scales for most part of the reionization history. During early stages (when the volume averaged ionization fraction ≤ 0.2) this is because the signal is dominated by fluctuations in $T_{\rm S}$. For reionization models that are solely driven by stars within high mass ($10^9 M_\odot$) haloes, the peculiar velocity effects are prominent only at smaller scales ($k 0.4$ Mpc^{-1}) where patchiness in the neutral hydrogen density dominates the signal. The conclusions are unaffected by changes in the amplitude or steepness in the X-ray spectra of the sources. We also study the effect of the evolution of the signal along the line-of-sight.

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