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Constraint on the dark matter halo formation in the early universe by the free-free emission

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We propose that the free-free spectrum in the CMB frequency range provides the constraint on the dark matter halo formation in the early universe and the density fluctuations on small scales.

When dark matter halos form, gas in the dark matter halos can be heated and ionized depending on their virial temperature.

Although such hot ionized gas is cooled and recombined to the neutral state by Compton scattering, they can produce free-free emission as long as the gas is heated enough to be ionized.

We show this emission can contribute to the background free-free spectrum and the amplitude depends on the fluctuations on small scales.

We find that the current observed free-free emission at high galactic latitude can provide the constraint on the density fluctuations on $k \sim \mathcal{O}(10)\text{Mpc}^{-1}$.

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