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Probing the DA and EoR Using Differential Observations of the SZE-21cm

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Probing the Dark ages (DA) and the Epoch of reionization (EoR), remains one of the challenges facing modern cosmology. Numerous probes have been proposed for exploration of these epochs and efforts are already under-way to detect signatures from them through observations of the 21cm cosmological signal, which corresponds to the 21cm transition of atomic hydrogen. Recently the EDGES collaboration claimed the detection of an absorption feature of the global 21cm background signal centered at 78 MHz. When compared to the standard 21cm models this feature appears at the correct frequency (corresponding to a redshift range of $z = (15-20)$) but it is larger by a factor of about two in amplitude. This work explores a recently proposed probe for the DA and EoR called the SZE-21cm, we simulate differential observations towards and away galaxy clusters using the standard 21cm models. The SZE-21cm presents advantages as it is a differential measure of the CMB spectrum on and off an area of the sky containing the cosmic structure under study, it is as a result not affected by large-scale foregrounds in observations at low-frequency. We show that observations of SZE-21cm can be carried out with radio interferometers at frequencies between 50 MHz and 250 MHz and used to establish the global properties of the 21cm background spectrum. Noting that detection towards an individual cluster may be challenging we demonstrate how computing the signal for multiple cluster samples may be beneficial and propose the use of the SZE-21cm to test results of current and upcoming experiments such as EDGES.

Apply to be considered for a student award (Yes / No)?

Yes

Level for award (Hons, MSc, PhD, N/A)?

PhD

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