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An Update on the Progress of EDGES

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The *Experiment to Detect the Global Eor Signal* (EDGES) is a collection of wide-band single-antenna radio telescopes operating between 50-200 MHz, situated in the radio-quiet *Murchison Radio Observatory* in Western Australia. Consisting of three essentially scale-invariant antennas operating in different bands (low, mid and high), the target of the experiment is to detect the globally-averaged 21 cm signal from Cosmic Dawn ($z \sim 30-12$) and the Epoch of Reionization ($z \sim 12-6$). These epochs conceal a wealth of information about the birth and growth of the first stars, galaxies and black holes, and the cosmological structure formation that produced them – all encoded in the brightness temperature of hydrogen's 21 cm spin-flip transition. To achieve the extreme calibration precision required to separate this cosmological signal from the instrumentally-distorted foregrounds, EDGES adopts a Dicke-switching approach with in-lab receiver calibration [1] to account for internal reflections – a technique that has become standard for current global experiments.

EDGES reported the first evidence of star formation in the high-redshift Universe ($z \sim 18$) in 2018 [2]. The extraordinary depth and flattened profile of the reported absorption feature in the sky-averaged 21 cm spectrum compared to theoretical expectation has caused a great deal of both excitement [3, 4] and concern [5, 6] in the community. The EDGES team has continued to expand the set of verification tests presented in [2], which originally tested that the absorption feature was recovered under different instrument configurations (alternate ground planes, different identical antennas, different antenna orientations) and processing options (with/without beam chromaticity correction, different beam models, alternate smooth foreground models) and data cuts (different times of day and LST cuts).

This talk will present updates in three categories: (i) new data and alternative hardware configurations that aim to expose systematics, (ii) improved analyses and (iii) upgraded hardware. I will report initial results from another low-band configuration in which the antenna is aligned at 45° with respect to the original ground-plane. In concert with new data from the mid-band instrument, these results address concerns with artifacts in the beam. Furthermore, I will report on analysis upgrades to the calibration process, foreground modeling, code reproducibility, beam modeling, and ultimate Bayesian parameter estimation. Finally, I will give updates on EDGES-3, the next-generation experiment that will feature in-field real-time calibration, a less chromatic beam, and higher calibratability with fewer systematics in the band. This update is expected to yield order-of-magnitude improvements in the resulting model residuals, and expose extant contributions from instrumental systematics.

References

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