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A New Era For EDGES

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The *Experiment to Detect the Global Eor Signal* (EDGES) is a wide-band single-antenna radio telescope operating between 50-200 MHz, situated in the radio-quiet *Murchison Radio Observatory* in Western Australia, aiming 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. EDGES uses state-of-the-art precision absolute calibration techniques [1] to reveal the thermal evolution of this period.

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] and concern [4], while new observations from the SARAS3 experiment suggest a null-result [5]. The EDGES team has continued to expand the set of verification tests presented in [2], in order to assess the possibility that instrumental systematics contribute to the inferred feature. These verifications have been principally along three axes: (i) new data and alternative hardware configurations, (ii) upgraded hardware, and (iii) improved analysis.

In particular, the EDGES team is gradually implementing an analysis pipeline that is fully transparent, reproducible and Bayesian at its core. This talk will present our fundamental Bayesian pipeline and some initial results in the context of instrumental calibration for the data corresponding to the reported feature of [2]. This pipeline allows for robust model selection, and we will discuss the implications for choosing orders of polynomials both in calibration and for foregrounds. It also provides stronger control for instrumental systematics and their correlations, resulting in more reliable estimates of the uncertainty of the inferred feature. We will compare these results to previous analyses, and show how this pipeline may be useful for comparison to data from other instruments in the future. 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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