Preliminay Measurements with the EDGES Low-Band Instrument

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Until late 2015, EDGES has been operating in the band ~ 100-200 MHz attempting to measure the global 21-cm line from the Epoch of Reionization (EoR), corresponding to the redshift range 6 < z < 15. However, this cosmological signal is expected to extend down to ~ 50 MHz due to physics from an earlier period known as Cosmic Dawn (15 < z < 30). The main spectral characteristic of the predicted signal from Cosmic Dawn is a wideband (~ 20 MHz) absorption feature with peak amplitude of ~ -100 mK. This signal should be superimposed to the foreground radiation that follows, to first order, a power-law model with spectral index $\beta \sim -2.5$ and brightness temperatures above 1000 K.

This talk will describe the deployment of the EDGES low-band instrument, which measures in the range 50-100 MHz aiming at detecting the global signal from Cosmic Dawn. It operates at the Murchison Radio-astronomy Observatory since late 2015 in parallel to the original EDGES (now EDGES high-band), and takes advantage of the lessons learned from challenges encountered during high-band measurements. Specifically, its design revolves around a blade wideband antenna that corresponds to a generalization of a dipole, and consists of two rectangular metal panels aligned horizontally above a ground plane. Extensive studies show that this design produces a beam that changes smoothly with frequency, resulting in less structure in the spectrum after convolving it with the expected foregrounds, compared to the fourpoint antenna employed in previous versions of EDGES high-band. Other key aspects of the instrument include a temperature-regulated low noise amplifier that operates at 25°C with stability better than 0.1°C, and front-end circuitry that allows to measure the reflection coefficient of the antenna remotely and automatically without disconnecting it from the receiver. These aspects allow bringing the data to an absolute antenna temperature scale, which is an important characteristic of the modern EDGES approach.

The talk will also present preliminary data, and will discuss them in the context of foreground modeling and of potential early constraints on the Cosmic Dawn prediction.