Characterization of the EDGES Receiver and its Capability for Constraining the EoR

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The Experiment to Detect the Global EoR Signature (EDGES) is attempting to place constraints on parameters that characterize the Epoch of Reionization (EoR). This is an important period of the Universe in which the intergalactic medium, mostly atomic Hydrogen (HI), transitioned from a neutral to an ionized state. Models and observations suggest that the EoR occurred between redshifts 13 and 6. There are predictions for the average evolution of HI in this period in the form of a characteristic signature of 21-cm radiation as a function of redshift. This radiation (emitted originally at about 1.4 GHz) needs to be measured in the 100-200 MHz range due to cosmological expansion. The goal of EDGES is to detect this signature using an extremely well characterized spectrometer.

The talk will describe the strategy used for calibrating the EDGES receiver. The strategy involves switching the input of the receiver between two transference standards of different noise temperatures, in addition to the antenna. These three spectra are obtained and recorded continuously during sky observations, and provide a first-order estimation of the antenna temperature. A second-order correction is necessary due to the imperfect impedance match between the receiver, the antenna, and the calibration references, and also due to the frequency-dependent noise characteristics of the receiver. A final calibration is applied, which references the antenna temperature to absolute standards measured at the input of the receiver in a controlled laboratory setting. Similar calibration methods used by other experiments have been described in previous work, but they were employed at lower frequencies and/or addressed different science goals (A.E.E. Rogers and J.D. Bowman, Radio Sci., 47, RS0K06, 2012), (G.J.A. Harker et al., MNRAS, 419, 1070-1084, 2012), (T. C. Voytek et al., ApJL, 782:L9, 2014). This talk will discuss the uncertainties involved in the EDGES calibration procedure, and their effect on the capability of this experiment for constraining the EoR parameters in the 100-200 MHz range.