Strengthening the Cosmological Interpretation of the EDGES Signal Through Instrumental Verification

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Verifying the detection of an absorption feature in the radio spectrum reported by the EDGES experiment, which could have a cosmological origin, represents one of the main objectives in low-frequency radio astronomy. Several global 21-cm experiments are attempting an independent detection from different locations. They include PRIZM, observing from Marion island; LEDA, located at the Owens Valley Observatory; and SARAS from India. However, significant challenges transform the detection verification into a daunting effort. These challenges include (1) achieving the accurate instrumental calibration required; (2) removing the contribution from strong astrophysical foregrounds despite our imperfect knowledge of them; and (3) minimizing the impact of unaccounted for environmental effects, such as ground radiation and radio-frequency interference.

In my talk I will describe the efforts conducted by EDGES during the past year to rule out instrumental and environmental artifacts and increase the confidence in the cosmological interpretation of the reported absorption feature. Most of the efforts to be discussed correspond to tests carried out at the EDGES observation site in the Murchison Radio-astronomy Observatory. The tests involve measuring the spectrum with different instrumental configurations. Specifically: (1) replacing the low-band antennas with versions optimized for different frequency ranges; (2) installing the low-band antennas over ground planes of different sizes and shapes; (3) removing the antenna from the receiver input and connect instead noise sources with noise temperature and spectral properties comparable to the astrophysical foregrounds; and (4) measuring at the receiver input other passive and active noise sources with an expected response that is spectrally flat. In all these cases, the spectrum has to be measured over several days in order to achieve the low noise level required. These field tests have been successful; i.e., measurements with other antennas and ground planes still show an absorption feature in the spectrum with characteristics similar to our original detection, while the spectrum from noise sources does not contain sharp features that resemble our detection. All these results strengthen the interpretation that the feature reported is not an instrumental or environmental artifact but, instead, a real distortion in the spectrum with an astrophysical origin. In my talk I will describe in detail these tests and their implications.