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Fundamental Cosmology from the Cosmic Dark Ages: The Case for a Very-Low Frequency Lunar Radio Array

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The highly-redshifted 21 cm line of neutral hydrogen holds great promise for cosmology. Observing this signal, however, is exceedingly challenging. Experiments must contend with the signal's inherent faintness, overwhelmingly bright astrophysical foregrounds, human-generated radio interference, and the Earth's own ionosphere. And, these challenges are all exacerbated for experiments looking to push to the highest redshifts where, during the time between the release of the CMB and the formation of the first stars, the 21 cm line is the only potential probe. However, measuring the spatial fluctuations of the hydrogen signal during these cosmic "dark ages" would be of tremendous cosmological value, providing multiple orders of magnitude more information than that available from the CMB. In this talk, I will review the cosmological promise of these measurements and present the basic attributes of a lunar-based radio interferometer that could hope to make such an observation. To conclude, I will discuss the research developments needed this decade to place such an experiment within the realm of possibility.

Primary author: POBER, Jonathan (Brown University)

Presenter: POBER, Jonathan (Brown University)

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