PAPER's Sweet Sixteen: Imaging the Low-Frequency Sky with a Sixteen-Element Array

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PAPER (The Precision Array to Probe the Epoch of Reionization) is a telescope that is being designed to detect the redshifted hydrogen signal from the early universe. The hydrogen is at a redshift $\sim 6 - 14$, bringing the spin-flip transition of neutral hydrogen from 1.4 GHz to a regime between 100 and 230 GHz. This experiment will be located in the radio-quiet zone of Western Australia at the Murchison Radio Observatory site, with 128 dual-polarization antennas.

We have successfully implemented an engineering array at the National Radio Astronomy Observatory in Green Bank, West Virginia. Green Bank is an excellent proving ground for instrumentation, configurations, and imaging methods that will be used for the Western Australia array. We present calibration methods and results with a sixteen-element array operating from approximately 100 to 200 MHz. Our longest baselines are $\sim$277 m, giving us a maximum resolution of 0.4° at 150 MHz. This instrument is well-suited for surveys with a large primary beam (FWHM$\sim$120°) pointed at the zenith. Results with eight-elements have been encouraging, pushing the image noise towards the confusion limit with long integrations. With sixteen-element capability, we will also produce "snapshot" images. We will use measurements of accurate fluxes and spectra of the brightest radio sources (Cyg A, Cas A, Tau A, etc.) to tie our catalog to previous studies, such as the VLSS (VLA Low-Frequency Sky Survey). Knowledge of these foregrounds is crucial for the epoch of reionization experiment, since foregrounds are many orders of magnitude above the statistical fluctuations of the primordial hydrogen. Future work will focus on improving the imaging resolution with longer baselines and probing the effects of the ionosphere on image fidelity.