Status of the Hydrogen Epoch of Reionization Array

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The Hydrogen Epoch of Reionization Array (HERA) uses the unique properties of the 21 cm line of neutral hydrogen to probe the Epoch of Reionization (EoR) and the preceding Cosmic Dawn. During these epochs, roughly 1/3 to 1 Gyr after the Big Bang, the first stars and black holes formed and heated and reionized the Universe. By directly observing the large scale structure of reionization as it evolves with time, HERA will profoundly impact our understanding of the birth of the first galaxies and black holes, their influence on the intergalactic medium (IGM), and cosmology. More details may be found in DeBoer *et al* (PASP vol. 129, 2017).

With support from the National Science Foundation, the Gordon and Betty Moore Foundation, and the HERA partners, HERA is funded to build and operate a 350-element array of 14-meter zenith-fixed antennas at the radio-quiet Karoo Astronomy Reserve in the Northern Cape of South Africa. Each element will operate from 50 - 237 MHz, corresponding to red-shifts from about 27 - 5. The full bandwidth is correlated initially at 97 kHz channels and 10 sec integrations, evolving to 30 kHz channels and 2 sec integrations. The new wide-band feed is a dual-polarization Vivaldi-based feed designed by Cavendish Laboratory, Cambridge University. The digitizer/channelizer is based on a field-programmable gate array (FPGA) board (Smart Networked Analog Processor; SNAP) designed as part of this effort, and is now part of the CASPER suite of hardware and tool-flow (https://casper.berkeley.edu). The SNAPs are being deployed into field-based "nodes".

The development and deployment of HERA has been staged, both in terms of construction (number of available elements) and hardware "epoch" (end-to-end replacement of signal path). Until this year, the entire signal path was derived and recycled from the previous PAPER array located at the Karoo site. HERA is currently in the midst of transitioning to the new node architecture. HERA operated with the previous hardware for two observing seasons (determined by when the anti-Galactic center is up at night, to avoid the Galactic center and the sun) with initially 19 elements, and then up to 70 (the number changes as new antennas are constructed and brought on line). Currently, the array has 142 elements constructed, with significant portions of 45 more completed. The full 350 elements is expected to be completed in calendar year 2019. Currently 6 new feeds are deployed (with an additional 4 at a Cambridge University test array in the UK and 1 at a test facility at the Green Bank Observatory in West Virginia). 50 systems are expected to be deployed in 2018, evolving to the full 350 in 2019. Note that this is approximately one season behind initial projections.