The Large-Aperture Experiment to Detect the Dark Ages

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The Large-Aperture Experiment to Detect the Dark Ages (LEDA) project seeks to detect or constrain the sky-averaged HI 21cm line at z ~20 and thereby characterize the physical conditions in the intergalactic medium during the transition from the Dark Age to the Epoch of Reionization. LEDA will make a measurement of the 21cm signal using a total power dipole (replicated five times to aid in the elimination of systematics). Such a detection will require accurate calibration of instrument gain patterns. To aid in this calibration, LEDA will combine the single dipoles with 251 antennas from Long Wavelength Array (LWA) at the Owens Valley Radio Observatory using a full correlation backend.

The LEDA FX correlator is a hybrid design, consisting of an FPGA based F-engine and Kepler GPU based X-engine, and capable of servicing 512 inputs. The initial digitization and transformation into the frequency domain is performed by 16 FPGA boards, before the correlation process is completed by cross-multiplication on 22 GPUs.

Each FPGA node sends 14.7Gb/s of data, requiring each GPU server to capture ~ 21.4 Gb/s for an aggregate data rate of ~235.4 Gb/s. The data capture is performed using the PSRDADA software package, and the data are cross-multiplied using a version of the Harvard X-Engine GPU code optimized for the Kepler GK110 (K20X) architecture. The complete correlator takes 36U and draws < 12kW of power, with a sustained processing performance of 62TFLOP/s.

First light for the deployed system was obtained on 29 July 2013. The design and deployment of the correlator will be discussed and the first results presented, along with an update of progress toward total power results.

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