Commissioning Results and Future Work with the Focal-plane L-band Array feed for the Green Bank Telescope (FLAG)

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Significant progress has been made in recent years in improving the sensitivity of phased array feed (PAF) receivers through optimizing the design of the antenna array, cryogenic cooling of the front end, and implementation of real-time correlation and beamforming in digital signal processing. We report on recent commissioning tests of the FLAG PAF receiver and next steps in the development of high sensitivity, wide field receivers for large single dish astronomical telescopes.

FLAG is a 19 element, dual-polarization, cryogenic phased array with direct digitization of RF signals at the front end, digital signal transport over fiber, and a real-time signal processing back end with up to 150 MHz bandwidth. The digital back end includes multiple processing modes implemented on graphical processing units (GPUs) that perform parallelized operations. Parallelization greatly increases processing speed and allows for real-time signal processing.

During FLAG commissioning, sensitivity consistent with a system temperature below 18 K was measured. To demonstrate the astronomical capability of the receiver, a pulsar (PSR B2011+38) was detected and an HI source (NGC4258) was mapped with the real-time beamformer and fine channel correlator respectively.

The presentation will give an overview of the FLAG system, back end signal processing implementation and data pipeline, measured performance figures of merit, and experimental results from commissioning tests. It will also provide a brief look at the design of Advanced L-band Phased Array Camera for the Arecibo Observatory (ALPACA). The ALPACA signal processing back end will build upon the prior work done on FLAG. With these and other recent developments in phased array feed technology, wide field PAFs promise to significantly improve the survey capability of astronomical observatories around the world.

Keywords: phased array feed, signal processing, beamformer