Searching for Low-Frequency Radio Transients using ETA

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The Eight-meter-wavelength Transient Array (ETA) is an array of 12 dual-polarization low-gain Galactic noise-limited active antennas and associated electronics designed to search for single dispersed pulses from astrophysical sources in the frequency range 29-47 MHz. A broad class of transients are of interest, including (but certainly not limited to) the hypothesized prompt emission from gamma ray bursts (GRBs) and pulses associated with the evaporation of primordial black holes (PBHs). ETA is sensitive to the entire sky, being limited only by the pattern of the antenna elements. The instrument is located on the campus of the Pisgah Astronomical Research Institute, in a mountainous rural region of Western North Carolina with relatively benign radio frequency interference (RFI) characteristics.

We are currently analyzing 53 hours of data collected over a three month time frame in Early 2007 using a new software tool chain that includes data validation, characterization of RFI, RFI excision, calibration and baseline removal, incoherent dedispersion, and pulse detection. RFI has proven to be a formidable problem not so much in that data is corrupted, but rather because it has proven difficult to automate the process of excision, making data reduction quite labor intensive.

Our initial objective is a search for PBHs in range 10-100 pc cm^{-3} with the objective of improving established rate-density limits by at least two orders of magnitude. Also, we are collecting and analyzing data collected from GCN-triggered observations with the goal of detecting GRB prompt emission. Observations of the diurnal variation of the Galactic background and strong sources are used to confirm the sensitivity and proper operation of the instrument and data reduction techniques. With about 10% of our current data set analyzed (as of September 2006), we have no significant detections to report. Upon completion, we plan to repeat the data reduction for DMs greater than 100 pc cm^{-3} (limited by the maximum contiguous recording time of about 1 hour) and DMs less than 10 pc cm^{-3} (limited primarily by unsuppressed RFI).

Additional observations using the current instrument are planned for Fall 2007 and and Winter 2008, aimed at increasing the available dataset by about an order of magnitude. Beginning in late 2008, observations will take advantage of long-baseline anti-coincidence techniques via a second similar instrument, dubbed "ETA2", now under construction.

ETA is a joint project of the Virginia Tech Departments of Electrical & Computer Engineering and Physics. Additional information is available via the project website, http://www.ece.vt.edu/swe/eta/.