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Interferometric Techniques for Radio Impulses from Ultra-high Energy Particle Showers

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Interferometric techniques are widely applied for a variety of radio detectors ranging from cosmology (redshifted 21 cm line and cosmic microwave background), radio astronomy (astrometry, imaging, and transient detection), and lightning. We present an interferometric technique for the reconstruction of ultra-wide band impulsive signals from ultra-high energy particles. This highly sensitive method was developed for the search for ultra-high energy neutrinos with the ANITA experiment but is fully generalizable to any antenna array detecting radio impulsive events from ultra-high energy particles. Applications of the interferometric method include event reconstruction, thermal noise and anthropogenic background rejection, and solar imaging for calibrations. We illustrate this technique with applications from the analysis of the ANITA-I and ANITA-II data in the 200-1200 MHz band. The ANITA collaboration has been developing a real-time interferometric trigger for the detection of ultra-high energy neutrinos and cosmic rays. I will discuss some of the key trades required in the application of interferometry to a real-time high data rate system. The interferometric trigger is expected to fly in the ANITA-3 balloon experiment in the 2014-2015 season.

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