A year of commensal observations with the V-FASTR transient detection system

Walter F. Brisken[2], Sarah Burke-Spolaor[1], Adam T. Deller[3], Walid A. Majid[1], Dayton L. Jones*[1], Divya Palaniswamy[4], Steven J. Tingay[4], David R. Thompson[1], Kiri L. Wagstaff[1], and Randall B. Wayth[4]

[1] Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, USA
[2] NRAO, PO Box O, Socorro, NM 87801, USA
[3] ASTRON, Oude Hoogeveensedijk 4, 7991 PD Dwingeloo, The Netherlands
[4] International Centre for Radio Astronomy Research, Curtin University. GPO Box U1987, Perth WA, 6845. Australia

The VLBA Fast Transients experiment (V-FASTR, R. Wayth et al., ApJ 735 97, 2011) is, as far as we are aware, the first and longest-running fully automated commensal system to search for fast radio transients. It applies incoherent dedispersion to spectrometer data from the Very Long Baseline Array (VLBA) software correlator. It then detects candidate events and archives the appropriate segments of raw voltage data for more thorough manual review. This experiment has several unique features. First, VLBA operations expose it to a wide range of observing frequencies, from 0.3-86 GHz. Second, it is possible to accurately localize event candidates using very long baseline interferometery. Finally, geographic separation of VLBA antennas has enabled new detection methods that are robust against terrestrial interference (Thompson et al., ApJ 735 98, 2011). This make the V-FASTR system a relevent technology testbed for geographically-distributed instruments like the Square Kilometre Array. In the meantime the system has placed new limits on the rate and magnitude of high-frequency fast transients (R. Wayth et al., ApJ 753 L36, 2012).

The V-FASTR system has now operated for over a year in concert with standard VLBA operations. It has accumulated over 2500 hours of telescope time. No unknown astronomical transient sources have been observed. However, the system has blindly detected eight known pulsars during routine array operations: J0332+5434, J1136+1551, J0826+2637, J1935+1616, J0157+6212, J01919+0021, J0147+5922, J1645-0317. Post analysis demonstrates that RFI-robust multi-station detection methods were essential for successful detections in at least three of the nine cases. V-FASTR has occasionally detected individual pulses from pulsars whose expected flux density is far below the VLBA detection threshold of 0.7 Jy at 1.6GHz. It is thought that these extreme events were caused by a combination of scintillation and intrinsic pulse flux variability. Our presentation will describe the experiment, its current event rate limits, and show examples of the anomalously strong pulses.

The International Centre for Radio Astronomy Research is a Joint Venture between Curtin University and The University of Western Australia, funded by the State Government of Western Australia and the Joint Venture partners. S.J.T is a Western Australian Premiers Research Fellow. R.B.W is supported via the Western Australian Centre of Excellence in Radio Astronomy Science and Engineering. The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc. This research was supported by the Keck Institute for Space Studies. Part of this research was performed at the Jet Propulsion Laboratory, California Institute of Technology, under the Research and Technology Development Strategic Initiative Program, under a contract with the National Aeronautics and Space Administration.