



Gauribidanur Pulsar System: A prototype software-based binary radio telescope for transient surveys

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Searching for fast astrophysical transients is of great interest in the radio astronomy community. Such transient surveys require a wide sky coverage with high temporal, spectral, and spatial resolutions, and fast data processing capabilities. In this light, we upgraded the recently commissioned Gauribidanur Pulsar System (GAPS) [1] operating at low radio frequencies (<100 MHz) with a “1-bit” raw voltage recording digital receiver. Binary voltage streams from each antenna element are recorded separately at the Nyquist sampling rate, and the beamforming is performed offline. Such a binary system reduces the tremendous data rates/volumes, and processing complexities associated with high-speed voltage recording systems. Multiple simultaneous beams can be formed covering the large field of view owing to the use of Log Periodic Dipole Antennas (LPDA), and search for dispersed pulses can be performed with high resolutions over a wide parameter space.

The initial results of pulsar detections using the upgraded system are shown in Figure 1. The pulsar average profiles and parameters closely match with those reported earlier from observations elsewhere in similar frequency ranges with multi-bit systems. Despite the reduction in sensitivity and nonlinearities that come with it [2], such 1-bit voltage recording system offers flexibility and is better suited where the goal is to cover maximum area of the sky for blind-search transient surveys with lower computing costs and data storage requirements.

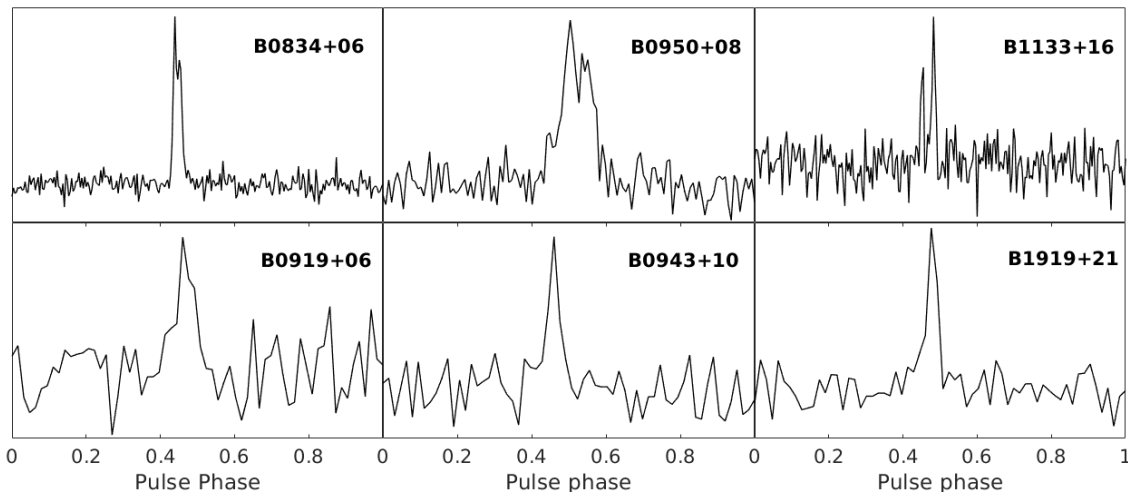


Figure 1. Average profiles of pulsars detected with GAPS using 1-bit raw voltage recording system

1. Kshitij S. Bane, Indrajit V. Barve, G. V. S. Gireesh, C. Kathiravan, and R. Ramesh, “Prototype for pulsar observations at low radio frequencies using log-periodic dipole antennas,” *Journal of Astronomical Telescopes, Instruments, and Systems*, **8(1)**, 017001 (4 February 2022), doi: 10.1117/1.JATIS.8.1.017001

2. J.H. Van Vleck and D. Middleton, “The spectrum of clipped noise,” *Proceedings of the IEEE*, **54**, 1, pp. 2–19, 1966, doi: 10.1109/PROC.1966.4567