

A 610 MHz pulsar search of the Galactic plane with the GMRT

*M. A. McLaughlin*¹, *B. C. Joshi*², *A. G. Lyne*³, *M. Kramer*³ & *D. A. Ludovici*¹

¹ Department of Physics, West Virginia University, Morgantown WV 26506

² National Center for Radio Astrophysics, Ganeshkhind, Pune 411007, India

³ University of Manchester, Jodrell Bank Observatory, Macclesfield, SK11 9DL, UK

Results of a search for pulsars between Galactic longitudes $45 < l < 135$ and Galactic latitudes $|b| < 3$ with the Giant Meterwave Radio Telescope at 610 MHz are presented. We give a current status report on the survey and describe the known and new pulsars that have been detected. Follow-up observations have been carried out with the GMRT and the Lovell Telescope. We present the properties of the new pulsars, including timing solutions, flux densities and multi-frequency pulse profiles. We also discuss the radio frequency interference environment (RFI) at the GMRT and possible methods of RFI mitigation.

1 Observations

The survey consists of 300 fields. The observations were conducted using typically 20 to 25 45-m GMRT antennas combined in an incoherent array mode at a frequency of 610 MHz. Each 43' by 43' field in this mode was observed for 35 minutes with a bandwidth of 16 MHz with 256 spectral channel across the band. The data in each channel were acquired with 16-bit precision every 256 μ s after summing the two polarizations and recorded to SDLT tapes for off-line processing. The 8 sigma threshold for detecting a pulsed signal with a duty cycle of 10 percent for the configuration used is 0.5 mJy, which is comparable to the sensitivity of the Parkes multibeam survey (Manchester et al. 2001).

2 Candidate Localization

The pulsar candidates were confirmed in the follow-up observations with the GMRT using the same observing configuration as used for the survey. The pulsar position was localized exploiting the multi-element nature of the GMRT. The range of baselines available for the GMRT antennas allows forming beams with a range of beam-widths when appropriate antennas are combined as a phased array to form an equivalent single dish with similar sensitivity as a 20 antenna incoherent array. Three combinations of the nearest 3, 5 and 6 antennas respectively were used in this mode to observe the candidate field and four fields offset in Right Ascension and Declination by half of Full Width at Half Maximum (FWHM) for the respective array. The respective FWHM in the above configurations were 20, 10 and 5 arcminutes. The detected signal-to-noise ratio of each new pulsar in these gridding observations was used to refine the position successively to 5 arcminutes accuracy. The refined position was used for timing observations at 1420 MHz with the Lovell Telescope at Jodrell Bank Observatory. This allowed follow-up confirmation and timing studies with high sensitivity with the Lovell Telescope and a rapid determination of pulsar parameters.

NAME	l_{field} (deg)	b_{field} (deg)	l (deg)	b (deg)	DM (pc/cm ³)	P (s)	Pdot (10 ⁻¹⁵)
J0026+6320	120.15	0.78	120.18	0.59	230.31	0.318357728337(2)	0.1500(2)
J2208+5500	101.25	-0.78	100.94	-0.75	101.03	0.93316093521(1)	6.988(5)
J2218+5729	103.95	0.78	103.52	0.49	162.75	1.056844	

Table 1: Timing Parameters of the new pulsars

3 Analysis

The data were analyzed using the pulsar searching package SIGPROC (<http://sigproc.sourceforge.net>). The data were dedispersed using 145 trial dispersion measures (DM) ranging from 0 to 2000 pc cm⁻³, with spacing determined by the dispersion smearing across each individual frequency channel. Periodicities were searched for using both a Fast Fourier Transform and a Fast Folding Algorithm. Known interference frequencies were eliminated and new pulsar candidates were identified through inspection of diagnostic plots. A single-pulse search was also performed; due to the large amount of impulsive interference in our data, the results of this search are still under analysis.

4 Results

Out of 300 fields observed so far, we have processed 214 fields, covering about 100 square degrees of sky and redetected 11 known pulsars. Three new pulsars, PSRs J0026+6320, J2208+5500 and J2218+5729, have been discovered so far. The observed parameters of the new pulsars are given in Table 1.

The entire data are being reprocessed with better radio frequency interference excision to look for sources similar to recently reported Rotating Radio Transient (McLaughlin et al. 2006), for which the parameters of this survey are particularly suitable. We are also extending the survey area to ($45 < l < 165$, $|b| < 3$) and plan to complete these observations in the coming months. We expect to report on the discovery of at least 6 pulsars by the time of the poster presentation.

A large part of our poster presentation will deal with the interference environment at the GMRT and the efficacy of different methods for RFI excision.

References

- [1] R. N. Manchester et al., *MNRAS*, **328**, 17–35(2001).
- [2] M. A. McLaughlin et al., *Nature* **439**, 817–820(2006).