

## A high Galactic latitude search for pulsars

B.C. Joshi<sup>1,2</sup>, M. Burgay<sup>3</sup>, A.G. Lyne<sup>1</sup>, R.N. Manchester<sup>4</sup>, A. Possenti<sup>3</sup>,  
F. Camilo<sup>5</sup>, N. D'Amico<sup>3</sup> and M. Kramer<sup>1</sup>

<sup>1</sup>Jodrell Bank Observatory, University of Manchester, UK

<sup>2</sup>National Centre for Radio Astrophysics, Post Bag 3, Ganeshkhind, Pune 411007, India

<sup>3</sup>University of Bologna, Italy

<sup>4</sup>Australia Telescope National Facility, CSIRO, Australia

<sup>5</sup>Columbia University, USA

**Abstract.** Millisecond pulsars (MSPs) are an important class of radio pulsars. Their observed spatial distribution is flux limited and is nearly isotropic. Many such pulsars have been observed at high Galactic latitudes. The preliminary results of a new survey with Parkes radio telescope using the 20 cm multibeam receiver are reported in this paper. The survey covers a region around the southern Galactic plane between longitudes  $220^\circ$  and  $260^\circ$  and latitudes  $|b| < 60^\circ$ . We have discovered two new pulsars and detected 15 known pulsars so far.

Although a vast majority of pulsars are observed close to the Galactic disk, pulsars, particularly MSPs, have been detected at high Galactic latitudes (Wolszczan 1991; Camilo, Nice & Taylor 1996; Lyne et al. 1998). Johnston and Bailes (1991) have argued that the observed spatial distribution of MSPs is flux limited due to their low luminosities and is consequently nearly isotropic. The recent Swinburne intermediate latitude survey (Edwards et al. 2001), which discovered 8 new MSPs, supports this argument. Thus, a sensitive survey is likely to discover new pulsars at high Galactic latitudes. Moreover, a higher sensitivity survey for new MSPs covering a range of latitudes is also required to determine their true spatial distribution, which has implications for the origin and evolution of these objects. MSPs are generally believed to be end-products of mass transfer in the evolution of low mass X-ray binaries (LMXBs) and a comparison of the spatial distributions of MSPs and LMXBs is useful to constrain this hypothesis (Ramachandran and Bhattacharya 1997). Simulations carried out by Toscano et al. (1998) predict a greater clustering of MSPs near the Galactic plane, but this needs to be established. A new survey is also required to increase the sample of long period pulsars (period  $> 2$  sec).

Parkes multibeam high Galactic latitude survey covers a part of the sky in the anti-center direction, which is less affected by scattering and sky background than the sky towards the Galactic center, allowing us to look for MSPs to a larger distance. The survey includes both low and high latitudes allowing better estimation of spatial distribution as a function of scale height. Finally, the 13 beam cooled 20 cm multibeam receiver at the Parkes radio telescope is used for the survey allowing high sensitivity combined with a faster sky coverage. The details of the instrumentation used and the data analysis procedure are described in Manchester et al. (2001). This survey is comparable in sensitivity with the Swinburne intermediate latitude survey and is an extension of the latter survey. The parameters of the survey are presented in Table 1.

Currently, 5000 out of 6456 pointings have been observed and a preliminary analysis for 1800 pointings has been carried out. We have discovered two new pulsars and redetected 15 known pulsars in the initial processing of the data set.

Table 1. The parameters of the survey.

Longitude Range	$220^{\circ} - 260^{\circ}$
Latitude Range	$-60^{\circ} - + 60^{\circ}$
Observing frequency (MHz)	1374
Total bandwidth (MHz)	288
Integration Time (s)	260
Sampling Time ( $\mu$ s)	125
Smin (mJy)	1

Table 2. The parameters for PSRs J0818 – 3233 and J0821 – 4220.

Pulsar	J0818 – 3233	J0821 – 4220
R.A. (J2000)	08:18:22.1(6)	08:21:23(4)
Dec. (J2000)	– 32:33:44(31)	– 42:20:24(16)
$P$ (s)	2.1612614488(6)	0.3967284256(3)
$\dot{P}$ ( $10^{-15}$ )	343(2)	2.1(6)
DM( $\text{cm}^{-3}\text{pc}$ )	138.2(2)	266.5(2)

Two of these are previously known MSPs (PSRs J0437 – 4715 and J1024 – 0719). The data processing procedure is being refined to improve interference rejection. Timing measurements were carried out during the last year and we have obtained phase connected timing solutions

for the two new pulsars. The parameters of these pulsars are presented in Table 2. The integrated profiles of the new pulsars are shown in Figure 1.

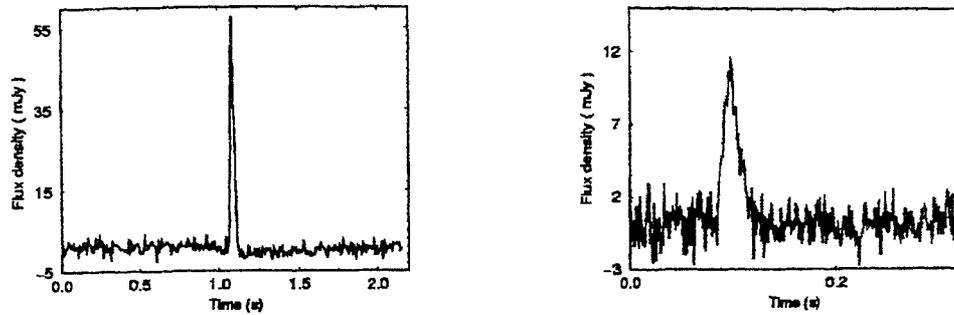


Figure 1. The integrated profiles for PSRs J0818 – 3233 and J0821 – 4220.

### References

- Camilo F., Nice D.J., Taylor J.H., 1996, *ApJ*, 461, 812.  
Edwards R.T., Bailes M., van Straten W., Britton M.C., 2001, *MNRAS*, 326, 358.  
Johnston S., Bailes M., 1991, *MNRAS*, 252, 277.  
Lyne A.G., et al., 1998, *MNRAS*, 295, 743.  
Manchester R.N., et al., 2001, *MNRAS*, 328, 17.  
Ramachandran R., Bhattacharya D., 1997, *MNRAS*, 288, 565.  
Toscano M., Bailes M., Manchester R.N., Sandhu J.S., 1998, *ApJ*, 506, 863.  
Wolszczan A., 1991, *Nat*, 350, 688.