Neutron Stars and Pulsars: Challenges and Opportunities after 80 years
Proceedings IAU Symposium No. 291, 2012
J. van Leeuwen, ed.

doi:10.1017/S1743921312024179

SPAN512: A new mid-latitude pulsar survey with the Nançay Radio Telescope

Gregory Desvignes[1], Ismaël Cognard[2], David Champion[1], Patrick Lazarus[1], Patrice Lespagnol[3], David A. Smith[4] and Gilles Theureau[3]

[1]Max-Planck-Institut für Radioastronomie, Auf dem Hügel, 69 D-53121 Bonn, Germany
email: gdesvignes@mpifr-bonn.mpg.de

[2]Laboratoire de Physique et Chimie de l'Environnement et de l'Espace, 3A Avenue de la Recherche Scientifique, 45071 Orléans cedex 2, France

[3]Station de radioastronomie de Nançay, Observatoire de Paris, CNRS/INSU, 18330 Nançay, France

[4]Université Bordeaux 1, CNRS/IN2P3, CENBG Gradignan, 33175 Gradignan, France

Abstract. We present an ongoing survey with the Nançay Radio Telescope at L-band. The targeted area is $74^\circ \lesssim l < 150^\circ$ and $3.5^\circ < |b| < 5^\circ$. This survey is characterized by a long integration time (18 min), large bandwidth (512 MHz) and high time and frequency resolution (64 μs and 0.5 MHz) giving a nominal sensitivity limit of 0.055 mJy for long period pulsars. This is about 2 times better than the mid-latitude HTRU survey, and is designed to be complementary with current large scale surveys. This survey will be more sensitive to transients (RRATs, intermittent pulsars), distant and faint millisecond pulsars as well as scintillating sources (or any other kind of radio faint sources) than all previous short-integration surveys.

Keywords. surveys, pulsars: general

1. Introduction

Major high-sensitivity pulsar surveys have recently started at different radio observatories due to improvement of digital backends and computing resources over the past few years. These L-Band surveys, ie. PALFA (Cordes *et al.* 2006), HTRU North (Barr 2011) and South (Keith *et al.* 2010), are concentrating their efforts at low galactic latitude ($|b| \lesssim 3.5^\circ$). We present here a new survey with the Nançay Radio Telescope (NRT) at intermediate latitude outside the PALFA sky that started early 2012 and designed to be more sensitive than the HTRU mid-latitude survey.

2. Observations

Observations are made with the new state-of-the-art NUPPI backend based on a CASPER† Roach board. Compared to the previous BON instrument used for past surveys (e.g. Cognard *et al.* 2011 and Guillemot *et al.* 2012) the bandwidth is increased by a factor of 4. Also this versatile backend now performs a full Polyphase Filter Bank to mitigate the frequency leakage of RFIs.

The targeted field of view ($74^\circ \lesssim l < 150^\circ$ and $3.5^\circ < |b| < 5^\circ$ for 230 square degrees) consists of a grid of ~ 5800 18-min pointings recorded with a 64 μs time resolution with 1024 channels over the 512 MHz bandwidth. Given the NRT system temperature and gain, we estimate the minimum flux density for long period pulsars to be 55-70 μJy

† https://casper.berkeley.edu/

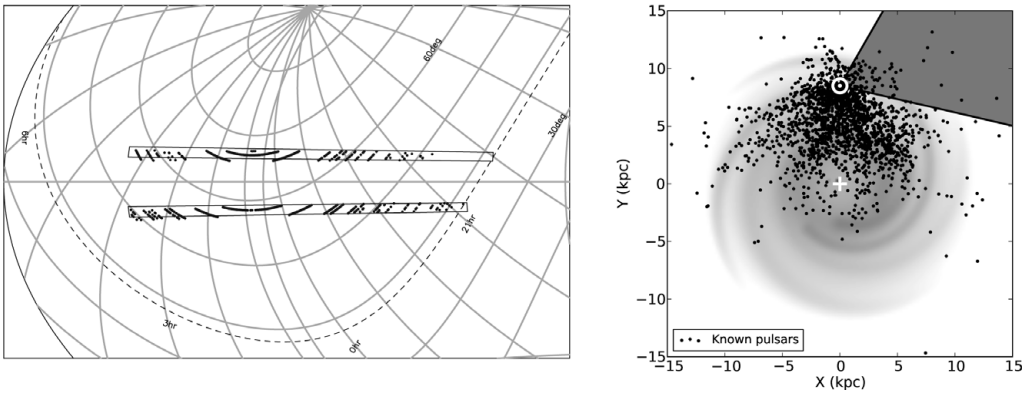

Figure 1. *Left panel:* View of the Galactic Plane in galactic coordinates. The two black boxes delimit the SPAN512 area and the black dots represent the 859 pointings made to date. The dashed line shows the Arecibo North declination limit. *Right panel:* View of the Galactic Plane from the North Galactic Pole. The Galactic Center is located at (0,0). The gray scale is computed from the NE 2001 electron density model by Cordes & Lazio (2002).

Table 1. Parameters of the SPAN survey

Sampling time	64 μs
Total bandwidth	512 MHz
Number of channels	1024
Center frequency	1486 MHz
Integration time	18 min
Final quantization	4 bits
Gain	1.4 K/Jy
System temperature	35 K
Nominal sensitivity	0.055 mJy
Total observing time	1740 hours

depending on the pointing declination. The basic parameters of the survey are listed in Table 1.

3. Processing

A total data volume of 50 TB is expected after completion of this program. To search these data, 2 different schemes are considered, both using the Presto† package:

• A quicklook pipeline that reduces the original time resolution by a factor of 4 is used on site and is able to keep up with the data acquisition. No acceleration search is performed at this stage.

• To search the full-resolution data with acceleration, we are currently implementing a new pipeline‡ to run at the IN2P3 Computing Center¶ developed originally for the ongoing PALFA survey. To remain sensitive to very short orbital period binaries, we also split the observations in half and analyze each separately before combining results. In the light of the recent discoveries of highly dispersed radio bursts (Lorimer *et al.* 2007 and Keane *et al.* 2012), the data are searched for single pulses up to a DM of 1800 cm^{-3} pc.

† https://github.com/scottransom/presto
‡ https://github.com/plazar/pipeline2.0
¶ http://cc.in2p3.fr/

https://doi.org/10.1017/S1743921312024179 Published online by Cambridge University Press

4. Conclusion

Preliminary results of the quicklook pipeline indicate a relatively low RFI environment (∼10% of the radio band being masked), especially considering the very wide bandwidth. In the observations to date, three previously known pulsars (including one MSP) were redetected.

About 860 of the 5800 planned pointings have been made (15% of the 230 square degrees of this survey) and completion is expected by 2013 with the discovery of 10 to 30 new sources according to population models (Lorimer *et al.* 2006).

Acknowledgements

The Nançay Radio Telescope is part of the Paris Observatory, associated with the Centre National de la Recherche Scientifique (CNRS) and the University of Orléans, France. We also acknowledge the Centre de Calcul CC-IN2P3. (IN2P3, CNRS Villeurbanne, France) for providing us with computing resources.

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