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Timing Observations of PSR B1937+21 at CRL

Y. Hanado, Y. Shibuya, F. Nakagawa, M. Sekido, M. Hosokawa, M. Imae

Communications Research Laboratory (CRL), 4-2-1, Nukui-Kita, Koganei, Tokyo 184-8795, Japan

Abstract. Pulsar parameters of PSR B1937+21 acquired from observations at the Kashima 34-m antenna over five years are consistent with published reports. The frequency stability is 2×10^{-14} over the data span of 6.5 years using Kashima data combined with Parkes data.

1. Introduction

CRL has conducted investigations on a millisecond pulsar to apply them to a precise time scale. We developed a timing observation system which uses an AOS (Acousto-Optic Spectrometer) instead of filter bank and has 200 MHz bandwidth (BW; 200 kHz×256 ch×4 units). We started weekly observations of PSR B1937+21 at S-band with the 34-m antenna at Kashima (35°57′N, 140°39′E) in 1997 Nov. We have reported the pulsar's parameters and frequency stability by using one unit's data (50 MHz BW) for the first three years (Hanado et al. 2002). In this paper we report on data from four units (200 MHz BW), combined with Parkes data in order to verify that our data are consistent with other sites' data.

2. Combination with Parkes Data

We combined the Kashima data at S-band (1997 Nov–2003 Apr) with Parkes data at L-band (1995 Aug–1996 Sep), and carried out parameter fitting by using TEMPO (Taylor & Weisberg 1989). Kashima data were obtained from one day's averaging and 4 units' accumulating. Initial parameters for fitting were derived from Lange et al. (2000), except DM deviation, which was newly estimated by the joint research with a Russian group (Ilyasov et al., these proceedings). The parameters after fitting (Table 1) were consistent with the previous reports (Kaspi et al. 1994). Figure 1a shows the residuals after fitting. Kashima residuals match well with Parkes's without any apparent gaps or unmodeled trends. Figure 1b shows the frequency stability σ_z (Matsakis et al. 1997) calculated from the residuals in Figure 1a. Our results are consistent with Arecibo's.

From these results, we can say that our data over 5 years are consistent with Parkes and other data. We were also able to check PSR B1937+21's frequency stability in the long term with this combination. These results are a good demonstration that a medium-aperture antenna is effective for timing observations of a strong millisecond pulsar.

Table 1. Parameters for PSR B1937+21 obtained from Kashima data combined with Parkes data. DM is quoted from Lange et al. (2000), and DM deviation is quoted from Ilyasov et al. (these proceedings).

Parameters	Our fit results		
RA (J2000)	$19^h39^m38^s.560107(7)$	Time scale	UTC
Dec (J2000)	$21°34'59''.1360(2)$	Ephemeris	DE200
PmRA (mas/yr)	−0.04(4)	DM (pc cm^{-3})	71.0299
PmDec (mas/yr)	−0.53(7)	DM deviation	−0.0012
π (mas)	2.9(8)	Epoch	MJD 51000
ν (Hz)	641.928249503944(2)		
$\dot{\nu}$ (s^{-2})	$-4.33110(4) \times 10^{-14}$		

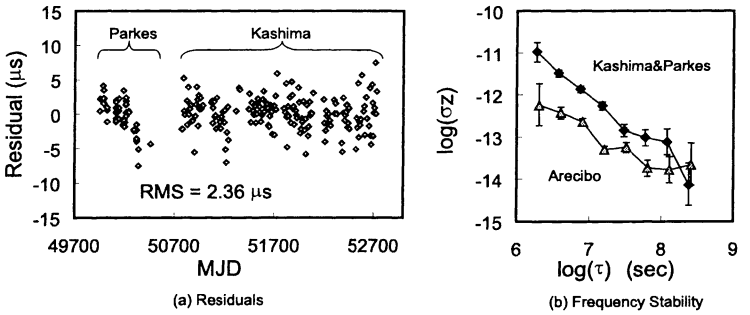

Figure 1. (a) Post-fit timing residuals, and (b) frequency stability of PSR B1937+21 obtained from Kashima data combined with Parkes data. Arecibo data was quoted from Matsakis et al. (1997).

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