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A WSRT Search for Millisecond Pulsars

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Abstract. Based on our examination of the characteristics of about 280 known pulsars and 40 millisecond pulsars (MSPs), we have derived selection criteria for MSP candidates: steep spectrum, highly linearly polarized point sources. The first sample of 14 candidates from the NVSS at 1.4 GHz and the WENSS at 325 MHz has been observed by the WSRT using PuMa at both 92 and 21 cm in May 1999. We have finished processing all data and find no evidence for MSPs for a dispersion measure range of 0 — 200 cm^{-3} pc in this first sample.

There are many point-like sources which have not been identified in the NRAO VLA SKY Survey (NVSS) and Westerbork Northern Sky Survey (WENSS) catalogues released two years ago. Some of them could be pulsars (Han and Tian, 1999). We have therefore investigated the characteristics of known normal pulsars and MSPs. Figure 1 shows two properties of 280 normal pulsars with known linear polarization and flux density. The MSPs are somewhat more strongly polarized and have steeper spectra than normal pulsars (Tian et al. 2000).

Based on our study, we have selected a sample of candidate MSPs from the NVSS and WENSS catalogues according to the following criteria: steep spectrum ($\alpha \leq -1.5$), high linear polarization ($\geq 15\%$), low flux density ($\leq$100 mJy at 325 MHz), and high galactic latitude ($\geq 30^0$). Our selection criteria can distinguish MSP candidates from both radio quasars and compact steep spectrum sources.

Table 1 shows the parameters for 14 candidates which have been observed by the WSRT at both 92 and 21 cm in combination with the new pulsar machine PuMa. We observed each candidate source for about 215 seconds, corresponding to a 2 Mpt time series with a sampling time of 0.1 ms at both frequencies. At 92 cm we used 39 kHz channels and a 10 MHz bandwidth, while at 21 cm we used 156 kHz channels and an 80 MHz bandwidth. This is sufficient to detect each of them if the emission is 100% pulsed. Including the time for set up and calibration, the total observation time was 3.5 hours. The data analysis was done using software developed by the pulsar group in Amsterdam.

With the data processing complete, the signal-to-noise ratio of most candidate pulsations over the range searched in period and DM is under 5, too low for any to be considered genuine new MSPs. Since our observations would have

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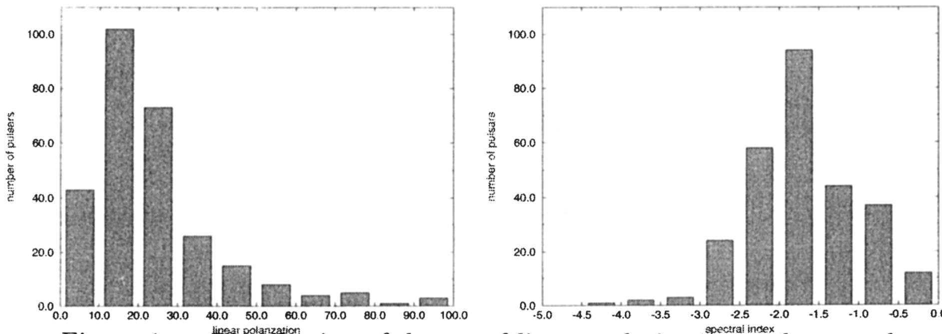

Figure 1. Distribution of degree of linear polarization and spectral index for 280 pulsars

been able to detect MSPs with $DM \leq 200$ cm^{-3} pc, future searches should aim for distant MSP candidates with generally larger DM values than in the present search. From our analysis of the data on all candidates with $DM \leq 200$ cm^{-3} pc, we find no direct evidence that any of the sources is a MSP.

Table 1. Parameters of 14 MSP candidates from WENSS and NVSS

RA (2000) h m s	Dec (2000) ° ′ ″	$S_{\rm WENSS}$ Jy	$S_{\rm NVSS}$ Jy	α ($S \propto \nu^{\alpha}$)	l °	b °	L/S %
08 37 16.0	55 28 13.4	0.036	0.0031	-1.69	129.479	37.448	75
16 01 31.8	33 30 24.7	0.027	0.0024	-1.66	20.654	48.434	71
09 05 02.6	49 53 01.7	0.028	0.0028	-1.58	136.149	42.217	44
08 35 27.9	66 58 49.1	0.030	0.0032	-1.54	115.399	35.387	42
09 54 31.3	47 30 42.7	0.034	0.0027	-1.74	137.320	50.663	31
11 24 42.3	38 31 40.8	0.024	0.0022	-1.64	142.341	69.188	27
16 14 27.5	34 37 50.7	0.028	0.0030	-1.54	22.639	45.859	27
09 12 55.3	57 39 40.7	0.020	0.0021	-1.55	125.570	41.903	22
13 46 40.4	60 03 17.2	0.041	0.0032	-1.75	77.192	55.887	21
15 26 54.7	60 58 50.7	0.047	0.0038	-1.73	62.952	47.292	21
08 40 07.7	32 25 52.3	0.021	0.0021	-1.58	158.439	36.590	19
11 21 46.6	41 47 04.2	0.032	0.0036	-1.50	135.411	67.116	19
12 29 47.3	37 25 43.8	0.046	0.0034	-1.79	110.758	79.188	19
09 16 15.0	46 44 28.1	0.028	0.0026	-1.63	140.167	44.401	15

References

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