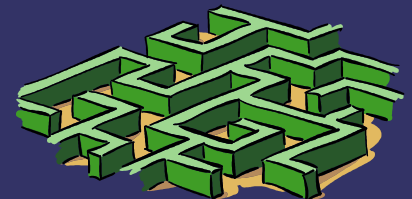


Polarization Observations of 20 millisecond pulsars

Wenming Yan (闫文明)

Xinjiang Astronomical Observatory
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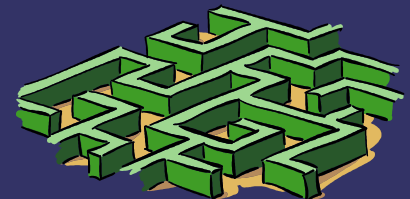
Outline

- ➔ Background
- ➔ Observations
- ➔ Data analysis
- ➔ Results
- ➔ Summary



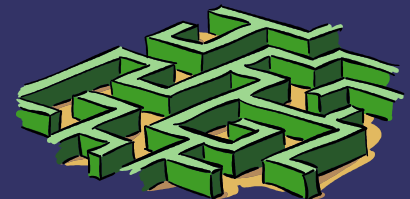
Background

- ⇒ Pulsars are highly polarized radio sources.
- ⇒ Polarization measurements can give us a lot of information.
- ⇒ MSPs have very different properties to those of 'normal' pulsars.
- ⇒ The polarization characteristics of MSPs are remarkably similar to those of normal pulsars.
- ⇒ The PA variations in MSPs are often complex and do not fit the RVM well.



Observations(1/3)

- ➔ The observations were made using the centre beam of the Parkes 20cm Multibeam receiver with PDFB2 between 2007 June and 2009 November.
- ➔ The total bandwidth was 256 MHz centred at 1369 MHz with 1024 channels across the band for most of the 20 pulsars.
- ➔ 17 pulsars were observed for 64 minutes each time, and 32 minutes for the other 3 pulsars (PSRs J1857+0943, J1939+2134, J2124-3358).



Observation(2/3)

- ⇒ All data were recorded using the PSRFITS data format with 1-minute sub-integrations.
- ⇒ A 2-minute calibration observation was made before each pulsar observation.
- ⇒ Flux density scales were established using observations of Hydra A.
- ⇒ Cross coupling between the two signal feed probes of the MB receiver was measured.



Observations(3/3)

Table 1. Observational parameters for the 20 PPTA MSPs

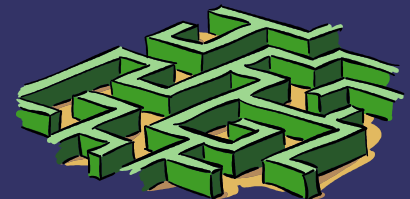
PSR	P (ms)	DM (cm^{-3} pc)	Nr of Channels	Nr of Bins	DM Smear (bins)	Nr of Obs.	Integ. Time (h)
J0437–4715	5.757	2.64	1024	1024	0.4	92	96.3
J0613–0200	3.062	38.78	1024	512	5.2	41	43.3
J0711–6830	5.491	18.41	1024	512	1.4	28	29.1
J1022+1001	16.453	10.25	1024	2048	1.0	34	34.3
J1024–0719	5.162	6.49	1024	1024	1.0	29	30.0
J1045–4509	7.474	58.17	2048	512	1.6	33	34.1
J1600–3053	3.598	52.33	1024	512	6.0	28	29.7
J1603–7202	14.842	38.05	1024	1024	2.1	23	23.7
J1643–1224	4.622	62.41	1024	512	2.8	34	36.1
J1713+0747	4.570	15.99	1024	1024	2.9	40	40.7
J1730–2304	8.123	9.62	1024	1024	1.0	23	23.7
J1732–5049	5.313	56.82	2048	512	2.2	24	24.7
J1744–1134	4.075	3.14	512	1024	1.3	33	34.4
J1824–2452	3.054	120.50	2048	256	4.1	27	28.0
J1857+0943	5.362	13.30	1024	1024	2.1	26	13.4
J1909–3744	2.947	10.39	1024	512	1.5	67	69.6
J1939+2134	1.558	71.04	1024	256	9.4	26	13.8
J2124–3358	4.931	4.60	1024	1024	0.8	25	13.1
J2129–5721	3.726	31.85	1024	512	3.5	25	25.5
J2145–0750	16.052	9.00	1024	2048	0.9	29	29.6

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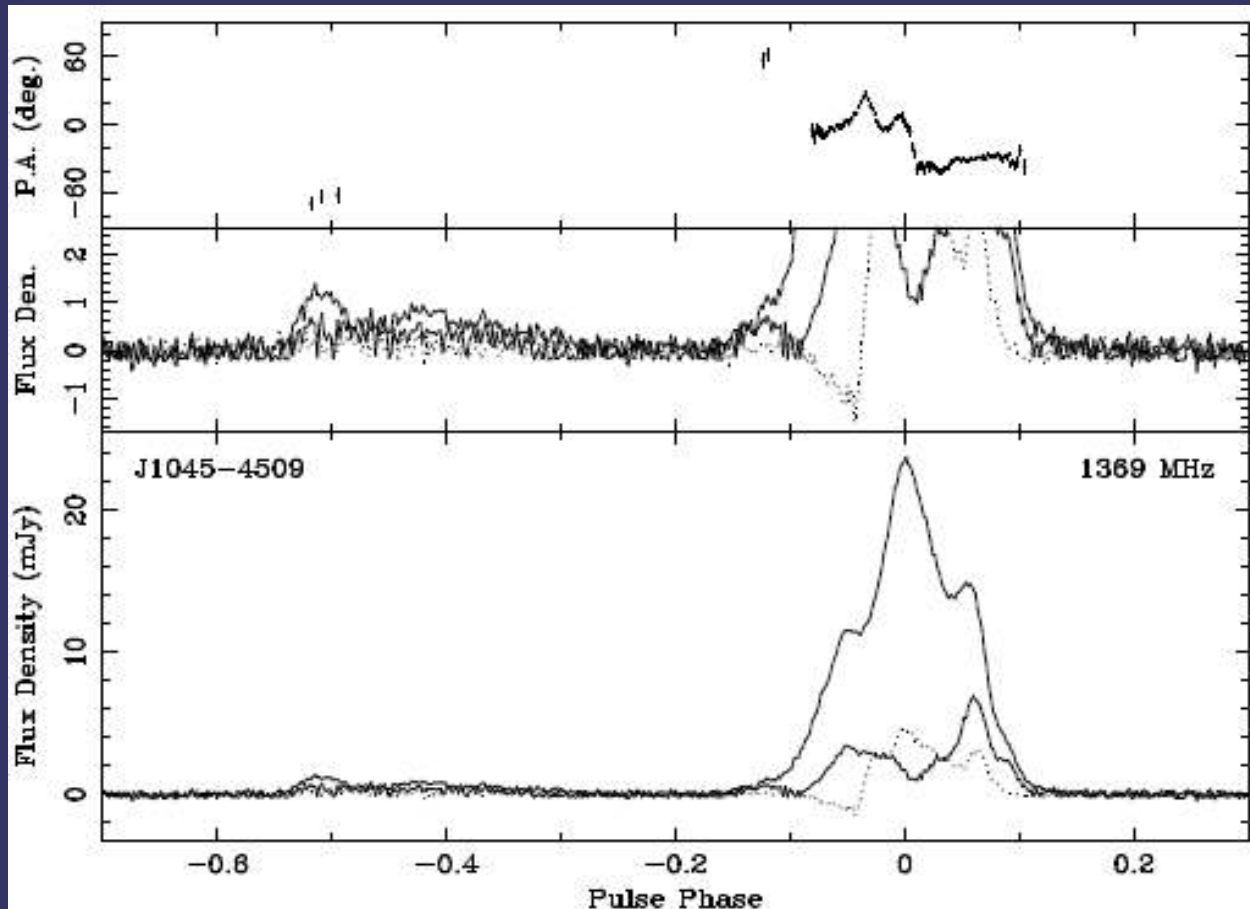
Data analysis

- ➔ All data were processed using the PSRCHIVE software package.
- ➔ We take the weighted average of RMs for each observation as the value of RM for a given pulsar.
- ➔ The ionosphere RM contribution was estimated using FARROT (at DRAO, Canada) and removed from the total RM.
- ➔ In order to accurately align the profiles, TEMPO2 was used to fit the TOAs for all observations for a given pulsar to give a timing model.

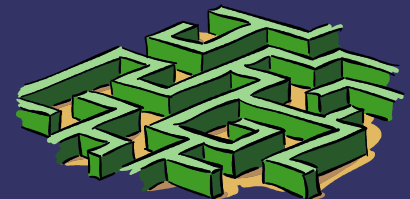


Polarization profiles(1/3)

➔ PSR J1045-4509

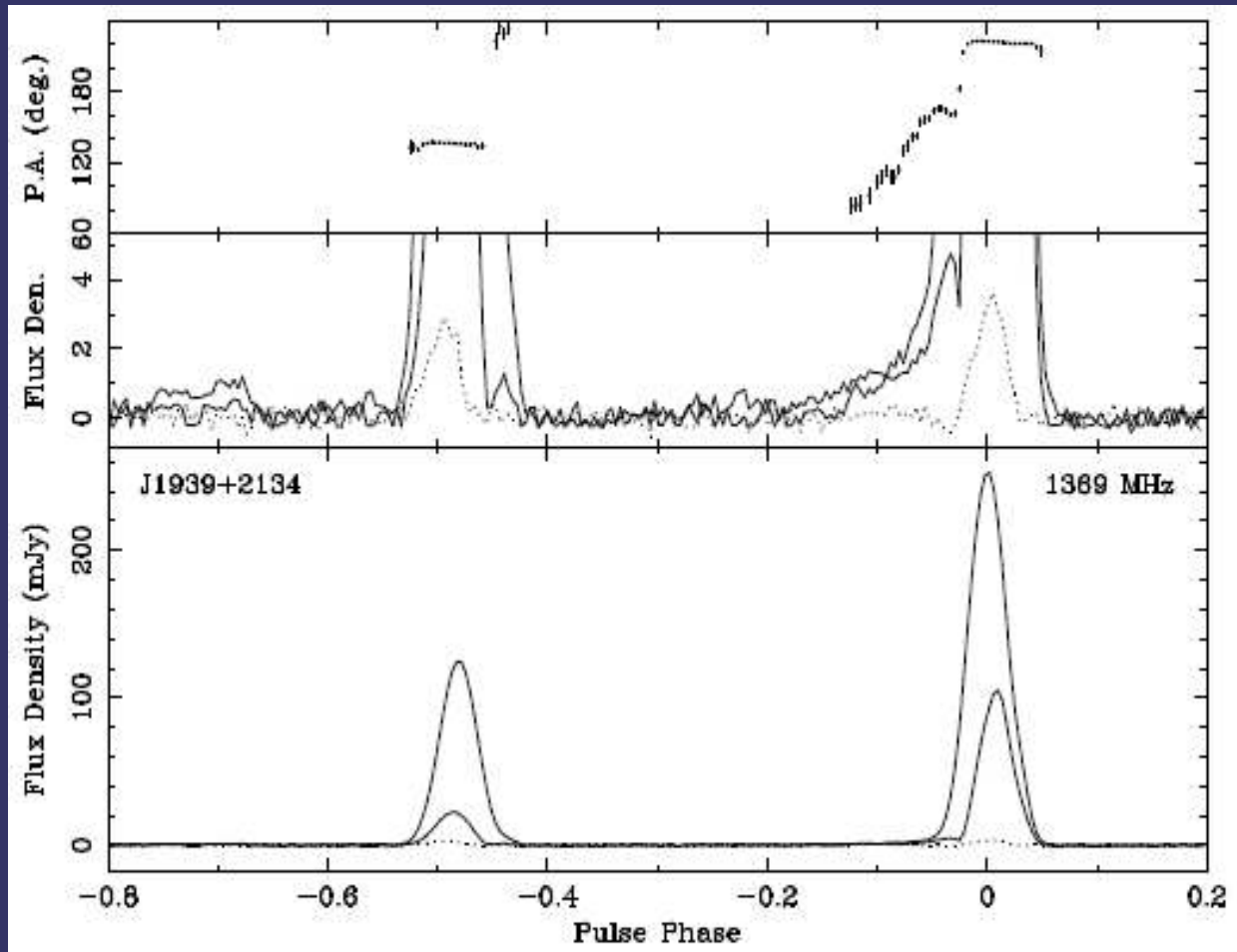


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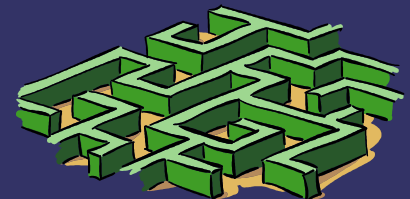


Polarization profiles(2/3)

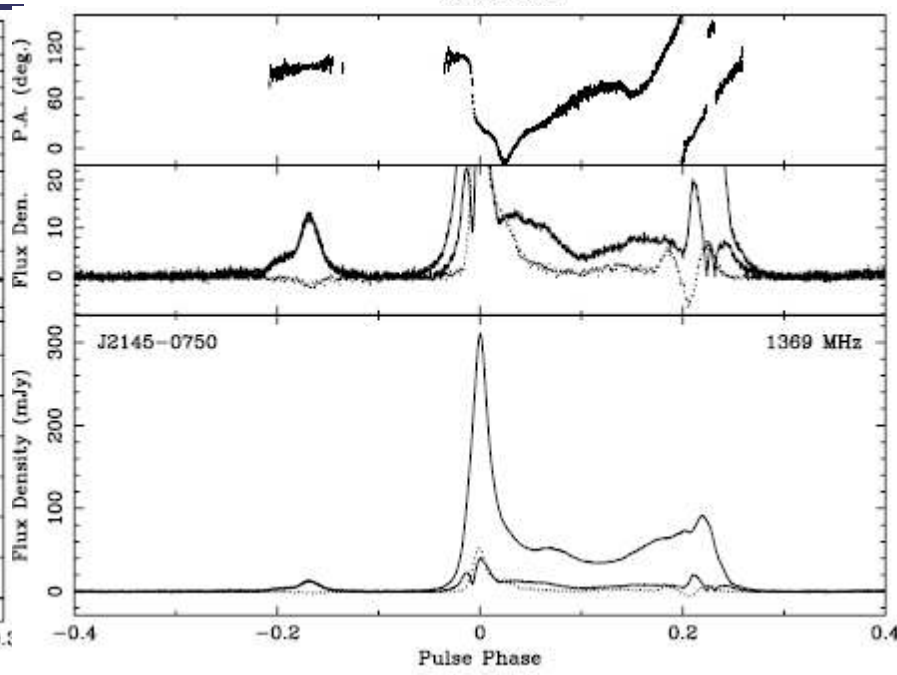
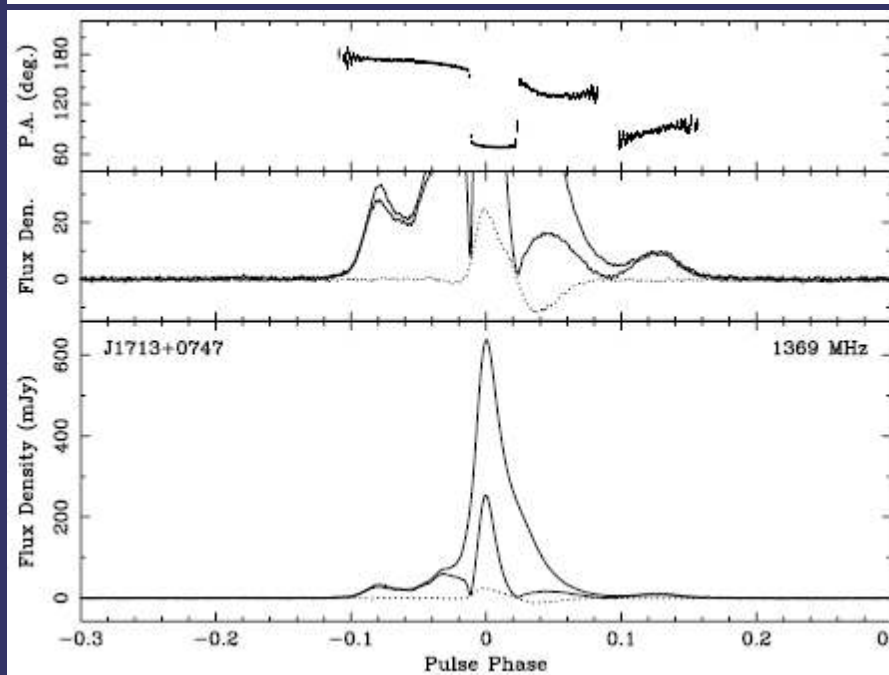
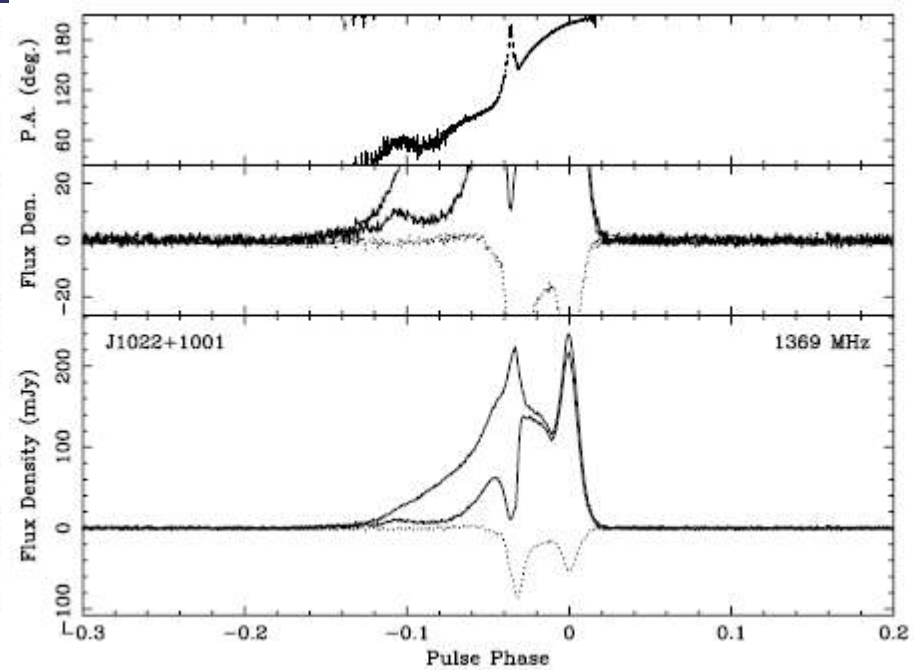
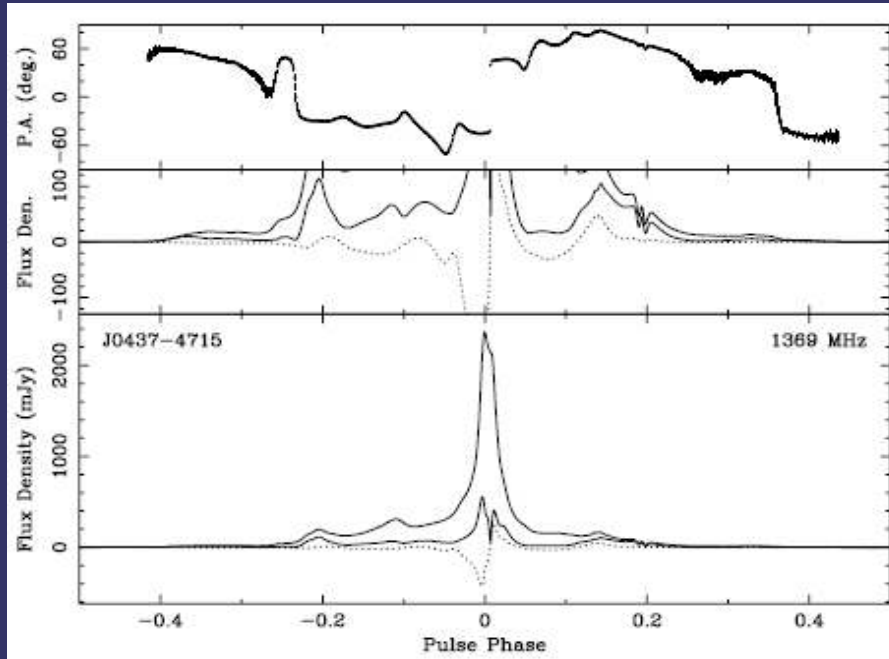
➔ PSR J1939+2134(PSR B1937+21)



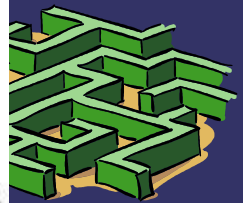
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Polarization profiles(3/3)

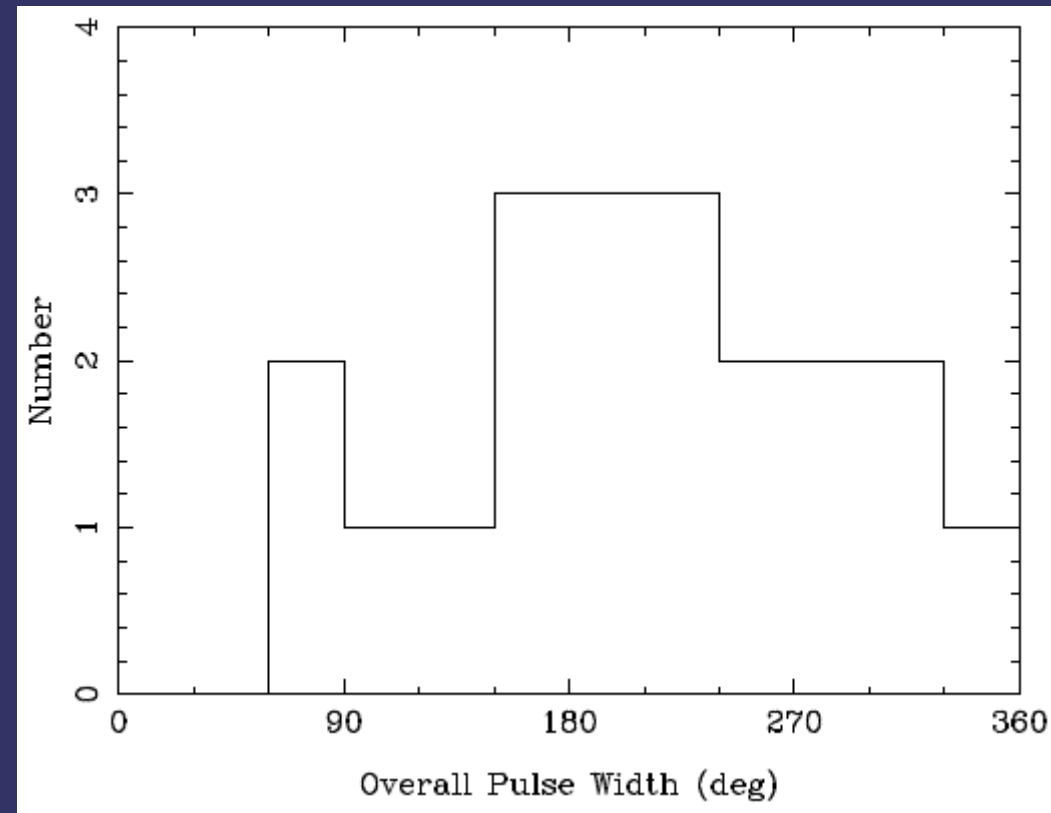


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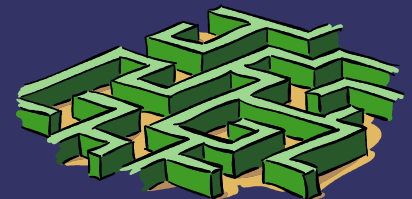


Overall pulse width

- ➔ Seven pulsars have emission spanning less than half of the period
- ➔ Five have emission over more than three quarters of the period



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Rotation Measure

PSR	Gal. l (deg)	Gal. b (deg)	Dist. (kpc)	RM (This work) (rad m ⁻²)	RM (Prev. Publ.) (rad m ⁻²)	$\langle B_{\parallel} \rangle$ (μG)
J0437-4715	253.39	-41.96	0.16	0.0 ± 0.4	$1.5 \pm 5^{\text{a}}$	-0.0 ± 0.19
J0613-0200	210.41	-9.30	1.25	9.7 ± 1.1	$19 \pm 14^{\text{b}}$	0.31 ± 0.03
J0711-6830	279.53	-23.28	0.86	21.6 ± 3.1	$67 \pm 23^{\text{b}}$	1.45 ± 0.21
J1022+1001	231.79	+51.10	0.56	-0.6 ± 0.5	—	-0.07 ± 0.06
J1024-0719	251.70	+40.52	0.53	-8.2 ± 0.8	—	-1.56 ± 0.15
J1045-4509	280.85	+12.25	0.30	92.0 ± 1.0	$82 \pm 18^{\text{b}}$	1.95 ± 0.02
J1600-3053	344.09	+16.45	5.00	-15.5 ± 1.0	—	-0.36 ± 0.02
J1603-7202	316.63	-14.50	1.17	27.7 ± 0.8	$20.1 \pm 5^{\text{b}}$	0.90 ± 0.03
J1643-1224	5.67	+21.22	0.45	-308.1 ± 1.0	$-263 \pm 15^{\text{b}}$	-6.08 ± 0.02
J1713+0747	28.75	+25.22	1.05	8.4 ± 0.6	—	0.65 ± 0.05
J1730-2304	3.14	+6.02	0.53	-7.2 ± 2.2	—	-0.92 ± 0.28
J1732-5049	340.03	-9.45	1.41	-8.5 ± 6.7	—	-0.18 ± 0.15
J1744-1134	14.79	+9.18	0.42	-1.6 ± 0.7	—	-0.63 ± 0.27
J1824-2452	7.80	-5.58	4.90	77.8 ± 0.6	$1 \pm 12^{\text{c}}$	0.80 ± 0.01
J1857+0943	42.29	+3.06	0.91	16.4 ± 3.5	$53 \pm 9^{\text{d}}$	1.52 ± 0.32
J1909-3744	359.73	-19.60	1.27	-6.6 ± 0.8	—	-0.78 ± 0.09
J1939+2134	57.51	-0.29	8.33	6.7 ± 0.6	$-10 \pm 9^{\text{c}}$	0.12 ± 0.01
J2124-3358	10.93	-45.44	0.32	-5.0 ± 0.9	$1.2 \pm 1^{\text{b}}$	-1.34 ± 0.24
J2129-5721	338.01	-43.57	0.53	23.5 ± 0.8	$37.3 \pm 2^{\text{b}}$	0.91 ± 0.03
J2145-0750	47.78	-42.08	0.62	-1.3 ± 0.7	$12 \pm 8^{\text{b}}$	-0.18 ± 0.1

References: (a) Navarro et al. (1997); (b) Manchester & Han (2004); (c) Rand & Lyne (1994); (d) Han et al. (2006).

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Summary

- ➔ Our polarization profiles generally have very high S/N ratios compared to earlier results.
- ➔ We have not only defined the polarization properties more accurately, but also revealed previously unknown profile features in many of the pulsars.
- ➔ We derive RMs for all 20 pulsars, eight of which have no previously published RMs.



THANKS!

