MEAN PULSE POLARIZATIONS OF 8 SOUTHERN PULSARS AT 1560 MHz

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Abstract

We present the results of mean pulse polarization observations at 1560 MHz of 8 pulsars with high southern latitude, large values of dispersion measure, short period and low flux density. All of these pulsars have strong linear polarization with a mean value of 47% and no previously published polarization data.

Observations

Polarization data of pulsar mean profiles have played a key role in our understanding of the magnetic field and the emission region. They provide data on the relative orientation of the pulsar rotation axis, the observer's line-of-sight and the pulsar magnetic dipole axis as well as giving basic information on the pulsar emission mechanism.

Although several groups have been actively measuring pulsar polarization in the northern hemisphere, no measurements have been made in the southern hemisphere since the late 1970's. The main reason for this is that a single frequency channel system of limited sensitivity had been used for these measurements and data were obtained only on the stronger southern pulsars (Hamilton *et al.* 1977a, McCulloch *et al.* 1978, Manchester, Hamil-

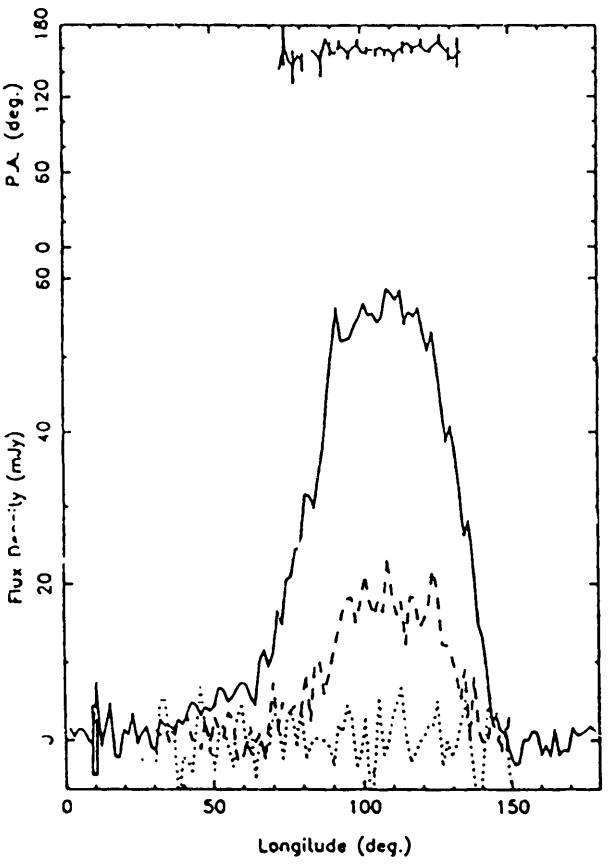

Figure 1 Mean profile of PSR 0905−51; see text for key.

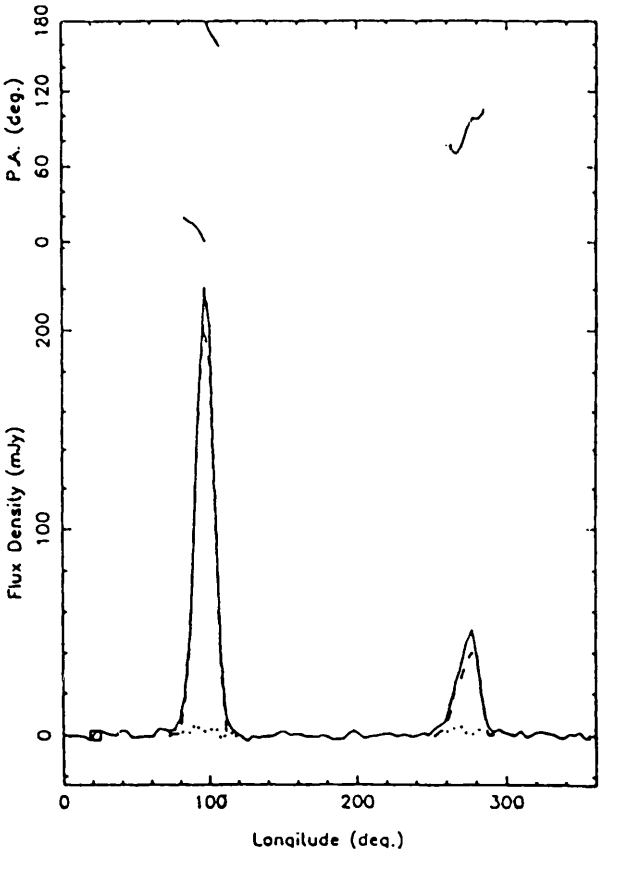

Figure 2 Mean pulse profile of PSR 0906−49.

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Table 1 Summary of the observing parameters and the computed parameters of these 8 pulsars.

PSR	P(ms)	S_{1562}(mJy)	DM	L/I(%)	$2\Delta\phi_{10}(^\circ)$	$2\Delta\psi(^\circ)$	$(d\psi/d\phi)_{max}$
0905−51	254	8.8	104.0	27	70	23	0.41
0906−49	107	9.4/2.4	192.0	88/76	26.6/27.6	44/33	−2.14/2.76
1054−62	422	23.3	323.4	32	46.4	52	−1.51
1323−58	478	10.1	283.0	19	34.3	85	3.4
1325−43	533	2.2	42.0	31	13.5	88	6.5
1719−37	236	1.6	99.7	44	14.9	33	3.2
1737−30	607	4.1	149.0	77	21.9	25	2.3
1800−21	134	9.9	230.0	54	115.9	120	−1.9

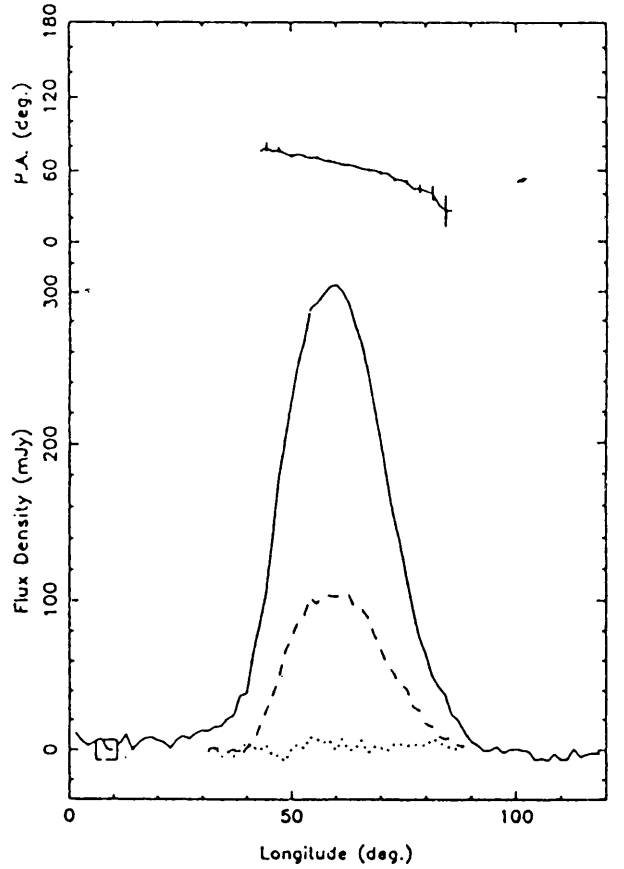

Figure 3 Mean pulse profile of PSR 1054−62.

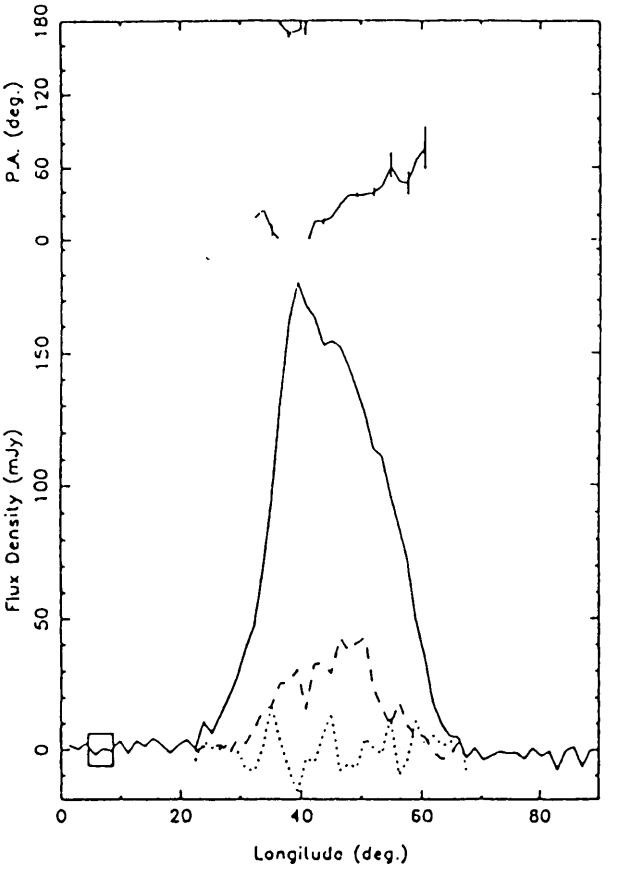

Figure 4 Mean pulse profile of PSR 1323−58.

ton, and McCulloch 1980).

The current observations were made in June and July 1988 using the 64-m telescope at Parkes and a 2 × 16 × 5-MHz filter bank from Jodrell Bank. It is an excellent system for de-dispersing pulsar signals and measuring their polarization properties. After detection, the signals were sampled at 1.07-ms intervals by a multi-channel one-bit digitizer system and recorded on magnetic tape. The observing frequencies range from 1522.5 to 1602.5 MHz. At these relatively high frequencies interstellar scattering is negligible for observations of this sample of pulsars. The preamplifiers were cryogenically cooled for all observations and the system noise (equivalent flux density) on the cold sky was 66 Jy.

This sample contains 47 southern pulsars. Here we present observations of 8 pulsars for which there are no previously published polarization data. Seven of these 8 pulsars have high southern declinations ($\delta \leq -30^\circ$). These pulsars have large values of dispersion measure (DM), and 4 of them (PSR 0906−49, PSR 1054−62, PSR 1323−58 and PSR 1800−21) have $DM > 192\,\mathrm{pc\,cm^{-3}}$. They have rather short periods ranging from 107 ms to 607 ms and low flux density. All of these pulsars have significant linear polarization with mean linear polarization 46%. The main pulse of PSR 0906−49, the first component of PSR 1737−30 and the precursor of PSR 1800−21 all are nearly 100% polarized. The linear polarization position angle swing,

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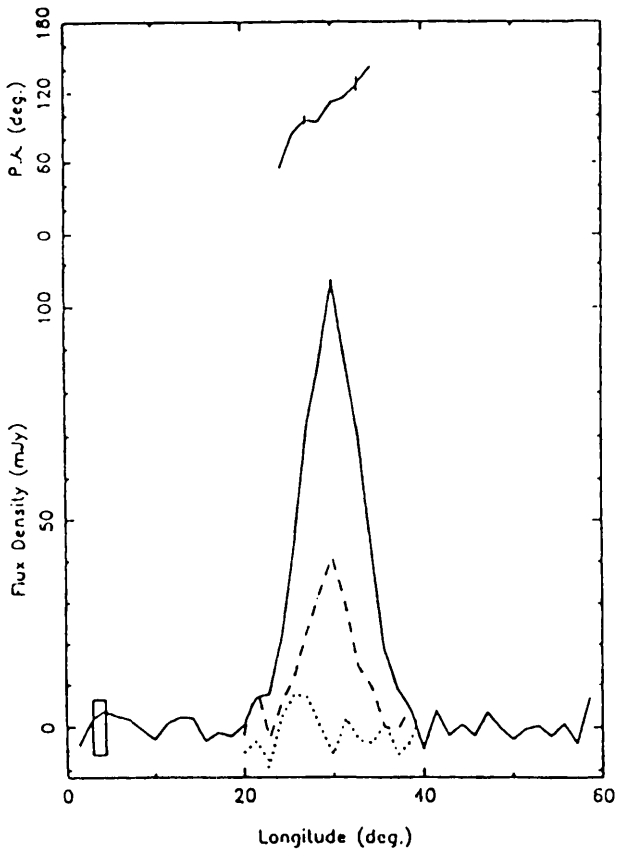

Figure 5 Mean pulse profile of PSR 1325−43.

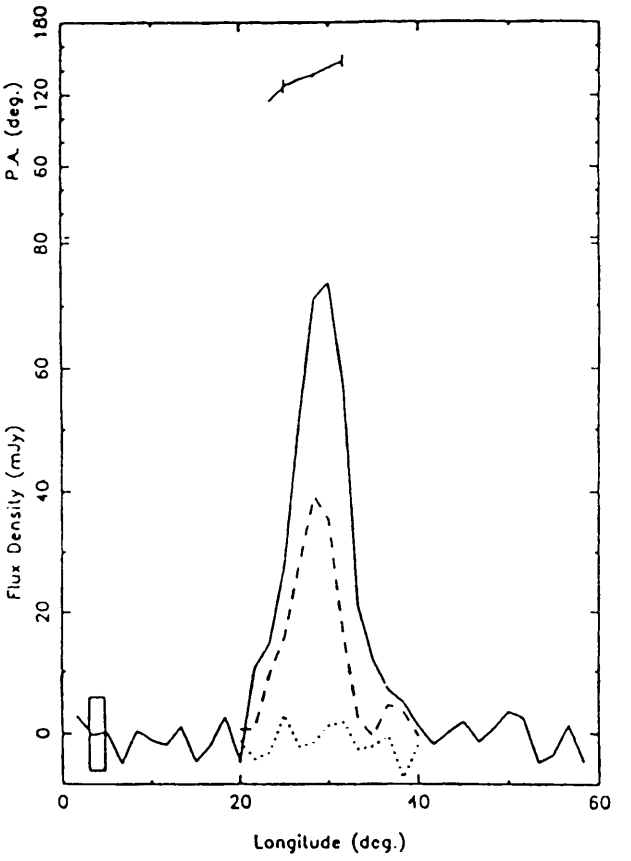

Figure 6 Mean pulse profile of PSR 1719−37.

$\Delta\psi$, and the maximum gradient of position angle, $(d\psi/d\phi)_{max}$, can be estimated from figures 1 through 8. These two parameters are important for the investigation of the geometry of the polar cap model. The magnetic axis inclination, α, the angle between the magnetic axis and the observer direction, β, the impact parameter (Lyne and Manchester 1988), β_n, and the position where the observer direction sweeps the emission cone (Wu *et al.* 1986), Q, can be estimated from $(d\psi/d\phi)_{max}$, $\Delta\psi$ and $\Delta\phi$.

Results

Figures 1 through 8 display the curves of the total intensity (full line), I, linear polarized intensity (dashed line), L, circularly polarized intensity (dotted), V, and the upper part of the figure gives the position angle, ψ, of the linearly polarized component. The amplitude of the rectangle shown in each diagram is the uncertainty in intensity due to random noise, and the width of the rectangle is the delay time due to interstellar scattering.

PSR 0905−51 has a very wide integrated profile; the apparent beamwidth of 10% intensity ($2\Delta\phi$) is 79°. The position angle varies little across the profile.

PSR 0906−49 has a relatively strong interpulse. It belongs to the two-pole model because the separation between the two components is 180°. Both main pulse and interpulse have extremely high linear polarization. The mean linear polarization of main pulse is 88%, of the interpulse 76%, and of the profile as a whole 82%. The position angle monotonically decreases across the main pulse and the position angle increases across the interpulse.

PSR 1054−62 is the strongest of these 8 pulsars with a mean flux density of 24 mJy at 1560 MHz. The linear polarization profile displays a single peak with depolarization at its two edges. The position angle decreases with longitude at a constant rate except at the trailing edge, which implies that the single profile is the leading component.

PSR 1323−58 may have overlapping components with a strong leading component. The circular polarization is low at about 7%, and it varies in sense.

PSR 1325−43 has a mean flux density 2.2 mJy. The total intensity profile has a stronger single peak with a weak leading component. There is a linear increase in position angle.

PSR 1719−37 is the weak pulsar in the group of 8 with mean flux density of 2 mJy. The integrated profile has a single main component with a weak trailing component. The mean linear polarization is about 44%. The position angle increases through

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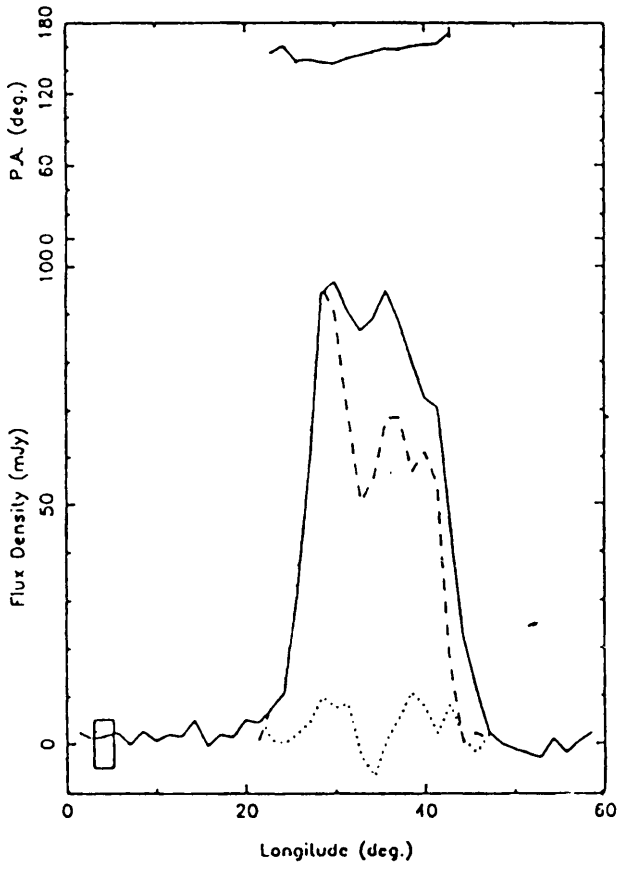

Figure 7 Mean pulse profile of PSR 1737−30.

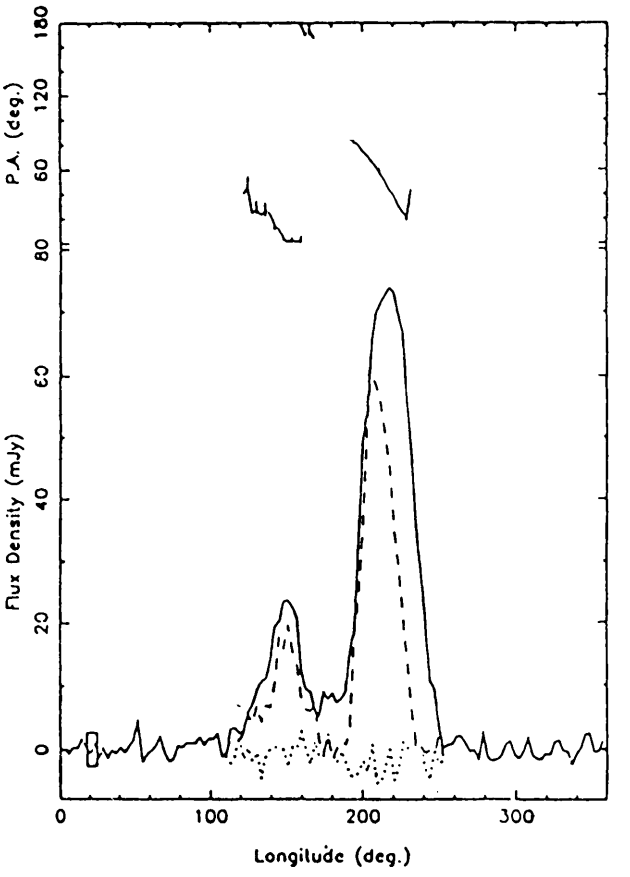

Figure 8 Mean pulse profile of PSR 1800−21.

the main component. The circular polarization is 15%, and varies in sense.

PSR 1737−30 has a three-component profile. The linear polarization also has three significant features. The left edge of the leading component has almost 100% polarization. The mean polarization is 77% for the whole profile. The right edge of the trailing component is strongly depolarized.

PSR 1800−21 has a very wide integrated-profile width and an apparent beamwidth of 115.9°. There is a strong precursor component which is similar to the main pulse of the Crab pulsar. Both the precursor and the main component have high linear polarization, but there is strong depolarization on the right wing of the main pulse. There is a regular increase in position angle through the profile of the two components. The circular polarization is high at 21%.

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