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DETECTION OF PULSARS PSR 1133+16 AND PSR 2045−16 AT LOW RADIO FREQUENCIES

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RESUMEN

Se han observado dos pulsares en baja frecuencia usando banda angosta para evitar problemas de dispersión de los pulsos. PSR 1133 + 16 fue observado en 26.3 MHz usando el radiotelescopio compuesto de 640 dipolos de la Universidad de Florida. PSR 2045-16 fue observado en 45 MHz usando el radiotelescopio compuesto de 528 dipolos del Observatorio Radio Astronómico de Maipú. Con el fin de mejorar la razón señal-ruido, se usaron técnicas de acumulación de períodos y promedio digital. Ambos pulsares fueron detectados promediando típicamente unos 400 a 600 períodos. Se obtuvo el perfil del pulso integrado, el ancho del pulso y una estimación de la densidad de flujo y la energía del pulso. Pronto se comenzarán las observaciones sistemáticas de otros pulsares usando ambos radiotelescopios.

ABSTRACT

Two pulsars have been observed at low radio frequencies using a narrow bandwidth to avoid pulse dispersion problems. PSR 1133 + 16 was observed at 26.3 MHz using the University of Florida 640-dipole radiotelescope. PSR 2045-16 was observed at 45 MHz using the Maipú Radio Astronomy Observatory 528-dipole radiotelescope. Digital averaging and period-stacking techniques were used in order to increase the signal-to-noise ratio. Both pulsars were successfully detected by averaging typically 400 to 600 periods. The integrated pulse profile, pulse width and an estimate of the pulse flux density and energy were obtained. The systematic observation of pulsars using both radiotelescopes will be soon started.

Key words: PULSARS

There is a lack of information about the characteris- s of the emission at low radio frequencies of pulsars 1 only a few measurements have been made at quencies below 100 MHz by Craft and Comella)68), Bash *et al.* (1970), Komesaroff, Morris and oke (1970), Slee and Hill (1971), Bruck and Usti- nko (1973), Bruck and Ustimenko (1976), Bruck *et* (1979) and Izvekova *et al.* (1979). The observations difficult to obtain because of the deterioration of the nal-to-noise ratio caused by the high galactic back- ound temperatures and the turn over of the spectra of ost pulsars. Also the dispersion of the pulses in the inter- llar medium and the short duration of the pulses restrict e bandwidth and time constant of the receiving radio- escope, thus reducing the sensitivity of the system.

Nevertheless, the sensitivity of the system can be atly improved if several hundreds or thousands of nsecutive periods can be averaged. This technique was d to detect pulsars PSR 1133 + 16 at 26.3 MHz and R 2045-16 at 45 MHz.

PSR 1133 + 16 was observed with a bandwidth of 8 kHz using the University of Florida large array at 26.3 MHz. PSR 2045-16 was observed with a bandwidth of 10 kHz using the Maipu Radio Astronomical Observatory large array at 45 MHz. The results of observations carried out during April, May and June, 1979 are presented in this paper.

The data was recorded in analog form on magnetic tape, and later on, played back, sampled and digitized using an analog-to-digital converter and a KIM I microprocessor. Further processing and analysis of the data was made using an Amdahl 470 computer.

Pulsar PSR 1133 + 16 was detected on 2 nights (out of 10 nights of data reduced) averaging over time intervals of 340 to 390 periods. A time resolution of P/38 was obtained for this pulsar (where P is the pulse period).

A plot of the data obtained on May 25, 1979 is presented in Figure 1. This plot represents the result of stacking and averaging about 390 consecutive periods (P = 1.188023 s). The dotted lines at each side of the

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mean value represent 3 standard deviations. Besides the main pulse in bin 25, an interesting and weaker pulse appears in bin 21; the separation between the two pulses is $\sim$ 125 ms. The pulse in bin 21 appears as strong as the pulse in bin 25 for a partial average of 180 periods. Bruck and Ustimenko (1973) detected this pulsar at 25 MHz and they were able to obtain two pulses also separated by about 148 ms (with a time resolution of P/16).

The peak flux density for this pulsar was estimated to be 150 Jy. The half intensity pulse width, mean flux density and mean pulse energy were also determined. These parameters are presented in Table 1.

Pulsar PSR 2045-16 was detected on 4 nights (out of 10 nights of data reduced) averaging over time periods ranging from 440 to 610 periods (P = 1.961383 s). A time resolution of P/62 was obtained for this pulsar. A plot of the data obtained on May 16, 1979, is presented in Figure 2. An average value for the peak flux densi of 131 Jy was estimated. The half intensity pulse widt mean flux density and mean pulse energy were al obtained. These parameters are also presented in Table

Both pulsars present large intensity variations on time scale of days. They can be strong for 1 or 2 nigh fading out and being undetectable for the next sever nights. Turtle and Vaughan (1968) reported also th kind of behavior for PSR 2045-16 at 408 MHz.

The pulse shape obtained at 26.3 MHz and 45 MI does not agree with the pulse shape obtained at high frequencies. The shape also seems to change slight from day to day. This behavior may be related to a t variation of the polarization plane of the linear polarized component during the time of each puls together with the fact that the observations were ma using a linearly polarized antenna. Both pulsars ha

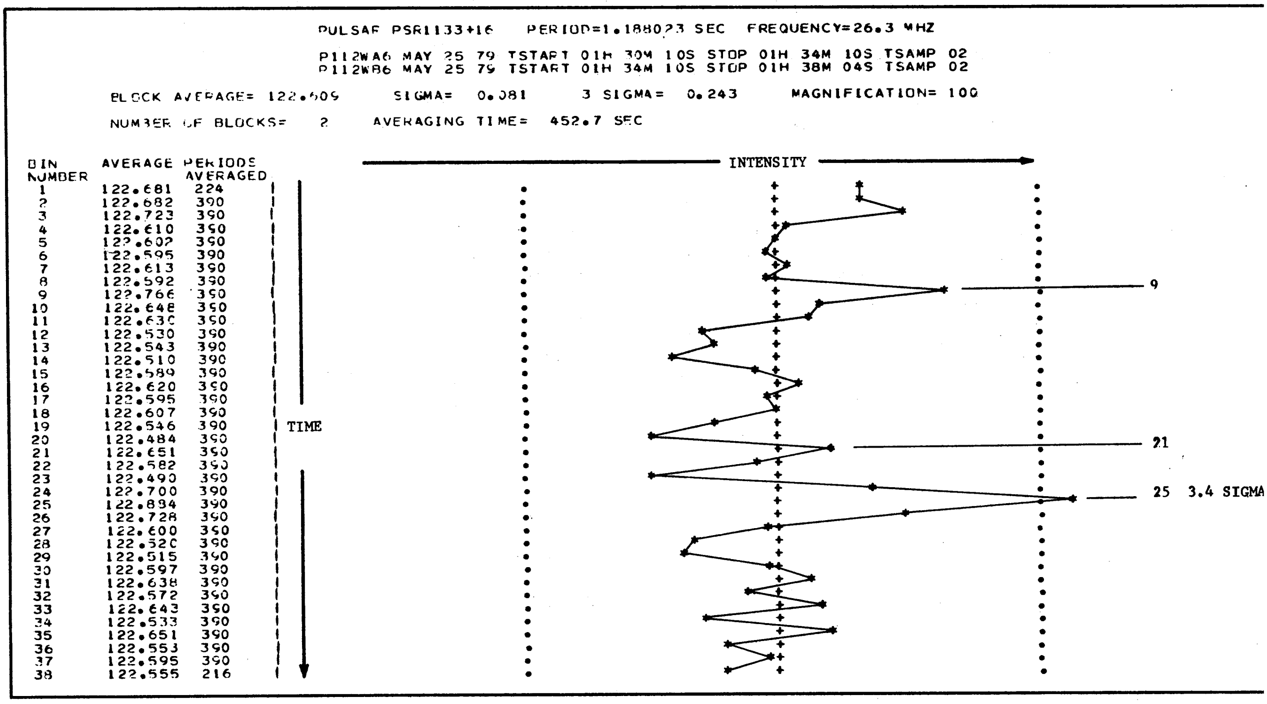

Fig. 1. Pulsar PSR 1133 + 16 recorded at 26.3 MHz on May 25, 1979. Bandwidth 8 kHz. Average over $\sim$390 periods.

TABLE 1

PULSAR PARAMETERS

Pulsar	Frequency (MHz)	Peak flux density (Jy)	Half intensity pulse width (ms)	Mean flux density (Jy)	Mean pulse energy (Jm^{-2} Hz^{-1} × 10^{-2})
PSR 1133+16	26.3	150	36	4.5	5.3
PSR 2045−16	45.0	131	31	1.93	3.78

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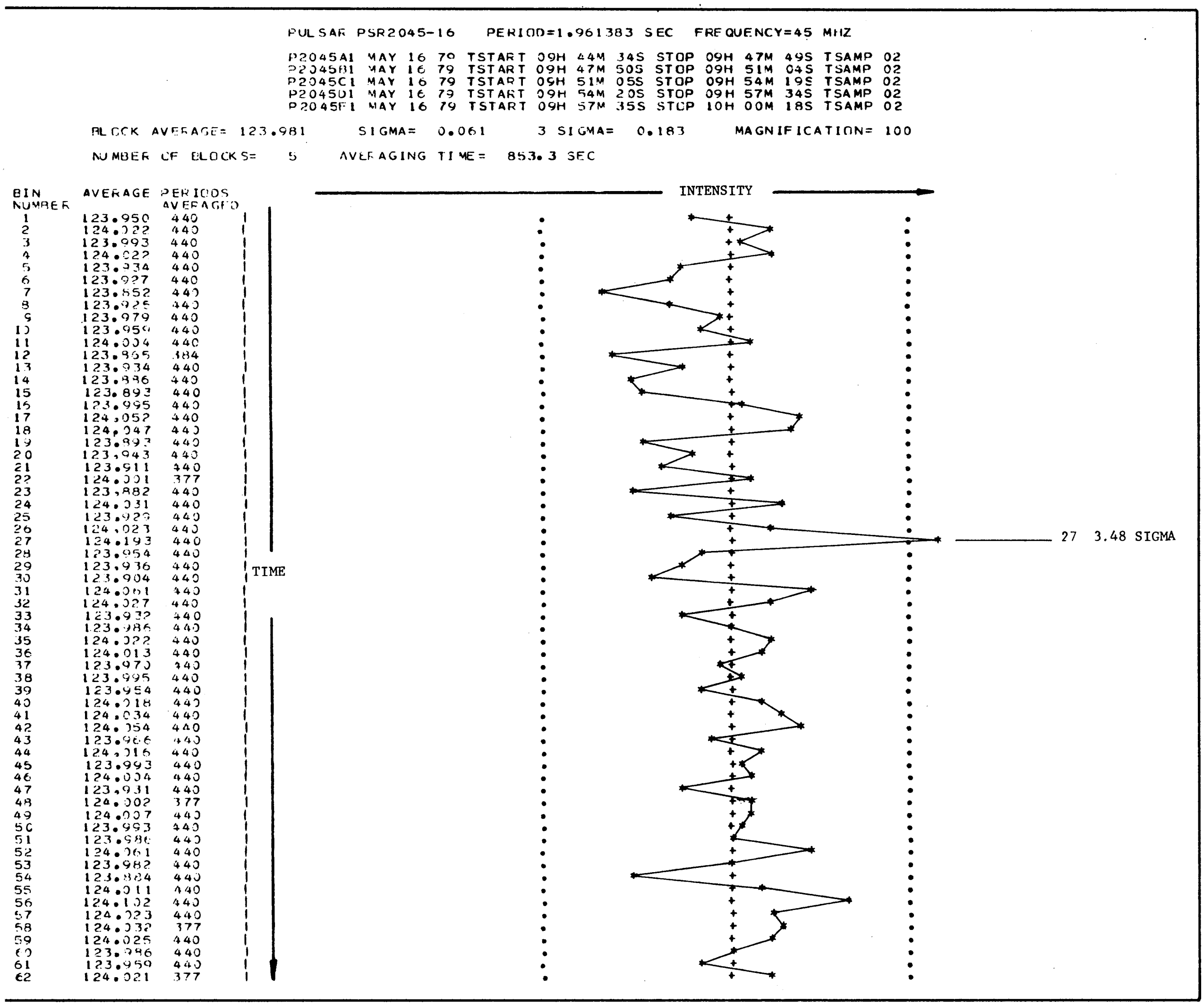

Fig. 2. Pulsar PSR 2045-16 recorded at 45 MHz on May 16, 1979. Bandwidth 10 kHz. Average over ∿440 periods.

een reported to have relatively high degrees of linear olarization at higher frequencies, and the tendency for oth is to increase the percentage of linear polarization 'ith increasing wavelength (Manchester, Taylor and [uguenin 1975; Alekseev and Suleimanova 1977). The ıdiation from PSR 1133 + 16 is about 60% linearly olarized at 63 MHz (Shitov 1972), and that from PSR 045-16 about 40% at 403 MHz (Manchester *et al.* 975). The angle of the polarized component changes ıroughout the pulse, being stable from pulse to pulse nly for part of the pulse but often presenting an rthogonal position for another part of it. In any case, ıore information is needed at low frequencies in order ɔ clarify this behavior.

A more detailed analysis of the results reported in ıis paper has been given by Reyes (1980).

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