OBSERVATIONS OF PSR 0823+26 AND PSR 0943+10 IN THE DECAMETER BAND

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Introduction

From December 1987 to February 1988 using the UTR-2 radiotelescope, we recorded the emissions of PSR 0823+26 and PSR 0943+10 at 25 and 16.7 MHz. Both pulsars are of considerable interest; PSR 0943+10 is one of several pulsars having two emission modes (Suleymanova and Izvekova 1984), and PSR 0823+26 has interpulse emission (Backer, Boriakoff, and Manchester 1973, Downs 1979) and dispersion measure, 19.466 pc cm^{-3}. It is known that using the Arecibo telescope at 25 MHz one could succeed in recording only PSR 0919+06 with $DM = 27.25$ pc cm^{-3} (Phillips and Wolszczan 1989, 1990). In these papers, the presence of the two modes of PSR 0943+10 emission was confirmed.

PSR 0823+26

In addition to the interpulse emission of PSR 0823+26, the extended component of its off-pulse emission was recorded by Smirnova and Shabanova (1986). They noted that the off-pulse emission spectrum is steeper than that of the main pulse. We have found that the main pulse width at the intensity level of 0.1 is 240°, the later, weaker component of the profile being clearly seen in figure 1.

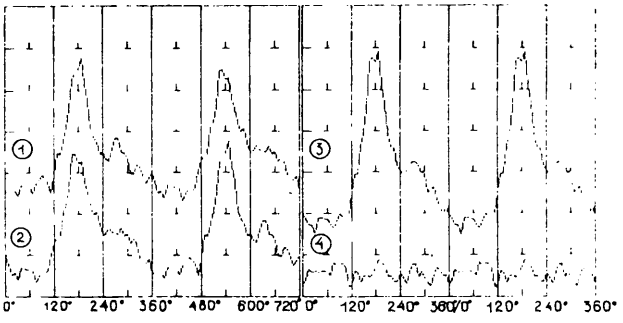

Figure 1 25-MHz profile of PSR 0823+26; 92-kHz bandwidth, 23 channels over 92 kHz, 48 points per period, 1000 periods.

The ratio of intensities of these components is $I_2/I_1 = 0.27$. Like other pulsars in the decameter band, PSR 0823+26 has variable emission intensity. Nevertheless we for the first time observed a different pulse form for the two-period coherent summation in the "neighboring" periods with absence of one of the profiles as shown in figure 2.

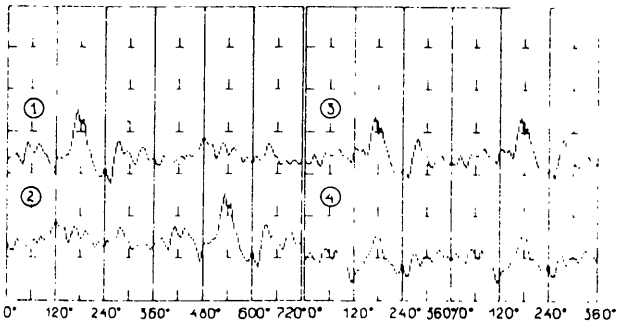

Figure 2 1000-pulse profile of PSR 0823+26

When computing the usual one-period summation we would see only intensity variations, but now we have to suggest that we are dealing with emission processes which are multiple in the pulsar period. The next feature is an intensity-increase of the second component accompanied by a practically complete absence of the first one as shown in figure 3.

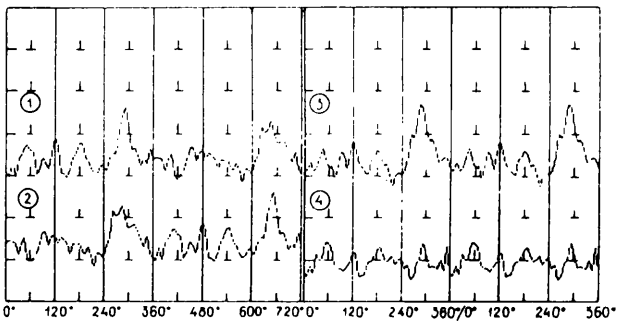

Figure 3 250-pulse profile of PSR 0823+26.

This phenomenon cannot be connected with the propagation medium of the pulsar radio-frequency radiation (PRR), and it seems to take place due to processes occurring in the pulsar magnetosphere itself. This fact agrees with the conclusions of Smirnova and Shabanova (1986) about the possibility of different sources for the main pulse region and the off-pulse emission. Another feature of the PRR of PSR 0823+26 is a flare of the "bridge" between the first and second components. This flare was observed for 45 minutes, the emission zone width for a half-intensity of the emission $W = 110°$, as shown in figure 4. Moreover, we succeeded in identifying the interpulse belonging to this pulsar. The interpulse does not stand out clearly against the background of the strong off-pulse emission occupying almost the whole period.

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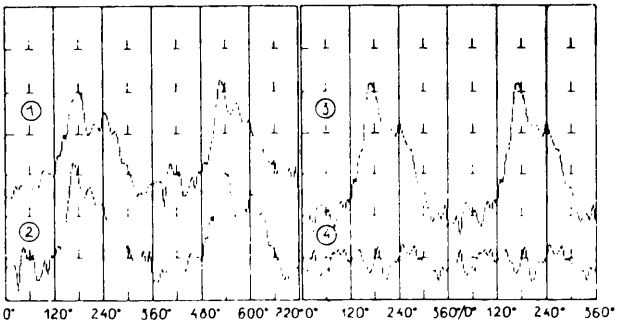

Figure 4 1000-pulse profile of PSR 0823+26.

PSR 0943+10

A peculiar feature of the emission modes for this pulsar is the emission intensity dependence on the pulse width, and a longitude delay of the second mode maximum in relation to that of the first mode (Suleymanova and Izvekova 1984). In Phillips and Wolszczan (1989) such a classification is made using only the morphological features since the width dependence had not yet been determined. Estimates of the "period" duration of switching the modes ($T < 30$ m) was confirmed. It also follows from Phillips and Wolszczan (1989) that the broadening of the average profile with decreasing frequency for the first mode practically ceased, and the second component at 25 MHz is narrower compared to the profile at 62 MHz (Suleymanova and Izvekova 1984). Our observations have shown that the profile width continues to increase with decreasing frequency. Figure 5 presents the average emission profiles at $f_1 = 25$ MHz and $f_2 = 16.7$ MHz.

We have not succeeded, as in Suleymanova and Izvekova (1984), in clearly discriminating between the two emission modes using the pulse dependence of intensity-width. Nevertheless our observations showed that a width decrease of the average profile was always accompanied by an emission intensity decrease as well. This fact is easy to explain by a threshold of the receiving equipment sensitivity. The same effect seems to be connected with the discrepancy of our results with those in Phillips and Wolszczan (1989, 1990) as to the width of the average profiles for PSR 0943+10, *i.e.* the profile width decreases when the weak intensity samples become zero due to amplitude quantization rather than being coherently summed. The summation of up to 600 individual profiles does not provide a stable average pulse waveform.

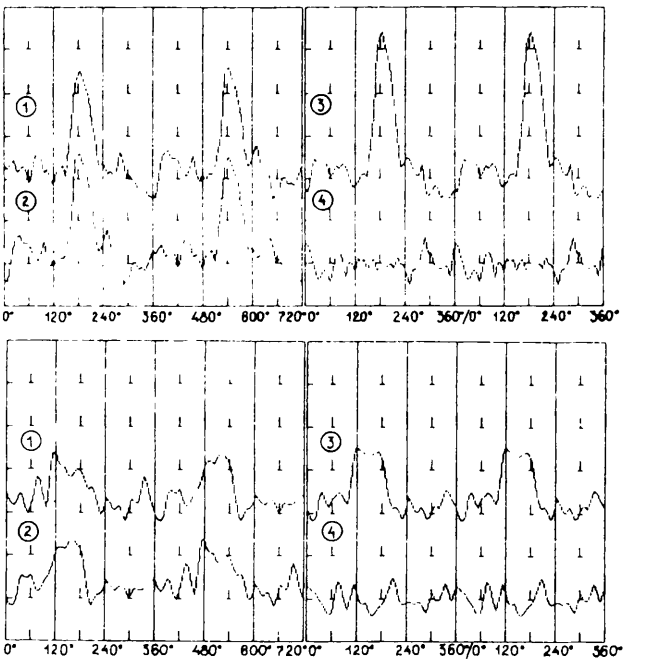

Figure 5 25-MHz (*upper panel*) and 16.7-MHz (*lower panel*) profiles of PSR 0943+10; 2700 pulses, 12 channels over 48 and 24 kHz, respectively, 47 points per period.

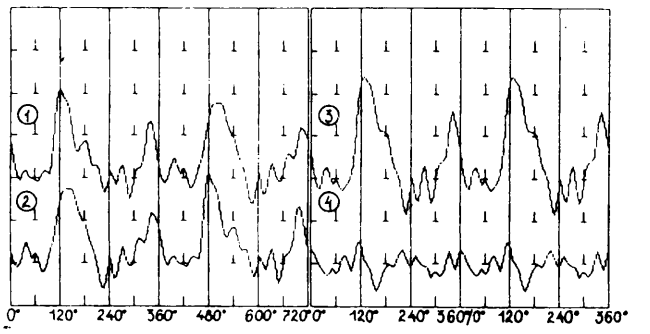

Figure 6 600-pulse profile of PSR 0943+10.

In figure 6 we present our results of the four successive two-period averages each having 600 pulses. These data and also those with a large averaging time indicate that there are statistically important differences between the "even" and "odd" pulsar periods. The off-pulse emission seems to be connected with this effect.

Conclusion

The presence of an extended off-pulse component of pulsar radiation, appearing at low frequencies, seems to be a general feature for all the pulsars which should be studied in detail.

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