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Window-threshold technique for detecting pulse components

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Abstract. We have analysed high-quality single pulse data of PSR B0329+54 at 606 MHz to study the structure of the emission beam. In order to unambiguously detect weak emission components in the integrated pulse profile, we have developed a new data analysis technique, which we term "window-thresholding". Applying this technique to the data, we have detected three new emission components for this pulsar and confirmed the presence of a component which was proposed earlier. Hence our analysis indicates that PSR B0329+54 has nine components, which is among the highest of all the known pulsars. The symmetric distribution of pulse components about the pulse centre, defined to be midway between the centres of the outer components, indicates that the emission beam is cônal.

Key words : Stars, Pulsars, PSR B0329+54

1. Data analysis

We obtained single pulse data from PSR B0329+54 at 606 MHz with a time resolution of 0.25 ms in August 1996 using the 76m Lovell Telescope at Jodrell Bank, UK. The details of observing system and the calibration procedures are identical to that used by Gould and Lyne (1998). The average pulse obtained from the data is shown in Figure 1.

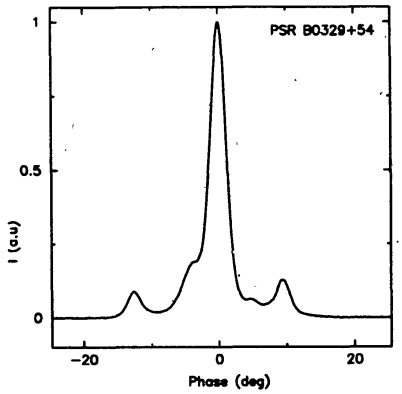

Figure 1. Average pulse profile obtained from the data at frequency 606 MHZ

To estimate the pulse profiles which clearly show the presence of weaker components we developed a 'window-threshold' technique. In this technique, we set a window in longitude and employ an intensity threshold while considering the single pulses for making average profiles, i.e., we consider all those pulses, which have intensity levels above the threshold within the window. In figure 2a, we have plotted the average pulse profiles which are obtained by applying this technique to each component window. The average profile obtained from all those pulses is plotted in figure 2b, which clearly shows the presence of 9 emission components in PSR B0329+54.

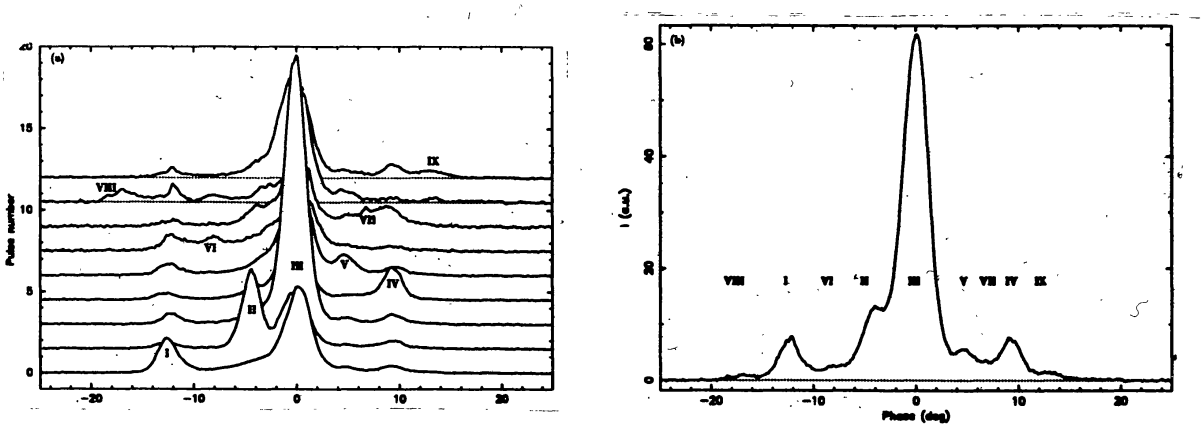

Figure 2a, b. (a) Average profiles obtained by using the window-threshold technique for each component and (b) the profile obtained by averaging the profiles in (a).

2. Conclusion

We have developed a technique based on windowing and thresholding, to detect weak emission components in pulsar profiles. Applying this to single pulse data of PSR B0329+54 we have detected three new emission components (VII, VIII and IX) of this pulsar, and also confirmed the presence of a component (VI) proposed by Kuzmin and Izvekova (1996). Now, this pulsar is known to have nine components, which is among the highest of all the known pulsars. Our findings favour the idea that the pulsar emission is annular or conal.

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