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Giant Micropulses from PSR J0437−4715

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1. Introduction

Although individual radio pulses from pulsars vary in amplitude from pulse to pulse, their height distribution in general does not extend to amplitudes more than 10 times the mean. Two notable exceptions are the Crab pulsar and PSR B1937+21 (Lundgren 1995, Cognard et al. 1996 and references therein) which occasionally emit single radio pulses that have amplitudes more than 100 times the mean. Here we report on the detection of short time-scale, extremely large amplitude radio pulses from the nearby millisecond pulsar PSR J0437−4715. The events we have observed are distinguished by having peak flux densities in excess of 10 times the average pulse amplitude, and occur only within a very narrow (80 μs) window centered on the main pulse.

2. Discussion

Observations of PSR J0437−4715 were made in July, 1995 at the 64-m radio telescope at Parkes, Australia. We report here a partial analysis of two 13-minute observations at 1380 MHz. Each polarization was complex (I,Q) mixed to baseband and filtered for a total bandwidth of 50 MHz. The four analog signals from the complex downconverter were digitized at 2-bit resolution and recorded on a 400 Mbit/s digital tape recorder (Datatape LP-400) along with timing information synchronized to the observatory clock.

To correct for the effects of interstellar dispersion, a 128-channel filter bank was simulated in software and the data were post-detection dedispersed using a dispersion measure (DM) of 2.64843 pc cm^{-3} (Bell et al. 1995). This resulted in a sample interval of 2.56 μs, somewhat shorter than the residual DM channel smearing of 3.1 μs.

The dedispersed time series were examined by creating histograms of sample signal-to-noise ratios (SNRs). We noted a significant tail to the expected Gaussian sample SNR distribution, and subsequent examination of the data near the largest samples revealed that all occurred at the expected epoch of the main pulse peak (Figure 1), as determined by the ephemeris of Bell et al. (1995). This rules out terrestrial interference as an origin for the outliers. A

more detailed analysis with a larger dataset, including observations at 430, 660, and 1380 MHz will be reported elsewhere.

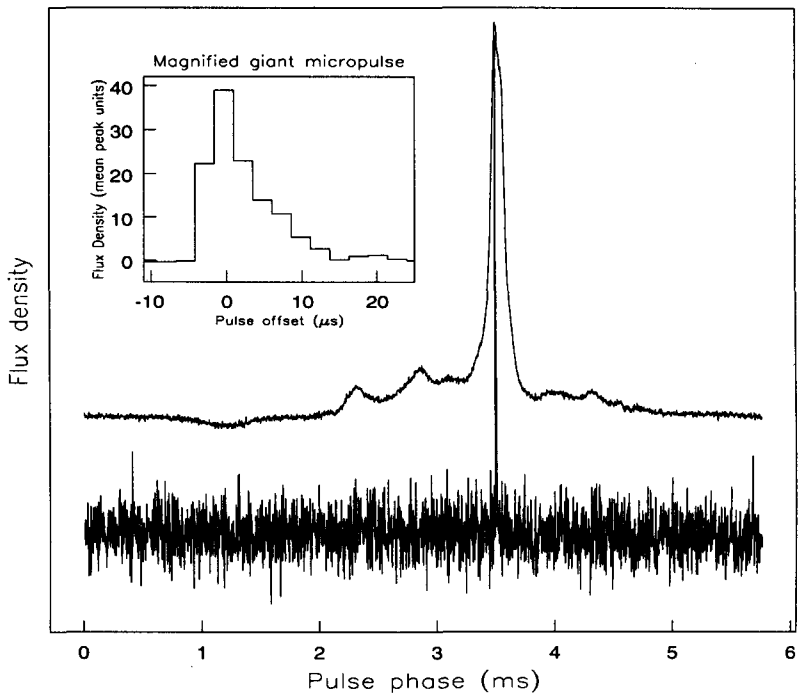

Figure 1. "Giant micropulse" from PSR J0437−4715 at 1380 MHz with 50 MHz bandwidth. This was the largest peak observed in 267895 pulses (~25 mins). The bins are 2.56 μs wide, and DM smearing across the 128 simulated frequency channels is 3.1 μs. The flux density is in units of the peak of the mean pulse profile. The average profile after folding ~12 min of data is shown as well. The relative phase of the peak of the average profile and that of the large single pulse were determined using the pulsar's known ephemeris.

References

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