OBSERVATION OF GIANT PULSES FROM THE CRAB (0531+21), 1133+16 AND 0950+08 PULSARS

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Introduction

Some pulsars exhibit an extraordinary feature: Occasionally they emit pulses which are much more energetic that the average pulses from the same pulsar.
In fact, the crab pulsar was originally detected by its giant pulses by Staelin and Reifenstein in 1968[1].
Since then, a few other pulsars which show the giant pulse phenomenon have been detected. A review is presented in the paper by Kuzmin[2]. A recent discovery is the detection of giant pulses from B0950+08, where the giant pulse phenomenon seems to be intermittent (Smirnova[3], Singal & Vats[4]).

Over the last 12 months, various observations of pulsar signals were made in order to determine the capabilities of the Stockert Telescope for pulsar measurements.
This data has now been reviewed for the evidence of giant pulses. For this purpose, the software toolchain for pulsar data has been amended.

Crab pulsar (B0531+21)

The crab pulsar has frequent and strong giant pulses, therefore it was expected that these pulses should be clearly visible in the data. In fact, all recorded data show the occurrence of giant pulses.
The plot below shows the average signal enlarged by a factor of 100, and the individual signal for each of the periods of one of the recordings from March 17th, 2013 above a certain threshold. The largest giant pulse is about 476 times stronger than the average pulse.
Only signals with intensity about 70 times stronger than the average pulse can be clearly attributed to a giant pulse, the others are buried in noise (and RFI) to some extent. Nevertheless it can be seen that there are a larger number of giant pulses in the range > 80 times the average.
One giant pulse was observed at the phase of the interpulse.

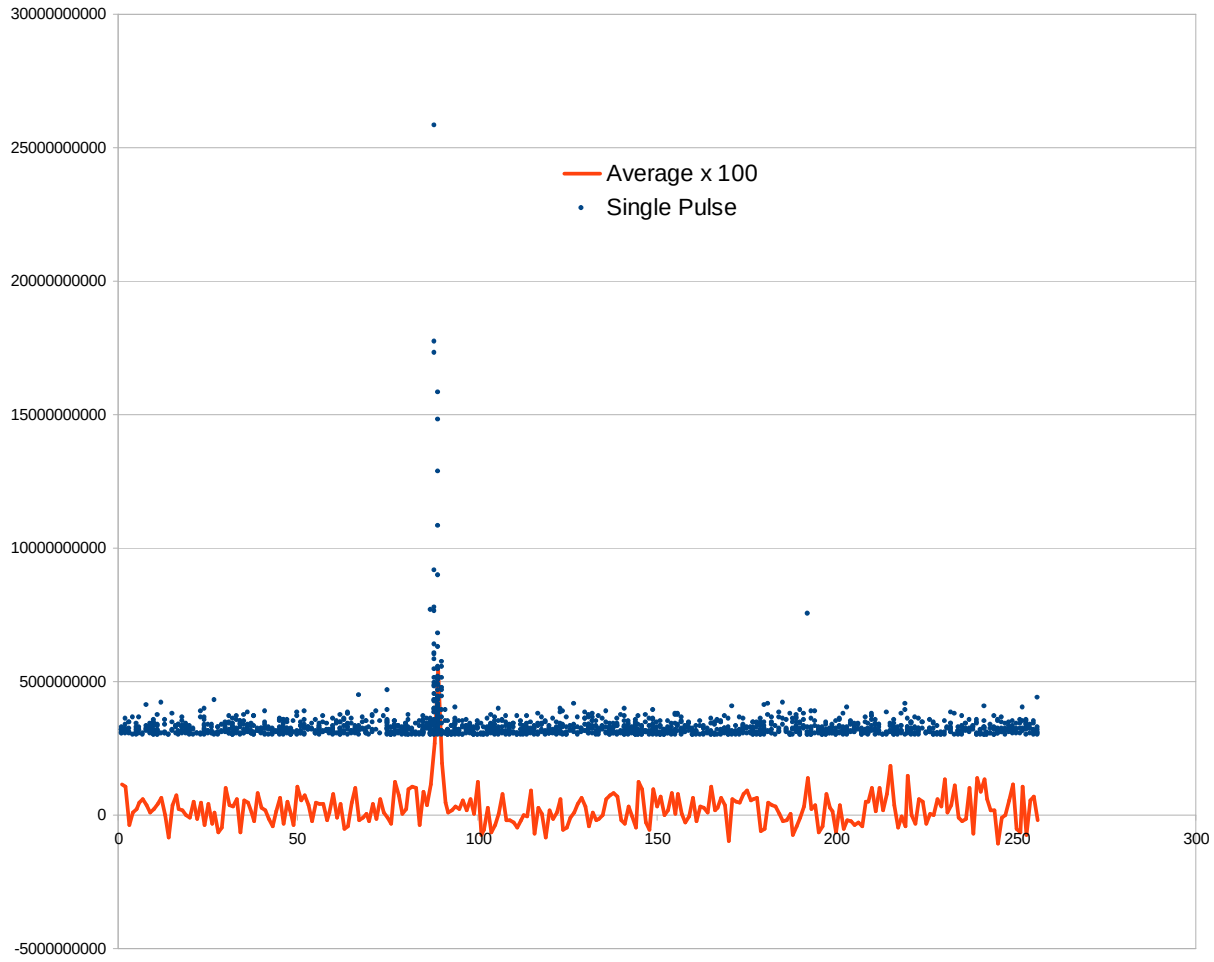

Figure 1: Average pulse and giant pulses from the crab pulsar. Record contains 22,935 pulse periods (about 13 min.). Pulse period is divided into 256 bins.

The cumulated number of observed giant pulses follows approximately a power law as expected for giant pulses.

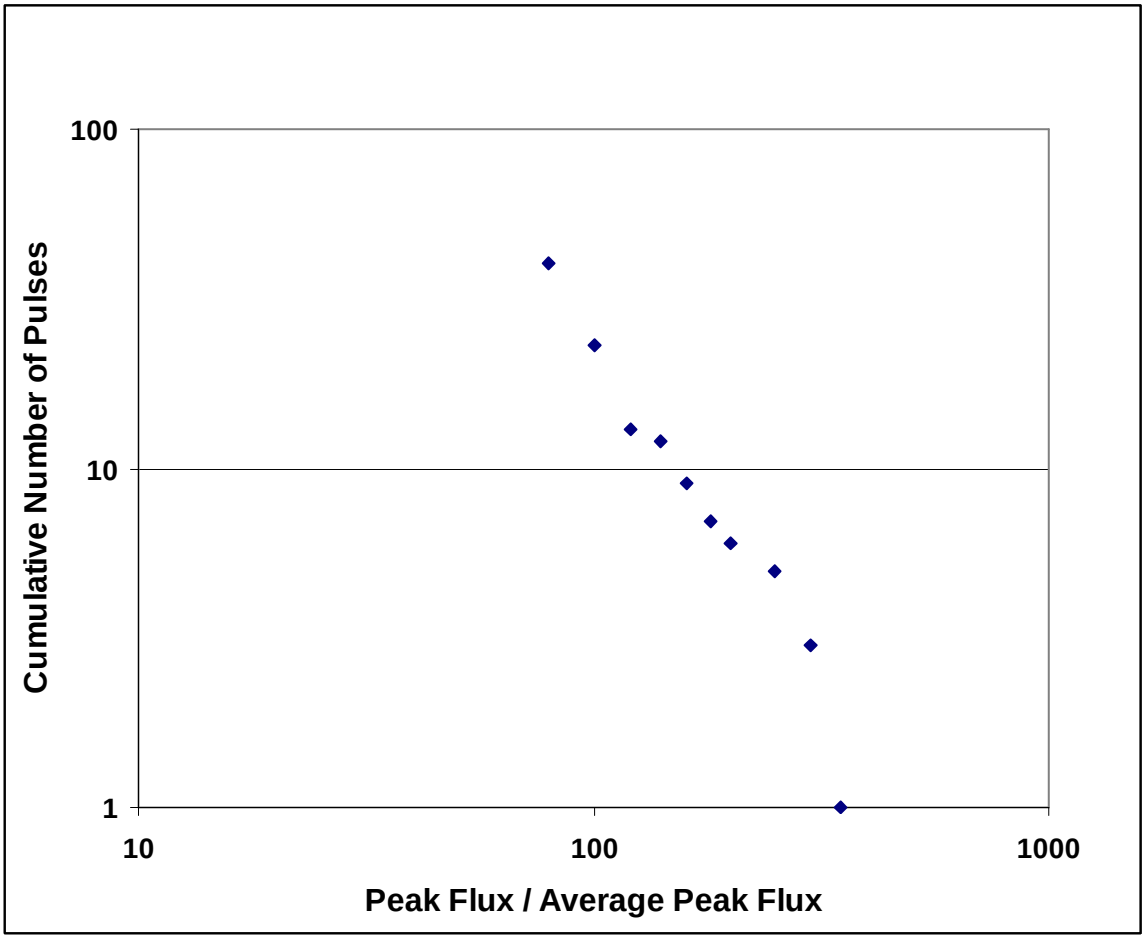

Figure 2: Cumulated number of observed giant pulses vs. peak flux show power law distribution

B1133+16

Giant pulses were also found in the signal from B1133+16.
This pulsar has a double pulse profile, and giant pulses can be observed in both features of the profile.
The average profile has been multiplied by a factor of 10. The largest observed pulse is 33 times larger than the average pulse.

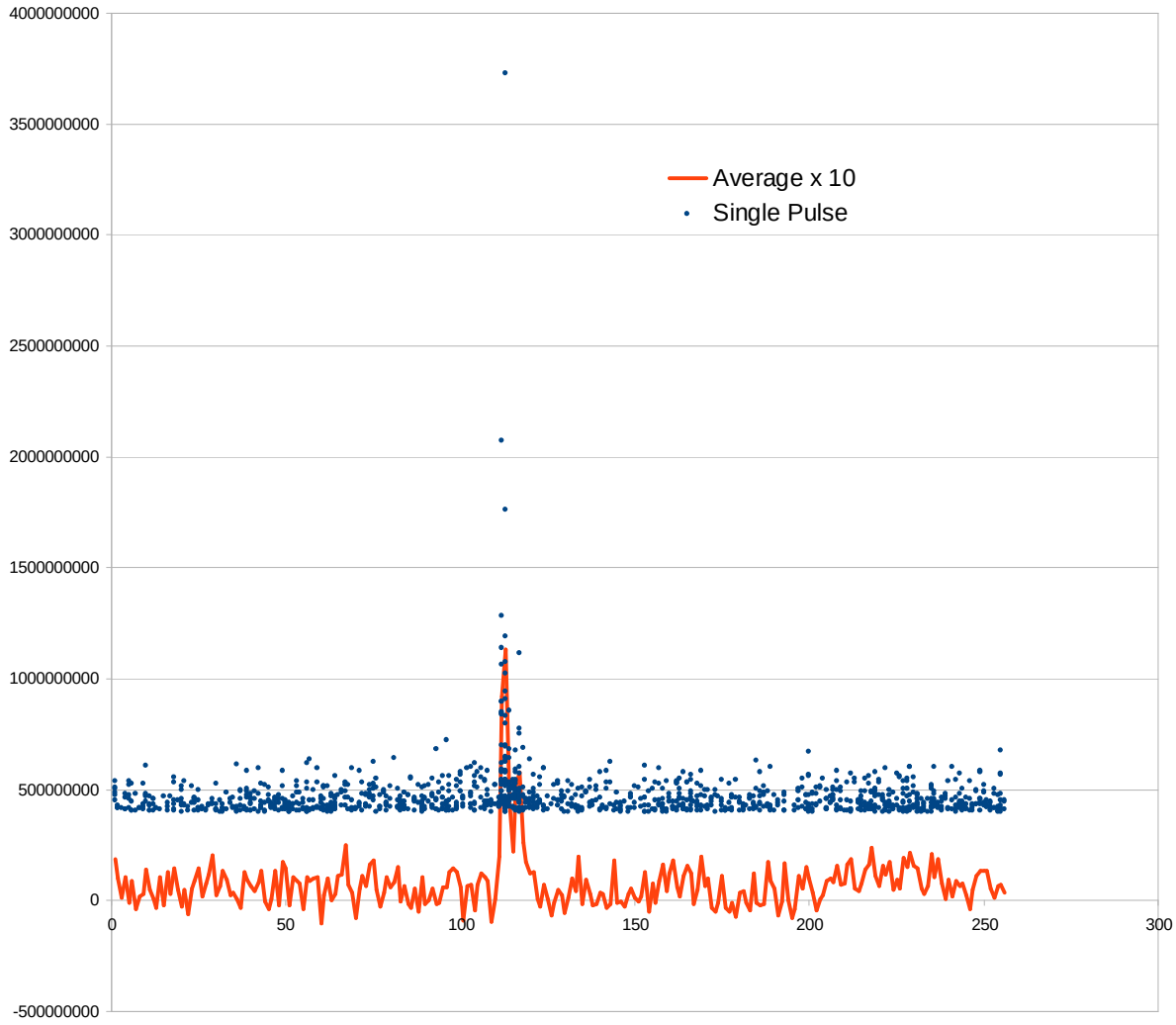

Figure 3: Average pulse and giant pulses from the B133+16 pulsar. Record contains 508 pulse periods (about 10 min.). Pulse period is divided into 256 bins.

B0950+08

Giant pulses were found in one recording of the B0950+08 observations. Other observations did not show any giant pulses. This is consistent with the finding from Singal and Vats[4], that the giant pulse activity is intermittent. The recording with the giant pulses was made on April 29th, 2012. The plot below shows the average profile multiplied by 10, the largest giant pulse is 28 times stronger than the average pulse.

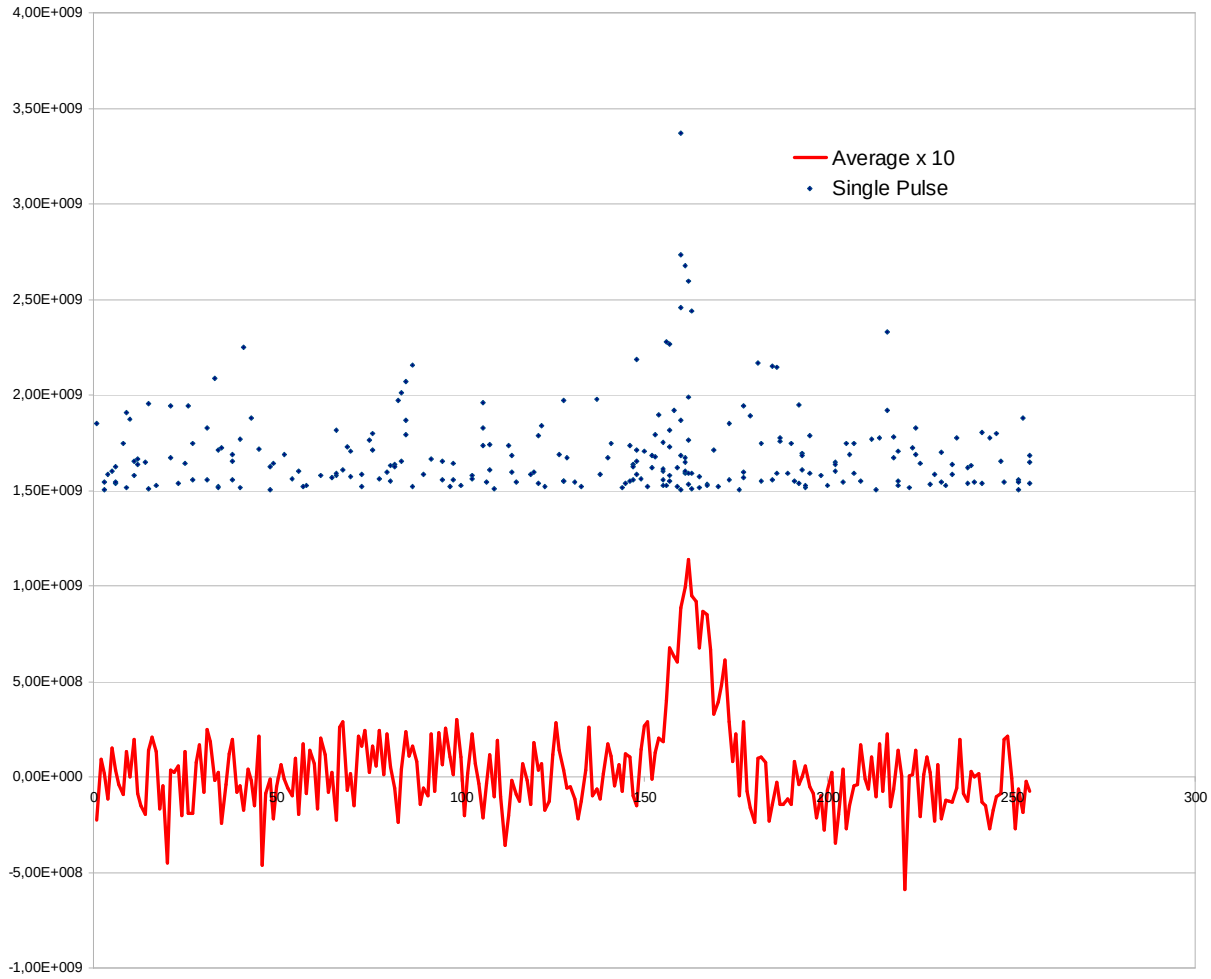

Figure 4: Average pulse and giant pulses from the B0950+08 pulsar. Record contains 1189 pulse periods (about 5 min). Pulse period is divided into 256 bins.

Other giant pulse emitting pulsars

Observational data was available from B0031-07, but no giant pulses were seen in the data. This may be attributed to the relatively short observation time of these recordings.

References

[1]Staelin, D. H., & Reifenstein, E. C., Science, 162, 1481 (1968)
[2]Kuzmin, A.D., Proceedings of the 363. WE-Heraeus Seminar, 72-75 (2006)
[3]Smirnova, T.V., Astronomy Reports 56 Vol.6, 430-433 (2012)
[4]Singal, A.K. & Vats, H.O, arxiv:1209.5093 (2012)