Pulsars:
Focus of Observations

Operations Report 2013

Development work

As a preparation for future expansions we have performed a trial to use the 25m dish at higher frequencies. For this purpose a 4 GHz receiver (C-band LNB) was mounted in an offset position besides the 21 cm receiver.
Even though this squint configuration is less than optimal and therefore has substantial side lobes, the fundamental usability of the dish at higher frequencies could be demonstrated. Both continuum sources and the pulsar B0329+54 could be observed.

In order to ease the operations the 21cm front end control was made network capable. Until then, switching filters configurations required someone to go up to the elevation level to switch manually.

A failure of the main board of the measurement computer triggered an upgrade of this system to have more disk space for pulsar observations. The insertion of a SSD has speeded up pulsar data processing substantially.

Software work was focused on the pulsar tool chain. In additions, several optimizations were done on various modules. An automatic log mechanism now allows to record all operator activities so that in case of any anomaly the history can be reviewed.
An additional control mechanism was implemented which allows to track satellites using the so called "2-Line Elements". Even though there is no immediate application, a couple of inquiries have triggered this development so that we are prepared should the need arise.

In order to make the 10m dish usable for radio astronomy, planning was performed and a computer interface to the angular encoders was acquired. Further implementation, however, was not possible due to limited human and financial resources. This will remain a task for 2014.

Measurements at the 25m dish:

Pulsar Observations:

As in the previous year, pulsar observations were the main objective. The aim was to extend observations to weaker and faster pulsars.
By then end of 2013 the list of observed pulsars had grown to a total of 52. This included the millisecond pulsar B1937+21 which has a rotational period of around 1.5 milliseconds and is one of the fastest known pulsars.
The weakest pulsar so far is B1133+16 which has a flux of 3 mJansky.

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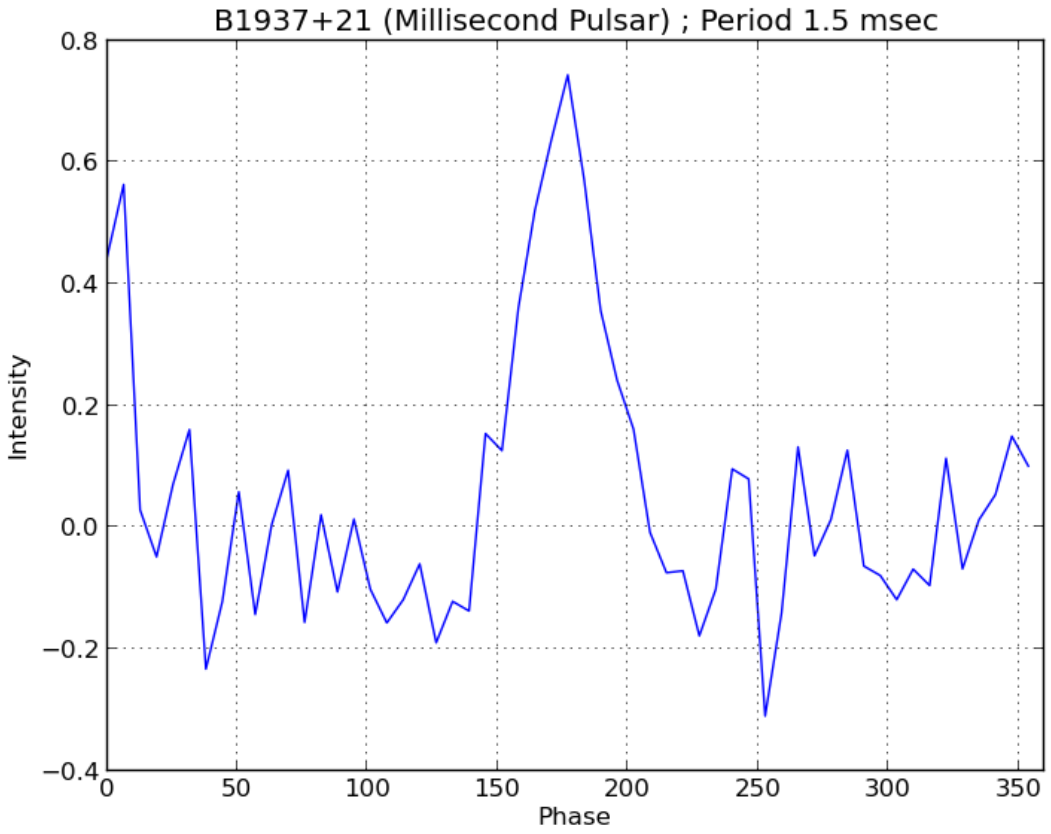

Signal of the millisecond pulsar 1937+21. This pulsar exhibits a pre-pulse and a main pulse with about 180° distance.
This recording has been made with the highest time resolution (about 50 µsec) which is available with the pulsar spectrometer.

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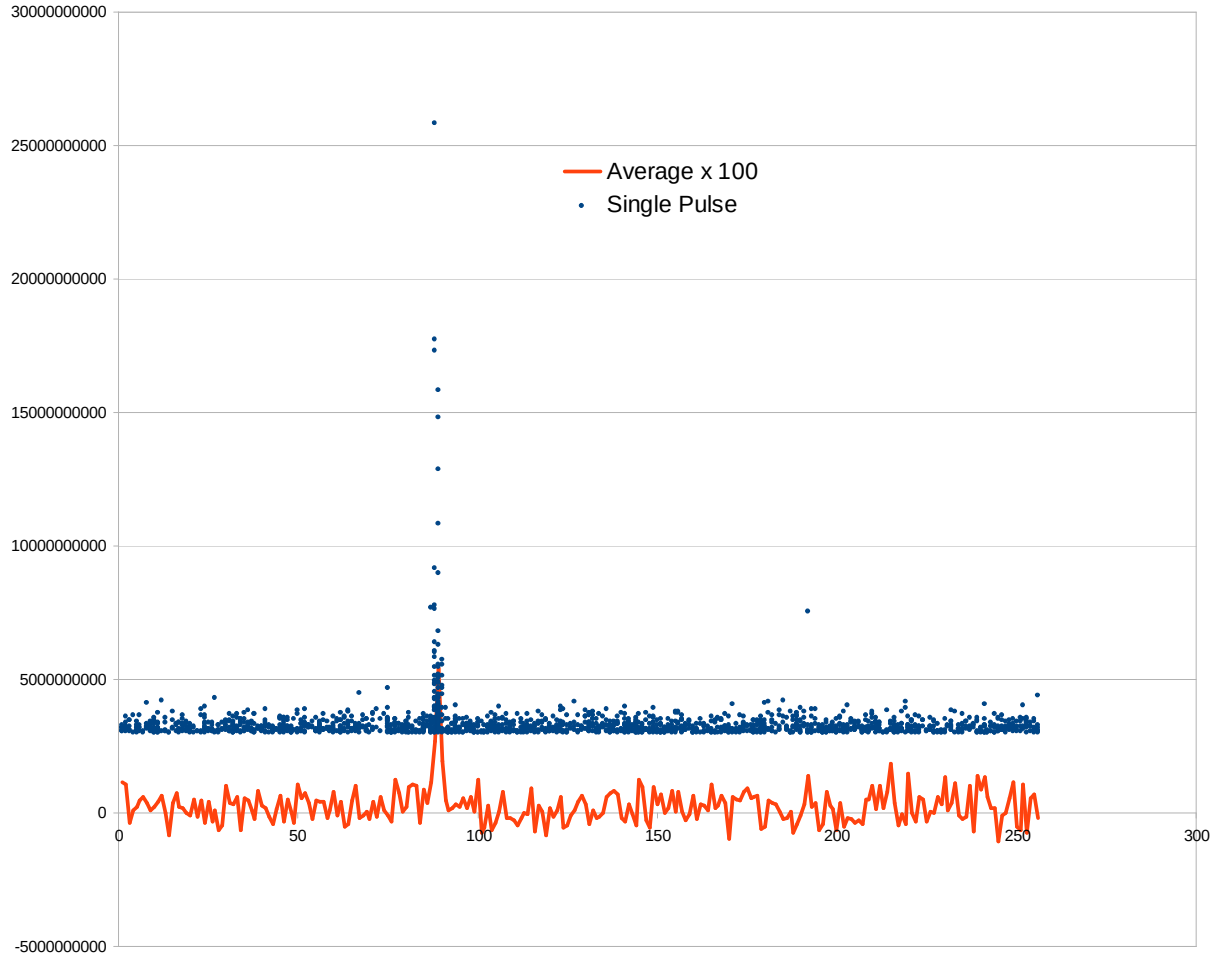
Pulsar Observations - Giant Pulses:

The extension of the pulsar tool chain opened the opportunity for single pulse analysis. Therefore it was possible to look for the phenomenon of "Giant Pulses". The most prominent example is the crab pulsar. Here the strongest observed giant pulses was 476 times stronger than the average pulse:



Average pulse (red, 100-times enlarged) and "Giant Pulses" (blue) from the crab pulsar. The duration of this observations was 22.935 pulse periods (about 13 min.)

For nearly all pulsars which can be observed with the Stockert telescope and which are known to produce giant pulse, the giant pulses were detectable in the data taken with our telescope:
(http://astropeiler.de/Dateien/Stockert_2013_Giant_Pulse_Observations.pdf).

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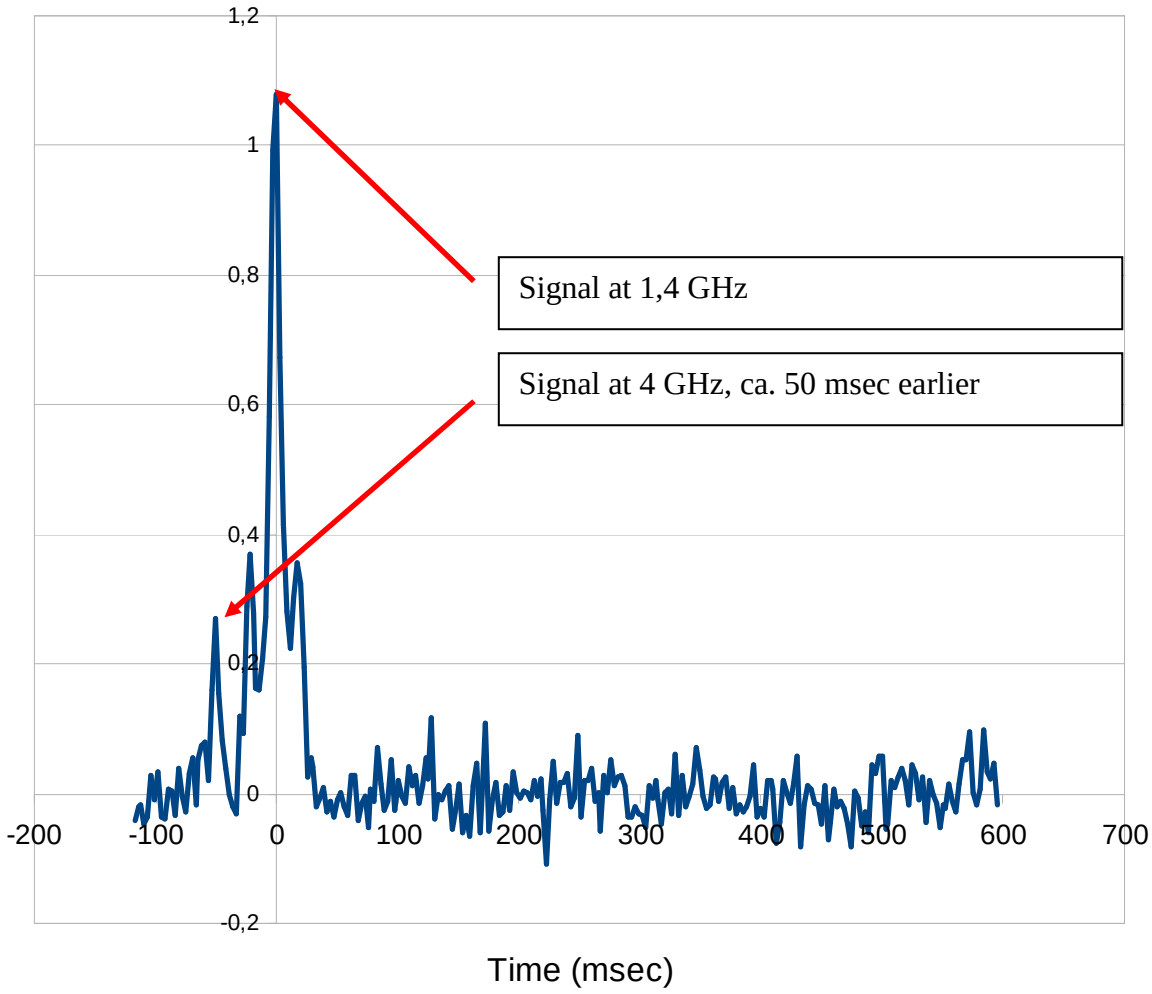
Pulsarbeobachtungen - Dual Frequency Proof of Concept:

The new offset receiver at 4 GHz allowed an experiment where the pulsar B0329+54 were observed at two frequencies.
One channel at 1.4 GHz and one channel at 4 GHz were recorded simultanously.
During the ongoing measurement the telescope was slewed in such a way, that in one position the 1.4 GHz receiver and in the other position the 4 GHz receiver was directed towards the pulsar.
By this method the delay due to the dispersion can be nicely demonstrated:



This experiment served as a "Proof of Concept" for a lab exercise.

Spektral Observations:

Observations of OH sources which had commenced last year were continued. By now all 4 OH maser emissions at 18 cm could be observed. Other activities were related to various OH absorption lines towards continuum sources.

Usage for university lab exercises

Radio astronomical lab exercises for universities have become a standard activity. In the year 2013 we were pleased to have students and their tutors form the universities of Bonn, Dortmund, Aachen and Mainz at our site.

"Jugend forscht"

"Jugend forscht" is a science competition for young people at school age. Also in the year 2013 the instruments on the Stockert were used for such exercises. The demand has increased and we were pleased to support three such undertakings by young researchers.

Outlook

Functionality and performance of the Astropeiler Stockert as a radio astronomical instrument could be demonstrated since its re-commissioning during the last years. Now that the foundations have been laid further detailed work is required to achieve further improvements.
If we succeed during 2014 to enable the 10 m dish for radio astronomy, the capabilities for observations will be further enhanced.
Extending the lab courses for universities is high on the agenda and continuous improvement of the experiments for this will require substantial resources.

Acknowledgements

The Northrhine-Westfalia foundation as owner of the site and partner of our association provides the foundation on which all our work is based. We are very grateful for being provided with this opportunity.
Our special thanks, like every year, goes to the Max-Planck Institute for Radio Astronomy and the Argelander Institute for Astronomy of the University of Bonn. Their members have supported us with valuable advice and support.

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We would also thank the universities which came with their students to us for lab courses. Their financial contributions for these courses supported us in operating and maintaining the Astropeiler.

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Wolfgang Herrmann