

Introduction

Using the digital receiver based on "Software Defined Radio" or SDR technology implemented at IAR {1}, it was developed a new receiver software to measure and process radio signals, allowing the measurement and detection of Pulsars.



IAR SDR-RTL receiver



Vela Pulsar Image (Wikipedia)

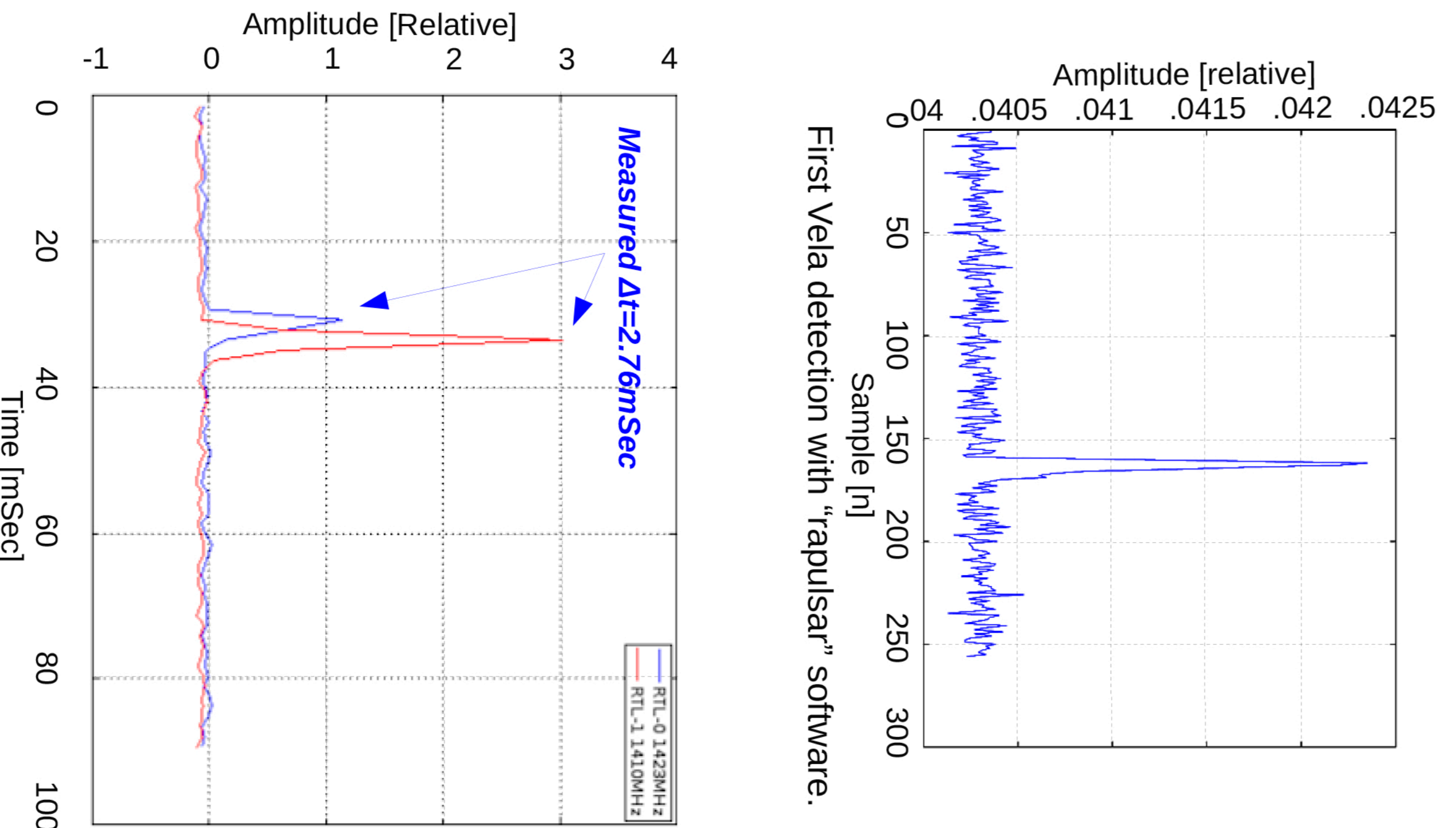
Software Defined Radio

The SDR systems are radio devices where typically hardware components such as mixers, filters, amplifiers, etc. are implemented in software using a personal computer or other embedded computing devices.

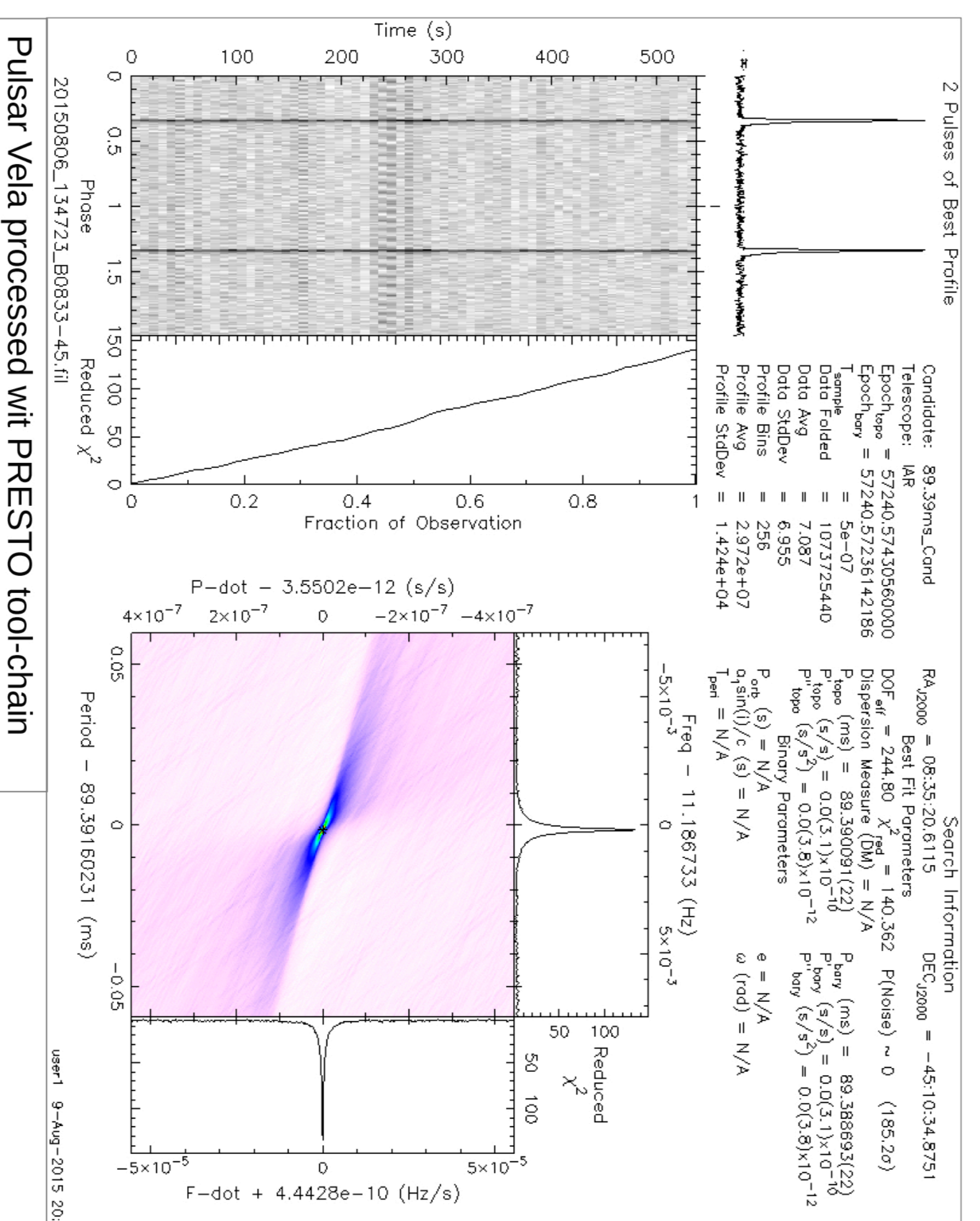
Unlike a conventional electronic receiver an SDR will have a reduced RF input stage followed by a fast digital conversion and all process of data is realized in software.

Resulting Observations

- **Vela Pulsar (PSR B0833-45 / PSR J0835-4510)**
 - Rotation speed of 89 milliseconds.
 - Located at a distance of 936 years.
 - Average intensity 1100mJy.
 - Dispersion Measurement of 67.99.
- **Pulsar PSR J0437-4715**
 - Discovered by the Parkes Observatory in Australia.
 - Rotation speed of 5.75 milliseconds.
 - Estimated to be at 509.8 light years.
 - Average intensity of 149mJy.



Two simultaneous channel detection of Vela with "rapulsar" software, the difference in time correspond to the time delay according the D.M. Value.



Conclusions

With a Low Cost SDR receiver (20USD) and a small bandwidth several Pulsar has been detected, other commercial SDR systems with Bandwidths of 50MHz to 100MHz will greatly improve the detection number of pulsars.

References:

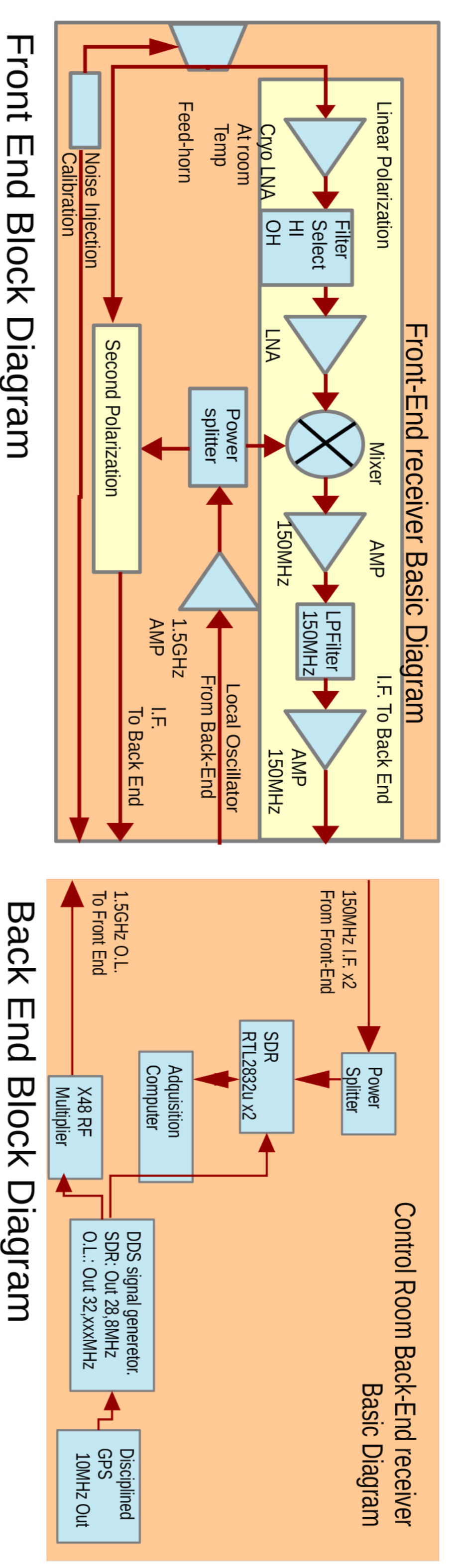
- {1} Poster at 58th AAA Hydrogen Observations using Software Defined Radio and the IAR1 Antenna <http://tempo.sourceforge.net/>
- <http://www.cv.nrao.edu/~sransom/presto/>
- http://www.cv.nrao.edu/~sransom/thesis_2001.pdf
- <http://www.y1pwe.co.uk/RARPrpgs/AmateurPulsarDetectionF.doc>



Project Description

To acquire signals from the radio telescope, two SDR receivers were installed in the control room of the radio telescope.

- Pulsars observed at 1413MHz with 2MHz Bandwidth.
- Up to 100 minutes Observations.
- Two SDR for Dispersion Measurements.
- SDR at 150MHz Intermediate Frequency.
- SDR Clock Synchronization with Time&Frequency GPS Time Base.
- Personal Computer for control and Acquisition.

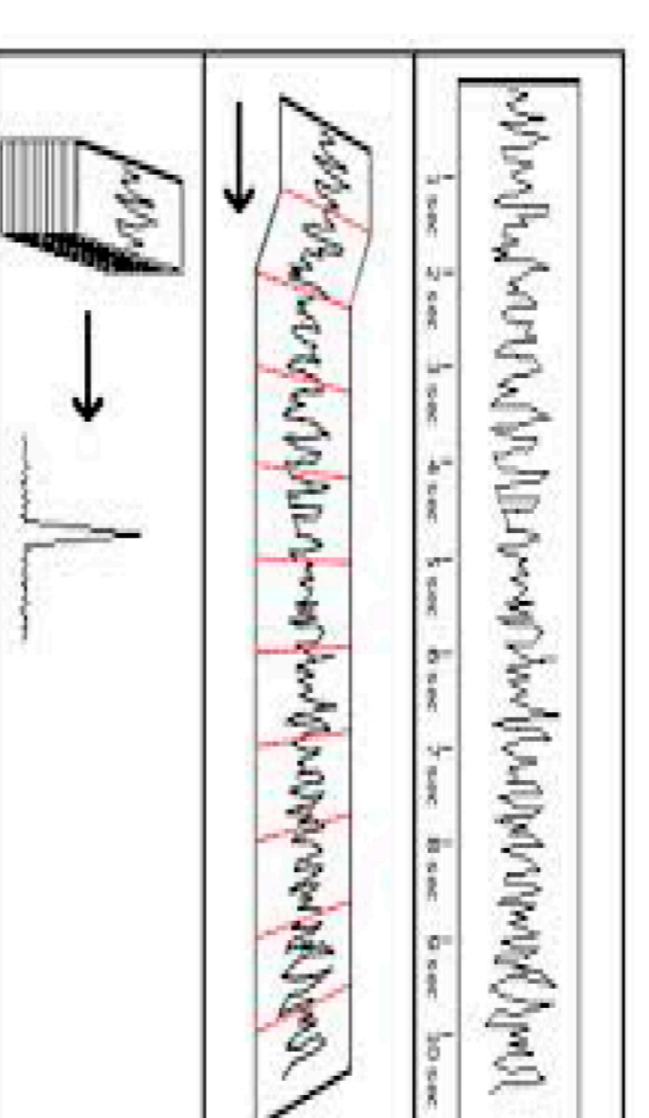


Software Description

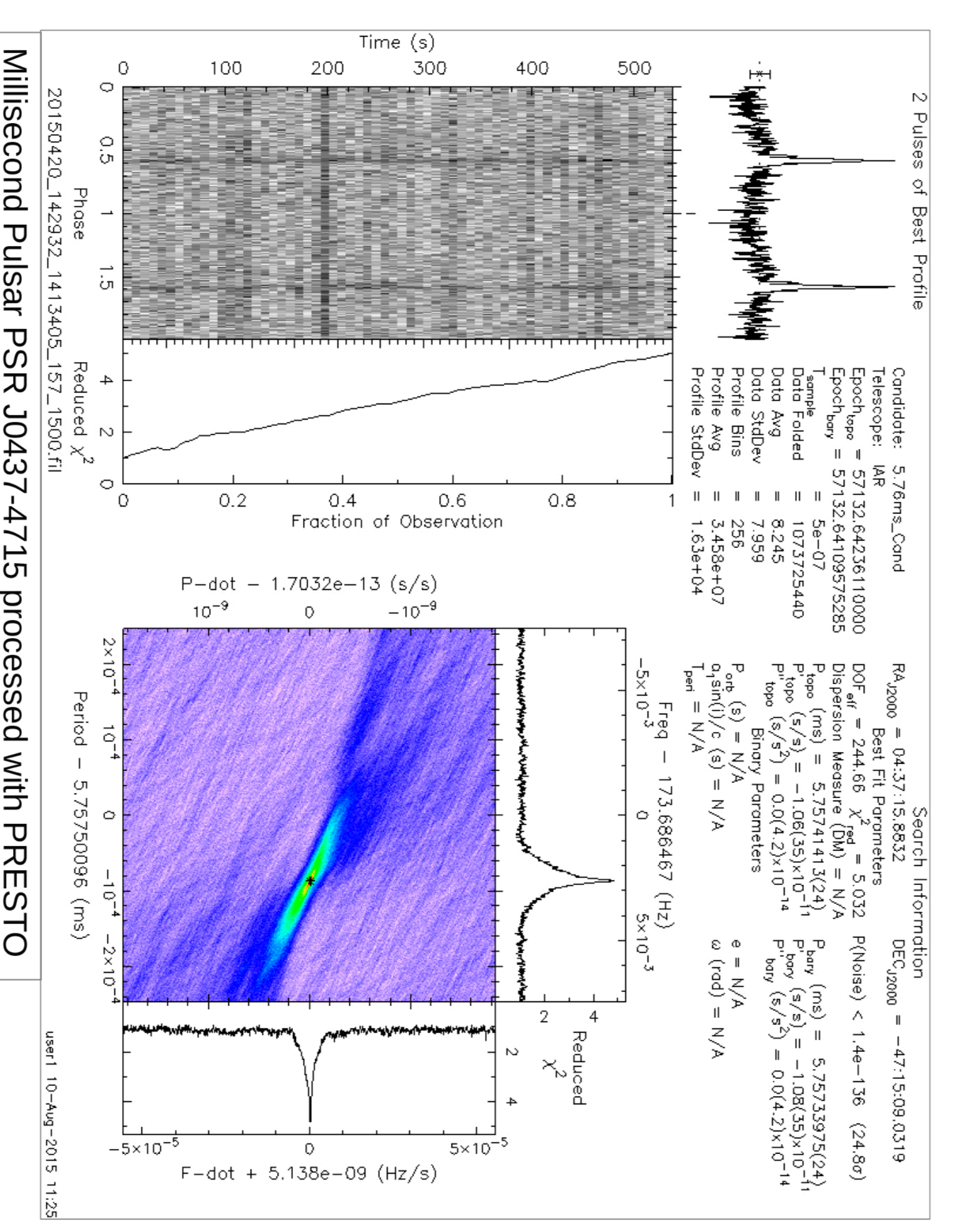
The detection of pulsars was performed using the technique of "folding" in which once known the period or frequency of the Pulsar the acquired data is "folded" and averaged in time series, in order to eliminate noise and leave only the signal of interest.

The programs involved are:

- Python Script that provides the interface with TEMPO program to know the adjusted value of the period of a pulsar for a certain date.
- Custom Application to process the raw files and "folding" the data, based on already known pulsar period.
- Application to convert the raw format files into ".fil format" to be processed with the PRESTO tool-chain, (Pulsar Exploration and Search Toolkit) developed by Scott Ransom from NRAO.



Time series "Folding" example.



Acknowledgment

The author wants to give a special recognition to the work and assistance, to develop the software for the presented work to the following people:

- Peter W. East.
- Steve Olney.
- Wolfgang Herrmann.

