

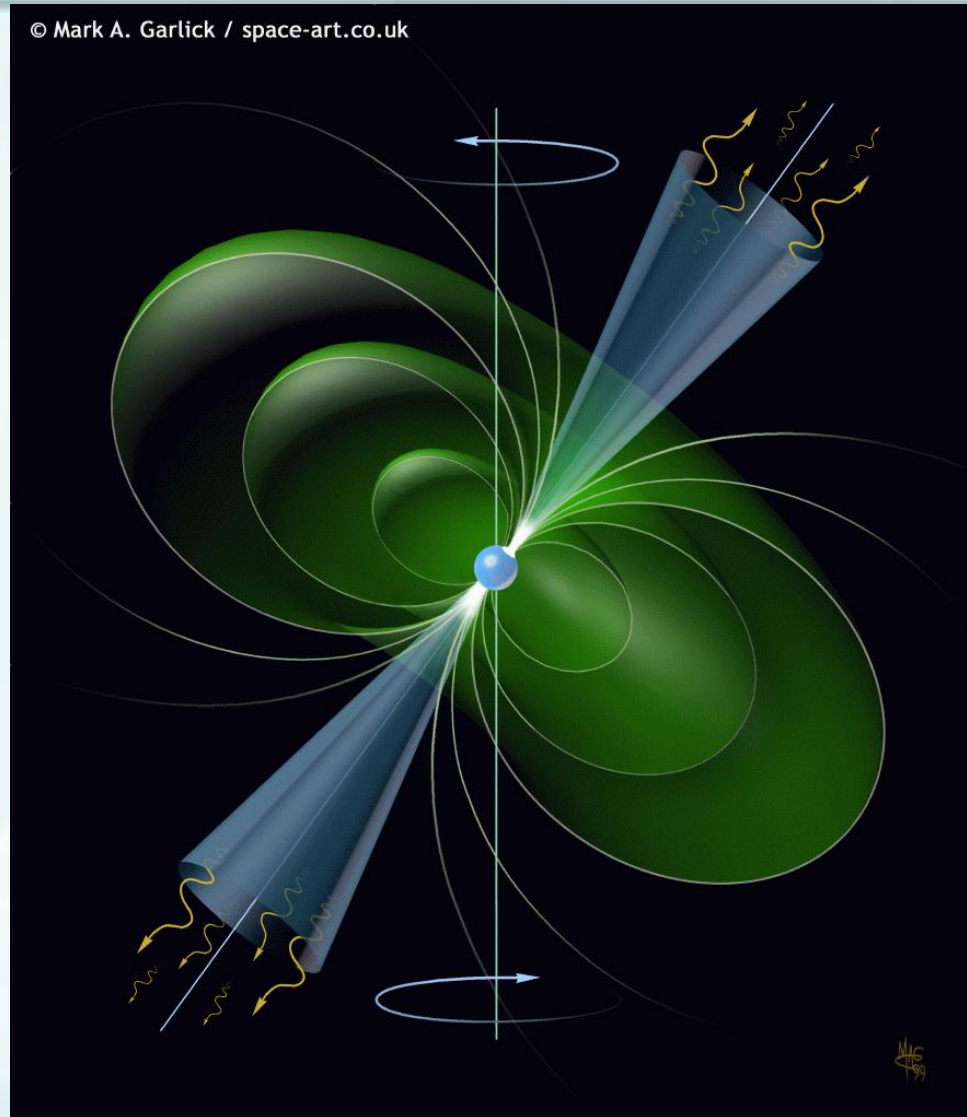
Monitoring and search for Giant Pulses with the LPA radio telescope at the 111 MHz.

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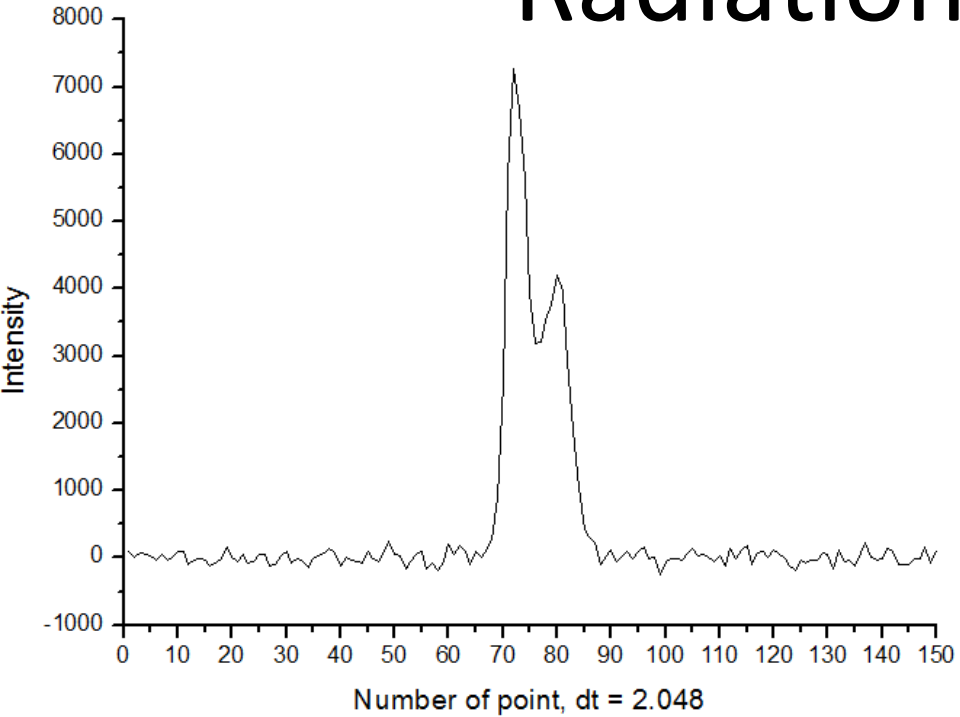
Pushchino Radio Astronomy Observatory ASC LPI

Introduction

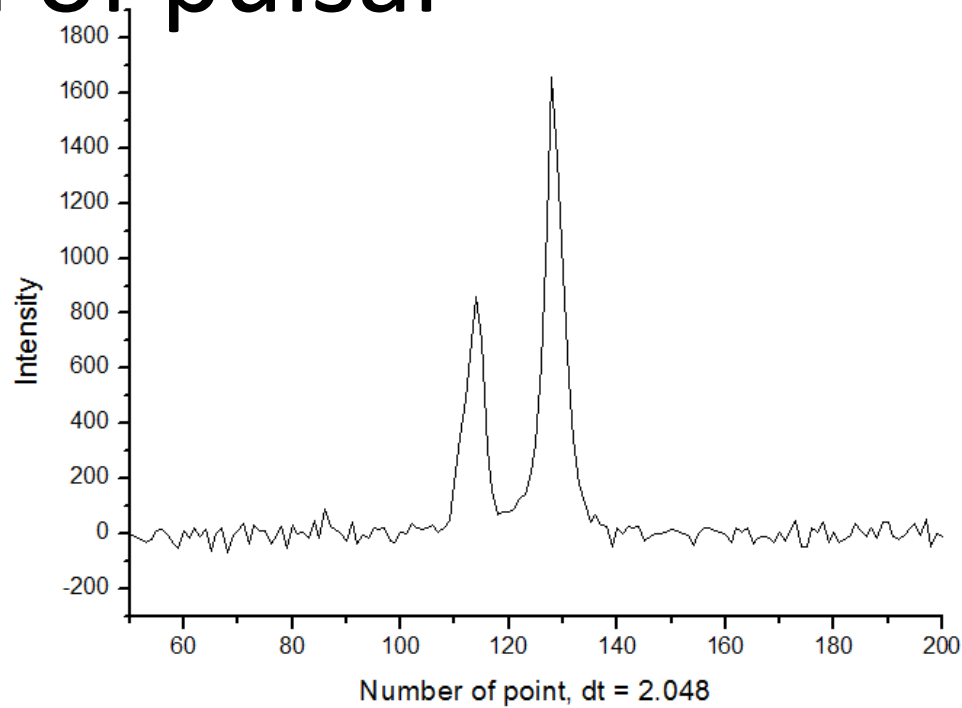


Pulsars are rotating neutron stars, which radiate radiations of different electromagnetic diapasons from their magnetic poles (radio, optical, gamma rays, X-rays).

Radiation of pulsar



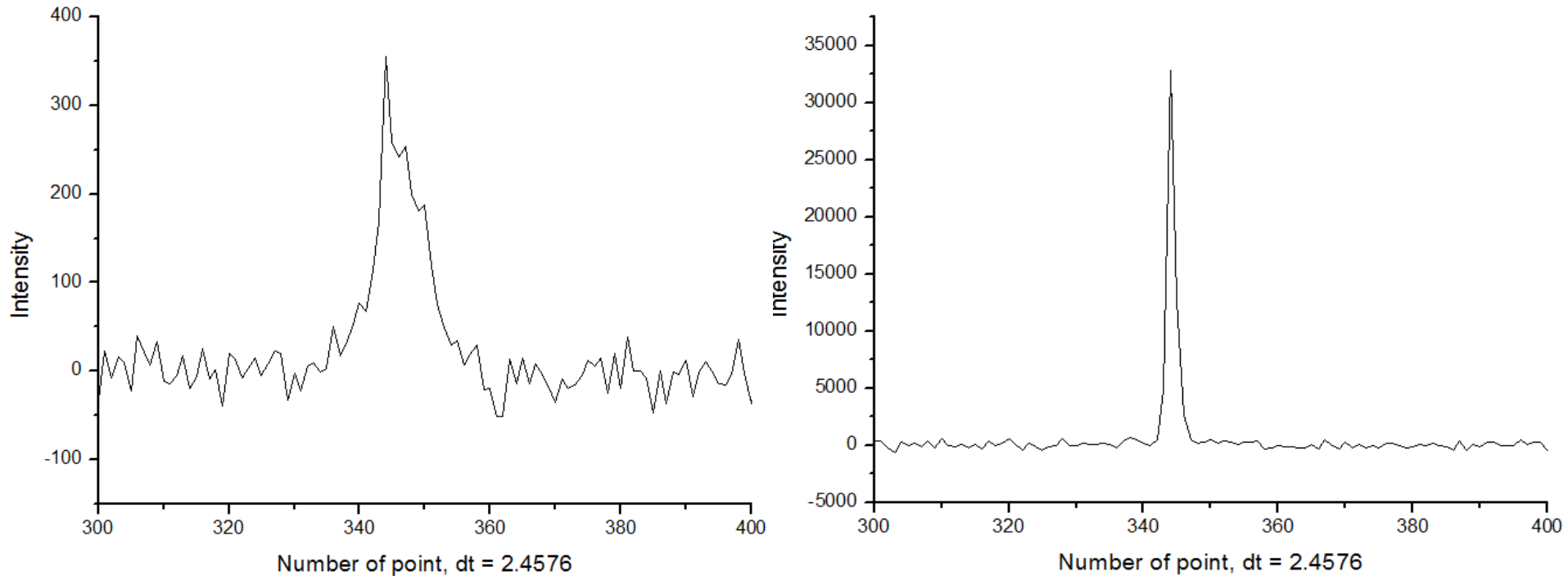
a



b

*Fig.1. Examples of average pulses of pulsars: a – PSR B0834+06, b – PSR B1133+16.
Intensity in arbitrary units, time in milliseconds
(observations made by author with LPI radio telescope at 111 MHz)*

Giant Radio Pulses (GRPs) of pulsars



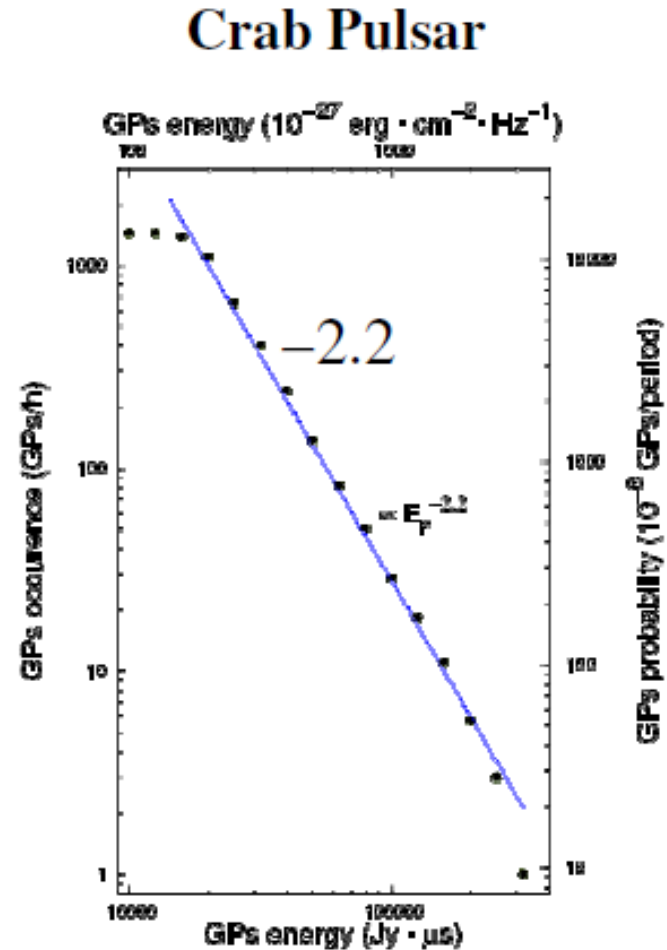
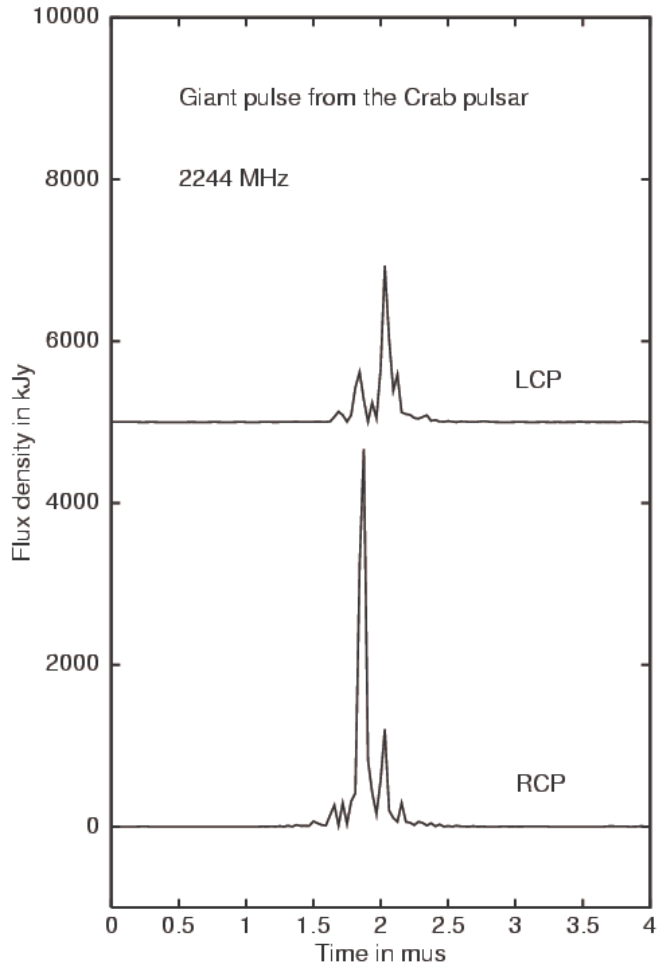
*Fig.2. a) Average pulse of PSR B1112+50, b) GRP from PSR B1112+50.
Intensity in arbitrary units, time in milliseconds
(observations made by author with LPI radio telescope at 111 MHz)*

Characteristics of GRPs

- The peak intensity of GRP exceeds the peak intensity of the average pulse by more than 30 times;
- Time duration of GRP is much shorter than the duration of the average pulse;
- Though the phase of GRPs is not stable, it is always placed within the phase of the average pulse;
- GRPs have a power-law energy distribution (in logarithmic scale).

Crab Pulsar (B0531+21)

- $S_{\text{peak}} \approx 5 \text{ MJy}$. $T_B \approx 5 \cdot 10^{39} \text{ K}$. $\Delta t \approx 0.4 \text{ ns}$.



(From «Amazing properties of giant pulses
and the nature of pulsar is radio emission», Popov M.V. et al., 2005)

Up to date known pulsars with GRPs

Table №1

Name of pulsar	Period of pulsar, c	P1, d. less	DM, cm⁻³ pc	B at LC, G
J0034-0721	0.942951	4.0821E-16	11.380	7.02e+00
J0218+4232	0.002323	7.7389E-20	61.252	3.21e+05
J0534+2200	0.033085	4.2276E-13	56.791	9.80e+05
J0540-6919	0.050499	4.7892E-13	146.500	3.62e+05
J0659+1414	0.384891	5.5003E-14	13.977	7.66e+02
J0953+0755	0.253065	2.2976E-16	2.958	1.41e+02
J1115+5030	1.656440	2.4928E-15	9.195	4.24e+00
J1752+2359	0.409051	0.6427E-15	36.000	7.11e+01
J1824-2452	0.003054	1.6200E-18	120.500	2.25e+09
B1823-3021	0.005440	3.3841E-18	86.834	4.34e+09
J1939+2134	0.001558	1.0512E-19	71.0398	1.02e+06
J1959+2048	0.001608	1.6851E-20	29.1168	3.76e+05

The goals of our research

- Monitoring of pulsars with GRPs to collect statistical information about energy and phase distribution of GRPs
- Observation of pulsars to search for GRPs.

Objects chosen for observation

Criteria of the sample: Declination of pulsars $> -10^\circ$

Low Dispersion measure

Sizeable peak flux density

- PSR B0031-07
- PSR B0218+42
- PSR B0656+14
- PSR B0711+09
- PSR B0823+26
- PSR B0834+06
- PSR B0919+06
- PSR B0950+08
- PSR B1112+50
- PSR B1133+16
- PSR B1237+25
- PSR B1508+55
- PSR B1541+09
- PSR B1752+23
- PSR B1855+09
- PSR B1919+21
- PSR B1929+10
- PSR B1946+35
- PSR B2016+28
- PSR B2020+28
- PSR B2110+27
- PSR B2154+40
- PSR B2212+47
- PSR B2310+42
- PSR B2315+21

Observations



Observations: tools and parameters

Radiotelescope: **LPA LPI**; Frequency of observations: **111.846 MHz**;

Bandwidth: **2.3 MHz**;

Duration of each observation session: **≈3 minutes**;

Time of observations: **October 2011 – June 2012.**

Processing data

- The quantity of all sessions of observations: ~800;
- For further processing individual pulses with peak intensities exceeding the peak intensity of an average pulse by more than 30 times were chosen;
- The pulses which satisfy “more than 30 times” criterion were detected from three pulsars.

Confirmation of generation GRPs from PSR B1112+50

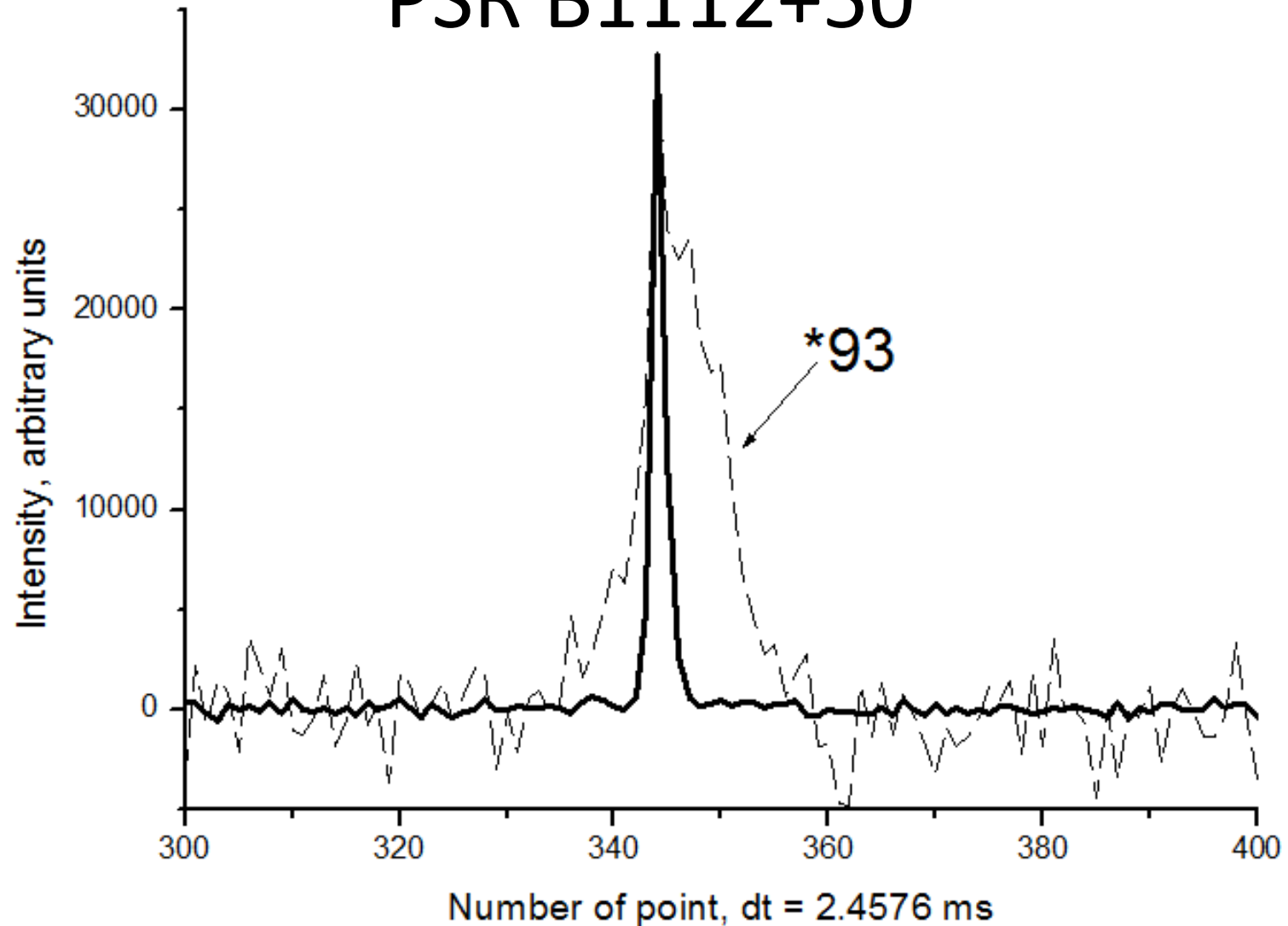


Fig.3. The strongest observed pulse from PSR B 1112+50 (solid line) is shown together with increased in 93 times average pulse (dashed line)

Distribution of pulses from PSR

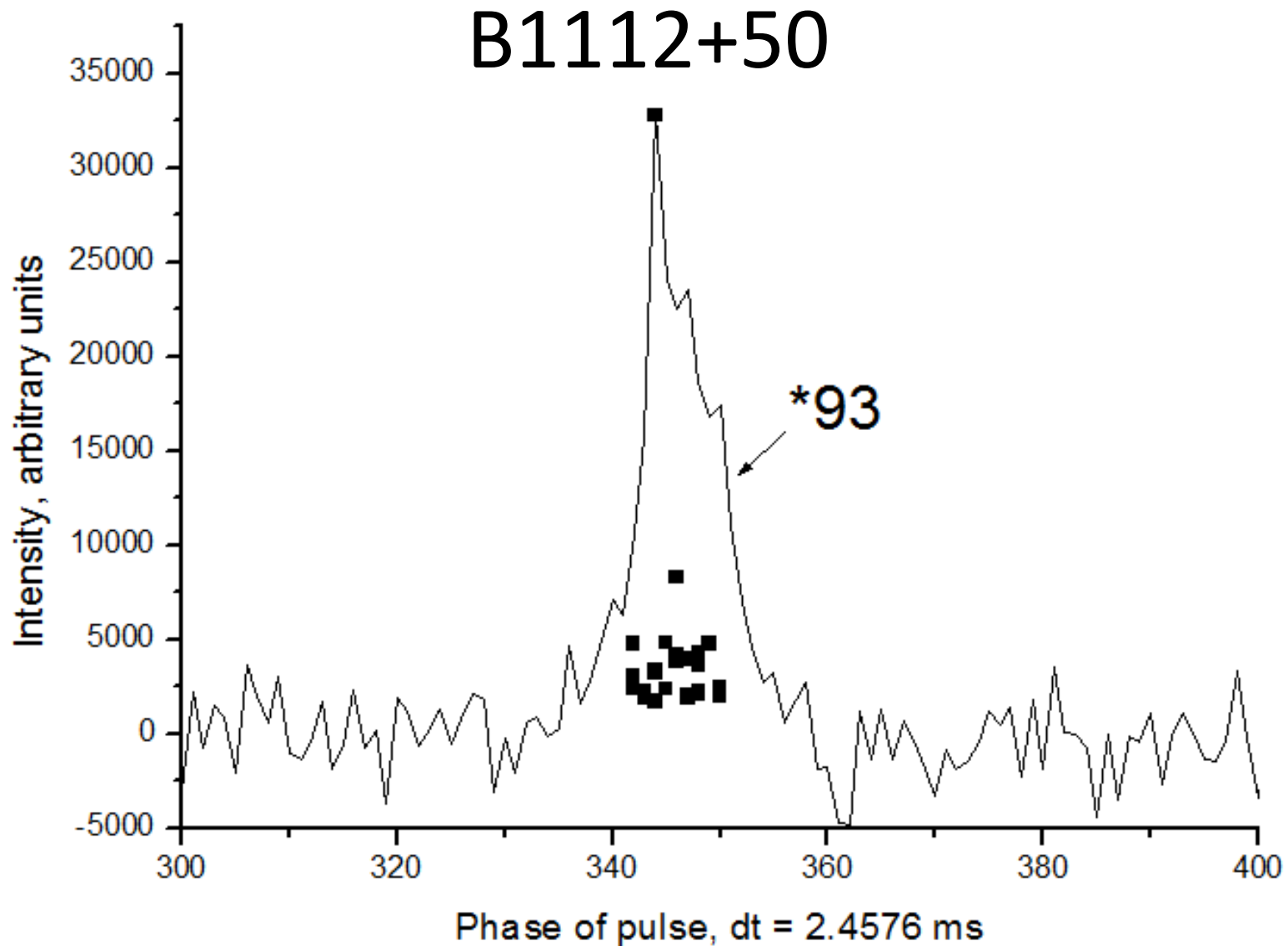


Fig.4. Distribution of pulses in a session of observation is shown together with the average pulse increased in 93 times.

Confirmation of generation GRPs from PSR B0950+08

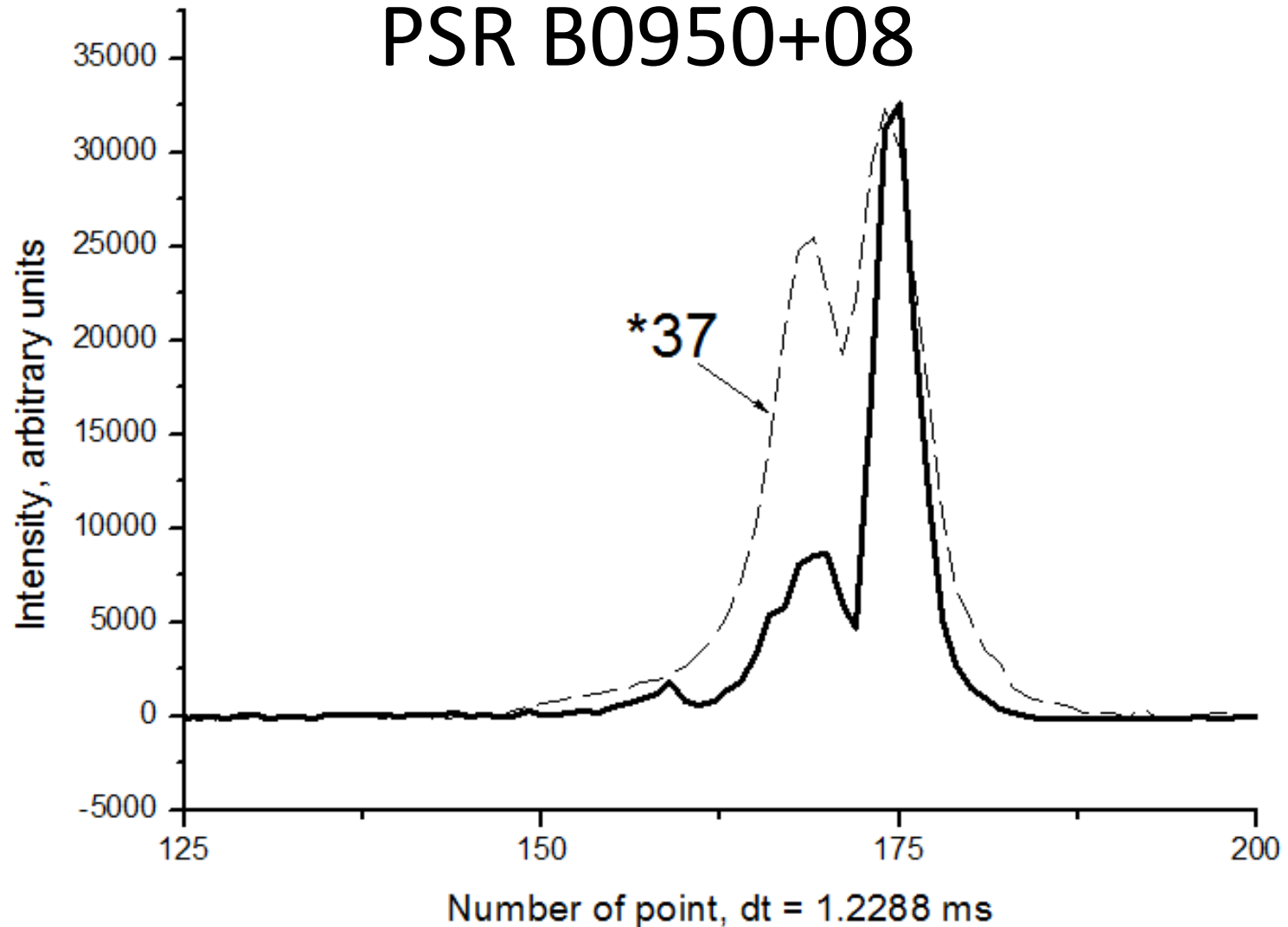


Fig.5. The example of observed pulse from PSR B 0950+08 (solid line) is shown together with increased in 37 times average pulse (dashed line).

Distribution of pulses from PSR B0950+08

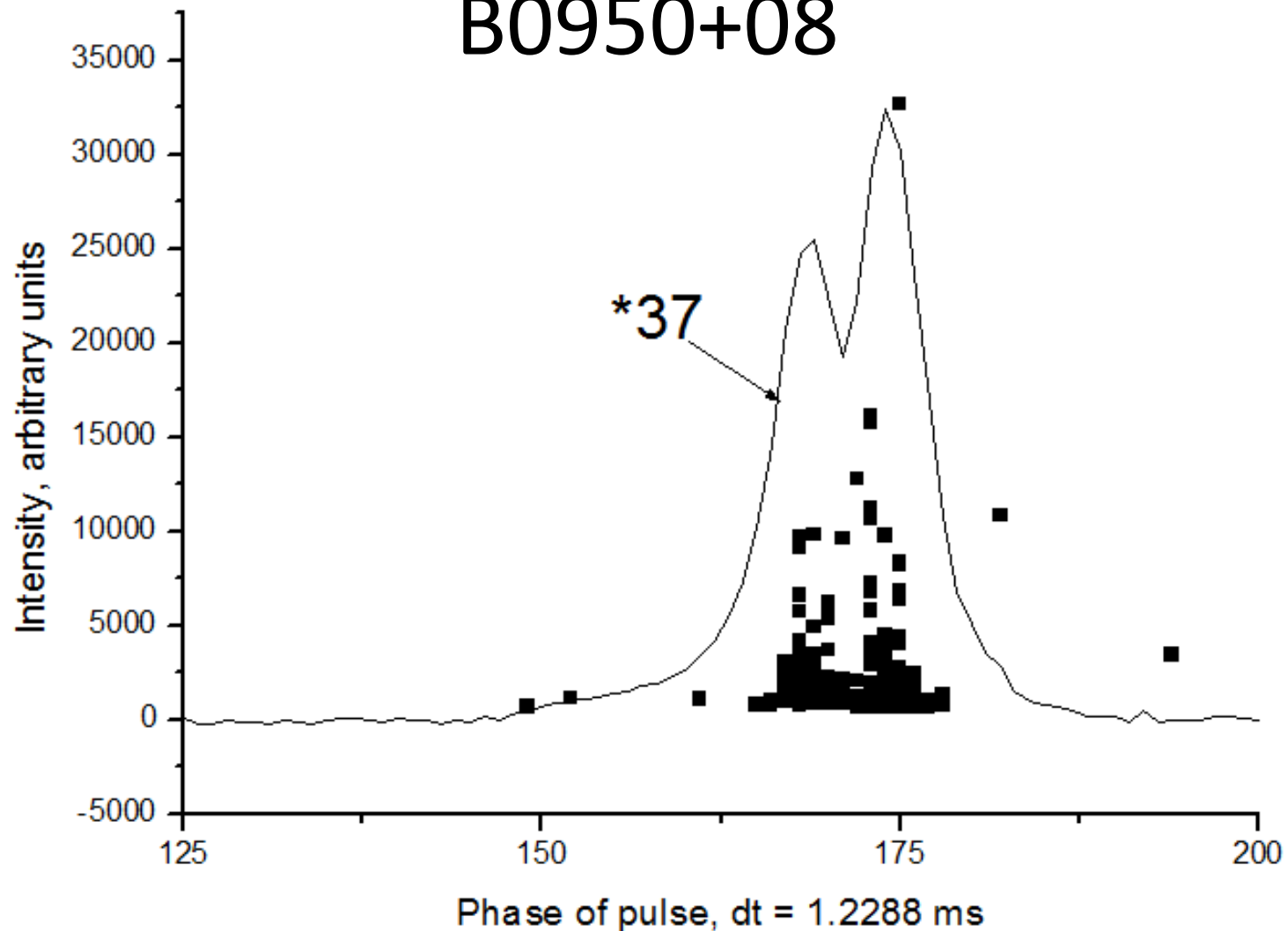


Fig.6. Distribution of pulses in a session of observation is shown together with the average pulse increased in 37 times.

Discovery of strong individual pulses from PSR B1237+25

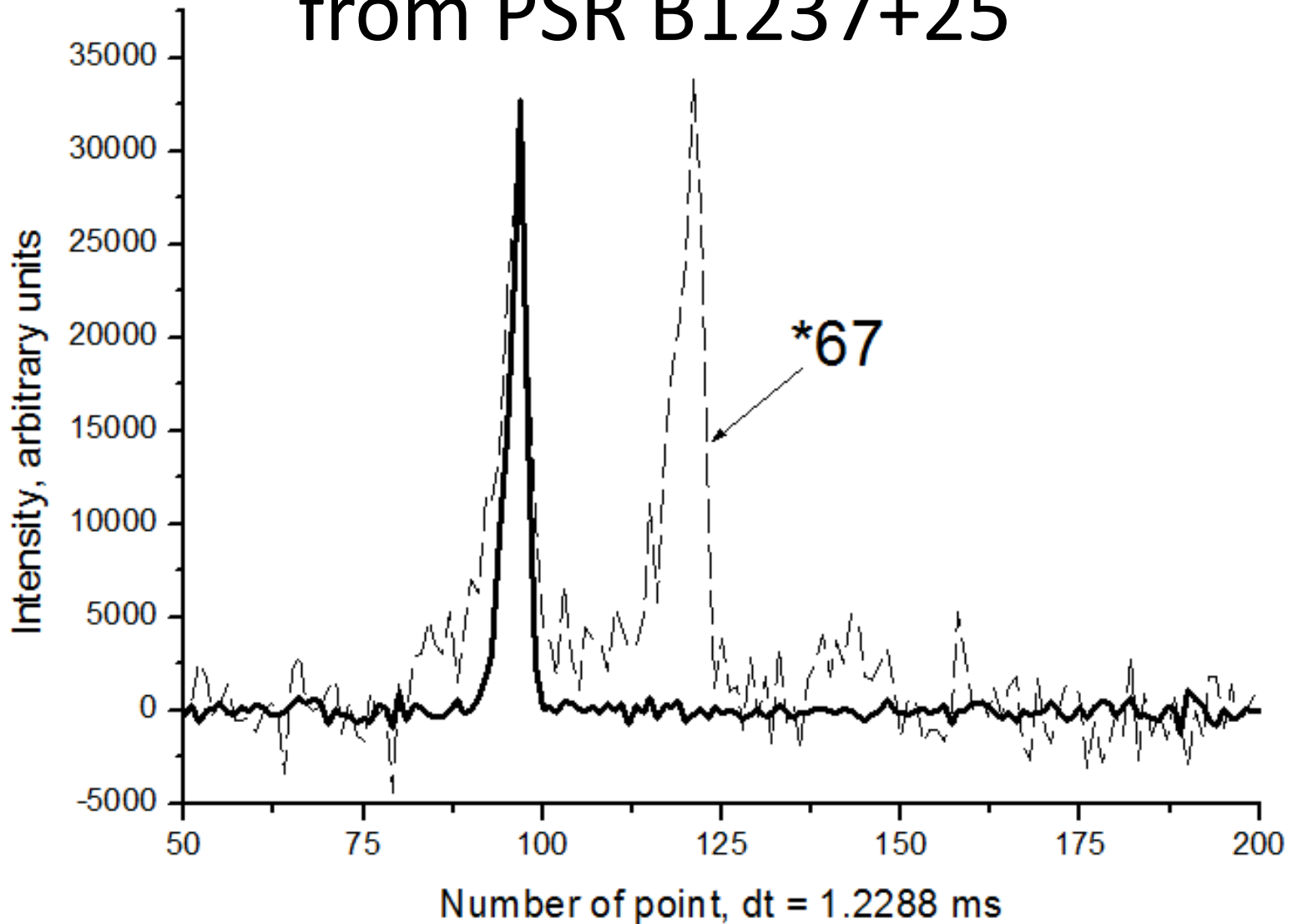


Fig.7. The strongest observed pulse from PSR B 1237+25 (solid line) is shown together with the average pulse increased in 67 times (dashed line).

Distribution of pulses from PSR

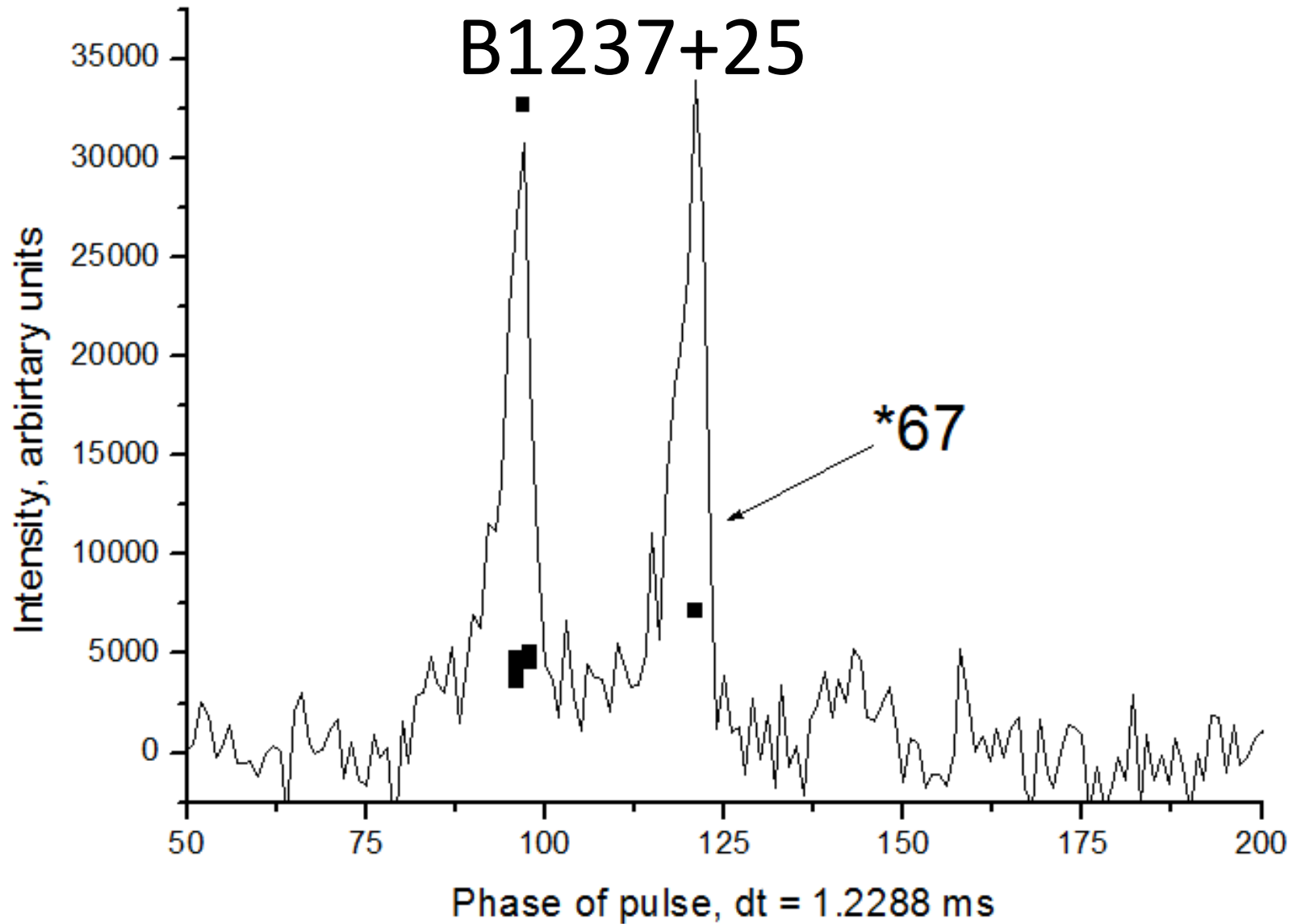


Fig.8. Distribution of pulses in a session of observation is shown together with the average pulse increased in 67 times.

Discovery of strong individual pulses from PSR B1237+25

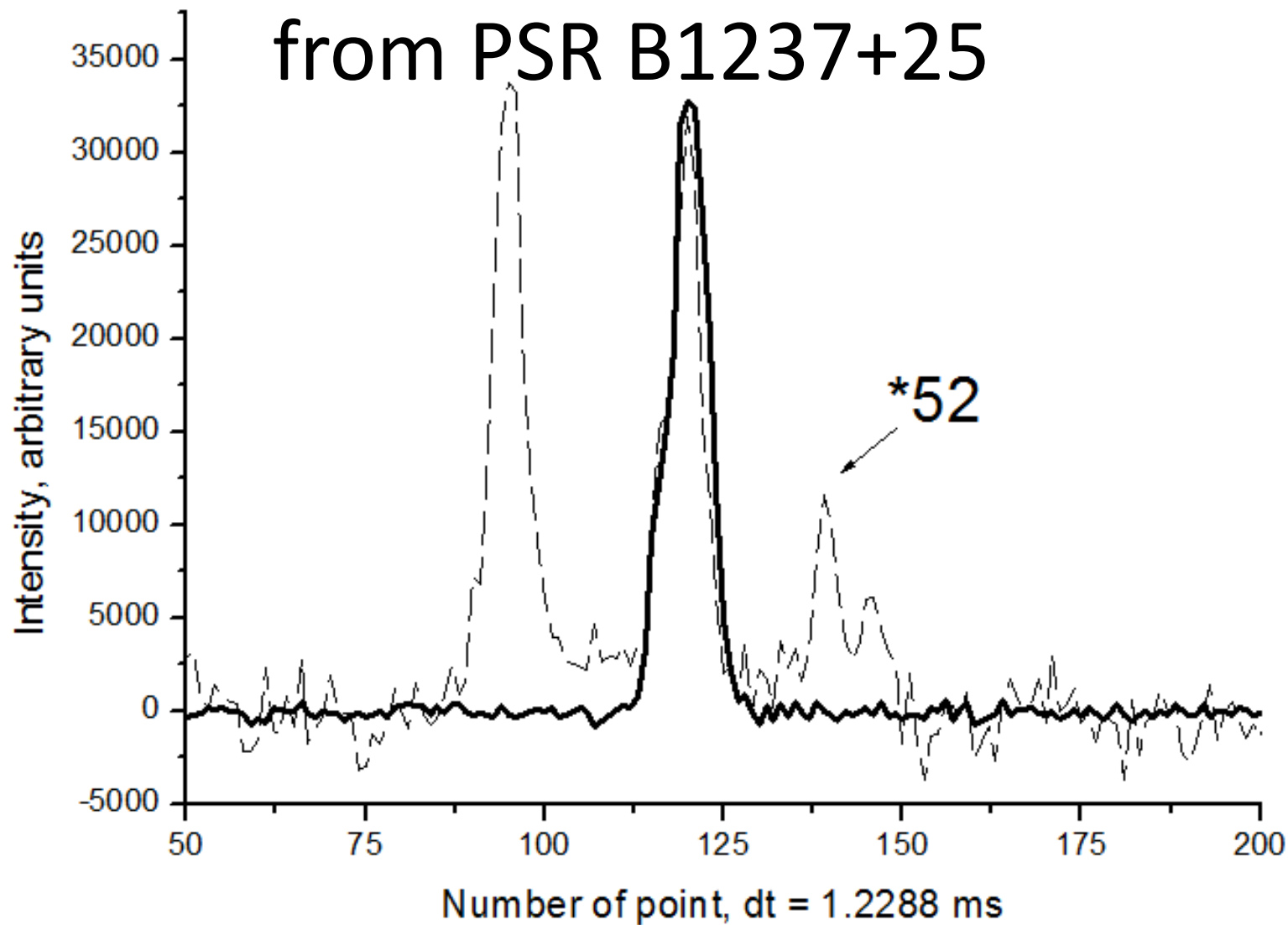


Fig.9. The strongest observed pulse from PSR B 1237+25 was generated in the phase of the second component of the average pulse. It is shown together with the average pulse increased in 52 times (dashed line).

List of pulsars with no found GRPs

- PSR B0031-07
- PSR B0218+42
- PSR B0656+14
- PSR B0711+09
- PSR B0823+26
- PSR B0919+06
- PSR B1508+55
- PSR B1541+09
- PSR B1752+23
- PSR B1855+09
- PSR B1919+21
- PSR B1929+10
- PSR B1946+35
- PSR B2016+28
- PSR B2020+28
- PSR B2110+27
- PSR B2154+40
- PSR B2310+42
- PSR B2315+21

During period of observations (October 2011 – June 2012)
there were no found pulses which satisfied our criterion of the GRPs.

Conclusions

- The regular generation of GRPs from PSR B1112+50 & B0950+08 was confirmed;
- The generation of GRPs from PSR B0031-07, PSR B0218+42, PSR B0654+14, PSR B1752+23 was not detected about $1 \text{ Jy} / \sin(\text{zenith distance})$ [$dt=1.28 \text{ ms}$] level;
- For the first time the generation of strong pulses from PSR B1237+25 which satisfy the main criteria of the GRP was detected ;
- During period of observations, pulses which satisfy the criterion of GRPs from other pulsars of our sample were not detected.

Literature

1. Hankins T.H., Kern J.S., Weatherall J.C. et al., Nature, 422, 141 (2003).
2. Catalog of pulsars
<http://www.wolframalpha.com/entities/pulsars-index/>
3. «Обнаружение гигантских импульсов пульсара PSR B1112+50», Ершов А.А., Кузьмин А.Д., Письма в астрономический журнал, том 29, №2, с. 111-115 (2003).
4. «Обнаружение гигантских импульсов пульсара PSR B0031-07», Кузьмин А.Д., Ершов А.А., Лосовский Б.Я., Письма в астрономический журнал, том 30, №4, с. 285-288 (2004).

Thank you for your attention!