Single pulse statistical analysis of magnetar AXP J1809-194

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Data

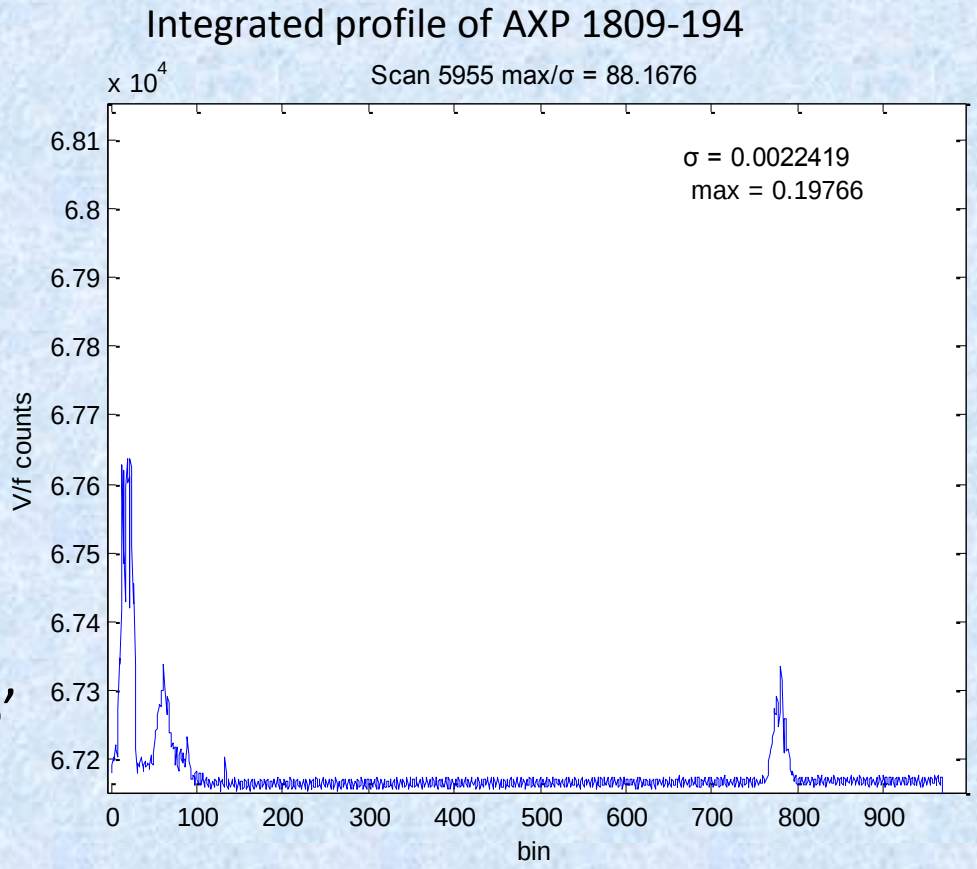
Magnetar

AXP J1809-54

- P=5.54 s
- dP/dt=11500 ss^{-1}
- DM=178 cm^{-3} pc

Observation frequencies

8.35 GHz and 2.6 GHz taken by the 100m Effelsberg Radiotelescope May-August 06’



Data

Pulsars

PSR B0329+54

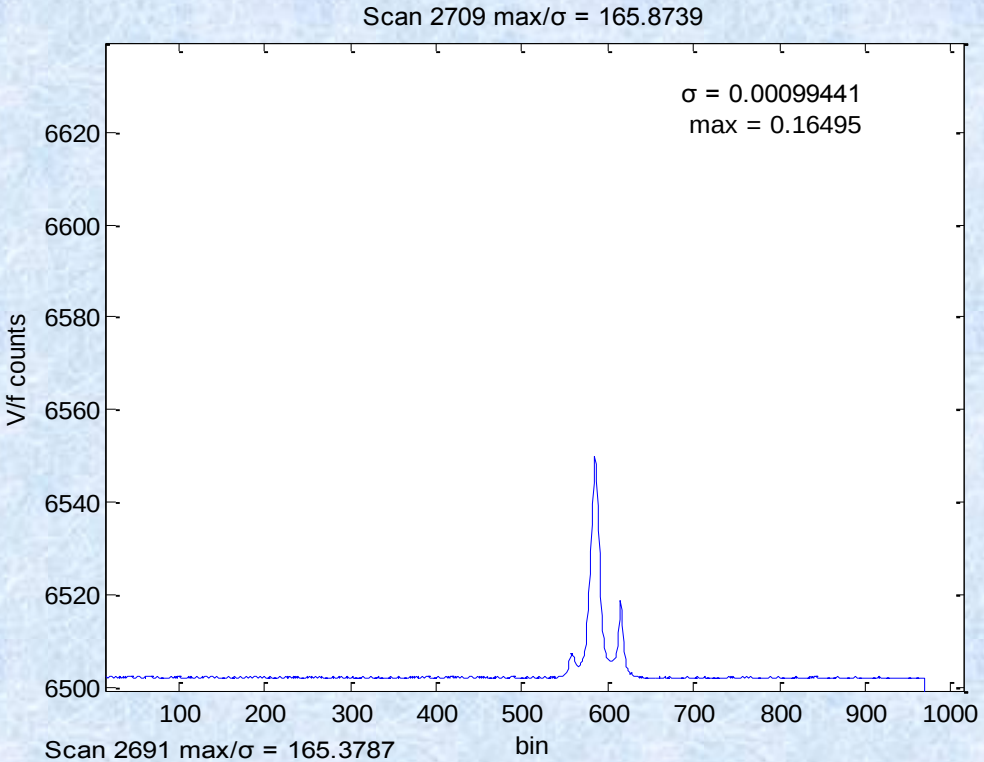
- P=0.7145 s
- dP/dt=2.05 ss^{-1}
- DM=2.05cm^{-3} pc

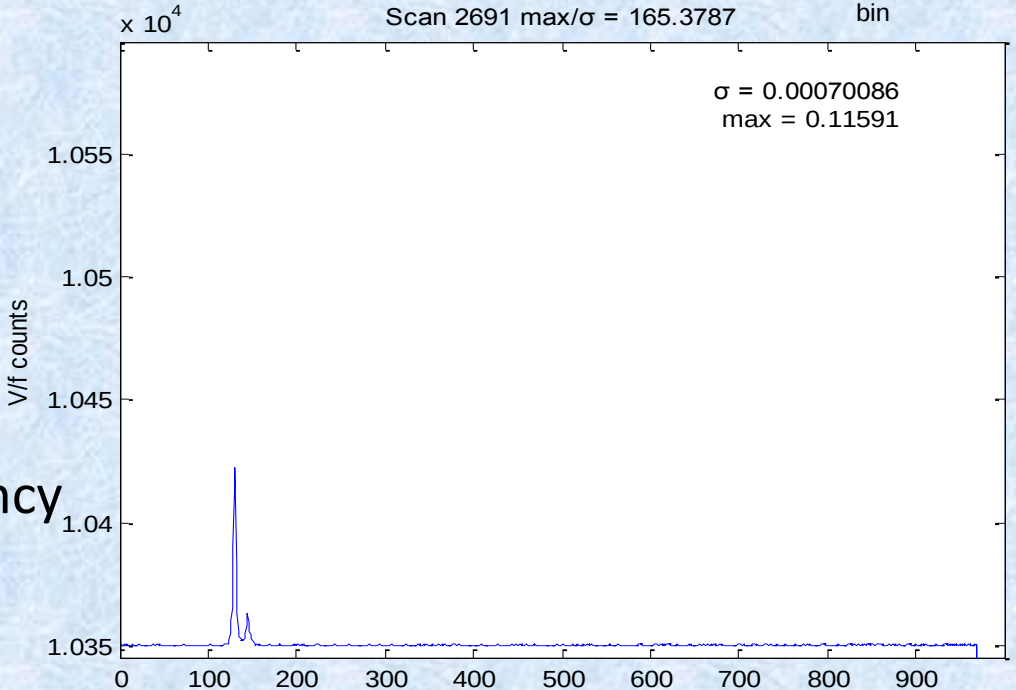
PSR B1133+16

- P=1.1879 s
- dP/dt=3.73 ss^{-1}
- DM=4.8cm^{-3} pc

Observation frequency

8.35 GHz





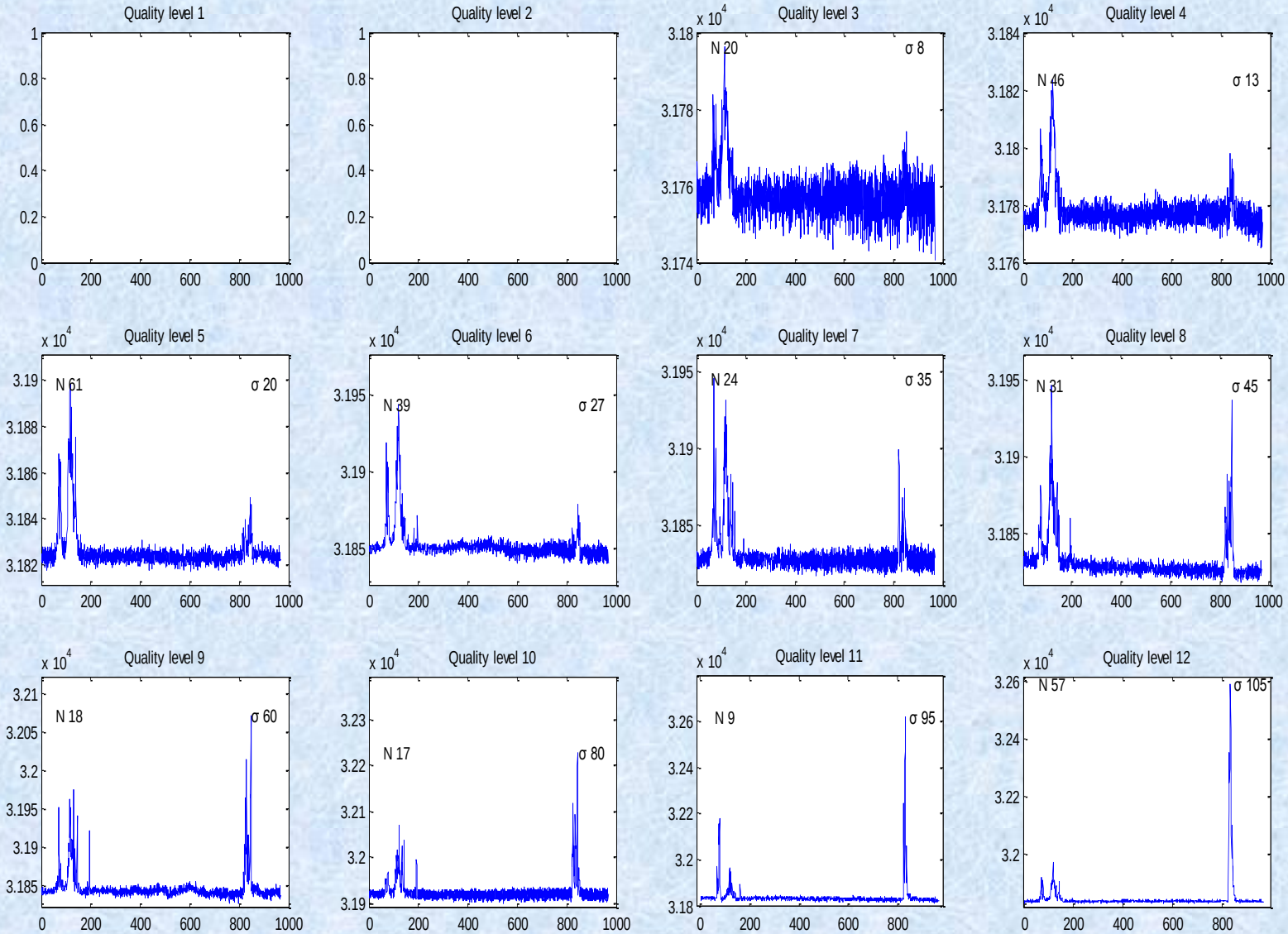
Data Analysis

- We used the “jhspuls” program in matlab environment.
- We investigated the quality of the single pulses by distributing them into quality classes according to both energy and maximum of the pulse.
- We investigated the single pulses for mode changing.

Data Analysis

- Quality

scan 7204
whole pulse



Results

AXP 1809-194, Scan 5954 max

Quality (σ)	Whole pulse	Main Pulse	1st Component	2nd Component	3rd Component	Interpulse
0-1	0	0	0	0	2	0
1-3	0	1	163	2	293	168
3-8	39	49	75	60	12	36
8-13	41	71	21	86	5	12
13-20	54	60	8	76	5	25
20-27	39	42	4	43	2	15
27-35	32	25	1	31	0	14
35-45	13	12	3	11	0	4
45-60	23	10	1	10	2	15
60-80	23	11	8	3	0	16
80-95	9	5	4	1	0	4
>95	50	37	35	0	2	14

Results

AXP 1809-194, Scan 5954 energy

Quality (σ)	Whole pulse	Main Pulse	1st Component	2nd Component	3rd Component	Interpulse
0-1	301	255	257	172	316	235
1-1.5	13	25	9	104	2	23
1.5-3	8	14	10	46	3	32
3-5	1	6	7	1	2	20
5-7	0	8	6	0	0	12
7-9	0	10	5	0	0	1
9-11	0	2	2	0	0	0
11-13	0	2	1	0	0	0
13-16	0	0	2	0	0	0
16-19	0	0	3	0	0	0
19-25	0	1	5	0	0	0
>25	0	0	16	0	0	0

Results

PSR 0329+54, scan 2709a max

Quality (σ)	Whole pulse	1st component	2nd component	3rd component
0-1	0	5	0	0
1-3	30	313	57	219
3-8	150	52	139	123
8-13	76	-	68	18
13-20	59	0	55	9
20-27	23	0	20	3
27-35	20	0	19	1
35-45	-	0	-	0
45-60	-	0	-	0
60-80	-	0	-	0
80-95	0	0	0	0
>95	-	0	-	0

PSR 1133+16, scan2691a max

Quality (σ)	Whole pulse	1st component	2nd component
0-1	0	-	12
1-3	130	157	278
3-8	124	104	75
8-13	41	36	8
13-20	26	24	4
20-27	12	11	-
27-35	9	9	0
35-45	11	11	0
45-60	8	8	0
60-80	4	4	0
80-95	4	4	0
>95	-	-	0

Results

PSR 0329+54, scan 2709a energy

Quality (σ)	Whole pulse	1st component	2nd component	3rd component
0-1	169	342	74	308
1-1.5	76	16	50	33
1.5-3	108	13	107	23
3-5	18	2	82	9
5-7	1	0	35	0
7-9	1	0	16	0
9-11	0	0	4	0
11-13	0	0	3	0
13-16	0	0	0	0
16-19	0	0	1	0
19-25	0	0	1	0
>25	0	0	0	0

PSR 1133+16, scan 2691a energy

Quality (σ)	Whole pulse	1st component	2nd component
0-1	267	231	338
1-1.5	39	43	28
1.5-3	43	50	9
3-5	15	24	3
5-7	4	12	0
7-9	6	2	0
9-11	1	6	0
11-13	1	0	0
13-16	1	4	0
16-19	0	2	0
19-25	1	2	0
>25	0	2	0

Results

Calculation of the single pulses' nulling percentage according to maximum.

Pulsar	*Freq. (GHz)*	*Whole Pulse*	*1st Comp.*	*2nd Comp.*	*3rd Comp.*	*Interpul.*	*Age (10^6 yr)*
AXP J1809-194	8.35	0.06%	37.3%	0.3%	91.4%	49.6%	
AXP J1809-194	2.64	0%	37.8%	92.3%	24.65%	1.4%	
PSR B1133+16	8.35	34%	44.2%	72.5%	-	-	5.5
PSR B0329+54	8.35	10.35%	85.1%	18.8%	63.3%	-	5.0

Results

Dispersion broadening calculation

- AXP J1809-194

  8.35GHz $\Delta t = 2.54\ msec$

  2.64GHz $\Delta t = 8.03\ msec$

- Resolution 5.3 msec.

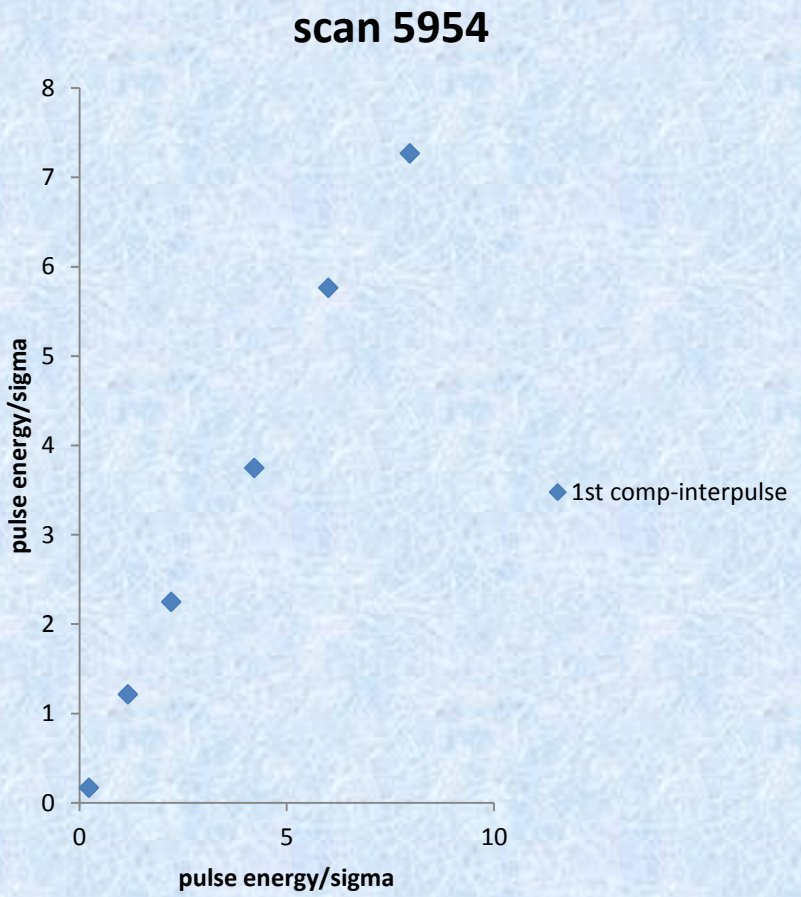
$\Delta t = 0.38\ msec$

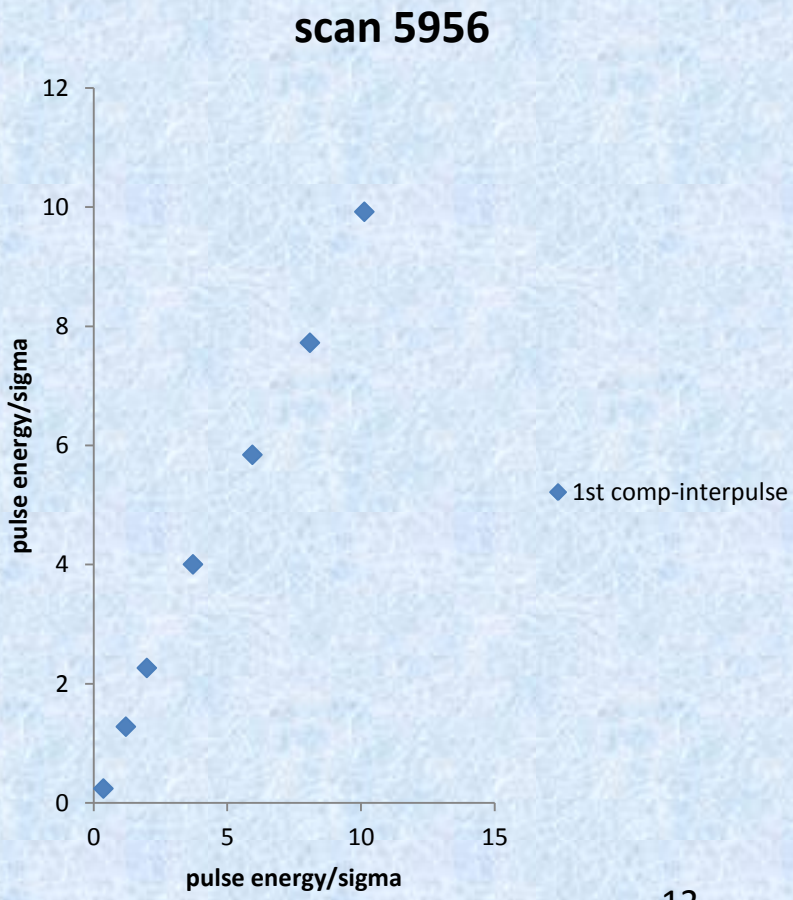
- PSR B0329+54

- PSR B1133+16 $\Delta t = 0.068\ msec$

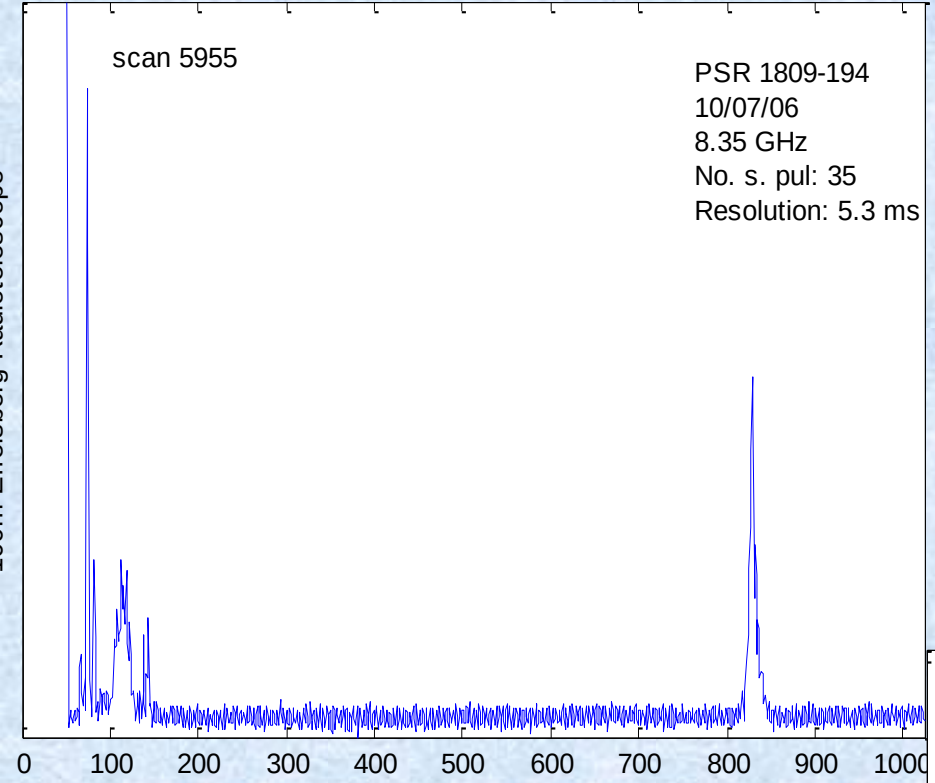
Results

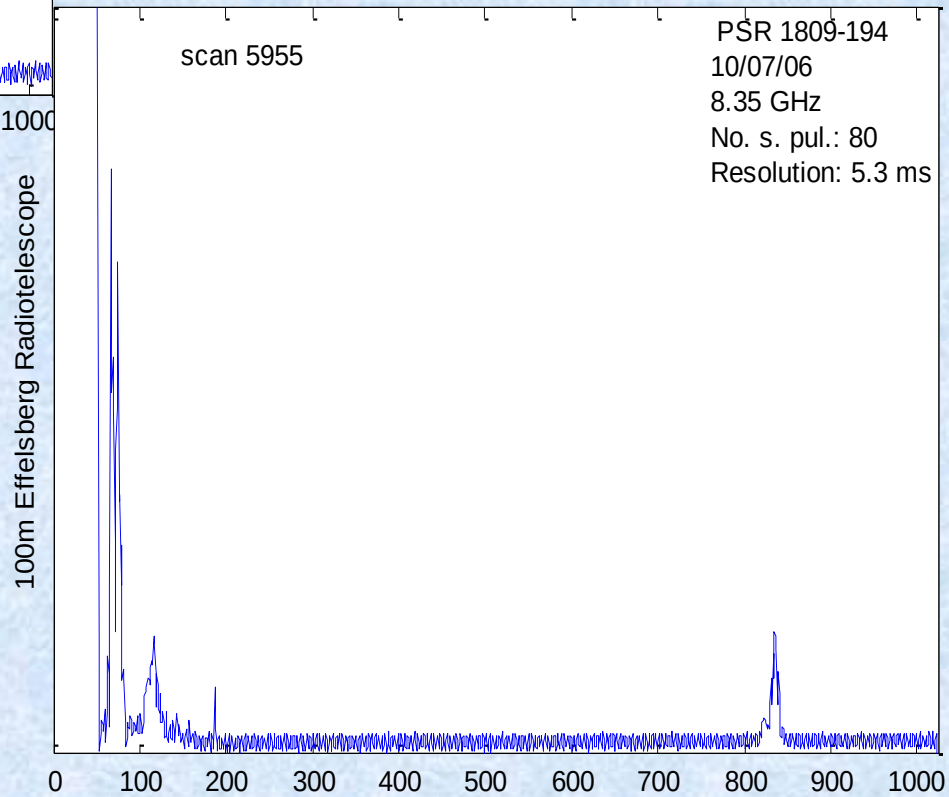
Correlation between different components of the magnetar in the aspect of the change of energy.

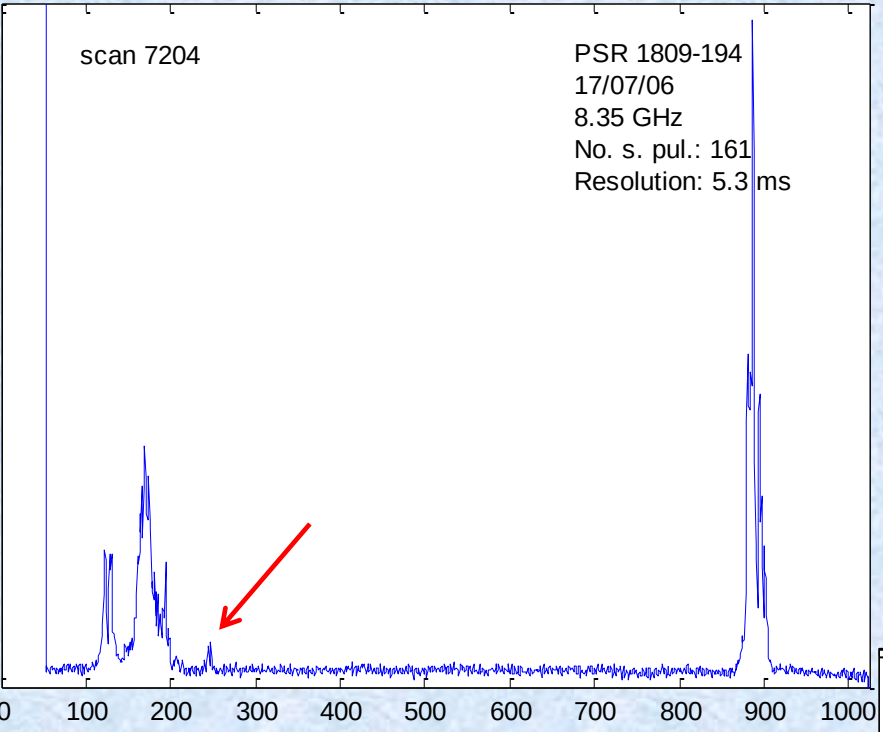


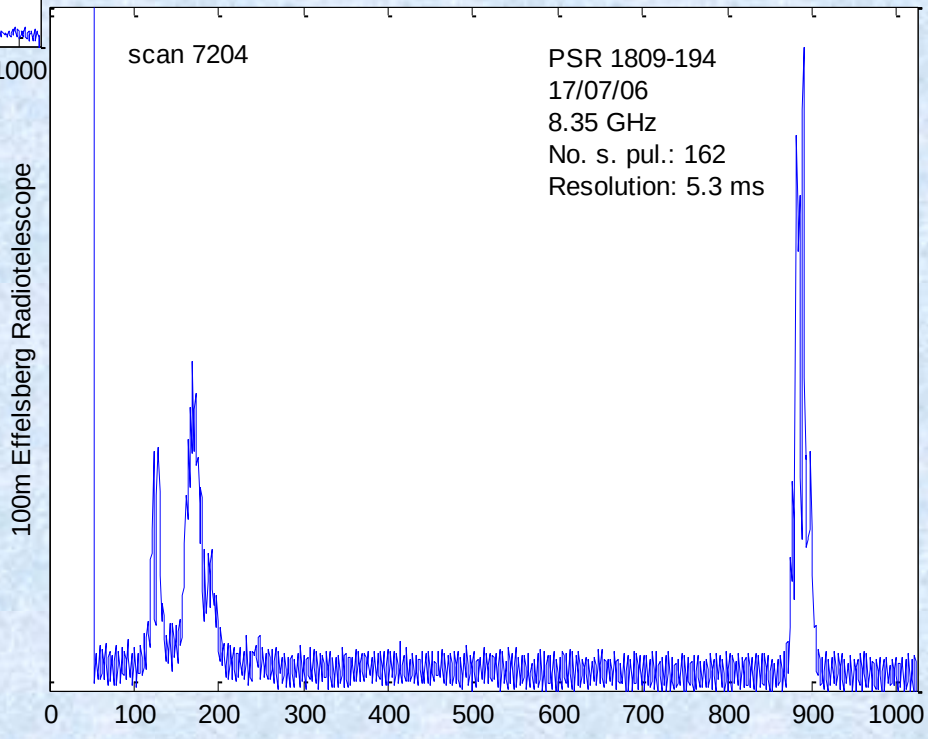


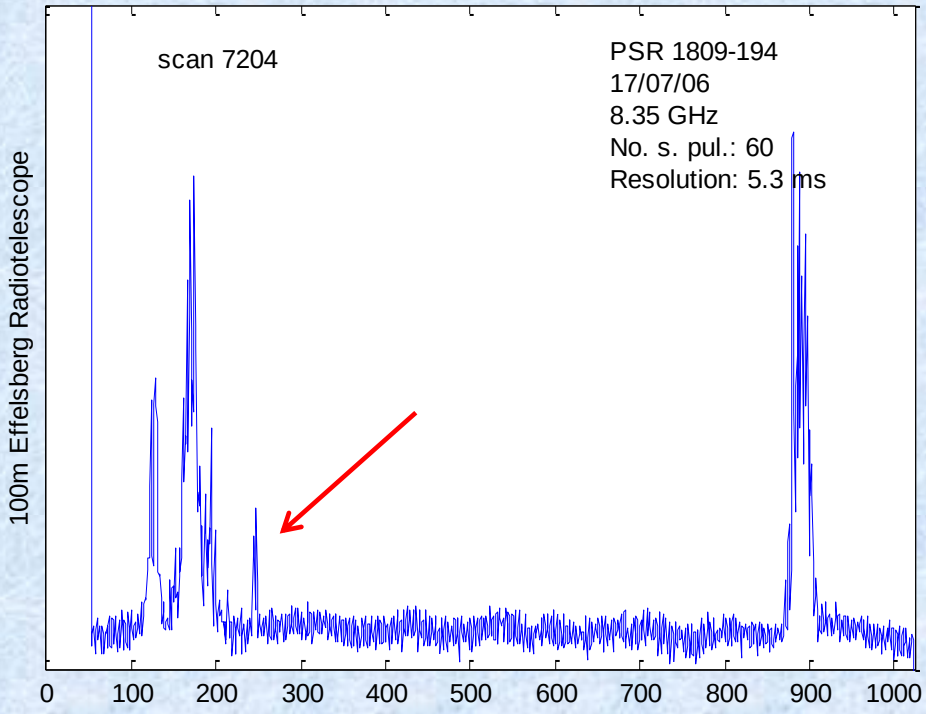
Results
Mode Changing

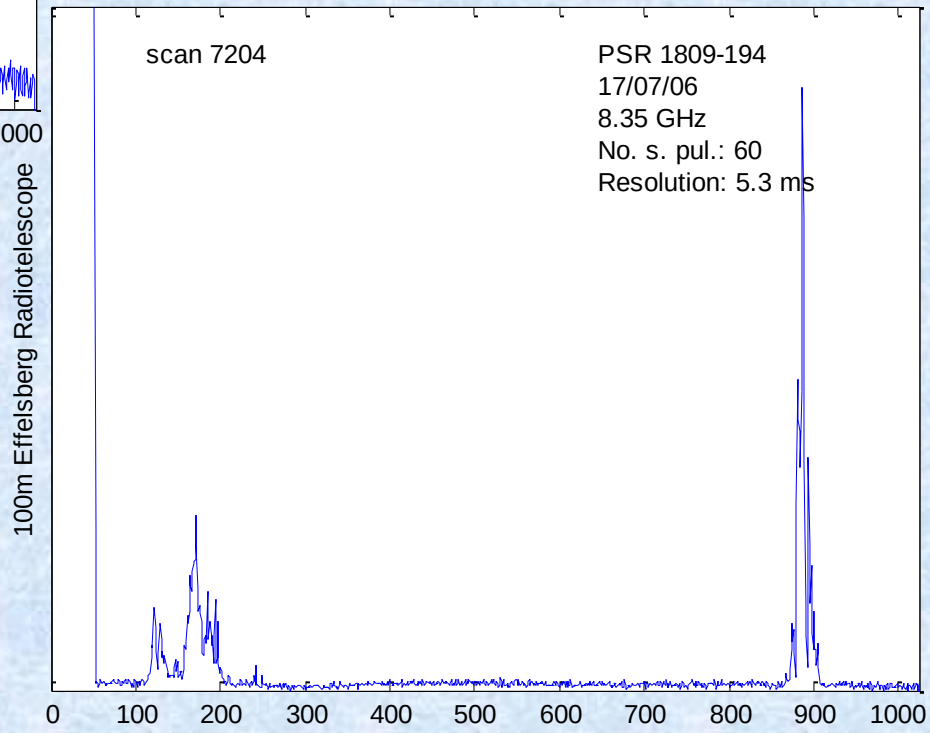


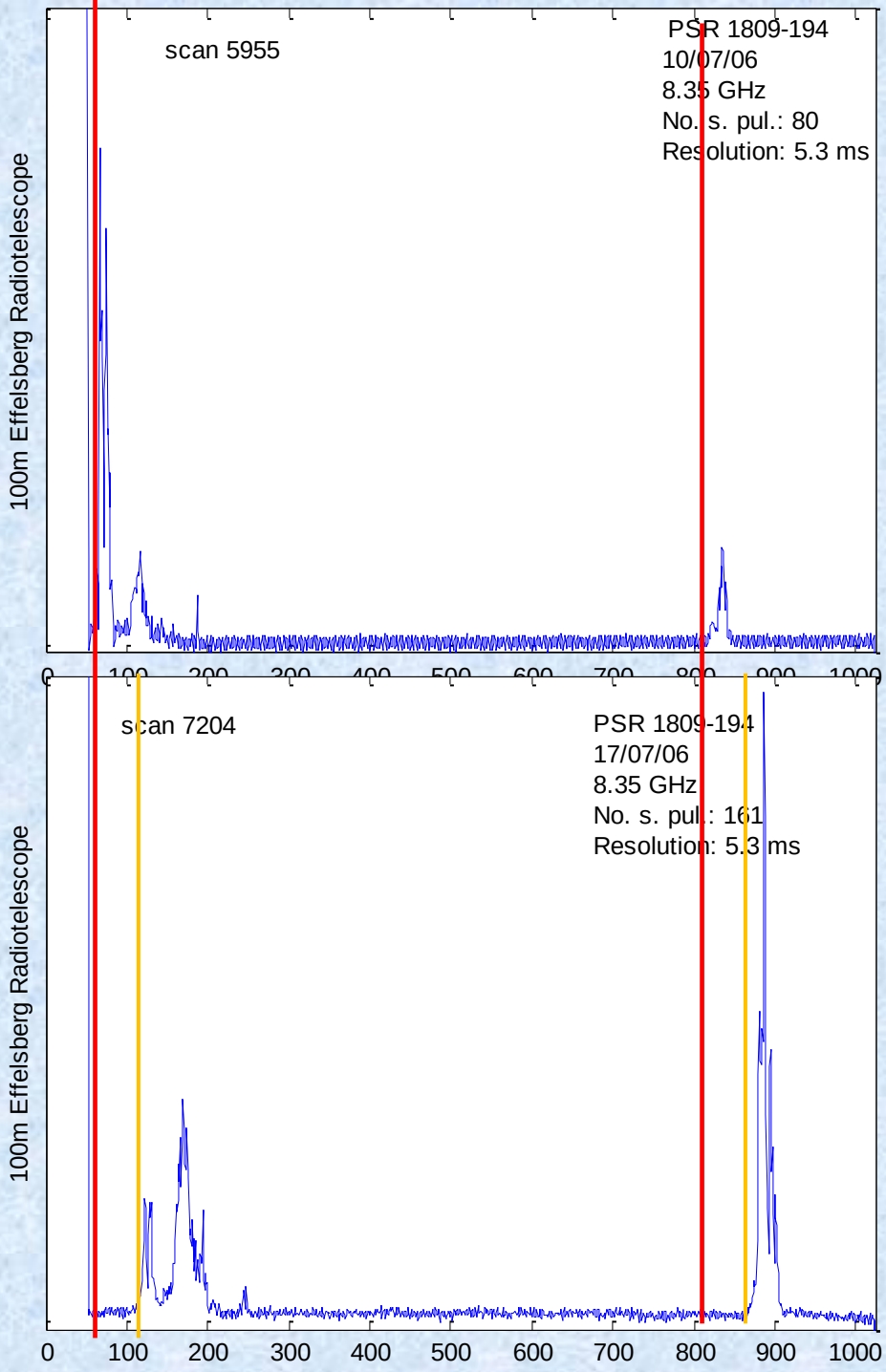



scan 7204
PSR 1809-194
17/07/06
8.35 GHz
No. s. pul.: 161
Resolution: 5.3 ms
0
100
200
300
400
500
600
700
800
900
1000


scan 7204
PSR 1809-194
17/07/06
8.35 GHz
No. s. pul.: 162
Resolution: 5.3 ms
100m Effelsberg Radiotelescope
0
100
200
300
400
500
600
700
800
900
1000


scan 7204
PSR 1809-194
17/07/06
8.35 GHz
No. s. pul.: 60
Resolution: 5.3 ms
100m Effelsberg Radiotelescope
0
100
200
300
400
500
600
700
800
900
1000


scan 7204
PSR 1809-194
17/07/06
8.35 GHz
No. s. pul.: 60
Resolution: 5.3 ms
100m Effelsberg Radiotelescope
0
100
200
300
400
500
600
700
800
900
1000


scan 5955
PSR 1809-194
10/07/06
8.35 GHz
No. s. pul.: 80
Resolution: 5.3 ms
100m Effelsberg Radiotelescope
0
100
200
300
400
500
600
700
800
900
1000
scan 7204
PSR 1809-194
17/07/06
8.35 GHz
No. s. pul.: 161
Resolution: 5.3 ms
100m Effelsberg Radiotelescope
0
100
200
300
400
500
600
700
800
900
1000

Further investigation

- From the integrated profile of AXP J1809-194 it is noticeable that the interpulse is located at ~75% P. Polarization measurements could specify the impact angle.