# Ghost Hunter Design Report

Team wyy: 武益阳 王宇逸

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# Idea

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2. Waveform of several PEs is the supersposition of single waveform of these PEs.

So, use threshold method to find the first PE and substract single PE waveform from original waveform, in order to search for the next PE.

# Find Single PE Waveform

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3. According to [1], the standard waveform for a single PE is:

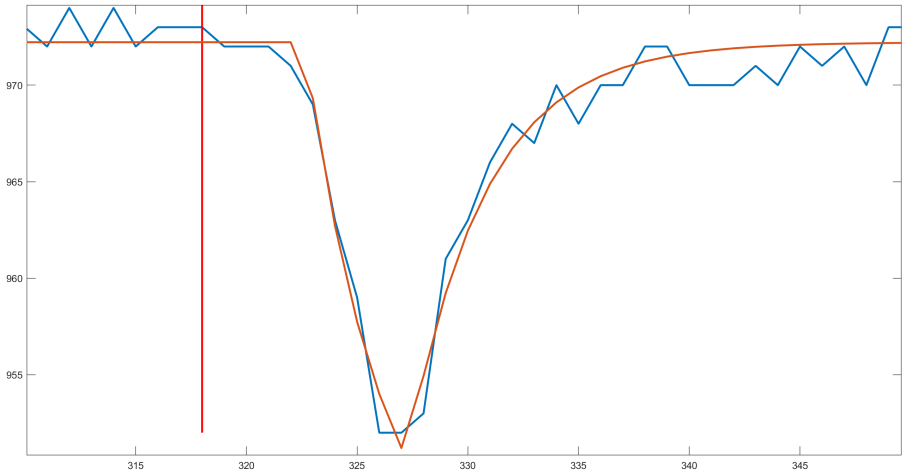
$$0 \leq t < T: \quad i_{in}(t) = I_s \left(1 - e^{-t/RC}\right)$$
$$T \leq t \leq \infty \quad i_{in}(t) = I_s \left(e^{T/RC} - 1\right) \cdot e^{-t/RC}$$

# Find Single PE Waveform

Fit single PE waveform with function

$$T_1 \leqslant t < T_2: \quad U = A\left(1 - e^{-t/RC}\right)$$

$$t \geqslant T_2: \quad U = A\left[e^{(T_2 - T_1)/RC} - 1\right] e^{-t/RC}$$



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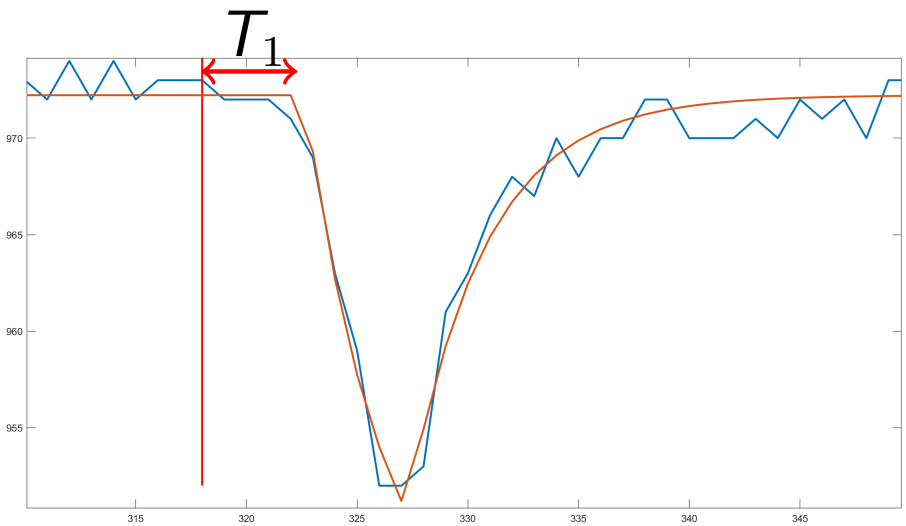

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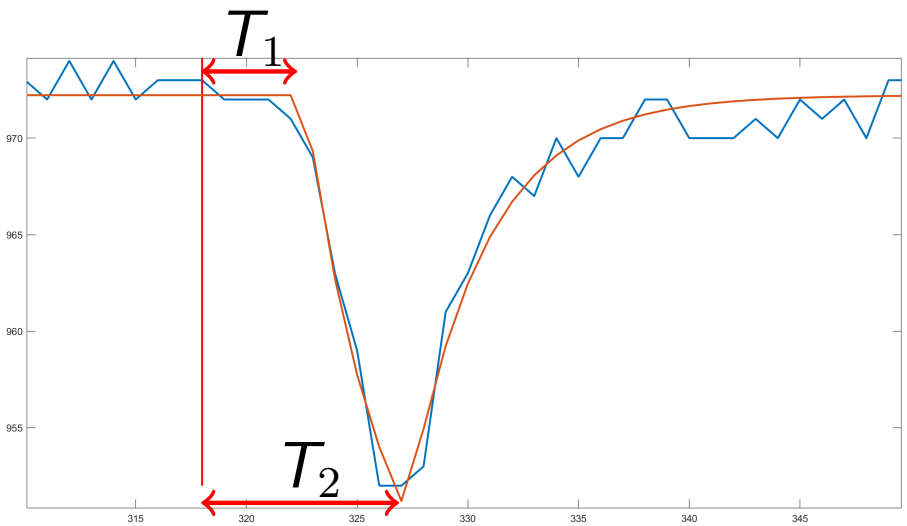
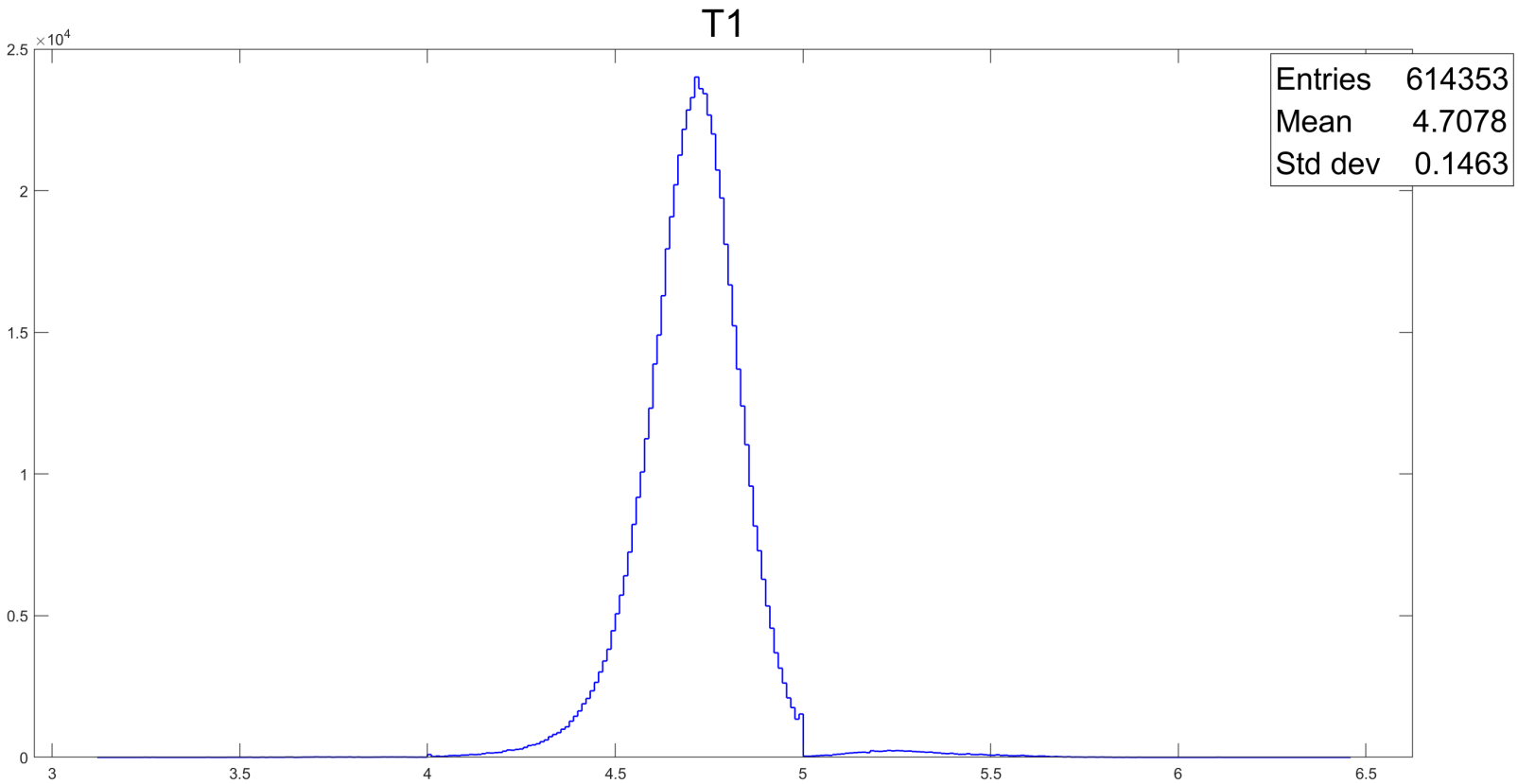
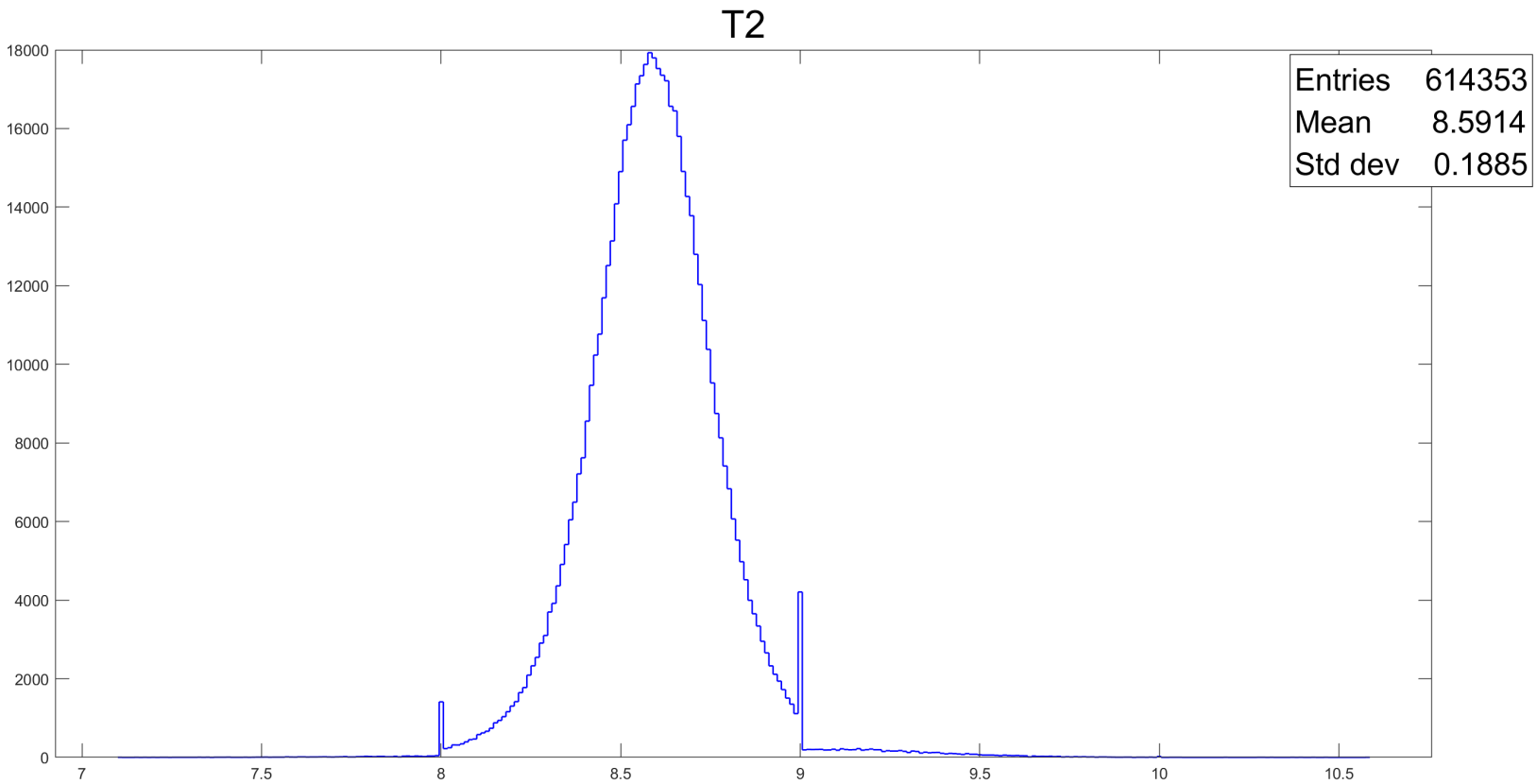


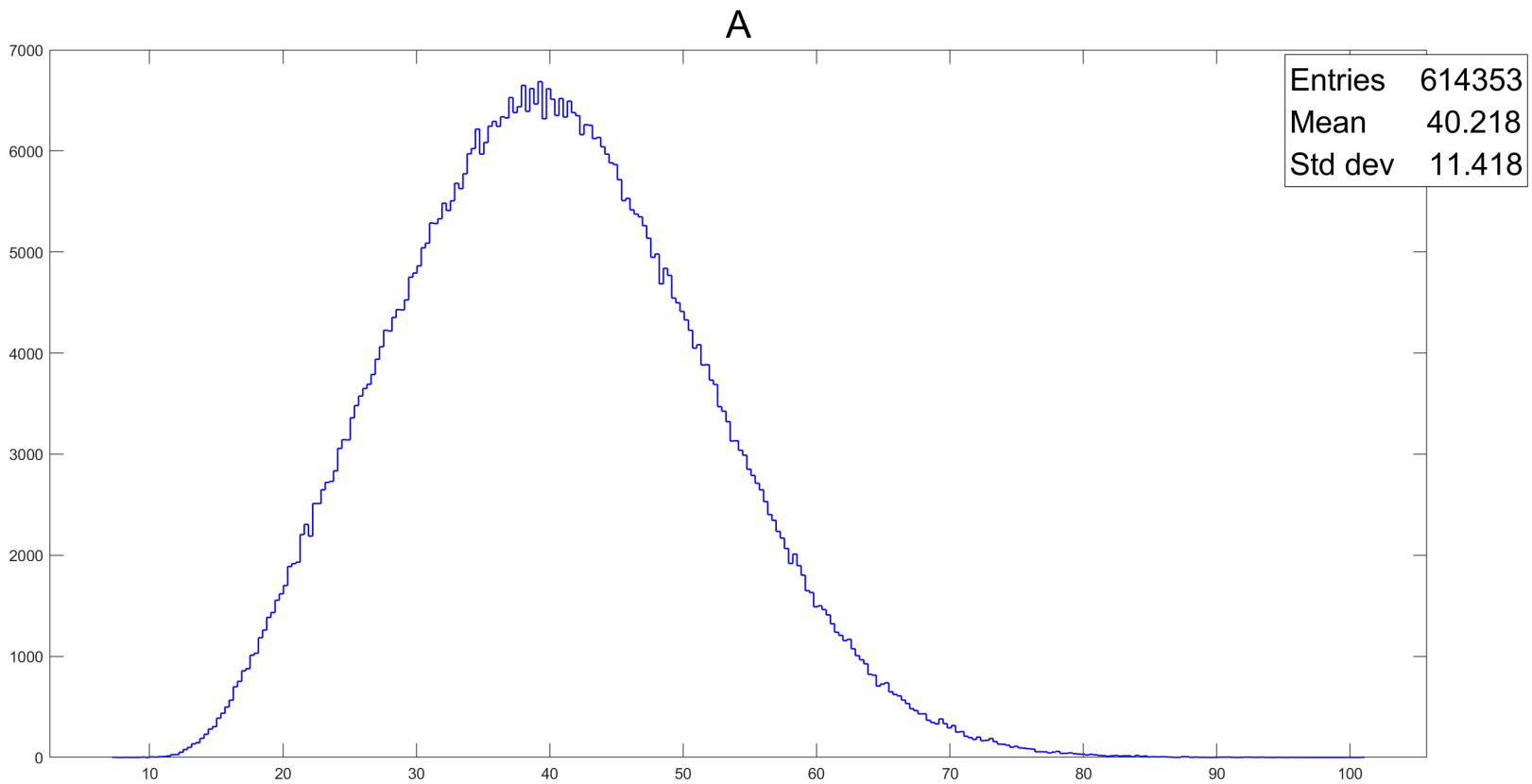
# Fit Results


T1
×10^4
2.5
2
1.5
1
0.5
0
3
3.5
4
4.5
5
5.5
6
6.5
Entries 614353
Mean 4.7078
Std dev 0.1463

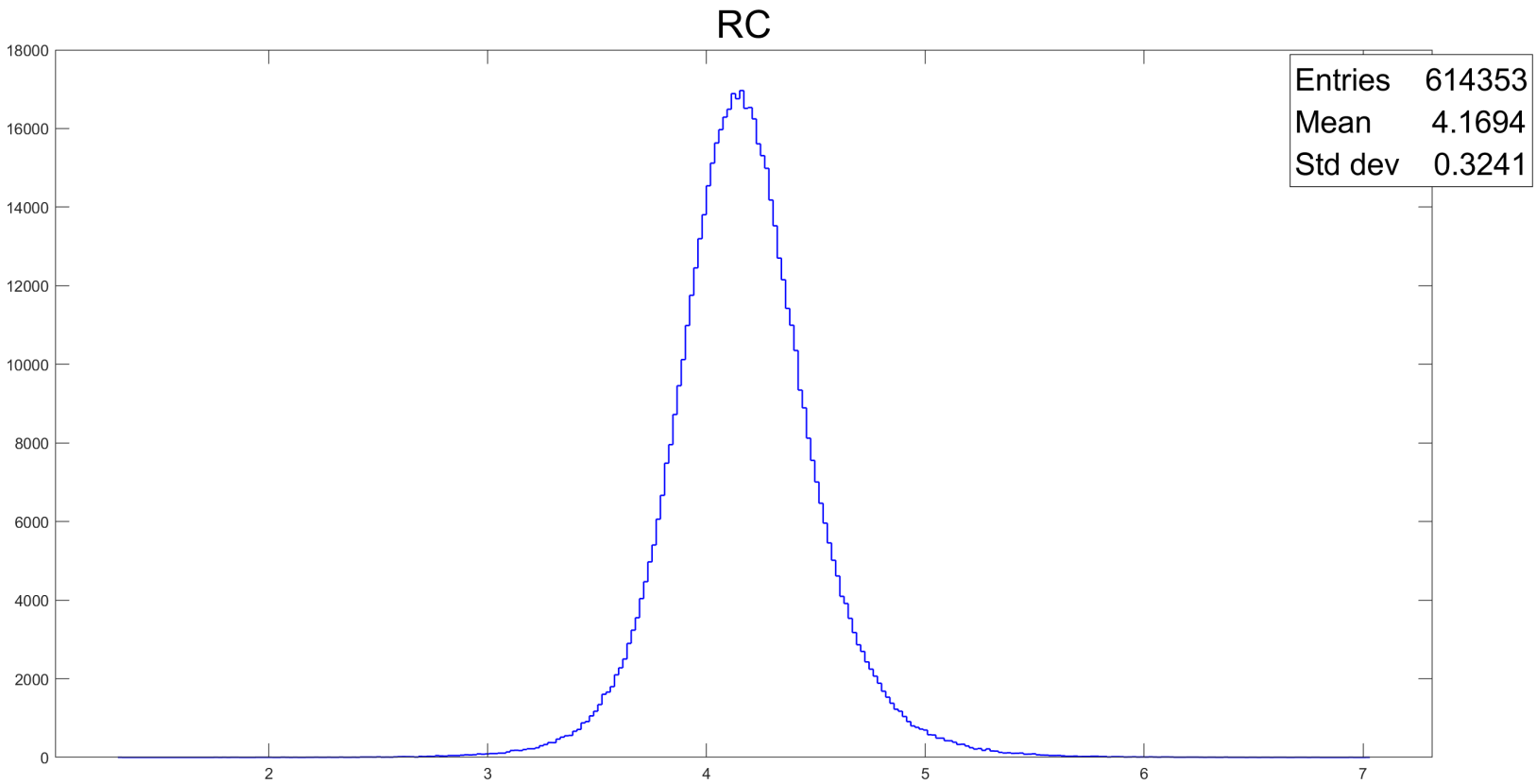
# Fit Results


T2
Entries 614353
Mean 8.5914
Std dev 0.1885
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
7
7.5
8
8.5
9
9.5
10
10.5

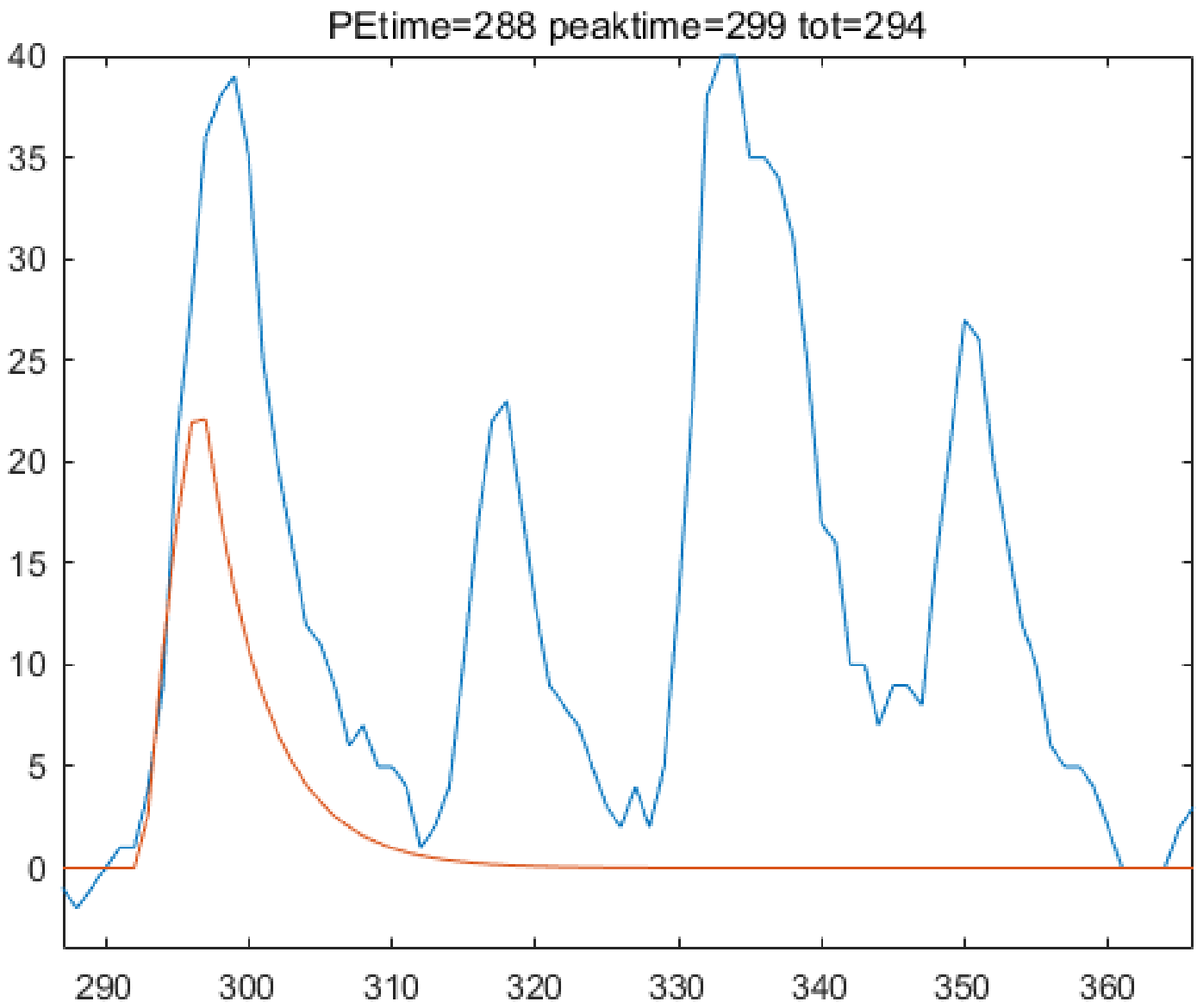
# Fit Results


A
Entries 614353
Mean 40.218
Std dev 11.418
7000
6000
5000
4000
3000
2000
1000
0
10
20
30
40
50
60
70
80
90
100

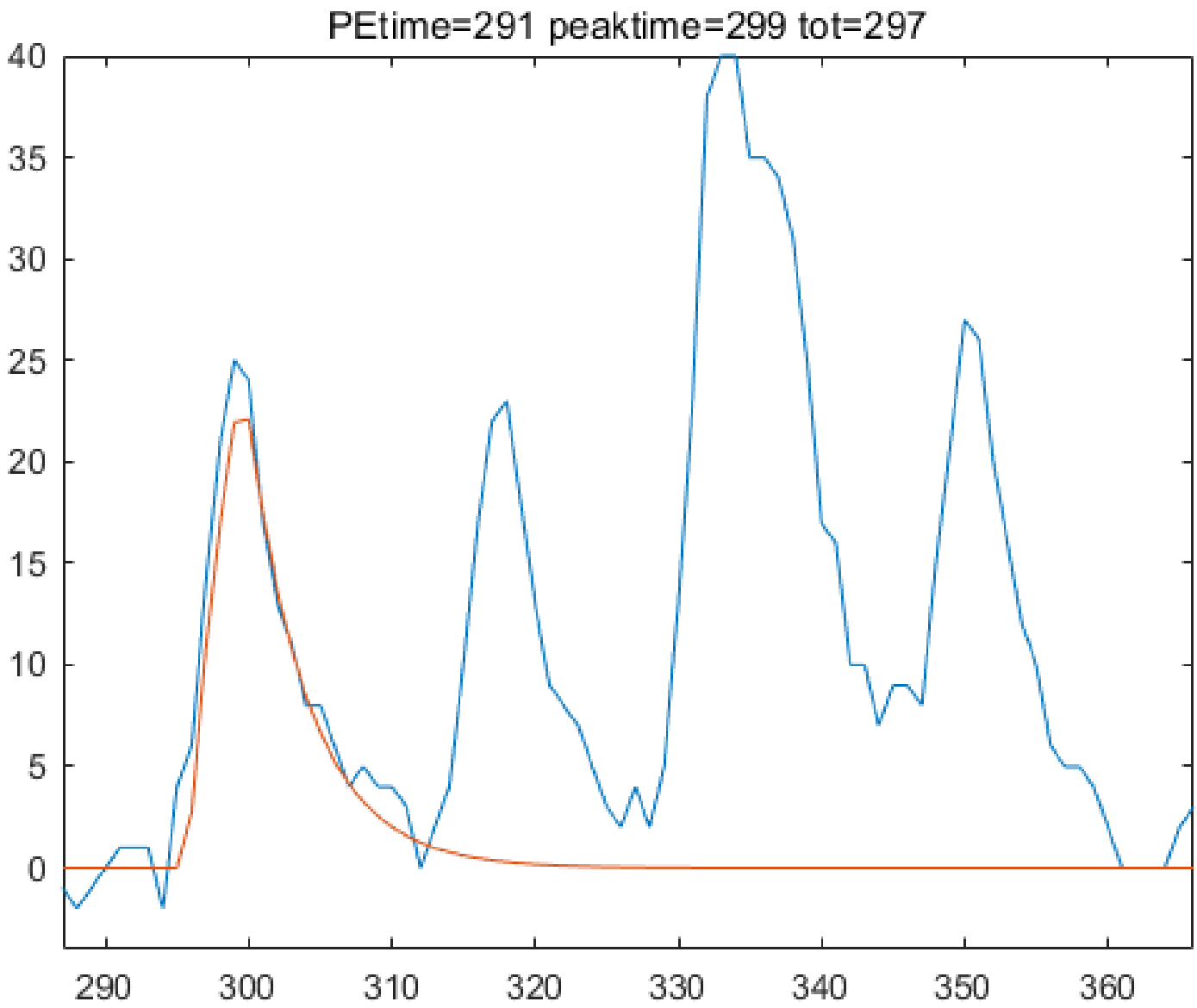
# Fit Results


RC
Entries 614353
Mean 4.1694
Std dev 0.3241
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
2
3
4
5
6
7

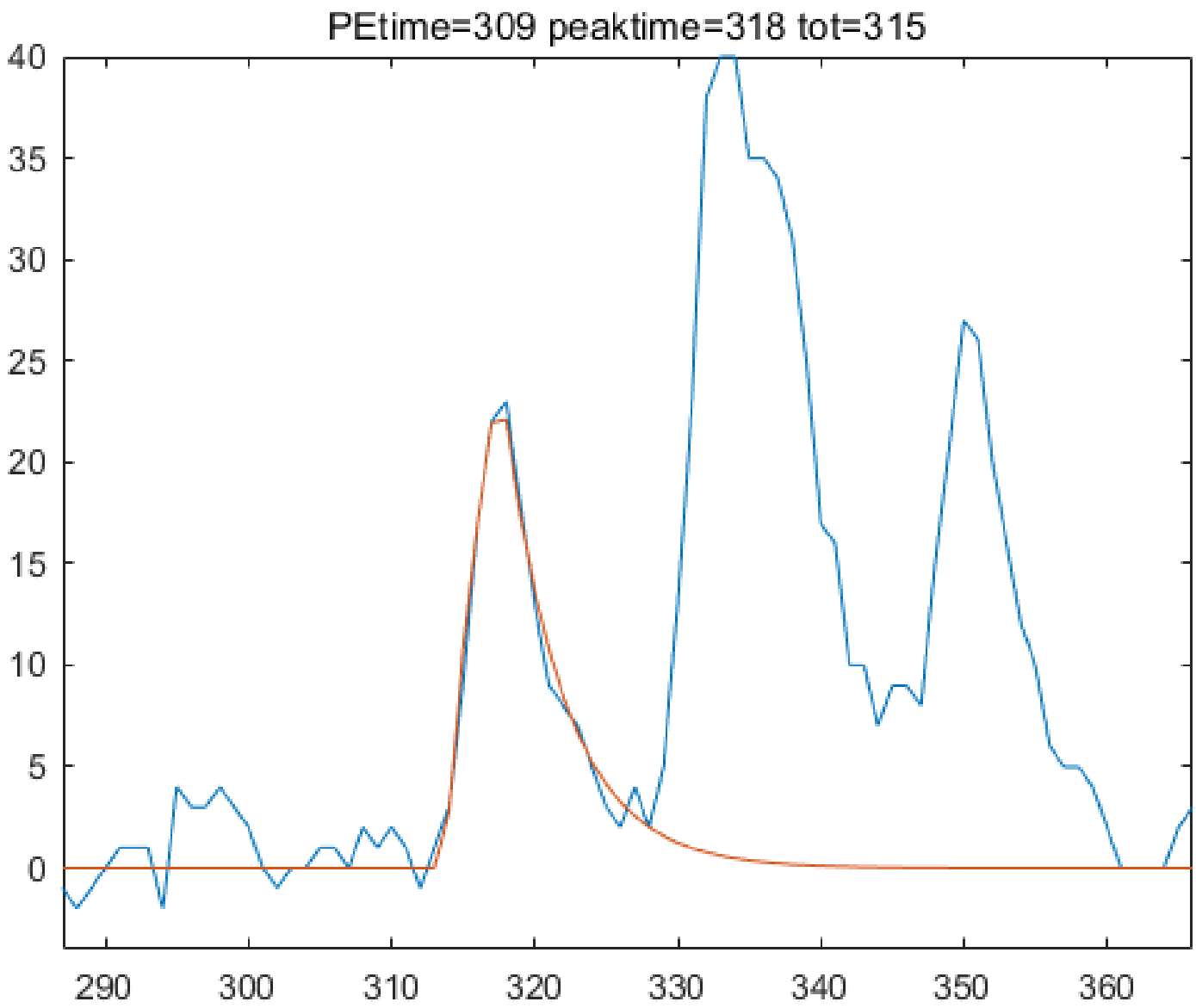
# Process


PEtime=288 peaktime=299 tot=294
40
35
30
25
20
15
10
5
0
290
300
310
320
330
340
350
360

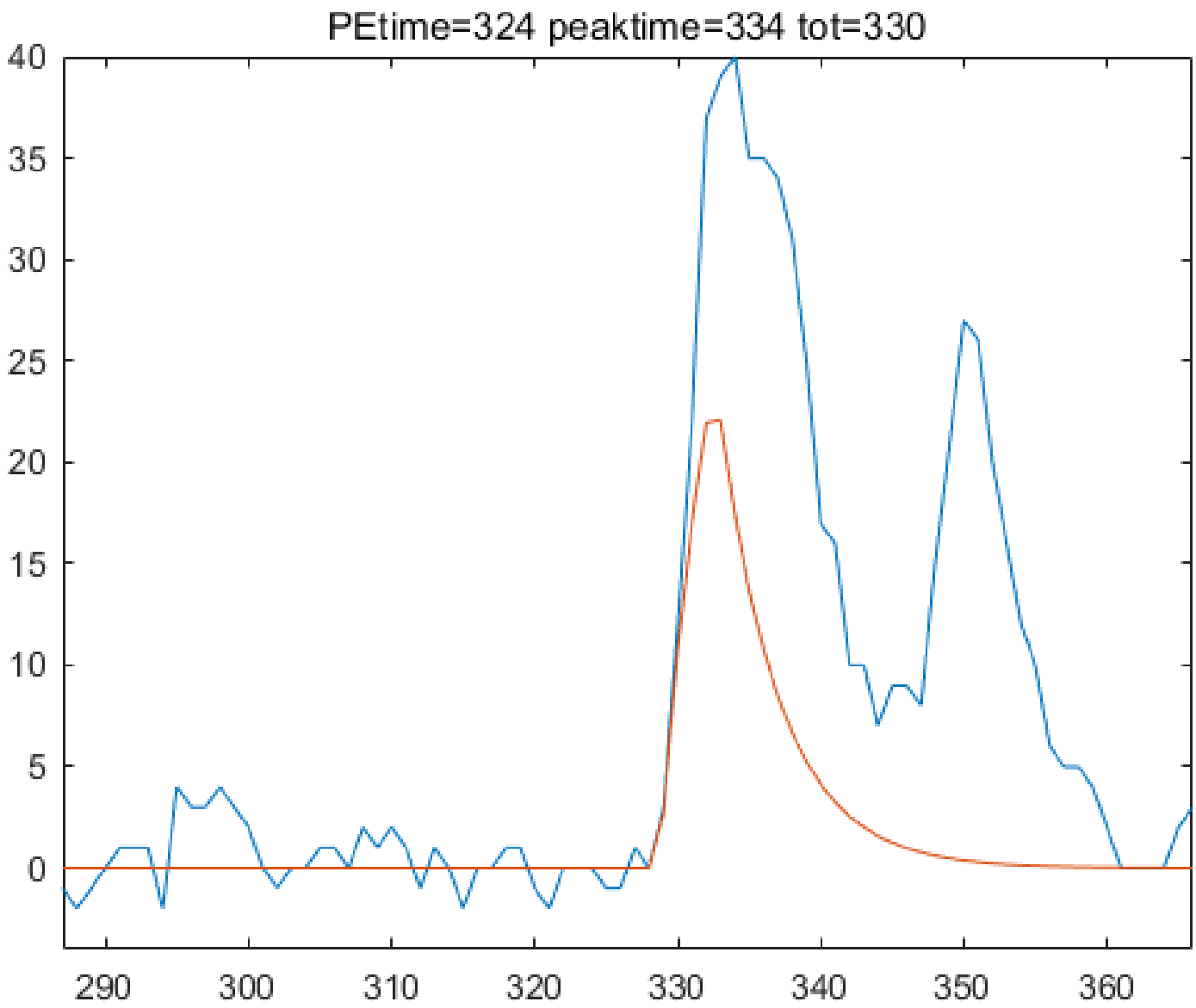
# Process


PEtime=291 peaktime=299 tot=297
40
35
30
25
20
15
10
5
0
290
300
310
320
330
340
350
360

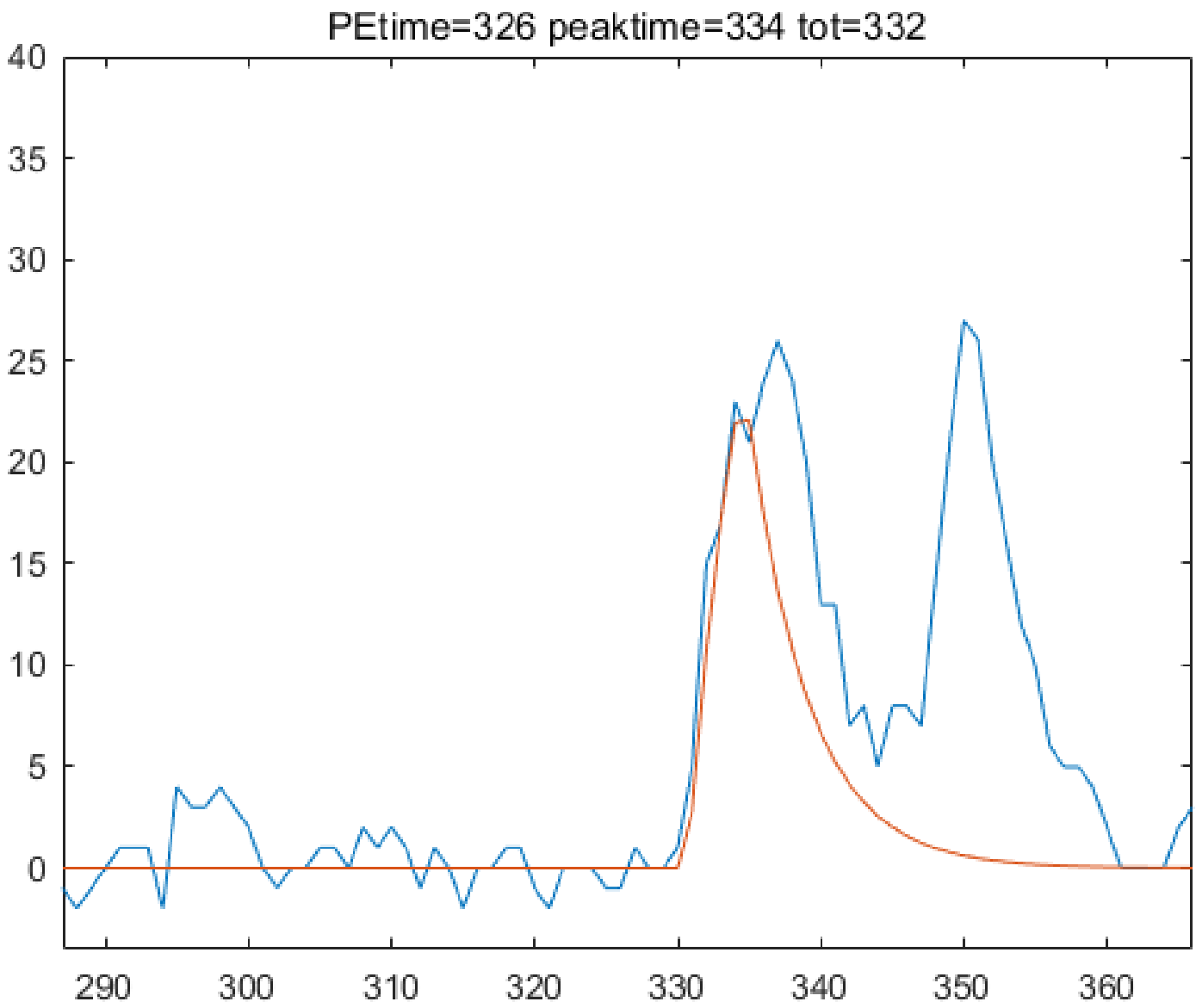
# Process


PEtime=309 peaktime=318 tot=315
40
35
30
25
20
15
10
5
0
290
300
310
320
330
340
350
360

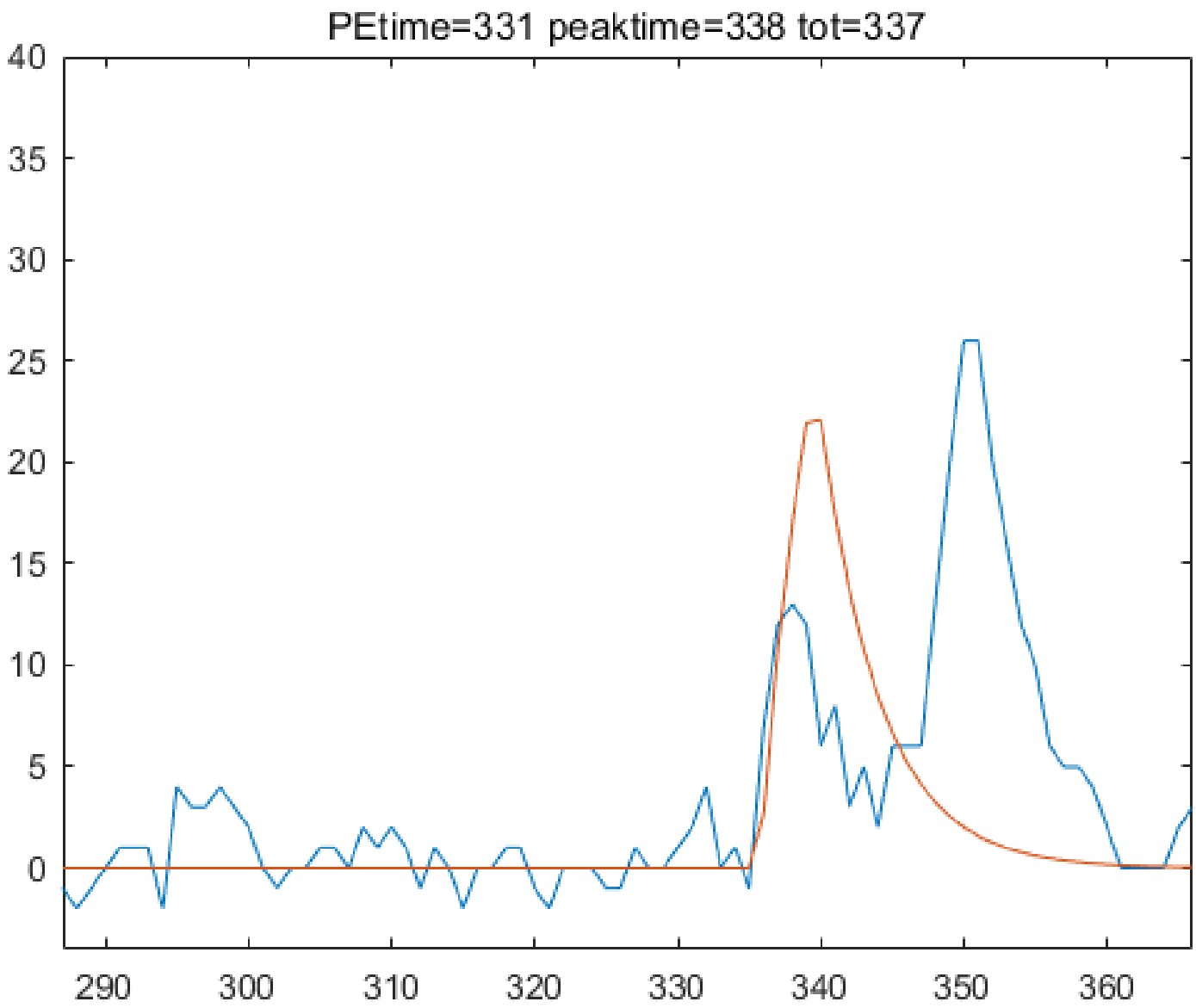
# Process


PEtime=324 peaktime=334 tot=330
40
35
30
25
20
15
10
5
0
290
300
310
320
330
340
350
360

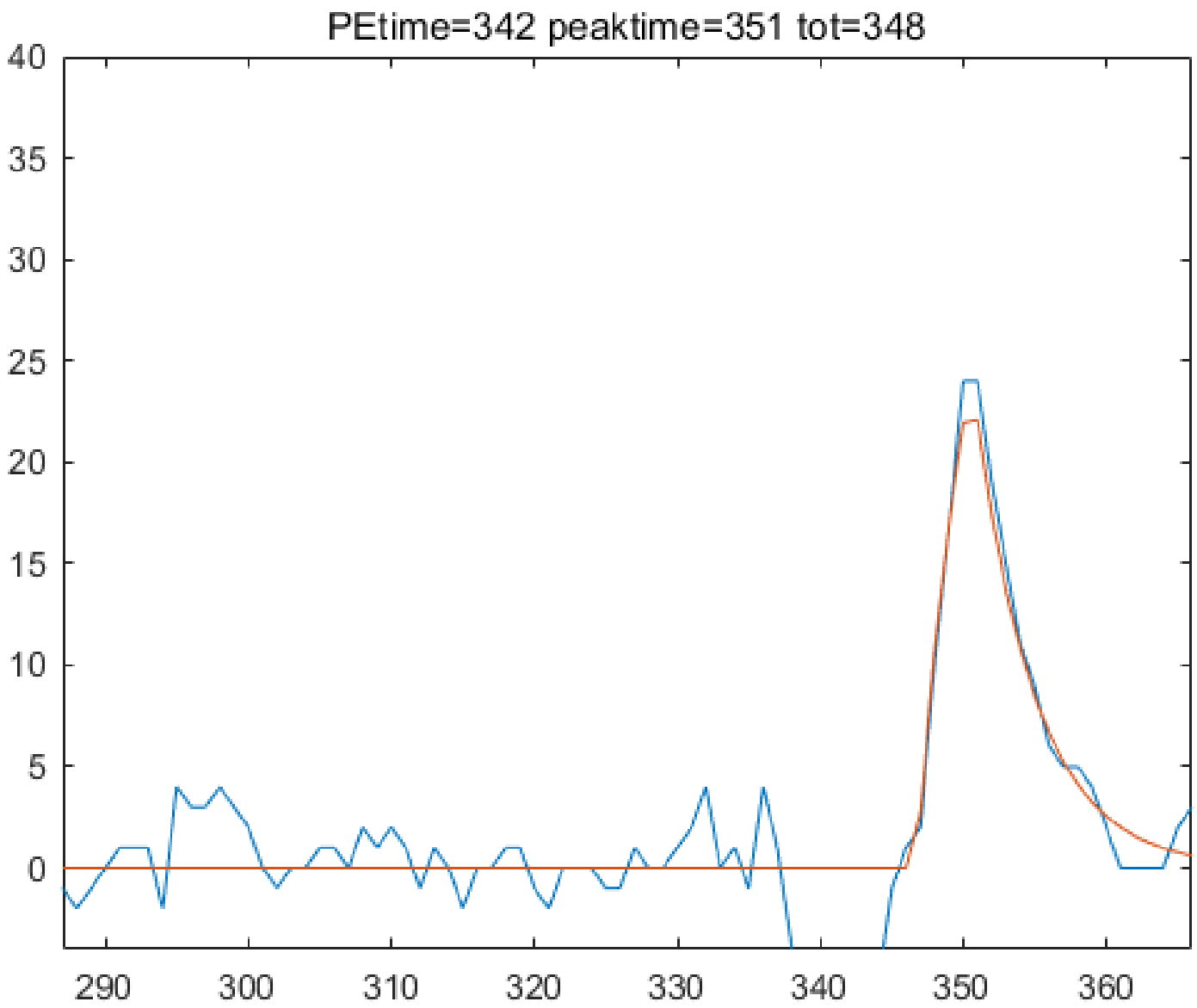
# Process


PEtime=326 peaktime=334 tot=332
40
35
30
25
20
15
10
5
0
290
300
310
320
330
340
350
360

# Process


PEtime=331 peaktime=338 tot=337
40
35
30
25
20
15
10
5
0
290
300
310
320
330
340
350
360

# Process


PEtime=342 peaktime=351 tot=348
40
35
30
25
20
15
10
5
0
290
300
310
320
330
340
350
360

# Process

answer: 288,291,309,324,326,331,342

truth : 288,291,309,324,325,329,342

wasserstein_distance = 0.4286

# Exceptions

- Tiny signals.

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Solution: process exceptional signals separatedly; cut fake PEs.

# Thanks for listening!

# Reference

Helmuth Spieler.

Pulse processing and analysis.

In *IEEE NPSS Short Course, 1993 Nuclear Science Symposium, San Francisco, California*, 2002.