Pulse selection

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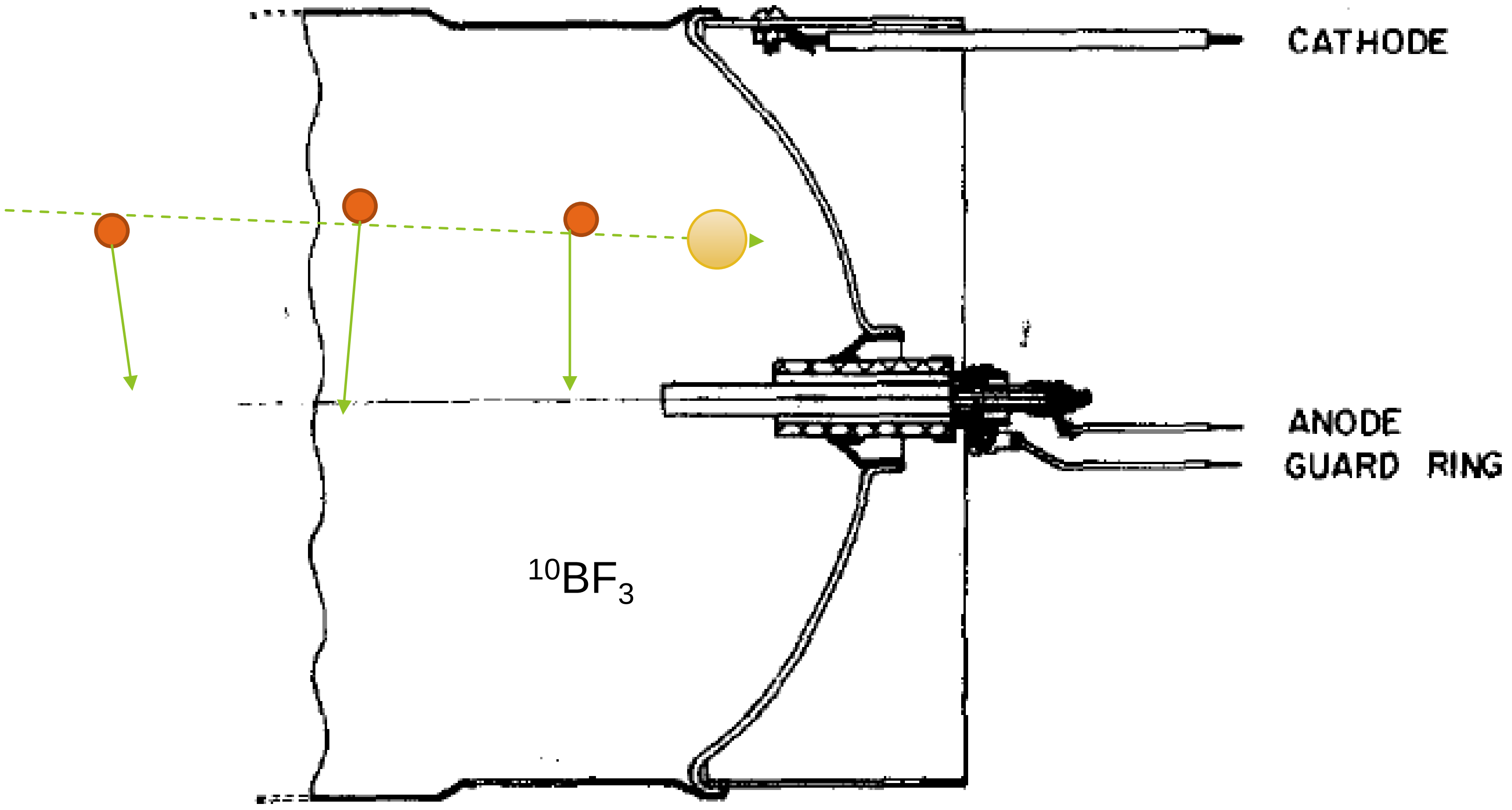
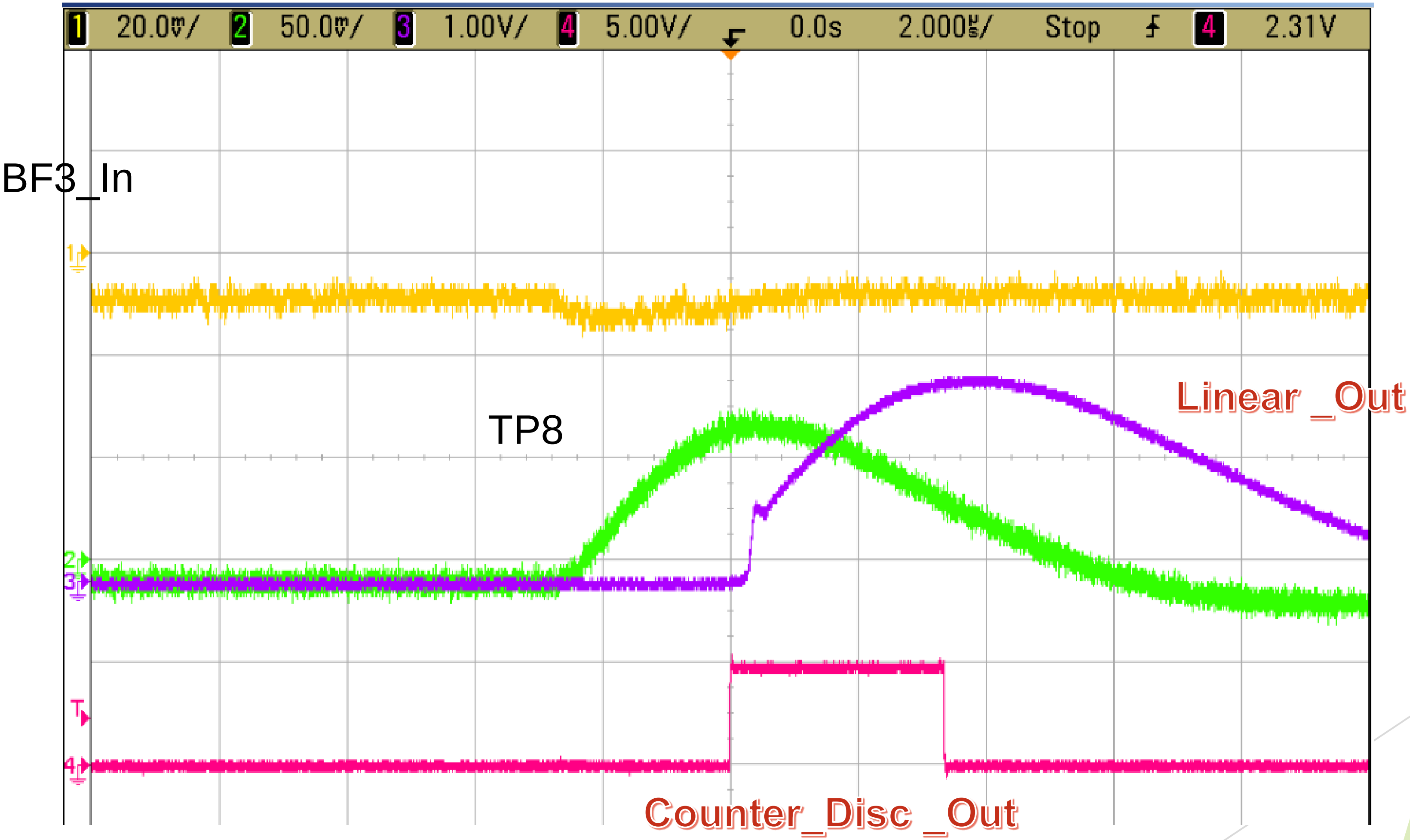
Inside a neutron detector

$n + {}^{10}B \rightarrow {}^{7}Li + {}^{4}He$



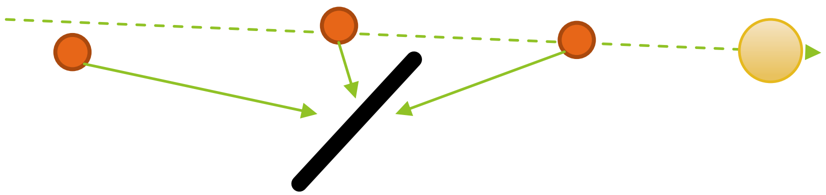
Credit: Paul Evenson

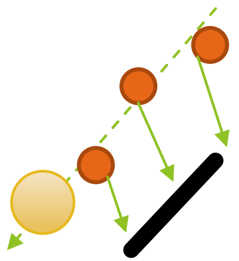
Signal processing in detector

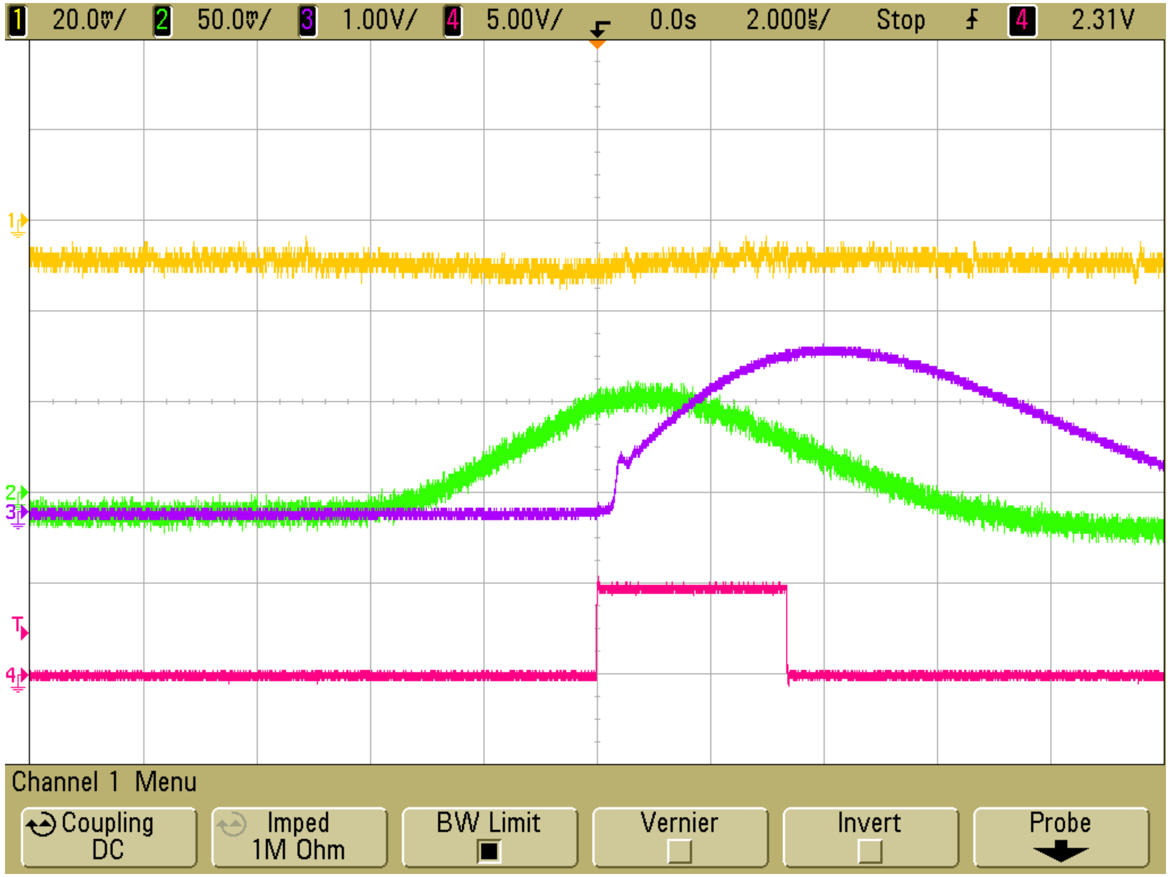


Credit: Paul Evenson

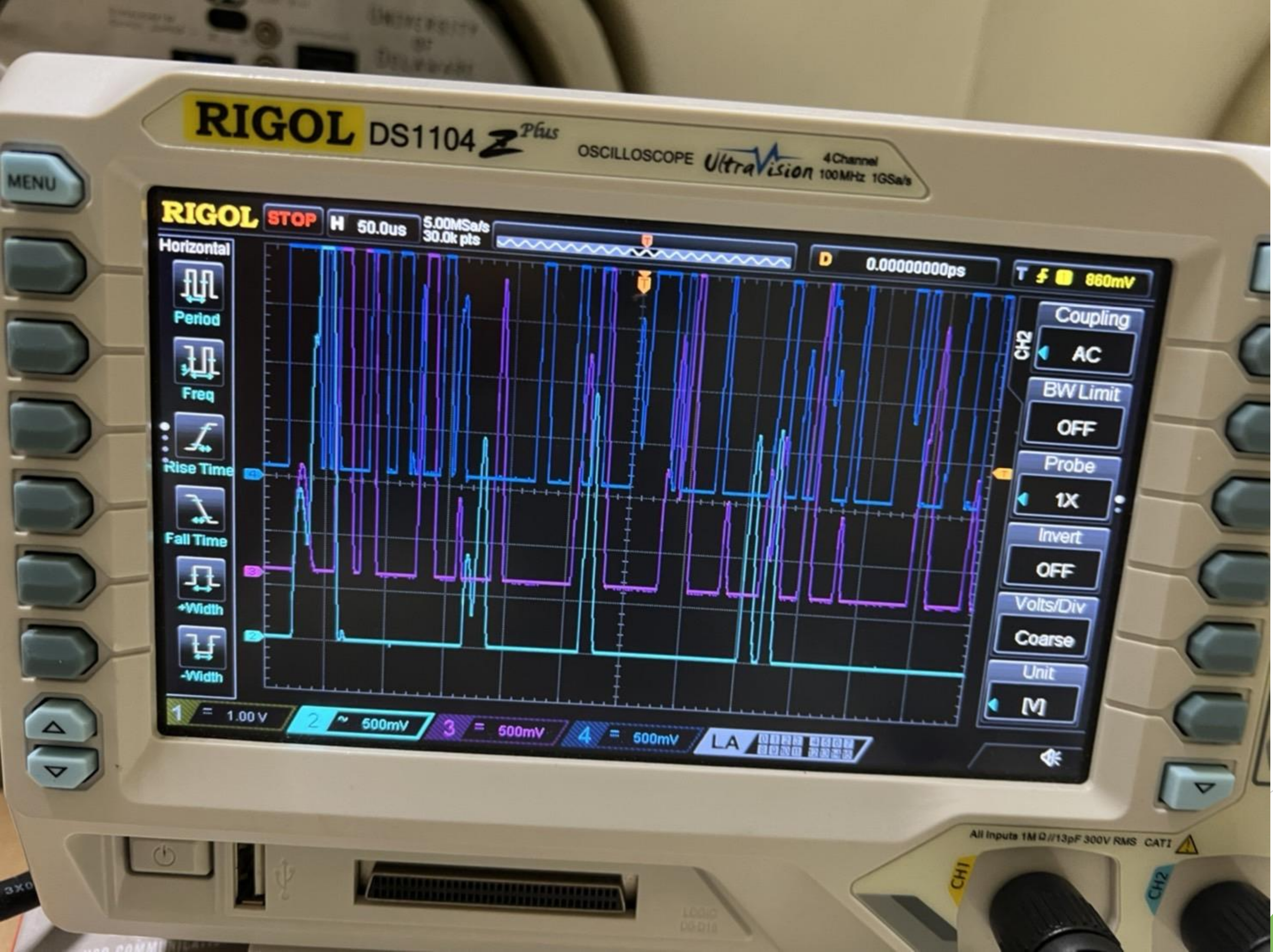
Signal processing in detector







Credit: Paul Evenson

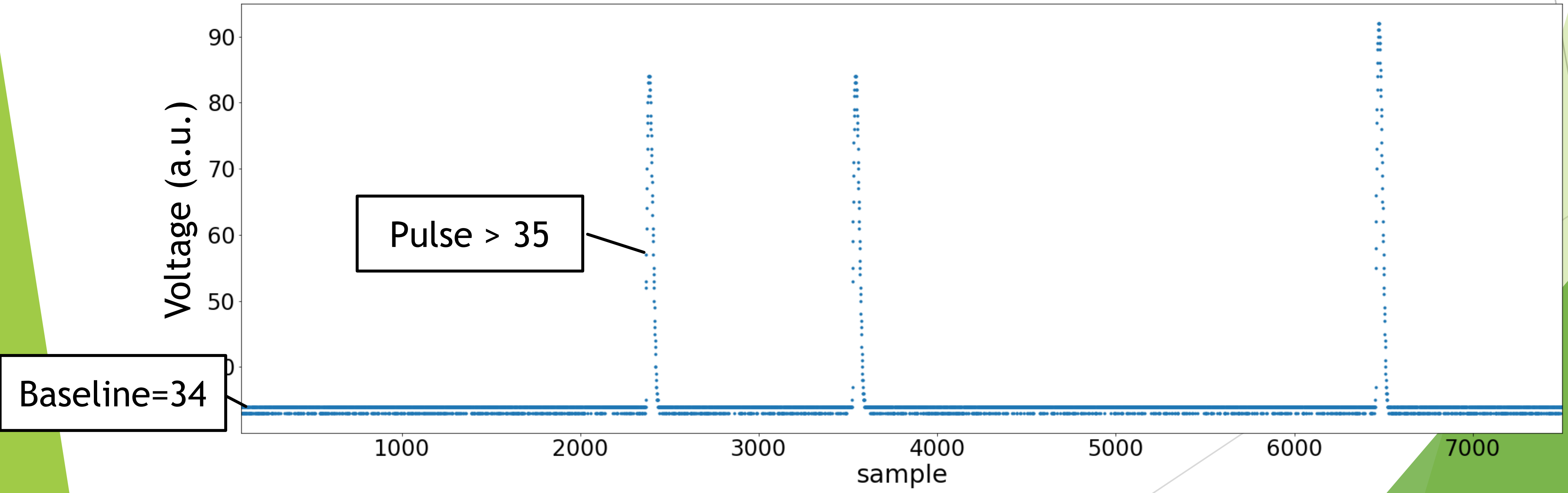


Oscilloscope measurement on detector linear output at
Princess Sirindhorn Neutron Monitor , Doi Inthanon

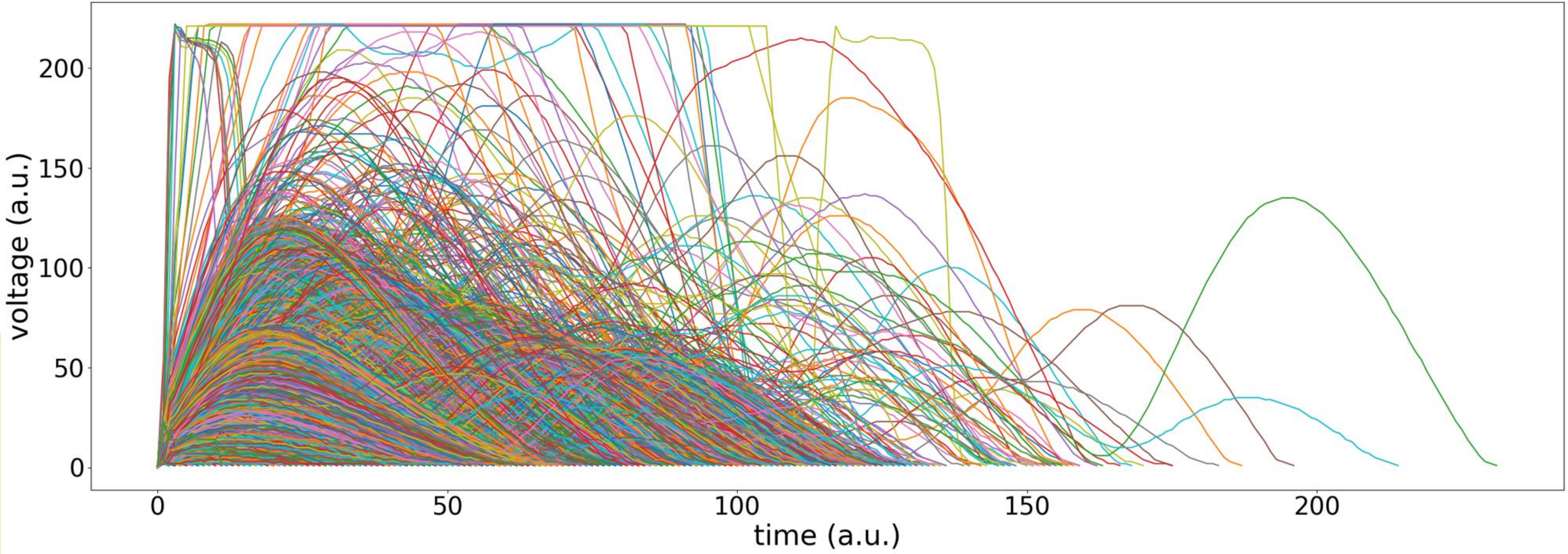
Credit: Kullapha Chaiwongkot

Pulse

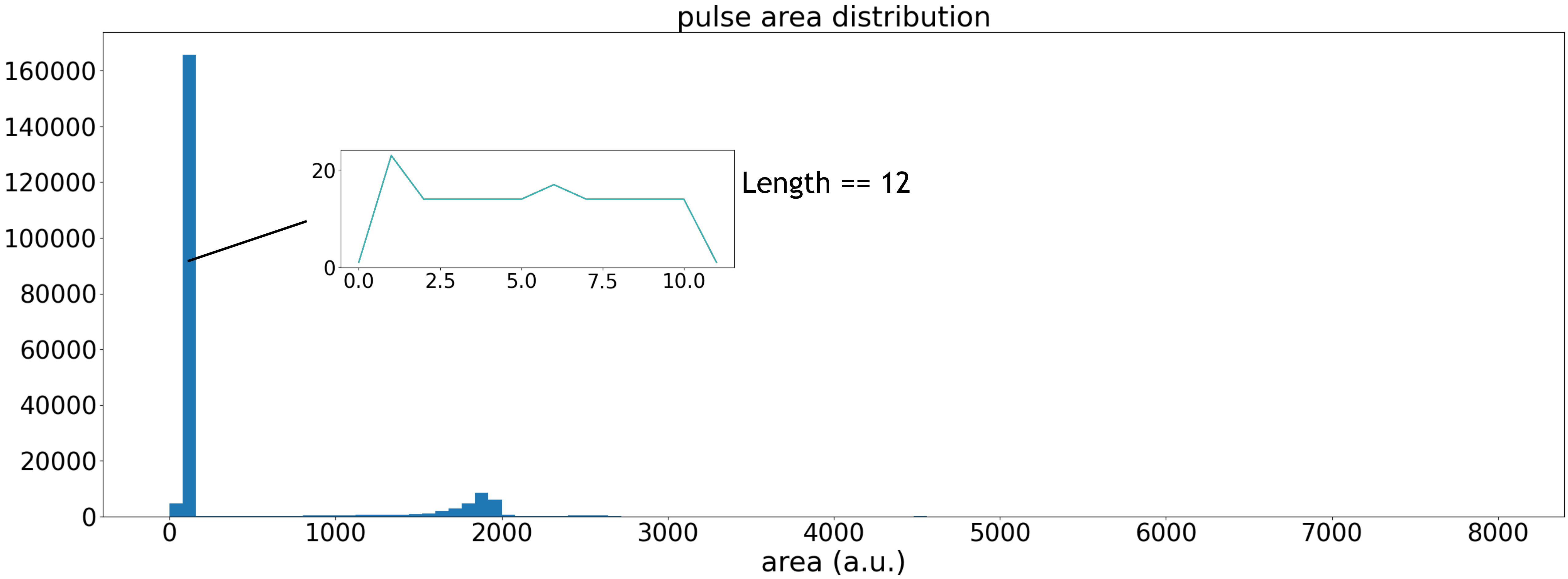
- Signal recorded in integer
- Baseline = mostly repeated integer
- Pulse > Baseline + 1



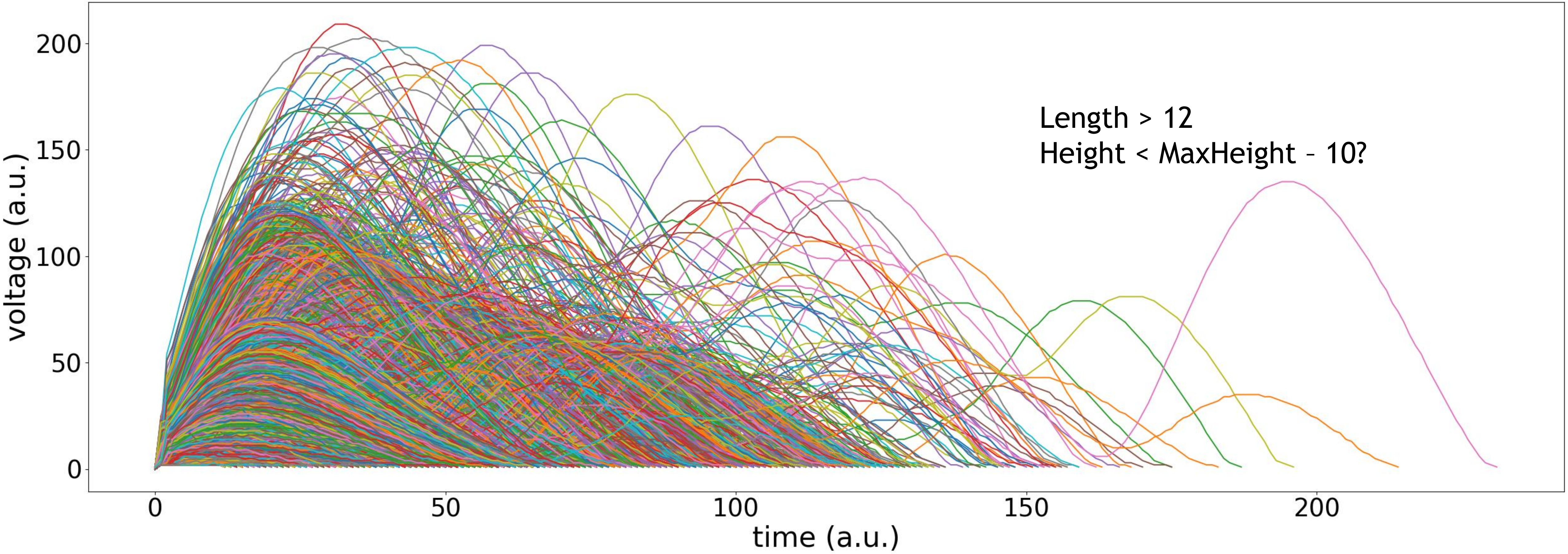
Pulse before filtering



Pulse before filtering: Histogram

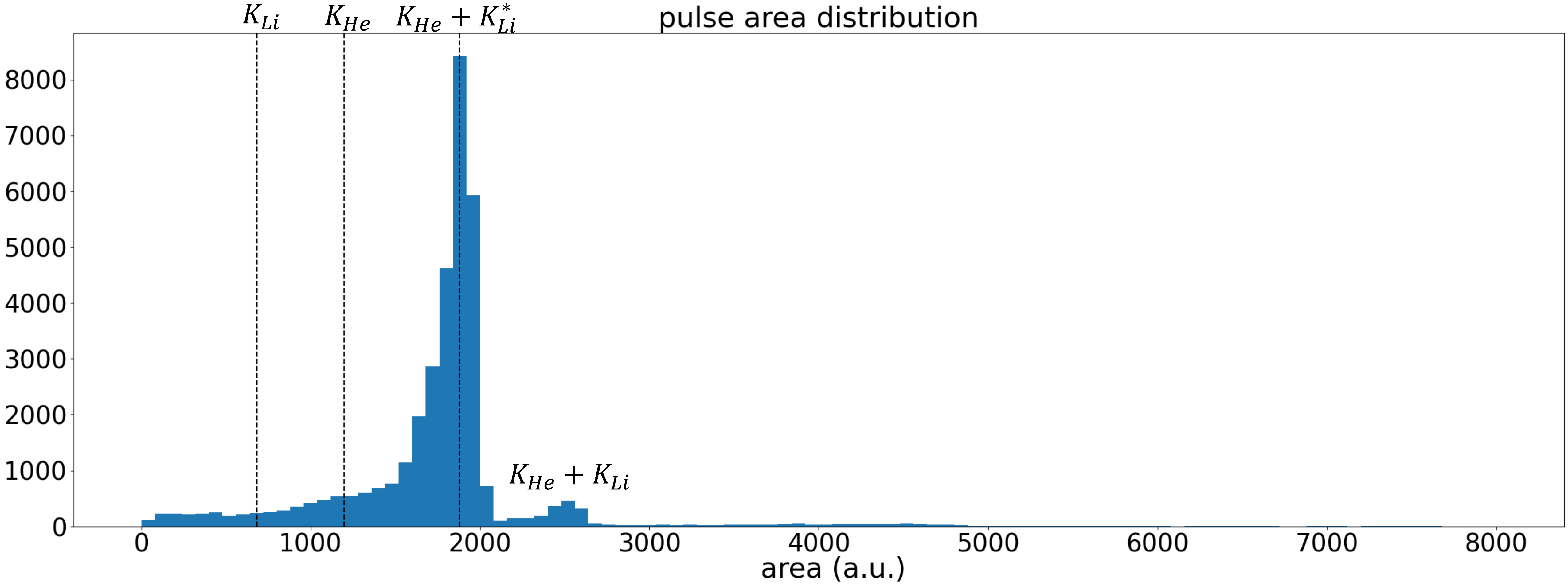


Pulse after filtering



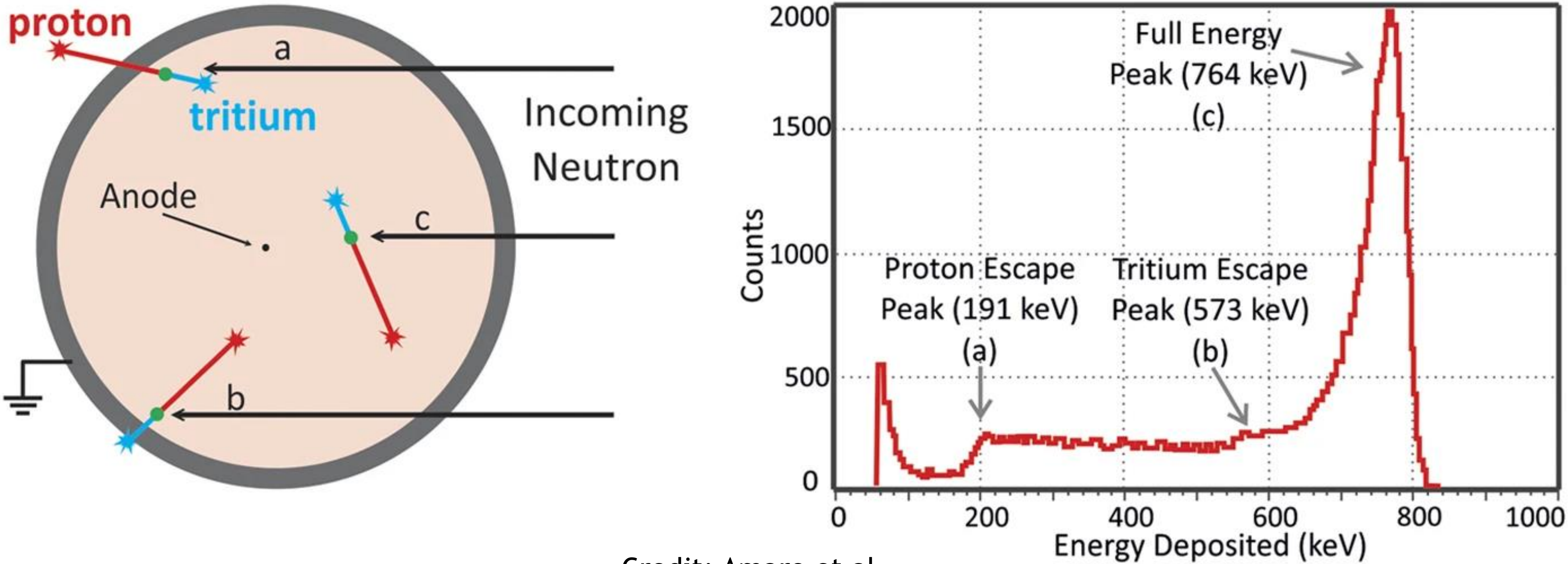
Length > 12
Height < MaxHeight – 10?

Pulse area distribution



$$\frac{K_{Li}}{K_{He}} = \frac{m_{He}}{m_{Li}}$$

Wall effect

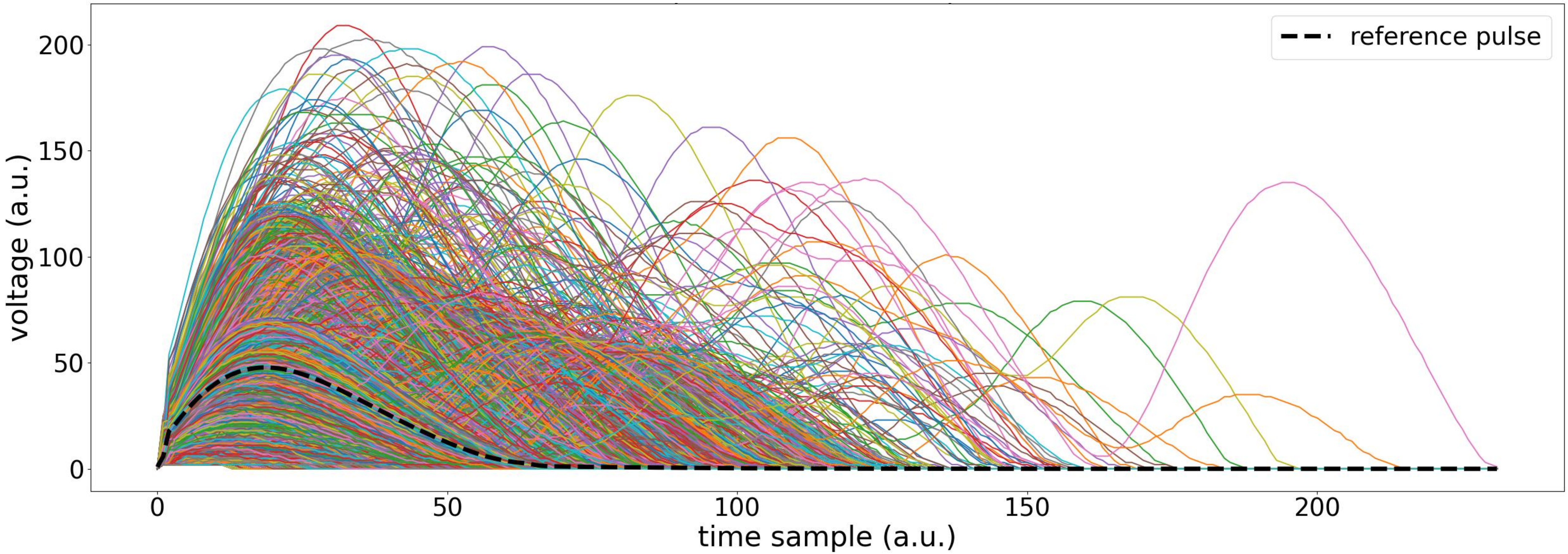


Credit: Amaro et al.

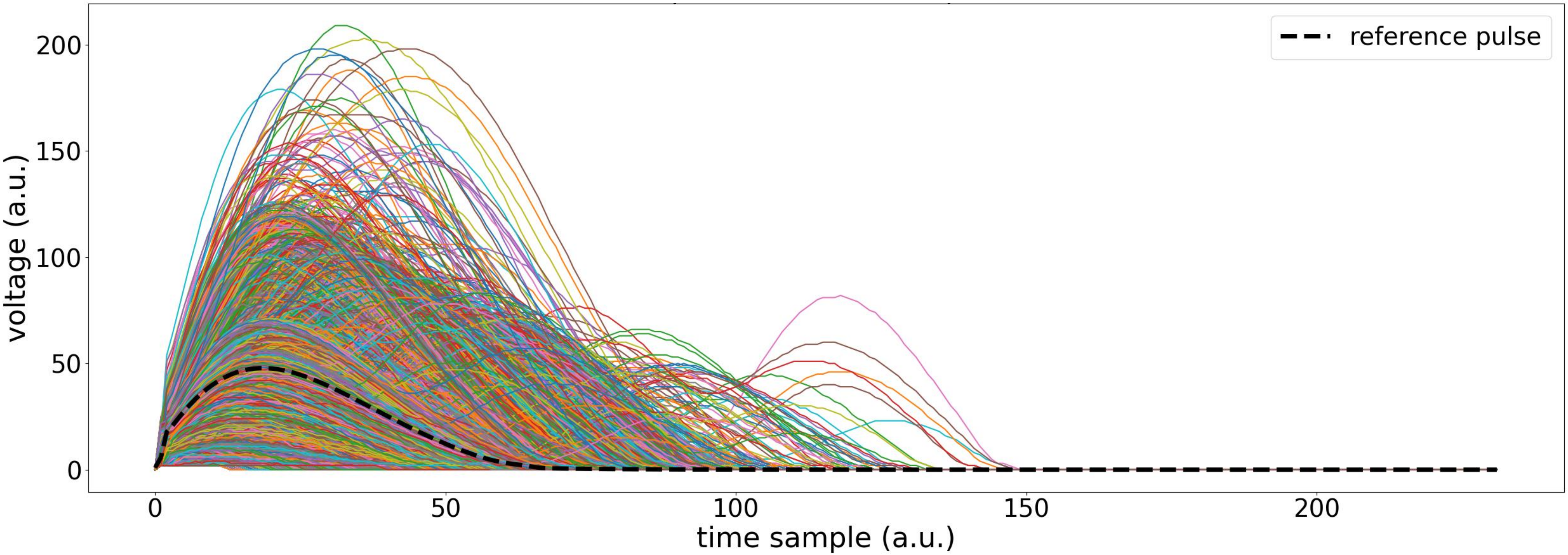
Remove abnormal pulse

- Calculate average pulse
- For each pulse
  - Scale its height to that of average pulse
  - Find sum of squared residual $\sum_i (x_i - x_i^{ave})^2$
  - Remove pulse that gives maximum residual from the loop
- Repeat until sum of squared residual < 1000 for every pulse

1% removed

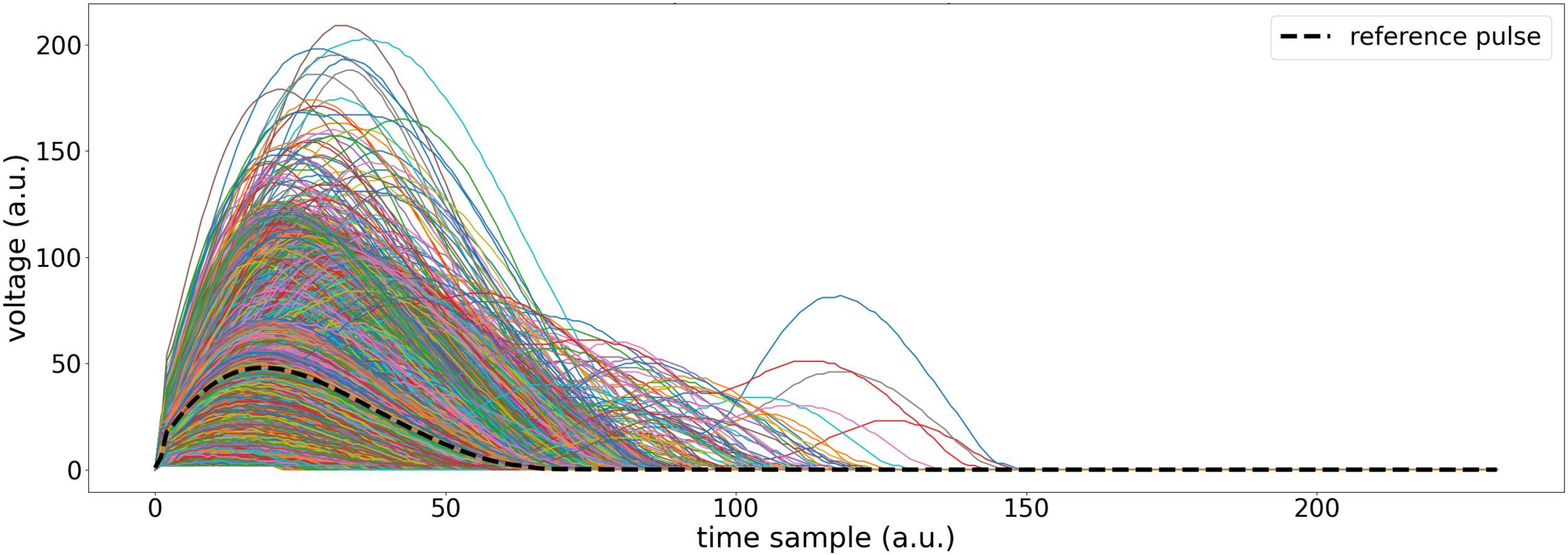

reference pulse
200
150
100
50
0
voltage (a.u.)
0
50
100
150
200
time sample (a.u.)

2% removed



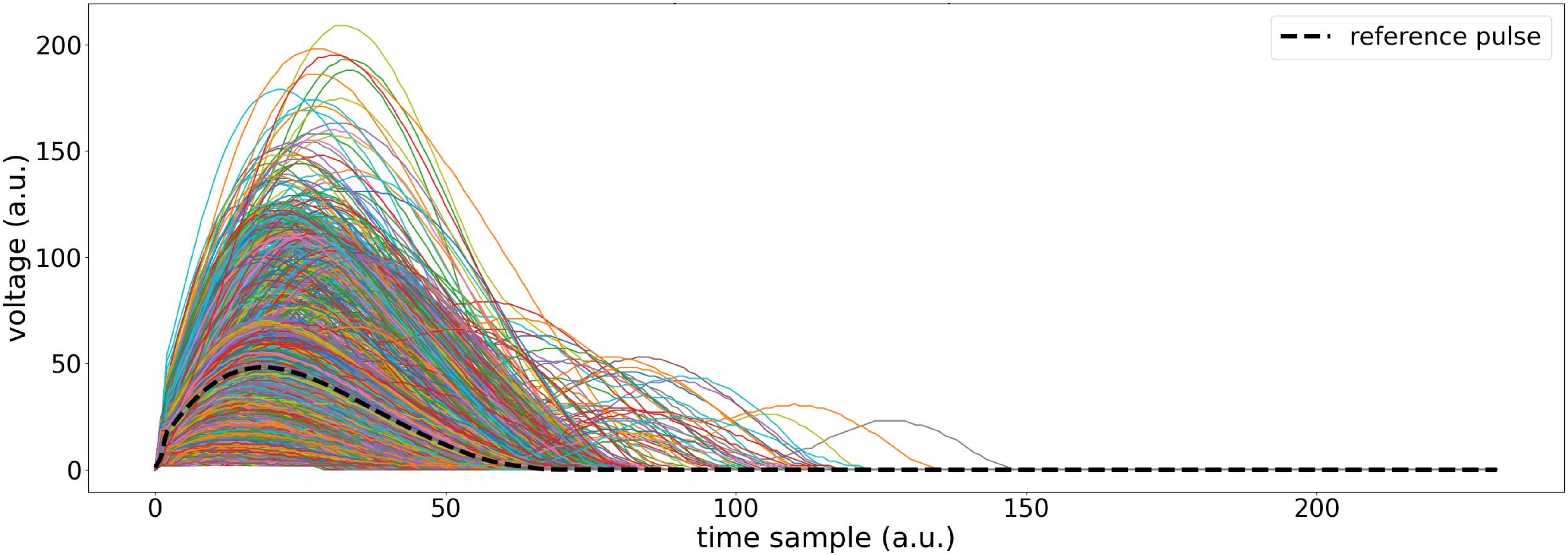
reference pulse
voltage (a.u.)
0
50
100
150
200
0
50
100
150
200
time sample (a.u.)

3% removed

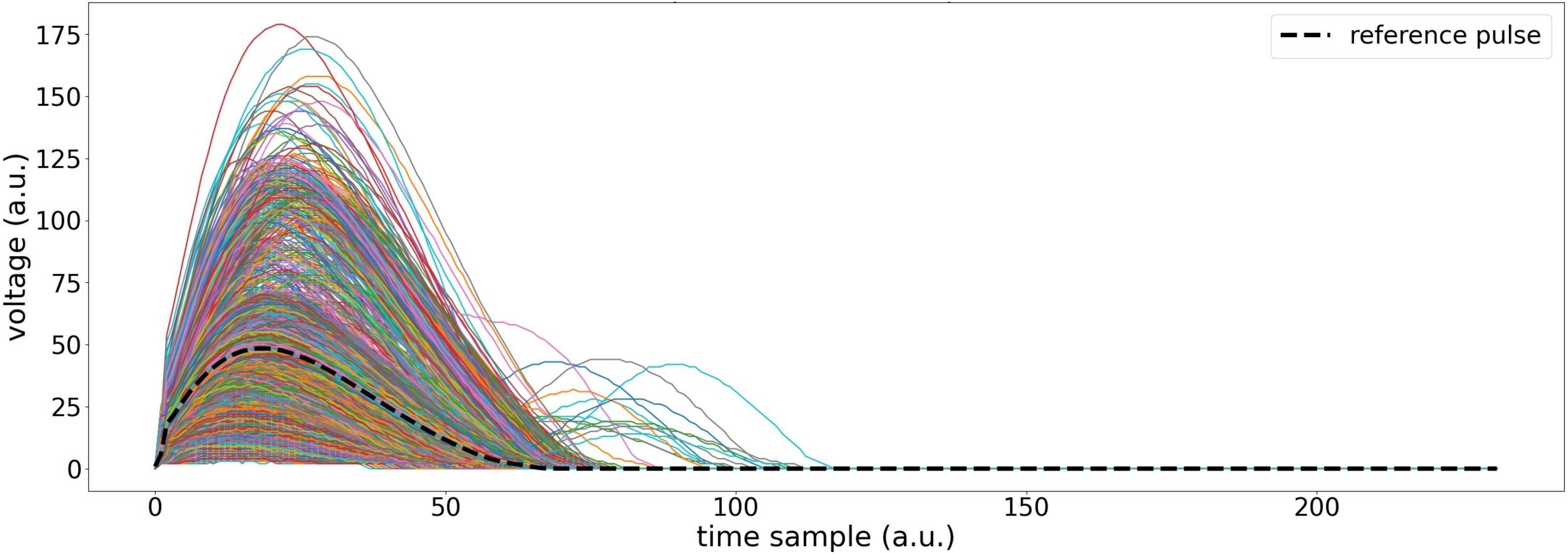


reference pulse
200
150
100
50
0
voltage (a.u.)
0
50
100
150
200
time sample (a.u.)

4% removed

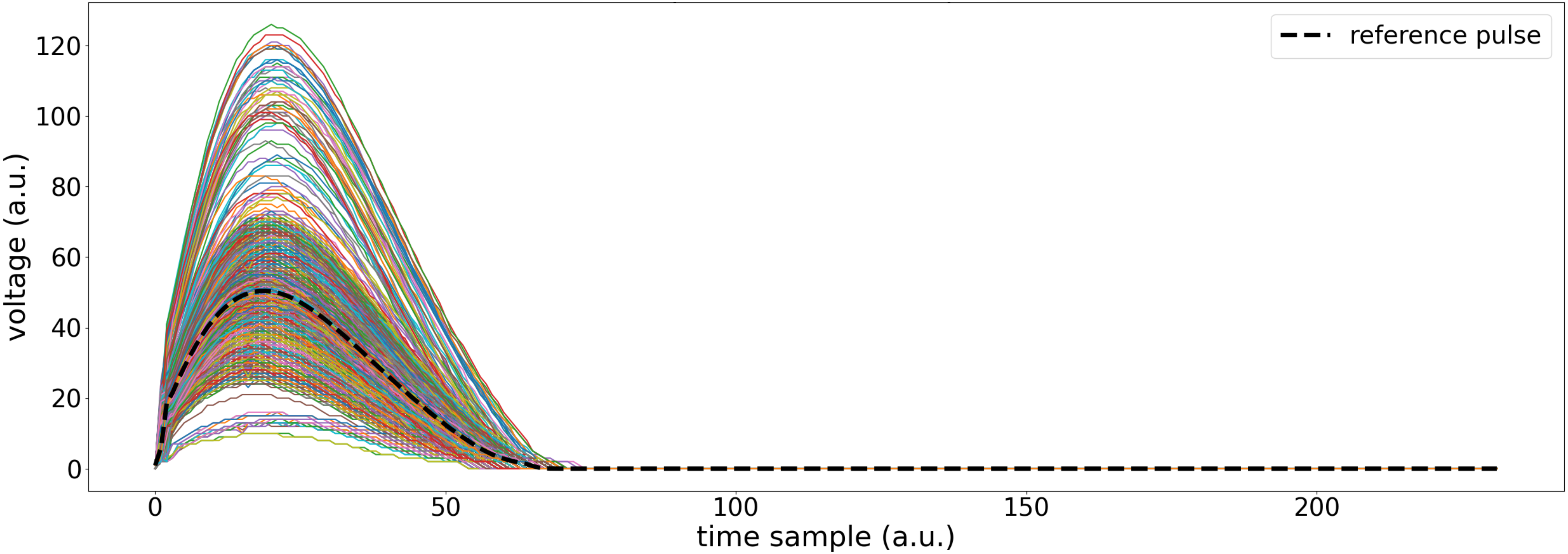


5% removed

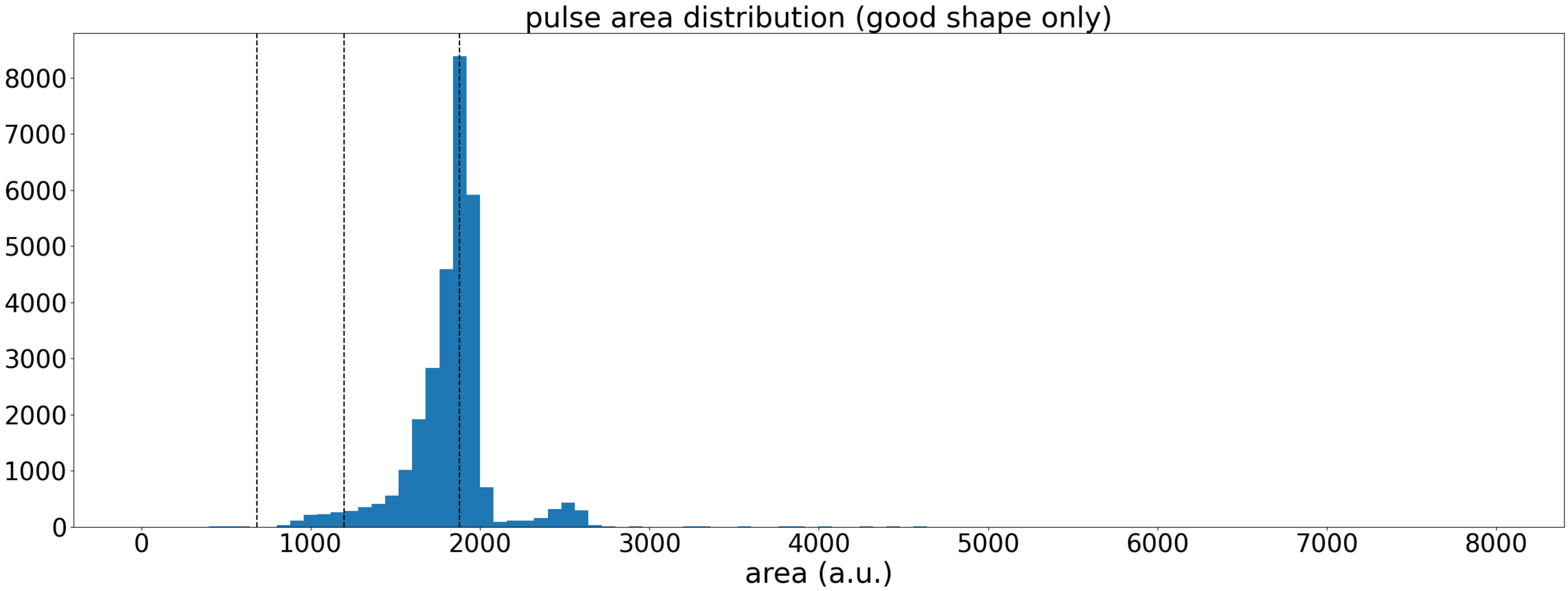


reference pulse
175
150
125
100
75
50
25
0
voltage (a.u.)
0
50
100
150
200
time sample (a.u.)

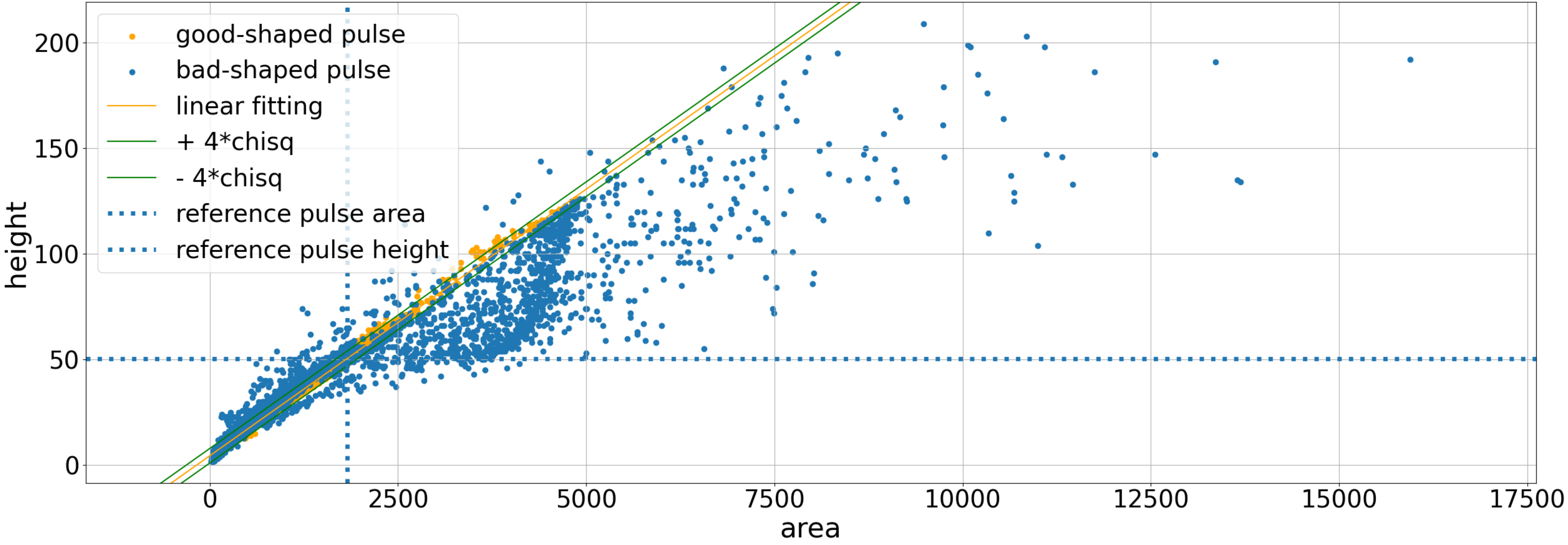
All have $\sum_i (x_i - x_i^{ave})^2$ < 1000 (good shape)



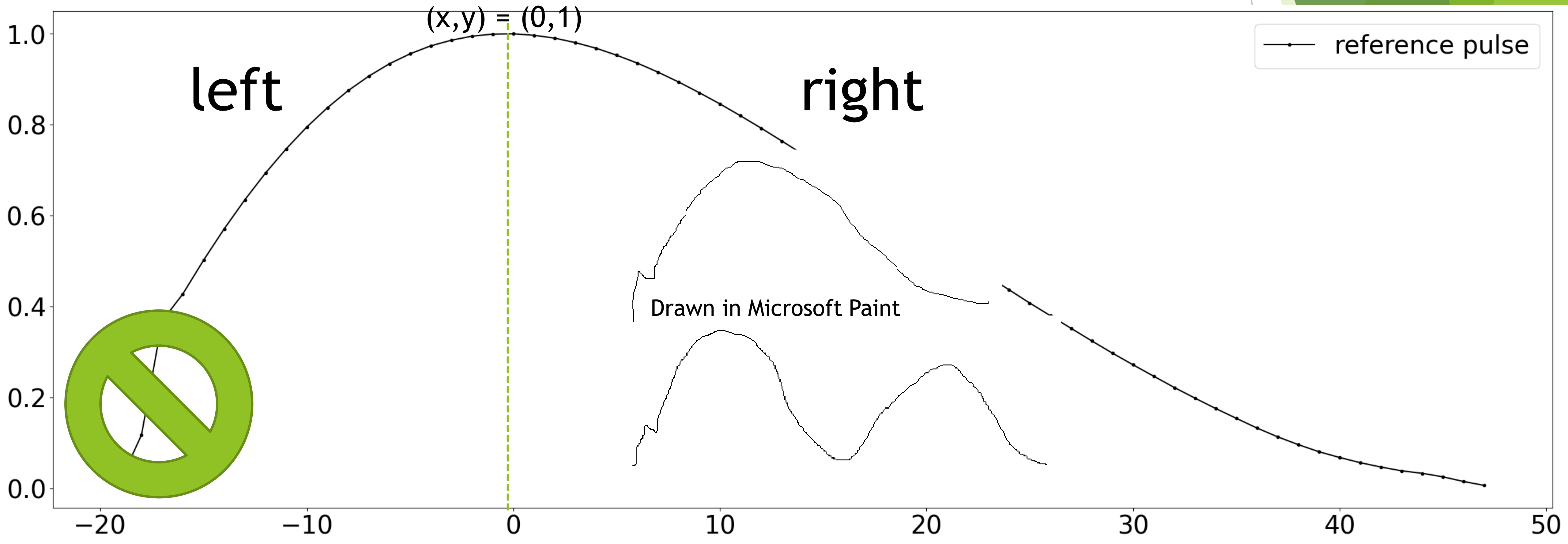
Pulse area distribution



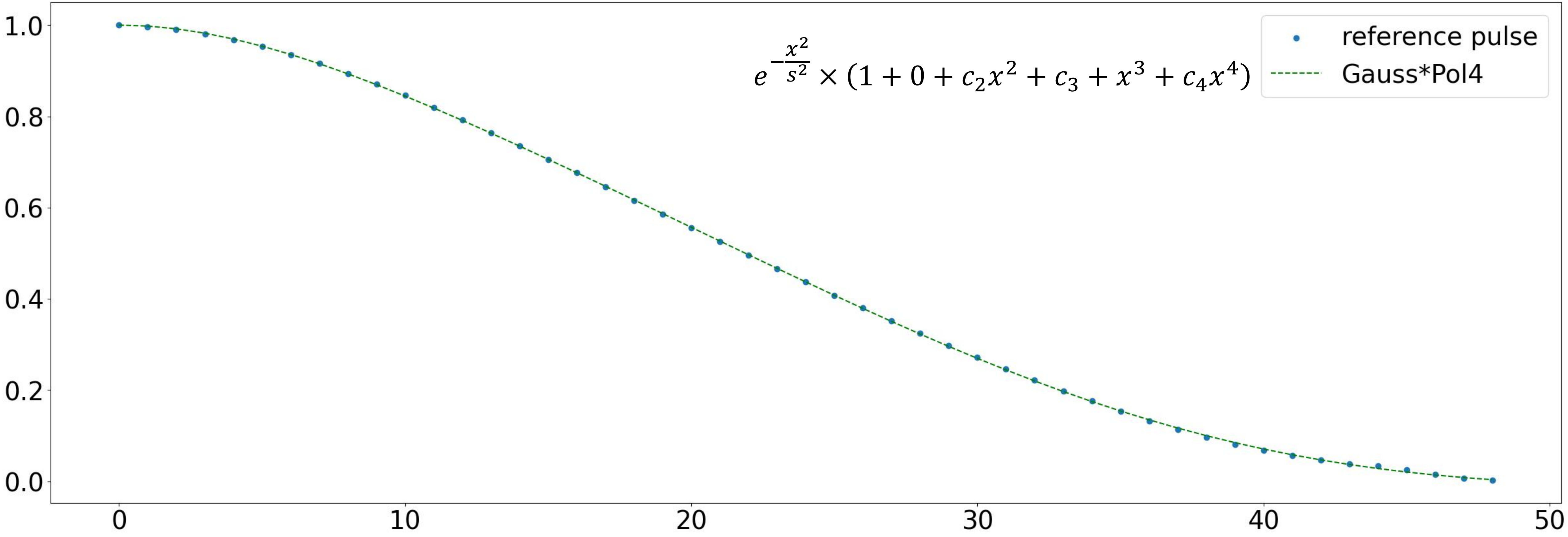
Linear fit to pulses of the similar shape



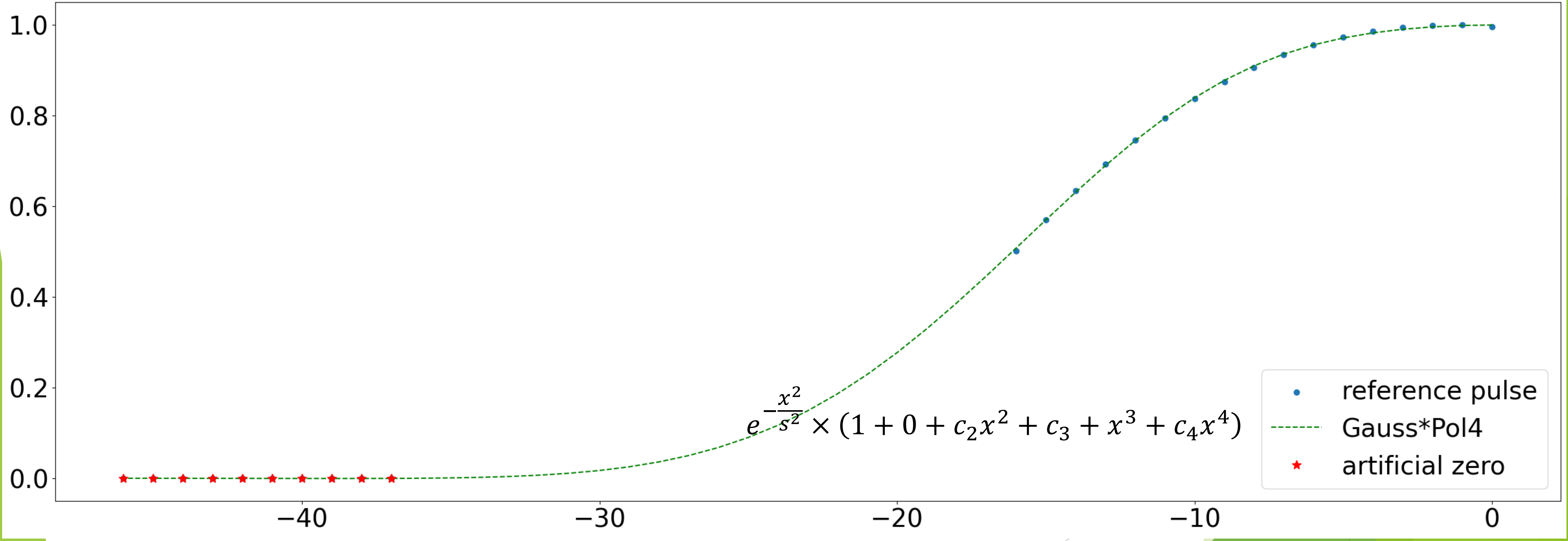
Reference pulse: Dots to function



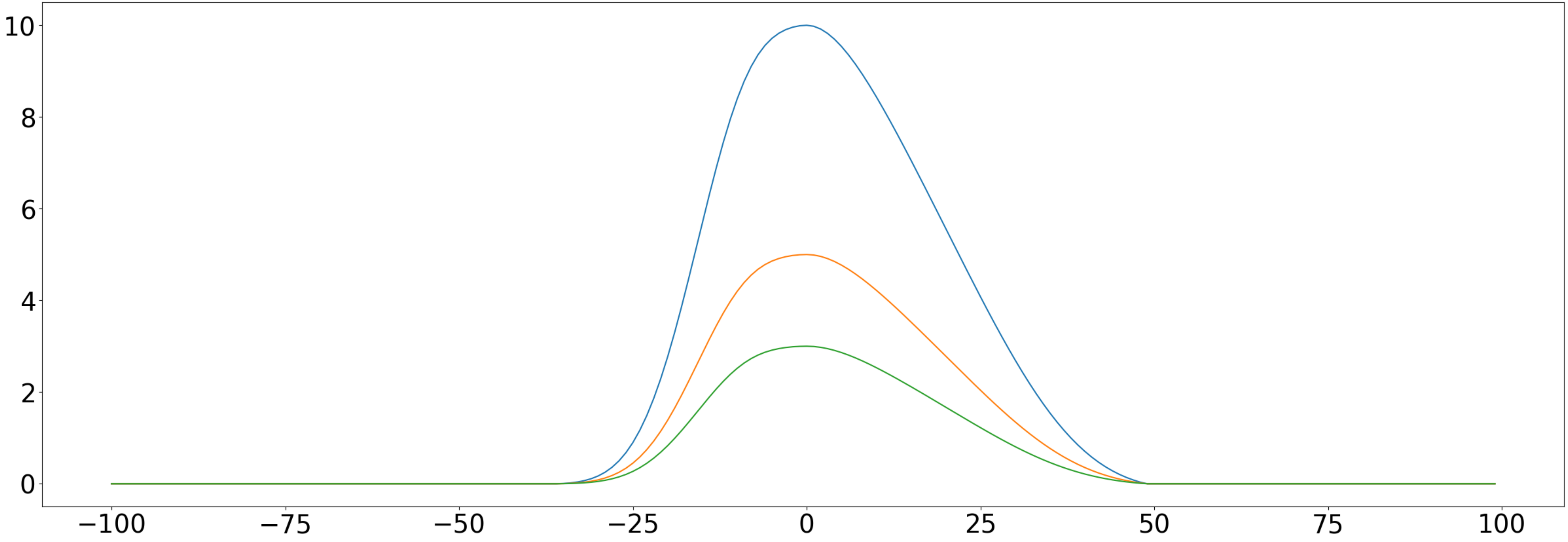
Reference pulse :Dots to function (right)



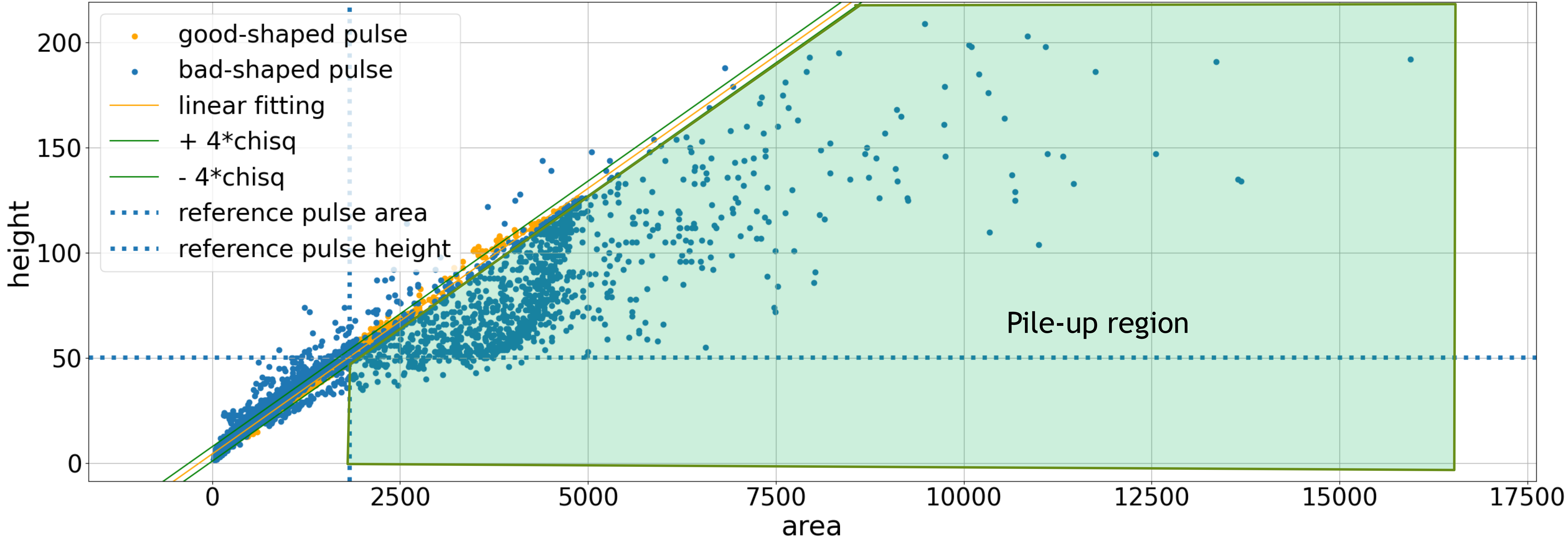
Reference pulse: Dots to function (left)



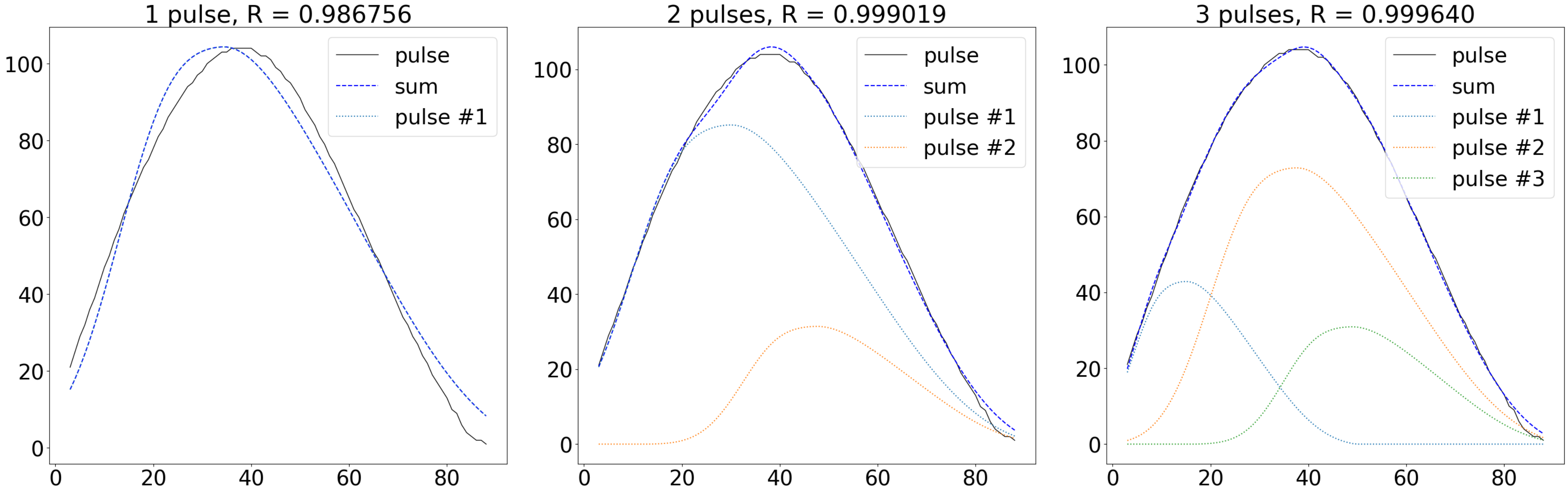
Reference pulse function on different scaling



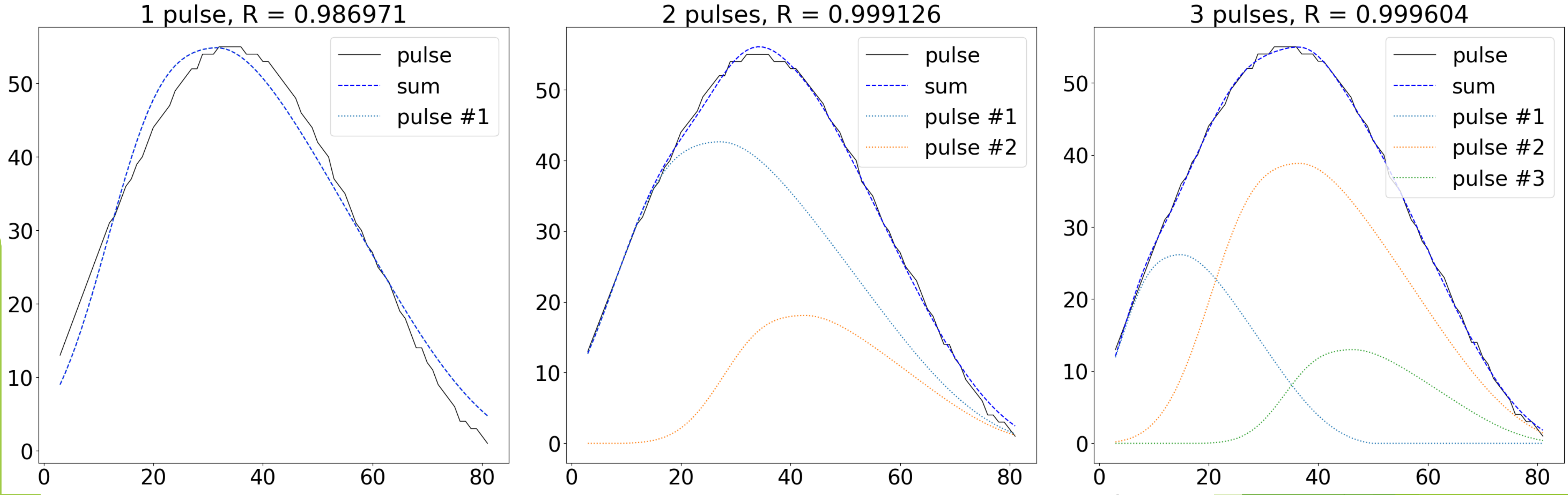
Trying fitting on pile-up pulse



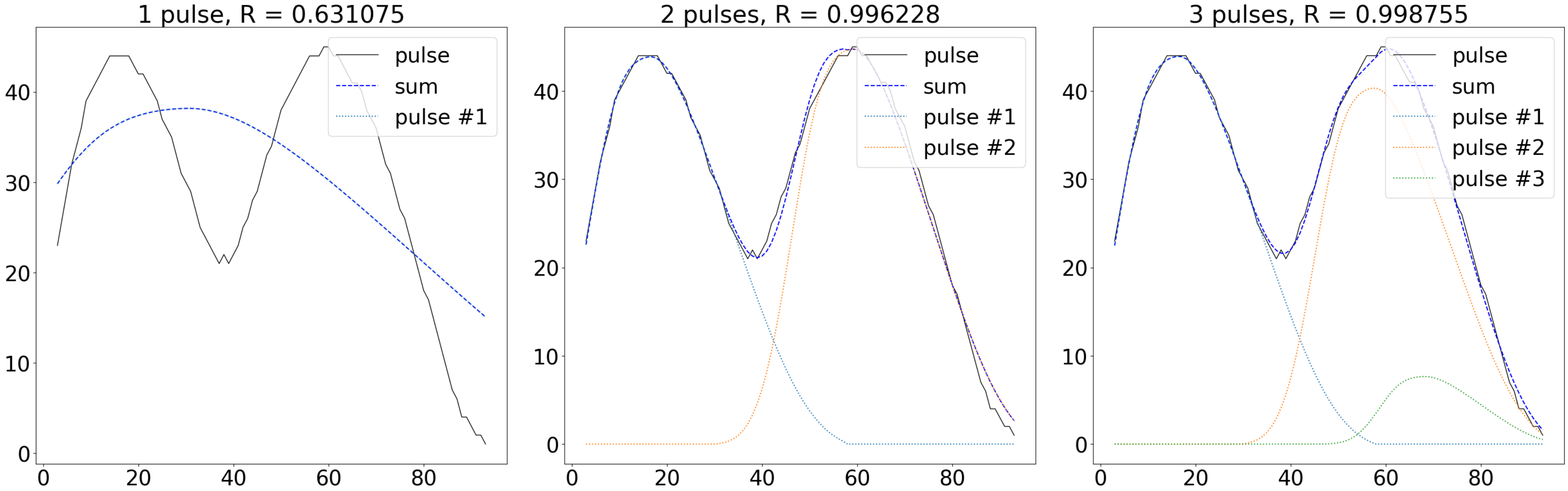
Fitting results



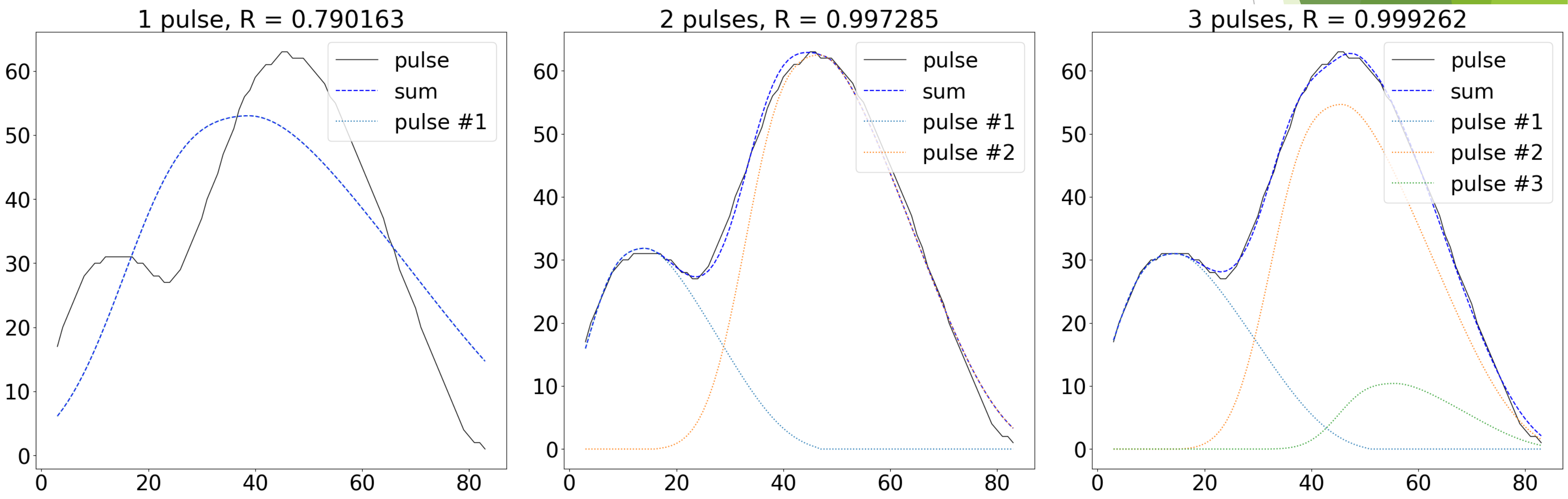
Fitting results



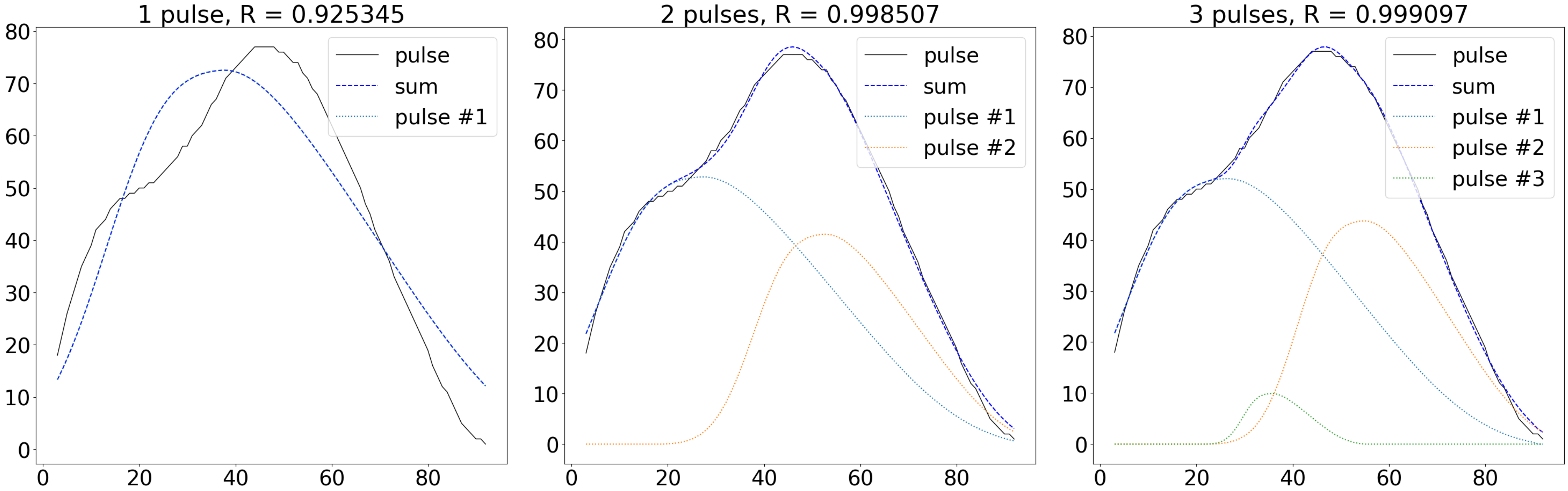
Fitting results



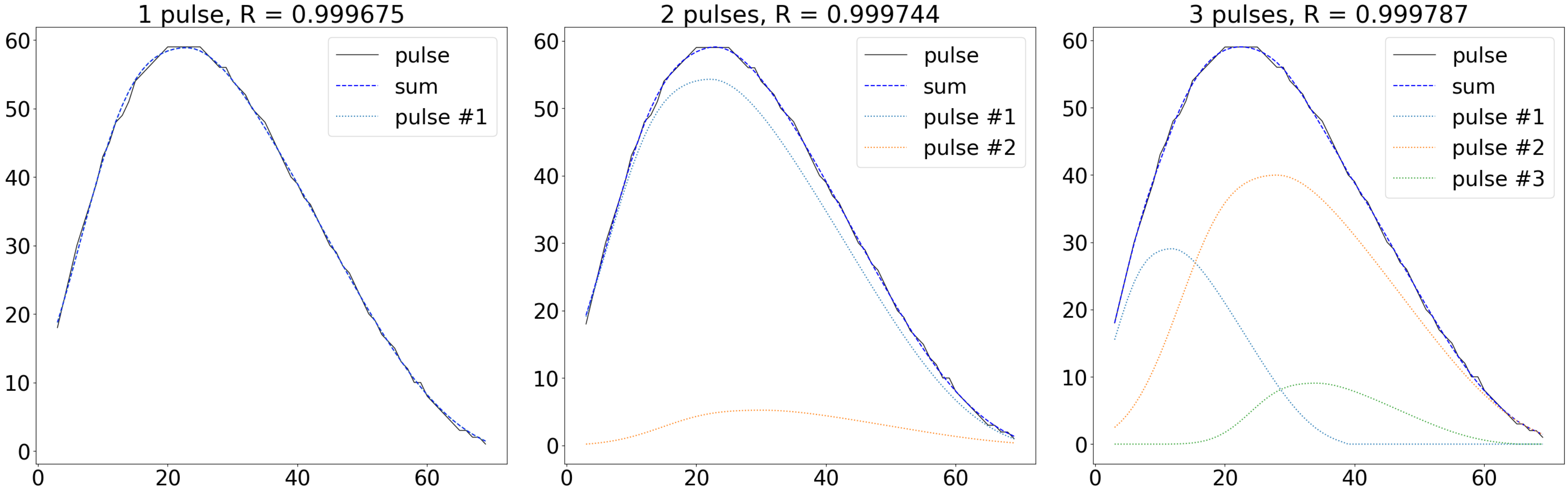
Fitting results



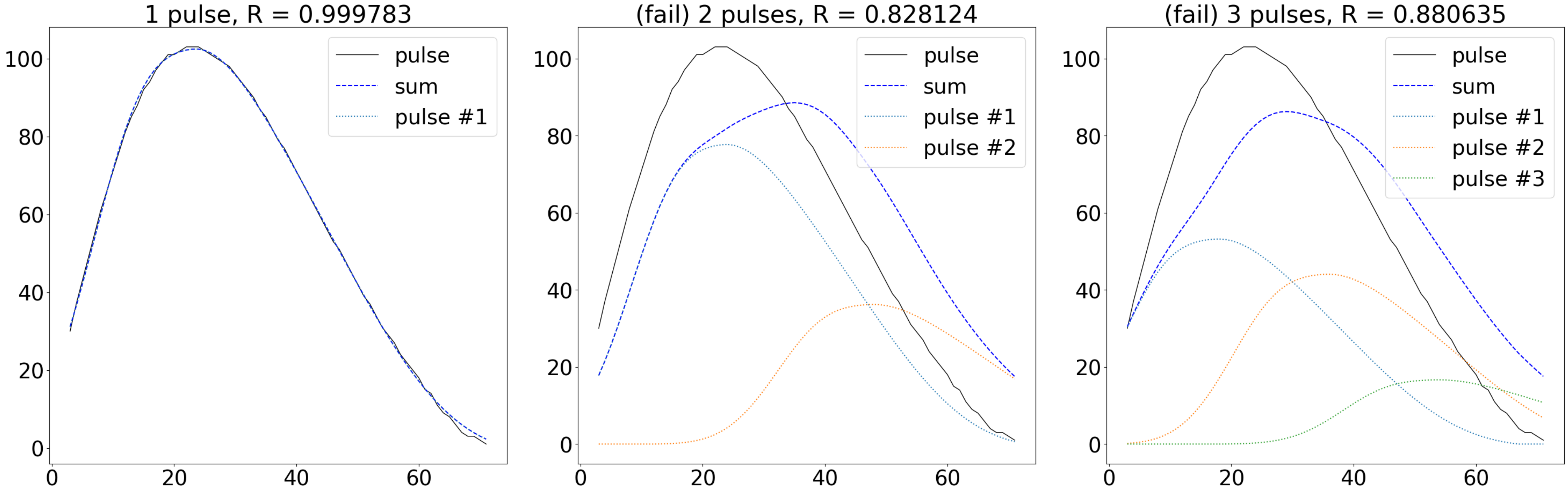
Fitting results



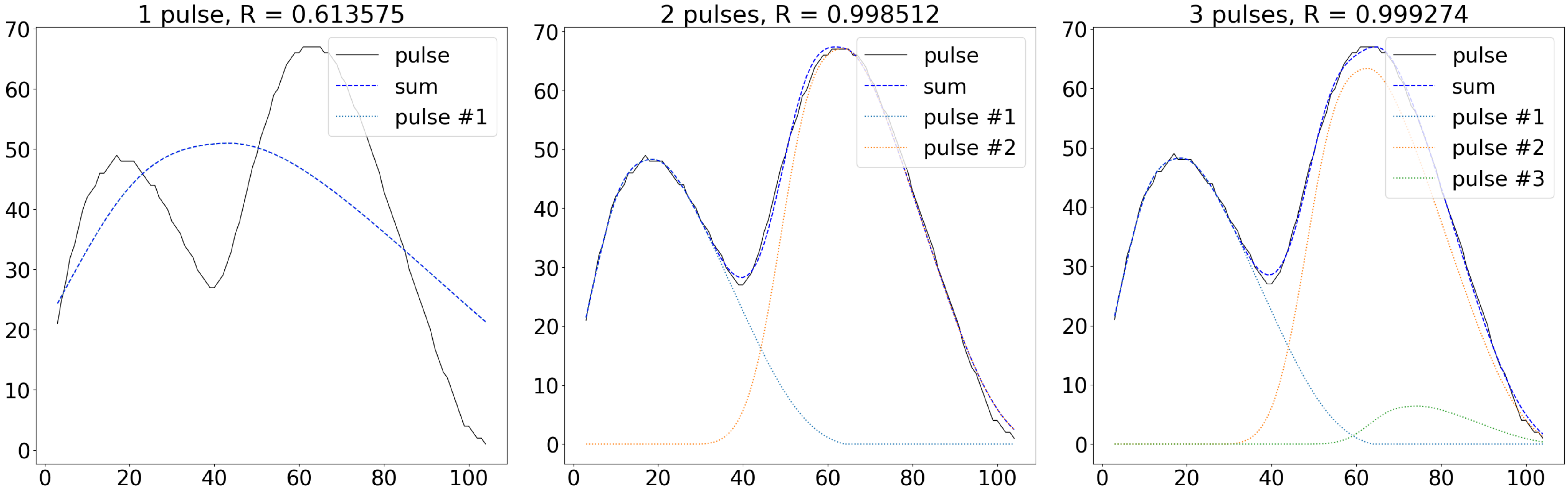
Fitting results



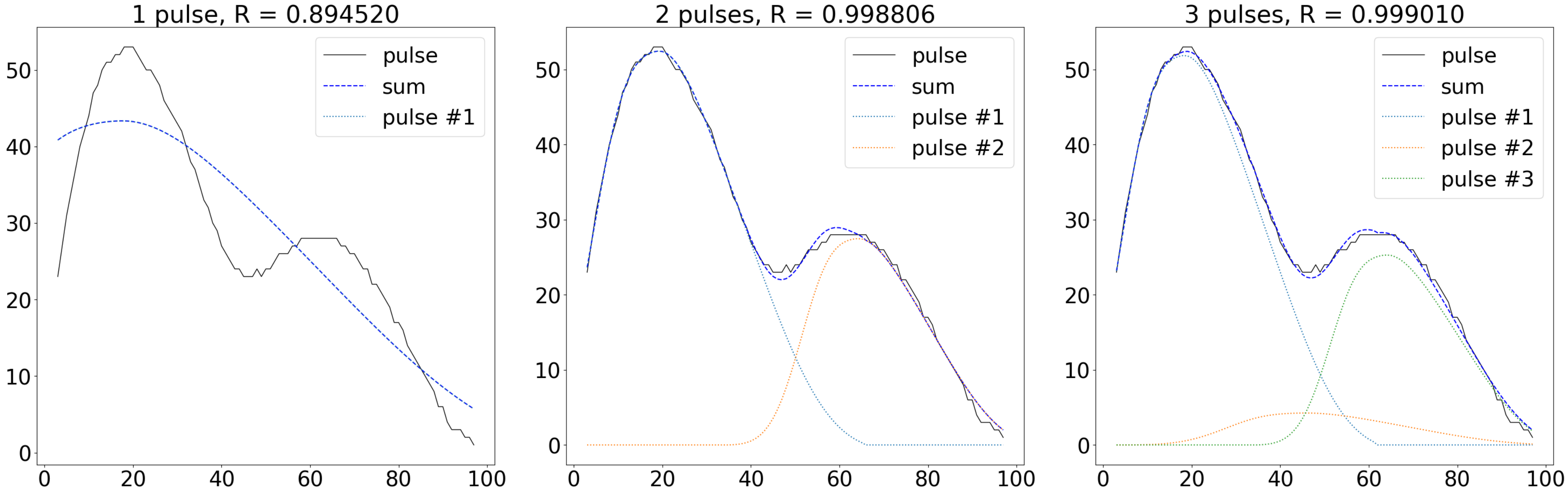
Fitting results



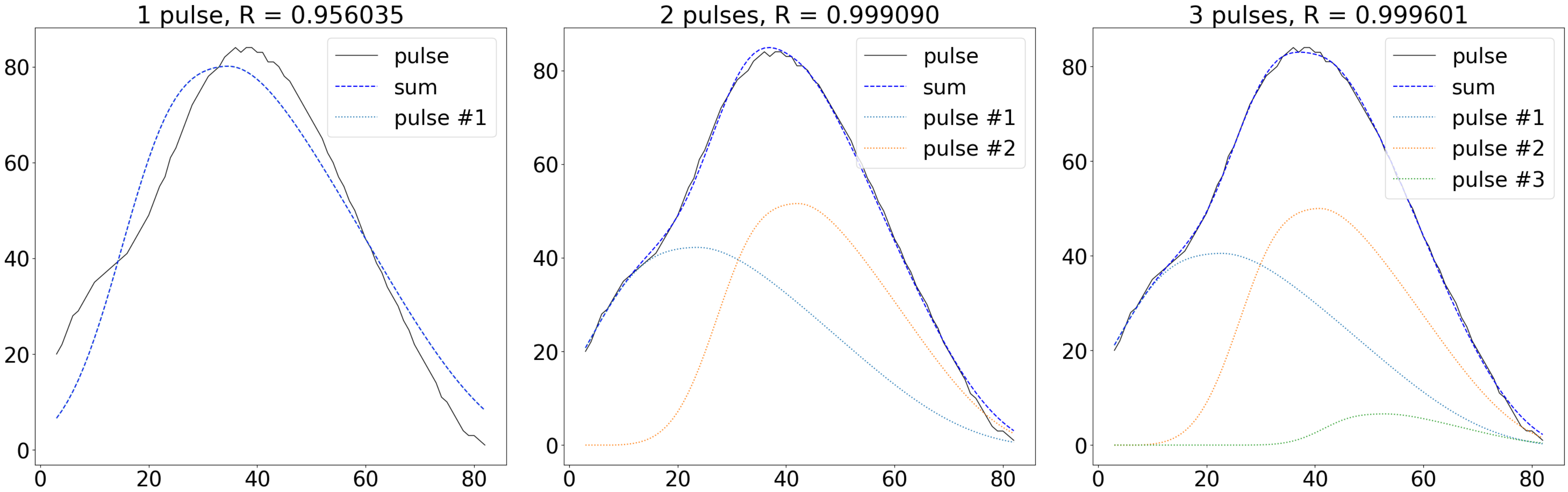
Fitting results



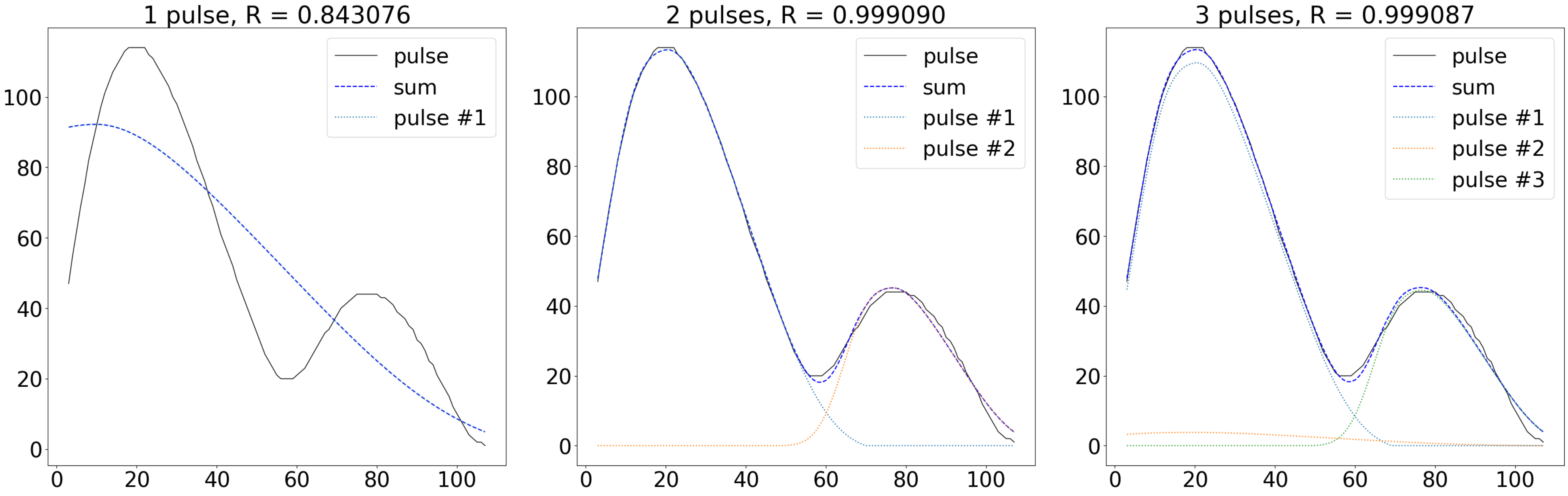
Fitting results



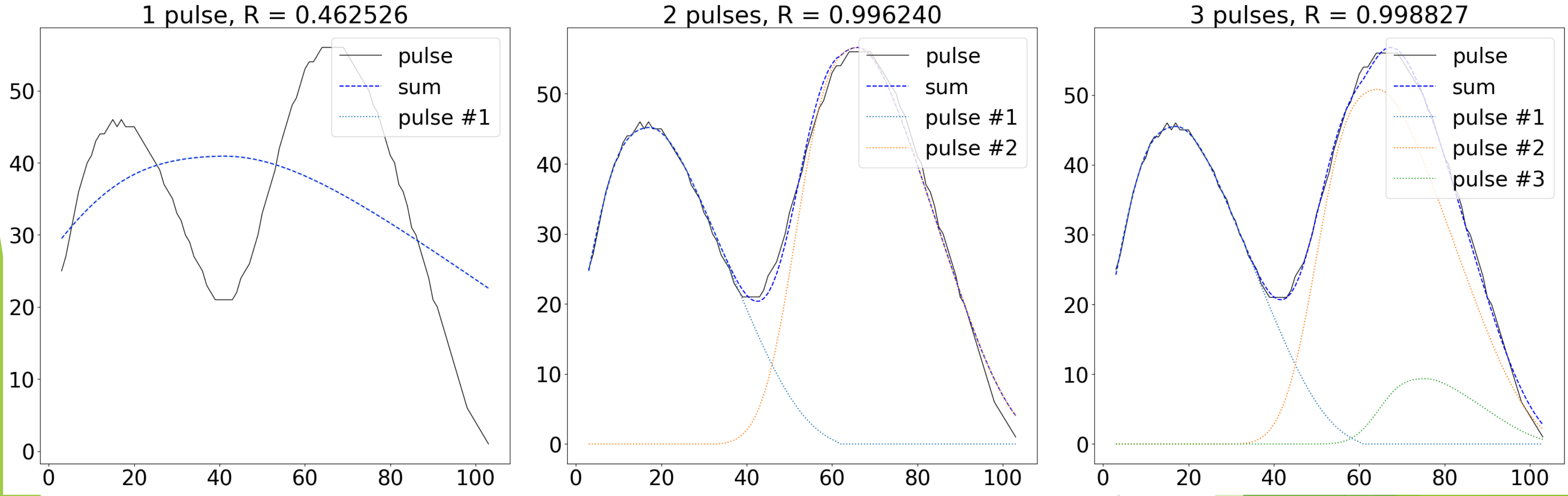
Fitting results



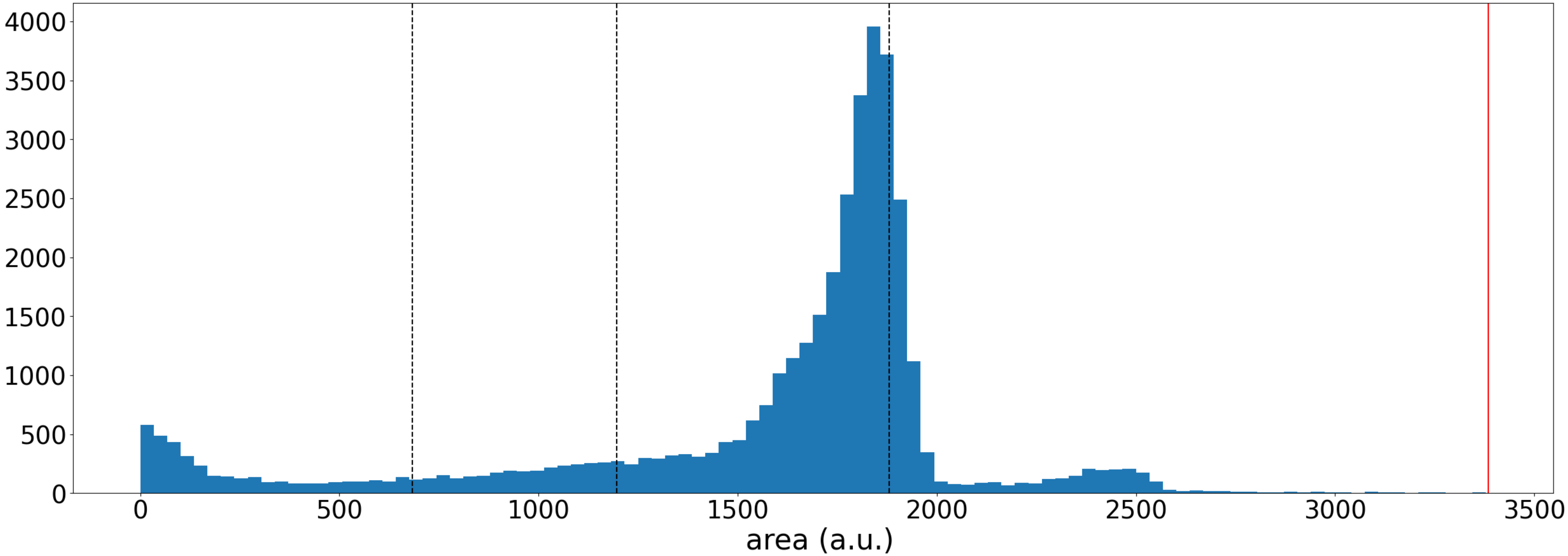
Fitting results



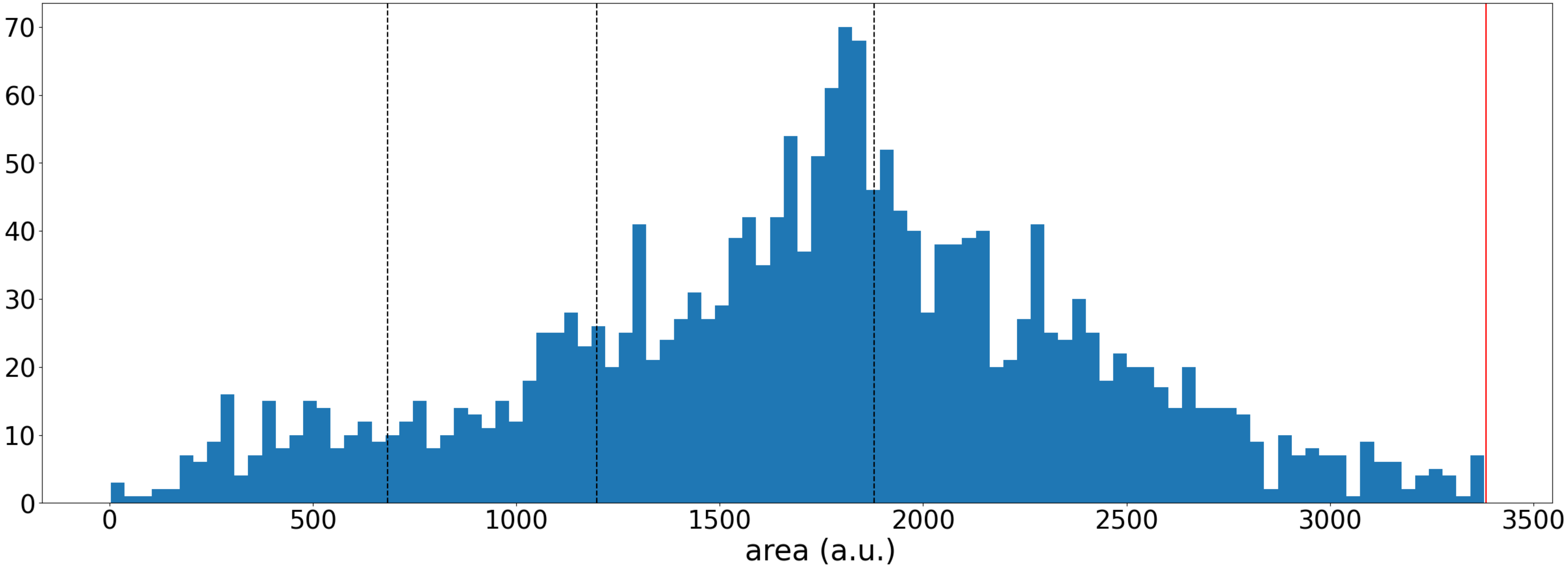
Fitting results



Pulse area distribution after deconvolution



Pulse area distribution after deconvolution (pile-up region only)



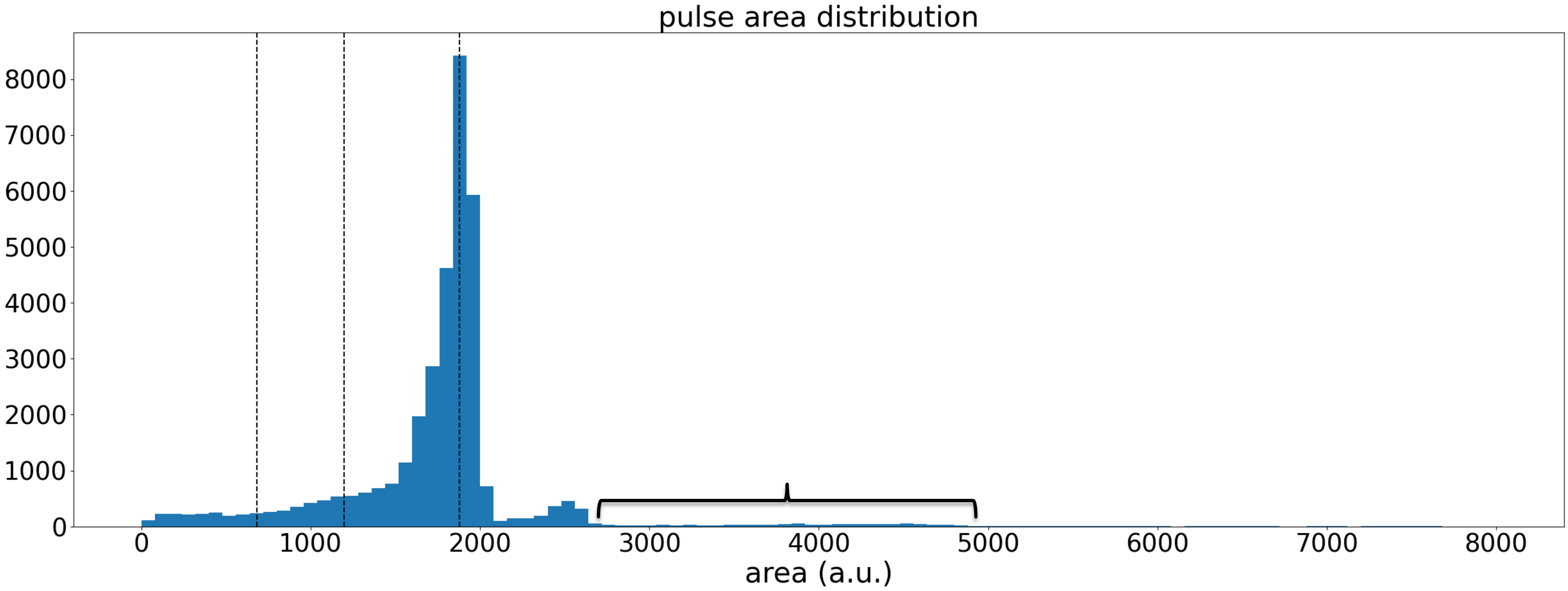
Pulse width are mostly around 0.9-1.1

Conclusion

- The method need majority of pulse being single
- Good enough for counting pulse but not good at finding exact pulse parameter of each pulse
- For real time pulse count, can only separate the singles and the pile-ups.

Future work

- Collect more data to confirm pile-up pulse distribution.



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Thank you

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