

Digital Pulse Shape Analysis with LArSoft

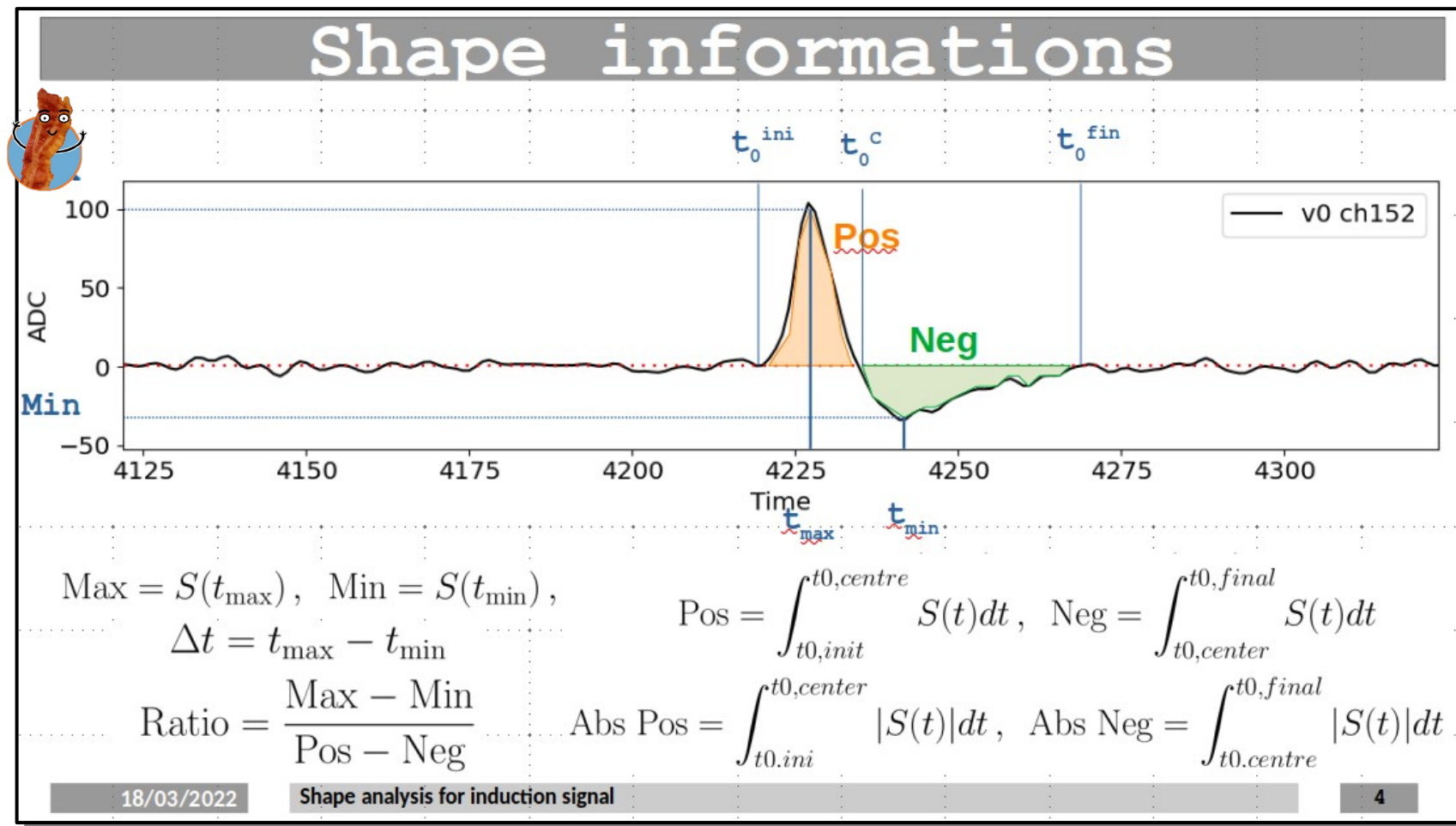
Sim/Reco meeting
Thibaut Houdy

26th of September, 2022

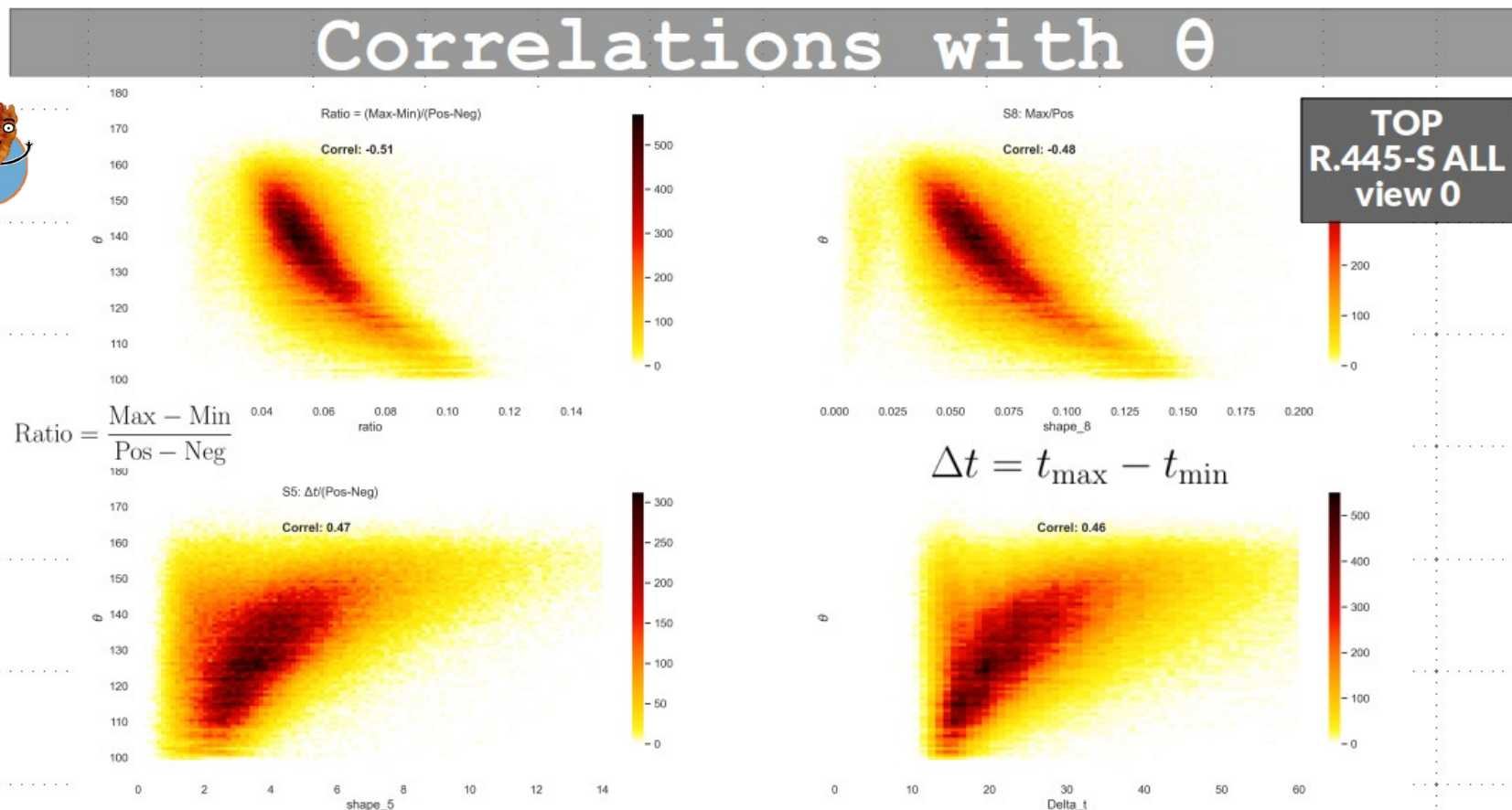
Goals

- Finding correlations between **signal shape and track vertical angle**
 - Comparing data and simulation
- This is expected due to **neighbour's effect**
 - → VD/HD difference?
- To my knowledge, only the mean is used for geometry (U, V, Y coincidence) and the integrated charge for energy (from collection plane, also from induction?)
 - → include an extra **information**. Similar to a deep learning method using hit's waveform
- What is the size of the effect? **How to integrate** this information in the reconstruction?
At which level of the signal treatment?
 - → First idea would be to have a parameter estimated on the fly scoring the angle of the hit's track and stored in the data frame

Follow up of a previous investigation



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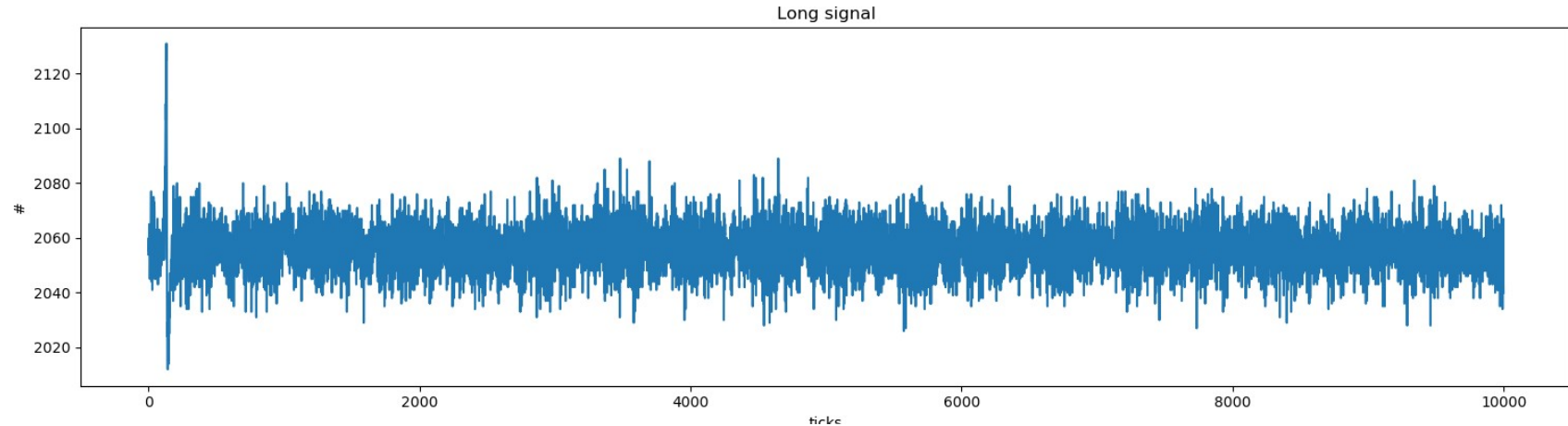
18/03/2022

This was done with Lardon. To study effect on standard analysis
→ need to look for this effect on LArSoft

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Raw waveform data

Run: 455, ev: 10899 , ch: 935, θ : 23, ϕ : 23

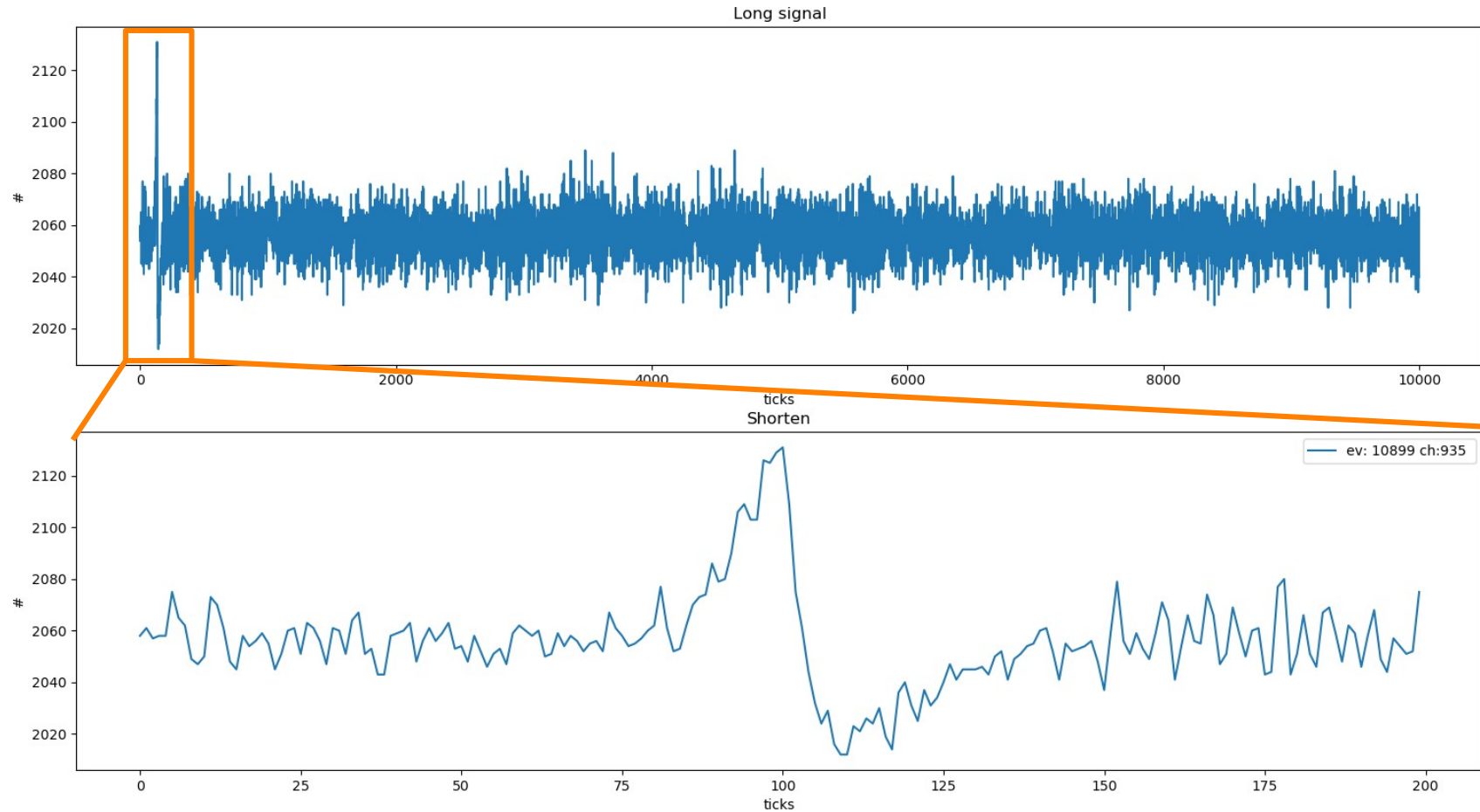


Data from Cold box run 455 (December 2021)

- 3x3.3 m² with 23 cm drift length
- cosmics with random trigger

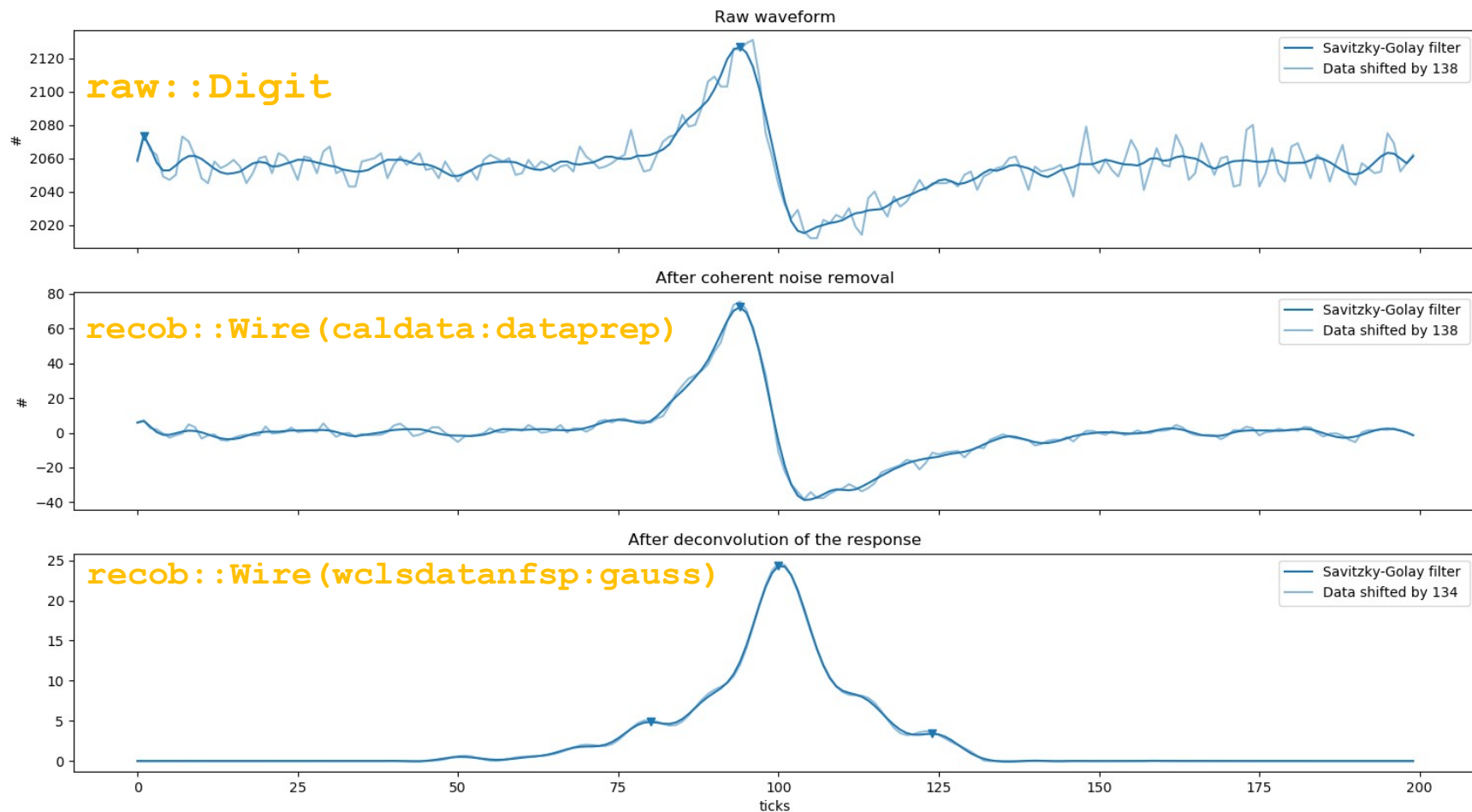
Raw waveform data

Run: 455, ev: 10899 , ch: 935, θ : 23, ϕ : 23



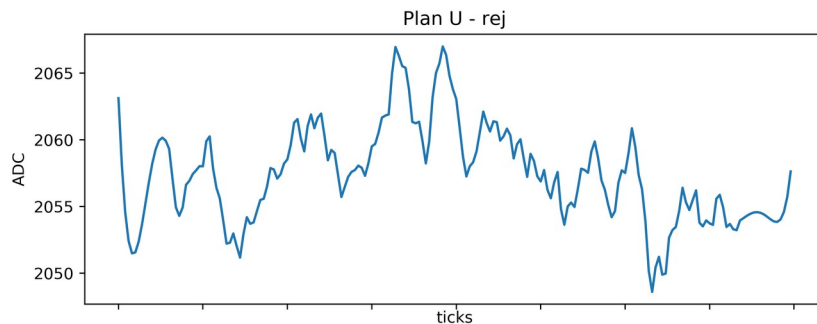
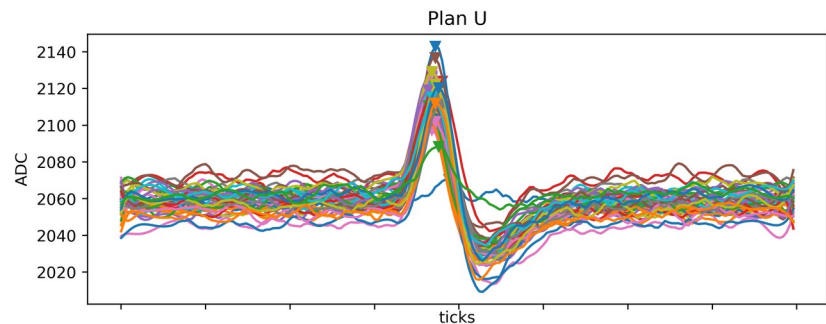
Signal treatment in LArSoft

Run: 455, ev: 10899 , ch: 935, θ : 23, ϕ : 23

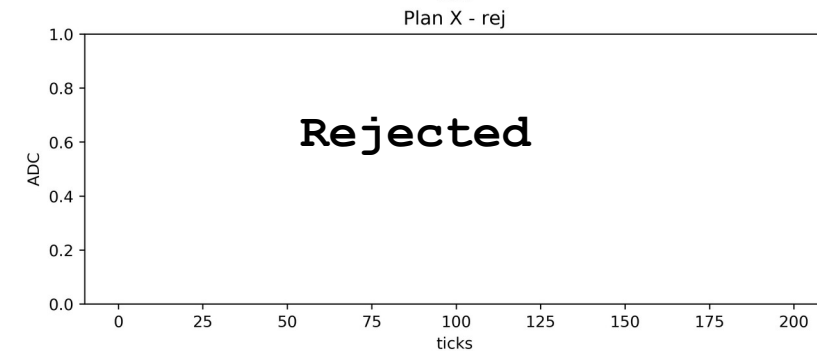
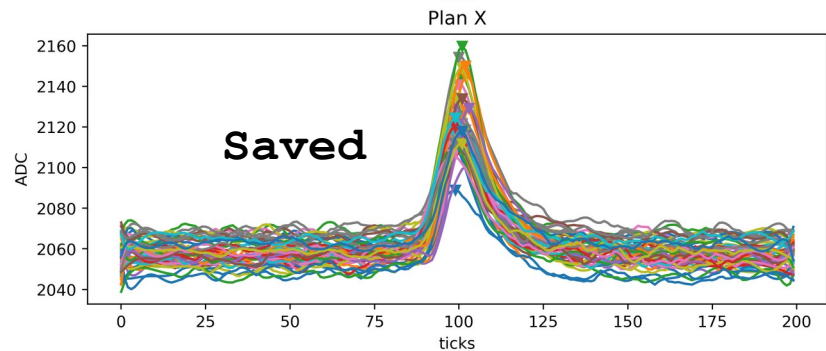
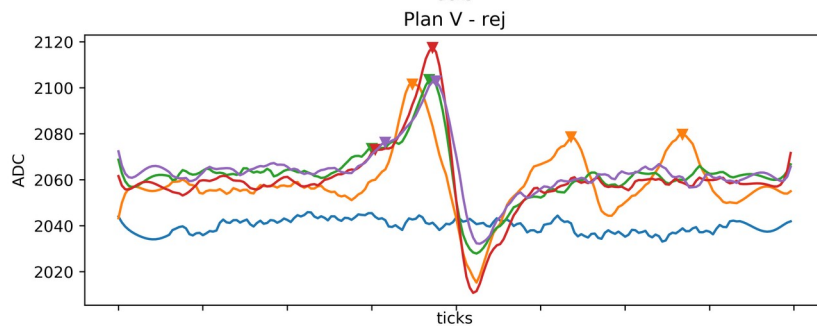
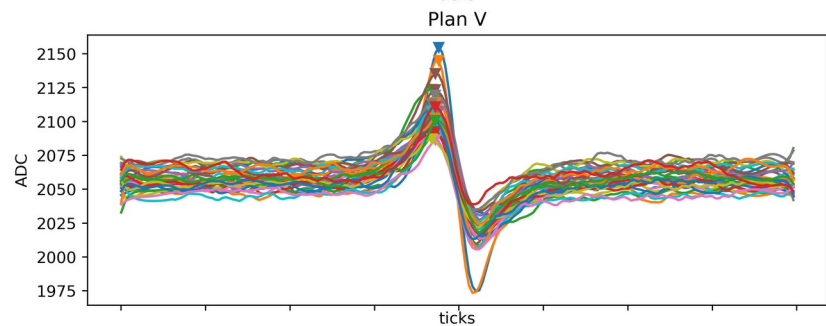


Savitzky-Golay filter for a better estimation of the peak position and height. Coherent with CNR

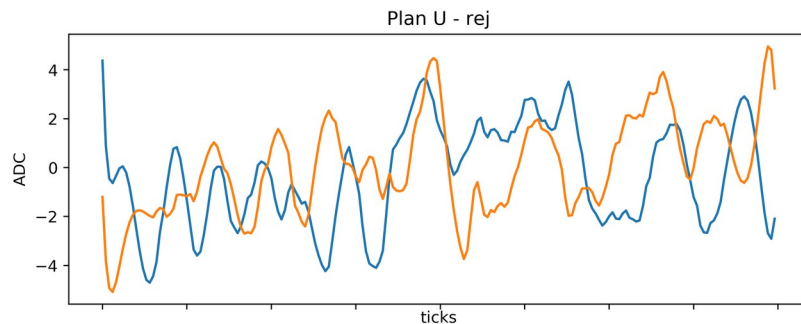
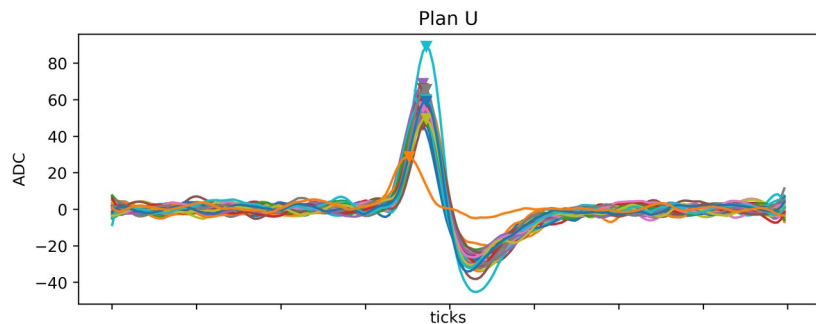
Raw waveforms



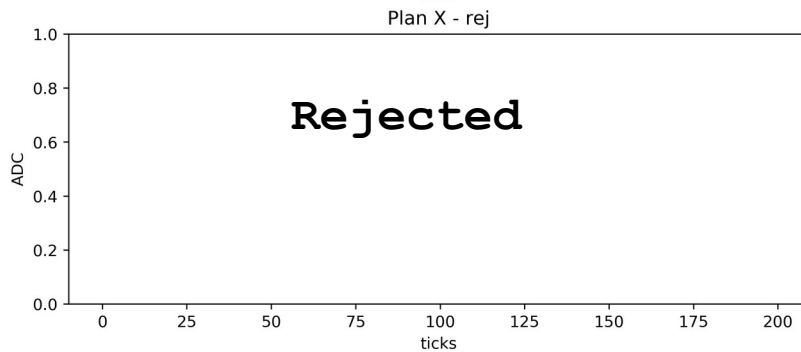
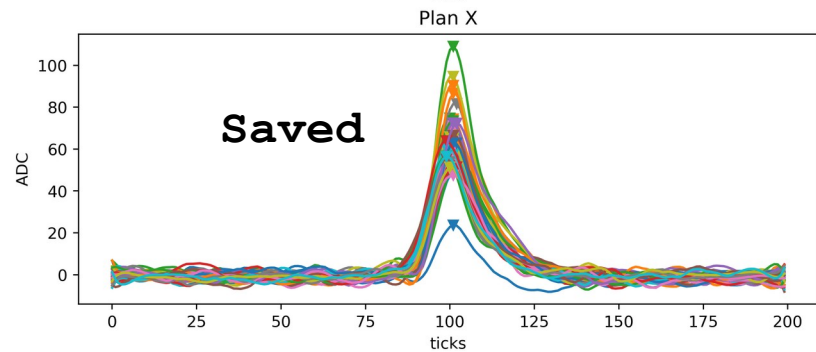
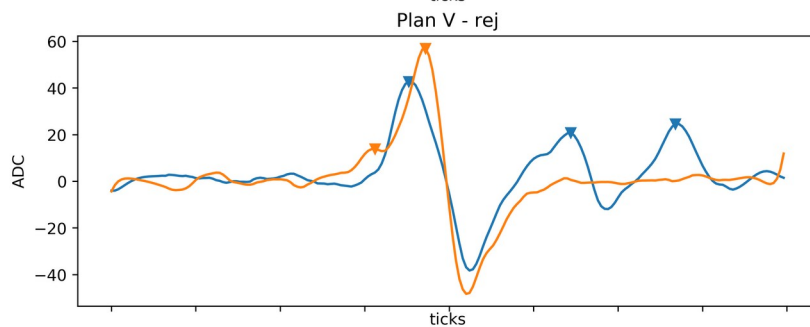
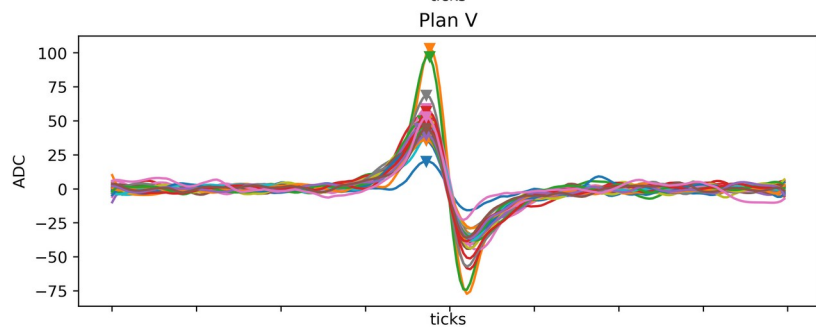
**TOP
R.445
S100**



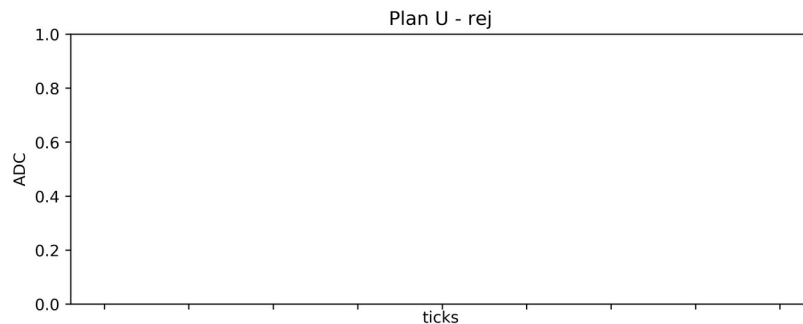
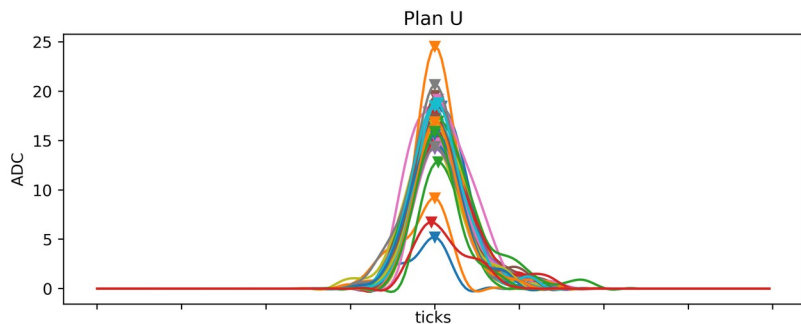
Coherent noise removal (CNR)



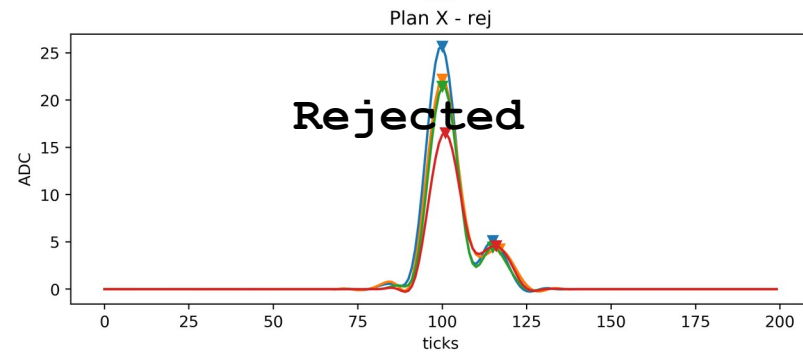
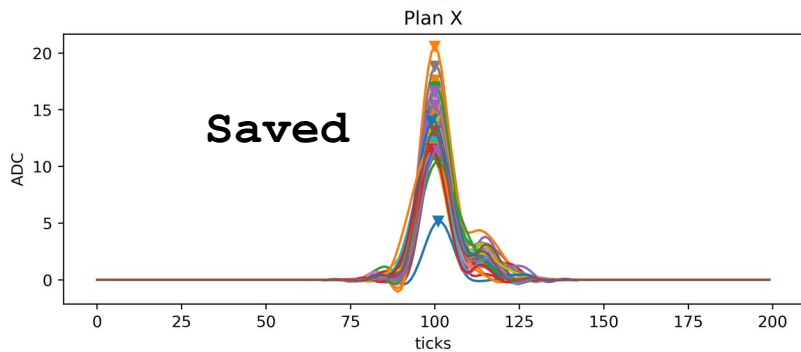
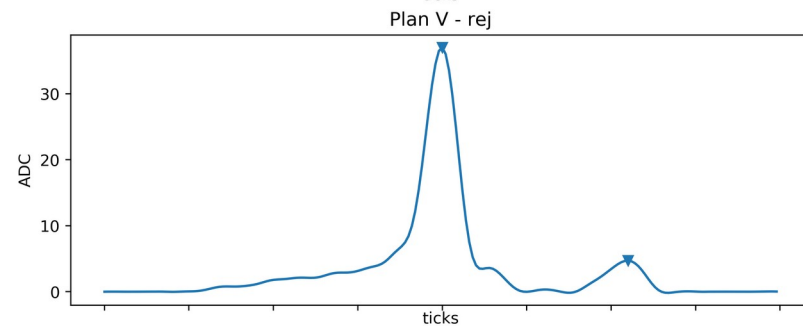
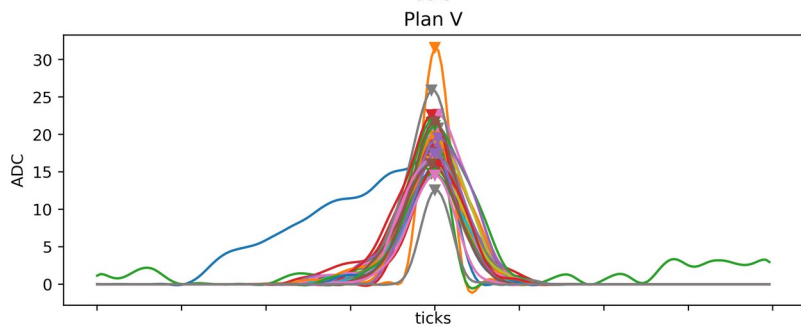
**TOP
R.445
S100**



Deconvolved waveforms

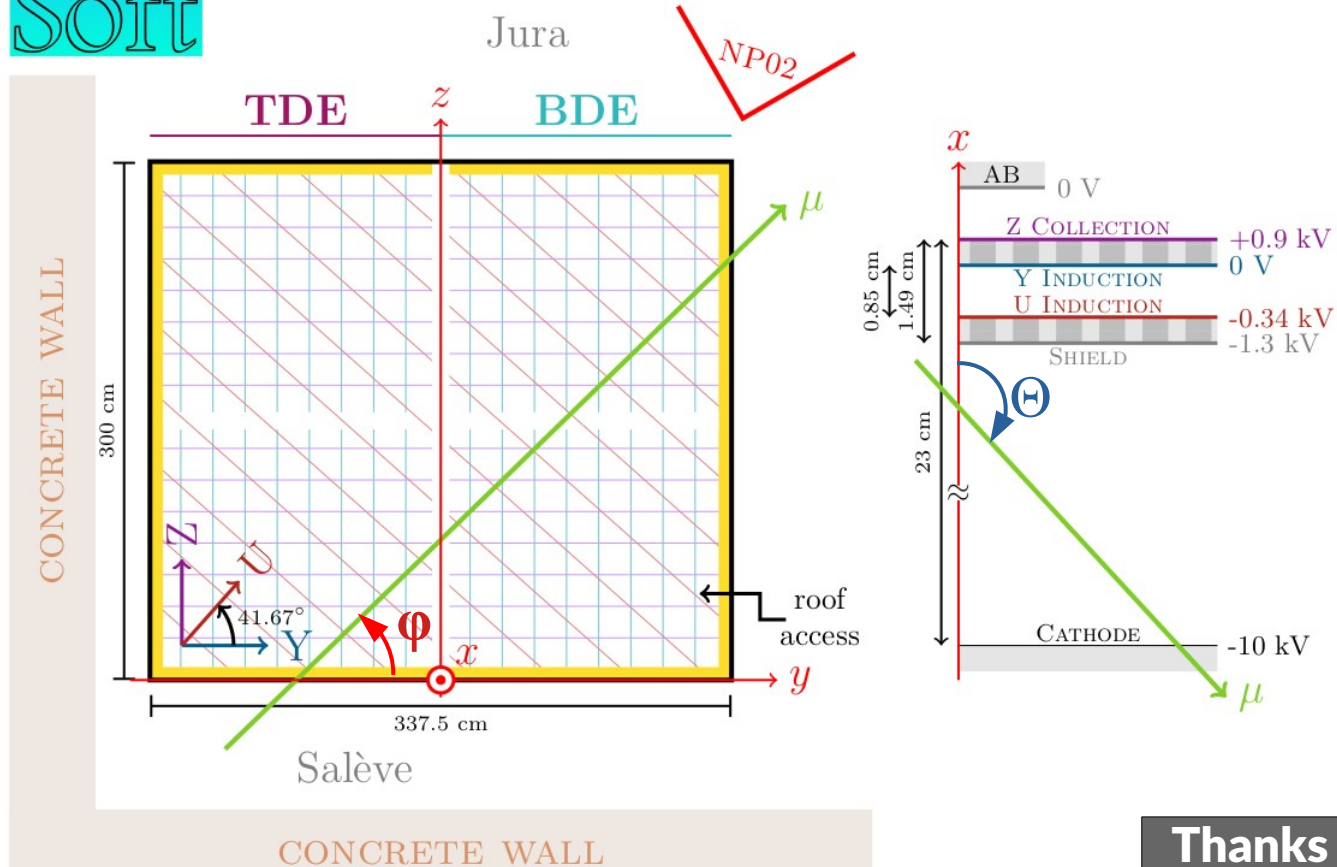


TOP
R.445
S100



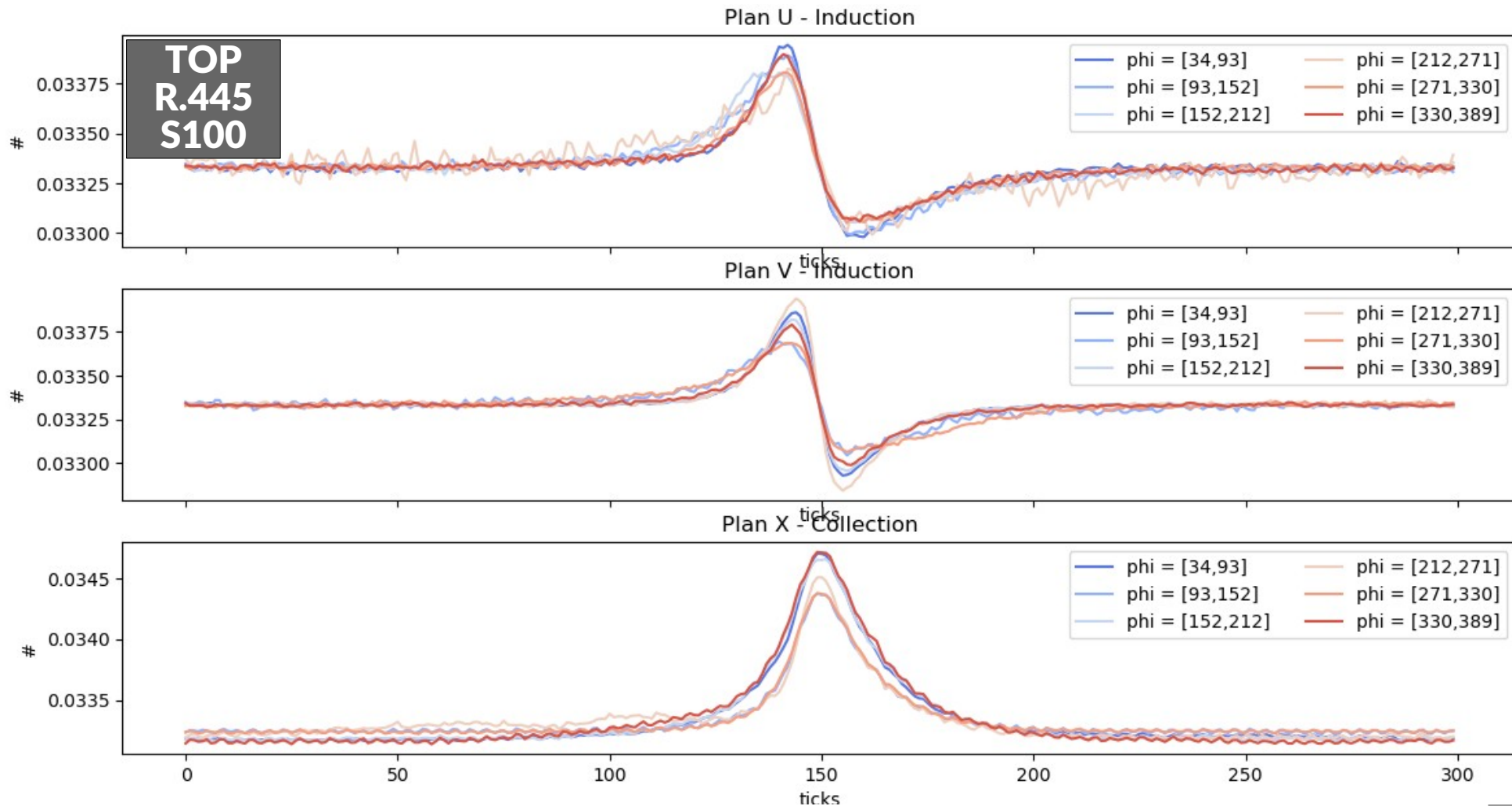
Angles definition

LAr
Soft

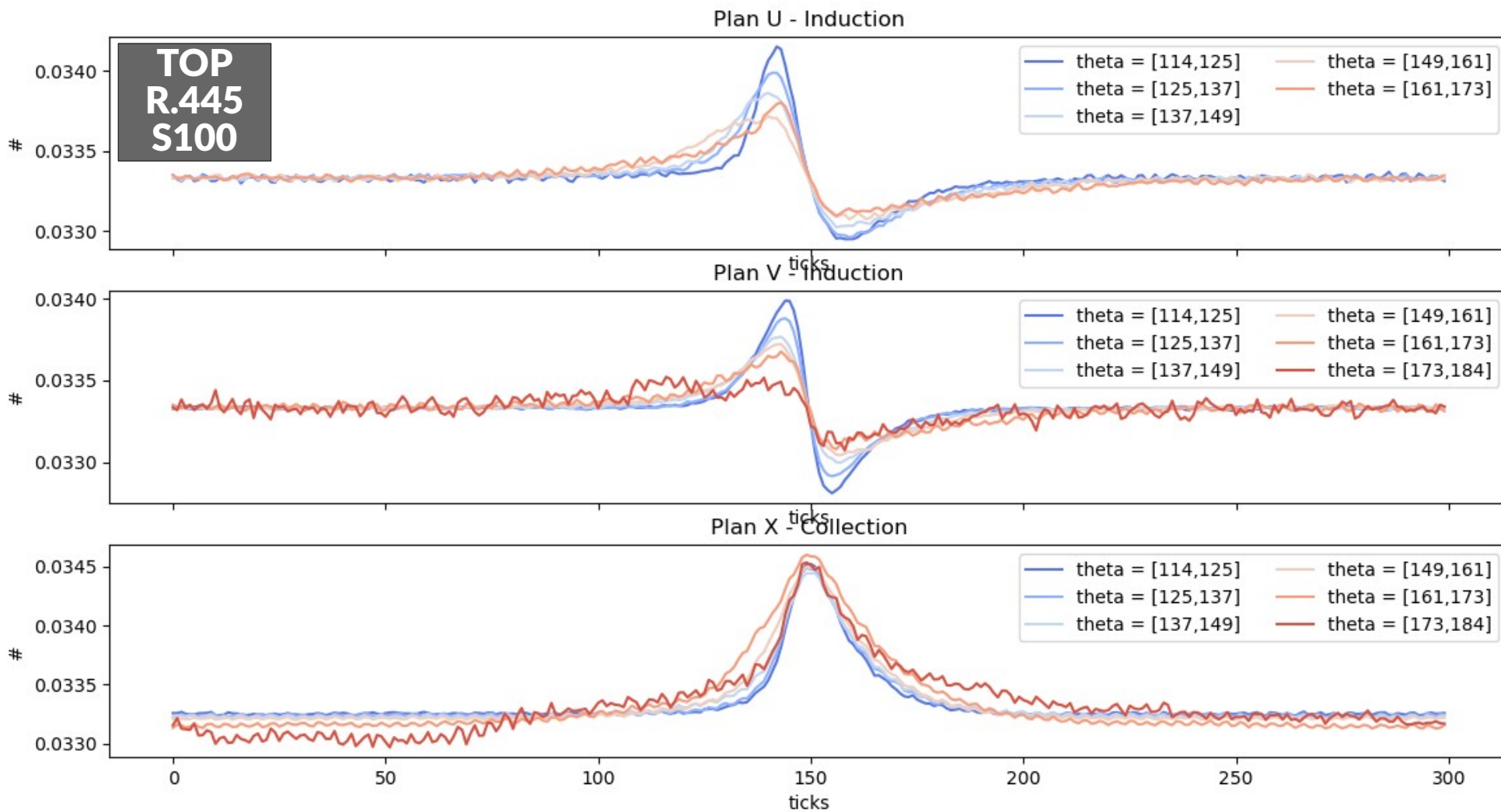


Thanks Laura!

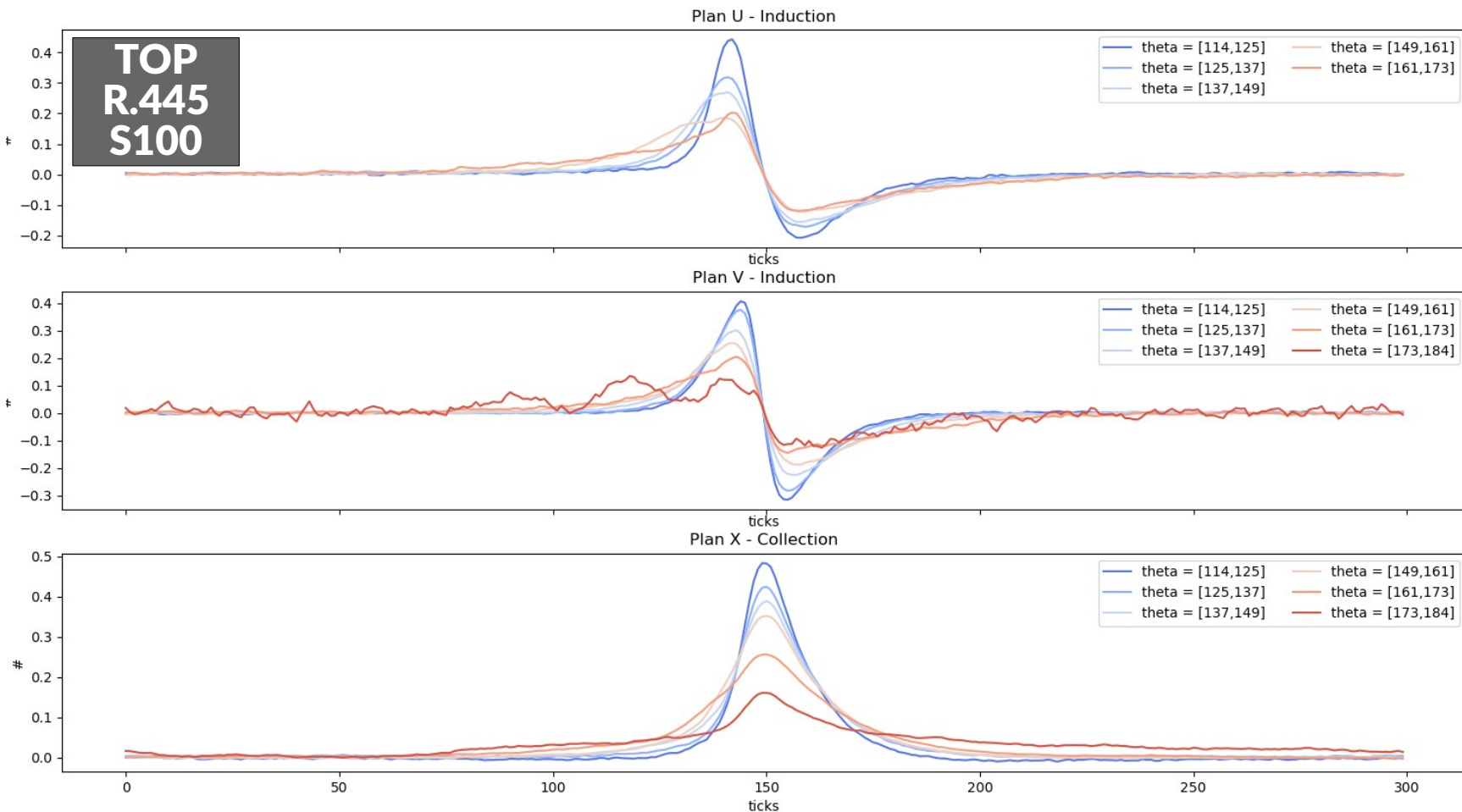
Raw waveforms φ template



Raw waveforms @ template



CNR waveforms @ template

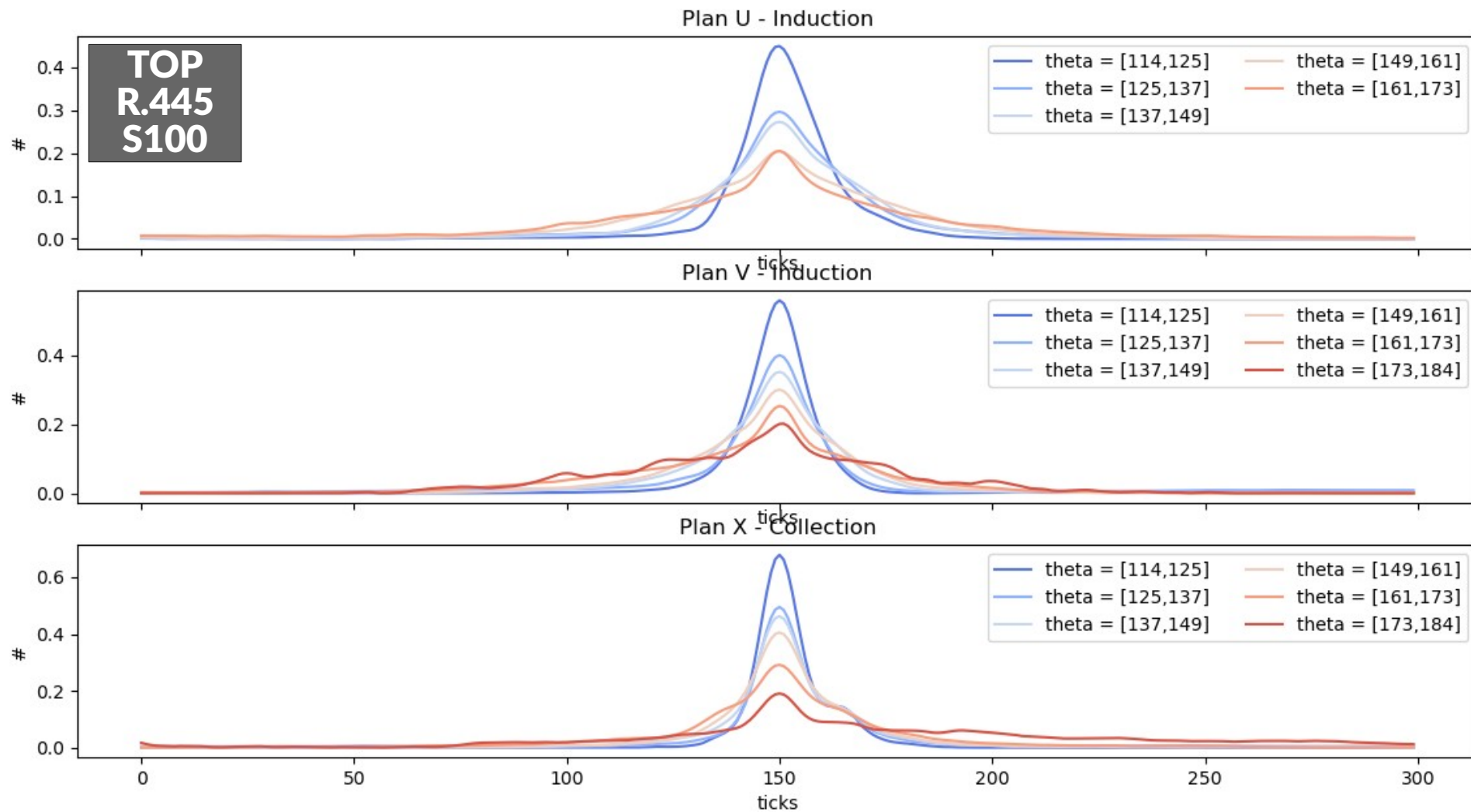


960 waveforms
from coldbox data
Top electronics,
run 455, sub
100

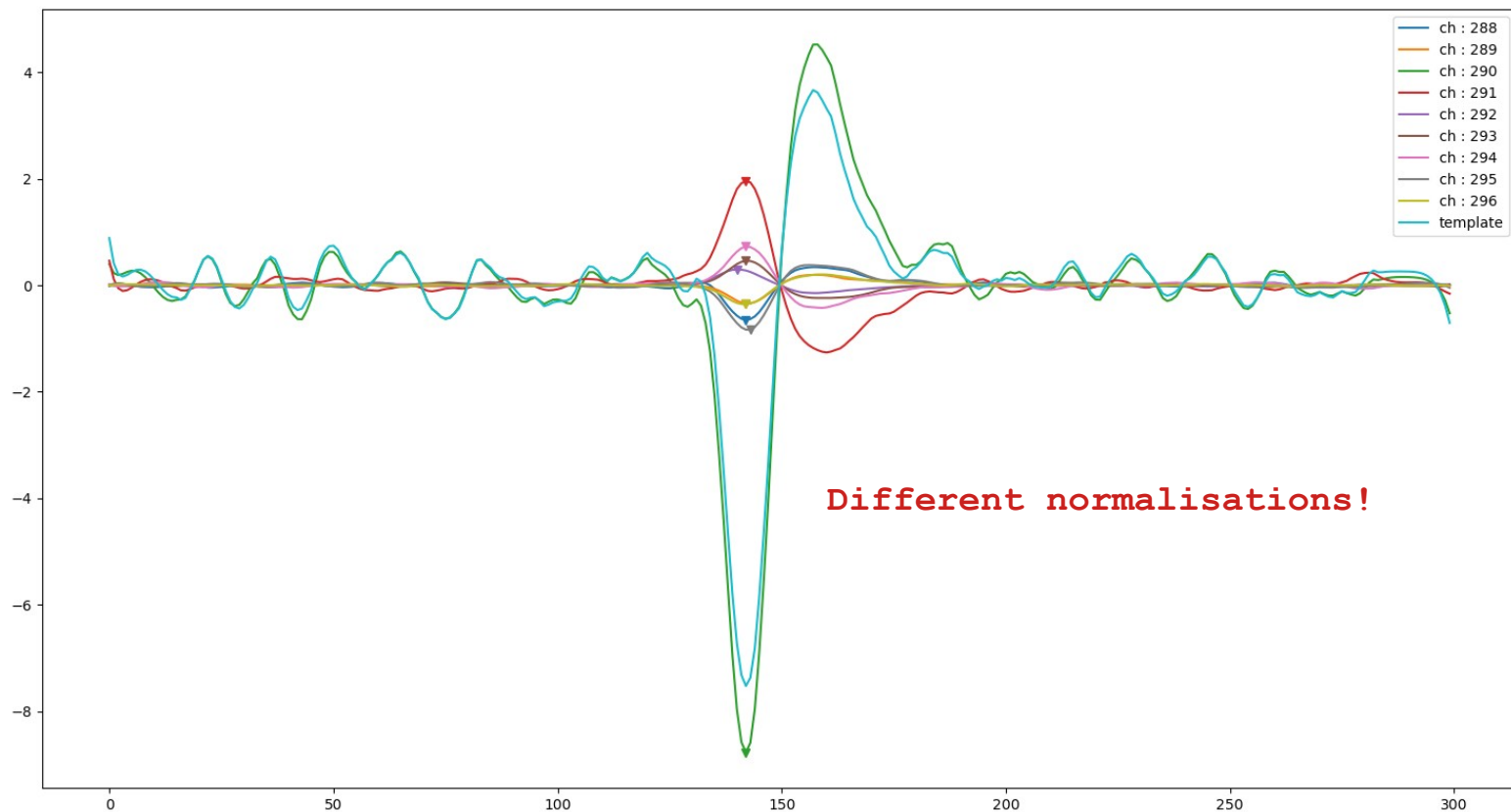
Average of the
waveforms clas-
sified depend-
ing on the track angle
→ 6 angular bins

Each angular
bin template
is normalized for
better display.

Deconvolved waveforms @ template

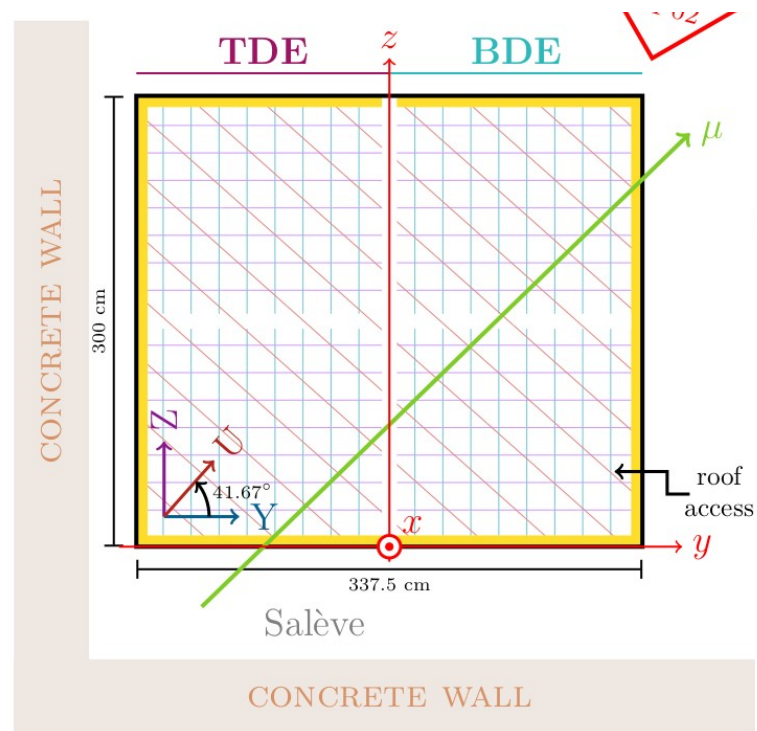
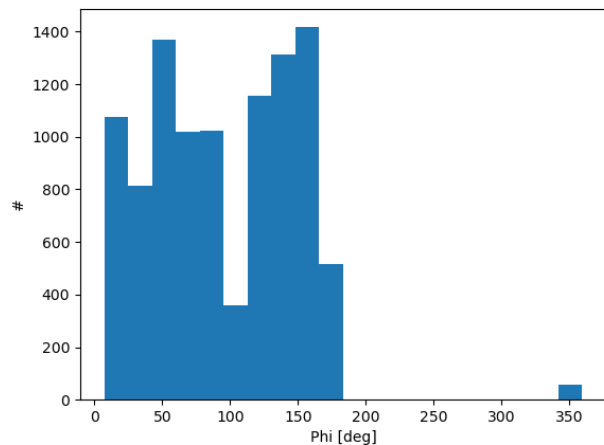
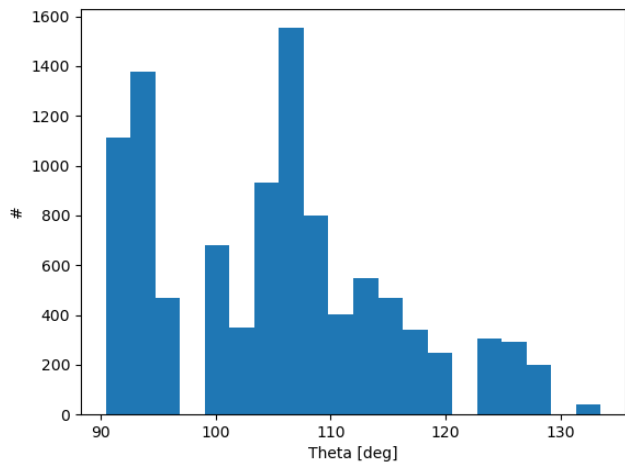


Marker for a start of a track?



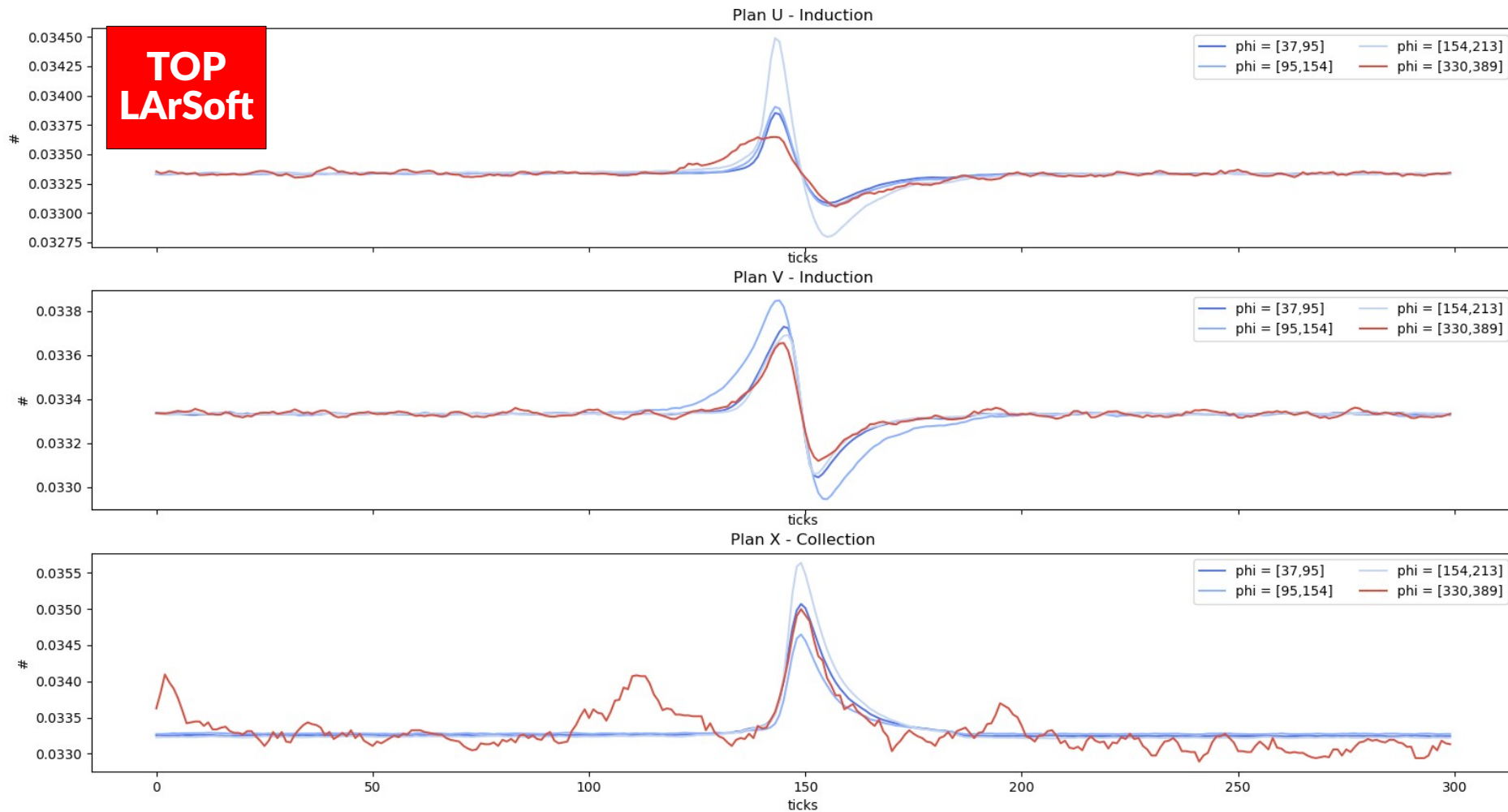
It seems that before real electrons crossing the CRP, the channels are triggered and induce a “negative symetrical bipolar” signal. Could be used as a marker for the start or end of a track? To be investigated whether this is systematic.

Simulation

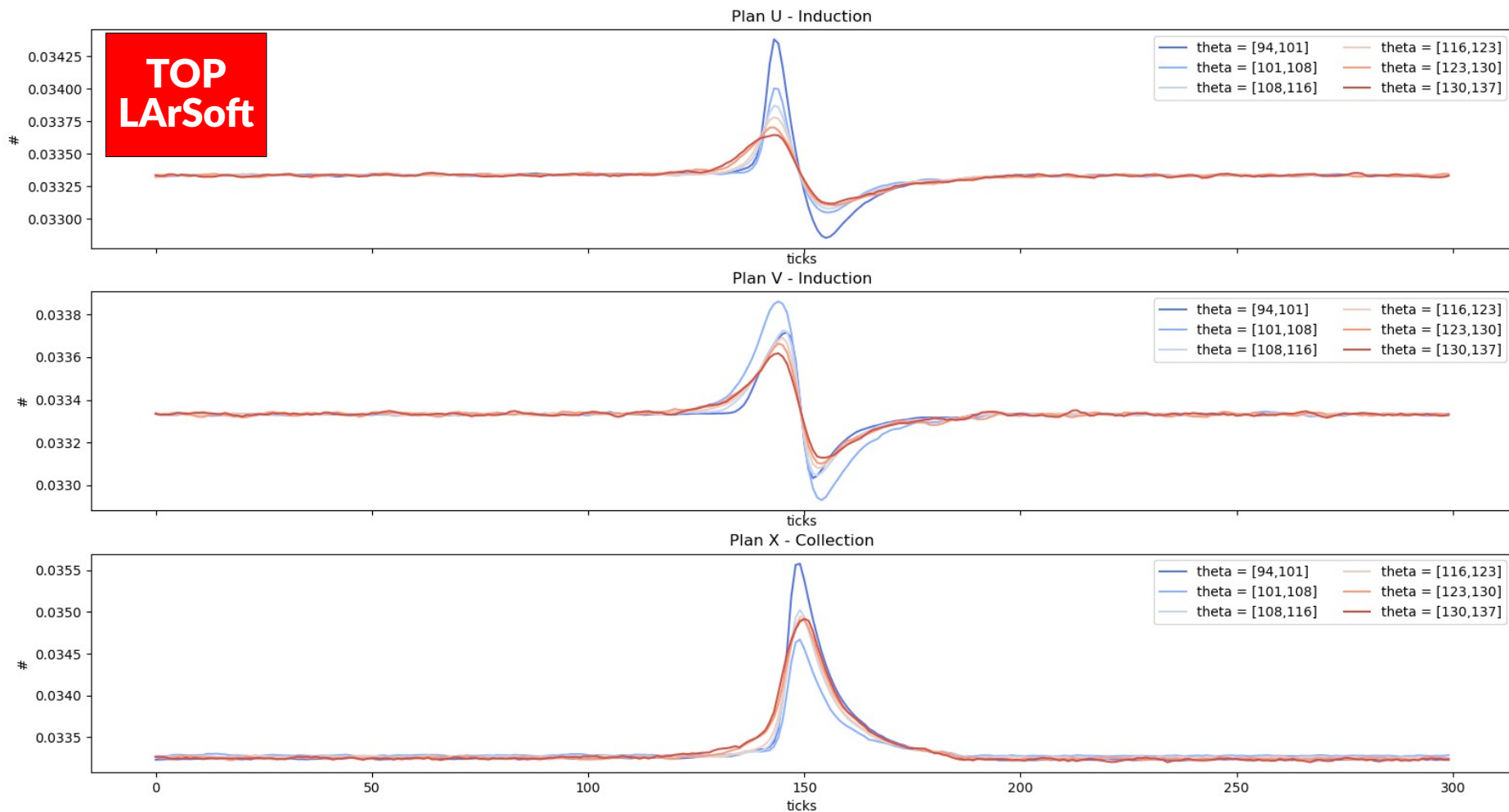


- 5 GeV muons in TDE
- Artificial statistics → per hits. Only 250 events

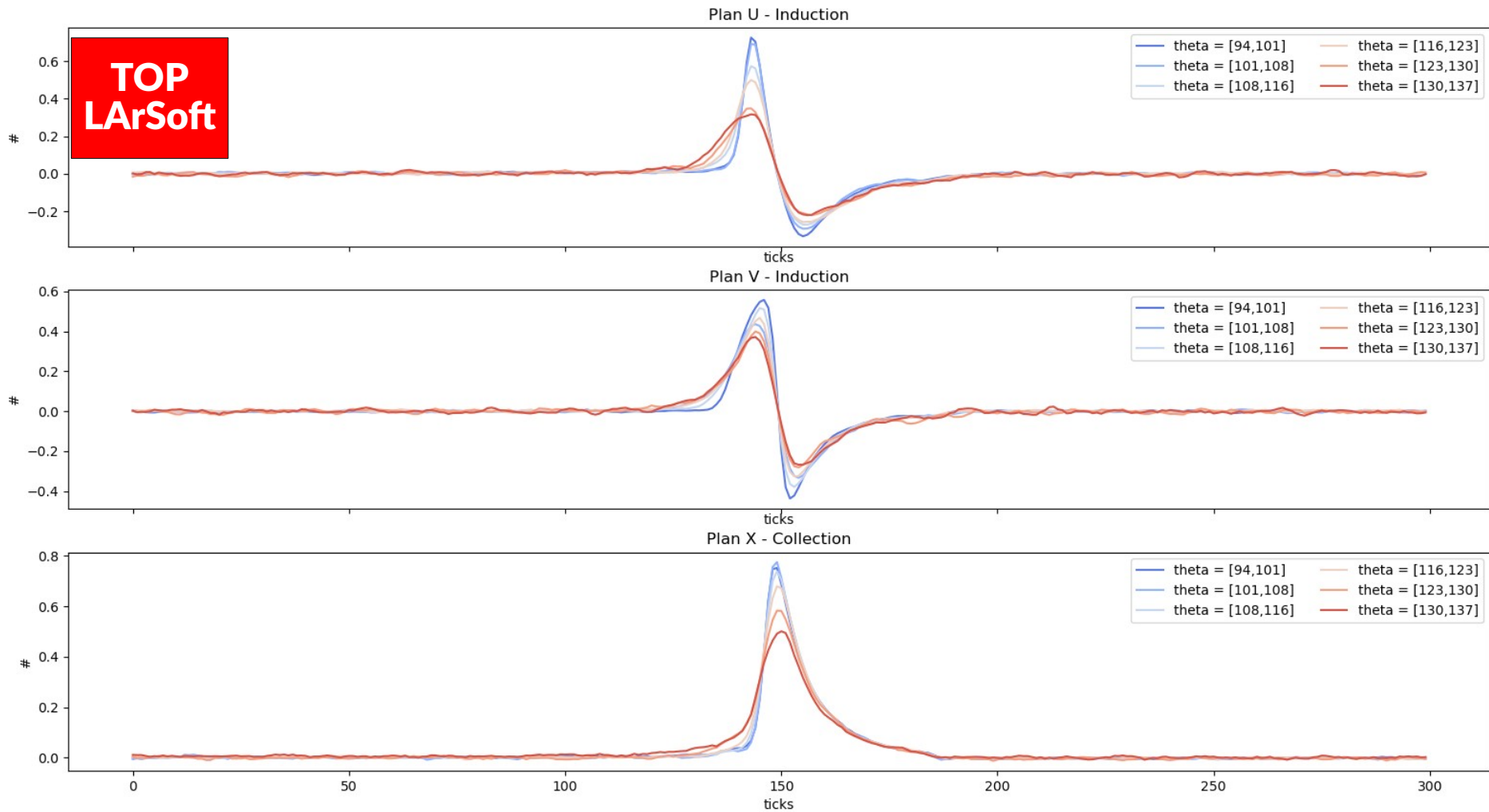
Raw waveforms φ template



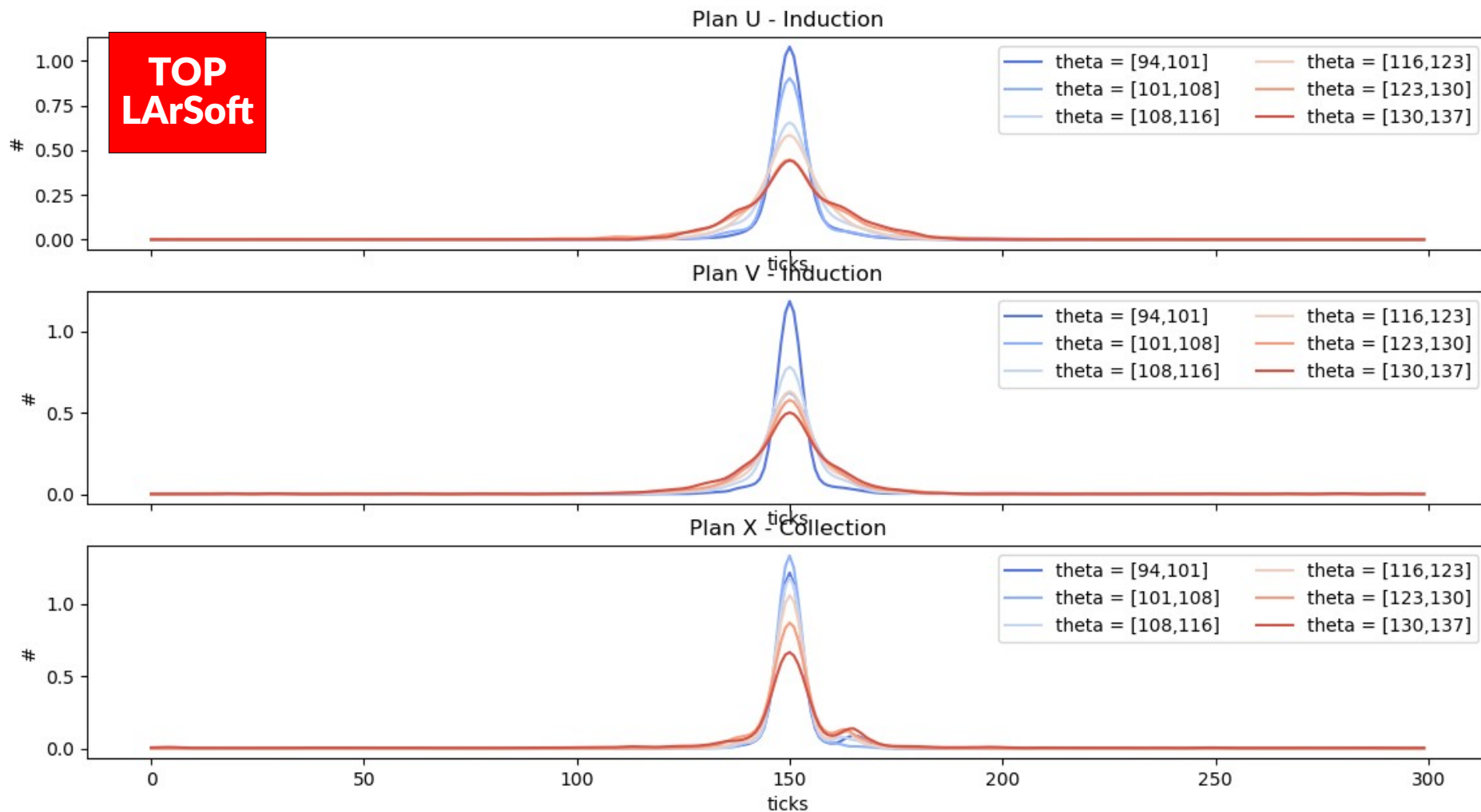
Raw waveforms © template



CNR waveforms © template

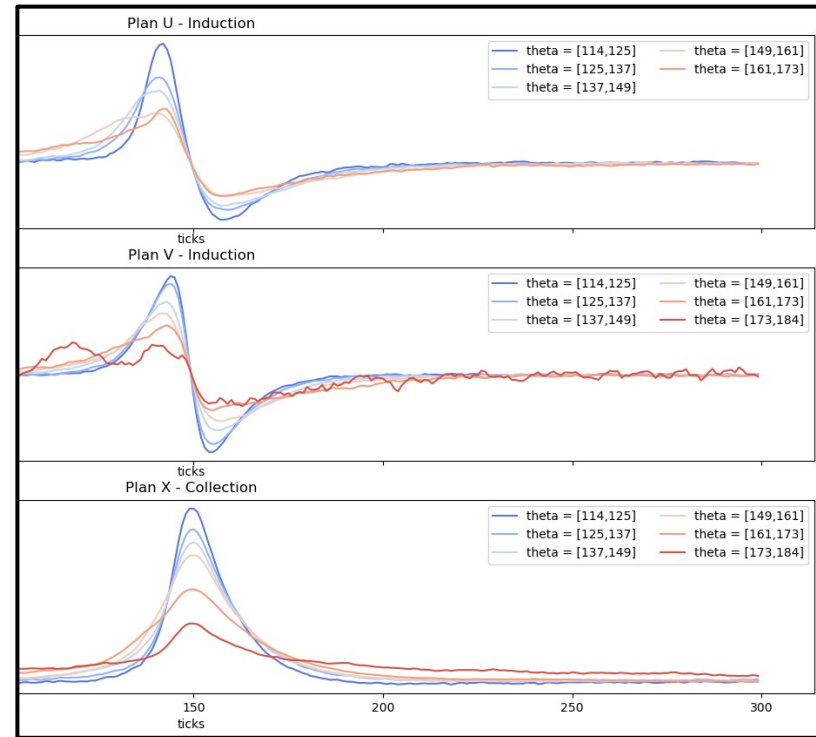


Deconvolved waveforms © template

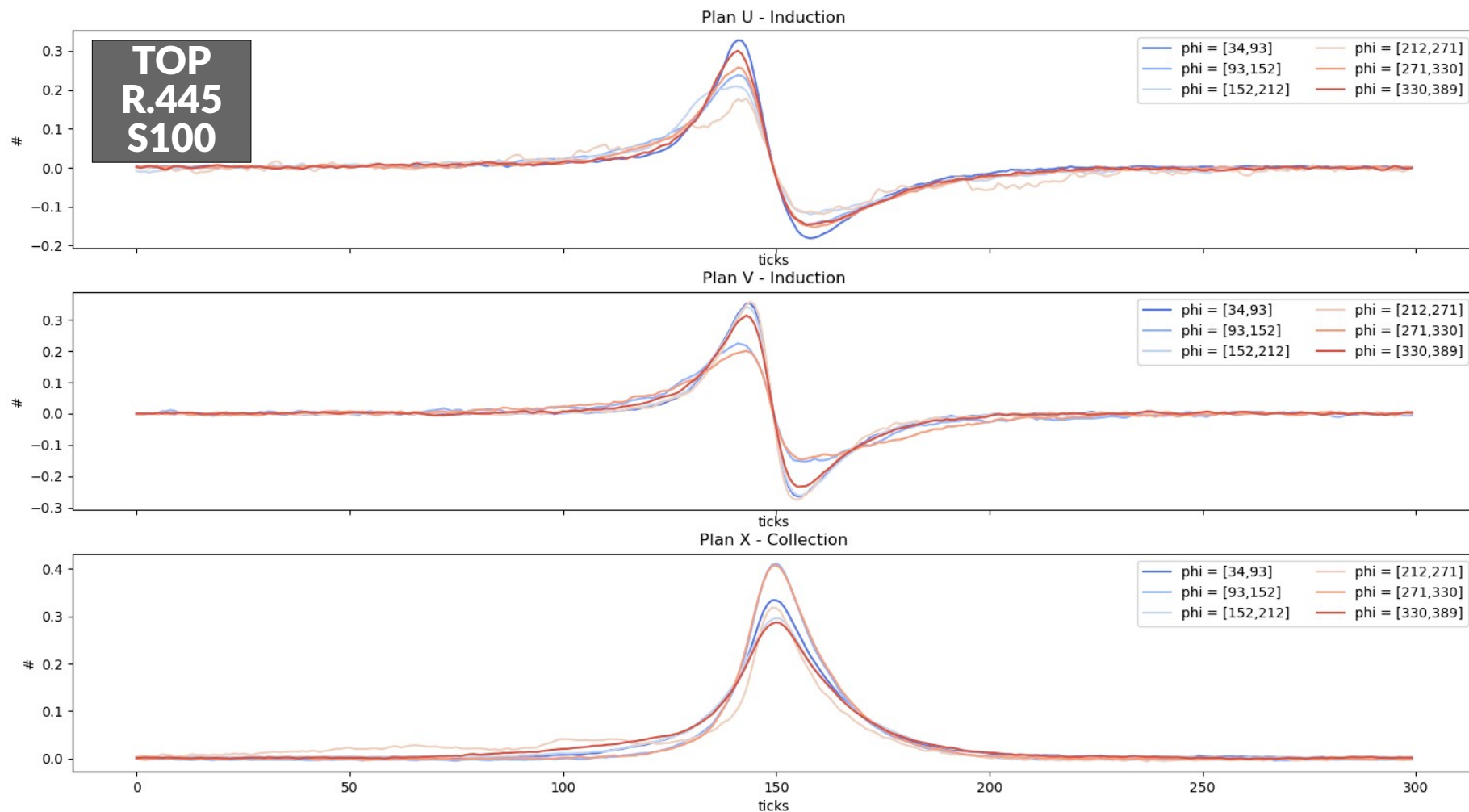


Conclusion

- As investigated with Lardon, LarSoft data shows a correlation between theta and shape.
- This correlation seems to be visible on any induction/collection plan. This was expected but how to use this information?
- This correlations seems to be visible at any signal treatment stage (raw, CNR, Deconvolved)
- Now running simulation to investigate whether this effect is also visible (not expected)
- Later, determine a criteria on the shape to be used as a discriminator between hits to infer track angle during reconstruction. The stage to which this criteria should be extracted is an open question.



CNR waveforms φ template



Deconvolved waveforms φ template

