



university of
 groningen

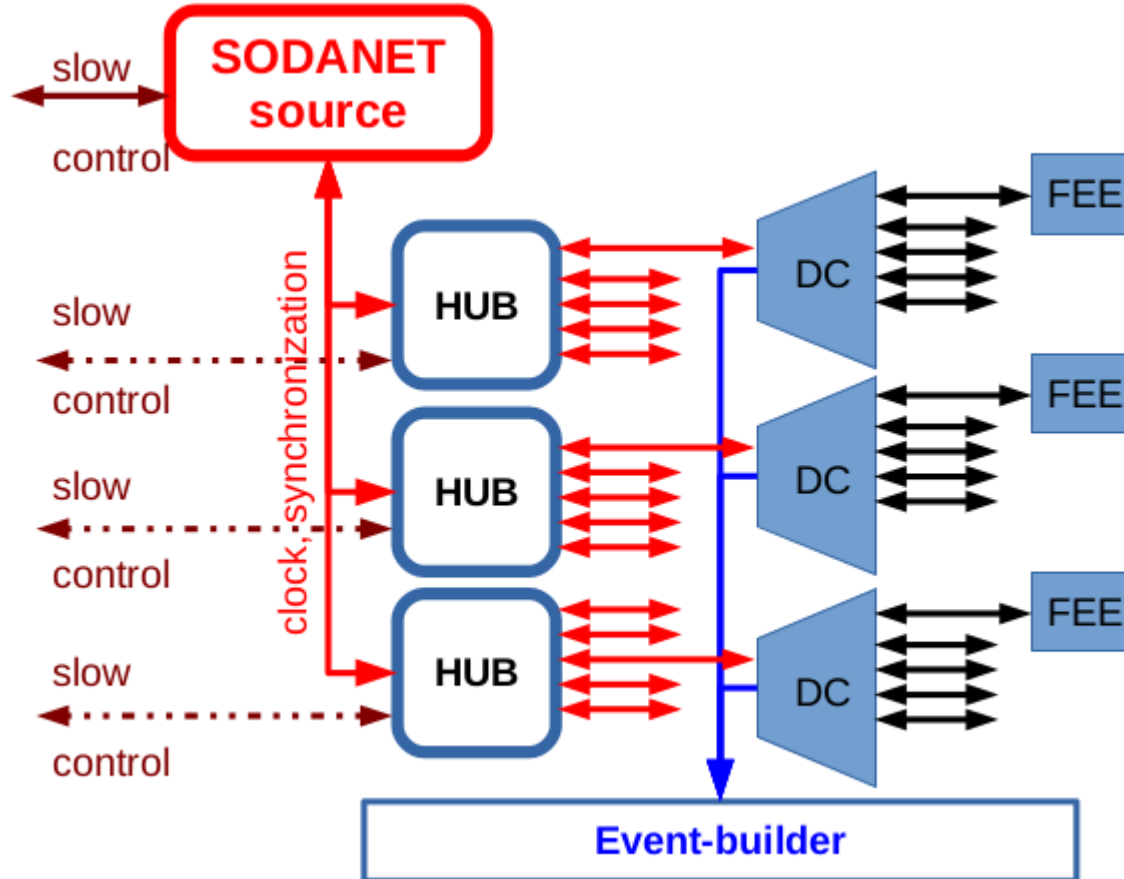
Beamtime at COSY: Data analysis results

Viktor Rodin

Myroslav Kavatsyuk

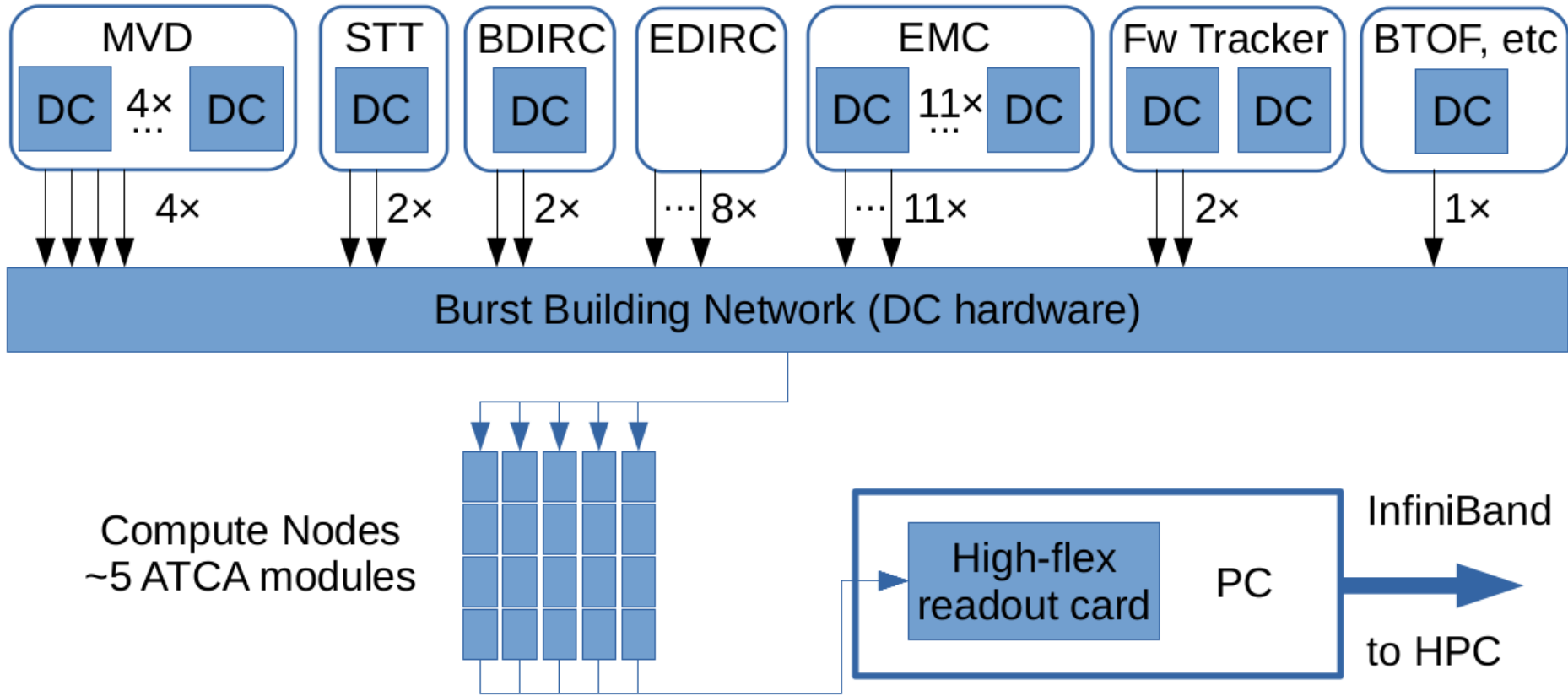
Peter Schakel

SODANET protocol



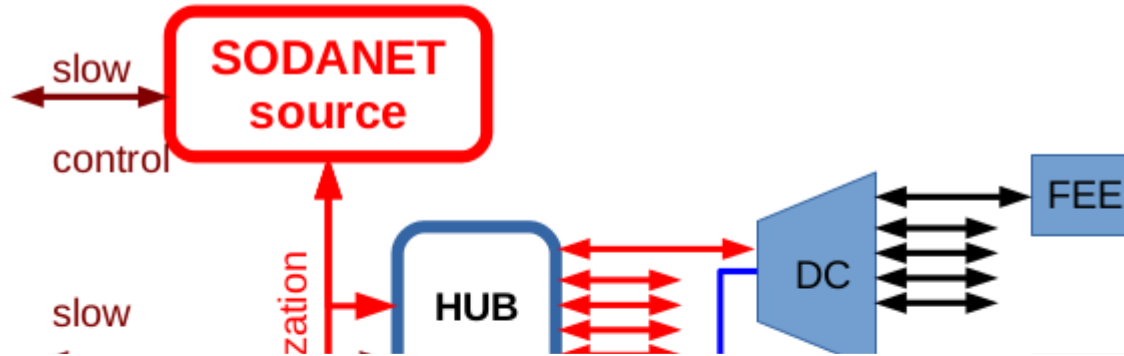
Data is read out as a one SuperBurst event (16 bursts) equal 38.6 μ s.

Burst Building Network

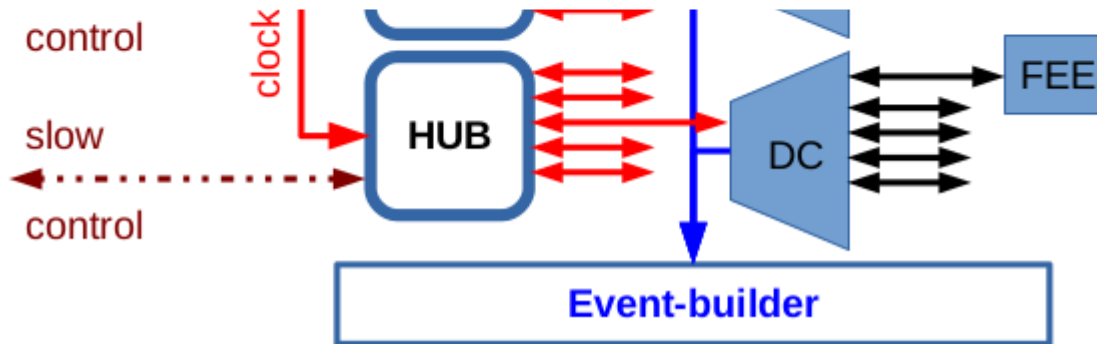


1562500 SuperBursts per minute
≈ 26040 SuperBursts per second

SODANET protocol

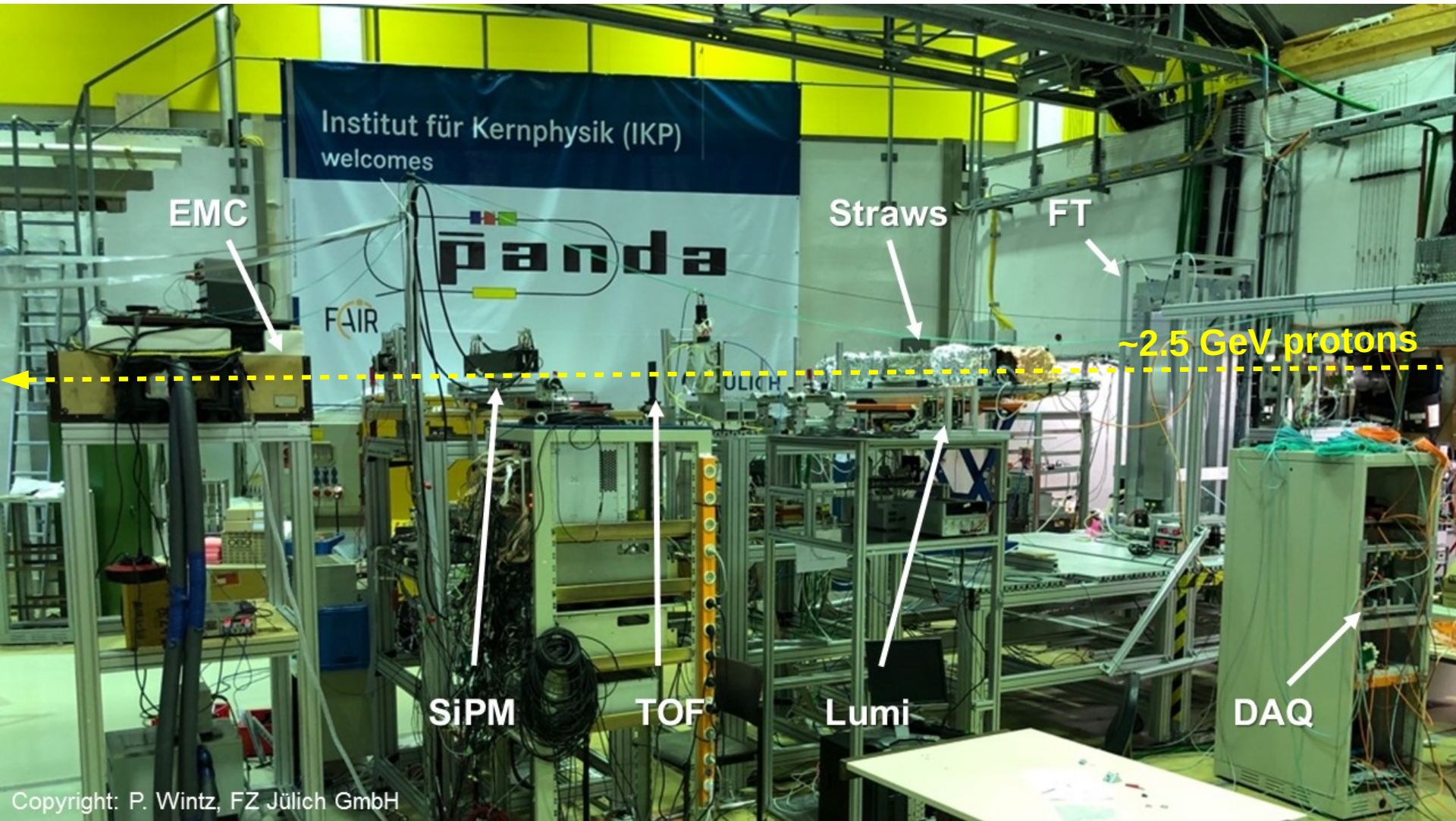


How can we check a stability of synchronization?

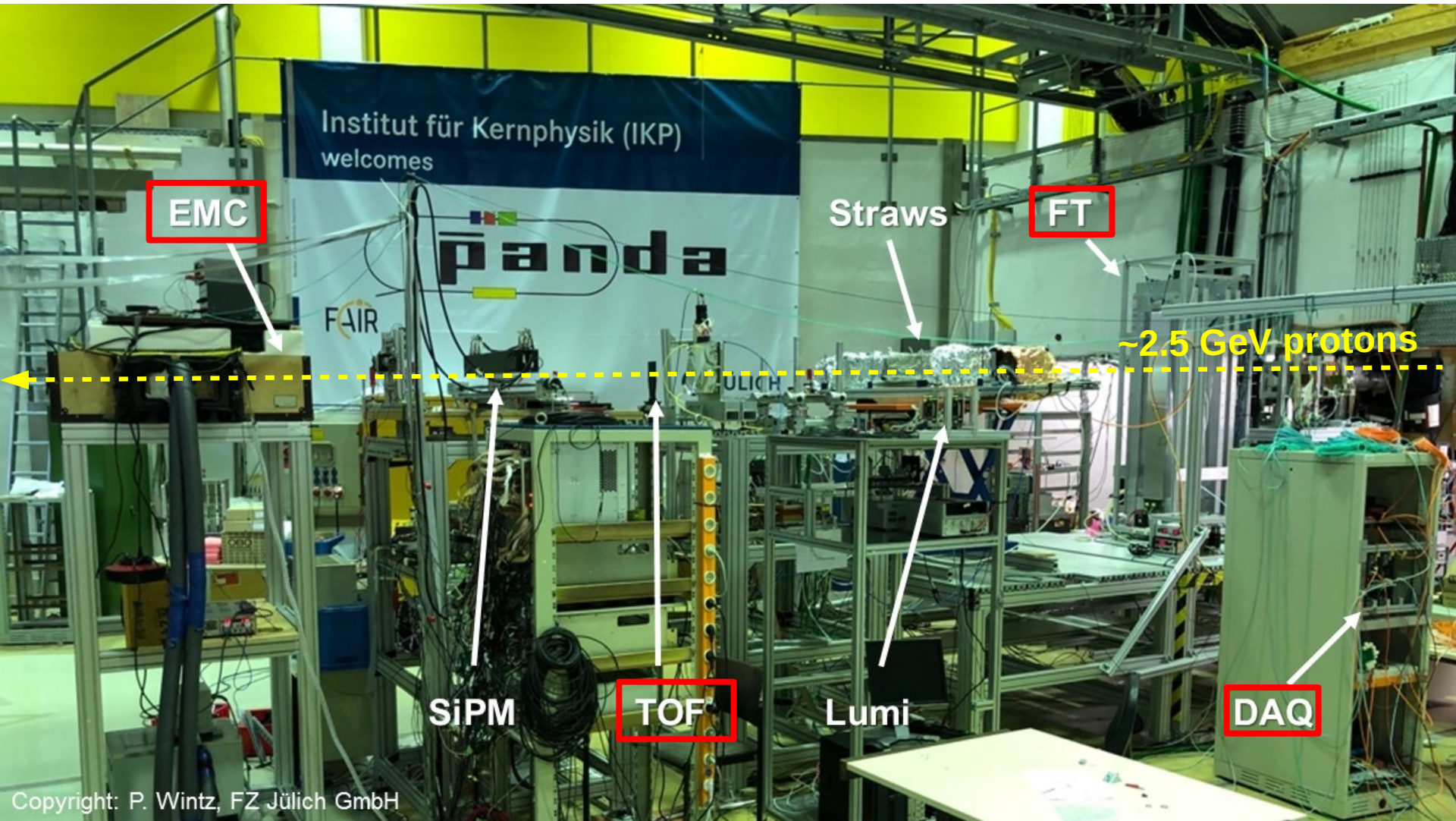


Data is read out as a one SuperBurst event (16 bursts) equal 38.6 μ s.

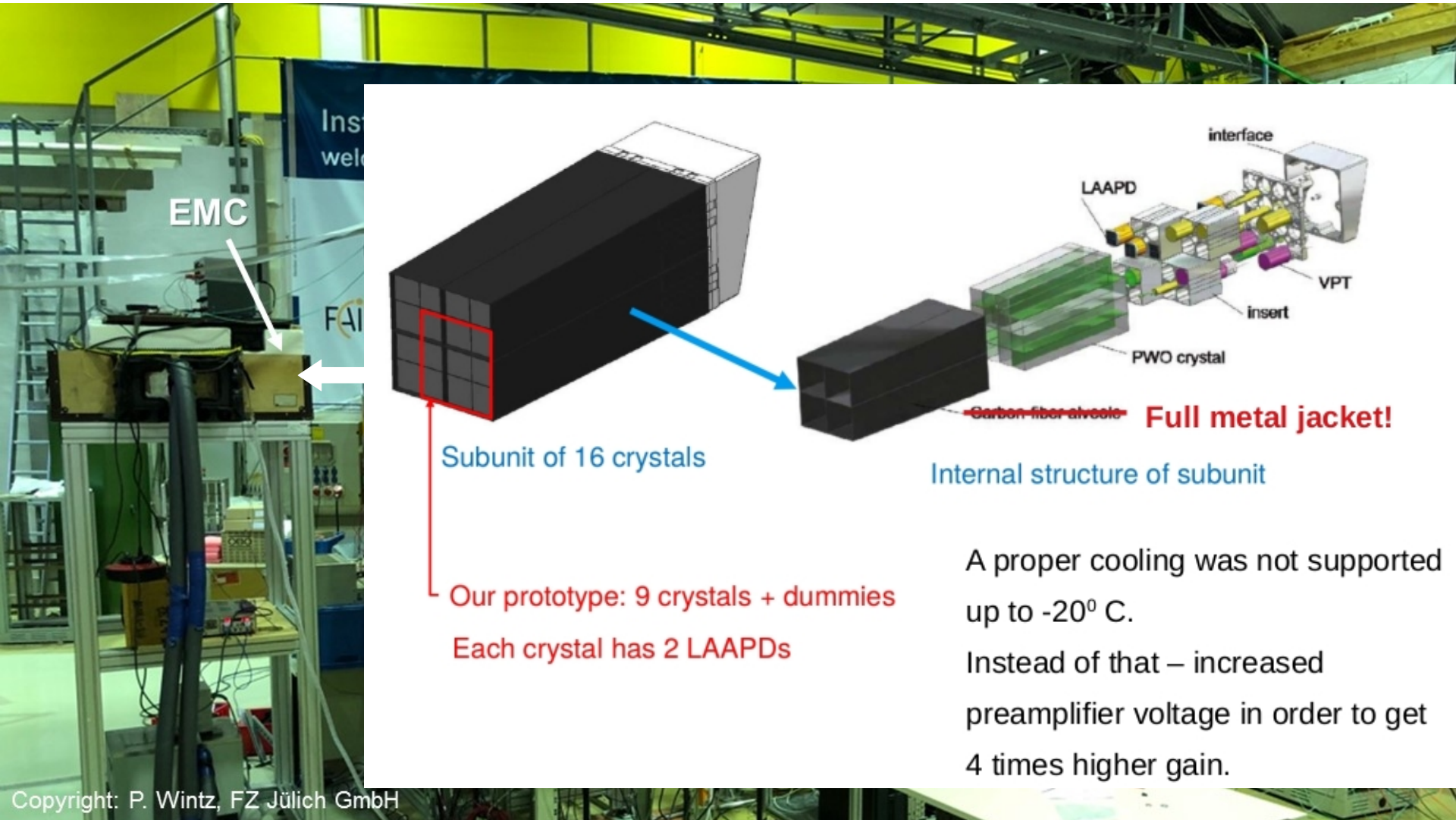
Final Setup at COSY (22.02.19)



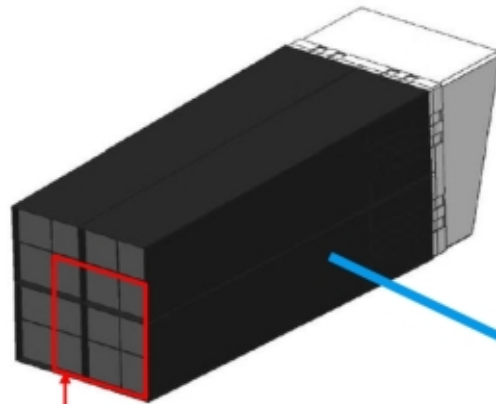
Final Setup at COSY (22.02.19)



Final Setup at COSY (22.02.19)

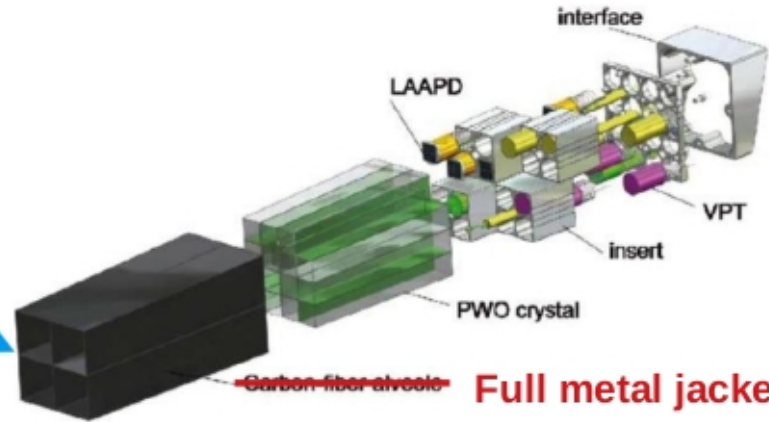


EMC



Subunit of 16 crystals

Our prototype: 9 crystals + dummies
Each crystal has 2 LAAPDs



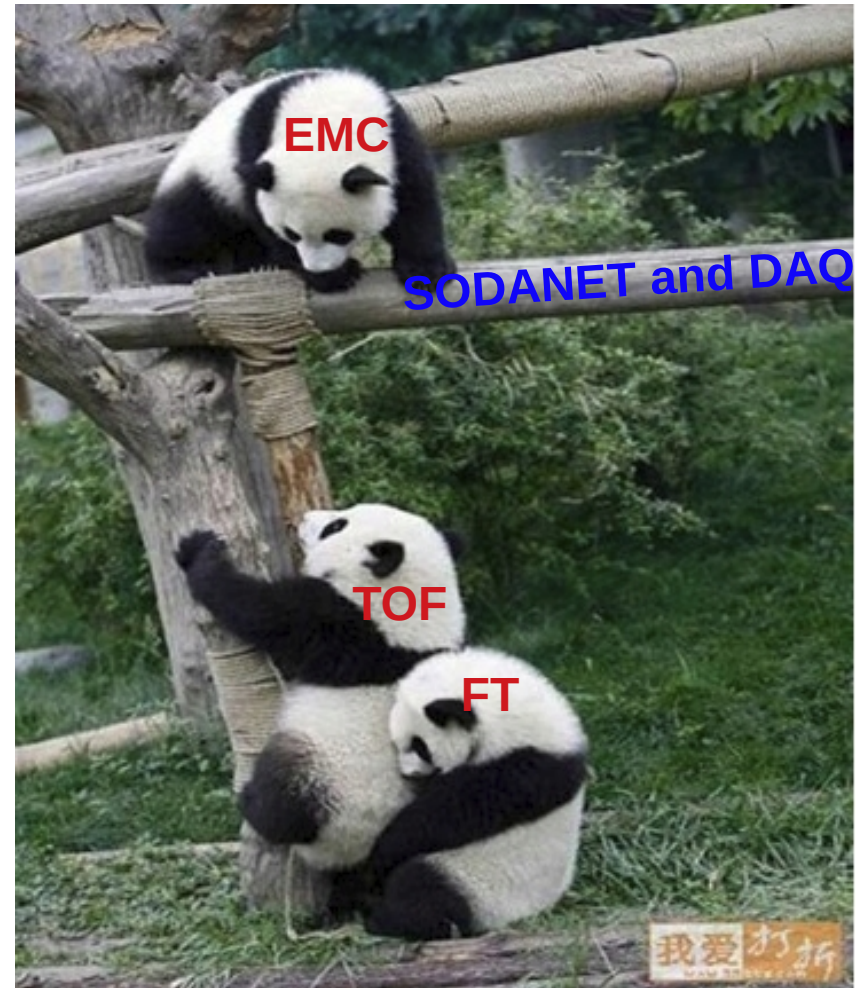
Internal structure of subunit

A proper cooling was not supported up to -20°C .
Instead of that – increased preamplifier voltage in order to get 4 times higher gain.

Measurement Strategy

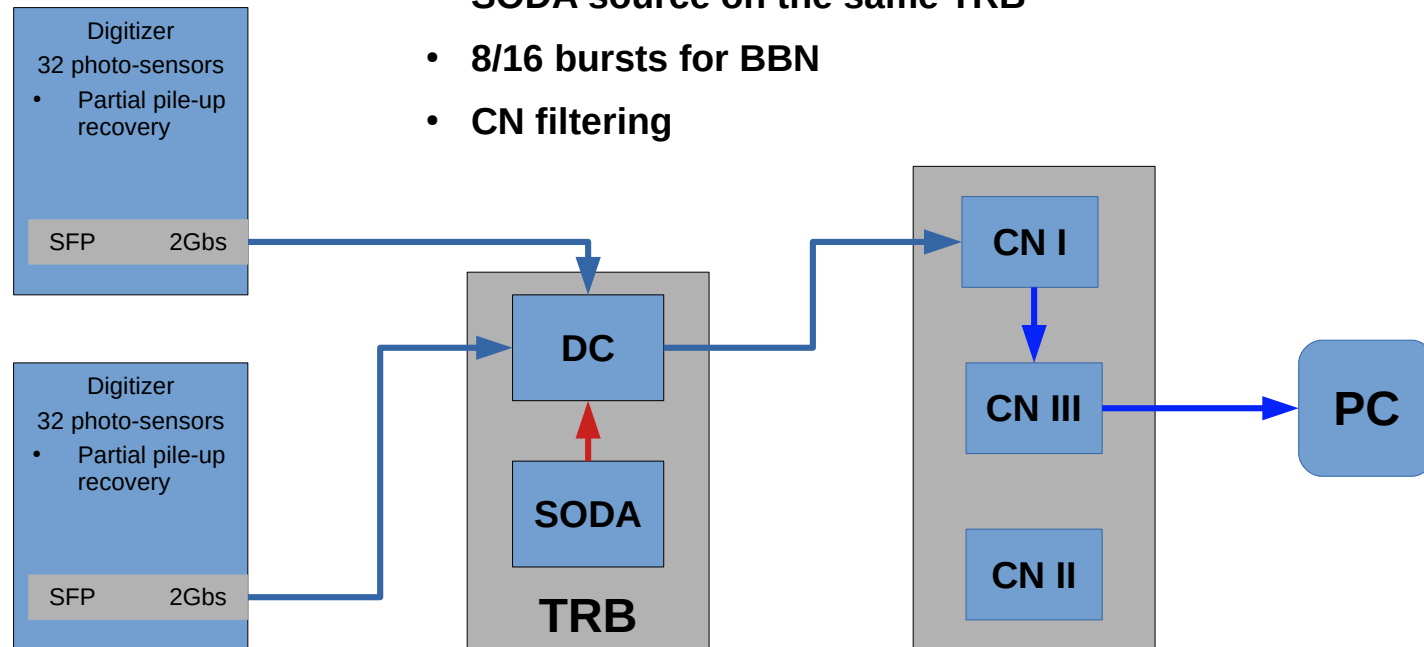
To check the synchronization quality of SODANET and the readout stability of DAQ system in general, a strategy of growing complexity was proposed:

- Only EMC Readout with 1 DC
- Only EMC Readout with 2 DC
- EMC+TOF Readout
- EMC+TOF+FT Readout



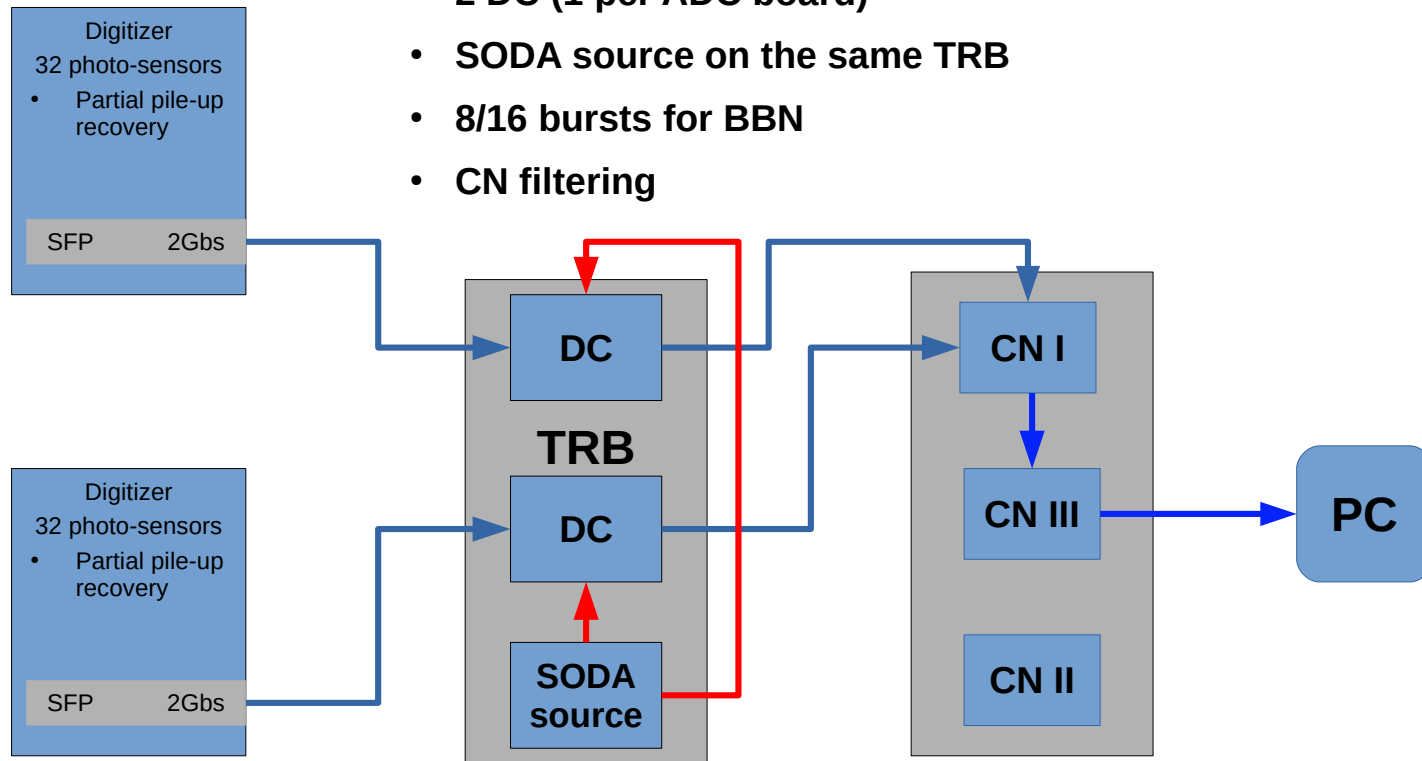
Only EMC with 1 DC

- EMC prototype – 9 crystals
- Light Pulser as a reference
- 1 DC
- SODA source on the same TRB
- 8/16 bursts for BBN
- CN filtering

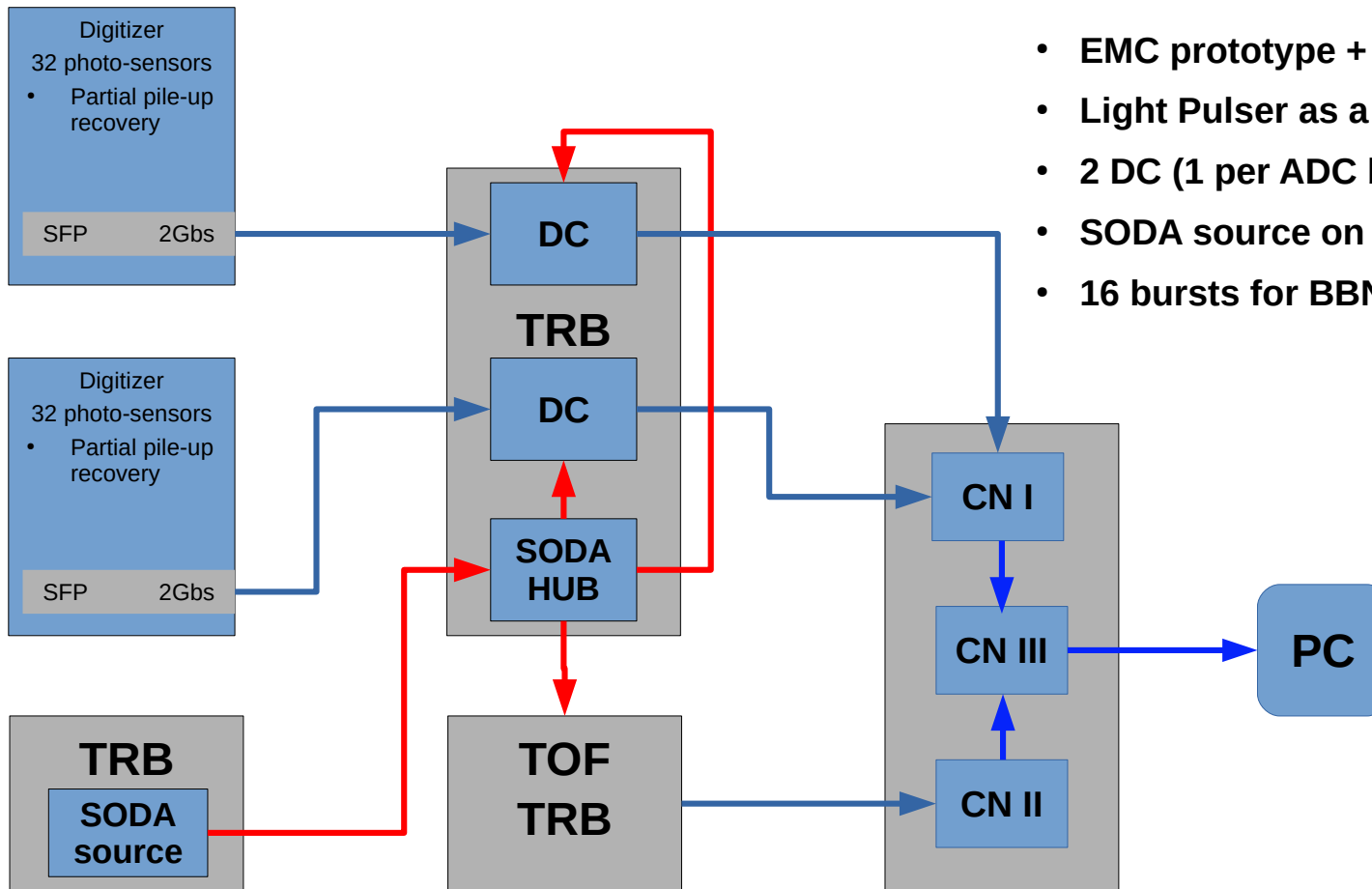


Only EMC with 2 DC

- EMC prototype – 9 crystals
- Light Pulser as a reference
- 2 DC (1 per ADC board)
- SODA source on the same TRB
- 8/16 bursts for BBN
- CN filtering

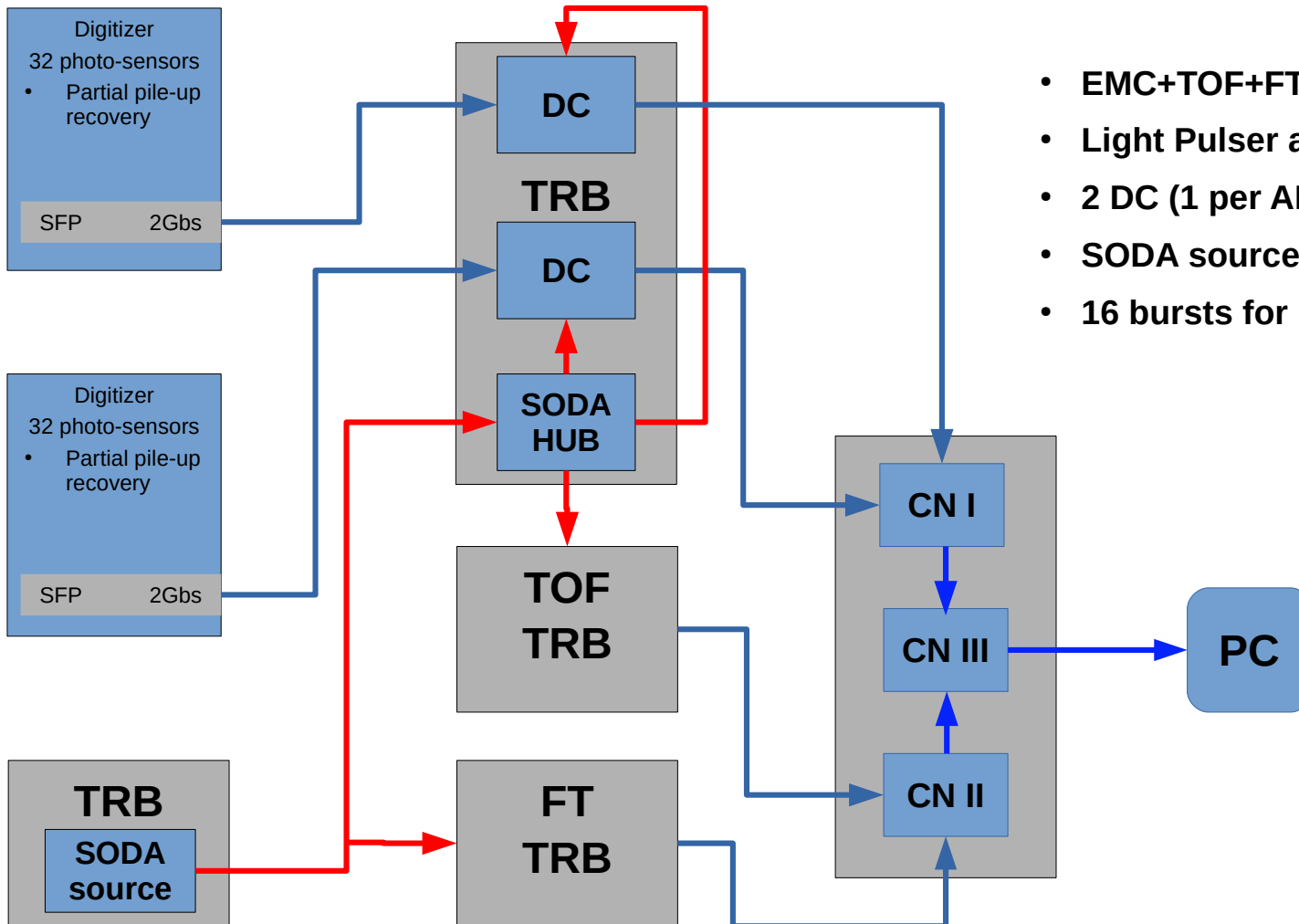


EMC+TOF



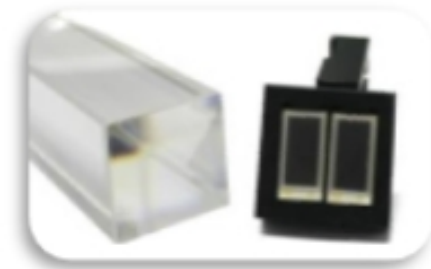
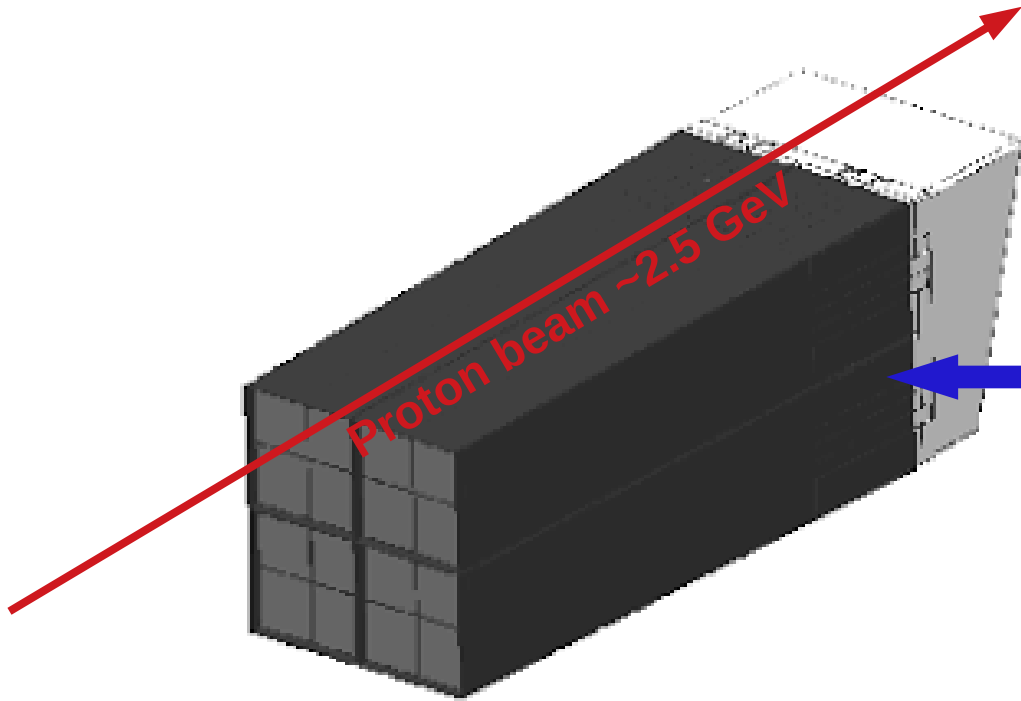
- EMC prototype + TOF bars
- Light Pulser as a reference
- 2 DC (1 per ADC board)
- SODA source on the different TRB
- 16 bursts for BBN, IIR, MWD filters

EMC+TOF+FT



- EMC+TOF+FT
- Light Pulser as a reference
- 2 DC (1 per ADC board)
- SODA source on the different TRB
- 16 bursts for BBN, IIR, MWD filters

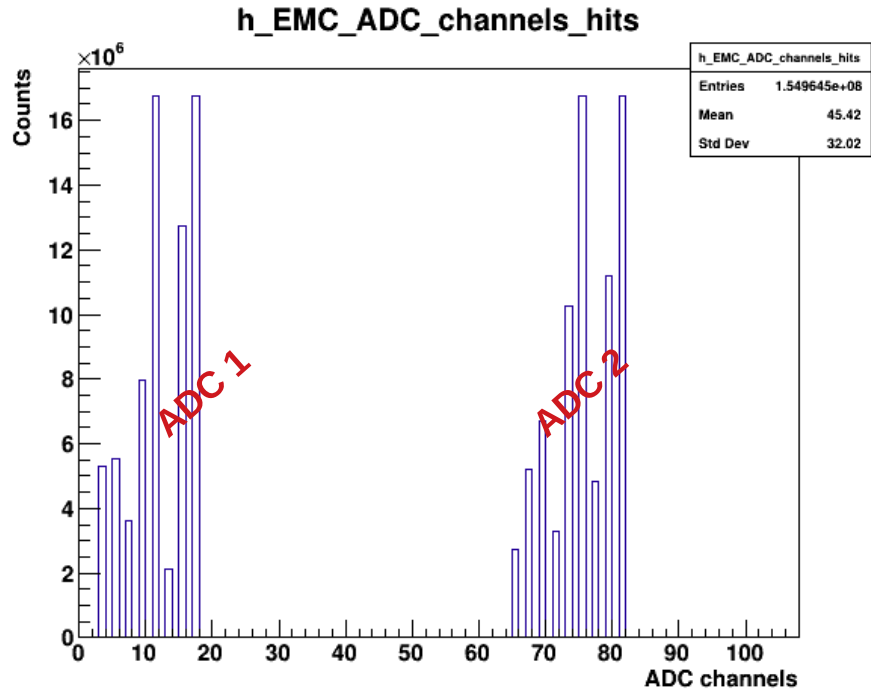
Some facts



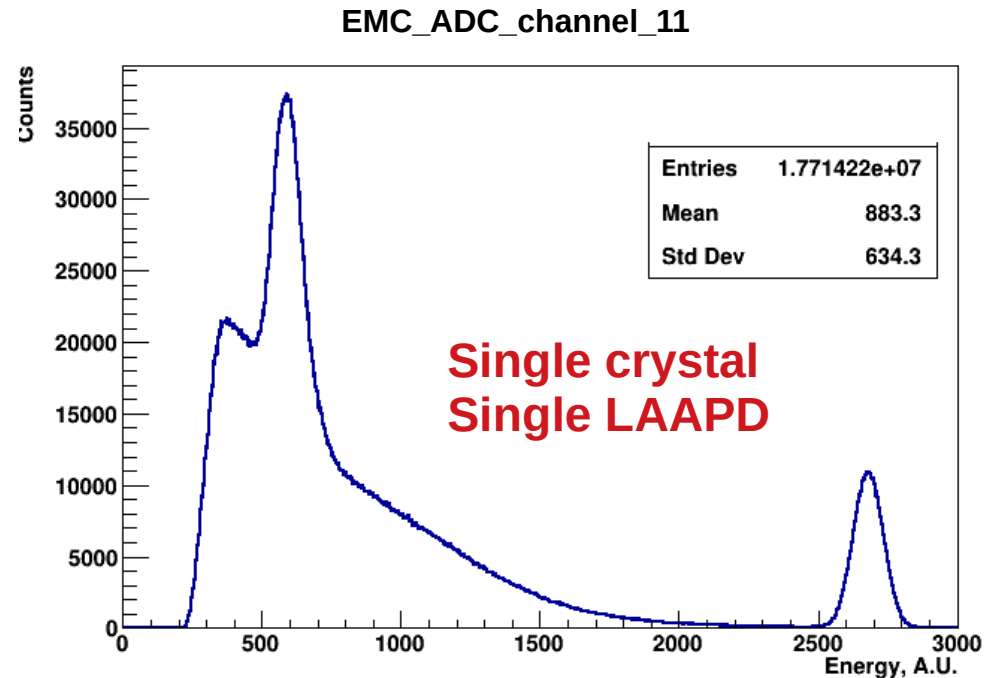
Estimated deposited energy ~ 200 MeV.

Nuclear counter events are expected!

Only EMC (1 DC) Results



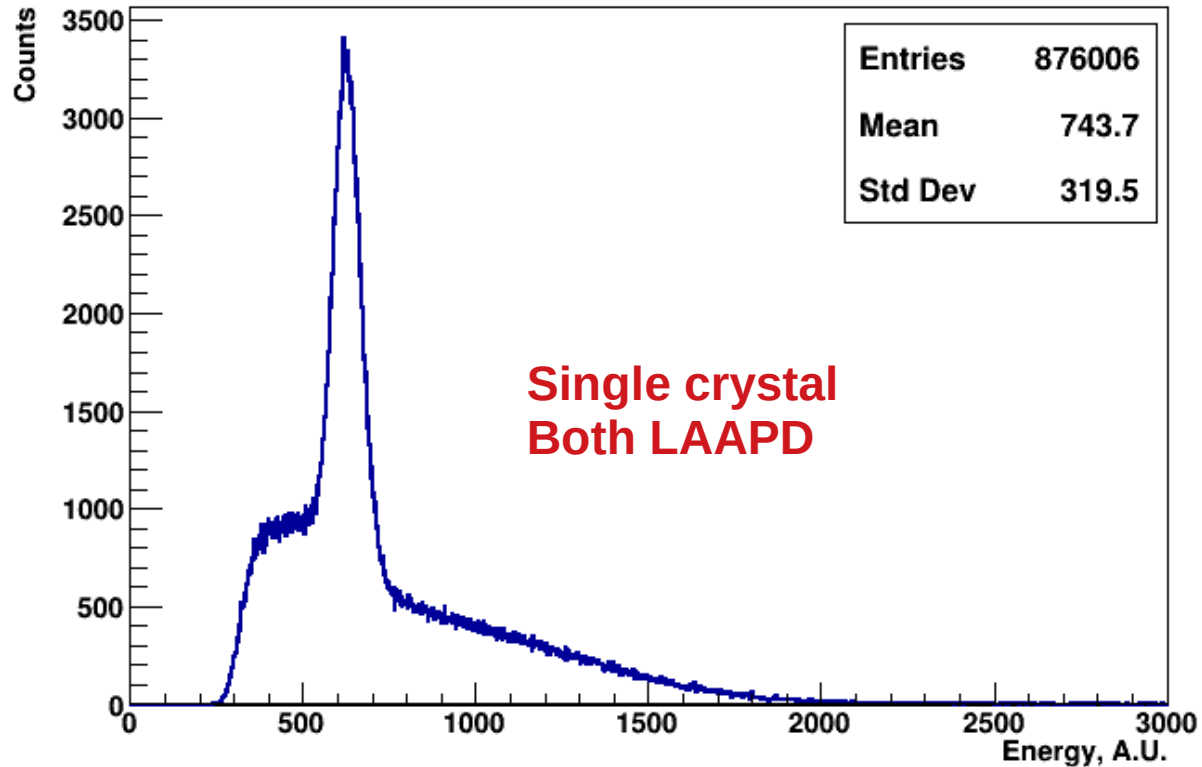
Each ADC board is represented as 64 channels corresponding High gain/ Low gain component of the photodetectors.



Energy spectra obtained from a single crystal (1 LAAPD). Light Pulser peak is from the right side.

Only EMC (1 DC) Results

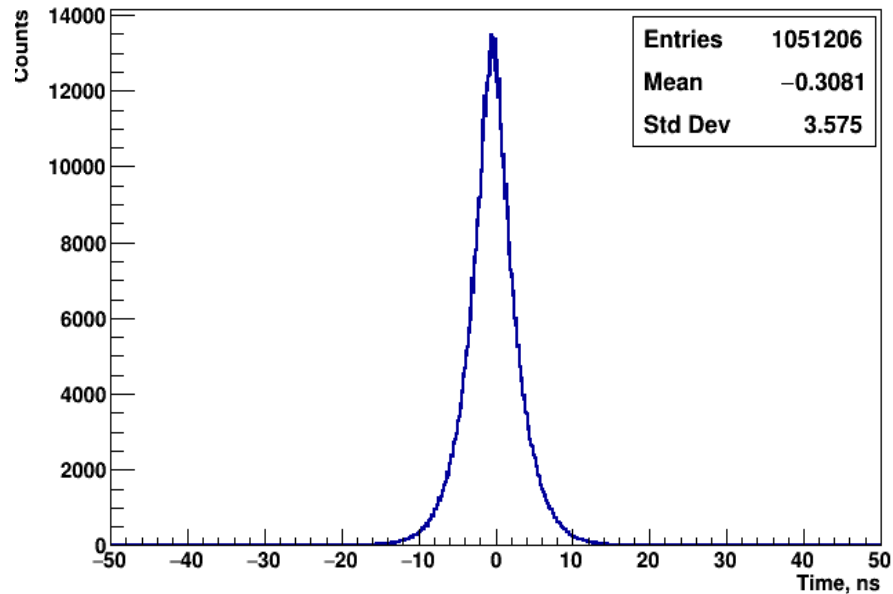
Deposited Energy



Deposited energy distribution for a single crystal
(both LAAPDs).

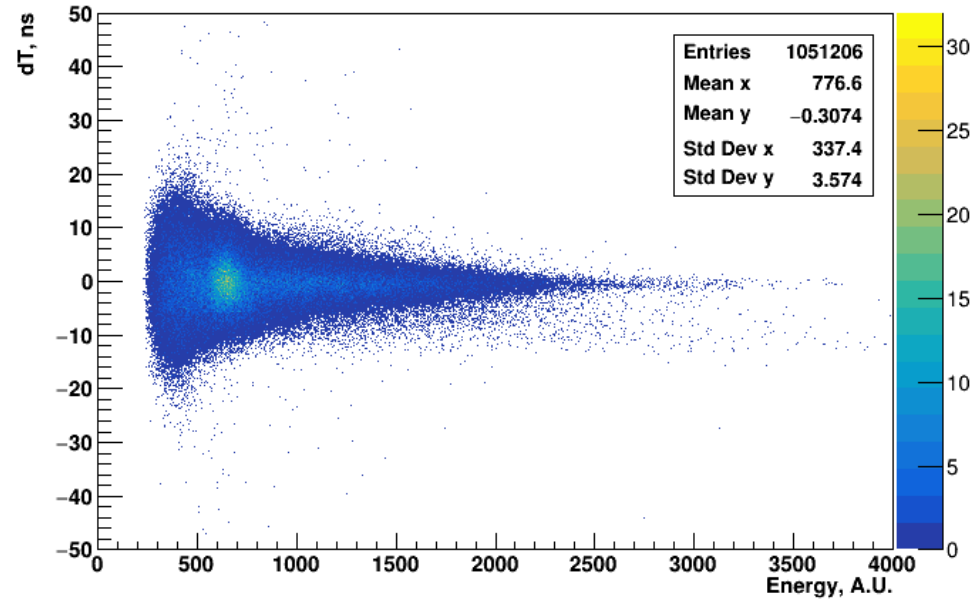
Only EMC (1 DC) Results

EMC_crystal_5



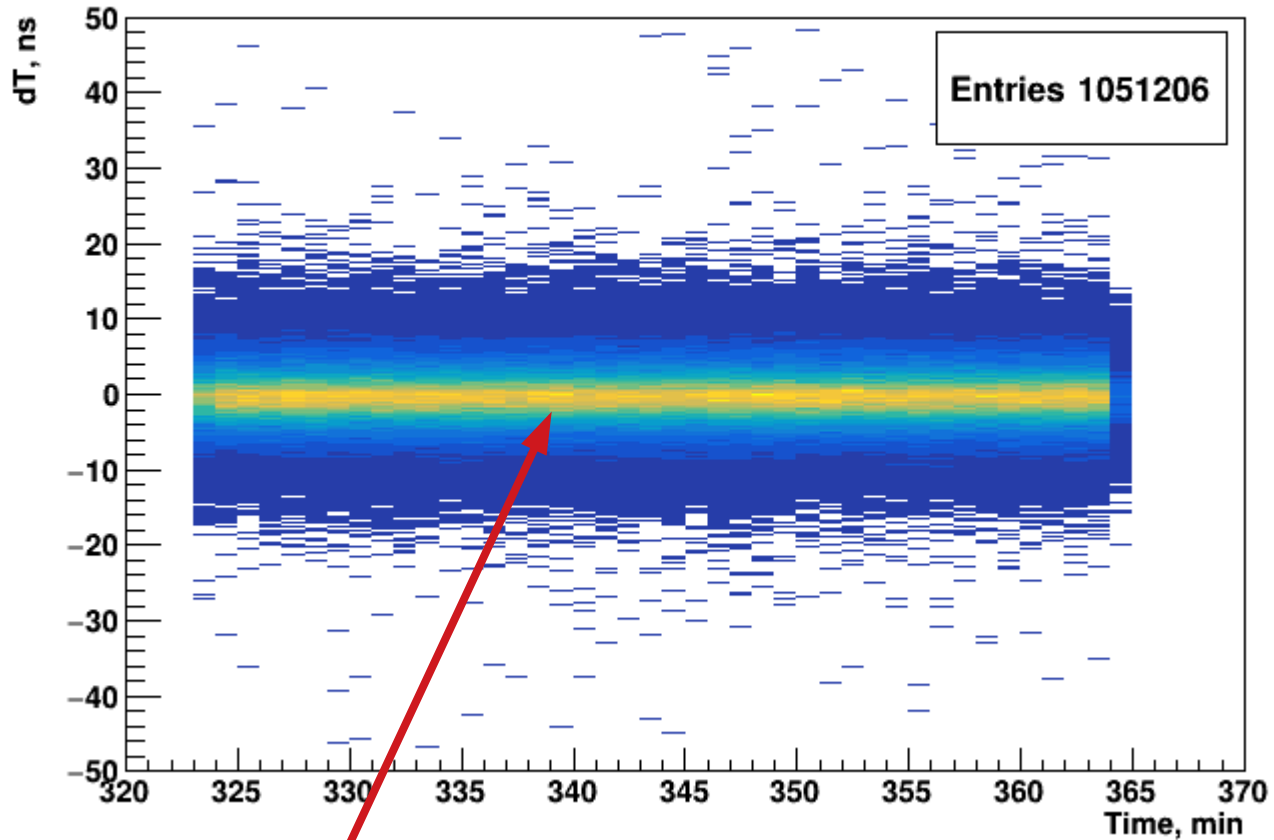
Time difference between 2 LAAPDs of 1 crystal
in case if only they are present in event.

Energy-dT correlation



dT-Energy dependence for that crystal.

Only EMC (1 DC) Results

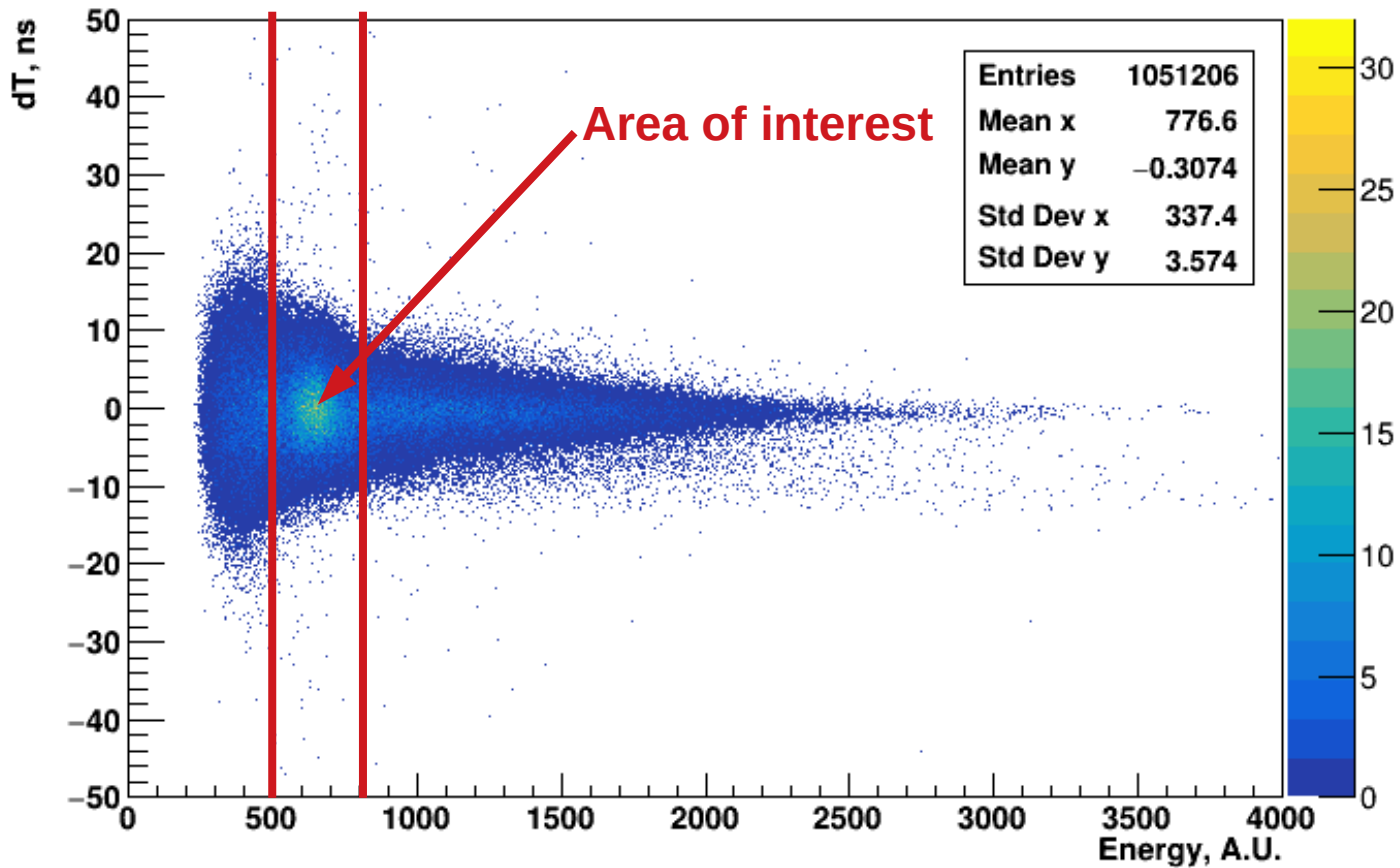


Time difference between
LAAPDs does not change
over minutes.



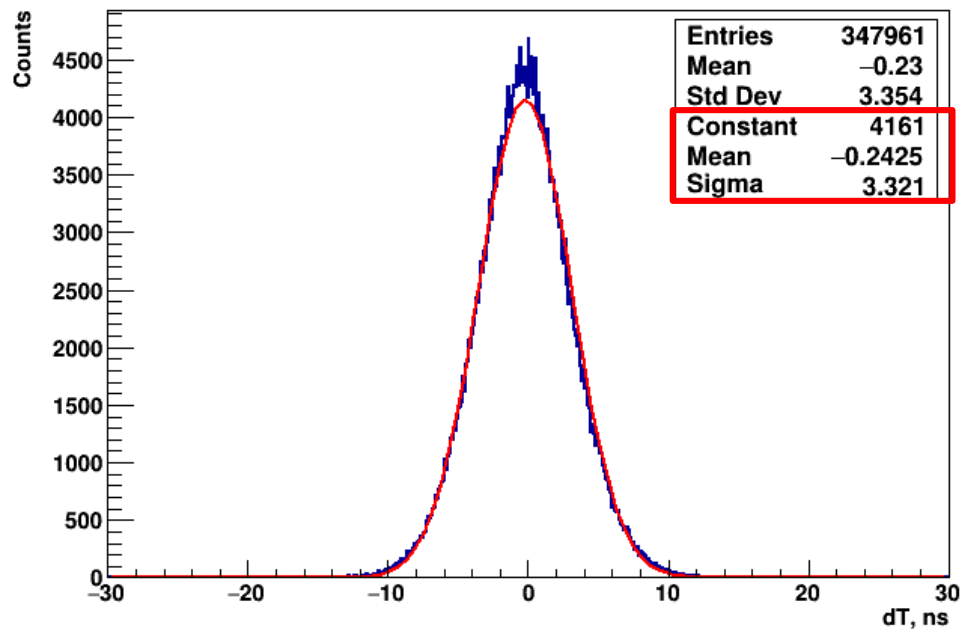
Synchronization is stable.
What about precision?

Only EMC (1 DC) Results

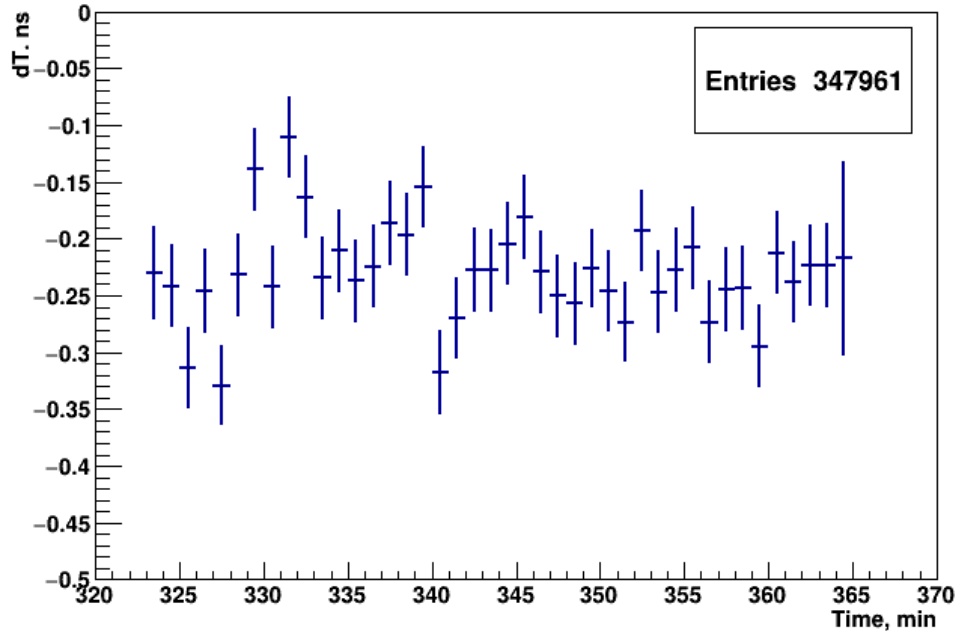


Red lines show Energy cut around proton beam peak.

Only EMC (1 DC) Results



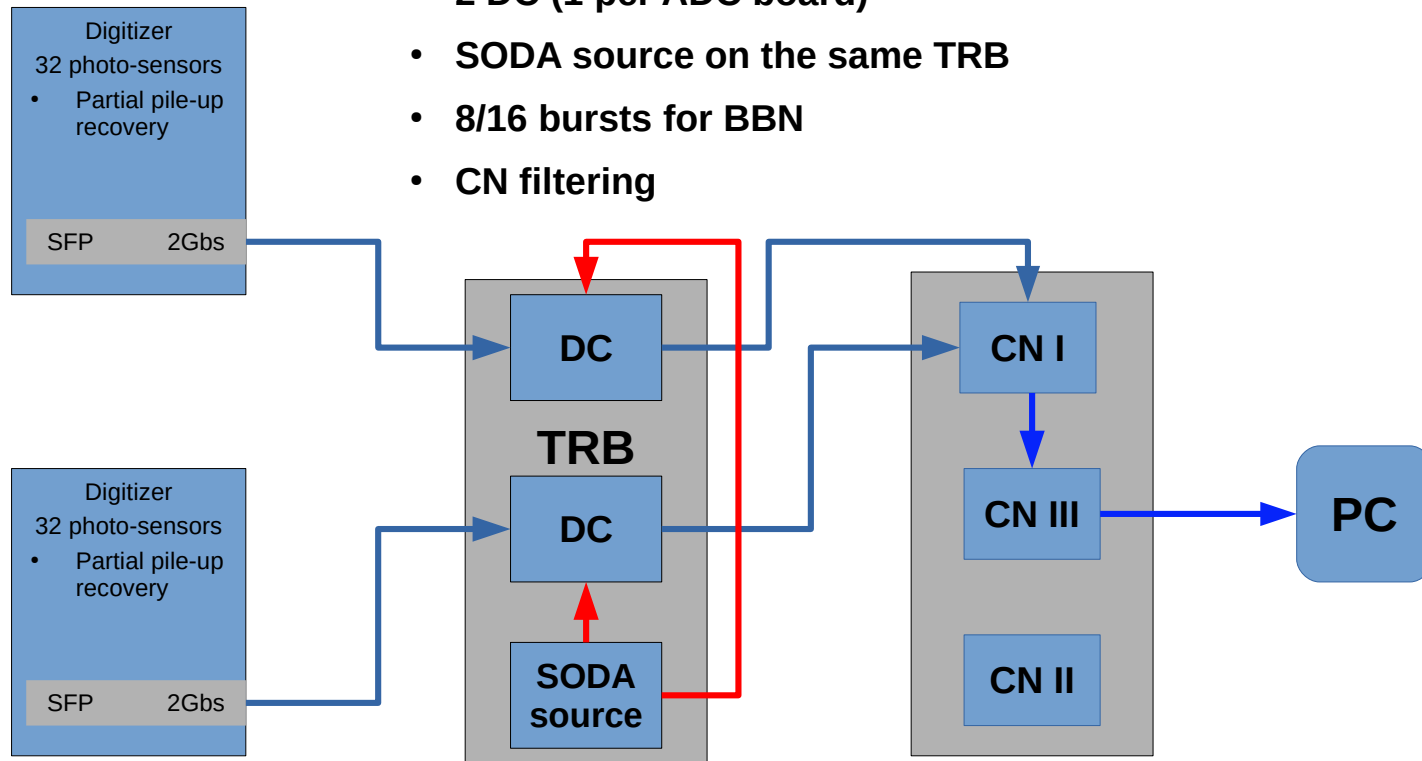
Time difference distribution after Energy cut. Values in red square show Gaus fit parameters.



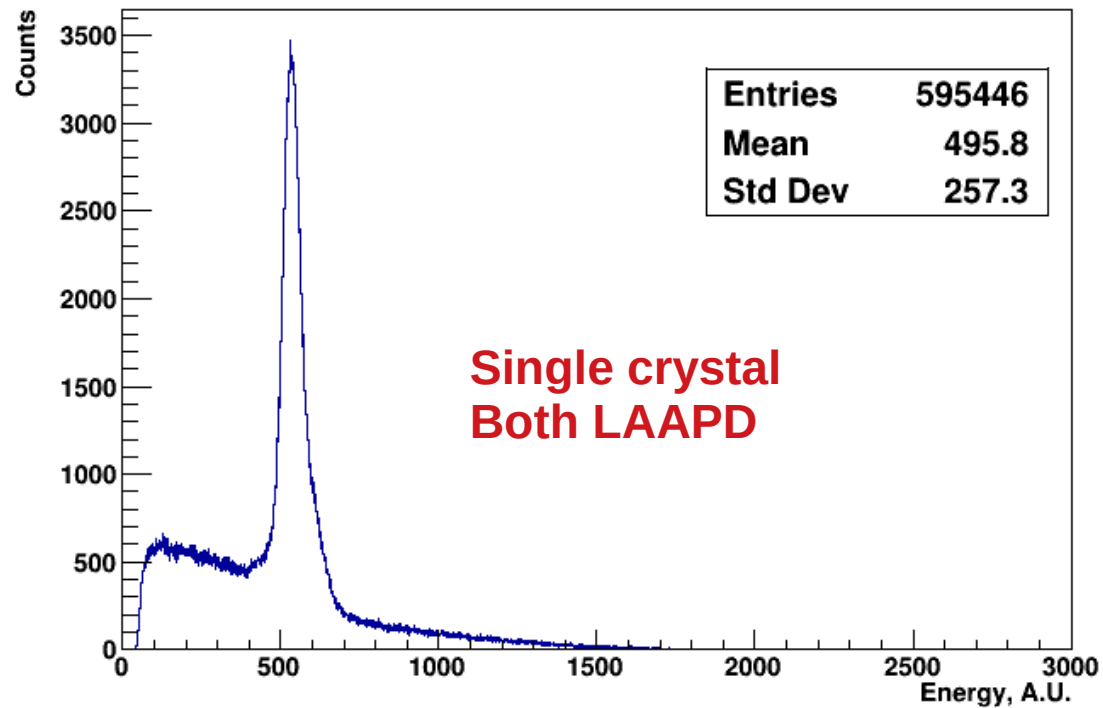
Evolution of time difference between 2 ADC channels belonging to 1 crystal.

Only EMC with 2 DC

- EMC prototype – 9 crystals
- Light Pulser as a reference
- 2 DC (1 per ADC board)
- SODA source on the same TRB
- 8/16 bursts for BBN
- CN filtering

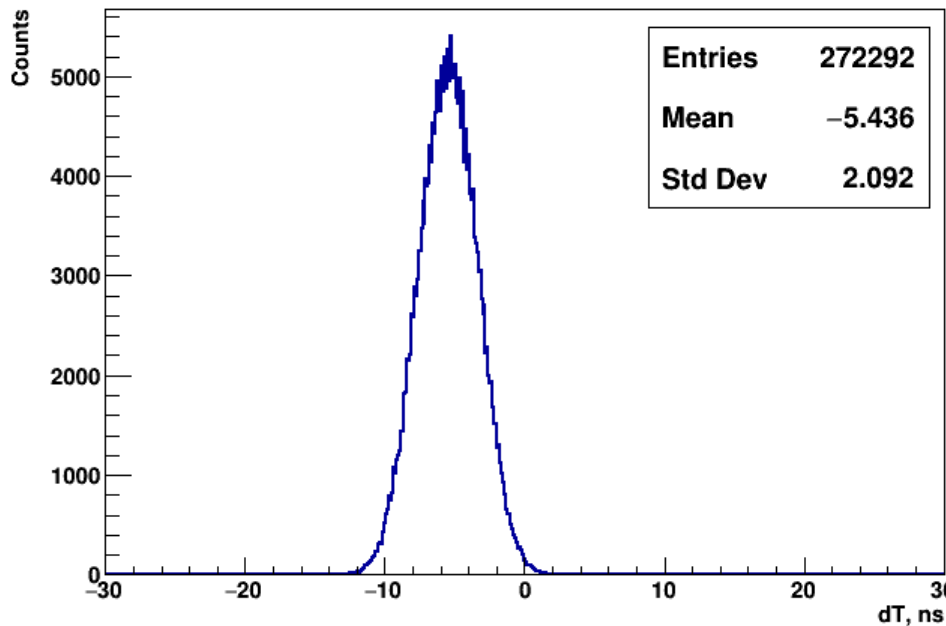


Only EMC (2 DC) Results

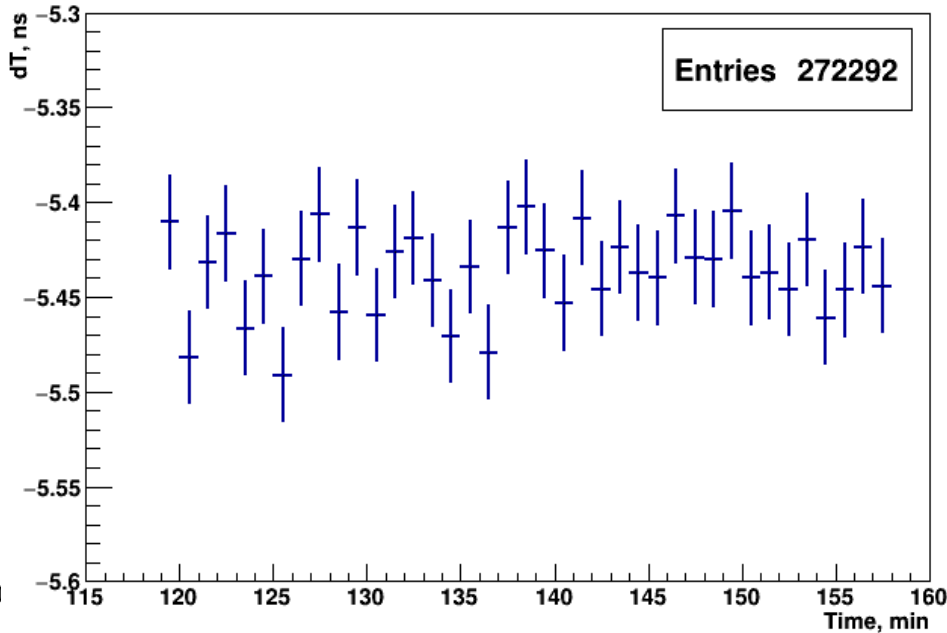


Energy deposition distribution for a
single crystal caused by proton beam

Only EMC (2 DC) Results

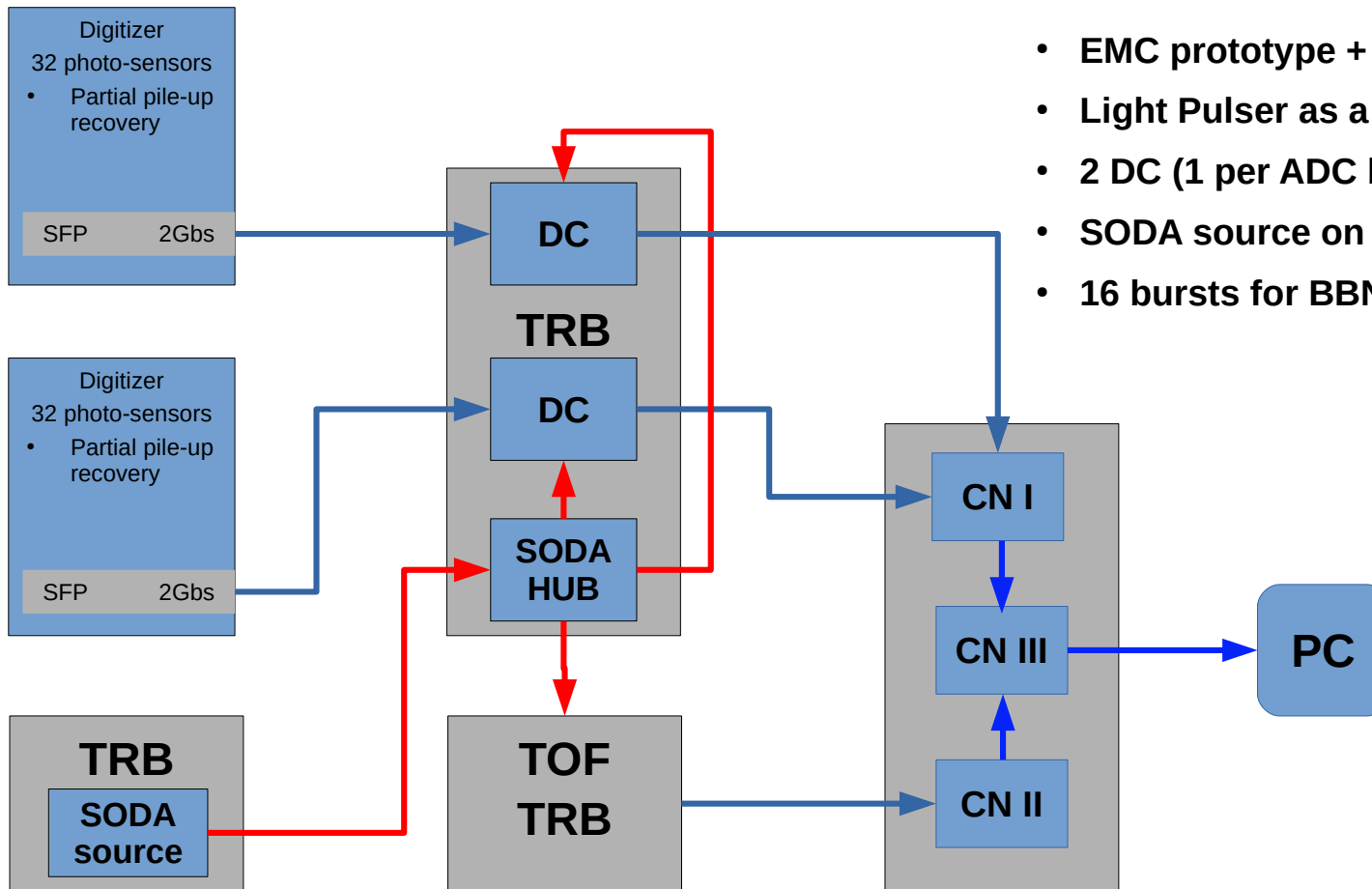


Time difference of 2 ADC channels belonging to 1 crystal. Energy cut is applied.



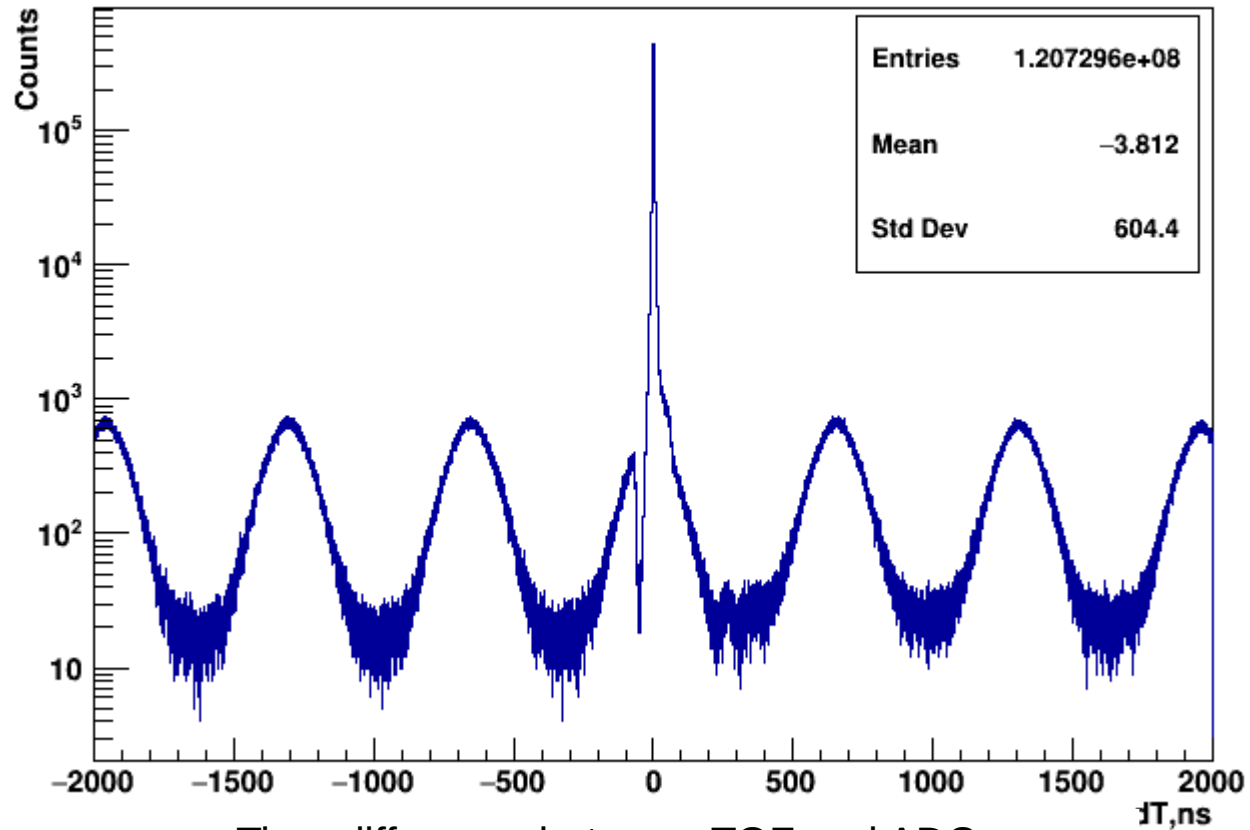
Evolution of time difference between 2 ADC channels belonging to 1 crystal.

EMC+TOF



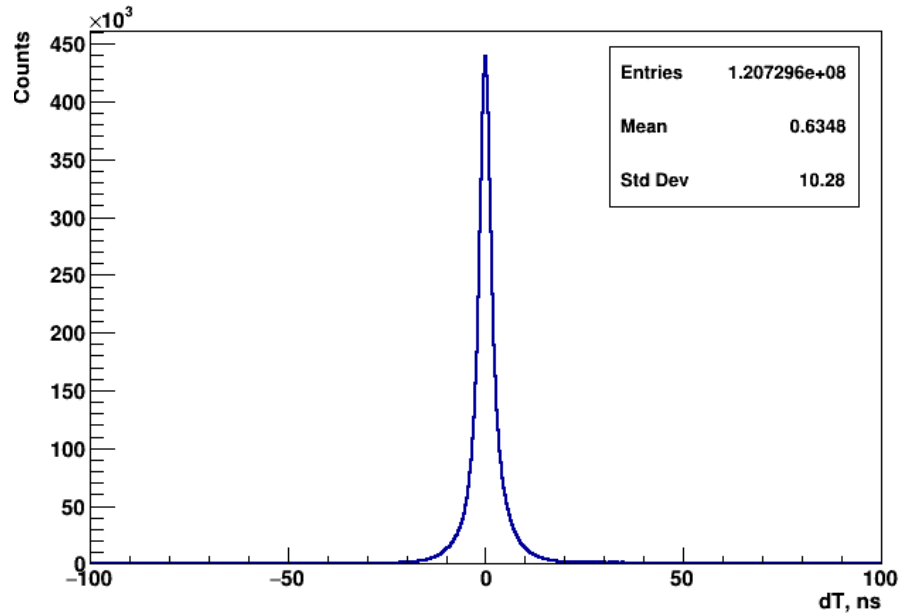
- EMC prototype + TOF bars
- Light Pulser as a reference
- 2 DC (1 per ADC board)
- SODA source on the different TRB
- 16 bursts for BBN, IIR, MWD filters

EMC+TOF Results

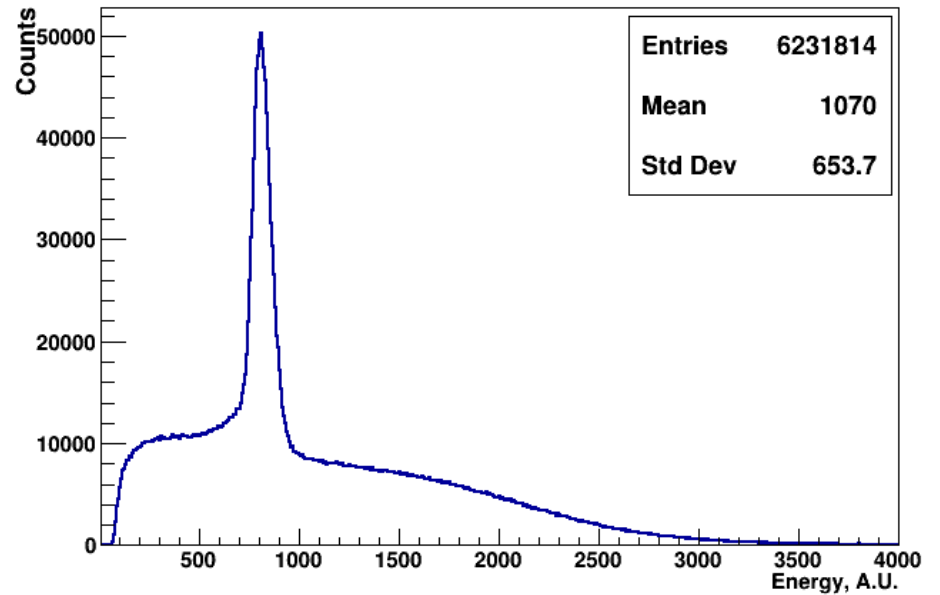


Time difference between TOF and ADC channels (log scale).

EMC+TOF Results

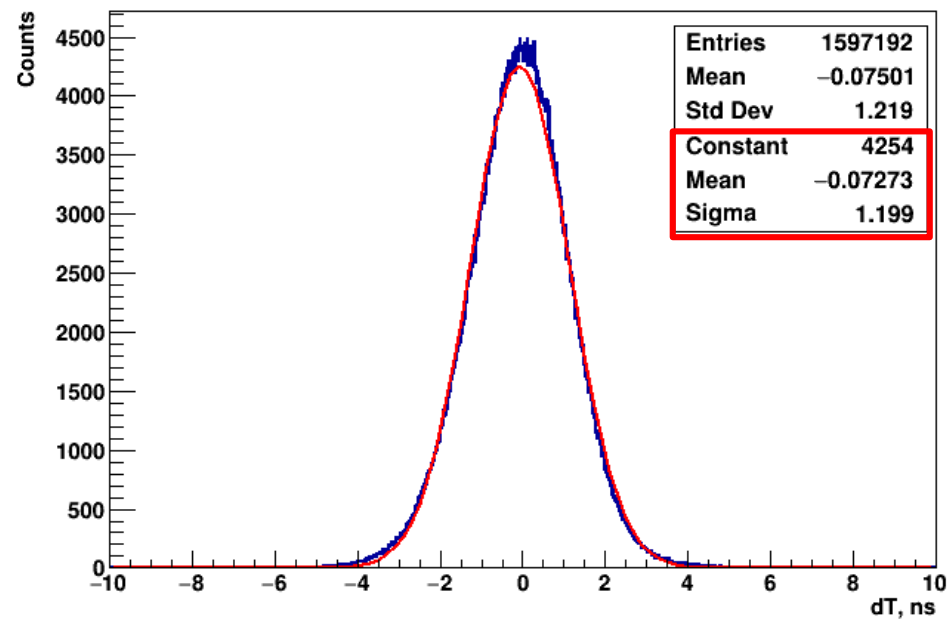


Time difference between TOF and ADC channels.

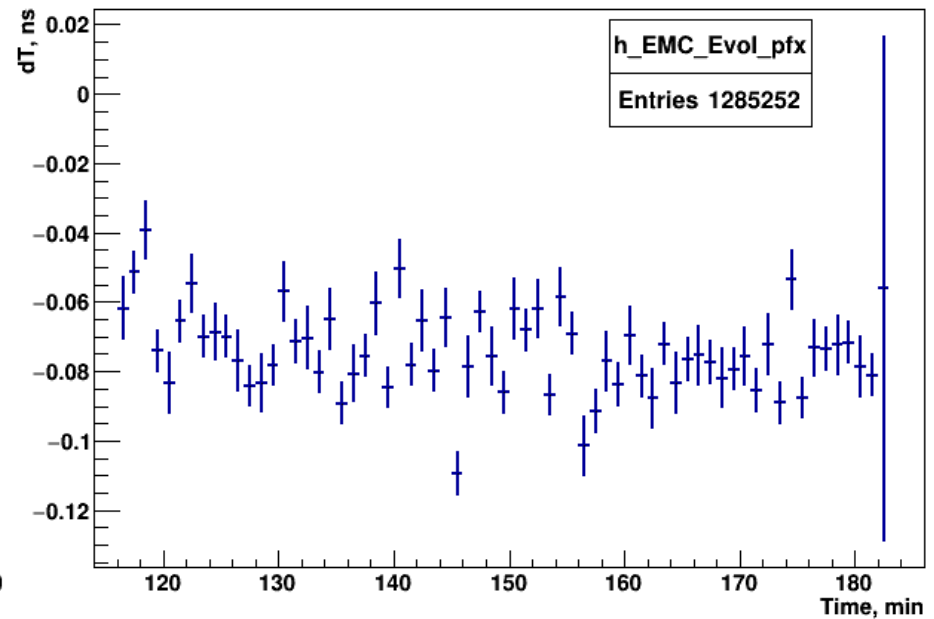


Cluster energy distribution (time gated).

EMC+TOF Results

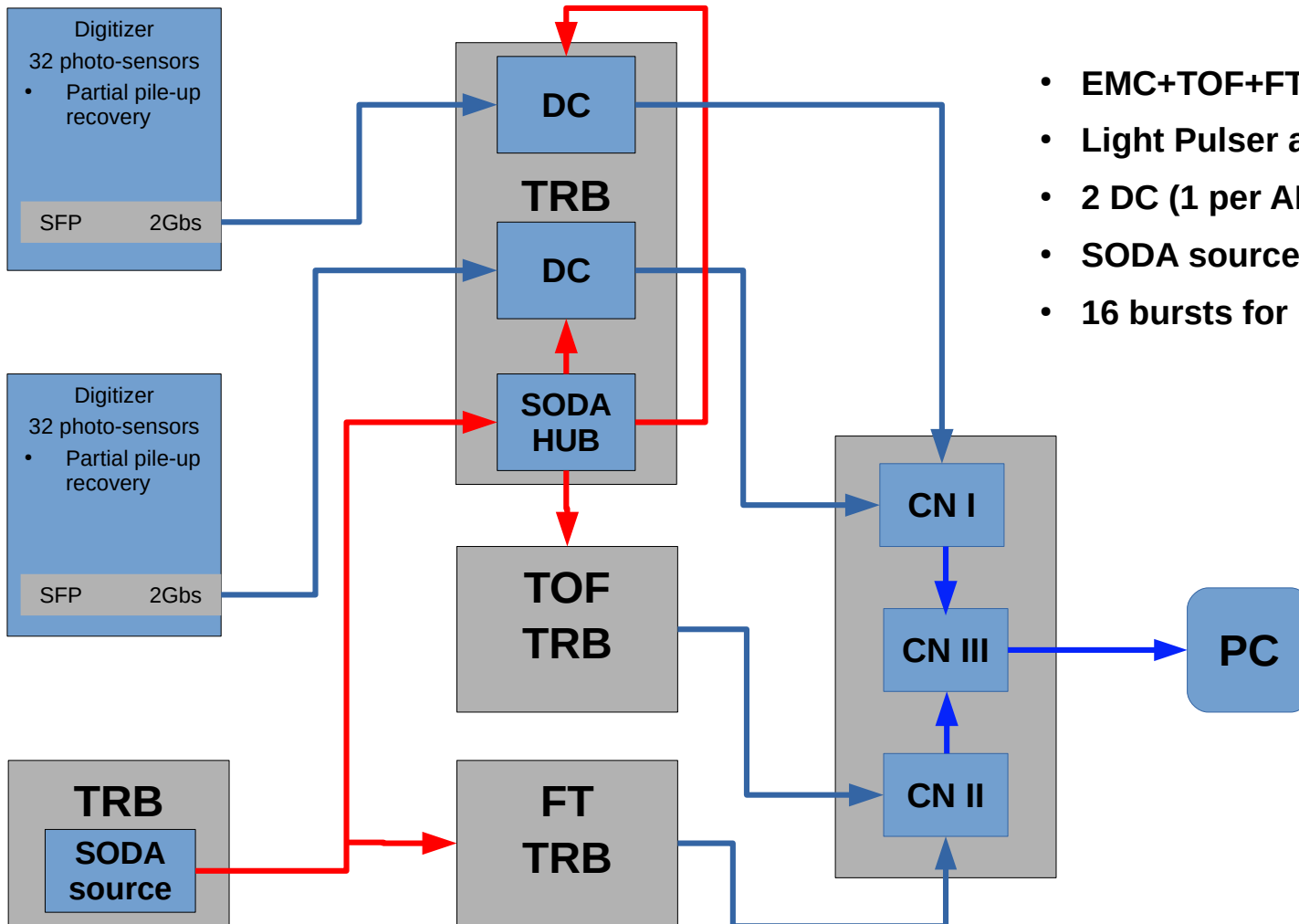


EMC-TOF time difference in case of energy gate for cluster. Values in red square show Gaus fit parameters.



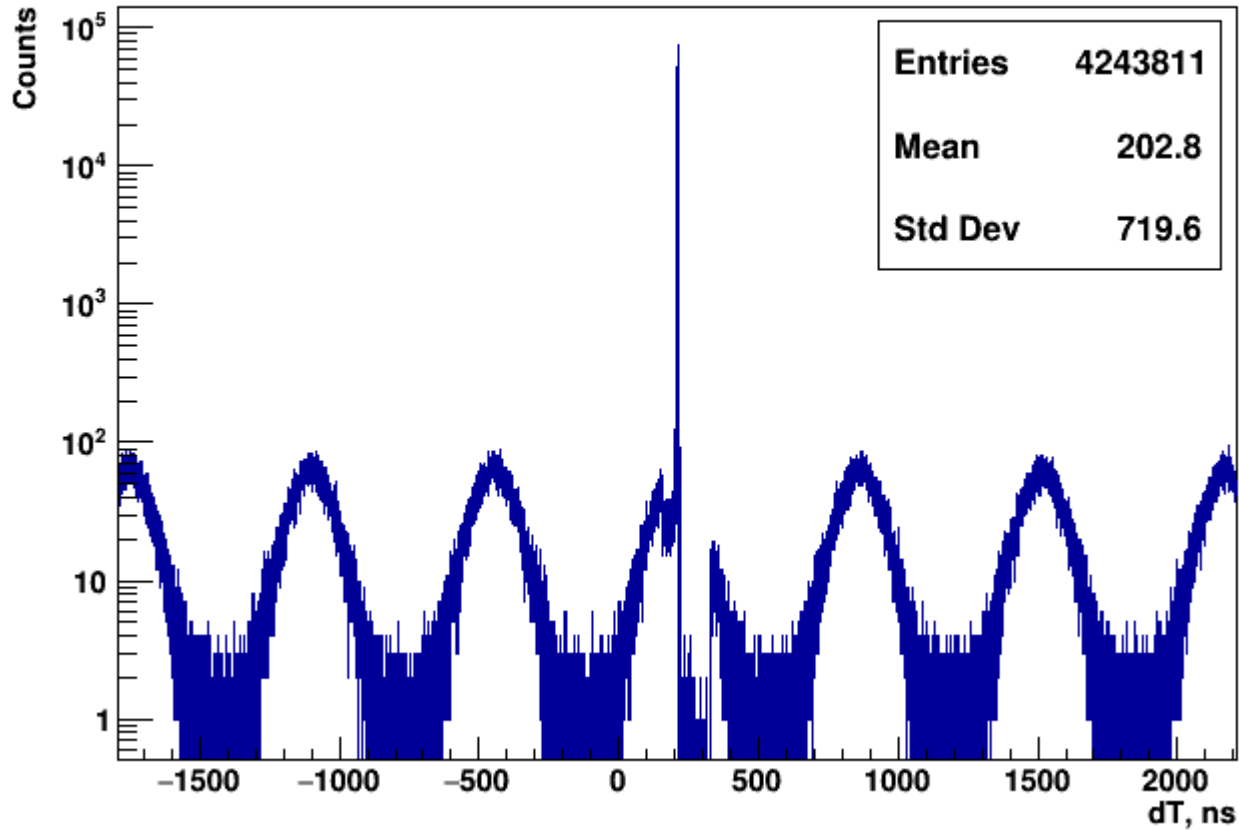
Evolution with time.

EMC+TOF+FT



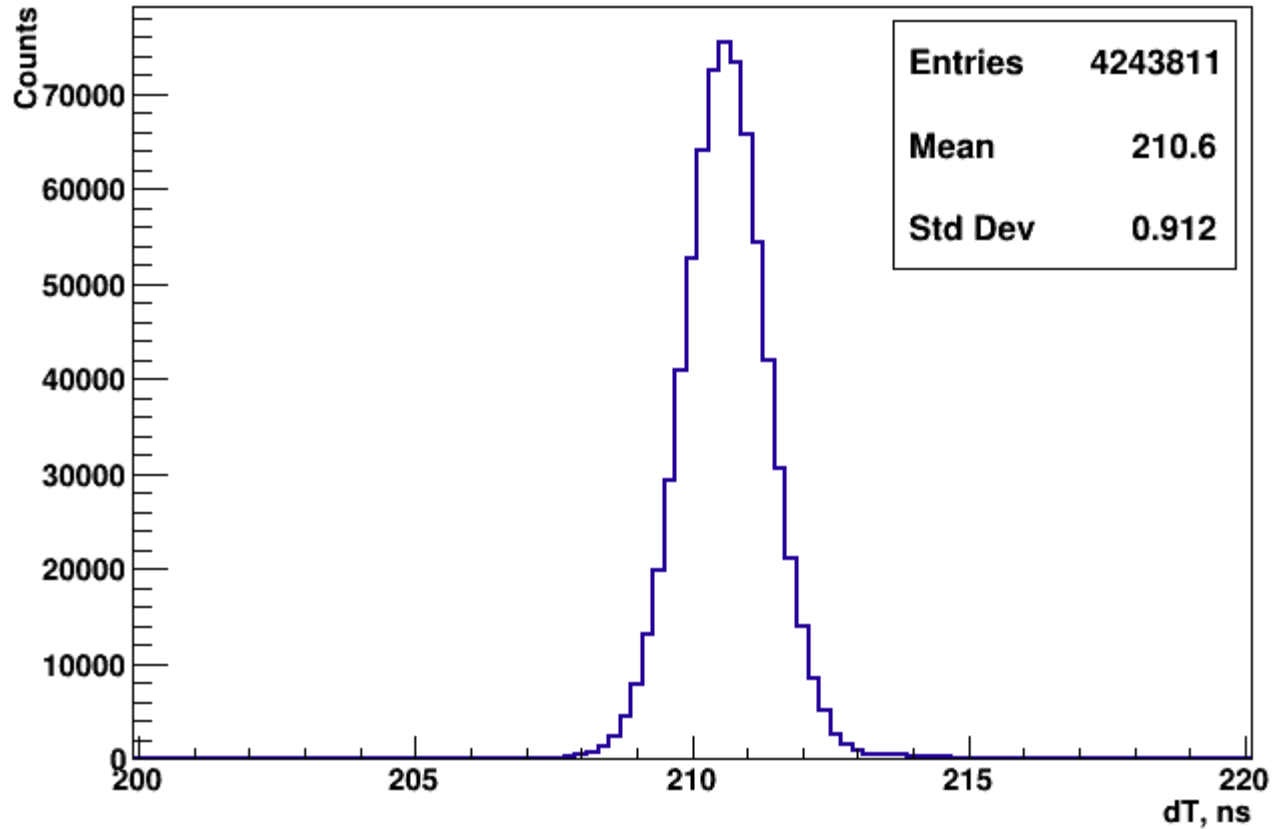
- EMC+TOF+FT
- Light Pulser as a reference
- 2 DC (1 per ADC board)
- SODA source on the different TRB
- 16 bursts for BBN, IIR, MWD filters

EMC+TOF+FT Results



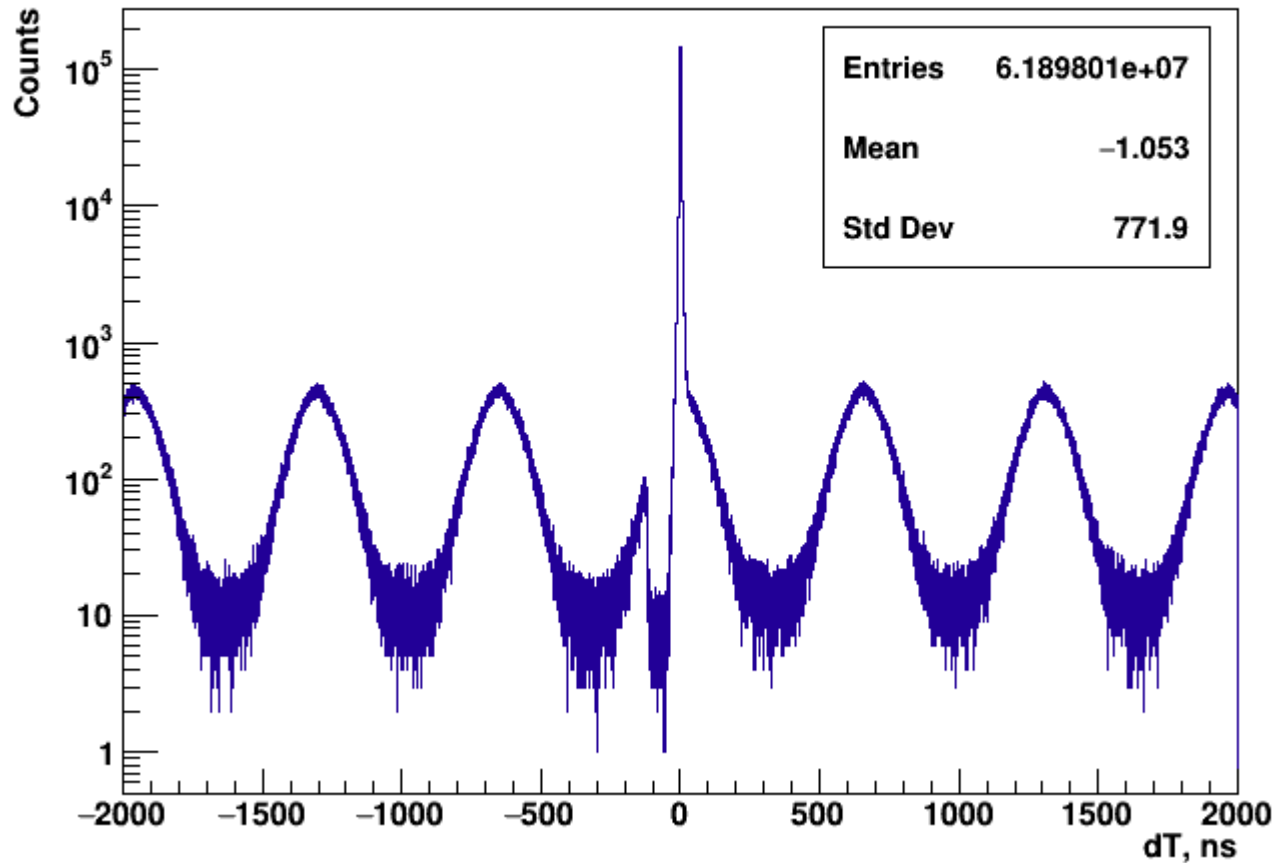
Time difference between TOF and FT channels (log scale).

EMC+TOF+FT Results



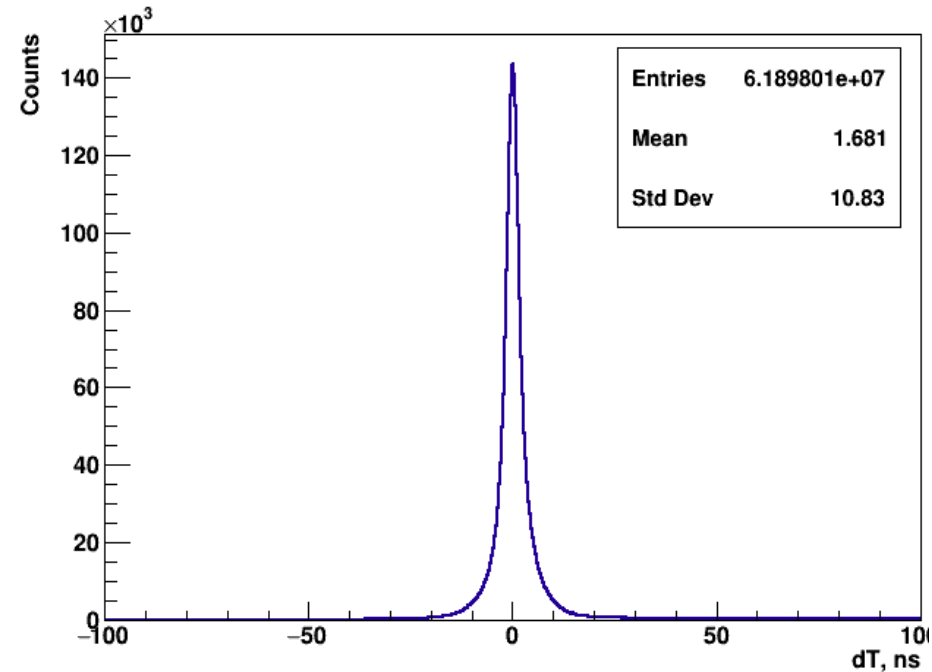
Time difference between TOF and FT channels.

EMC+TOF+FT Results

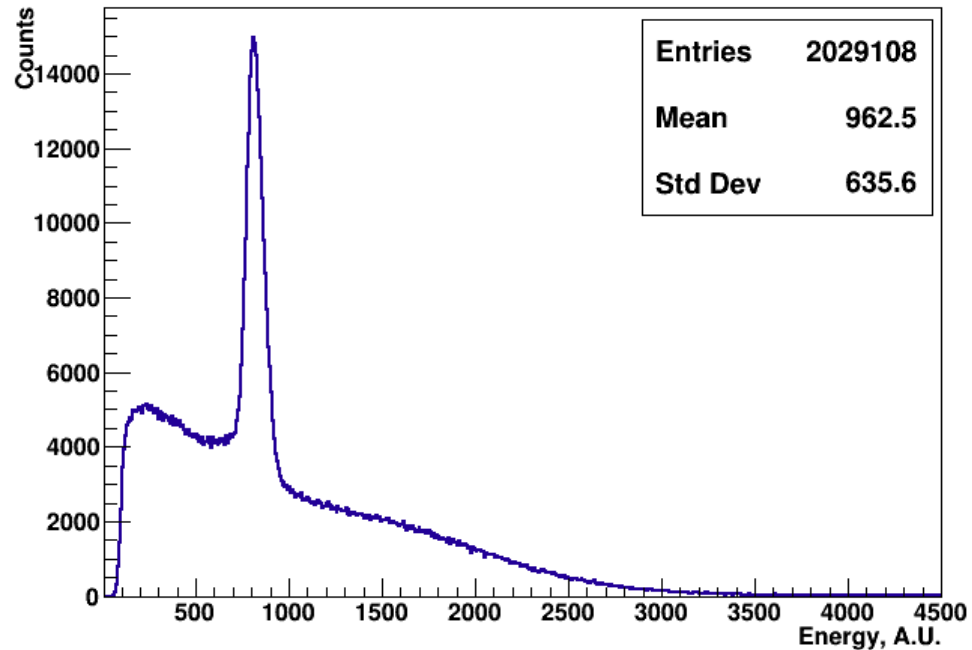


Time difference between FT and EMC channels (log scale).

EMC+TOF+FT Results

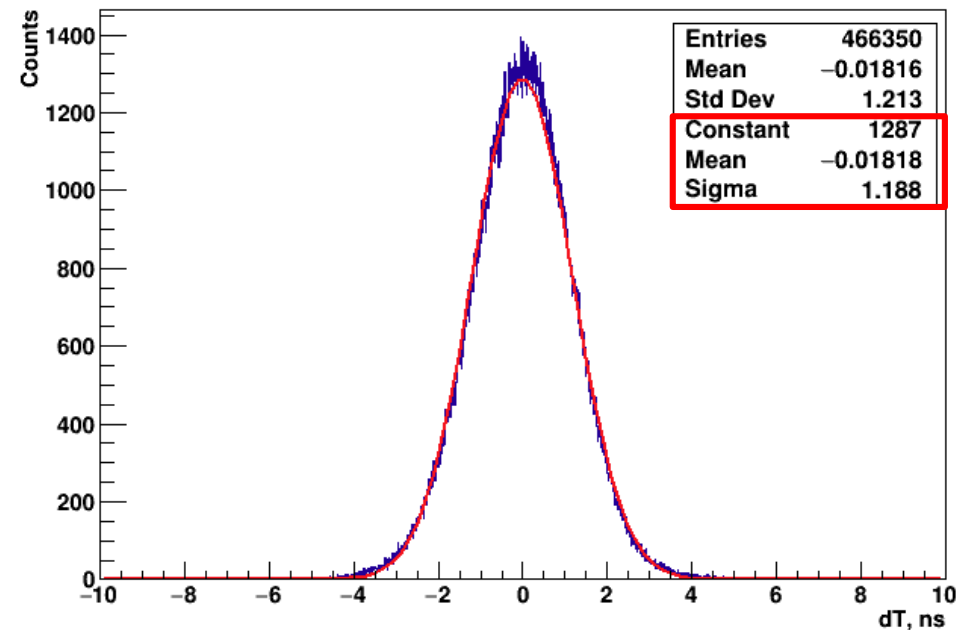


Time difference between FT and EMC channels

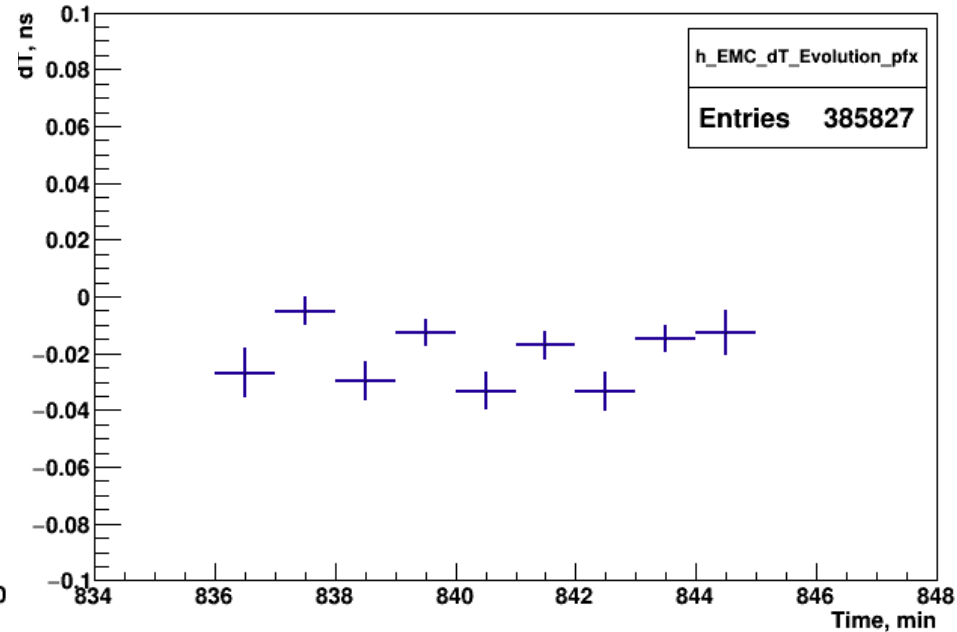


Cluster energy distribution (time gated).

EMC+TOF+FT Results



EMC-FT time difference in case of energy gate for cluster. Values in red square show Gaus fit parameters.



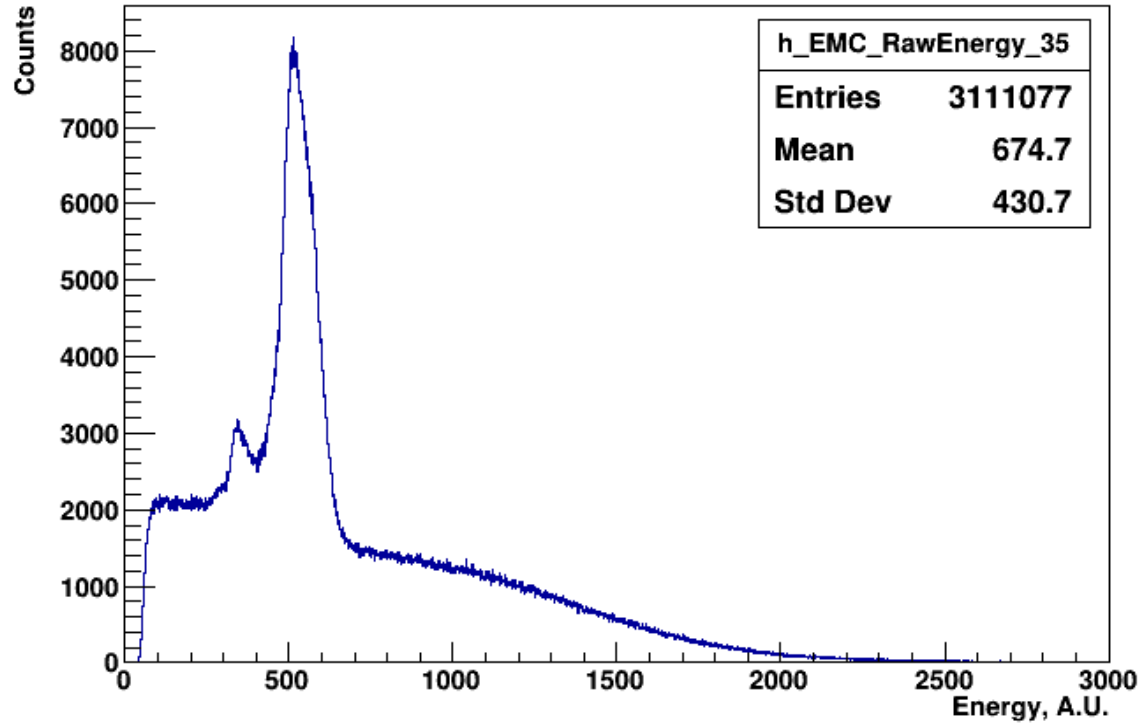
Evolution with time.

Summary

- Current prototype of the DAQ for PANDA showed possibility to handle data from the multi-component detector system
- Synchronization of the readout was stable at all chain configurations
- Data taking during beamtime helped to reveal shortcomings and bottlenecks of this system

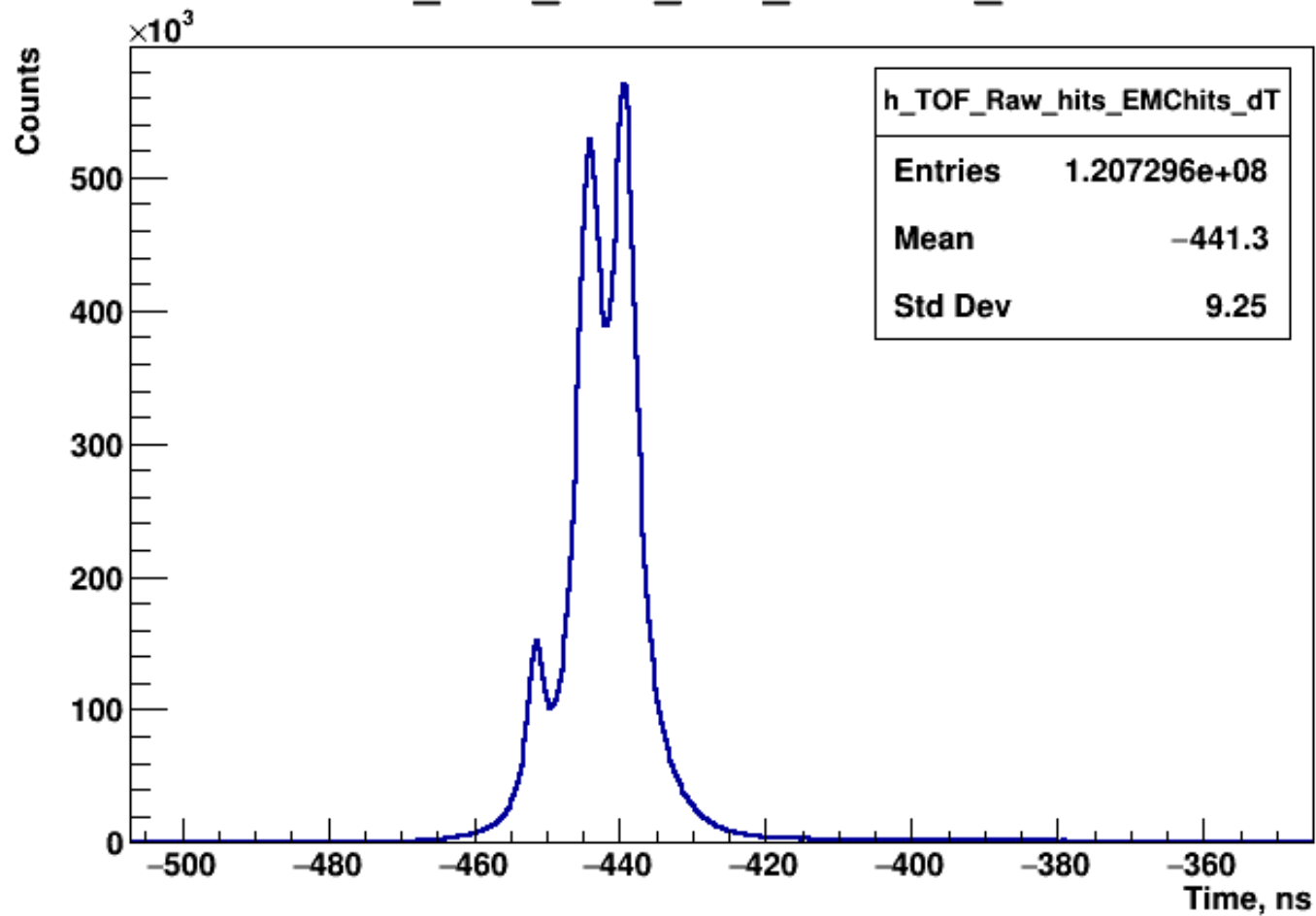
Additional Slides

Cluster Energy



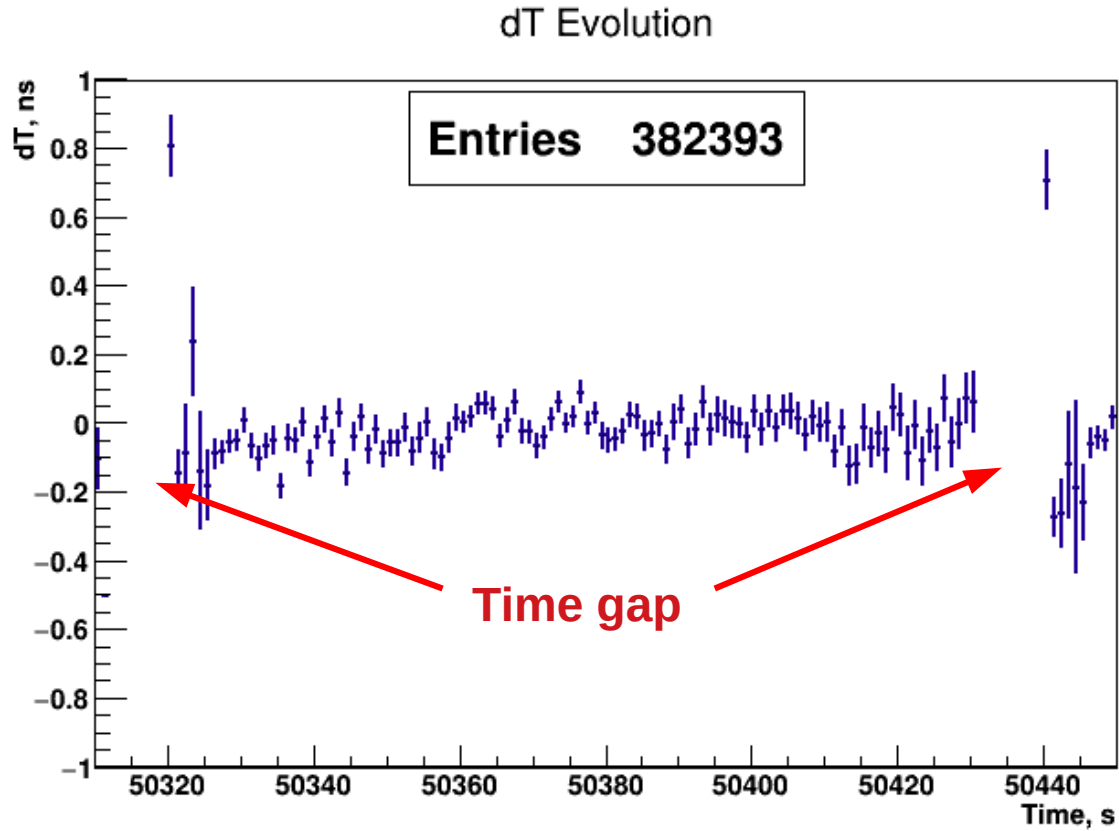
Cluster Energy is defined by sum of the energy deposited during a short time in each crystal .
Time window is taken from the left picture.

h_TOF_Raw_hits_EMChits_dT



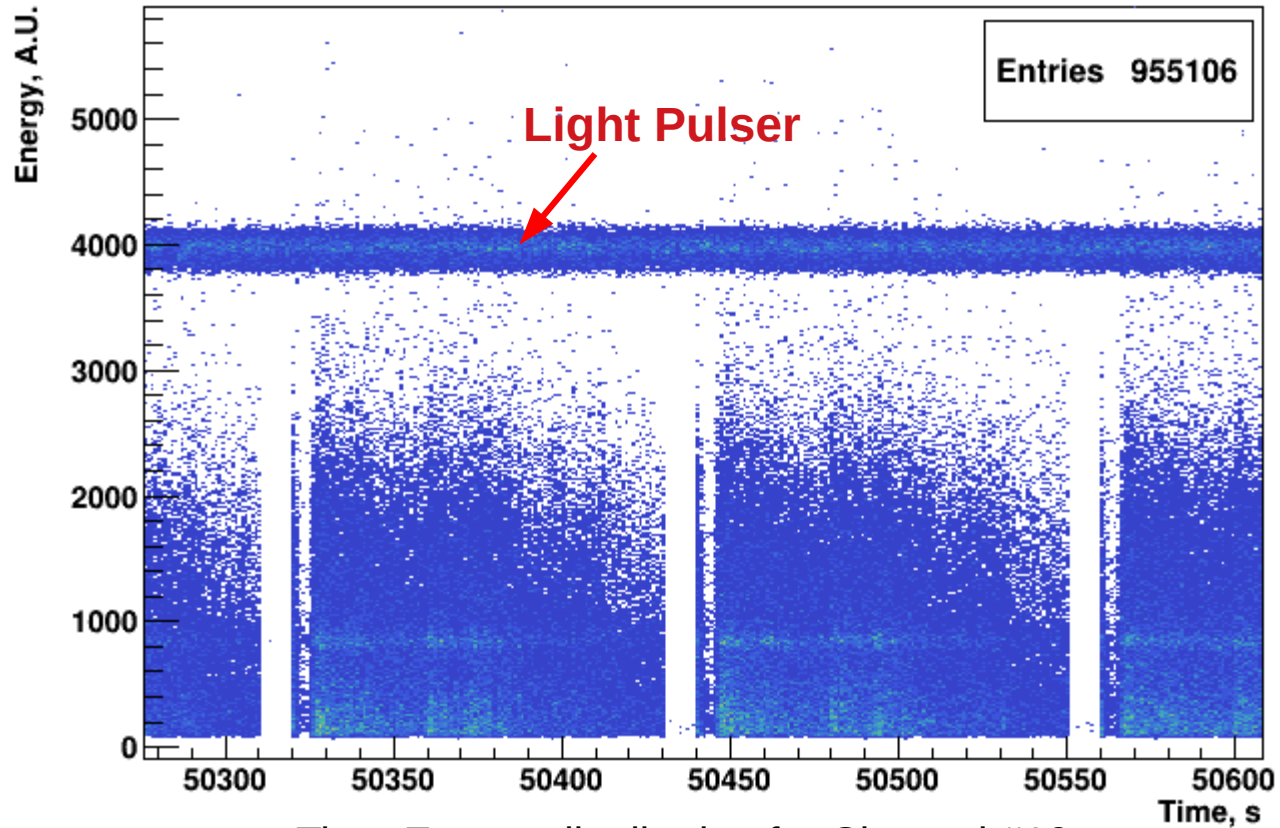
EMC+TOF+FT Results

Time scale in seconds



EMC+TOF+FT Results

Time scale in seconds



Time-Energy distribution for Channel #10