



Update of BWEC Activities

Oliver Noll

PANDA-Collaboration Meeting 18/1

March 2018

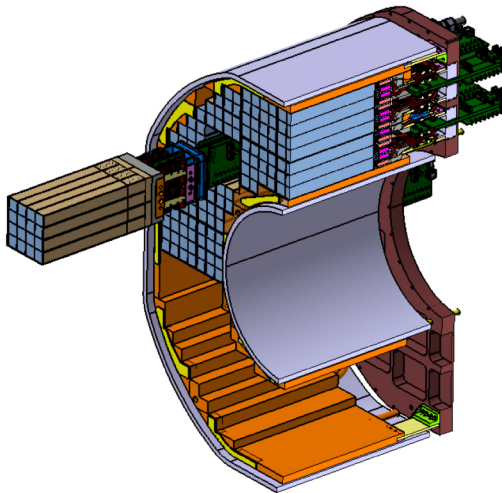


- 1 PROTO16-2
- 2 PANDA ROOT
- 3 APFEL ASIC Feature Extraction
- 4 Benchmark Tests with the HitDetection ASIC
- 5 Test Beam February 2018



PROTO16-2

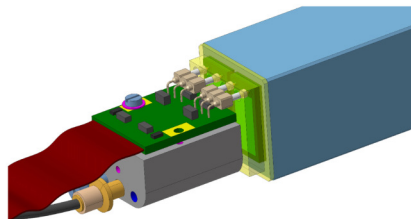
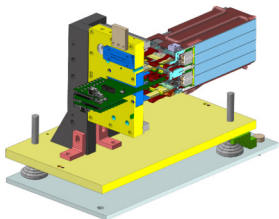
Modular Design of BVEC



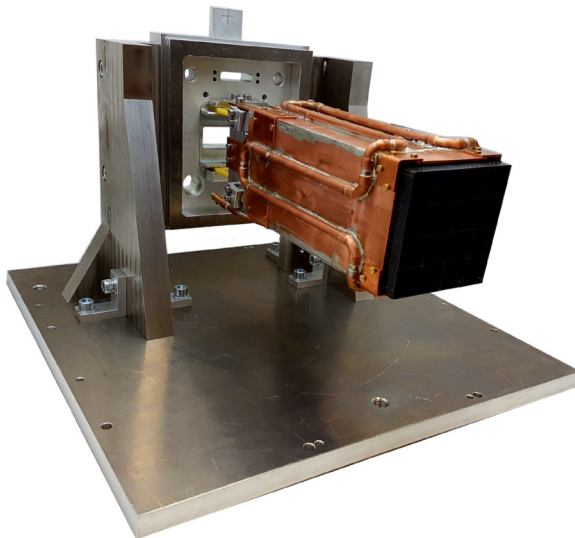
PROTO16-2

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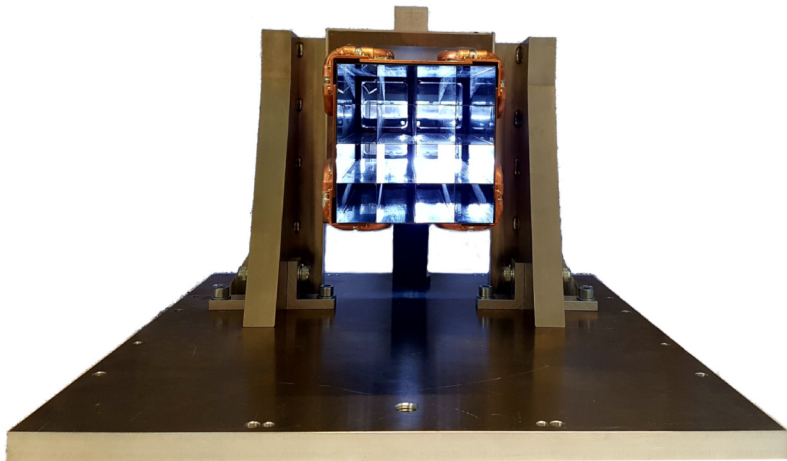
- Prototype with all final BVEC parts
- Helps to do more things in parallel
 - DCS tests
 - DAQ tests
 - Light pulser tests
 - ...



Holding structure with cooling shell and alveole



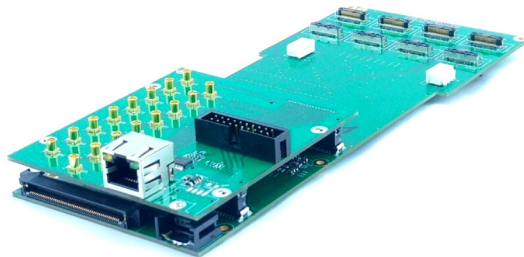
A fancy picture with light from the background



Final capsule design



Current line driver boards

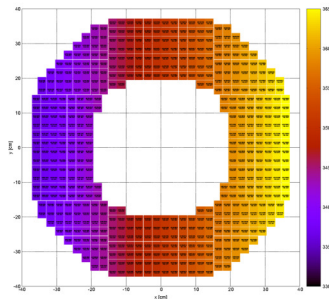
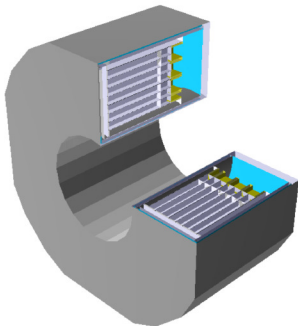




PANDA ROOT Implementation

PANDA ROOT

- Full implementation of BWEC
- Also dead material
- Official crystal numbering convention
- **Now available in PANDA ROOT repository**



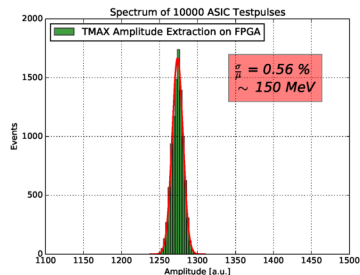
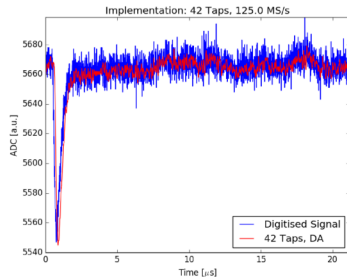
APFEL ASIC Feature Extraction

Feature Extraction

- Modification of transfer function
- Suppression of HF noise
- Determination of amplitude
- T_0 determination

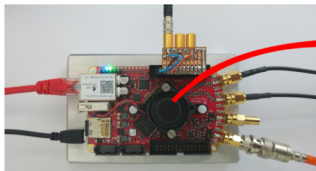
Implementation

- Distributed Arithmetic
- 9 → 32 channels/FPGA
- Tested with developer board



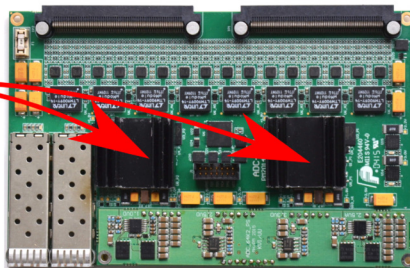


APFEL ASIC Feature Extraction



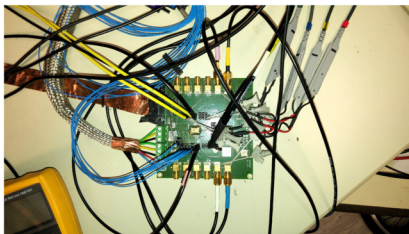
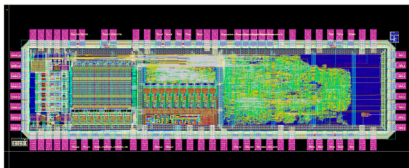
RedPitaya: One channel DAQ

x 64



PANDA SADC (P. Marciniwski): 64 channel

Benchmark Tests with the HitDetection ASIC



Measurements

- Linearity of ADC ✓
- Dynamic of ADC ✓
- Analog memory ✓
- Threshold scans ✓

Results

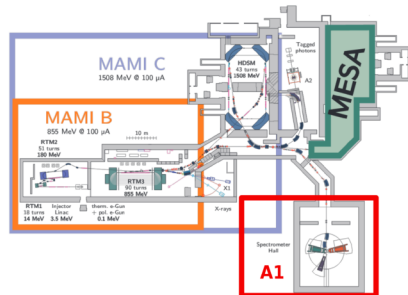
Next talk by Phillip Grasmann

L. Capozza, H. Deppe, H. Flemming, P. Grasmann, O. Noll, P. Wieczorek

Test Beam February 2018

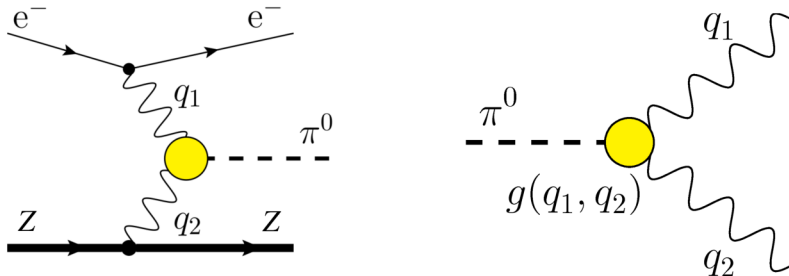
Beamtime

- 3 days of beam (5 planned)
- A1 Spectrometer Hall
- $E_{beam} = 1.5 \text{ GeV}$
- I_{beam} up to 200 nA
- **Spectrometer+PROTO16**



→ Feasibility study for FAIR Phase-0

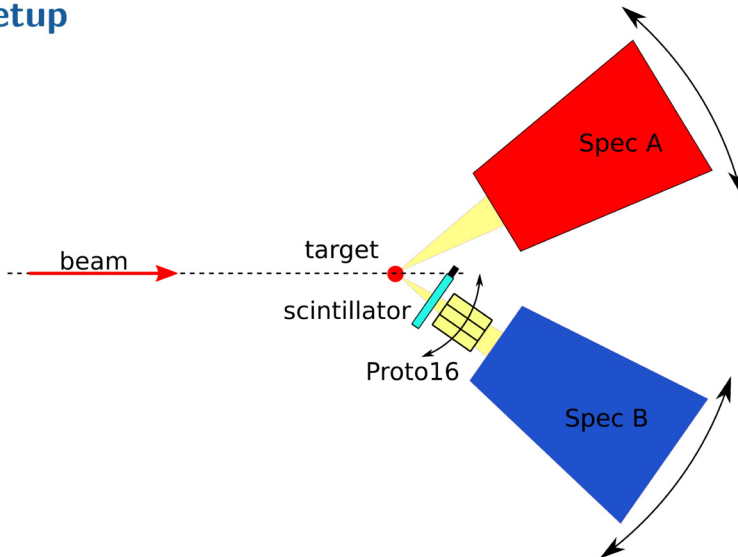
Primakoff Pion Production: $e p \rightarrow e p \pi_0$



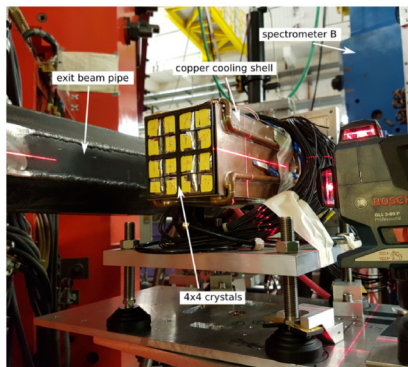
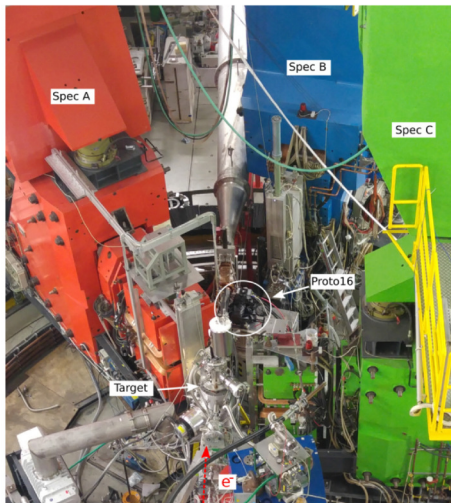
- Scattered e^- can be measured with spectrometer
- Decay photons can be measured with our EMC

→ Measurement of the π_0 EM transition FF dependency on q^2
 → Related to hadronic correction to $(g-2)_\mu$ (light-by-light scattering)

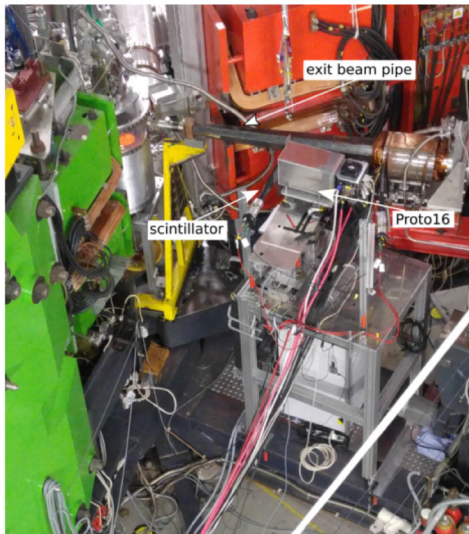
Beam Tests at MAMI in A1 Spectrometer Hall Setup



Beam Tests at MAMI in A1 Spectrometer Hall Setup



Beam Tests at MAMI in A1 Spectrometer Hall



Measurements

Rates and Spectra with:

- Three targets: C, Ta and CH_2
- Different beam currents up to 200 nA
- Three different angles: 9° , 14° and 36°

Next beamtime

- Coincidence measurement with Spectrometer
- Identification of π^0 events

Summary and Outlook

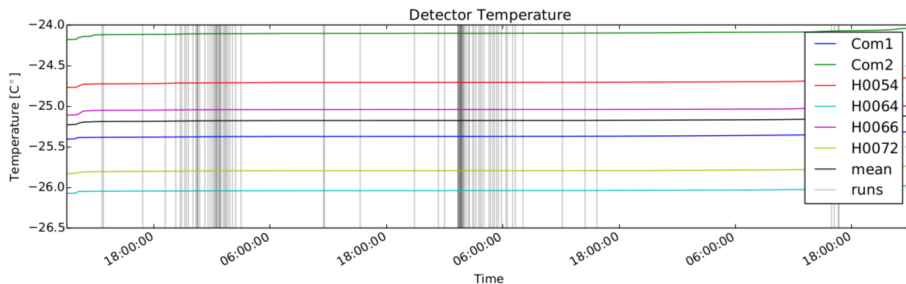
- PROTO16-2
 - All parts available
 - Final mounting after CM
- PANDA ROOT
 - Now BWEC in PANDA ROOT repository
- APFEL ASIC feature extraction
 - Improved implementation
 - Transferring to PANDA SADC is ongoing
- HitDetection ASIC
 - Benchmark tests are done
 - Promising results
 - Next talk by Phillip
- Test beam February 2018
 - PROTO16-1 + A1 spectrometer
 - Stable operation of prototype in EM - environment
 - Plenary talk by Luigi on Friday



Backup

Beam Tests at MAMI in A1 Spectrometer Hall

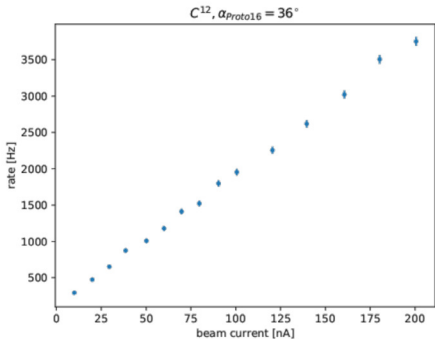
Temperature inside Proto16 during the Beamtime



→ Temperature is stable: $\Delta T < 0.1 \text{ K}$

Beam Tests at MAMI in A1 Spectrometer Hall

Consistency check:
linear calorimeter rate dependency on
beam current



To Do:

- Analysis of threshold scans
- Comparison of scintillator rates and calorimeter rates
→ distinguish between electron and photon events
- Analysis of the energy spectrum



Single Channel Test-Bench

Setup

- Full equipped single channel
- RedPitaya DAQ

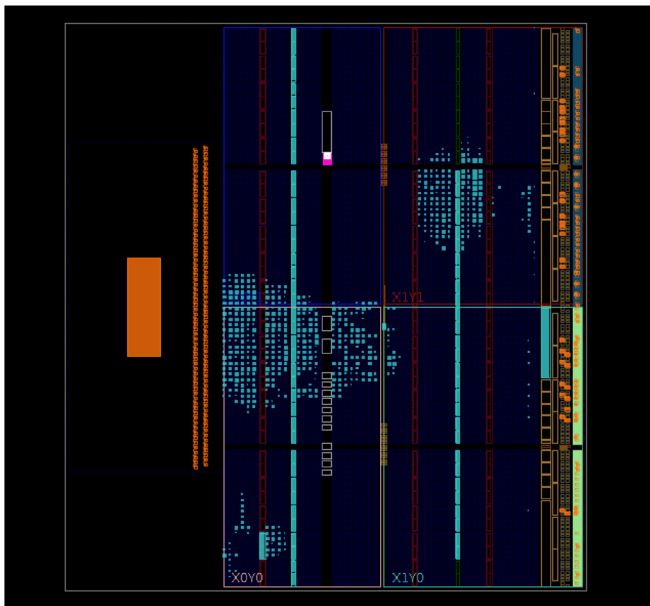
Aim

- Defined measurements (force and position)
- APD/Crystal coupling
- Optical fiber coupling
- ...



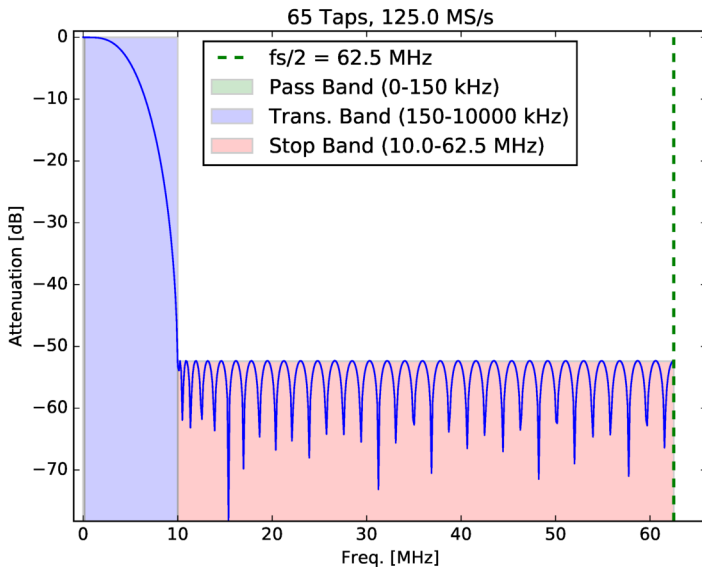


FE - Smoothing via Finite Impulse Response (FIR) Filter



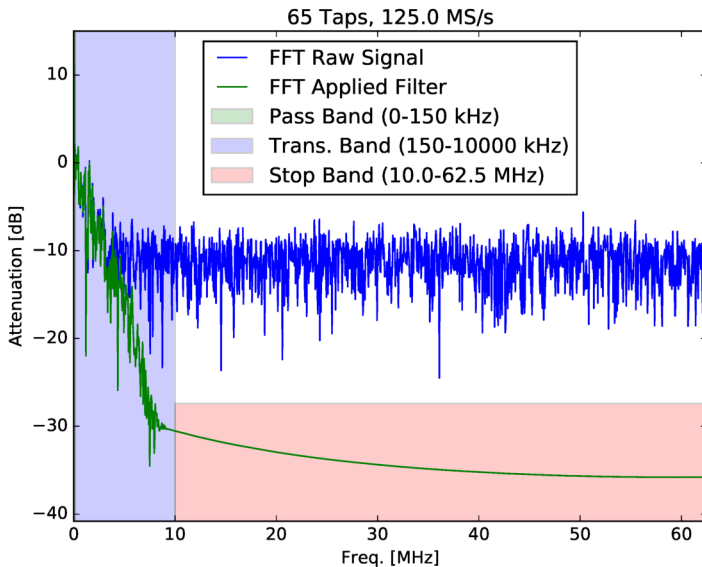


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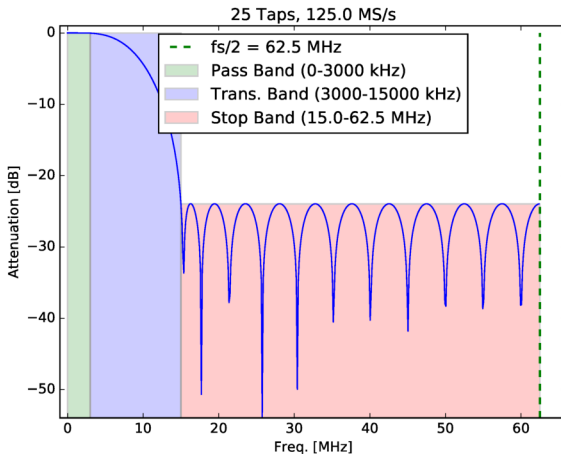


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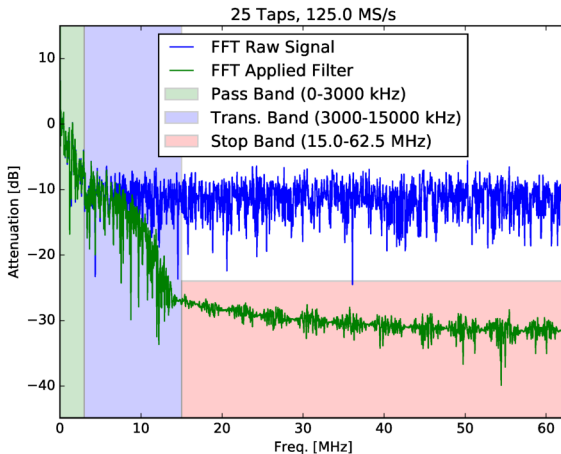


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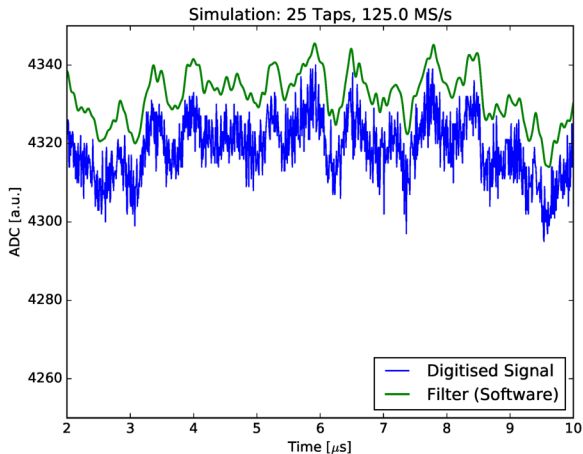


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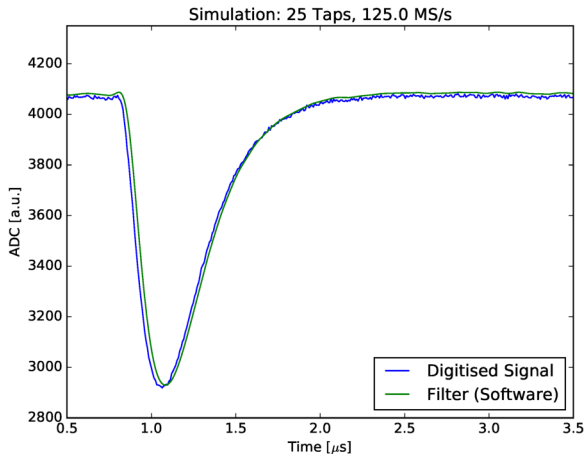


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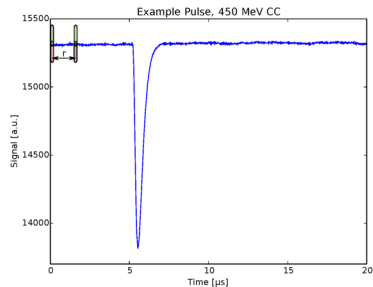
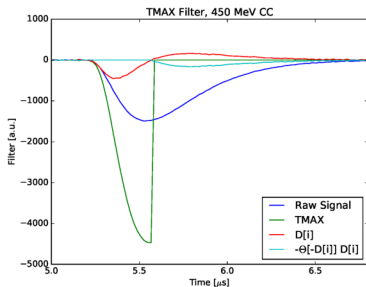




FE - Smoothing via Finite Impulse Response (FIR) Filter



TMAX Filter



Derivative:

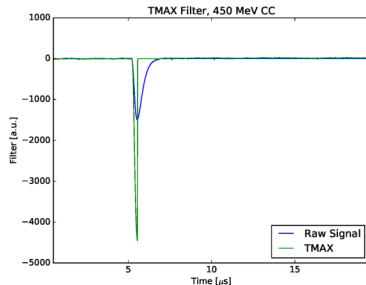
$$D[i] = T[i + r] - T[i]$$

Heaviside function Θ :

$$x \mapsto \begin{cases} 0 & x < 0 \\ 1 & x \geq 0 \end{cases}$$

TMAX:

$$F_{TMAX} = \sum_{i=0}^N D[i] - \Theta[-D[i]] \cdot D[i]$$



TMAX Filter

TMAX Filter

- Sensitive on rising edge
- Cancels out falling edge
- No overshoot
- Short dead time

Derivative:

$$D[i] = T[i + r] - T[i]$$

Heaviside function Θ :

$$x \mapsto \begin{cases} 0 & x < 0 \\ 1 & x \geq 0 \end{cases}$$

TMAX:

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