STRAWS AND EMC JOINT TESTS

GRZEGORZ KORCYL, PANDA FEE/DAQ Workshop 2018

Goals

- First mini-PANDA prototype
  - 2 independent subsystems
  - SODANet synchronization
  - Burst-building on Compute Nodes

- Evaluation of DAQ components:
  - Synchronization
  - Burst-building
  - Preparation tests done by Peter Schakel

- Framework for development of online-tracking on straws

Detector setup

- Straws
    - 4 layers: 2 vertical, 2 horizontal
    - Each layer has 2 modules
    - Each module has 32 straws
    - 256 straws in total

- EMC
    - 3x3 crystals

Layer 3 – H
Layer 4 - V

Layer 1 – H
Layer 2 - V

EMC
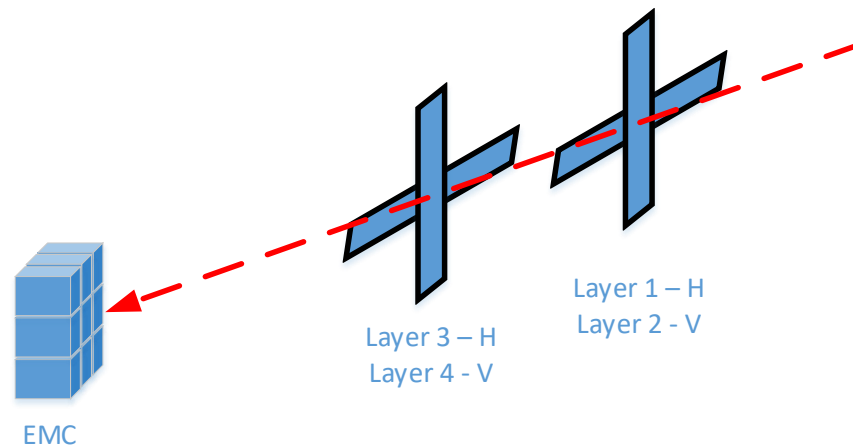
Many thanks to Jerzy Smyrski and Bartek Korzeniak for straws preparation!

Many thanks to Myroslav Kavtsyuk, Peter Schakel and Victor Rodin for EMC preparation!
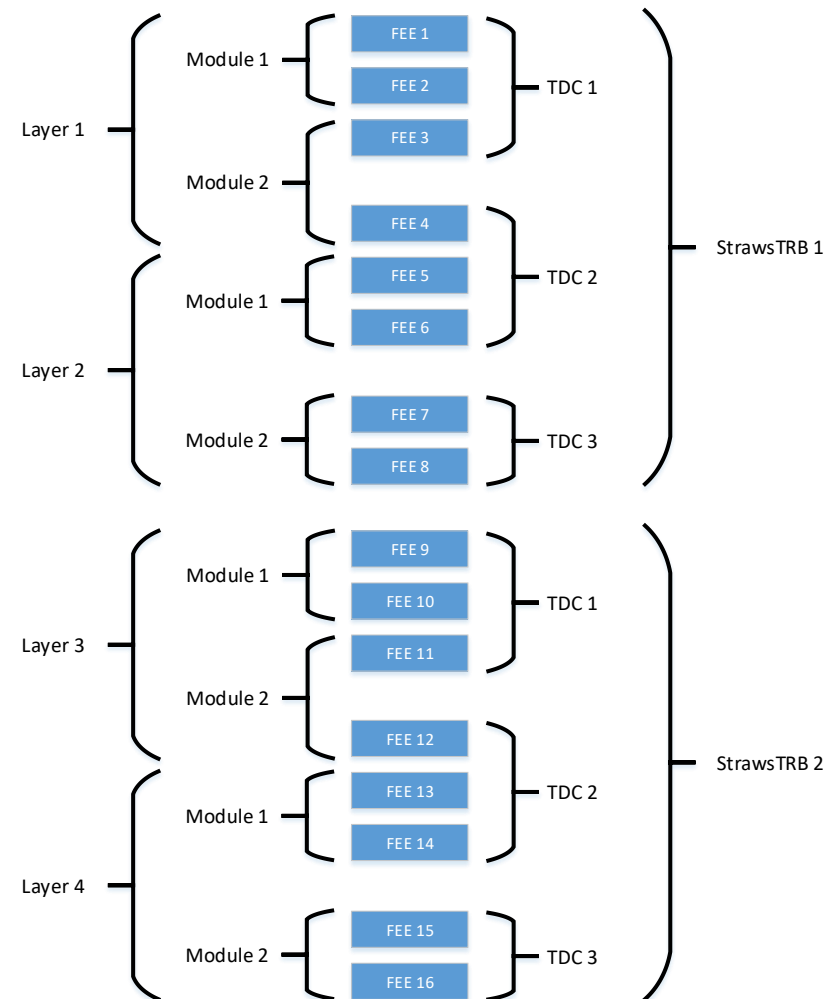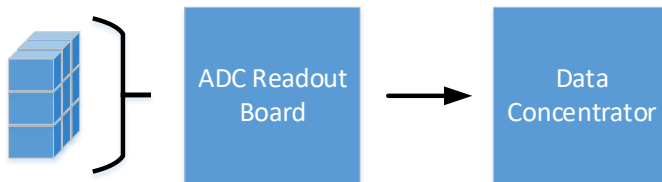
Readout setups

- Straws
  - 16x PASTTREC FEE cards
  - 2x TRBs

- EMC
  - EMC ADC card
  - Data Concentrator
    - TRB3 Peripheral design

SODANet synchronization
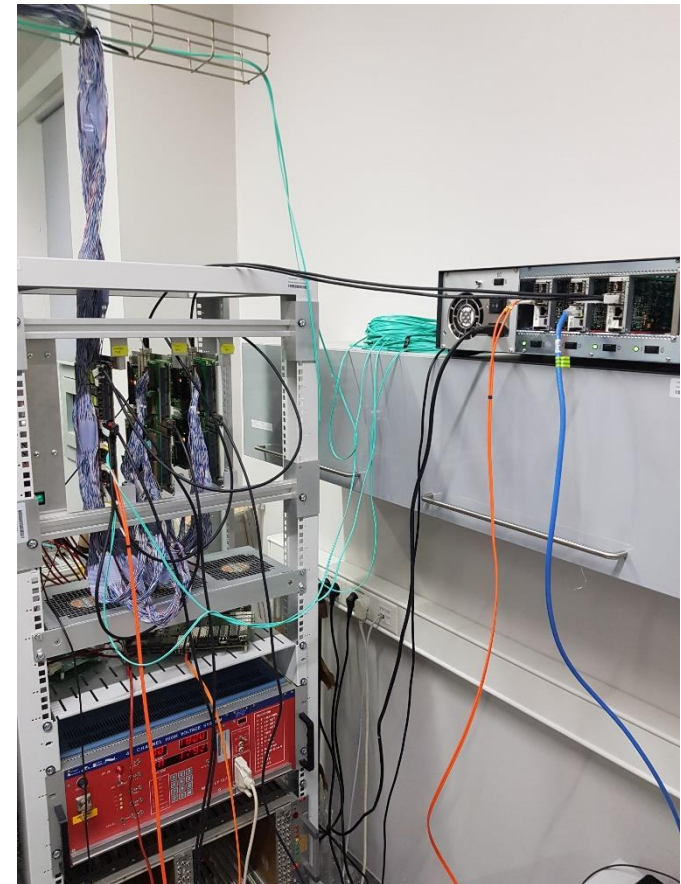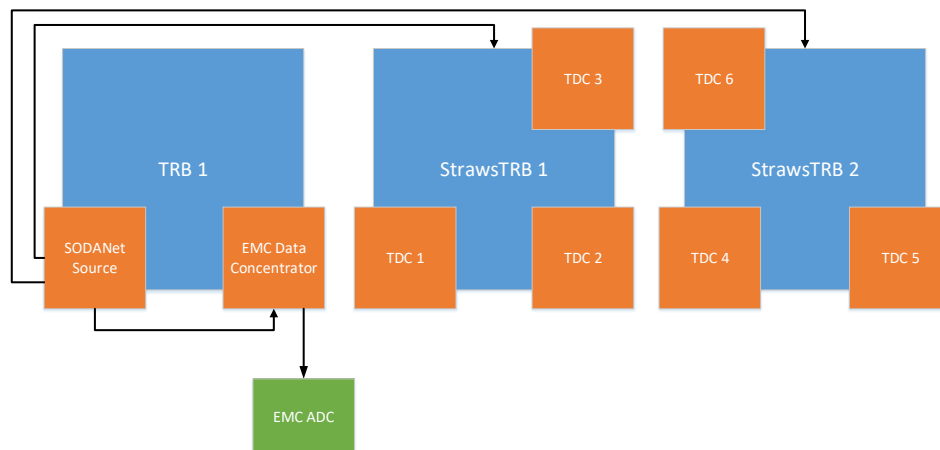
- 3x TRBs
  - TRB1:
    - Slow control Gateway
    - SODANet Source
    - EMC Data Concentrator

  - StrawsTRB1 and 2
    - TDCs for PASTTREC readout
    - Central FPGA as SODANet receiver and local DC

Burst building

- Data sources:
  - EMC
    - 1x Optical link 2Gb, 8/10b
   - Output from the EMC Data Concentrator

  - Straws
    - Each StrawsTRB
      - 1x Optical link 2Gb, 8/10b
      - 1x Optical link Gigabit Ethernet (mirrored data)

- Compute Nodes:
  - CN1: receives data from EMC DC and forwards to CN3 through backplane

  - CN2: receives and merges data from StrawsTRB1 and StrawsTRB2, forwards to CN3 through backplane

  - CN3: receives and merges data from CN1 and CN2, sends out to storage through Gigabit Ethernet
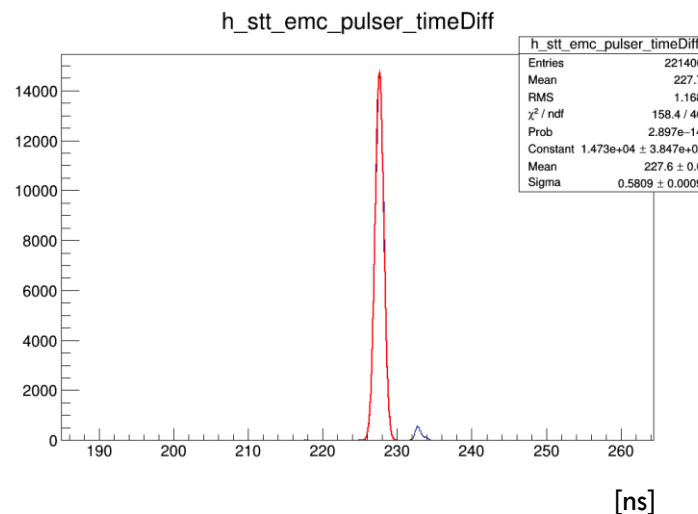
- Additional Straws data burst building
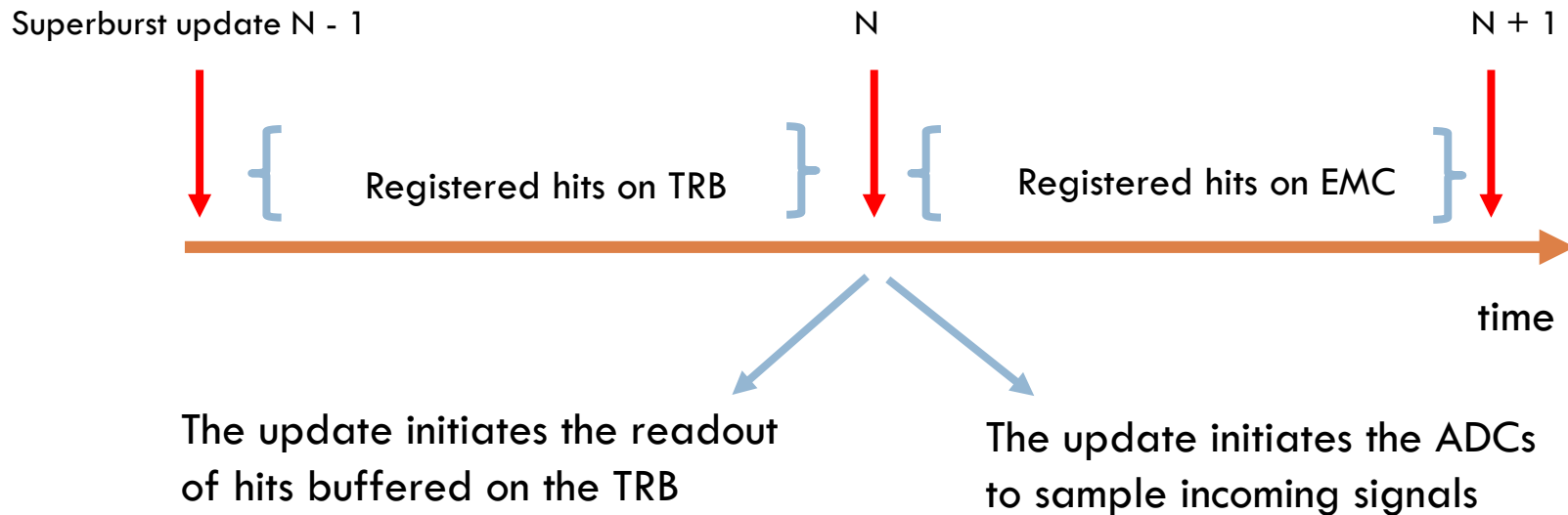 - Standard event builder on PC from direct GbE data
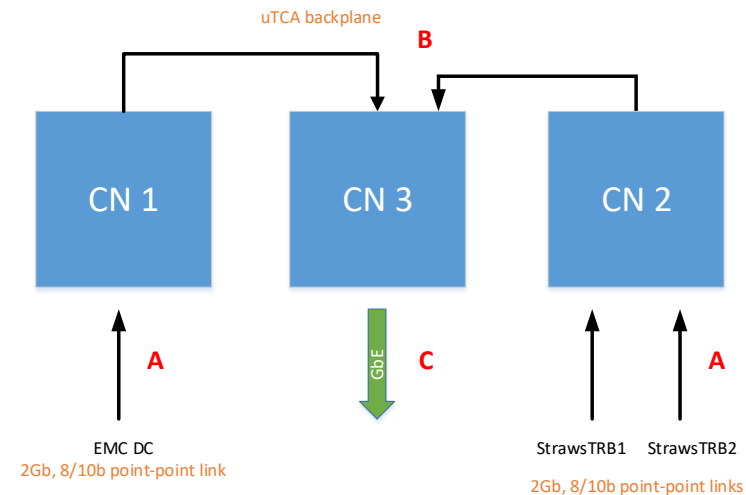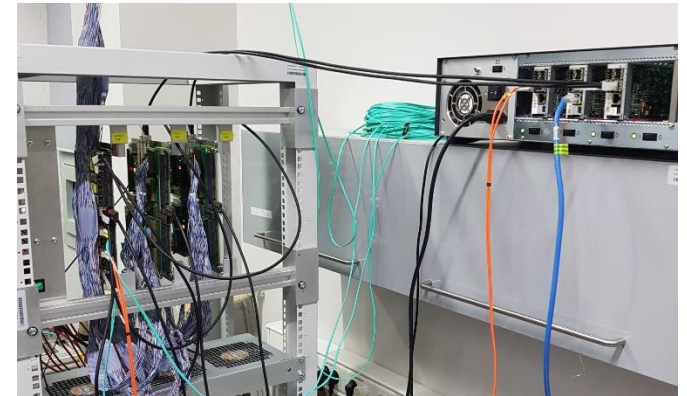
First test - pulser

- Pulser supplied to:
  - LED located in EMC box
  - TDC channel of StrawsTRB1

- Verification of proper SODANet synchronization
- Verification of proper Burst-Building
- Verification of custom data unpacker

- Pulser visible in the same bursts with 0.5ns resolution (raw data, no calibration)
- Determines the time offset between subsystems for the same event (227 ns)

h_stt_emc_pulser_timeDiff

h_stt_emc_pulser_timeDiff	
Entries	221406
Mean	227.7
RMS	1.168
χ^2 / ndf	158.4 / 46
Prob	2.897e-14
Constant	1.473e+04 ± 3.847e+01
Mean	227.6 ± 0.0
Sigma	0.5809 ± 0.0009

[ns]

Superburst number mismatch

- Backward and forward data tagging

Superburst update N - 1   N   N + 1

Registered hits on TRB   Registered hits on EMC

time

The update initiates the readout
of hits buffered on the TRB

The update initiates the ADCs
to sample incoming signals

- Hot-fix on the TRB – tag the data with N + 1

Second test – cosmic run

- 2 weeks of cosmic data collected

- Run for development and evaluation of analysis software

- Low-level data filtering in software before storage
  - Based on size in headers
  - Reduction down to ~1% of SBs to storage

- Data collected for tracking development
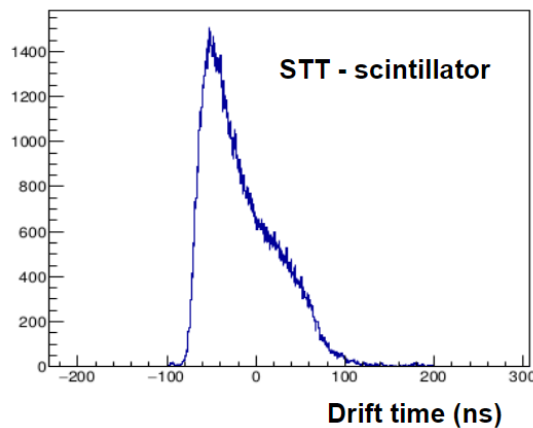
- Analysis done by Akshay and Narendra

FT

EMC

Straw

0.505 cm

~150ns

Drift Time

~3ns

Time measurement

~1m
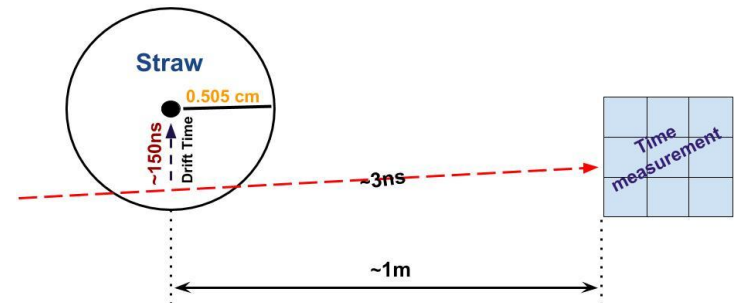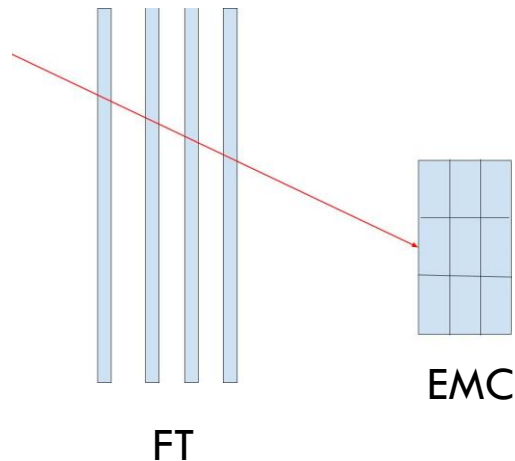
Cosmics analysis

- Superbursts selection
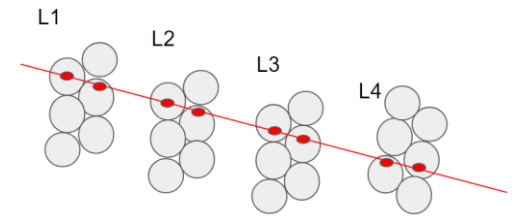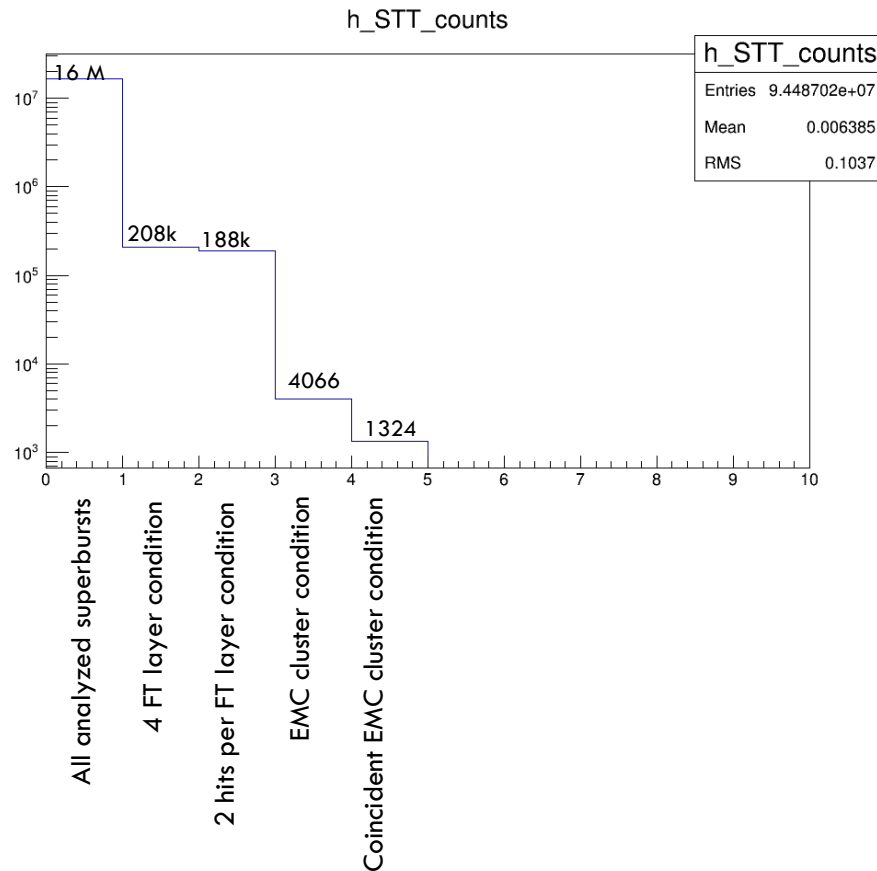
Cosmics analysis

- Drift-radius calibration

STT - scintillator

Drift time (ns)

Lead time difference with a scintillator - ~200 ns
Paweł Strzempek-2017

STT - EMC

h_STT_EMC_timeDiff	
Entries	15387
Mean	322.2
RMS	49.74

Drift time (ns)
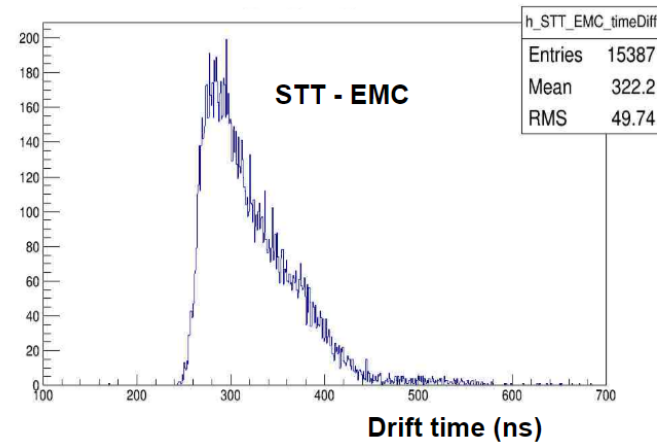
Cut on time window – (220 – 450) ns

Drift Time

drift distance [mm]

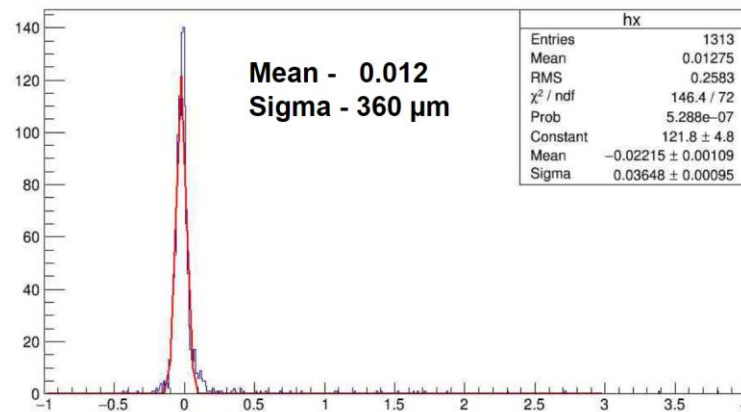drift time [ns]
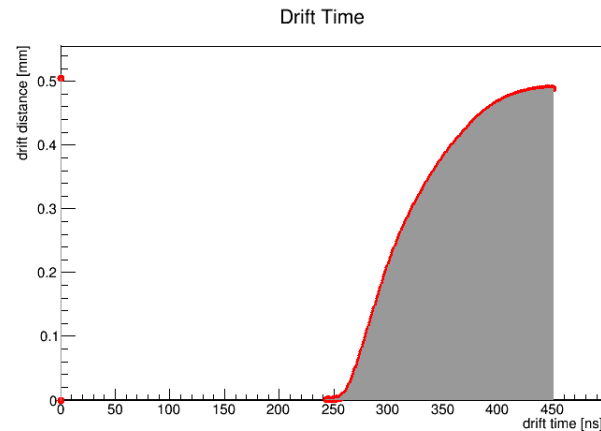
Cosmics analysis

- Preliminary tracking results
  - Two sets: for vertical and horizontal modules
    - Horizontal modules have fixed track inclination angle
- Work in progres
  - Further calibrations required
  - Extraction of tracks from more complex conditions

Spatial resolution for X coordinate [cm]

Straws Preprocessing

- Use GbE network and commercial switch

- Keep TRBs as they are

- Introduce high-level processing on ZCU102 platform

Slave
Slave
Slave
Slave
Slave
Slave
Slave
Slave
Slave
Slave
Slave
TRB N
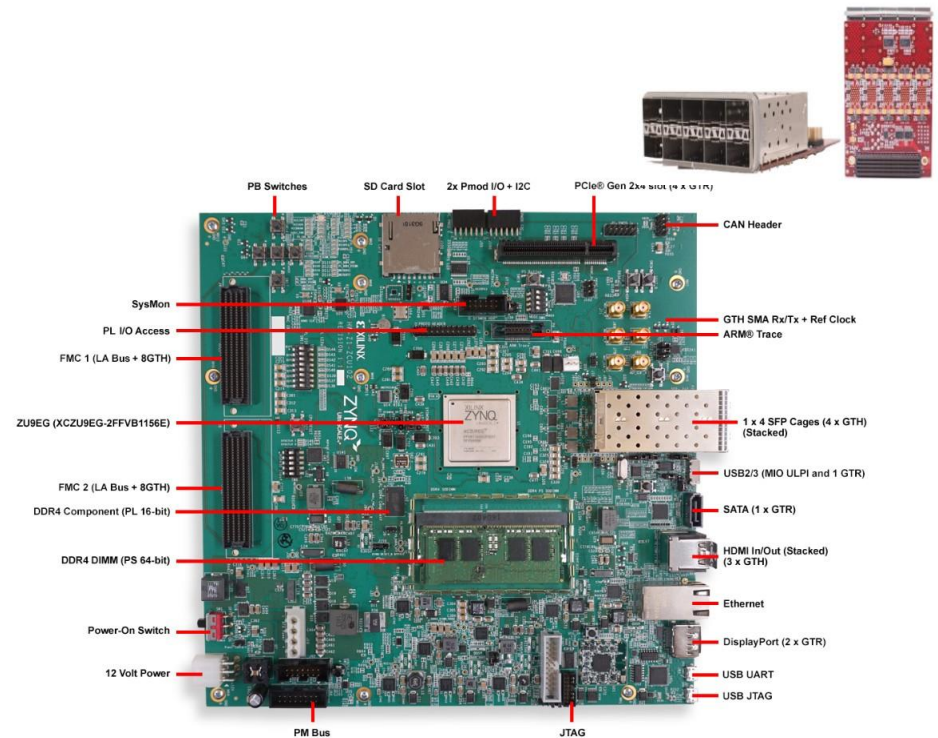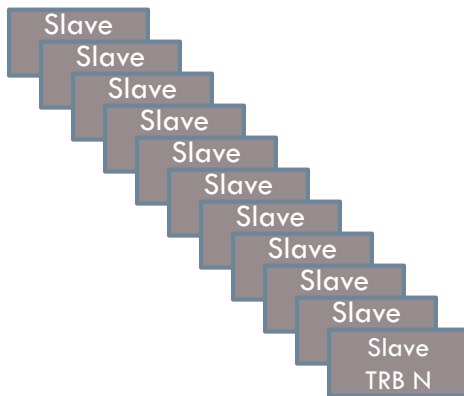
ZCU102
Zynq Ultrascale+ MPSoC
XCZU9EG-2FFVB1156
4GB DDR4
20 SFP+ links

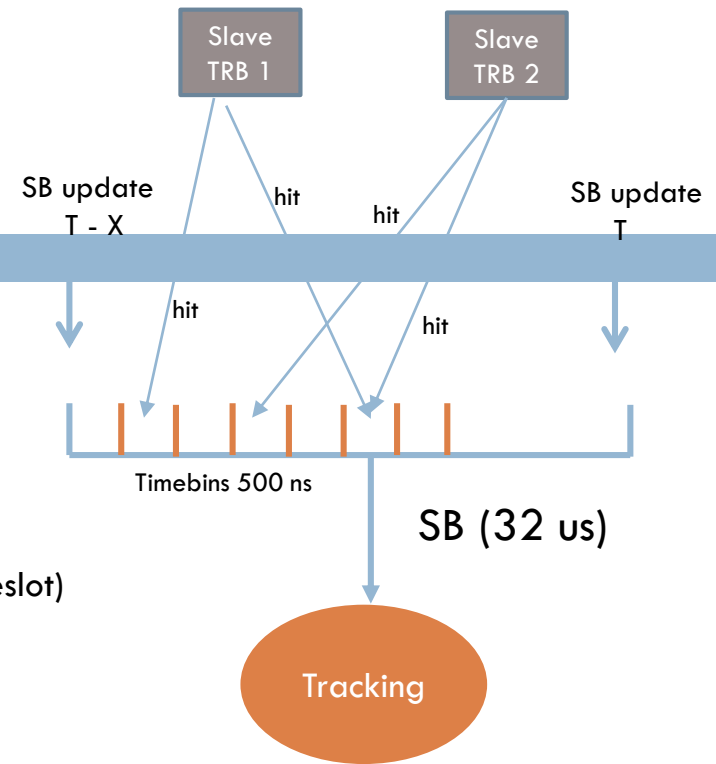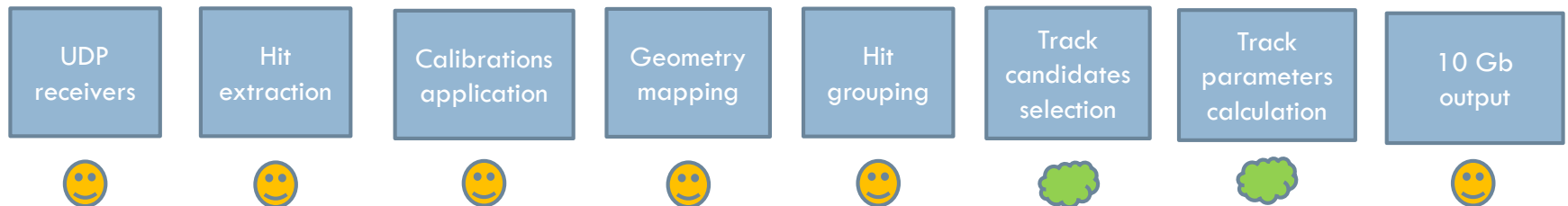2.5k EUR

Straws Preprocessing

- Hardware:
  - Receive and reassemble SB fragments
  - Parse and decode HIT data
  - Apply calibration constants
  - Qualify HITs into Timebins (e.g.: 32 us / 64 = 500 ns timeslot)
  - Preprocess Timebins in parallel and find track candidates
  - Calculate track parameters
  - Forward data to the integrated procesor or output link

- Collected data as input for simulations

Slave TRB 1

Slave TRB 2

SB update T - X

hit

hit

SB update T

hit

hit

Timebins 500 ns

SB (32 us)

Tracking

| UDP receivers | Hit extraction | Calibrations application | Geometry mapping | Hit grouping | Track candidates selection | Track parameters calculation | 10 Gb output |

Summary

- We had a stable setup up and running
  - Running synchronized for couple weeks

  - Burst-building performance
    - Some bottlenecks identified, under investigation by Peter Schakel

- Setup as a framework for Straws tracking on FPGA

- **Thanks for all people involved!**

- Further plans:
  - December beamtime in Juelich
    - FT modules evaluation
    - First tests of online tracking
  - Straws at HADES