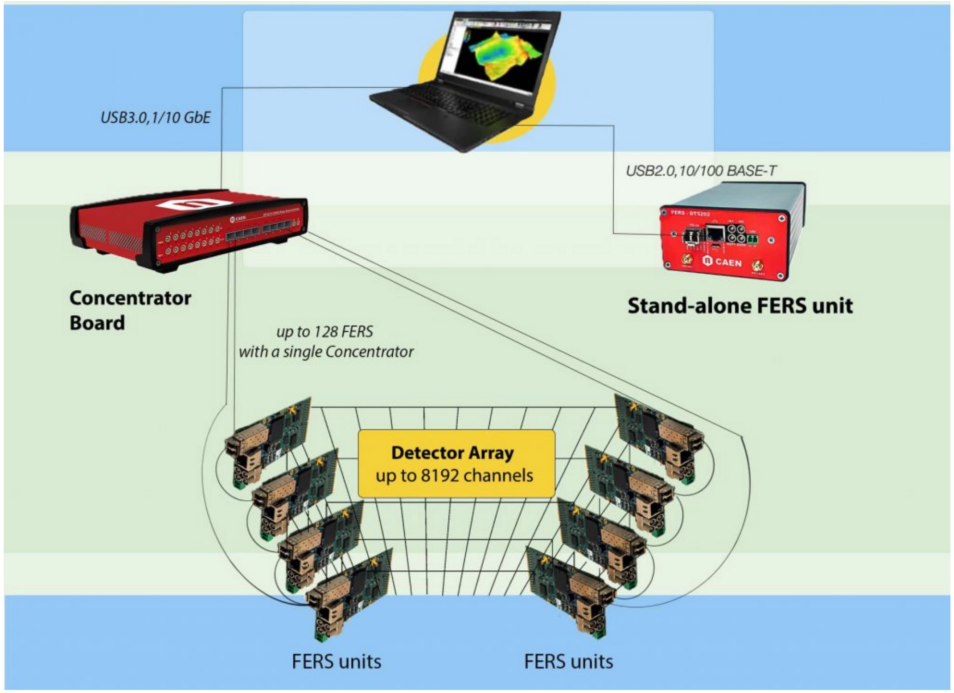
TMS Electronics
Task Force Status

Thomas Kutter, LSU
Vittorio Paolone, UPitt

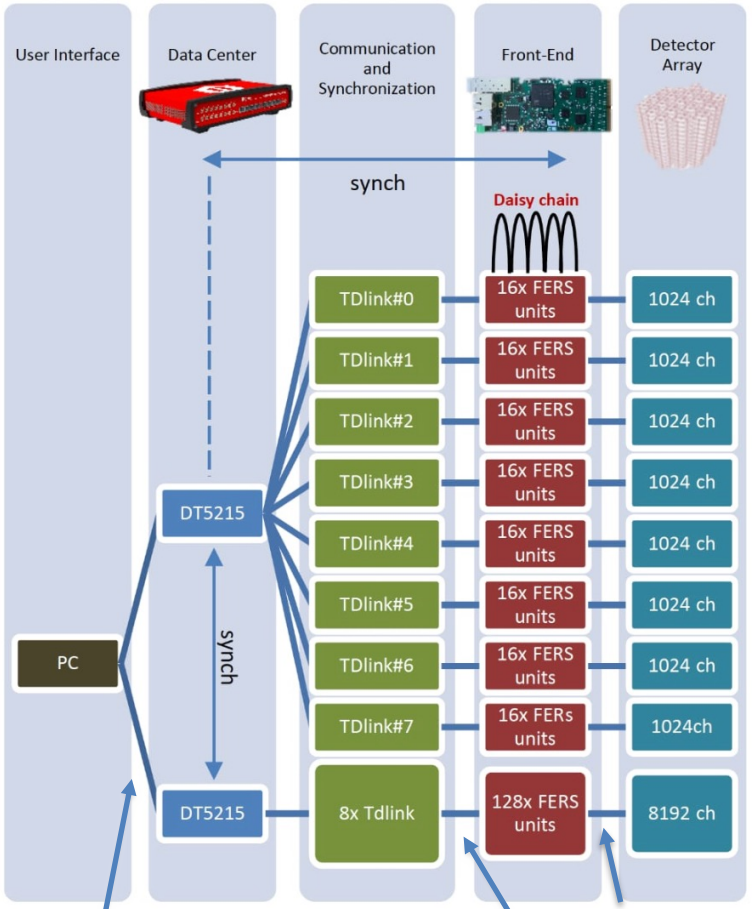
Dec. 6, 2023
TMS Meeting

CAEN Off-the-shelf Option

A5202 Front End Readout System (FERS)
– 64 or 128 channel version



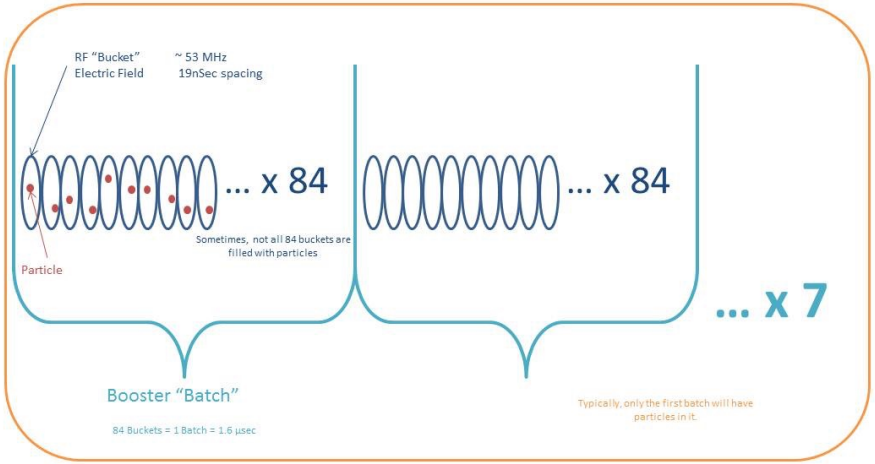
DT5215 (Concentrator Board)
– Up to 8192 channels per DT5215



TMS: 19200 channels
→ 3-each Concentrator Boards
→ 300-each 64 channel A5202 or
150-each 128 channel A5202

Basic Measurement Needs

- Signal timing and magnitude per channel
- “deadtime free” for our timing and occupancy pattern



- Trigger requirements:
  - Global
  - Self triggered
  - Programmable trigger sequence
  - Free streaming data readout

7 Batches = 1 MI Cycle (11.2 microSec)

≈ 530 filled RF buckets ≈ 10 µs

Repeat every ~1 s

Questions about CAEN Electronics

Three different operating modes

1. Spectroscopy mode
   a) 10 µs dead time due to A/D conversion on (Citiroc chip) → seemed unlikely candidate operating mode
   b) Asked questions to confirm our understanding
   c) discussions were useful to gain insights into some of inner workings
2. Timing mode
   a) each channel operates independently
   b) Near deadtime less
   c) Can measure time and time over threshold (ToT) as approximation of signal amplitude
3. Counting mode (not suitable)

Other questions

Questions about CAEN Electronics

Timing mode

a) Near deadtime less

- some saturation due to readout bandwidth may occur; CAEN tested up to 10 MHz

→ perform follow-up measurements

→ Get more accurate estimate of occupancy due to events from TMS steel and rock walls

b) Can measure time and time over threshold (ToT) as approximation of signal amplitude

- ToT about RMS ～0.5% at 4.5 pC input signal

  (factor ～3 worse compared to spectroscopy mode)

  worse at lower input signals

Questions about CAEN Electronics

Timing mode

b) Can measure time and time over threshold (ToT) as approximation of signal amplitude

- ToT about RMS ～0.5% at 4.5 pC input signal
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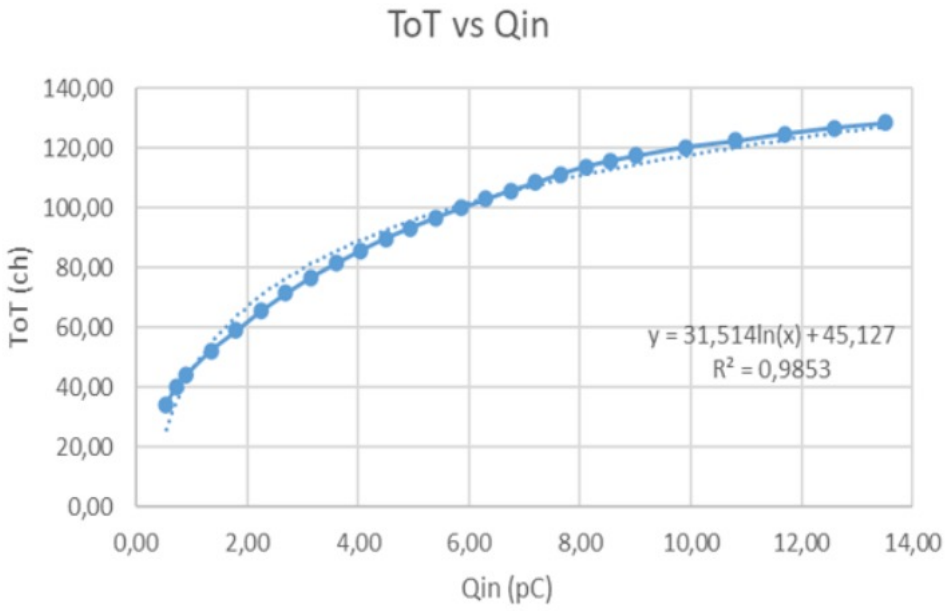
Check:

→ Time stamp and ToT matching

→ ToT vs Qin stability:

- Channel to channel; chip to chip
- Over time



Questions about CAEN Electronics

Other

- Trigger options
  - Global: ok ; self: ok ; trigger sequence: possible with firmware adjustments

→Some firmware programming may be required to accommodate our needs

→CAEN willing to work with us

- Potential issues due to channel count (19,200) ?
- Resets
- LED pulse triggers
- (long-term) availability

Meeting with CAEN Summary

- Productive meeting and detailed discussion over 2+ hrs
- No show stoppers identified
- Perform some prototyping/testing on our end
- CAEN open for more discussion/questions/follow-up

Other Prototyping Status News

- Long cable measurements started, first data in hand and findings under discussion by experts

- TMS scintillator (from mechanical prototype)+ WLS fiber soon to be shipped from ANL to LSU and UPitt for light yield measurements and checks
  - WLS fiber diameter

  → Choice of SiPM

  → Noise

  → Effect on electronics

Tentative Timeline and Milestones

Working backwards:

Aug. 2023:
- Information gathering (including electronics requirements)
- Identify range of options to consider:
  - (dis)advantages, unknowns, limitations, …
- start identifying required test measurements and prototyping needs

→ Rule out non-viable options [none so far]

Sept. 2023:
- Prioritize prototyping/testing tasks and development needs
- define associated program
  - Person power
  - Existing and (possibly) new test stands

→ Limit tasks to most promising and feasible options

Oct. – Dec. 2023:
- Execute prototyping and development program
- Document outcomes, conclusions drawn and decisions taken
- Refine program based on (intermediary) results and issues identified

} Bureaucratic and logistics delays …

Jan. 2024:
- TMS electronics design largely defined and agreed upon

Feb: 2024:
- write draft PDR + review/editing