SBS HCAL – FADC update

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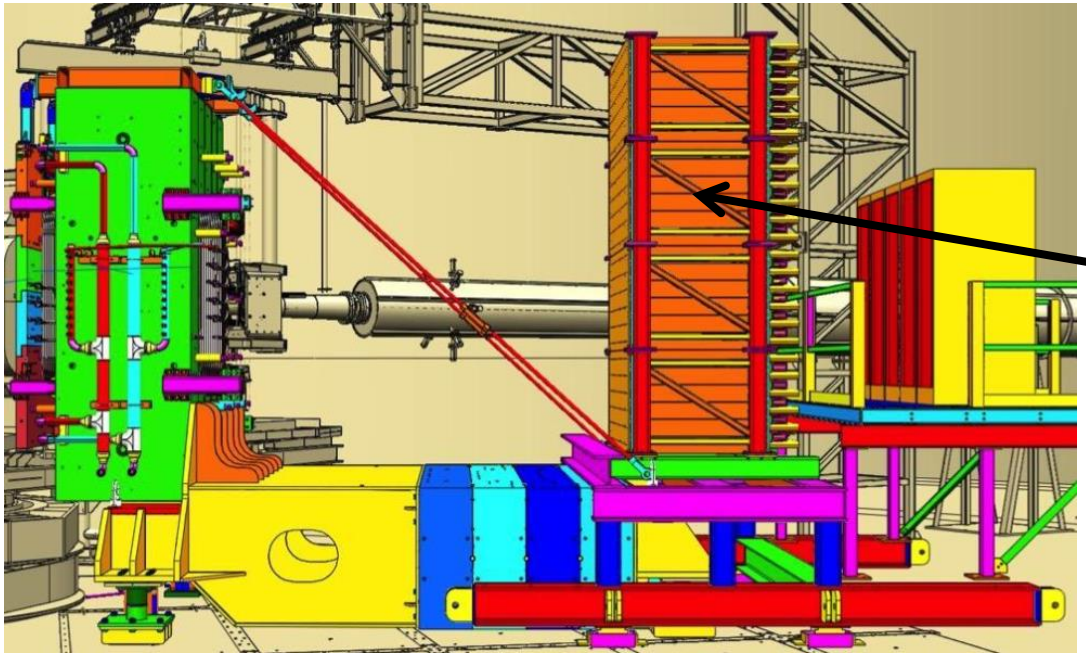
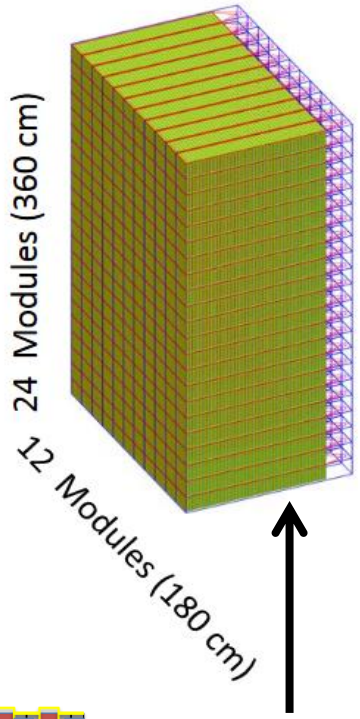
Outline

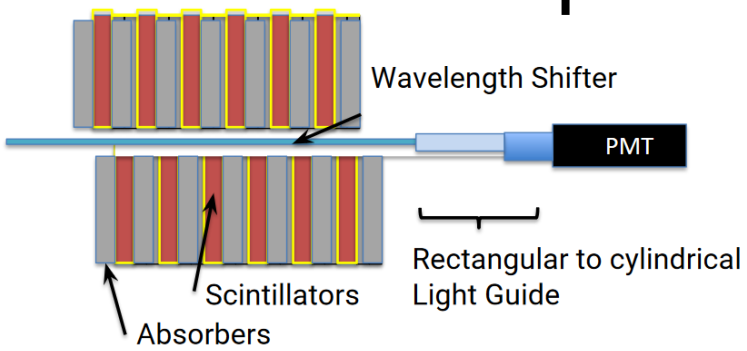
- SBS – brief overview
- DAQ:
  - ❑ Timing
  - ❑ fADC signal sampling
  - ❑ Trigger: cluster finding and coincidence
  - ❑ VETROC implementation for geometry matching

Overview of HCAL design





- 288 modules
- Expected rates of 1.5 MHz of singles



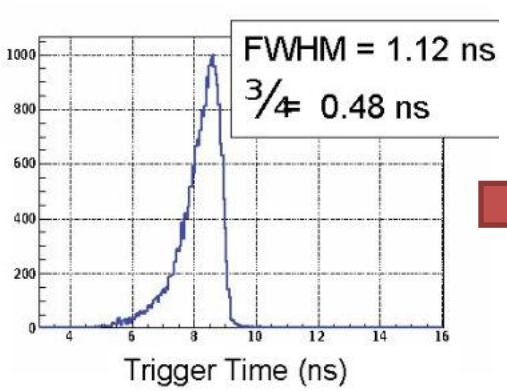
(Camsonne, Super Bigbite Collaboration Meeting, July 2017)
(Cornejo, Super Bigbite Collaboration Meeting, July 2017)
(Franklin, Super Bigbite Collaboration Meeting, July 2015)

HCAL – DAQ requirements

Timing:

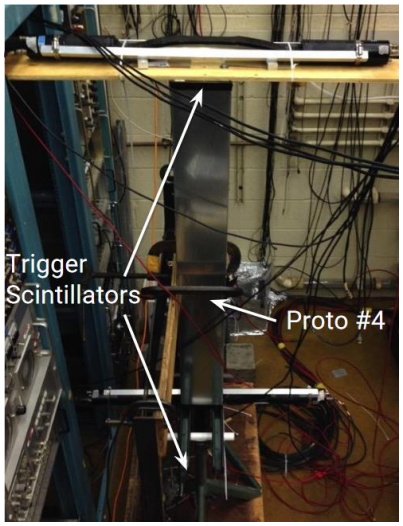
- To be better than 1.0 ns (so one can use TOF to remove inelastic)

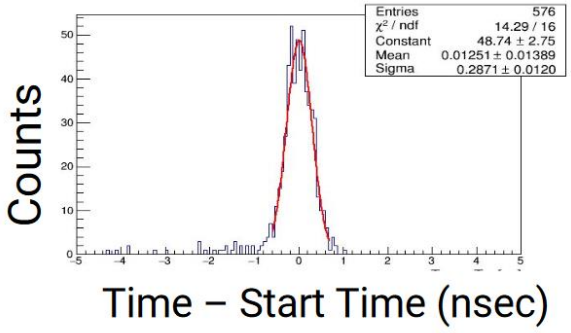
Simulation



(Gregg's DOE review)

Prototype test with cosmic rays (CMU)





Timing resolution of module:
277 ps for cosmics

- To use VETROC or F1-TCD: high resolution TDC

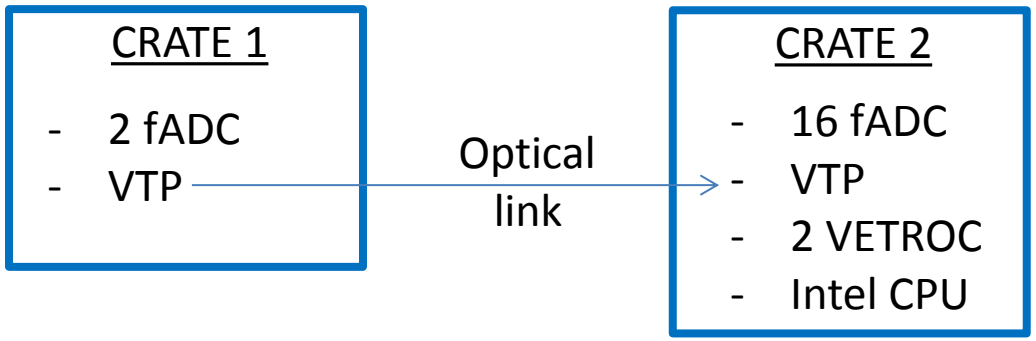
- We need to better understand effects of pile-up
  - Simulation
  - Test run

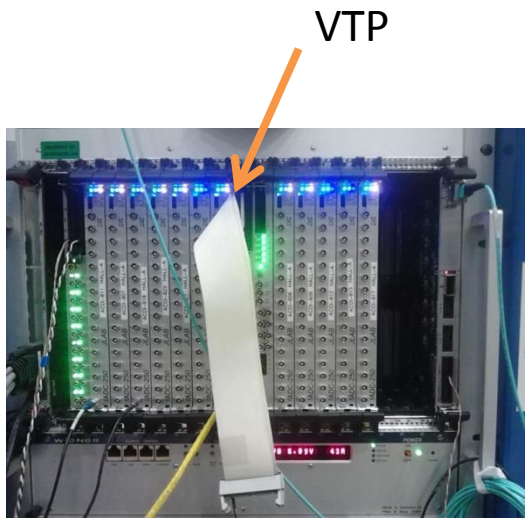
HCAL – DAQ requirements

Energy:

- Use of fADC 250 MHz (12 bit)
- 288 channels ➔ 18 fADCs modules

2 crates needed + 2 VTP modules (clustering)
2 VETROC (coincidence with ECAL)





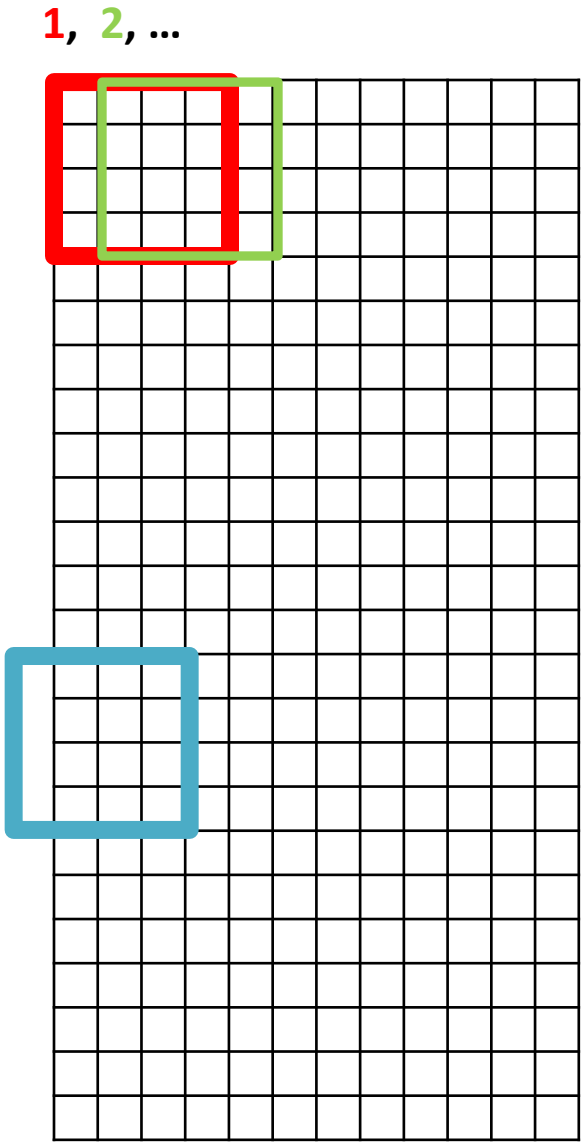
- Mostly running in raw data mode (samples within 40ns)
- We have these modules, most of them in the TestLab
- Running tests for setting up trigger now…

HCAL – DAQ requirements

Trigger:

- HCAL to be part of the trigger
- 95% efficiency with trigger threshold at 25% peak signal
- Require VTP programing for clustering and coincidence

- Clustering:
  - Form regions with 4x4 channels
  - Total number of possible regions: 189
  - How about the edges? (Bogdan suggestion)
    - We lose part of the shower out of the calorimeter
    - Possibility of considering 3x4 regions on the edges, perhaps with a lower threshold?

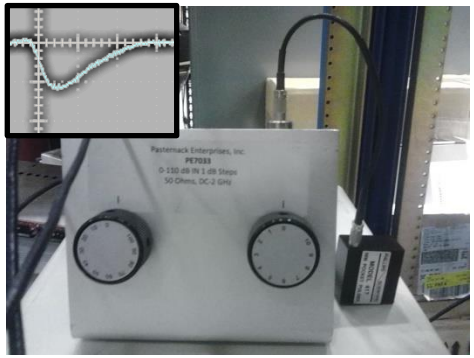


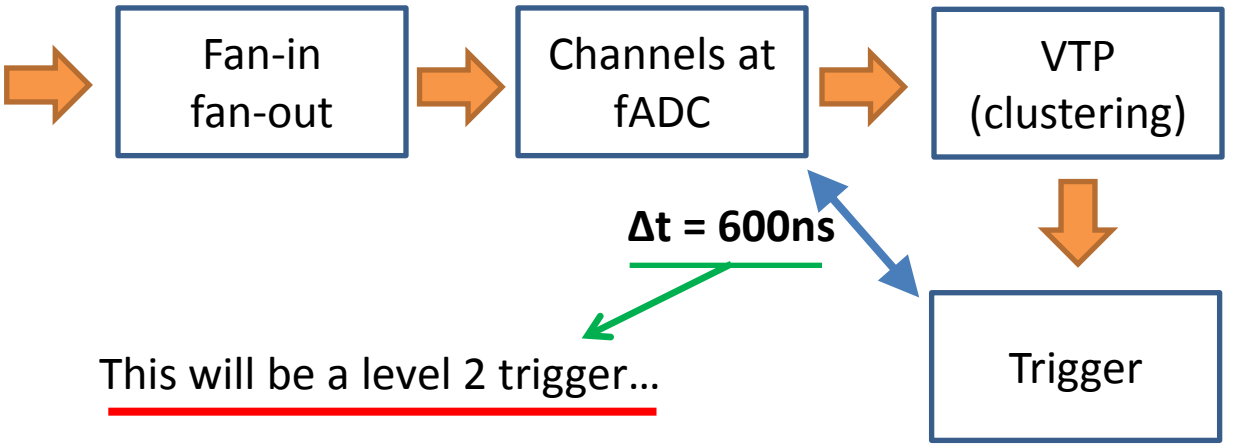
HCAL – test of trigger formation

Trigger:

- Clustering:
  - Status
    - Ben Raydo implemented in VTP already!
    - Taking 9 clock cycles to run (can be optimized if needed)
    - Tests undergoing:

NIM 417 pocket pulser 1.2V@6ns
+ attenuator





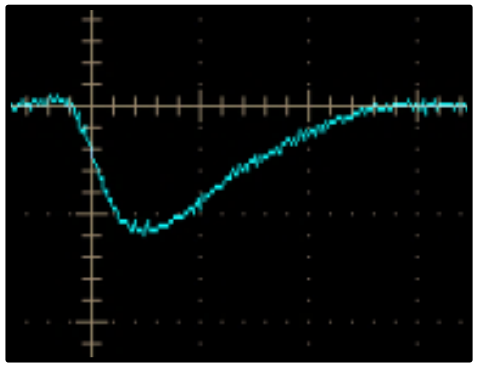
HCAL – offline analyzer

- Offline analyzer updated to decode raw data from HCAL (by Juan Carlos Cornejo)

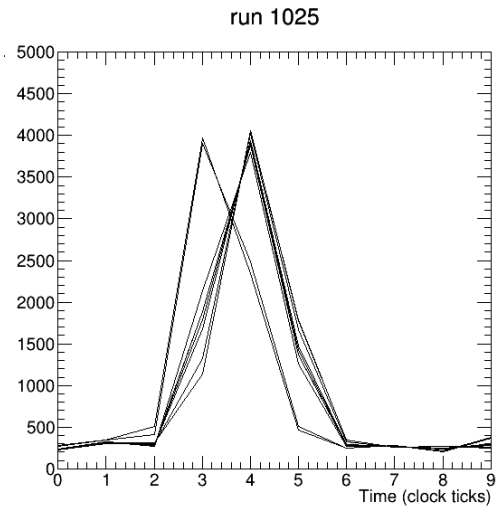
- Pedestal subtraction and gain applied to data - reading from a database

- First tests:

  - Raw data reading (first 10 events):



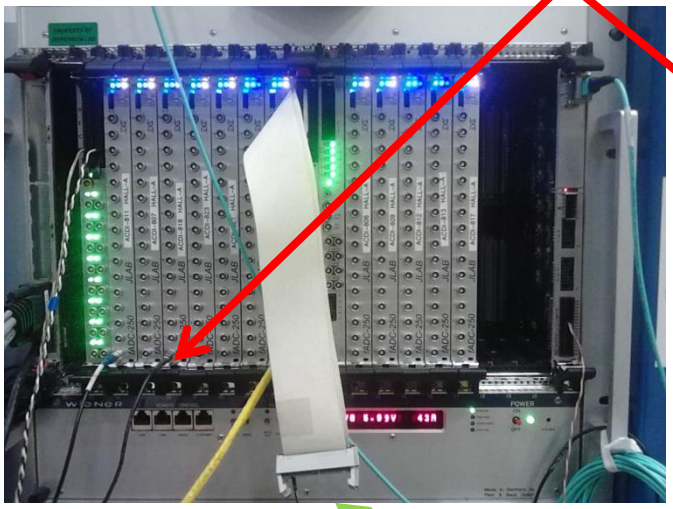
(from NIM pulser)

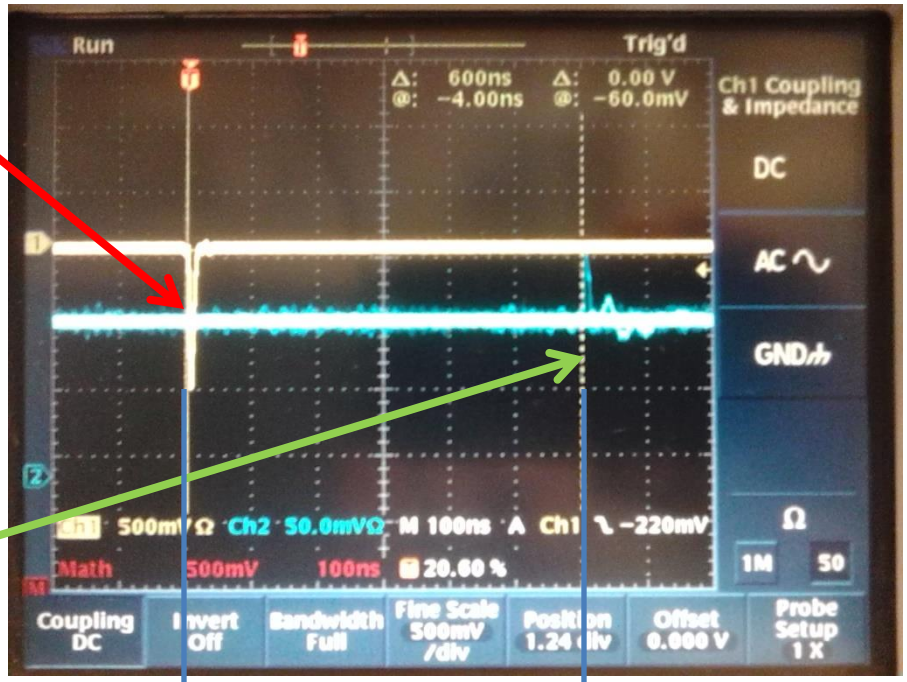


  - Tests of trigger from cluster undergoing

VTP Time

NIM Pulser – input fADC





Output trigger from VTP

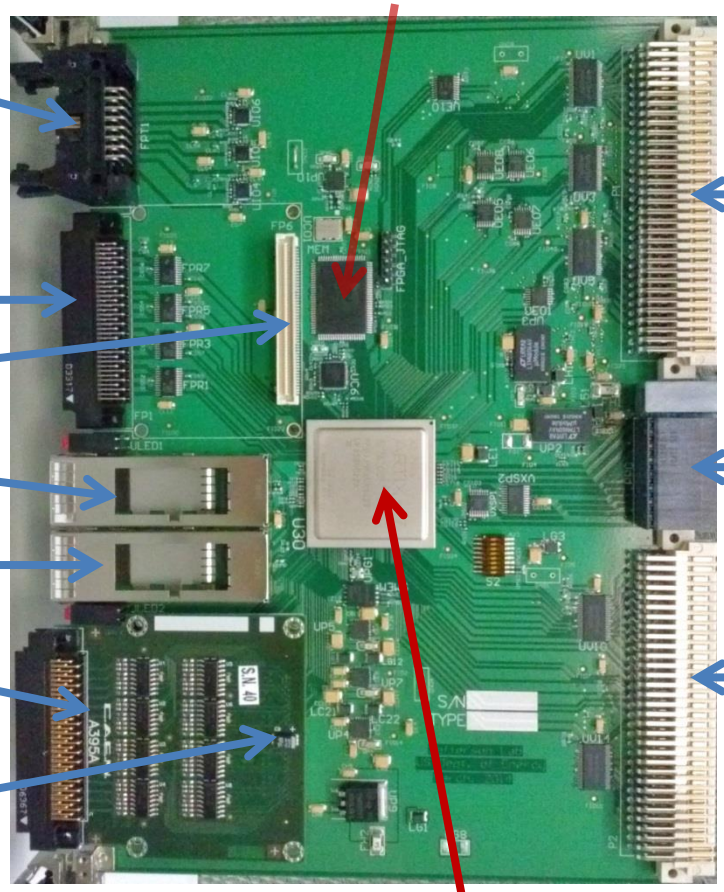
Δt = 600 ns

VETROC board

- Developped for Compton and SoLID MRPC
- 64 input + 8 input and 8 output
- Extension with mezannine to 128 channels (compatible with V1495 mezzanines)
- additionnal 64 channels with back daughter board
- Optical link
- VXS link for triggering purpose
- Will try to develop high resolution TDC (possibly 25 ps resolution)
- Estimate price around 2.5 K$ for 64 channels and about 4 K$ for 128 channels

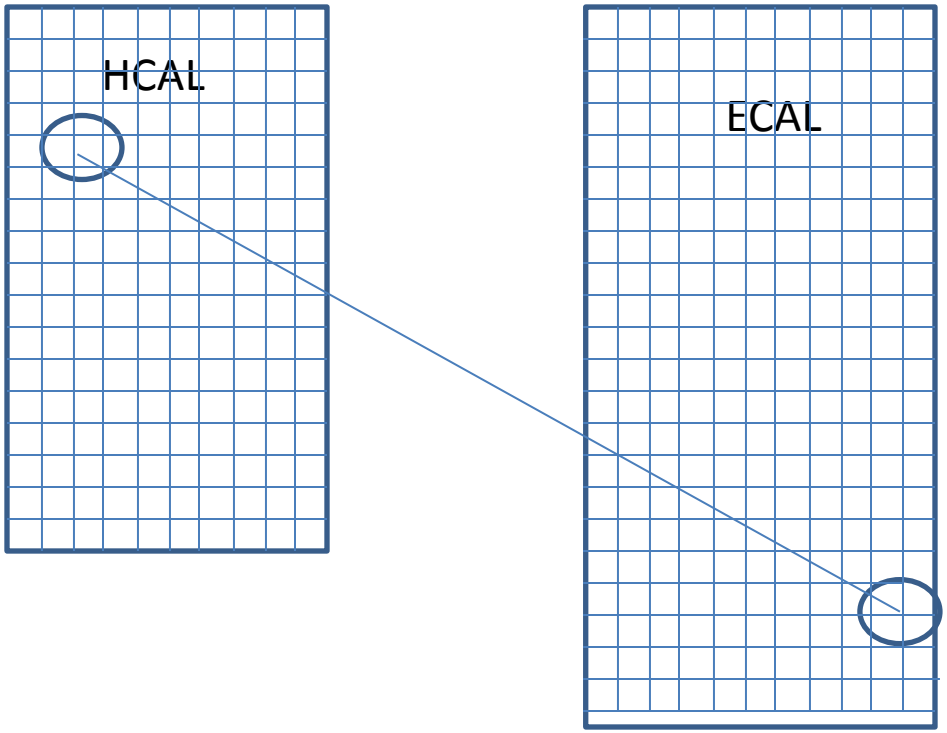
vXS fPGA-based Time to Digital Converter (vfTDC)

preliminary



HCAL VETROC

- Take all ECAL sum
- Look up table from simulation
- Test trigger speed and efficiency



Status

- Have hardware : 2 VETROC
- Need to have signal from VETROC to VTP
- Implementation by Ben, getting a try to implement it
- Eventually need correspondence matrix from Montecarlo

Conclusion

- Marco tested basic trigger functionality with pulser
- Might be interesting to look at cosmics
- Need to add VETROC
- Need look up table