GEM readout-status, issues and concerns

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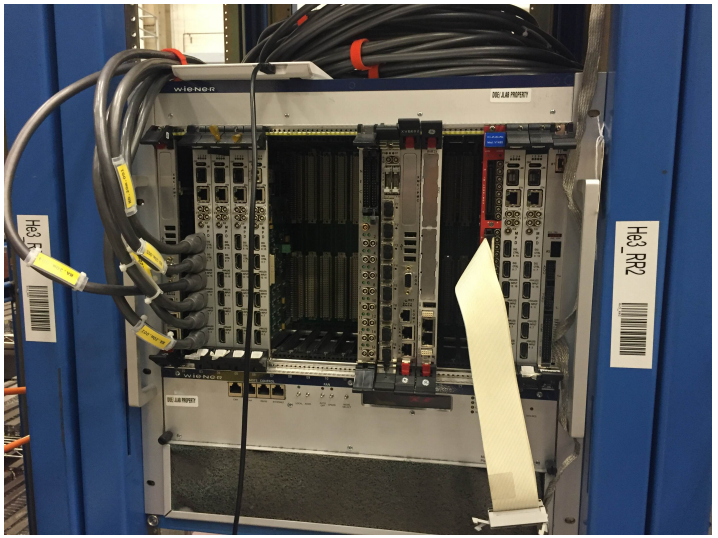
SBS Collaboration meeting

Outline

- Current MPD(3.0) setup
- Readout Rate
- Summary

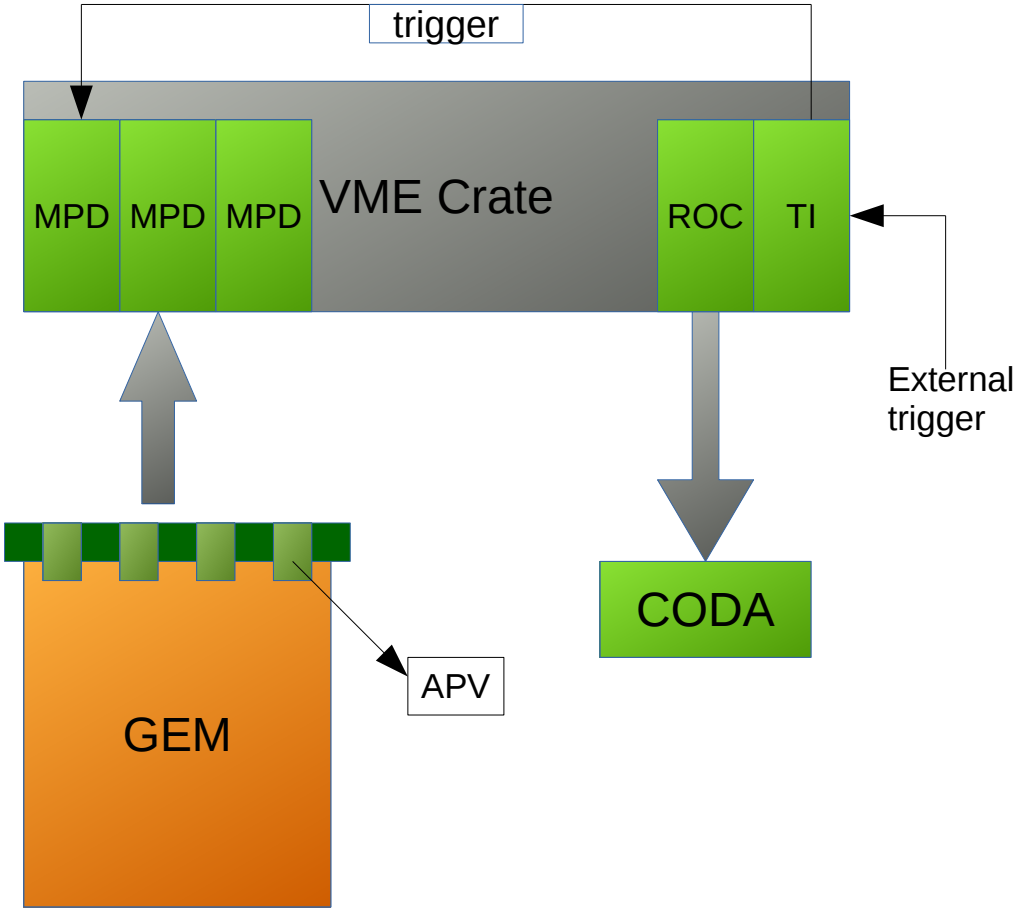
Current MPD(3.0) setup

MPD(Multipurpose Digitizer)

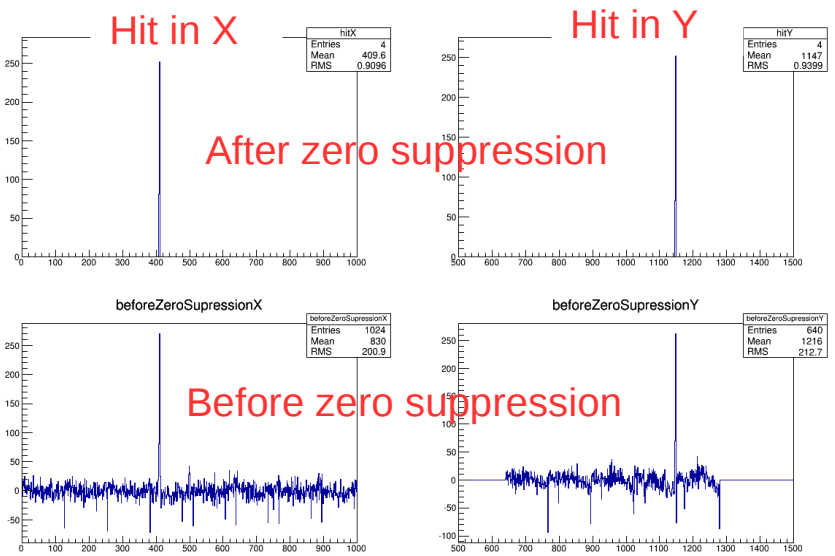


VME crate with ROC, MPD and TI

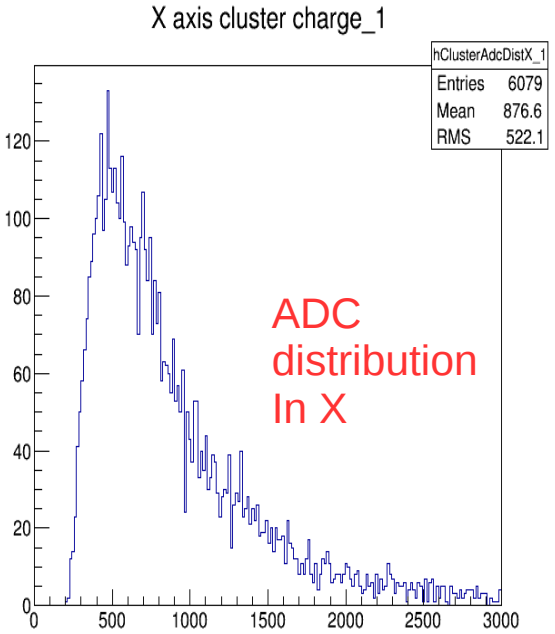
Each MPD module reads up to 16x128 channels

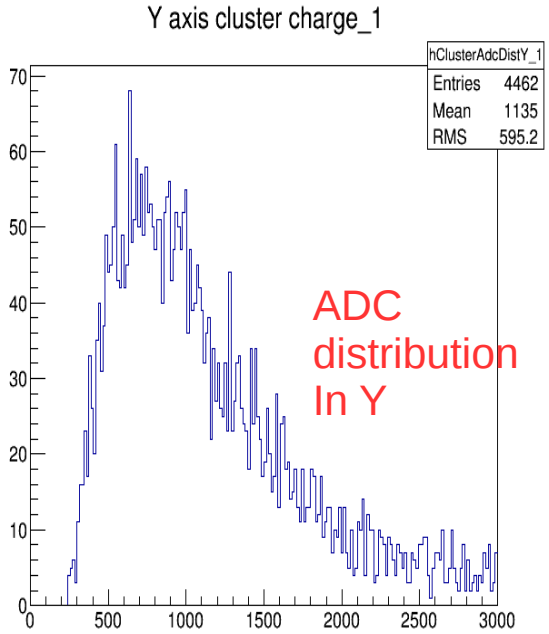


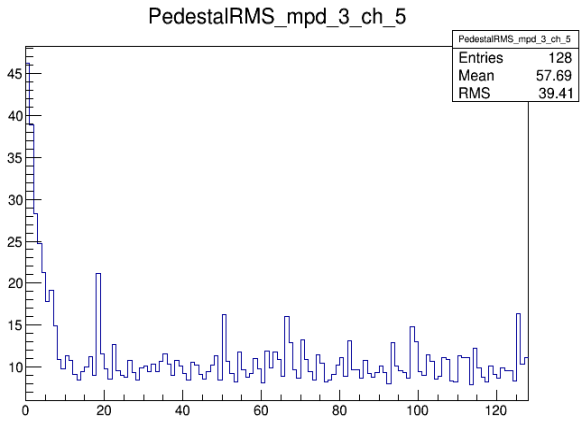
^{90}Sr data on a 60x50cm GEM at Test Lab



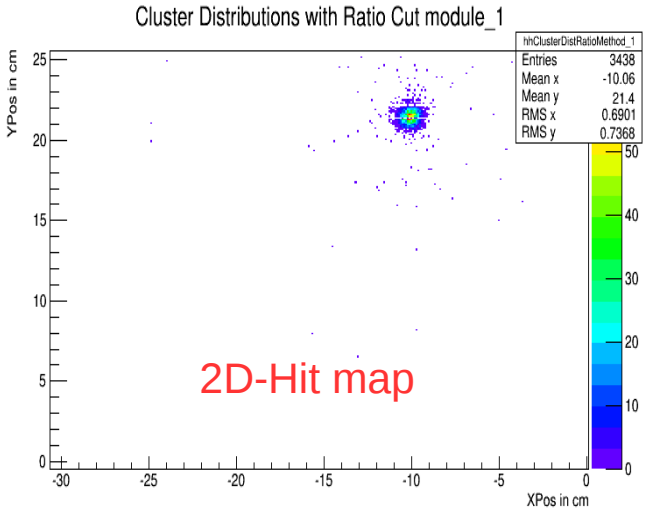
Zero suppression

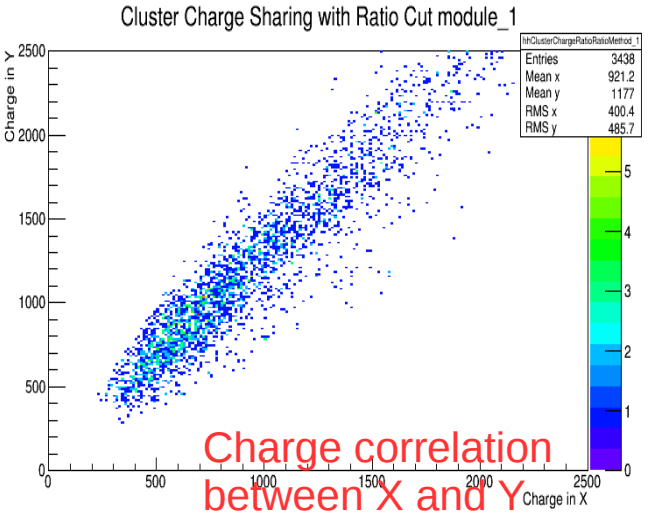






RMS of pedestal noise of 128 channels on APV-25





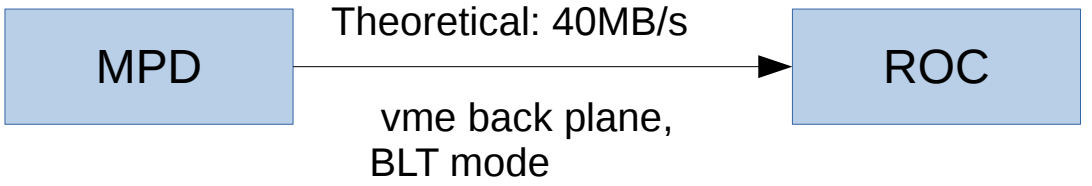
Hit cluster reconstruction

Rate capability-current status

Busy time measured with 1 APV in BLT block transfer mode(theoretical maximum: 40MB/s)

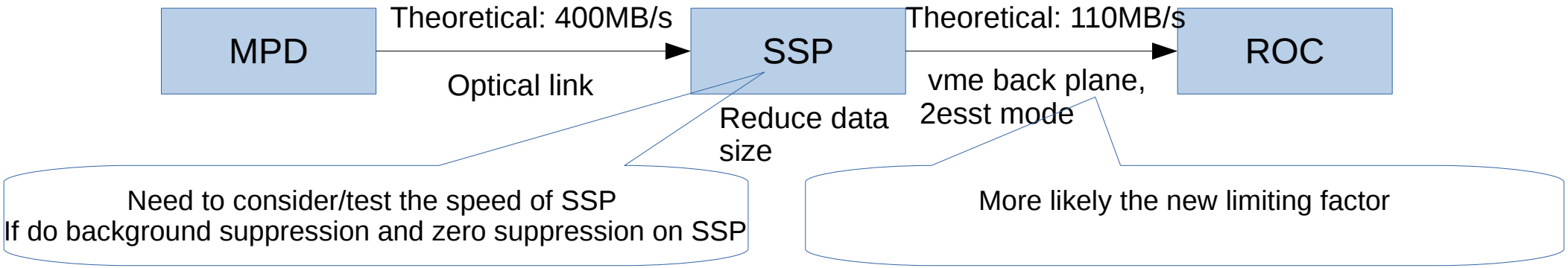
Readout mode	Total busy time (overhead+data transfer) (μs)	Number of words transferred	Actual transfer speed
3 time sample	130(60+70)	390(1560Bytes)	~20 MB/s
6 time sample	200(60+140)	780(3120Bytes)	

- Fully loaded MPD(15 APVs, calculated from the linearly increased busy time of 1,2,3,4 APVs):
  busy time (15 APV, 6 time sample, BLT mode): ~2500μs



Rate capability-in near future MPD4.0 setup

- Expect huge increase with new setup, optical link provides 10 times higher transfer speed from MPD to SSP
- Also, Evaristo and Paolo is combining two channels' 32-bit data(actual size 16-bit) into one 32-bit word in the MPD firmware. This can increase rate by a factor of 2(from MPD to SSP, so with Optical link this should not be a limit anymore)
- After these, the busy time would be about 125μs, 4KHz should be fine.
- The new bottle net would be from SSP to ROC(which talking through vme back plane) or the processing speed of SSP.
  In case of 24 MPDs are connected to each SSP, the 6 time sample data size at 4kHz is 2000MB/s. So there need to be a factor of 36(=2000/55) reduction on the data size. It needs to be done by deconvolution and timing cuts for back ground suppression, which needs considering the processing power of SSP and how much background suppression cuts can offer.(Need to test, not easy to achieve)
  Solution may be:
  1. Decrease number of MPDs connected to SSP.
  2. Higher speed transfer method from SSP to ROC(optical link?)
  3. Using information from other detectors to determine rough region of hit
- Another limit comes from the disk writing speed. 250MB/s for all 880 APVs for back tracker has roughly same limit as SSP-ROC transfer do. So if we plan to upgrade, we better do both.



Summary

What's done:

- Using BLT mode block transfer, MPD(firmware version 3.0) is fully working with CODA, busy time 2.5 ms, tested
- Analysis software mostly ready(except tracking part).

Work ongoing and to do:

- Seamus and Charlie is implementing the standalone analysis software into HallA analyzer.
- Test MPD 4.0 in these two weeks. For getting optical link between SSP and MPD to work(Evaristo, Paolo and Bryan). After this we can test the readout rate of the new setup, with different methods to reduce data size at SSP.
- Evaristo and Paolo is going to pack the data(16-bit, but currently occupying 32-bit space in MPD) into 32 or 64 bit words in MPD to increase readout speed by factor of 2.
- Preparing to test MPD in DVCS and gmp experiment in October.

Challenge and things to finalize:

Challenge is mostly about readout speed.

- Will we do zero suppression in MPD
- At SSP level we need to reduce data by large factor.
  To upgrade, we can either reduce number of MPDs connected or change transfer type from SSP to ROC.
- Tracking code. (going to be tested in October beam test)