Thought of creating Target Incident Data by Simulation

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AI Data monitoring

1/28/2021

Challenge to create sample data in simulation

- Systematic study of integrated signal and individual signal
- Statistics
  - How many POT?

Systematic study: Integrated vs Individual (I)

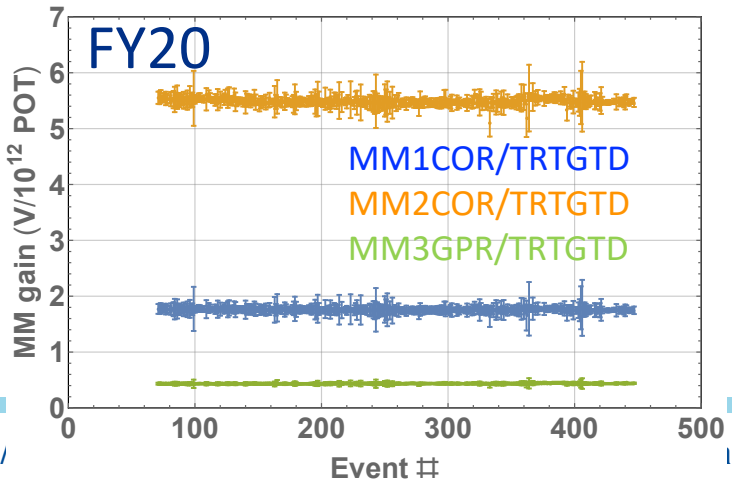
- Accuracy of integrated signal can be 2 % (or maybe 1 %)

ACNET Index

MUON MONITOR "Acnet Index" (seen from beams eye view)

Tube #, Column / Row	1	2	3	4	5	6	7	8	9	
1 upper left	152	161	170	179	188	197	110	119	128	upper right
2	153	162	171	180	189	198	111	120	129	
3	154	163	172	181	190	199	112	121	130	
4	155	164	173	182	191	104	113	122	131	
5	156	165	174	183	192	105	114	123	132	
6	157	166	175	184	193	106	115	124	133	
7	158	167	176	185	194	107	116	125	134	
8	159	168	177	186	195	108	117	126	135	
9 lower left	160	169	178	187	196	109	118	127	136	lower right
	hv feed throughs are here									

- In acnet code speak:
  - E:HADCOR = { SUM(i= 104, 152-199) [(E:HADMDS[i] – E:HADMPD[i])*hadcal[i]] } * [1.0 - 0.00105*(E:HMGPR - 700.0)].
  - E:MM#PRC = { SUM(i= 104, 152-199) [(E:MMA#DS[i] – E:MMA#PD[i])*mm#cal[i]] } * [1.0 - 0.00105*(E:MM#GPR - 800.0)].



Layout of MM pixel

Integrated signal

- MMA#DS is a signal when the beam is turned on
- MMA#PD is a pedestal when the beam is turned off
- Gas pressure is calibrated
- mm#cal is a individual signal calibration

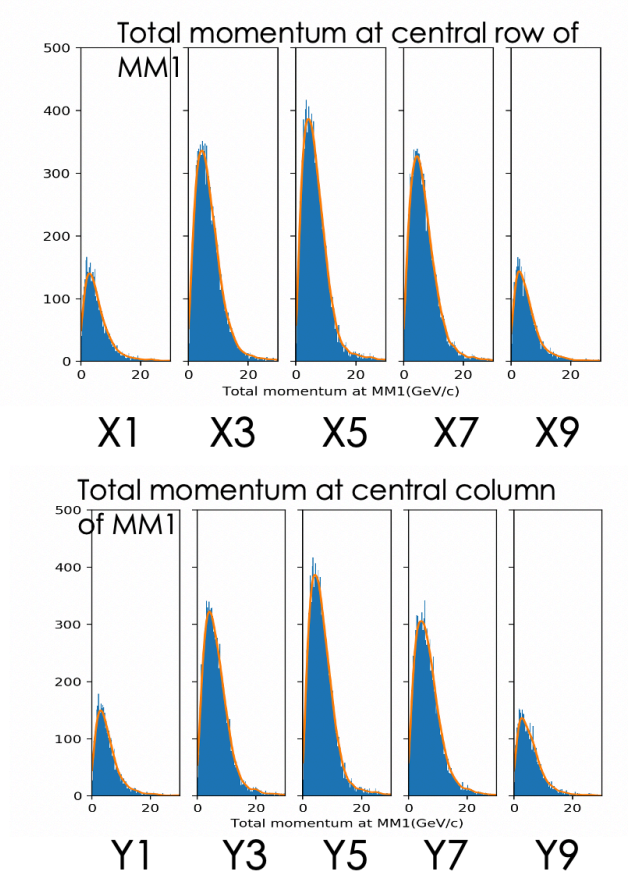
Fermilab

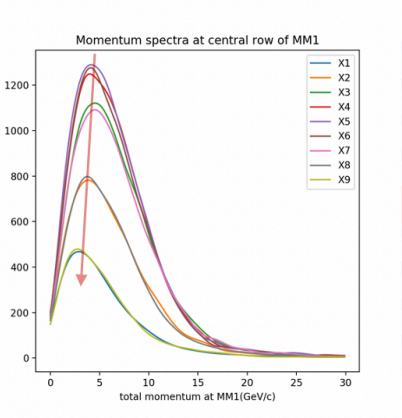
Systematic study: Integrated vs Individual (II)

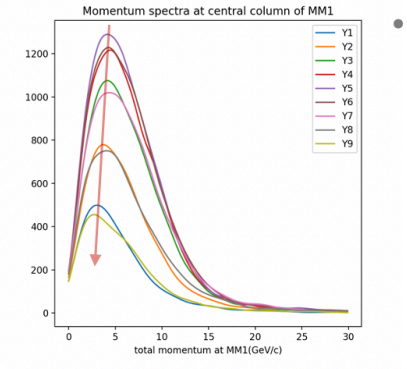
- What pions (phase space) does individual pixel observe??

Y. Yu

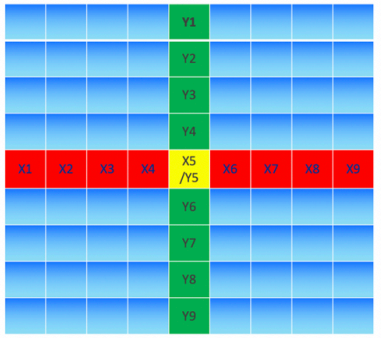
Different spectra for different pixels







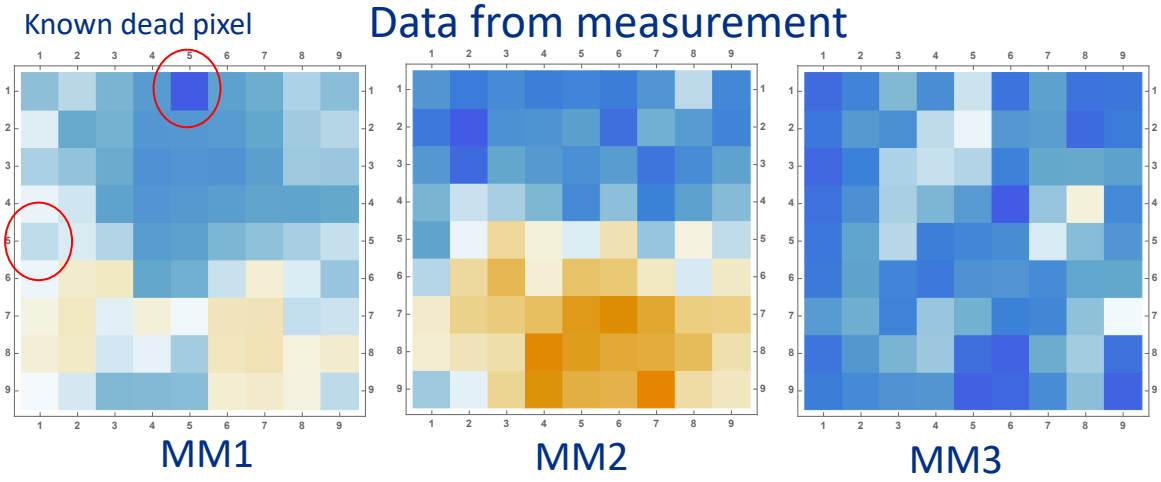
MM1



- The peaks of the spectra move to low momentum from center to edge of MM1.

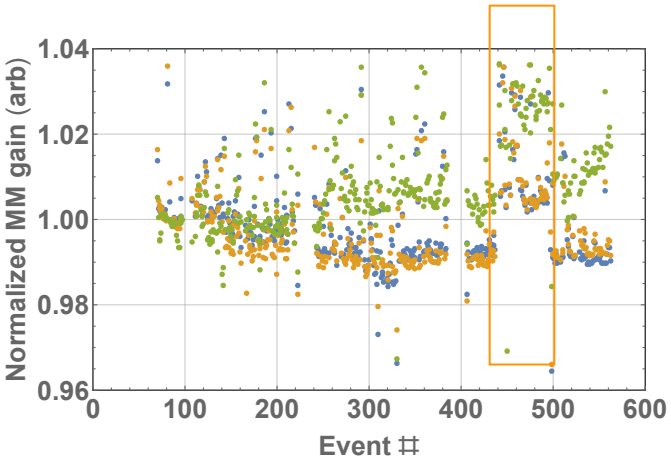
Systematic study: Integrated vs Individual (III)

- Proton beam position is offset by -0.05 mm in y direction
- Plots on right-hand-side show the deviation from the reference signal

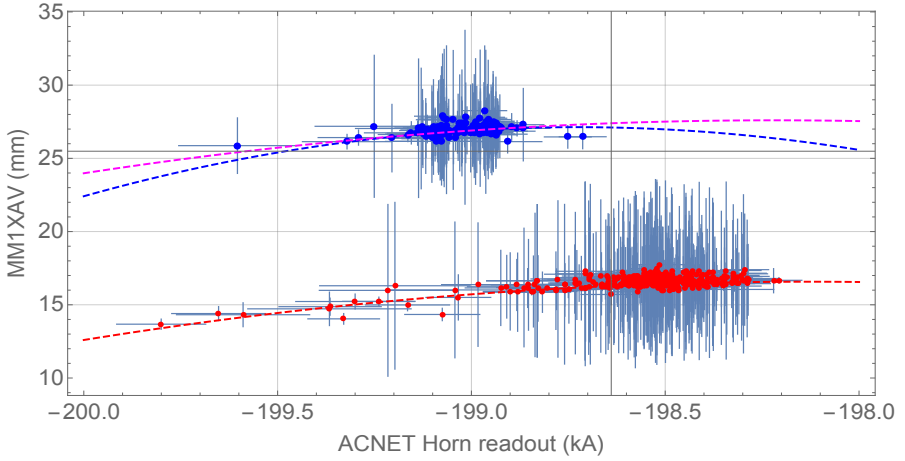


Other primary parameters to affect on the mm signal gain

Bad gas



Horn current



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Statistics in simulation

- Need know POT vs accuracy
  - This value tells us the required simulation time to create one event
  - This is also needed to propose the run time to High Power Computing facility (like NERSC)
- Example
  - Create sample data for missing target fin
  - AI needs 1,000 samples for training
  - Target has 48 fins
  - Total sample events 48,000
  - If the required run time to create one event is 1-hour (I guess this value is very optimistic even we use HPC), we need 48,000 hours of running simulation
  - Combine other conditions (e.g. two missing fins, etc), number of conditions become infinite

Possible alternate ways

- May pre-weighted a neural network from physics point view
  - Find a correlation among individual pixel with a specific physics condition, like horn current dependence or beam position dependence
- Develop different AI algorithm
  - So far, I have no clue on this idea…