

Front Tracker Status

E. Cisbani / RM / R

SBS Weekly Meeting

2015 Jan 14

BA=Bari
CT=Catania
GE=Genova
LE=Lecce
RM=Roma-ISS

E=Engineer
P=PhD Student
R=Researcher
S=Student
T=Technician

E. Bellini / CT / R
S. Colilli / RM / T
A. Del Dotto / RM / P
C. Fanelli / RM / P
F. Giuliani / RM / T
A. Grimaldi / CT / T
F. Librizzi / CT / R+T
M. Lucentini / RM / T
P. Musico / GE / E
R. Perrino / BA+LE / R
L. Re / CT / S
F. Santavenere / RM / T
D. Sciliberti / CT / T
C. Sutura / CT / R

(all part time involvement)

Production/Test Summary

	Produced or Assembled	Tested or under test	NOT Accepted	Comment
GEM foils	51	33	7	2 can be probably recovered
Readout+Honeycomb	15 + 18	8	1	bad gluing, probably still usable
GEM Module	8 / 16	4		Test Beam; one with pressure compensation chamber
Front End Electronics	345 / 345	80	3 + 44	In latest delivery (11/14): 44 did not pass the power check (bad PCB quality for bonding ?) - under investigation
VME Modules	28 / 28	16	3	minor bug, maybe related to DAQ configuration procedure
Backplane	80 / 80	24		
Patch Panel	50 / 50	20		First delivery presented several bugs in connector soldering, returned to company and fixed

Electronics

- **Firmware Development**

- Major release under testing:
 - VME memory map reorganized;
 - Use external SDRAM;
 - Improved readout performance;
- Ethernet 1Gbit Optical Fiber successfully tested
- Multi-sample preprocessing under definition (estimate arrival time for improved trigger time correlation – better zero suppression) ⇒

- **Flexible backplane**

- Reduced material budget (< 1/3 respect to rigid version)
- 5 prototypes ordered

- **Open issues**

- Long cable noise pattern
- Card discovery procedure sometime fail due to I2C signal oscillations at start-up
- DAQ software for new firmware release

GEM module assembling

- 8 modules assembled (4 under test ...)
- Added pressure compensation chamber to one module; it required:
 1. unglue the gas connectors
 2. clean surface (avoiding dust inside the module)
 3. glue new frames
 4. cure gluing under some pressure

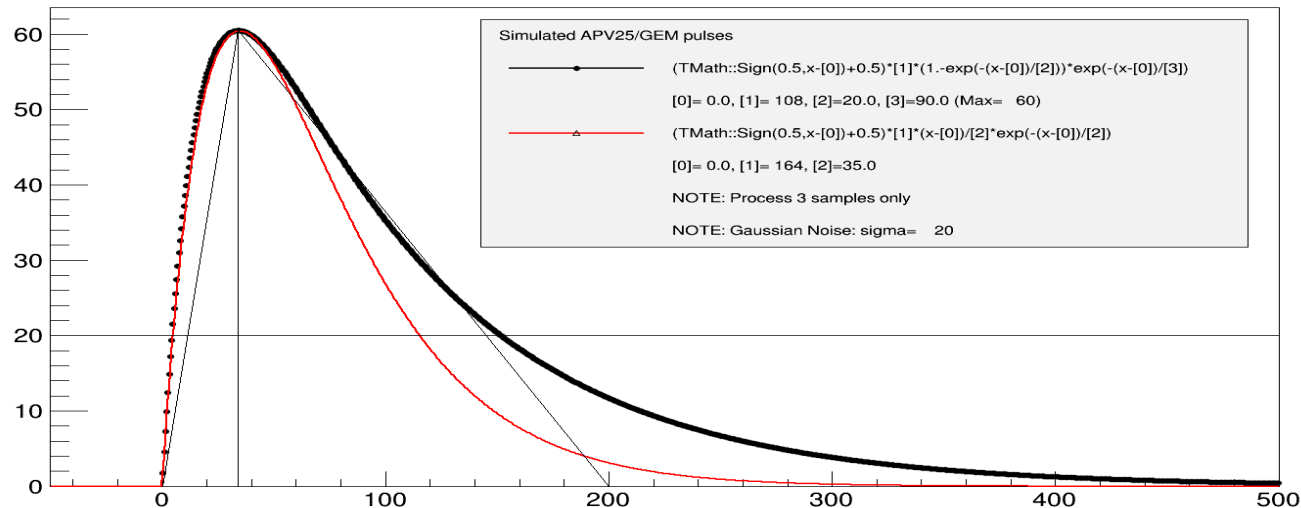
module likely damaged during glue curing due to mistake in vacuum bag operation (gas plugs not removed) → use «conventional» Pb bricks
- Plan to add the compensation chamber to the other 7 modules (next 4 weeks)
- Then continue assembling new modules (procedure slightly modified to include the pressure compensation frames)

Time correlation Estimation (1/2)

Main purpose:

find simple algebraic expressions for the estimation of the amplitude and start time (that can be implemented in hardware – FPGA)

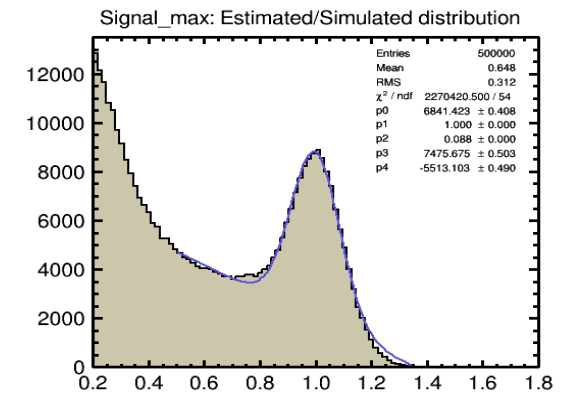
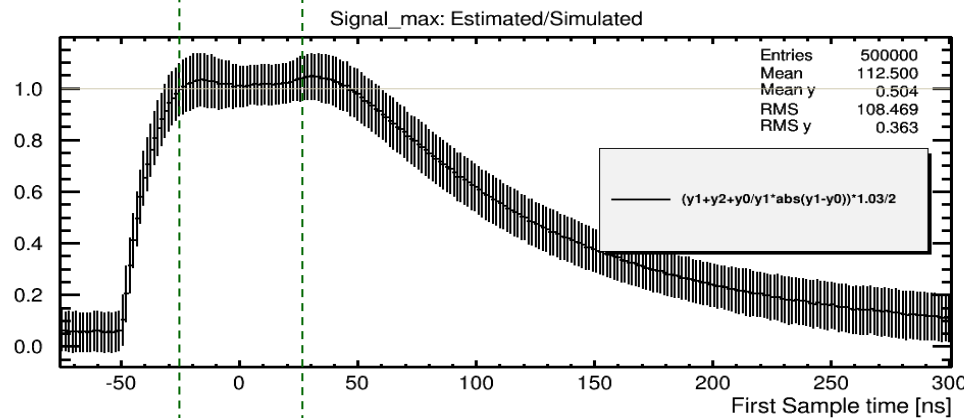
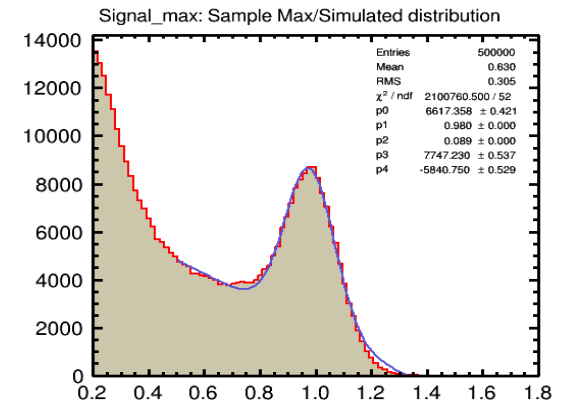
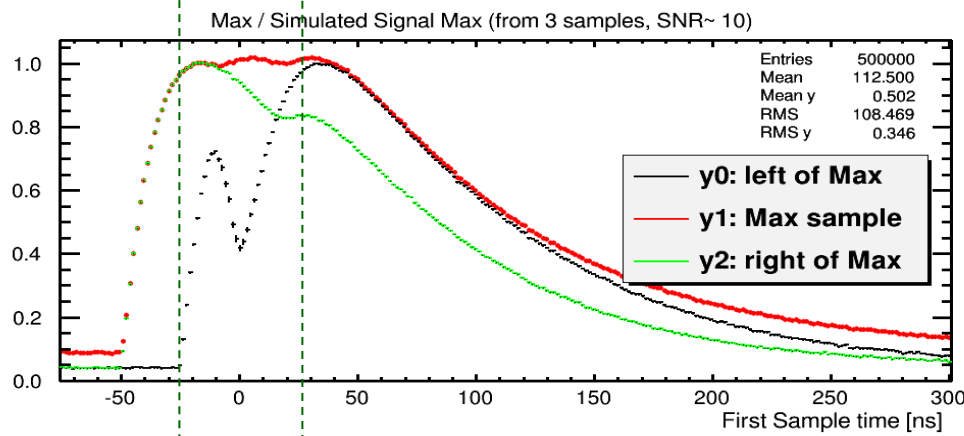
$$(TMath::Sign(0.5,x-[0])+0.5)*[1]*(1.-exp(-(x-[0])/[2]))*exp(-(x-[0])/[3]))$$



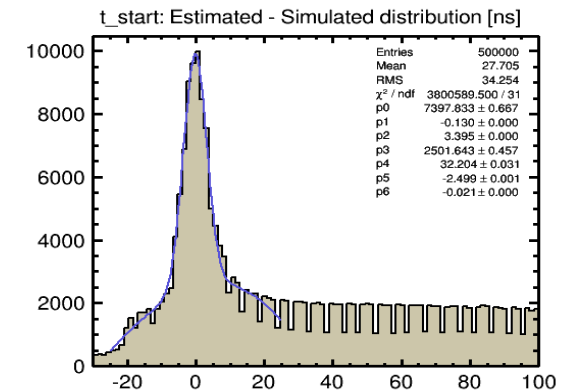
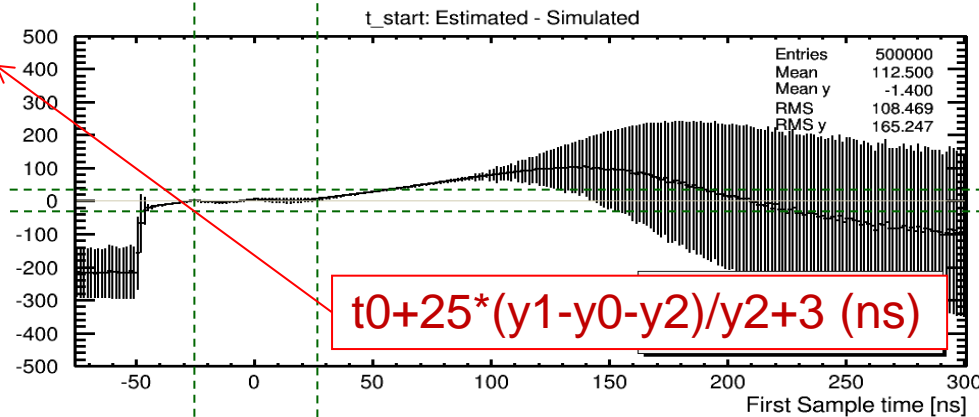
- Use analytic function for signal shape (above)
- Add random gaussian noise
- Sample at fixed period (25 or 75 ns) – take 6 samples
- Use simple expressions to estimate signal amplitude and start time
- Study difference estimated-simulated for amplitude and start time relative to:
 - SNR and first sample time (relative to signal start time)

Time correlation Estimation (2/2)

SNR=10



Try to implement in hardware



First sample within ± 25 ns (period) of the signal to get «good» estimation of time and amplitude

Dec 2014 / Short Beam Test @ COSY

4 Large GEM
modules + small
GEM reference

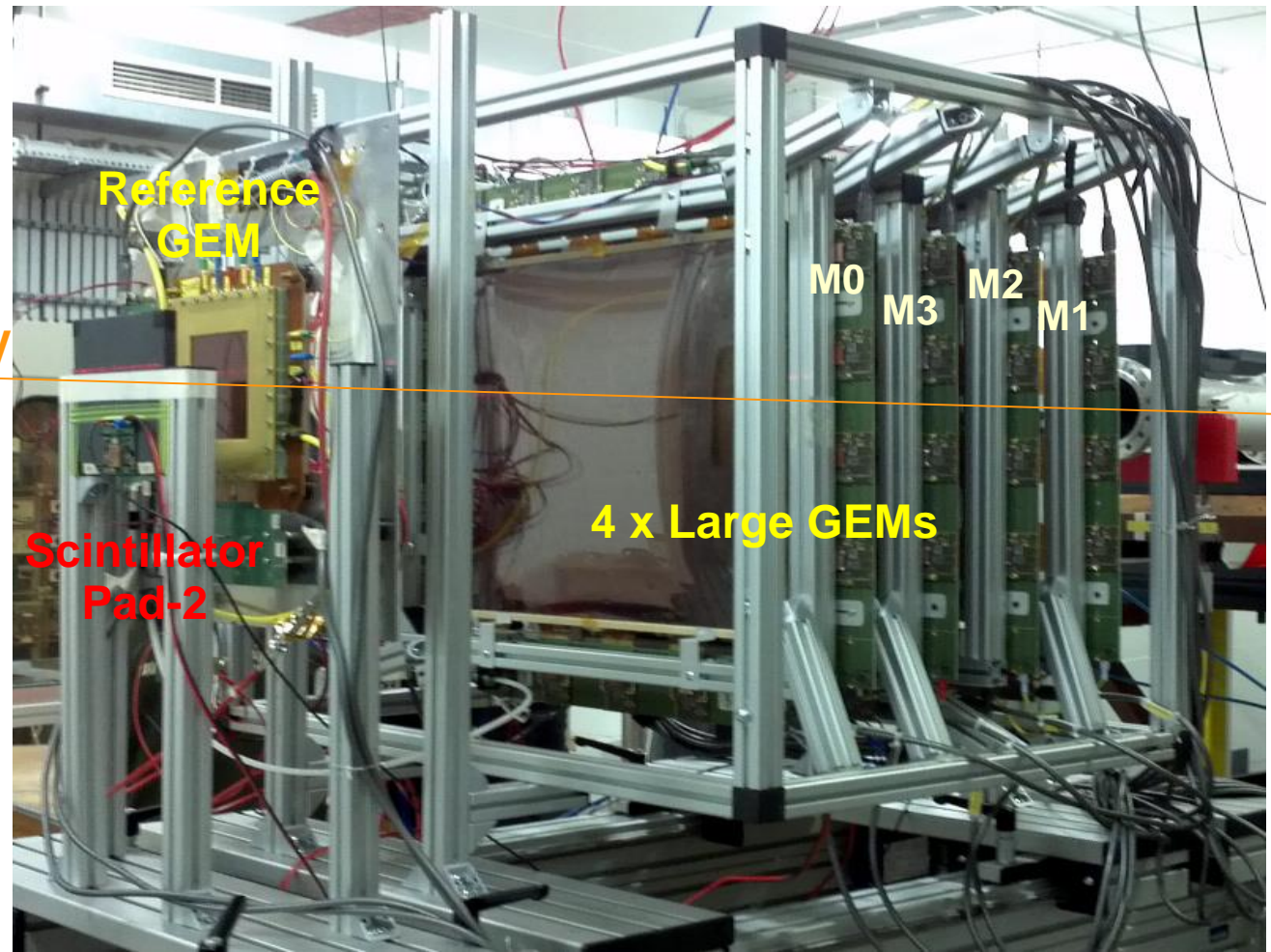
Main Goals:

- Study GEM response in high intensity proton beam; investigate HV and gas flow

2.8 GeV
Proton
Beam

Last minute
opportunity

3 days of data taking



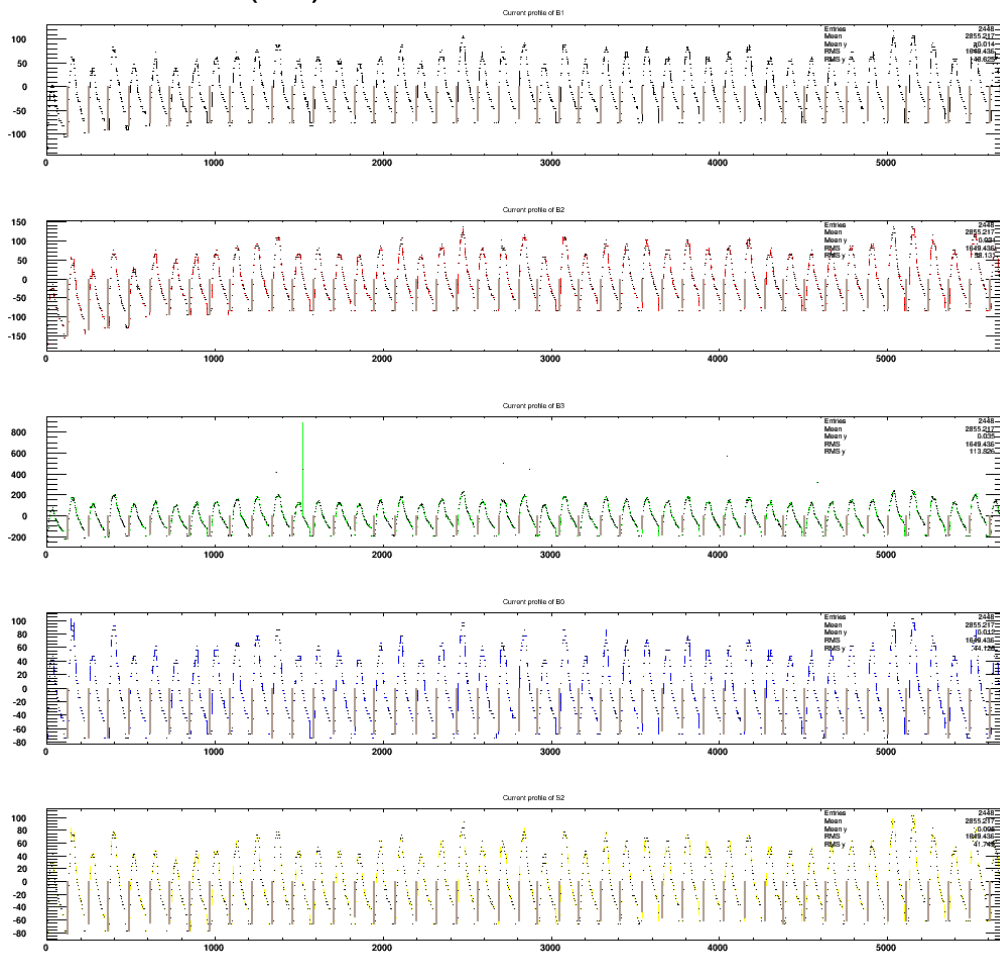
→ Runs at different:

High Voltage, gas flow, beam intensity, beam position

No feedback/monitor real time information from the accelerator

Beam Bunch and HV

HV Current (nA)

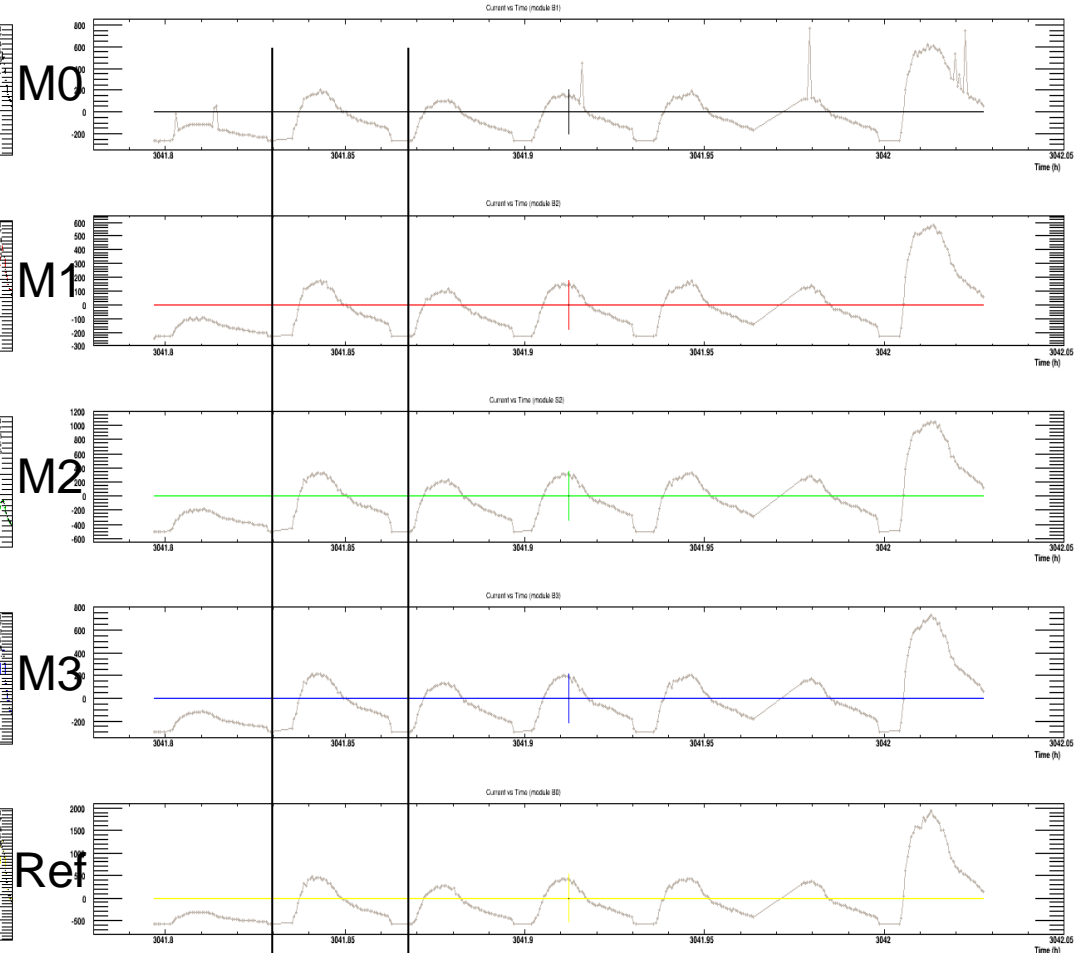


Time (min)

Beam Intensity: 1.4 , 8 , 16 x 10⁹ protons/bunch

Bunch length: ~ 122 s

Beam spot: ~ 10 cm²



Single bunch

HV Dividers (nominal resistors)

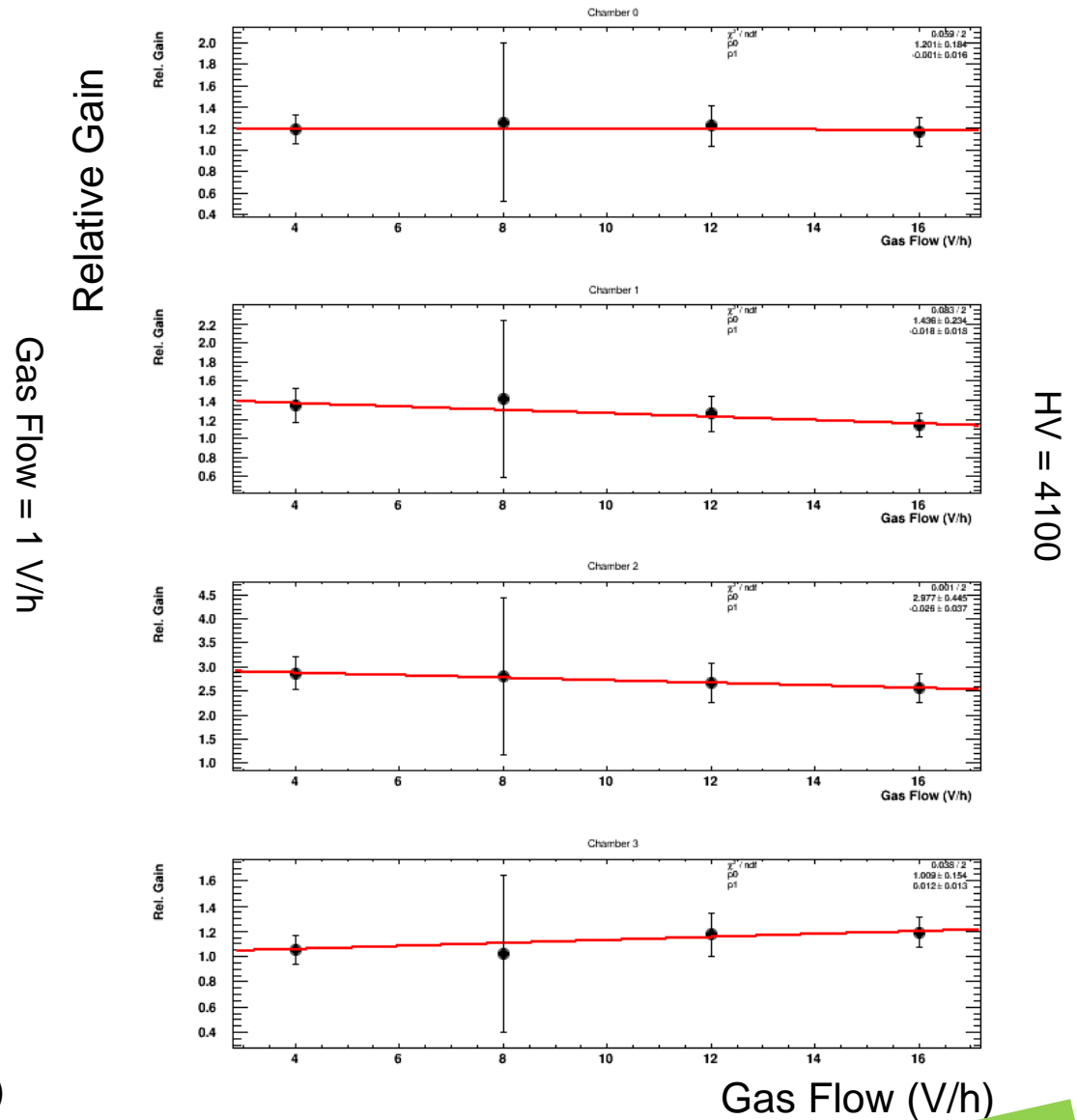
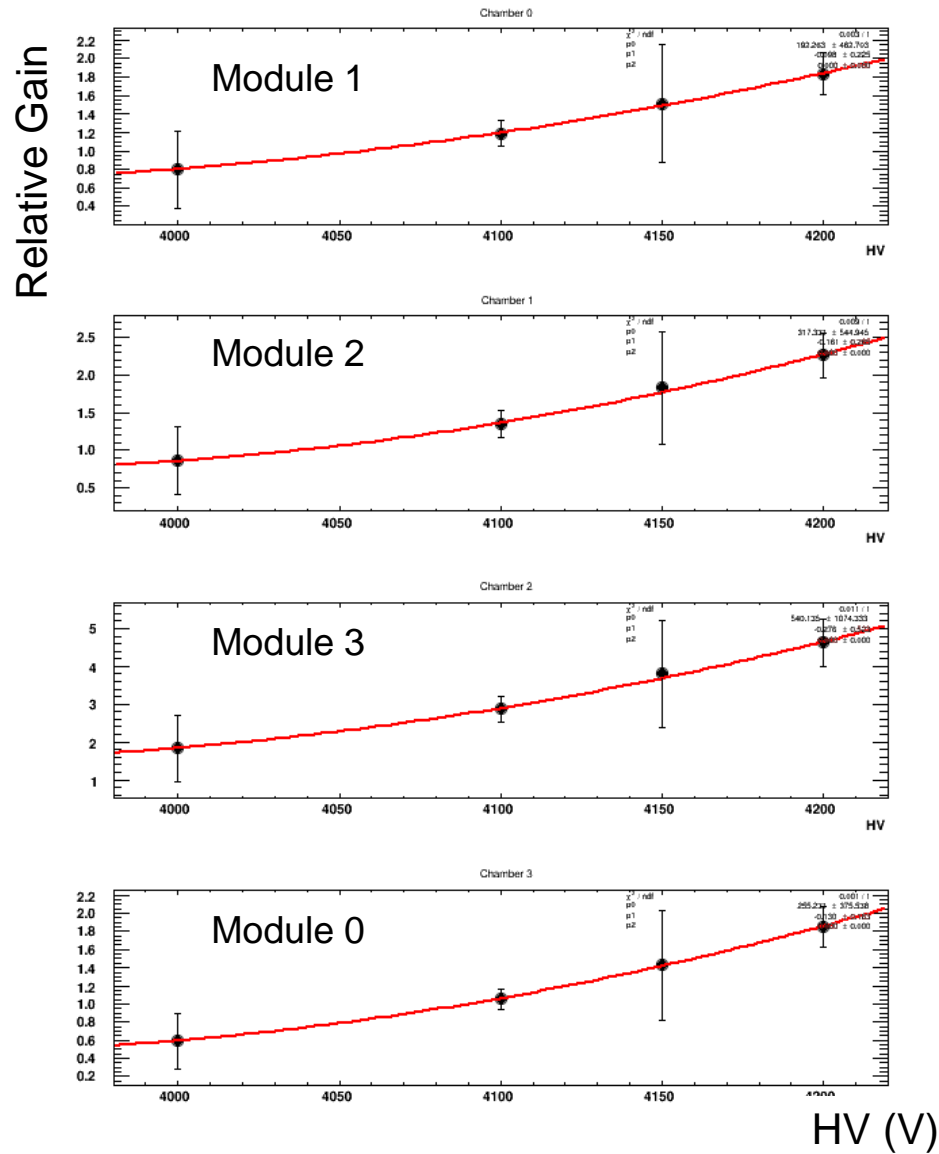
M0, M1: 441k, 7.2M, 3.76M, 7.2M, 3.63M, 7.2M, 2.98M, 7.2M, 1k

M2: 441k, 7.2M, **3.92M**, 7.2M, **3.57M**, 7.2M, **3.57M**, 7.2M, 1k

M3: 441k, 7.2M, 3.92M, 7.2M, **3.92M**, 7.2M, **3.92M**, 7.2M, 1k

Ref: 441k, 4.8M, 2.66M, 4.8M, 2.43M, 4.8M, 2.27M, 4.8M, 1k

High Voltage current monitor



Gain is relative to reference GEM module (at 4100 – gain ~ 6000)

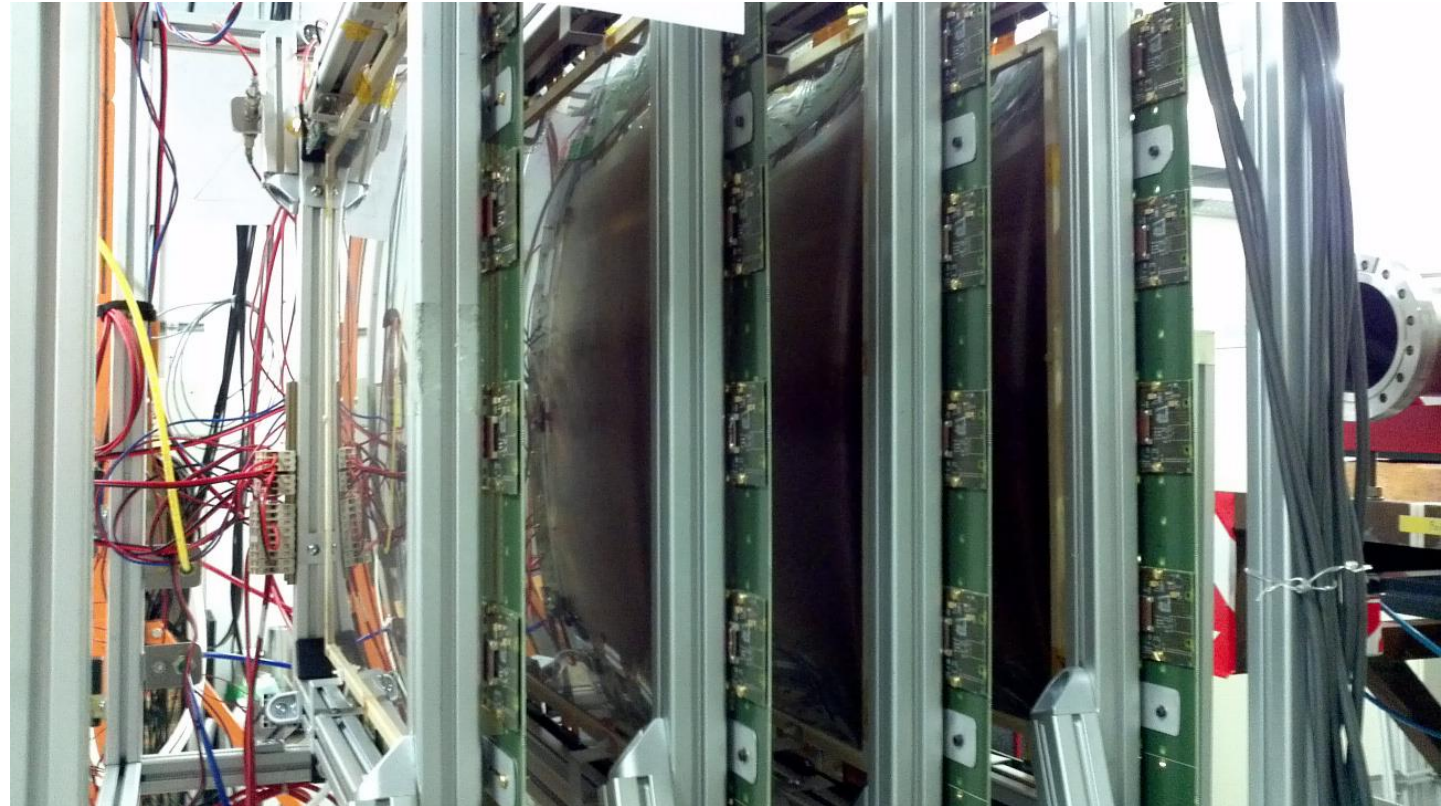
Different HV dividers: modules 0 and 1 similar «low» gain, 2 higher, 3 largest

No relevant effects vs gas flow

Gas flow up to $16 \text{ V}_{\text{singlemodule}}/\text{h}$



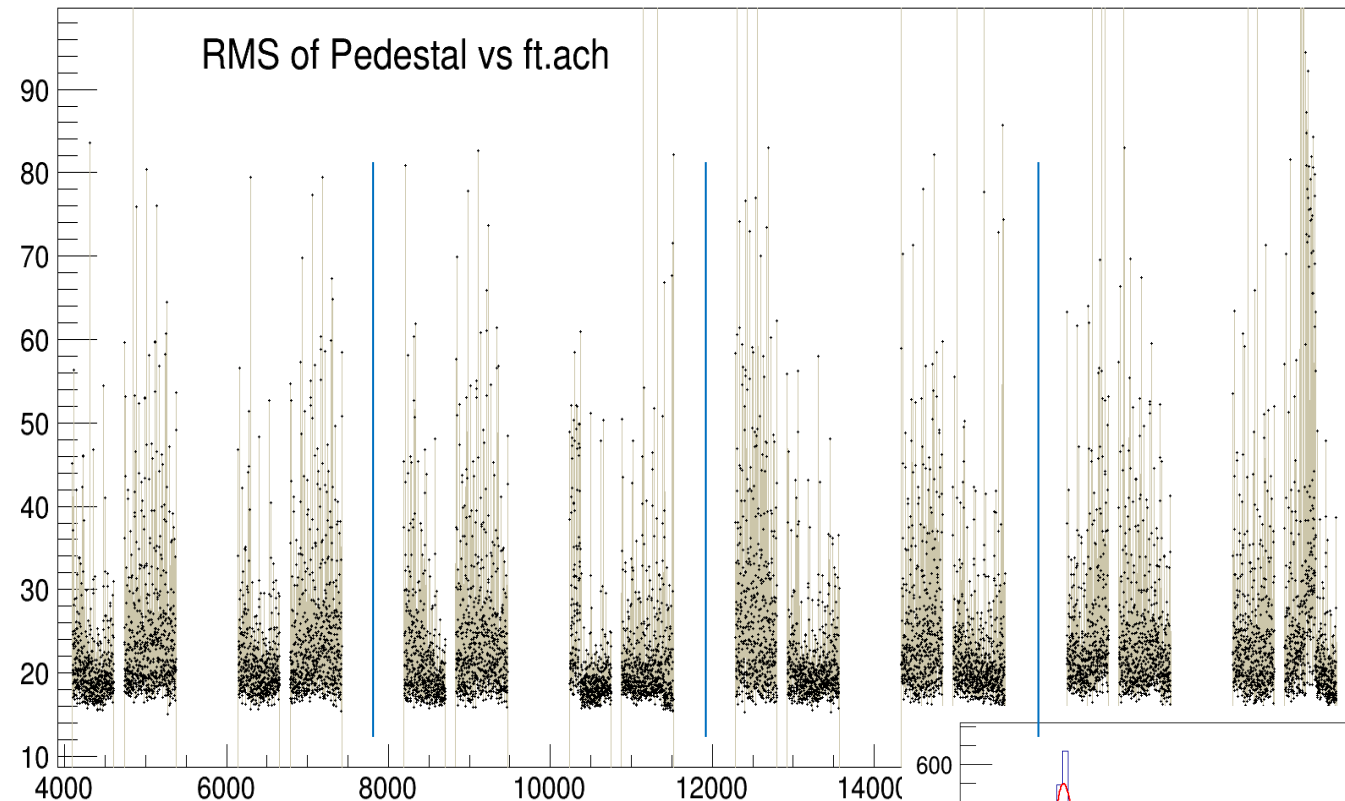
$\leq 1 \text{ cm}$



By mistake: max gas flow very high!

First chamber started to spike at high rate;
and probably got partially damaged (temporarily ?)

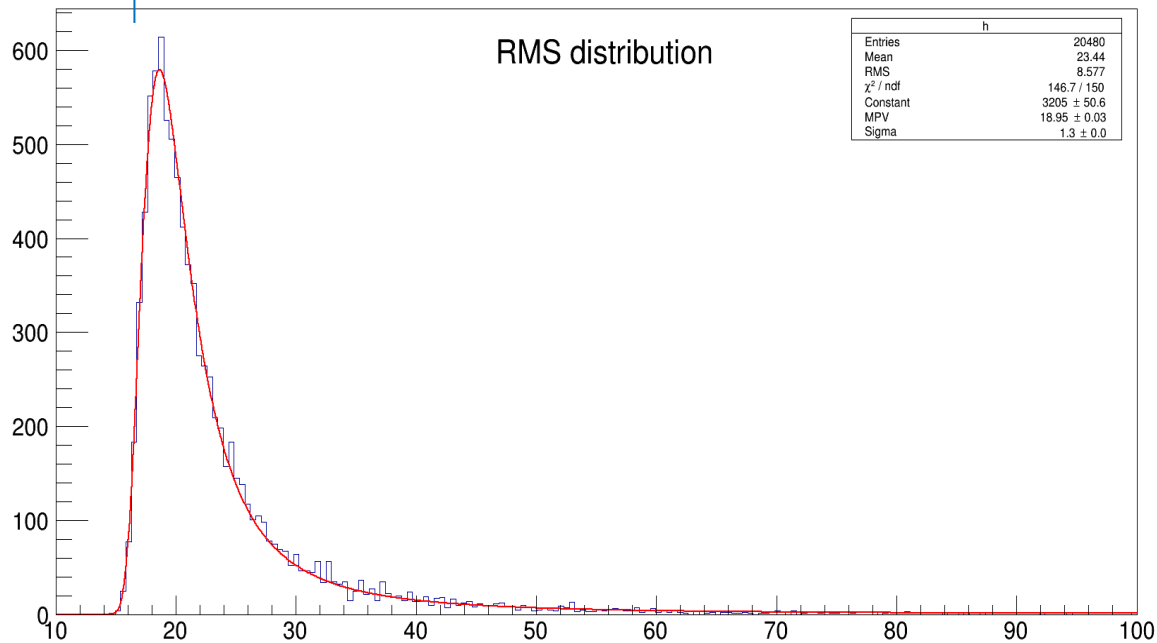
Noise



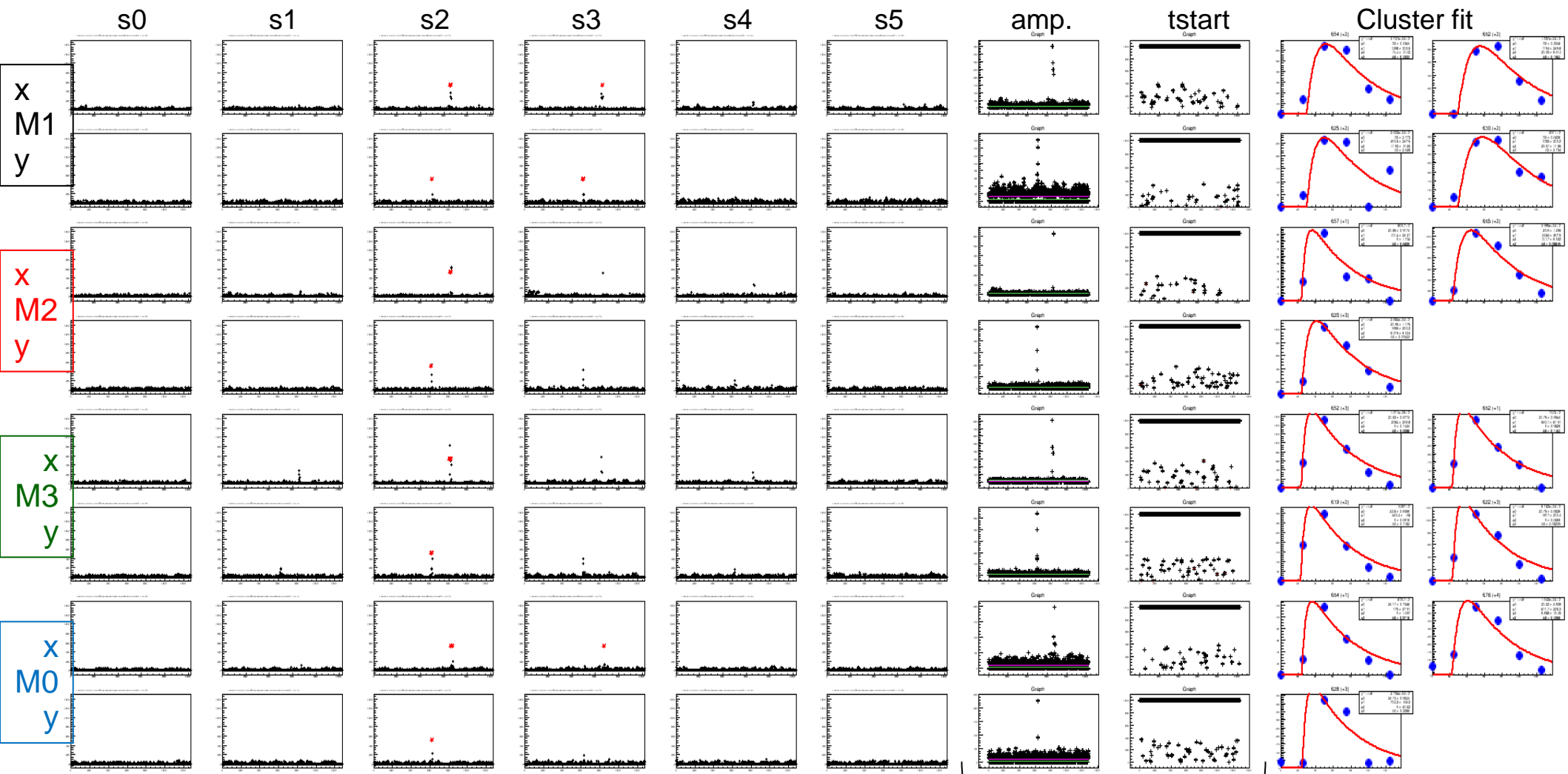
Two cards (or their connections) significantly more noisy

Cable length = 6m

Reasonably uniform response but still to be improved!



Event Display / Example



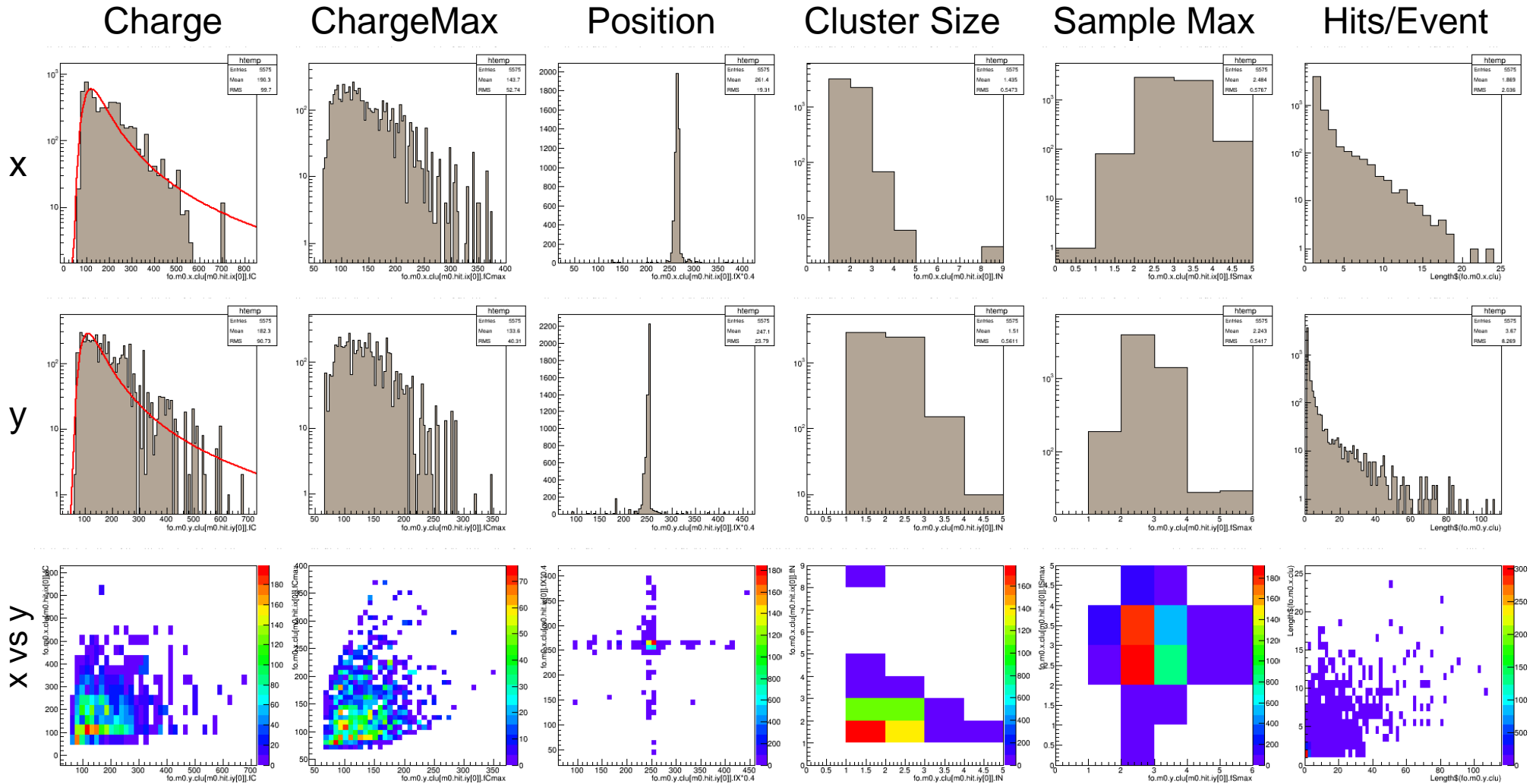
Sampling period: 75 ns!

(forgot to set it back to 25 ns after latency calibration)

Amplitude and start time estimated from 3 samples

Aggregate data (M1)

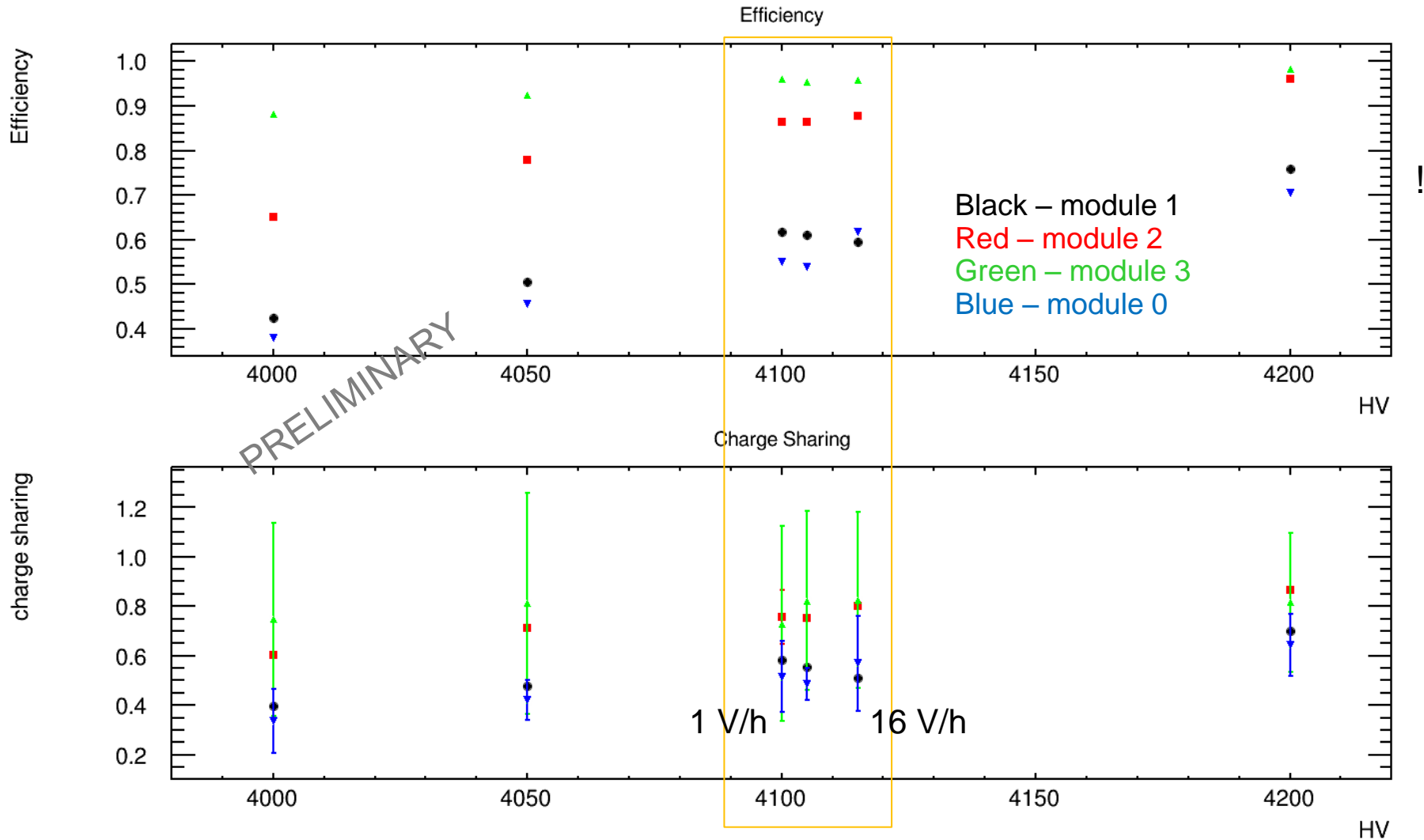
Run 240
HV=4100 V



Use new estimation for cluster charge,
possible effect of large proton intensity in charge correlation

First results / Central position

Beam Intensity: 1.4×10^9 p/bunch ~ 1 Mp/s/cm²; beam position: module center



Not able to see effects vs gas flow