Behaviour of CNGS Muon Detectors

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Behaviour of CNGS Muon Detectors

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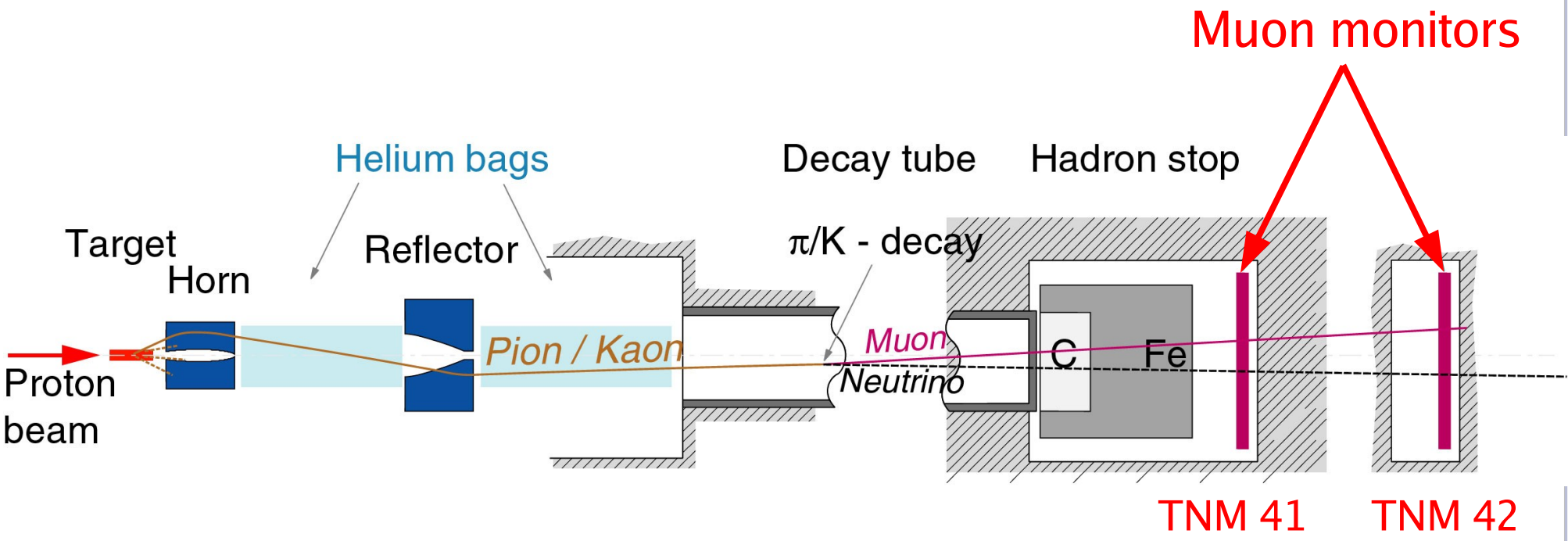
General presentation of the experiment

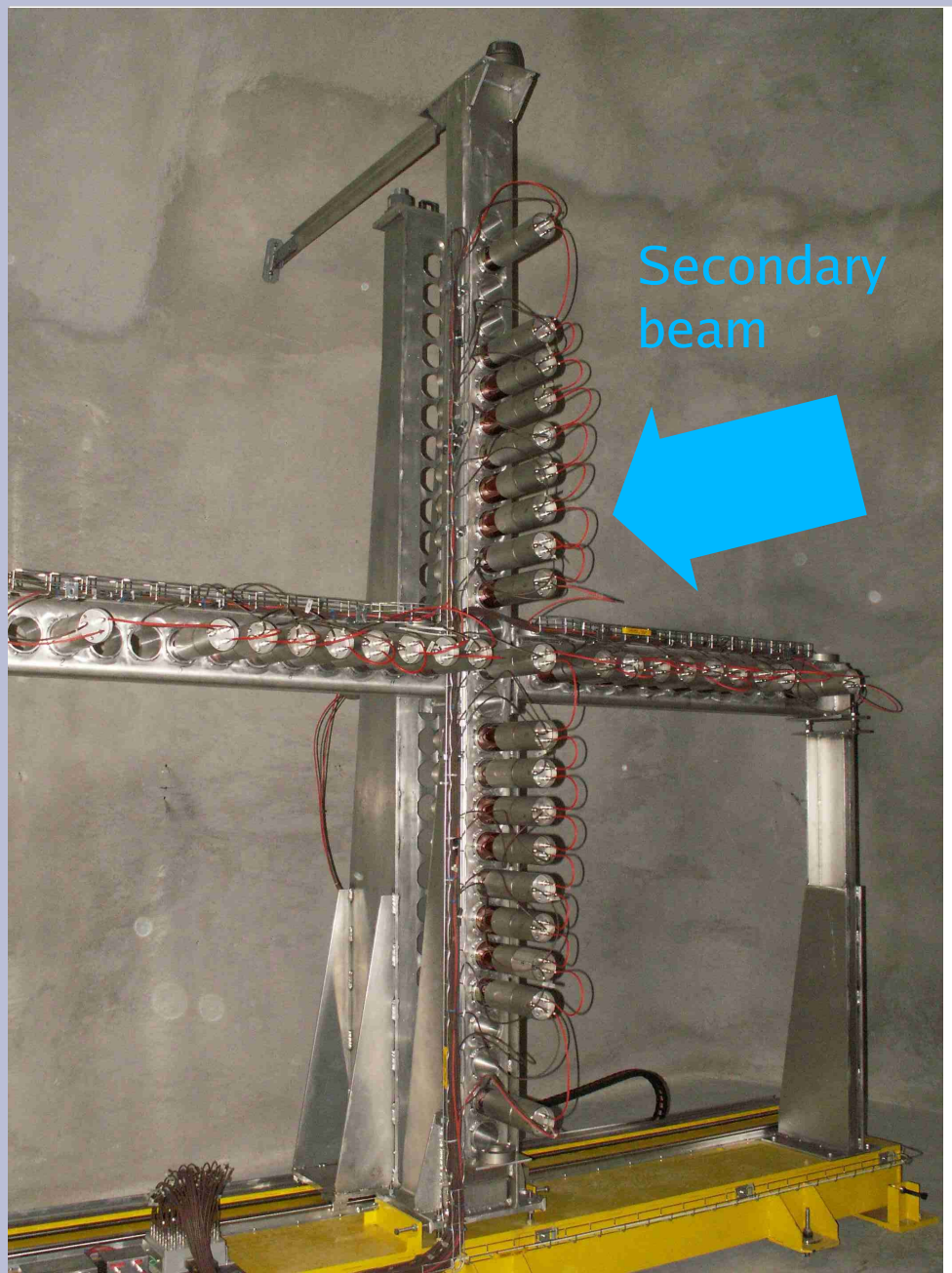
Global structure of the CNGS experiment



Decay: $\pi/K \rightarrow \mu_\nu + \nu$

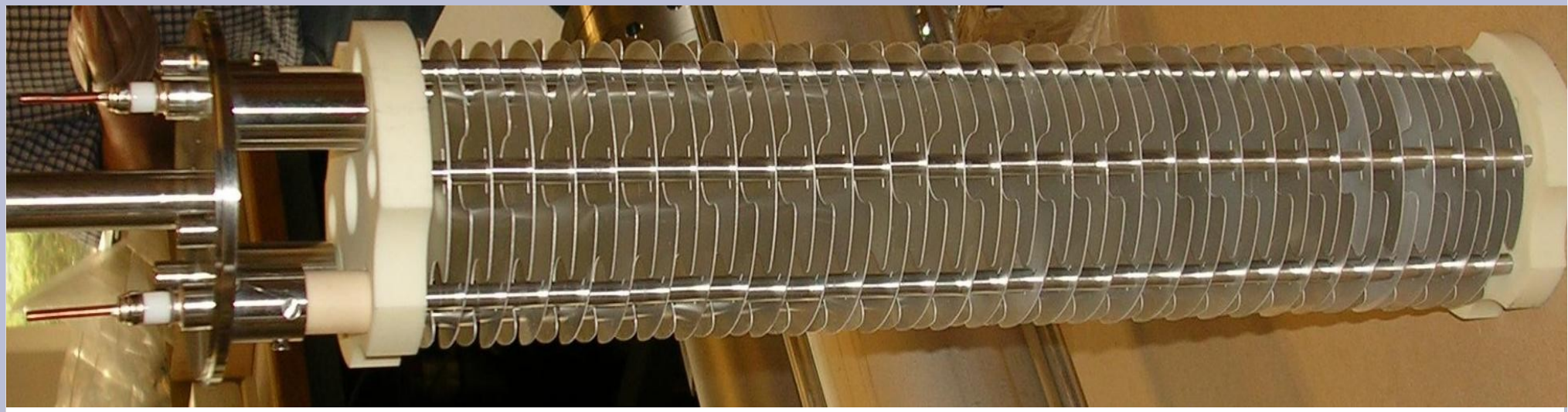
Measuring muons <=> Measuring neutrinos

One 'cross'



- 42 detectors:
  4 x 10 + 1 + 1
- Sorted by direction:
  - Horizontal
  - Vertical
- Sorted by cross number:
  - 41
  - 42

LHC Beam Loss Monitors



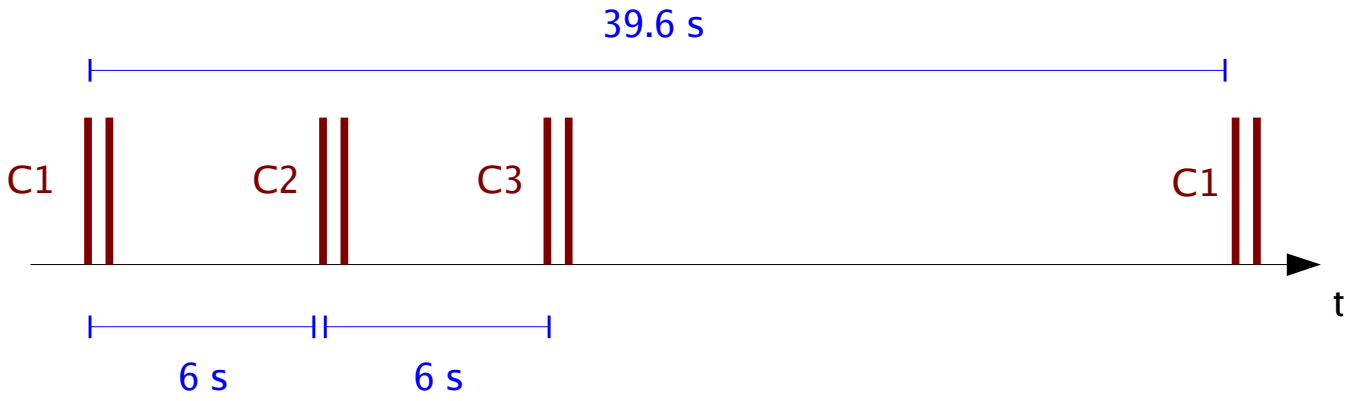
- Ionization chambers
  - 50 x 16 x 16 cm
  - 61 electrodes
  - N_2, 1.1 bar
- Electric field:
  - 2006: 1600 V/cm
  - 2007: 2400 V/cm
- Charged particles ionize the gas, and ions/e^- drift

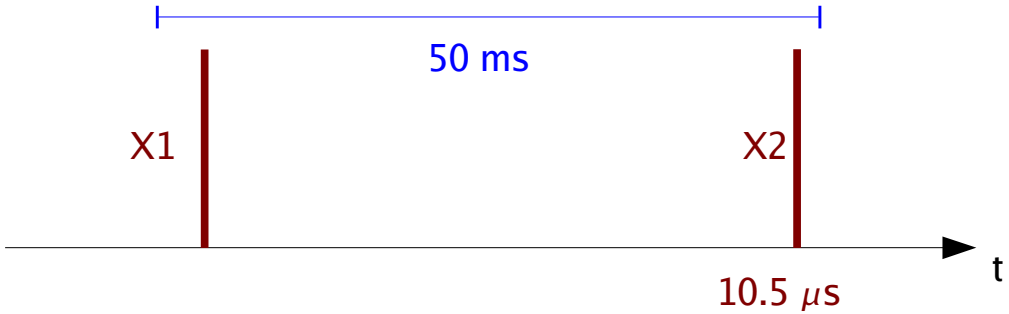
Vocabulary...

- Intensity: protons on target (p.o.t.)
- Collected charges:
  - Number of charges collected from the detector
  - Should be proportional to intensity
- Detector signal (charges / p.o.t.)
- Extractions 1 & 2, lasting 10.5 μs each, separated by 50 ms.
- 1 supercycle = 39.6 s
  - 3 CNGS cycles, 6s each.

Timing

- 1 supercycle = 3 cycles x 2 extractions





Behaviour of CNGS Muon Detectors

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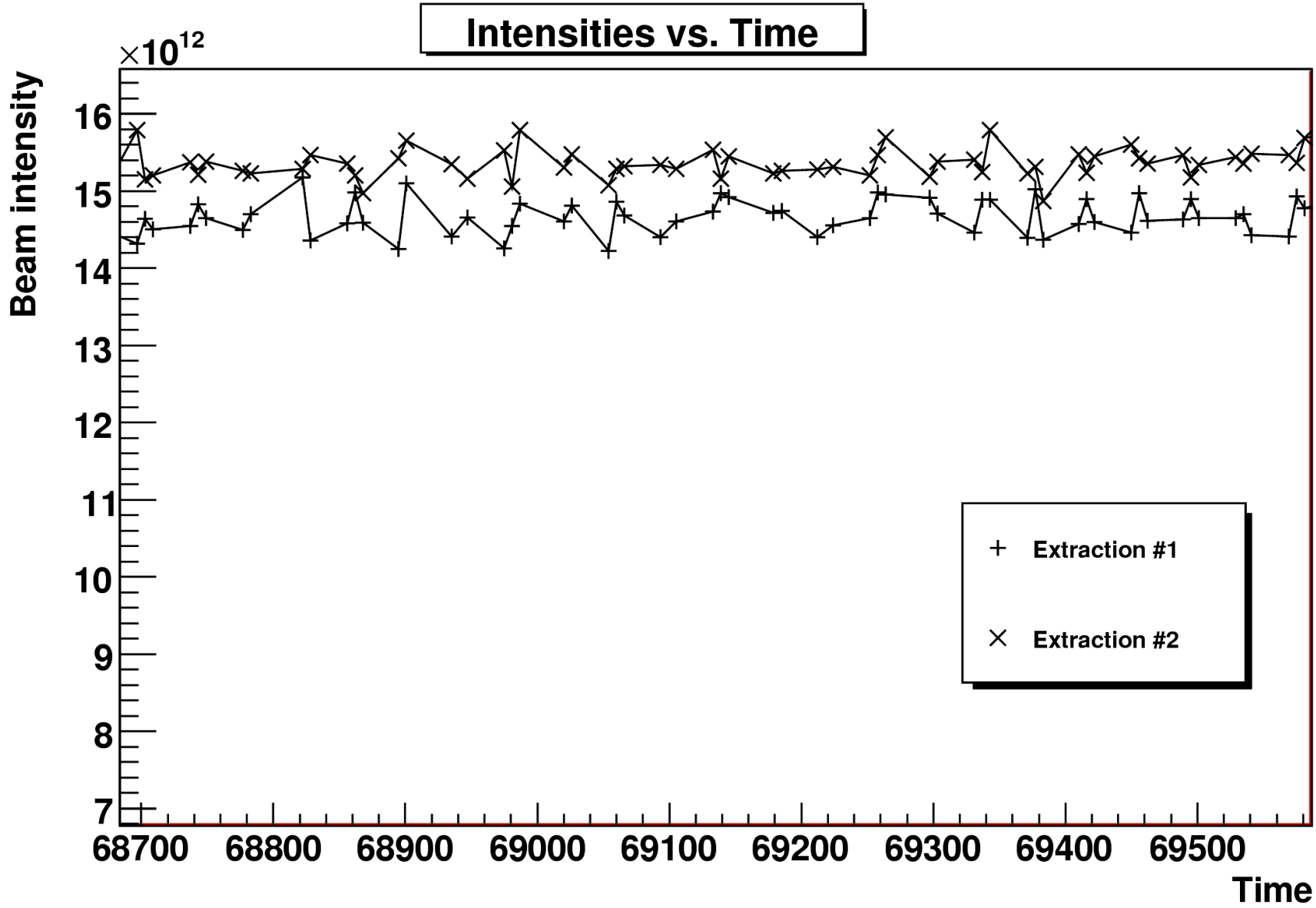
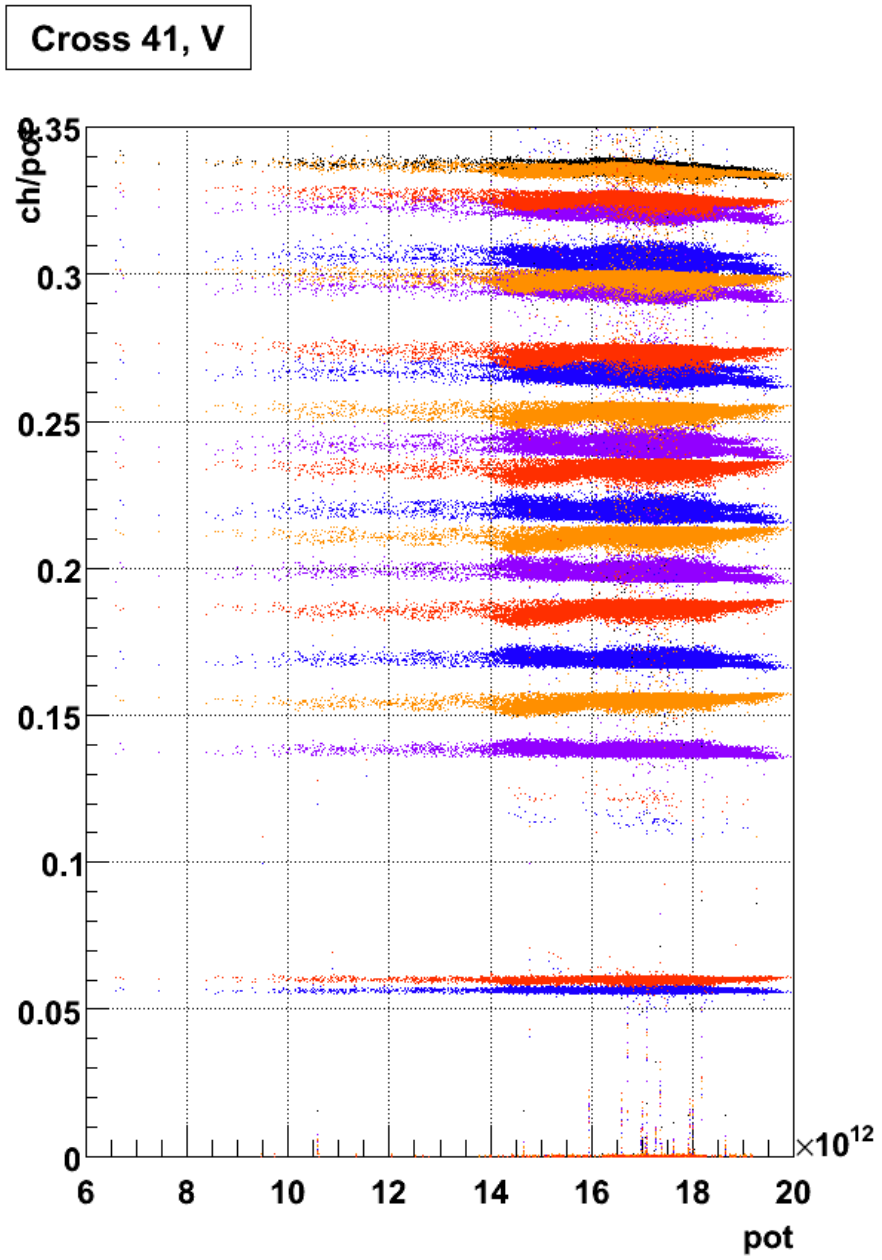
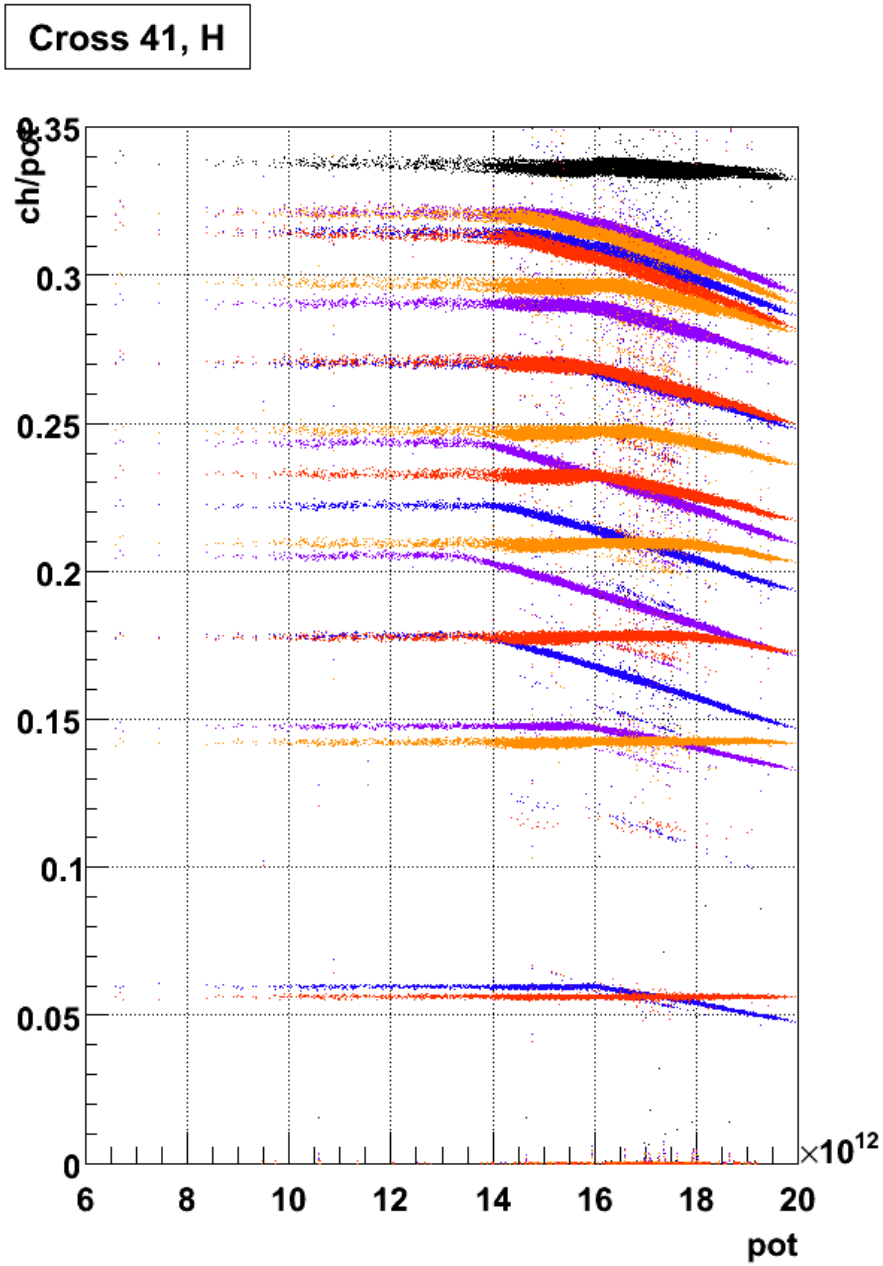
Description of 2007 data

Beam intensity vs time



Result for 2007
(physics run –stable beam)





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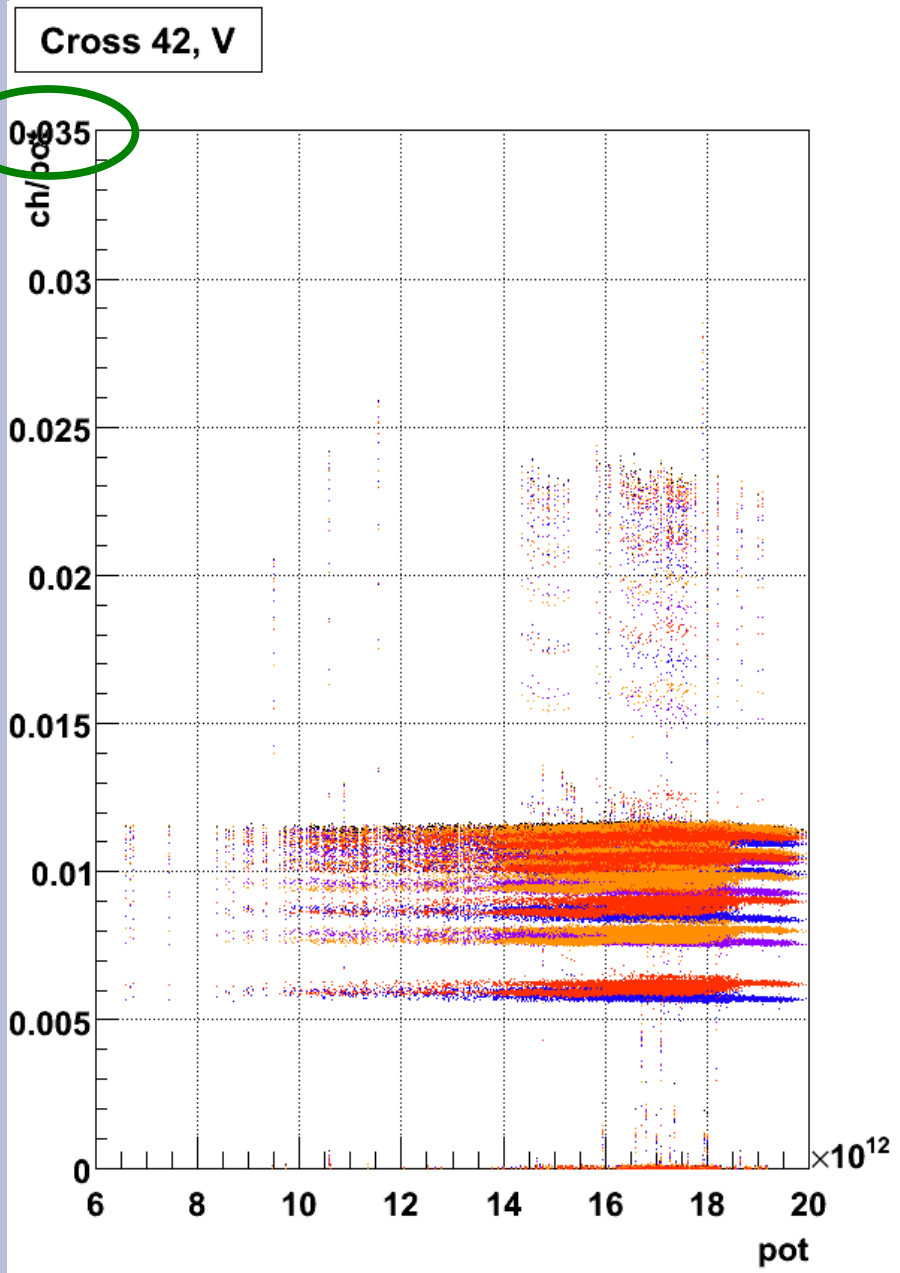
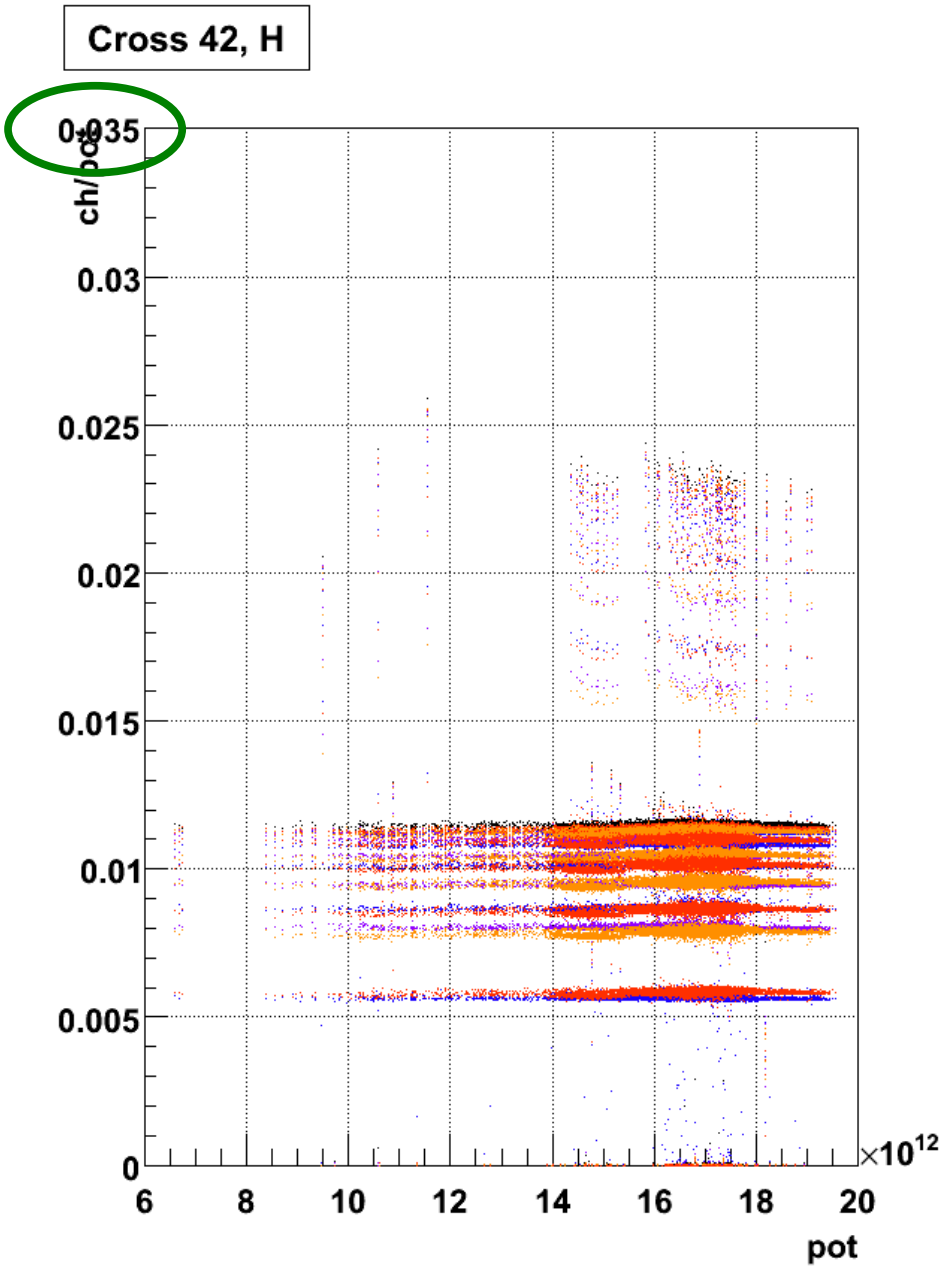
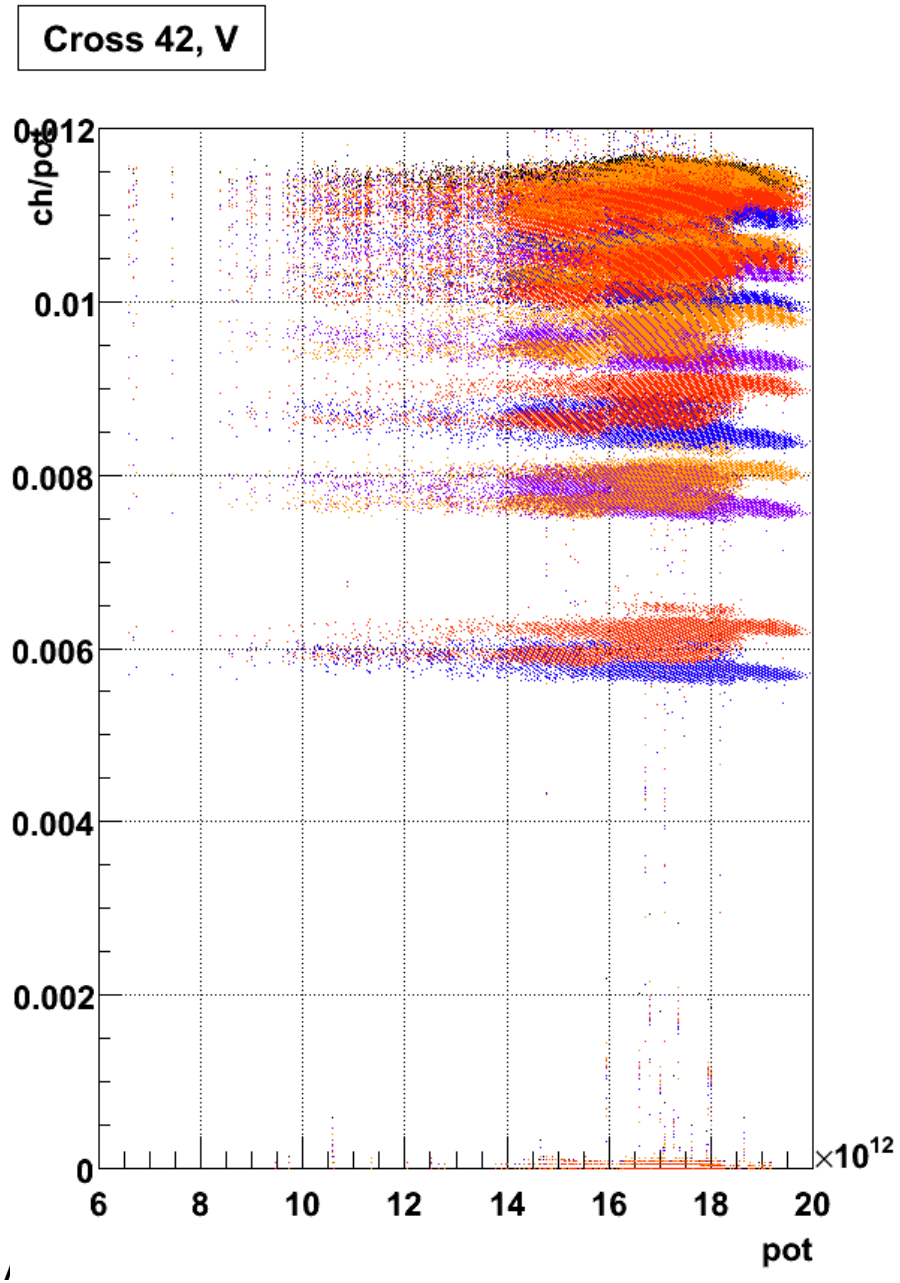
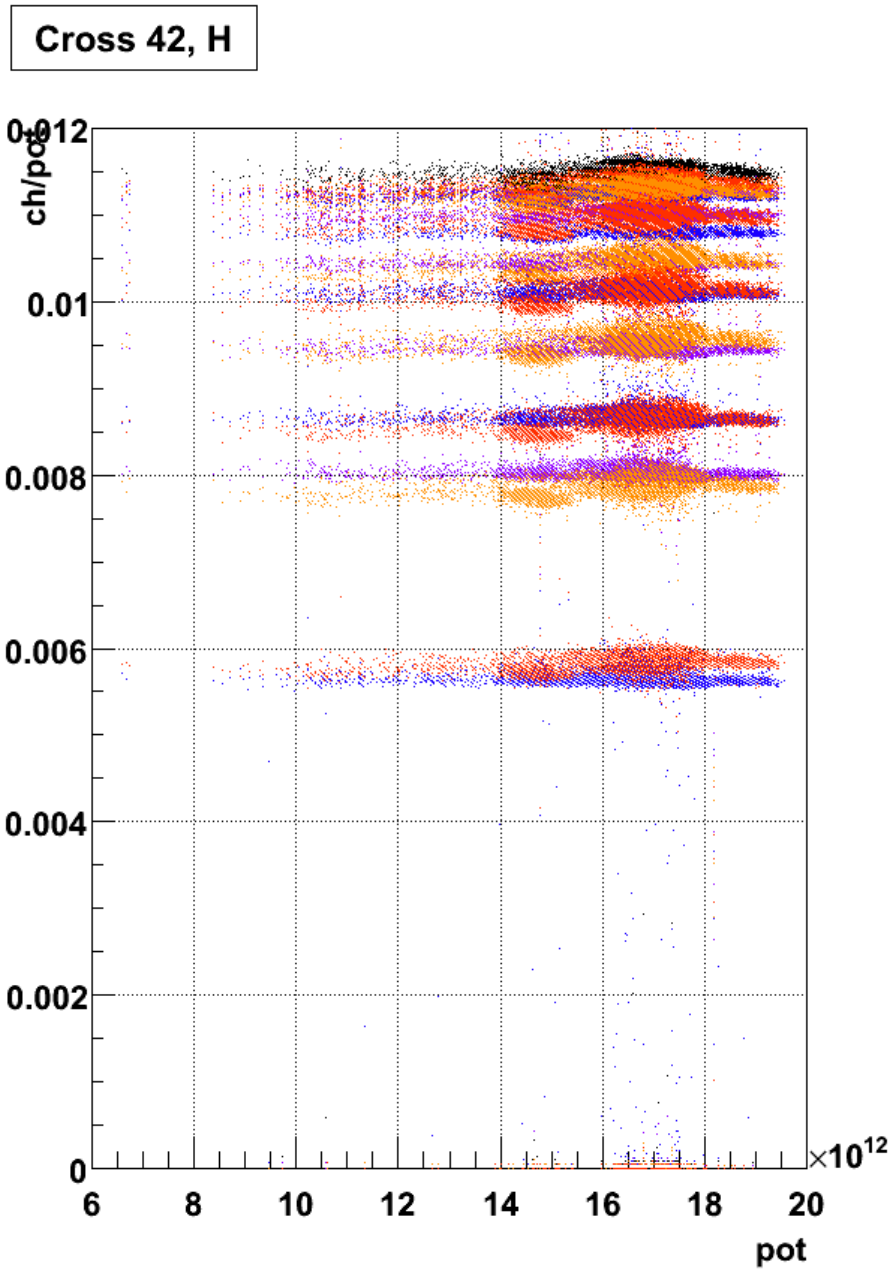


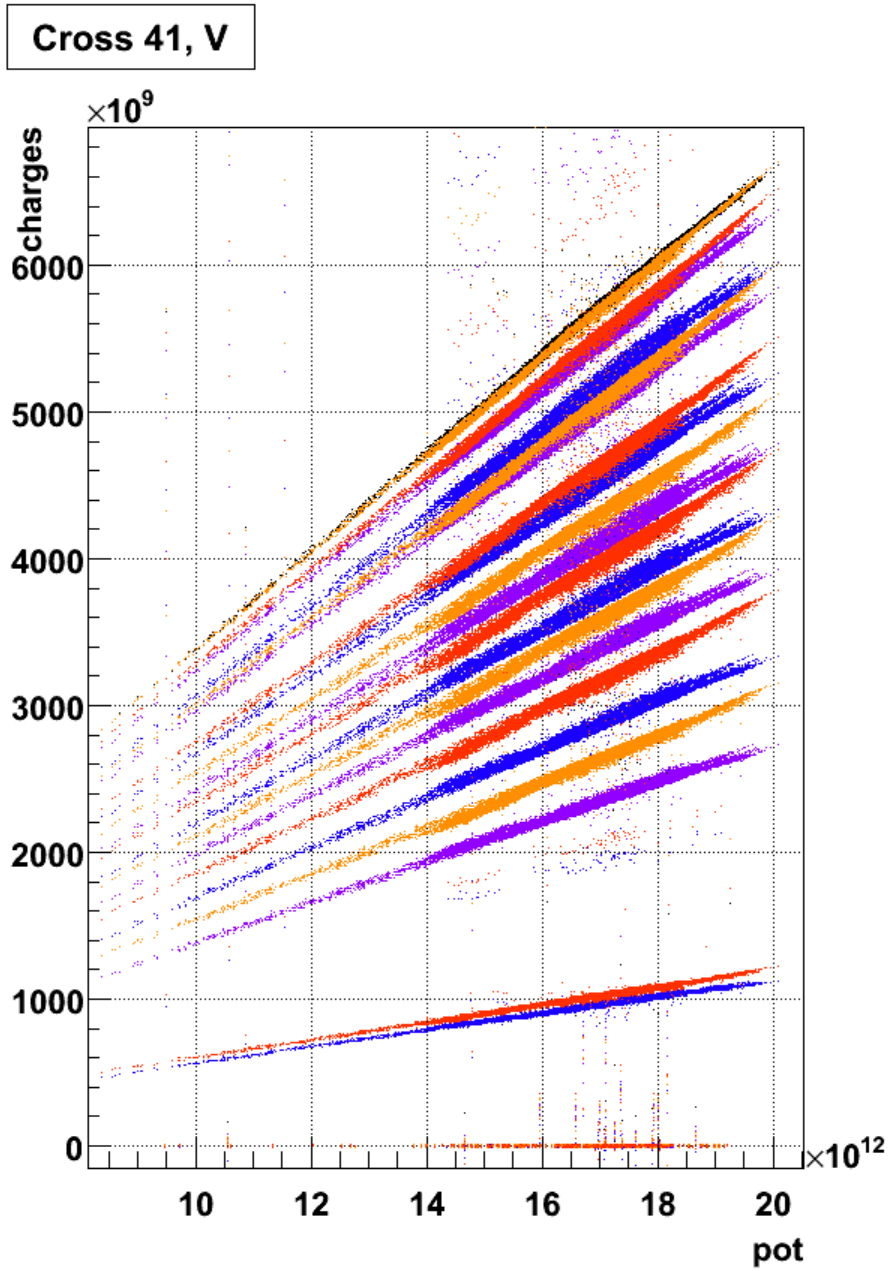


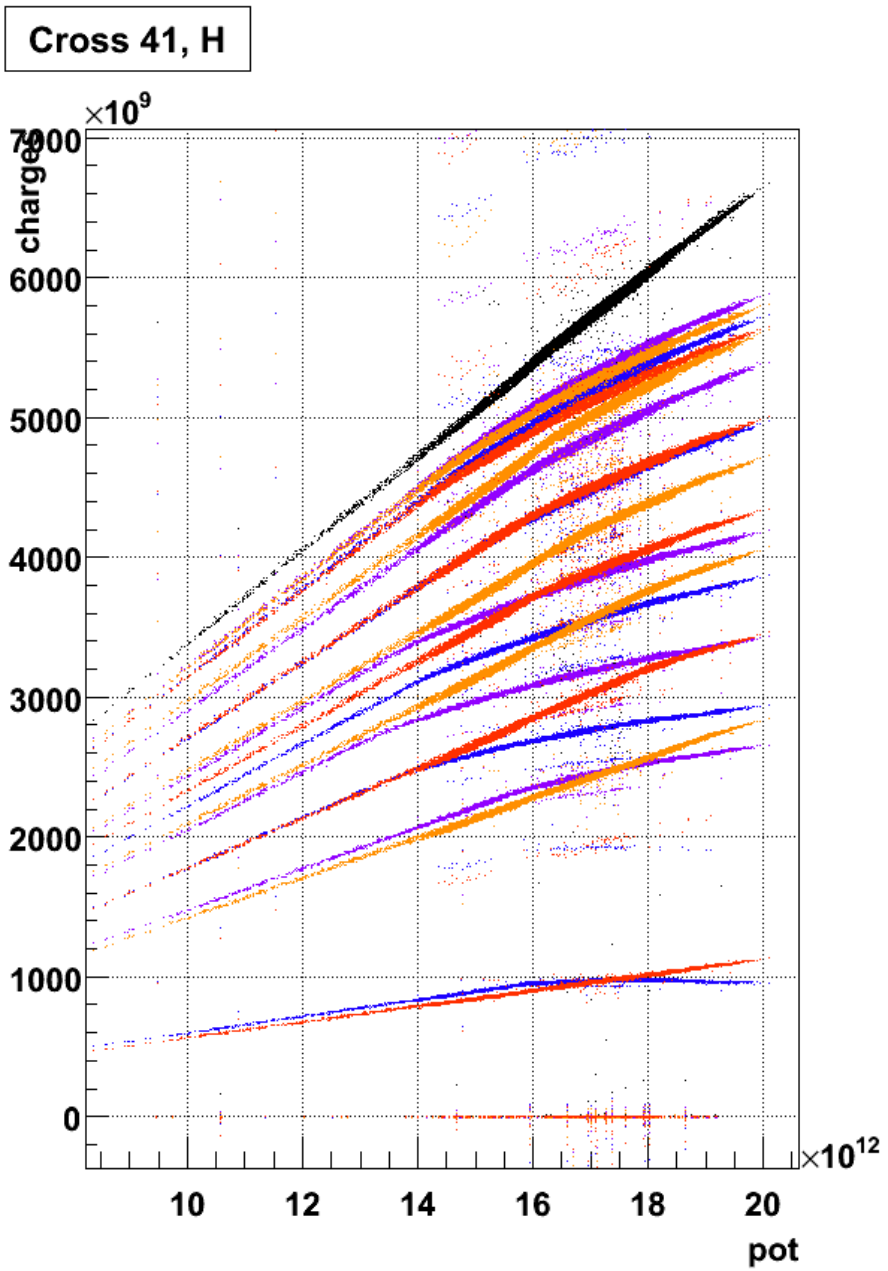
Cross 42, closer view



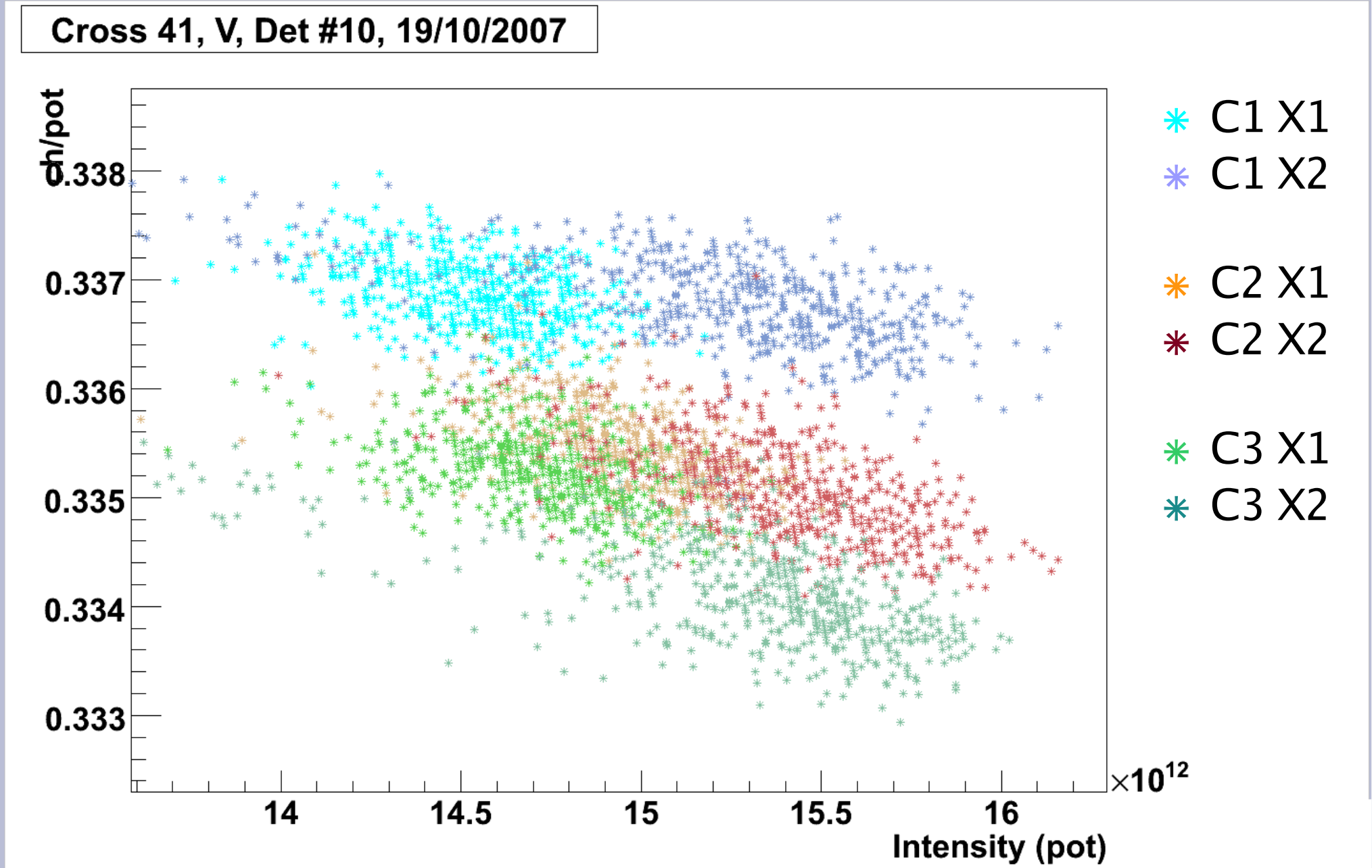


Number of collected charges

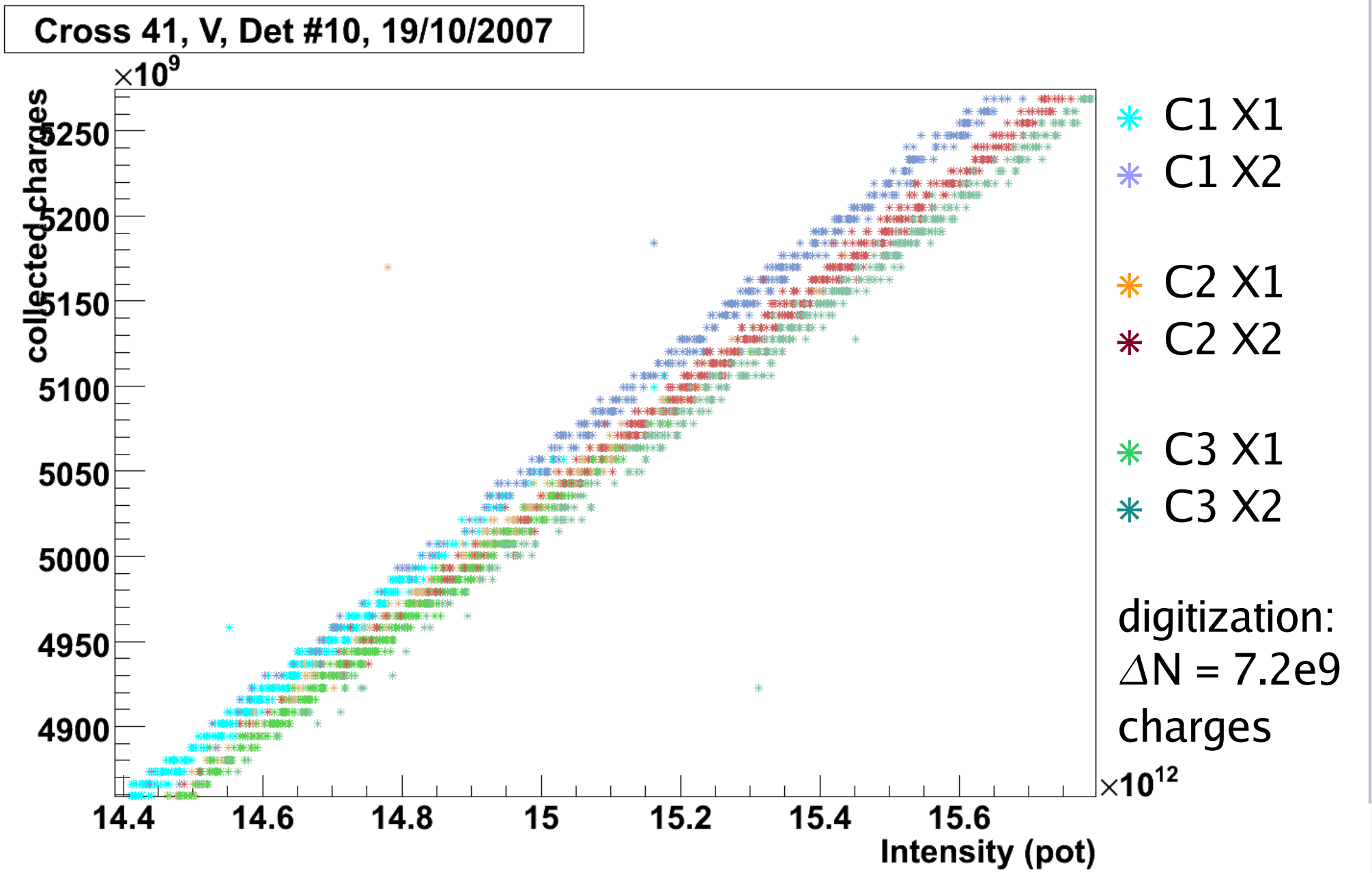




Center monitor, closer view: cycles and extractions



Center monitor, closer view: collected charges



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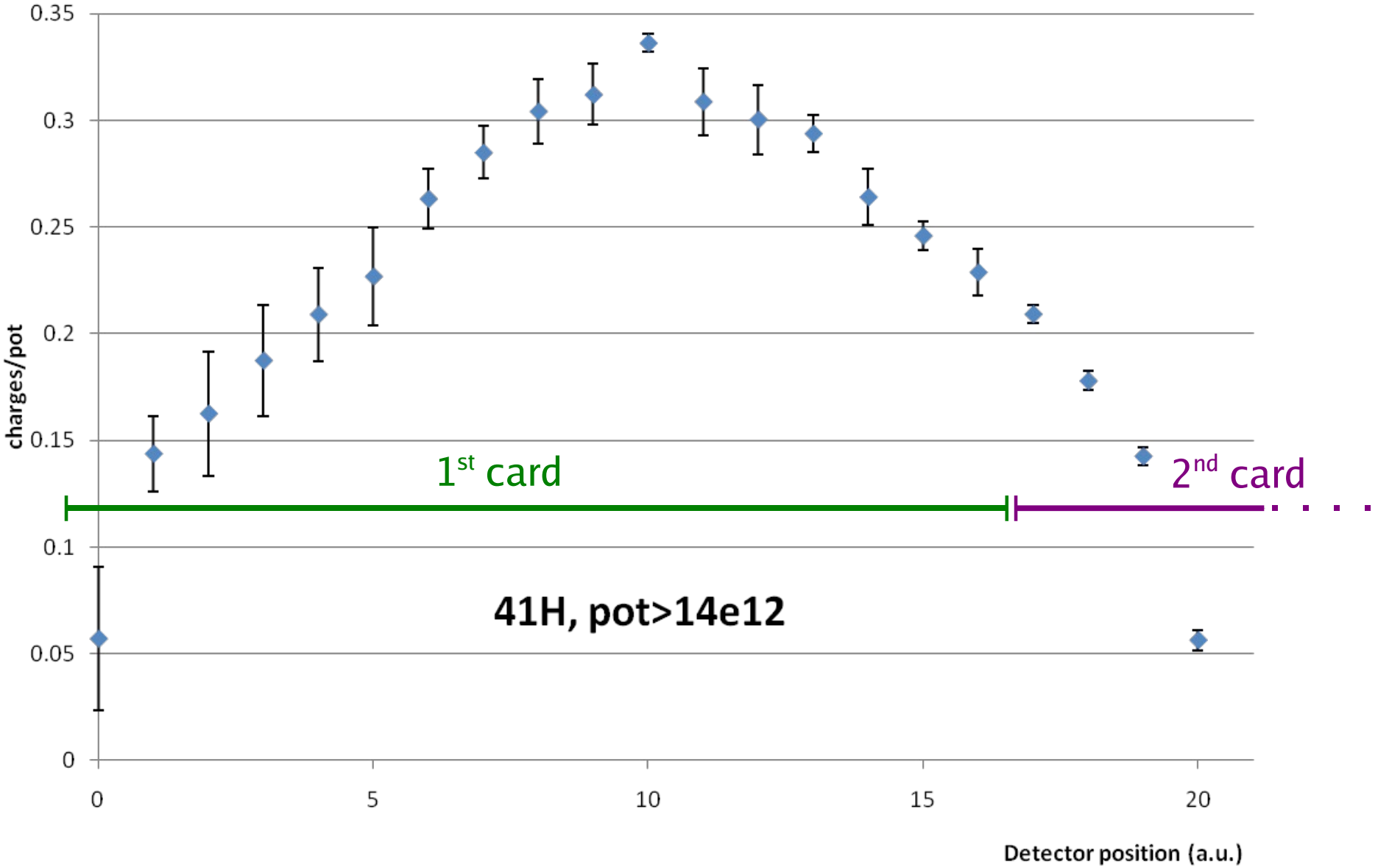
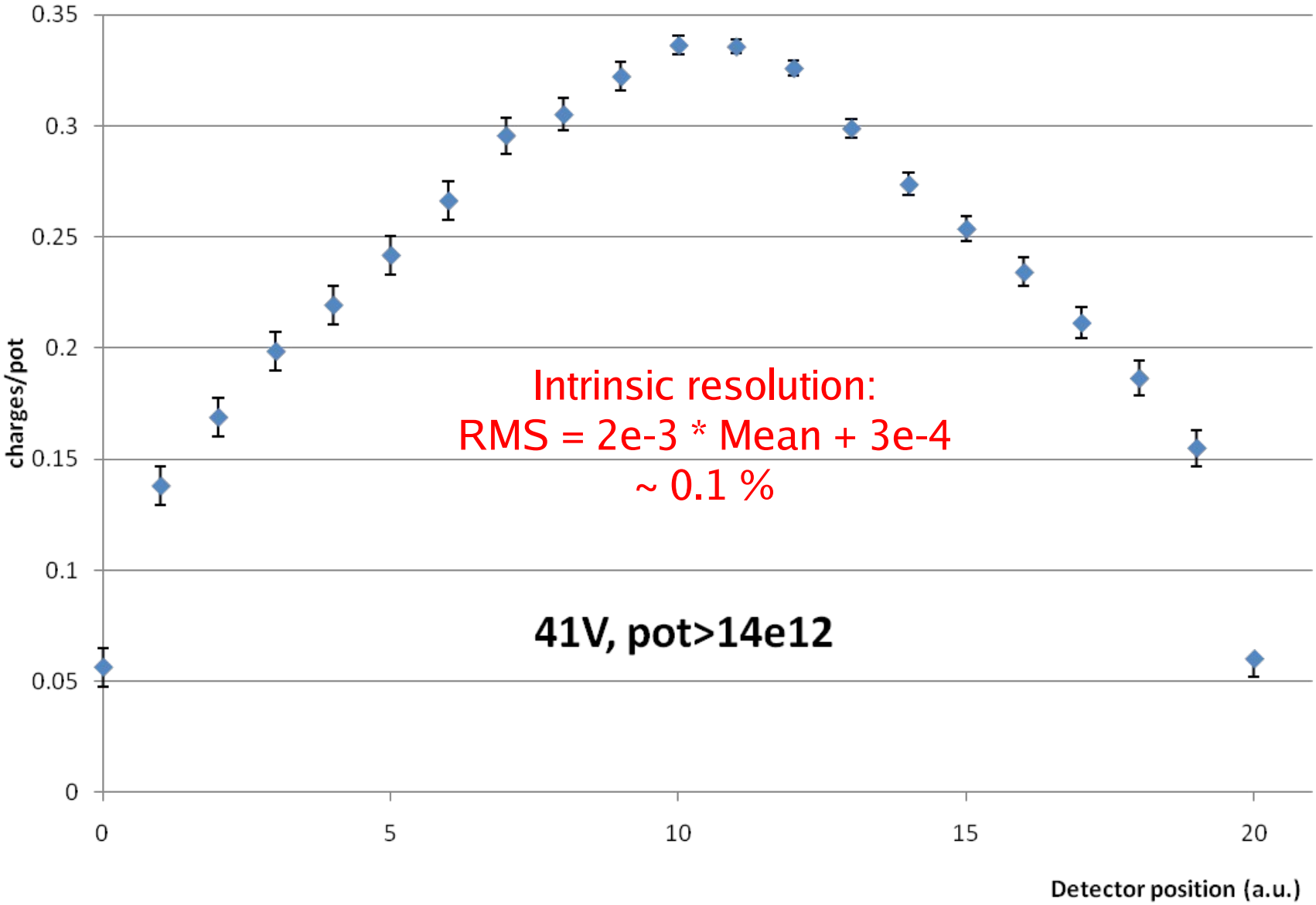
About this unexpected behaviour...

Comparison horizontal/vertical



Comparison horizontal/vertical

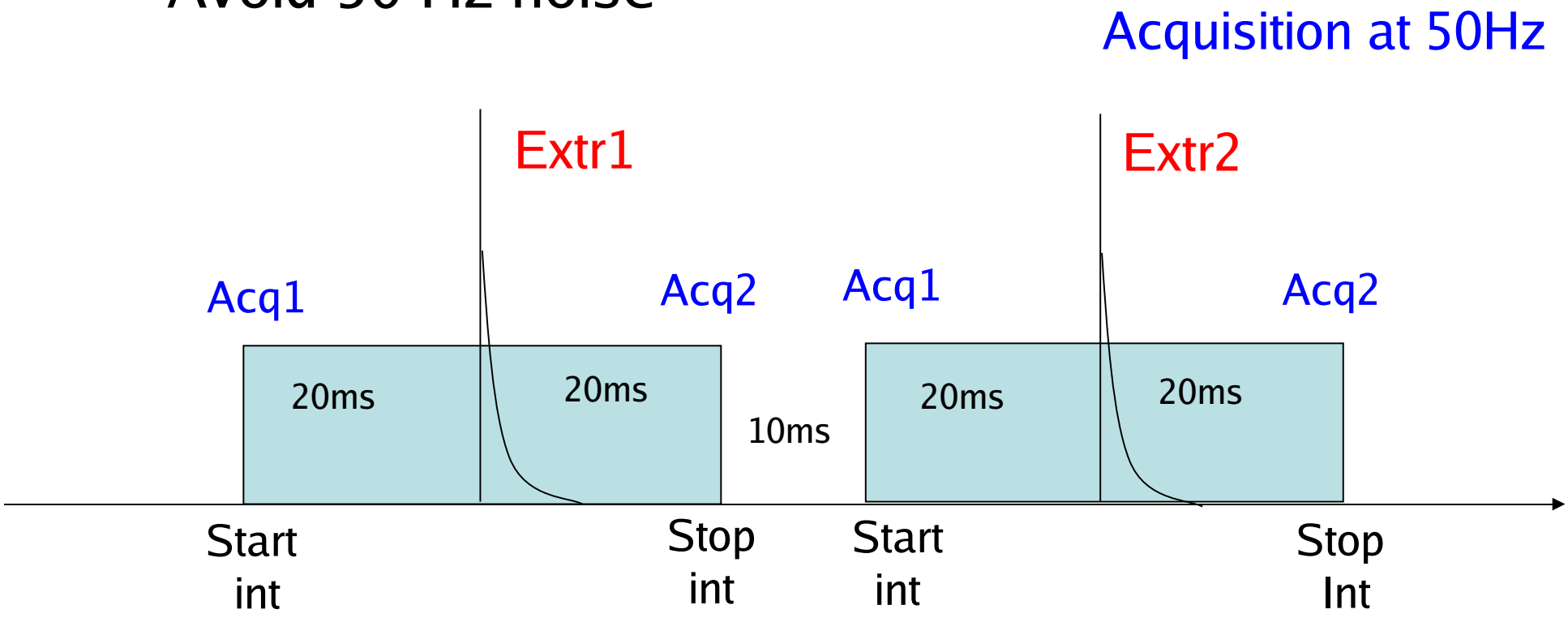


Non-linear behaviour: checks

- Origin of the detector
  - 2 productions centers: CERN and Protvino
- Electronic cards:
  - 16 channels per card
  - Some detectors from vertical and horizontal are connected to the same card
- All cards were removed from the tunnel and checked separately.
  - linearity

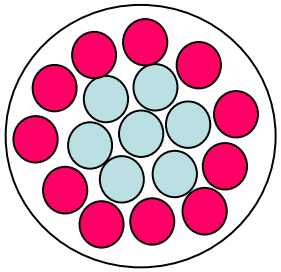
Non-linear behaviour: checks

- Timing
  - No lost charges
  - Avoid 50 Hz noise

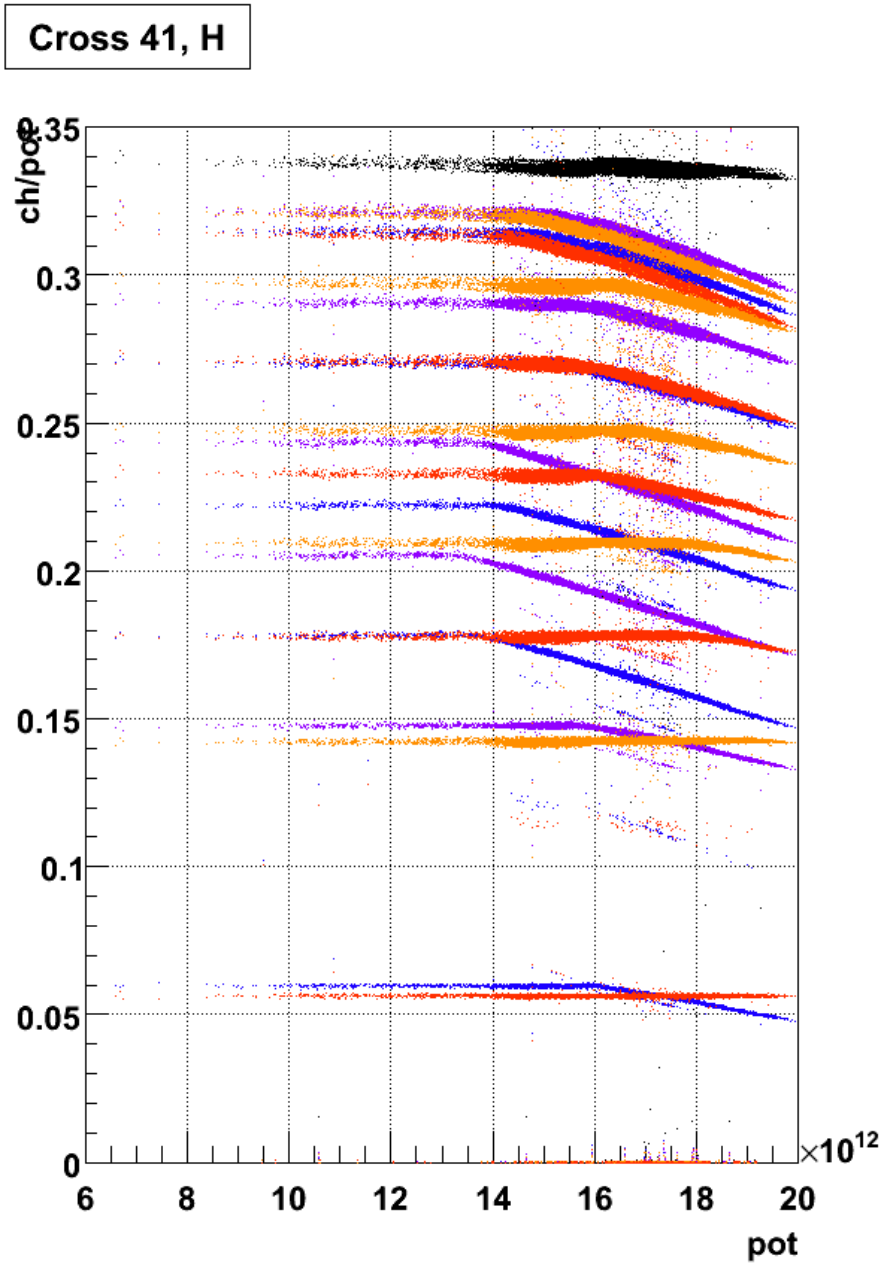


Muon Detector Timing and Cabling

- Cabling Topology



- Multiwire cables for horizontal detectors (cross-talk)
- Multiwire cable for vertical detectors, twisting around horizontal ones (external part: high capacity between cables and ground)



Non-linear behaviour: checks

- No threshold on X axis (pot)
- No threshold on Y axis (ch/pot)
- No dependence on centroids (position of the center of the beam profile)

2008: changes to the system

- A 220 nF capacitor was added between each wire and the shielding, making it the dominant one (cable capacitance: 35 nF)
- V = Q/C => V drops => less coupling
- Discharging time increases => ~ 5 ms (still short enough)

Behaviour of CNGS Muon Detectors

Comparison with 2006 data

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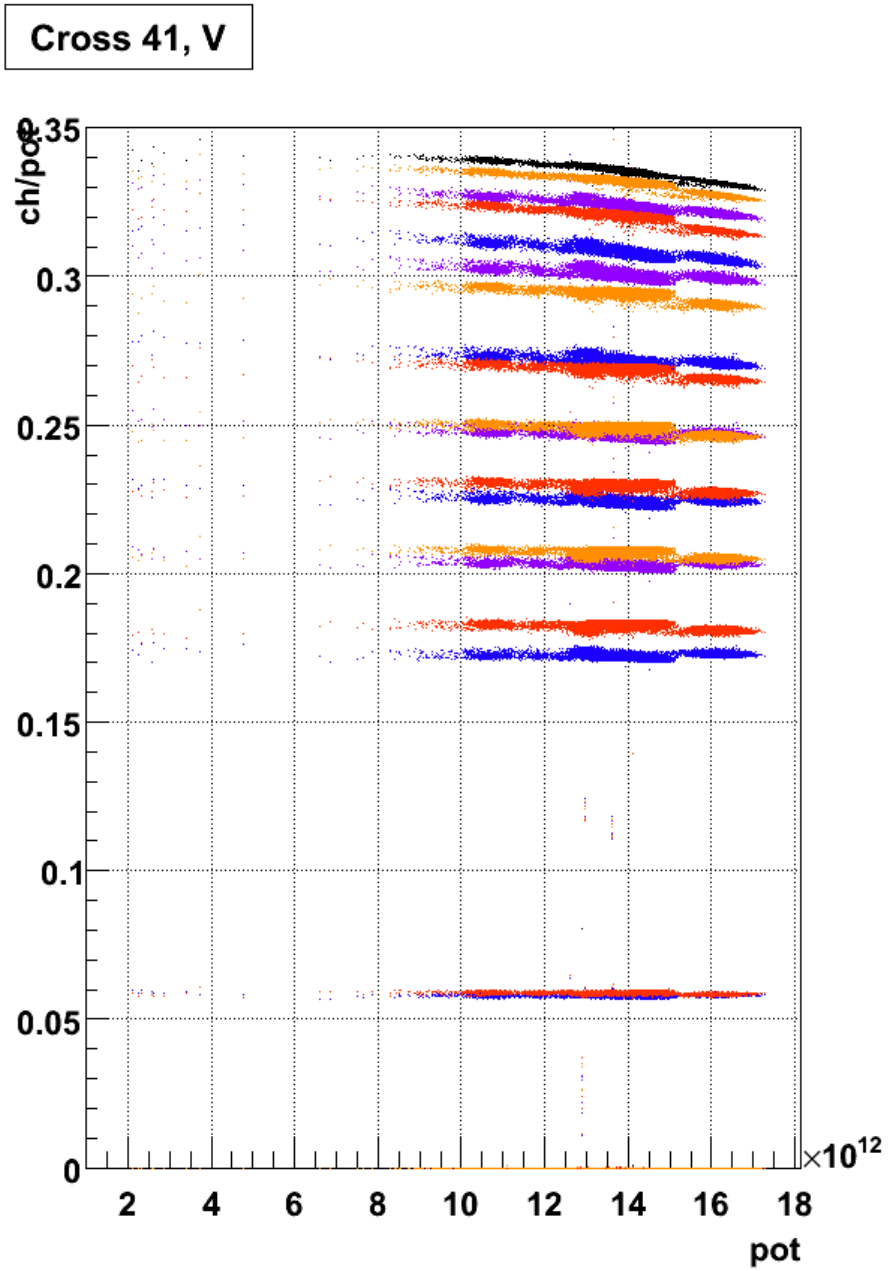
2006 results



- 2006: 1600 V/cm
  - Non-linear effect
- 2007: 2400 V/cm
  - No effect
- Under investigations…
  - Recombination losses
  - Space charge effect

Behaviour of CNGS Muon Detectors

Thank you for your attention...
Any question?

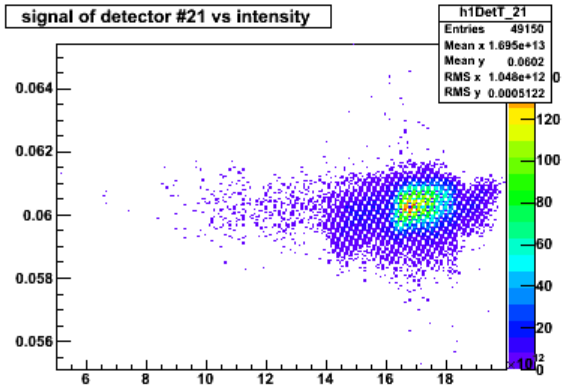
Spare slides

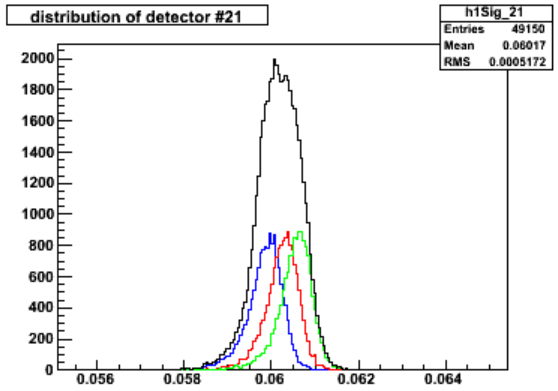
Monitor origins

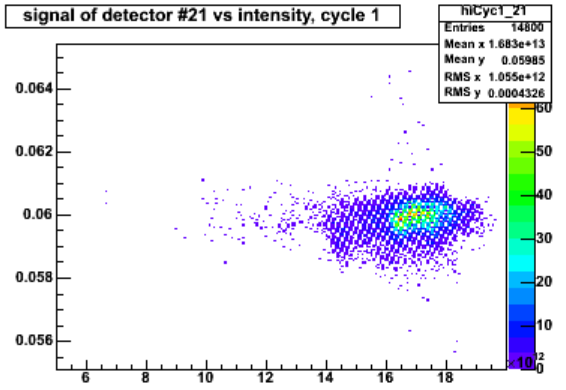
Det #	Origin
1	Protvino
2	Protvino
3	CERN
4	Protvino
5	Protvino
6	CERN
7	Protvino
8	CERN
9	Protvino
10	CERN

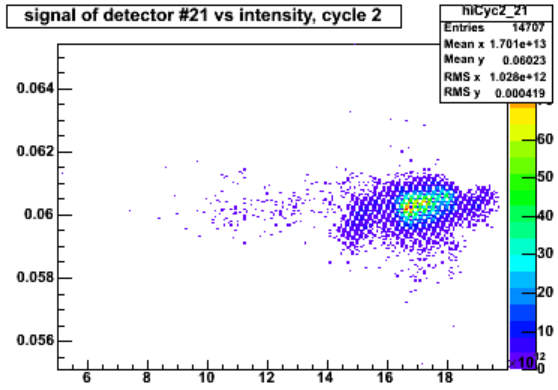
Det #	Origin
11	CERN
12	CERN
13	Protvino
14	CERN
15	Protvino
16	CERN
17	Protvino
18	Protvino
19	CERN
20	Protvino
21	Protvino

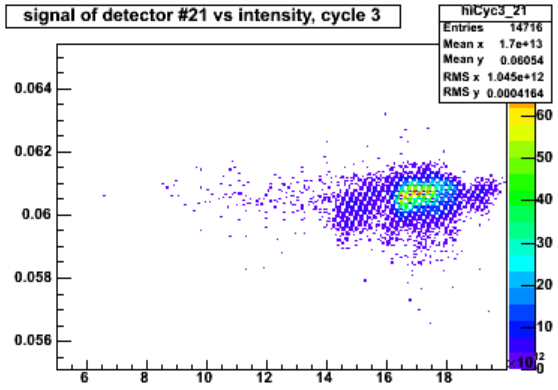
RMS Calculation

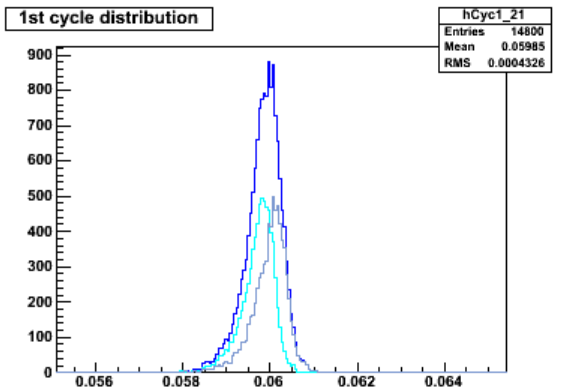


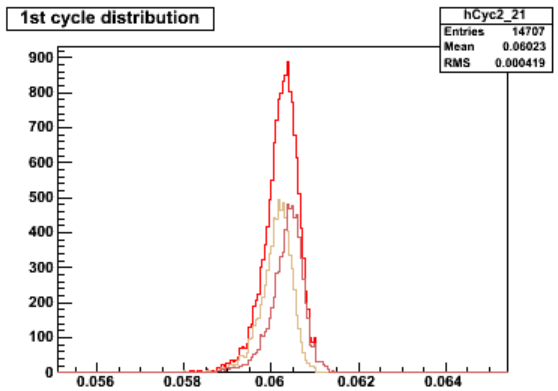


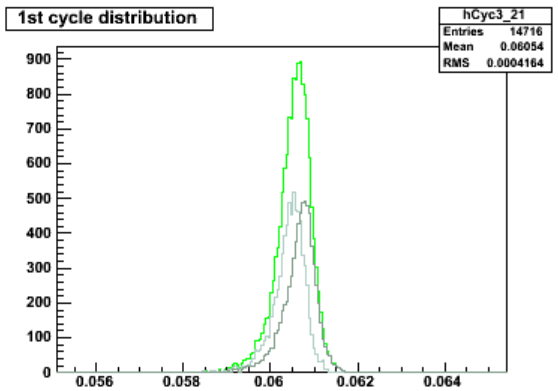






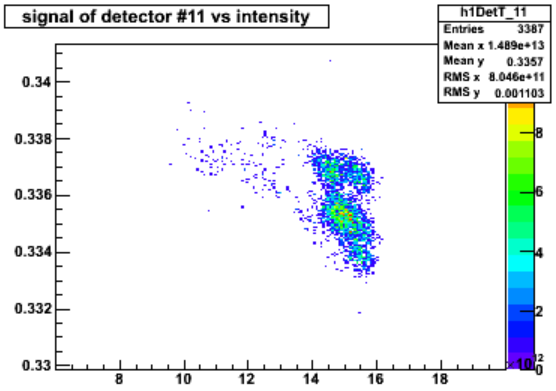


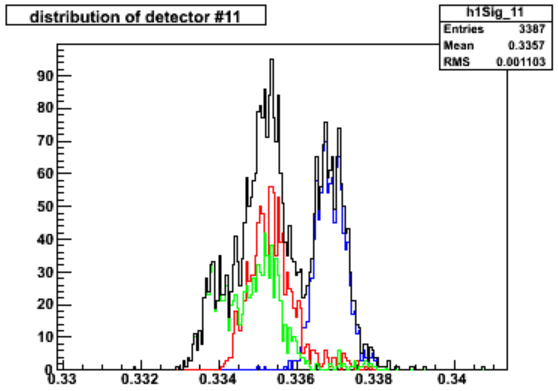


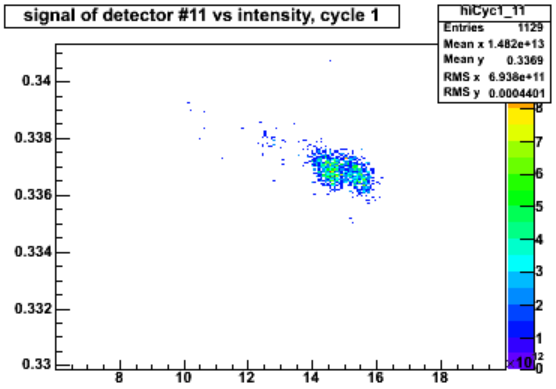


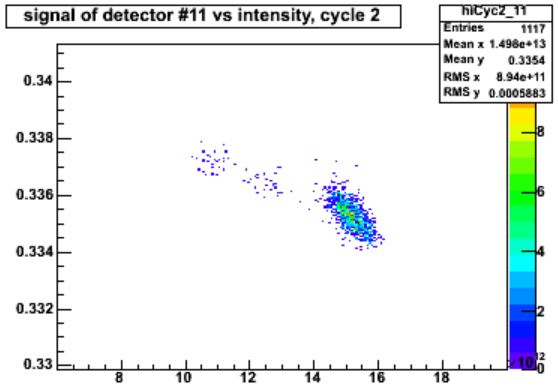
A. M

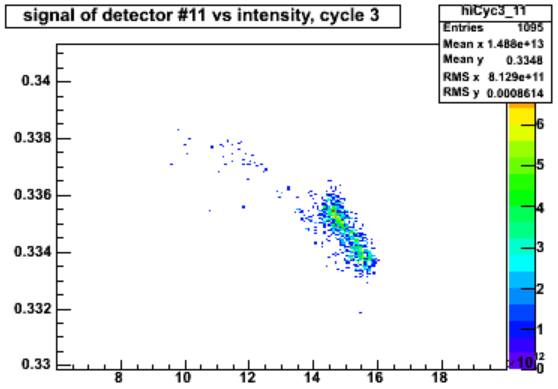
RMS Calculation

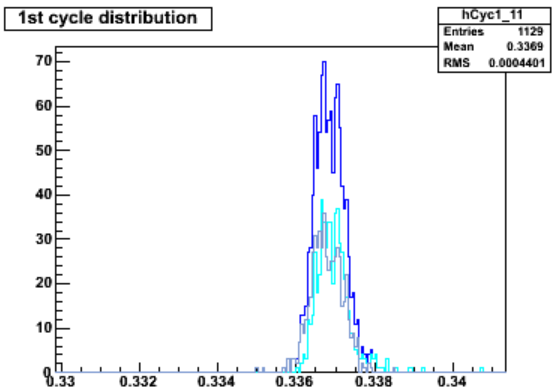


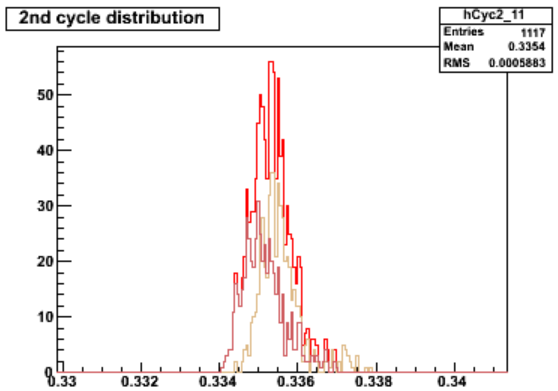


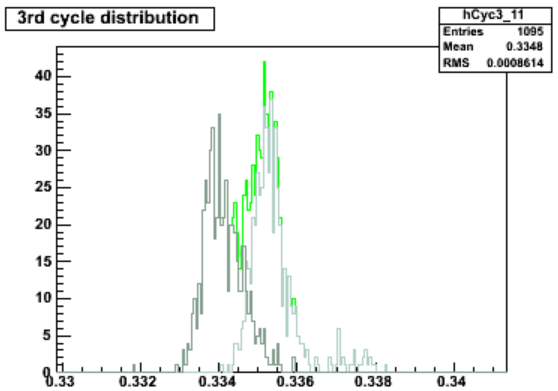






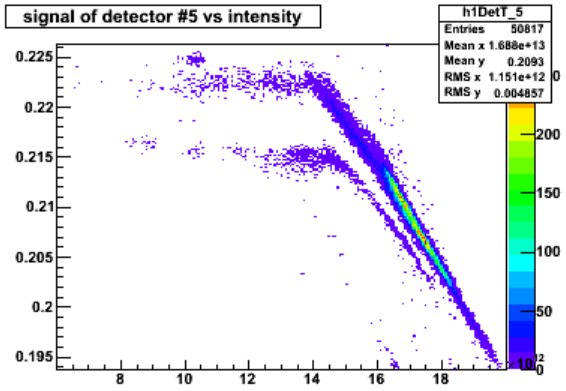


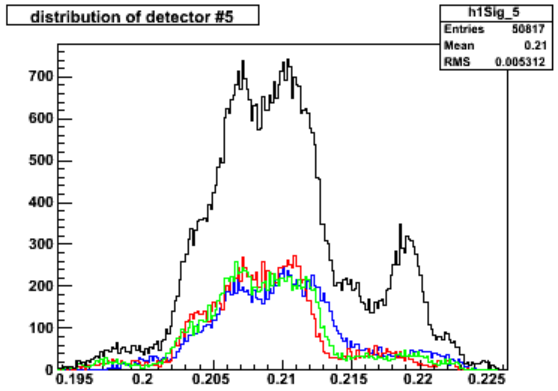


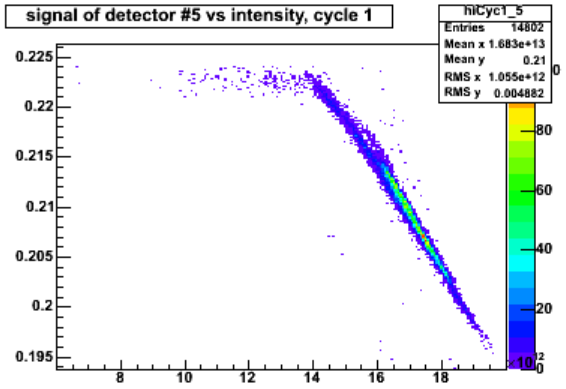


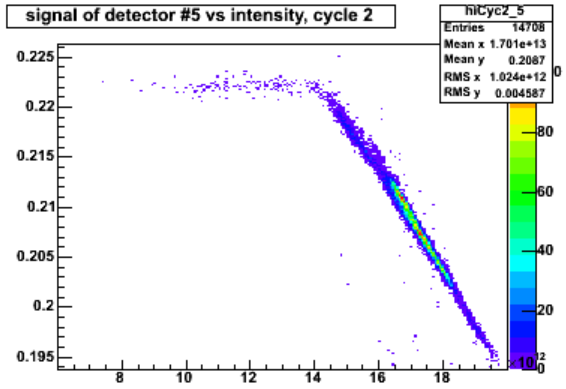
A. M

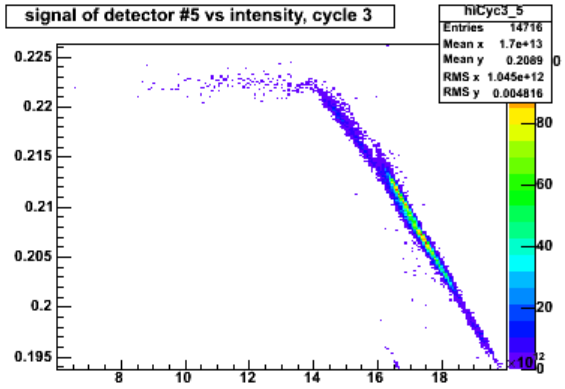
RMS Calculation: incorrect detector

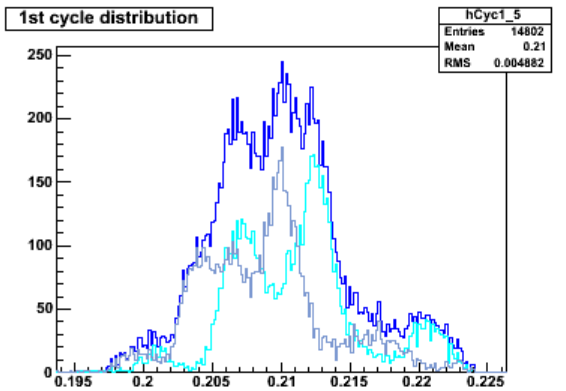


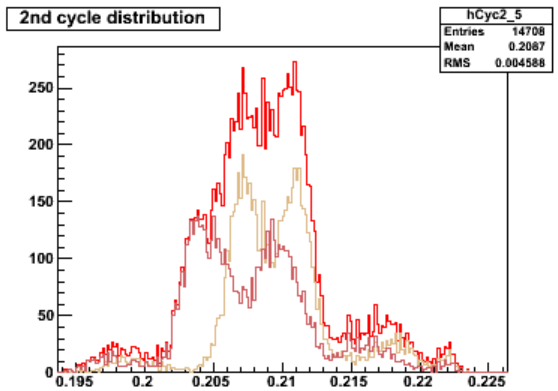


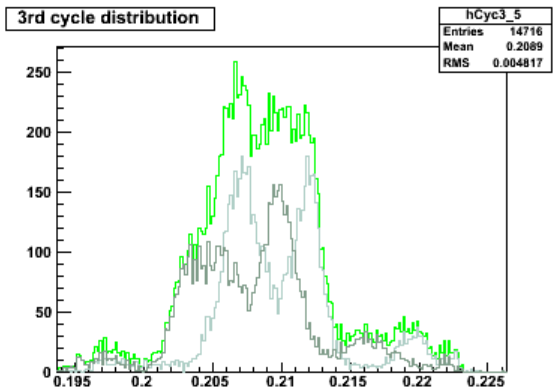












A. M

Characteristic values for 2007

- Extraction: 10.5 μs
- e- drift: 200 ns
- Ions drift: 200 μs
- Cables: 800m, 32 nF
- Resistor: 5 kOhm
- Electronic input
  - Voltage rise time: 200 μs
  - Characteristic decay time: 160 μs
  - Total discharge time = 5 *160 = 0.8 ms