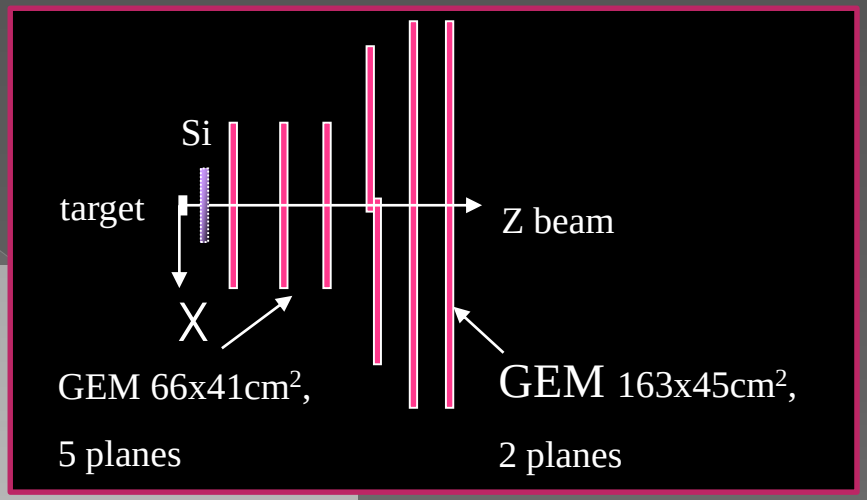
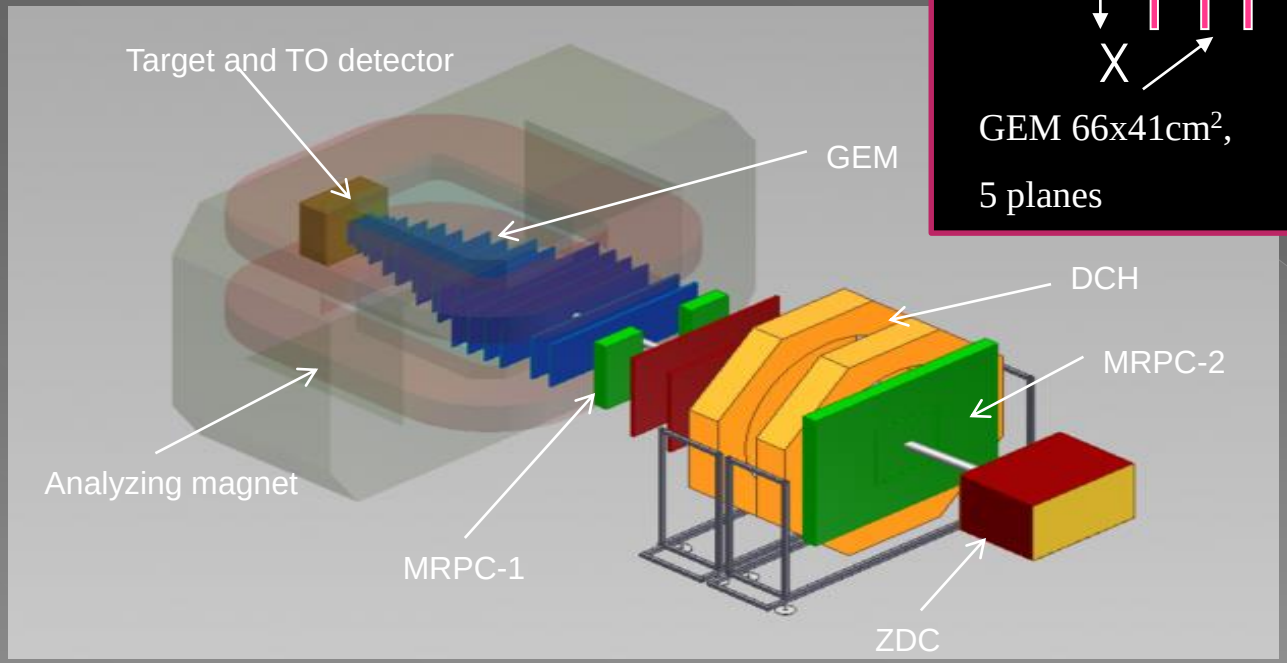
Application of IDE162 ASICs in the GEM detectors for the BM@N central tracker

Elena Kulish on behalf of BM@N Collaboration

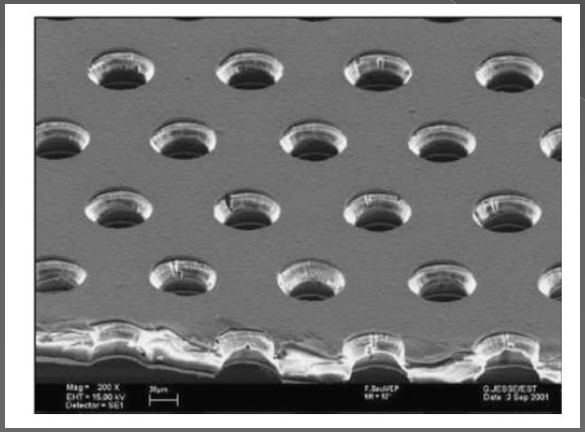
BM@N experiment

Collisions of Nuclotron heavy ion beams with fixed targets provide a unique opportunity to study strange mesons and multi-strange hyperons close to the kinematic threshold. One of the main goals of the experiment is to measure yields of light hyper-nuclei, which are expected to be produced in coalescence of Λ-hyperons with nucleons.

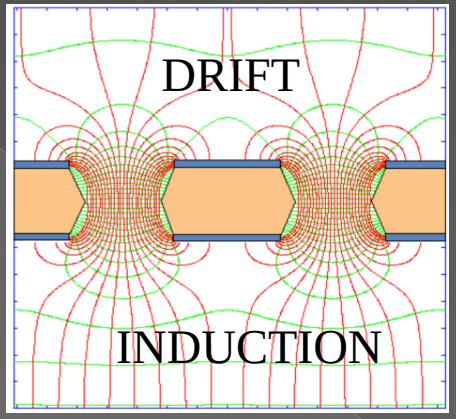




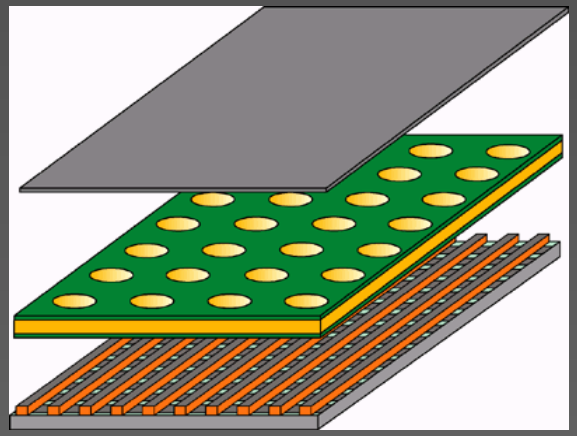
The gas electron multiplier (GEM)



Electron microscope picture of a section of typical GEM electrode, 50 μm thick. The holes pitch and diameter are 140 and 70 μm, respectively.



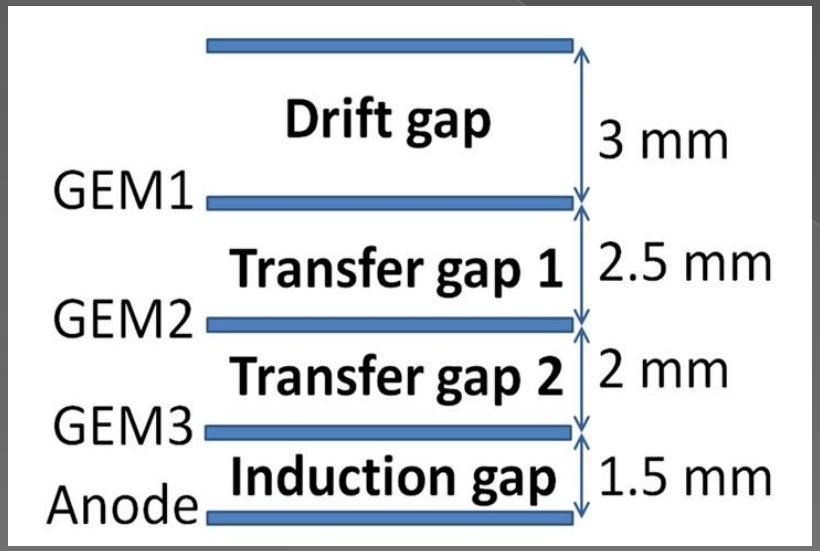
Electric field in the region of the holes of a GEM electrode



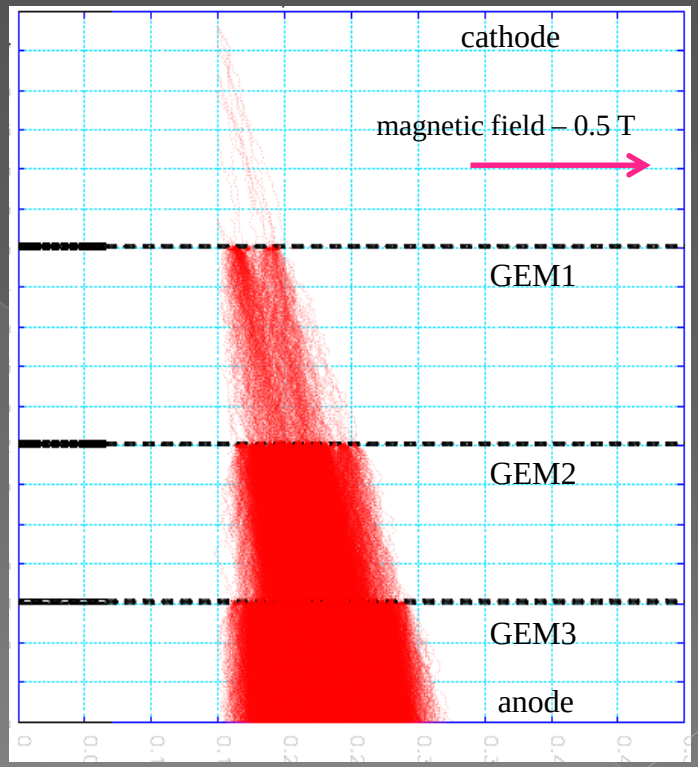
Schematics of single GEM detector with Cartesian two-dimensional strip readout.

BM@N triple GEM detector scheme

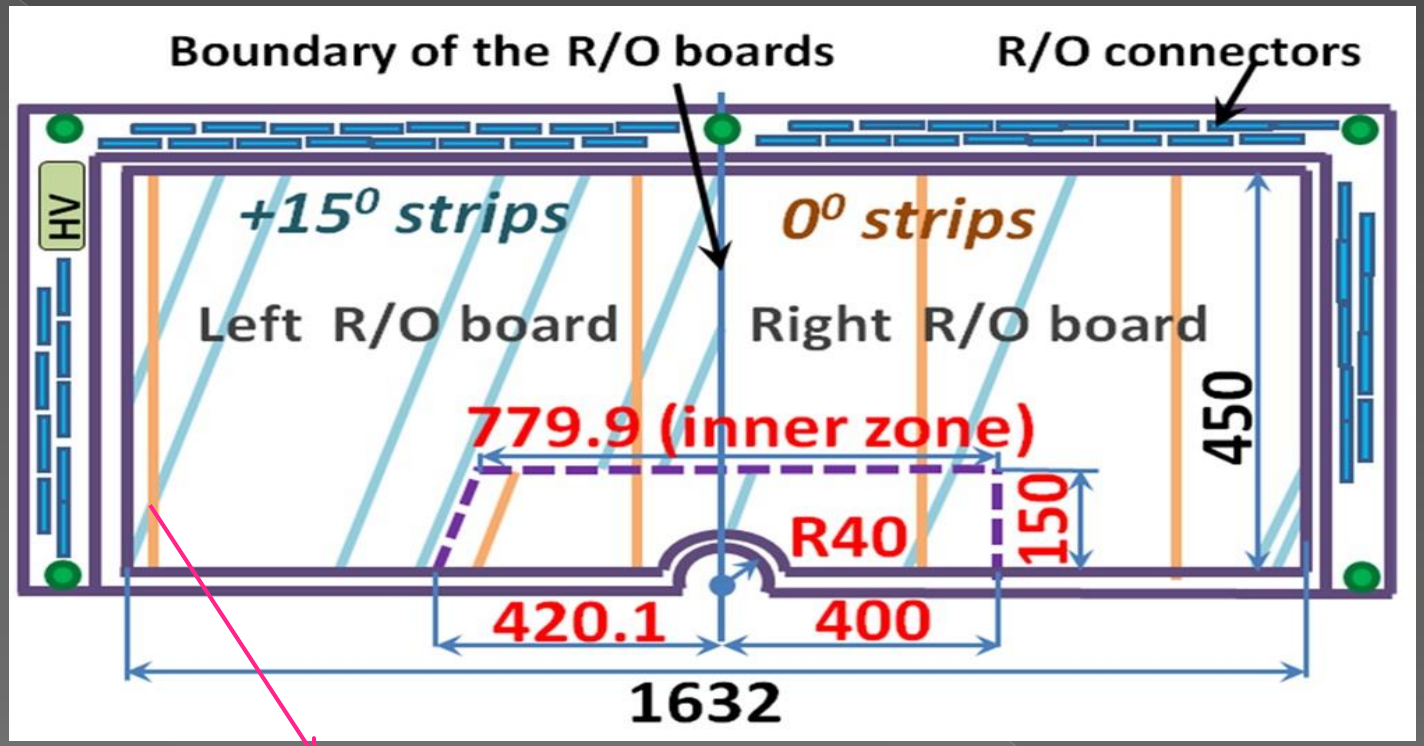
Schematic cross section of BM@N triple GEM detector

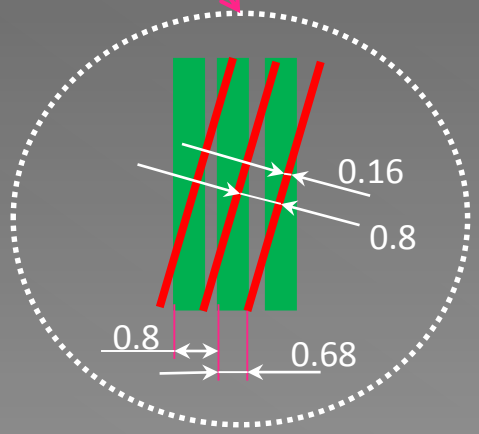


Avalanche for the triple GEM cascade in magnetic field of 0.5 T (Garfield simulation)



BM@N GEM 1632x450 mm^2 chambers

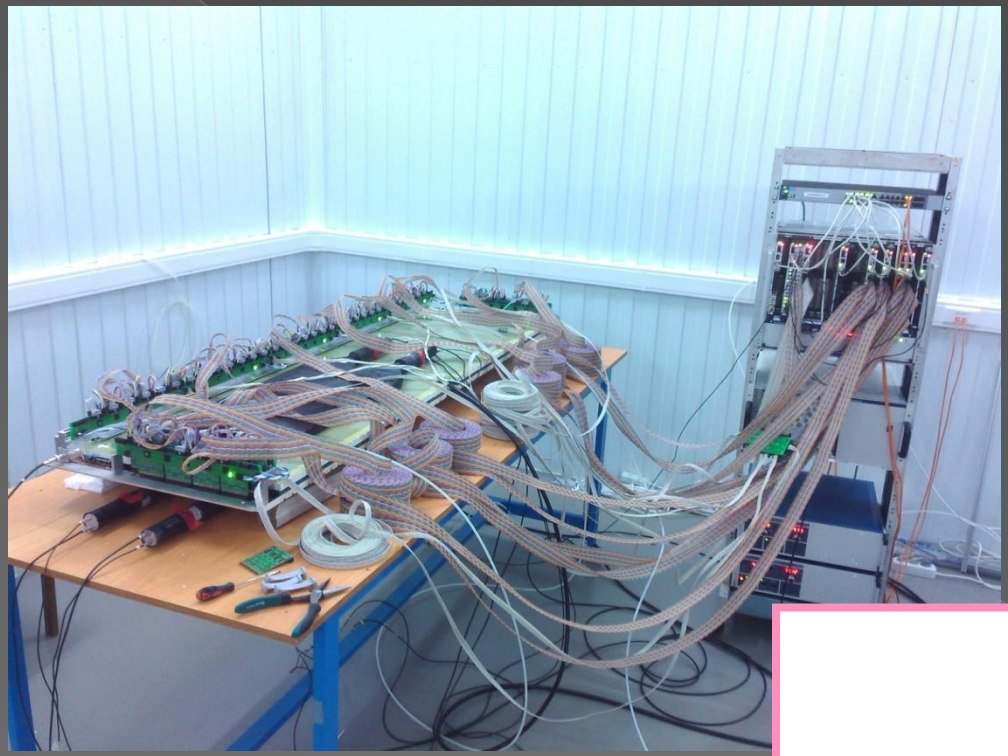




5 chambers 660x412 mm^2
3 chambers 1630x450 mm^2
Small chamber: total strips **2160**
R/O connectors (128 pins): **17**
Big chamber: total strips **6365**
R/O connectors (128 pins): **50**

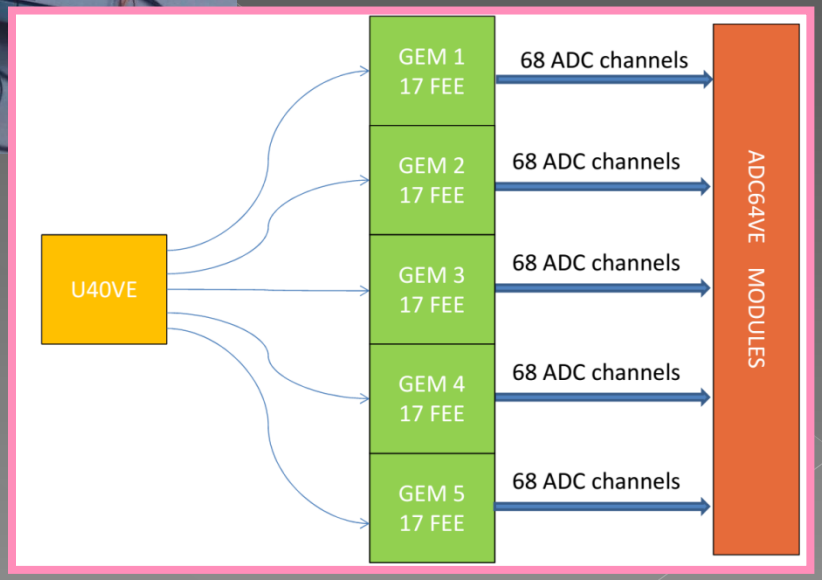
~ 30000 readout channels

GEM electronics



GEM chamber equipped with front-end electronics and DAQ crate

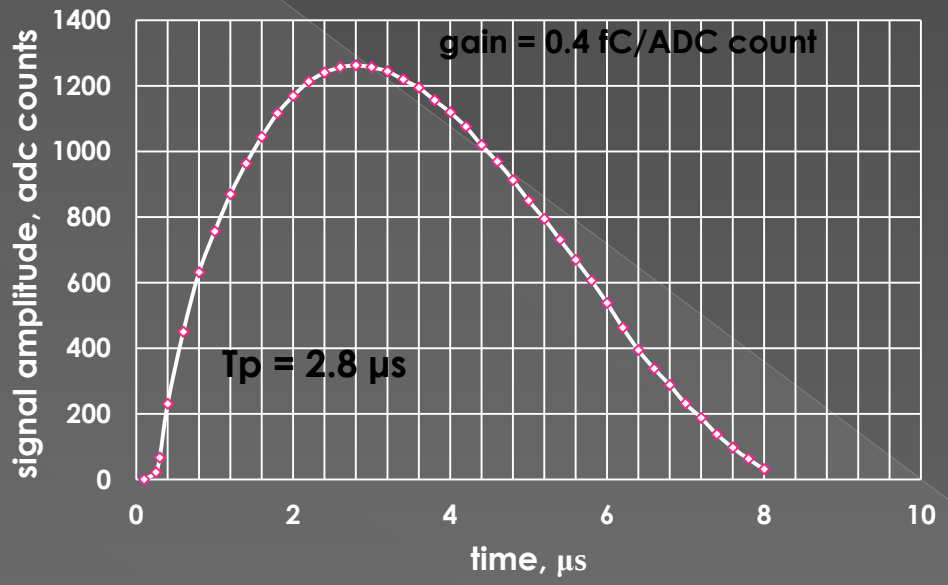
128 channel read-out card. Front and back side view



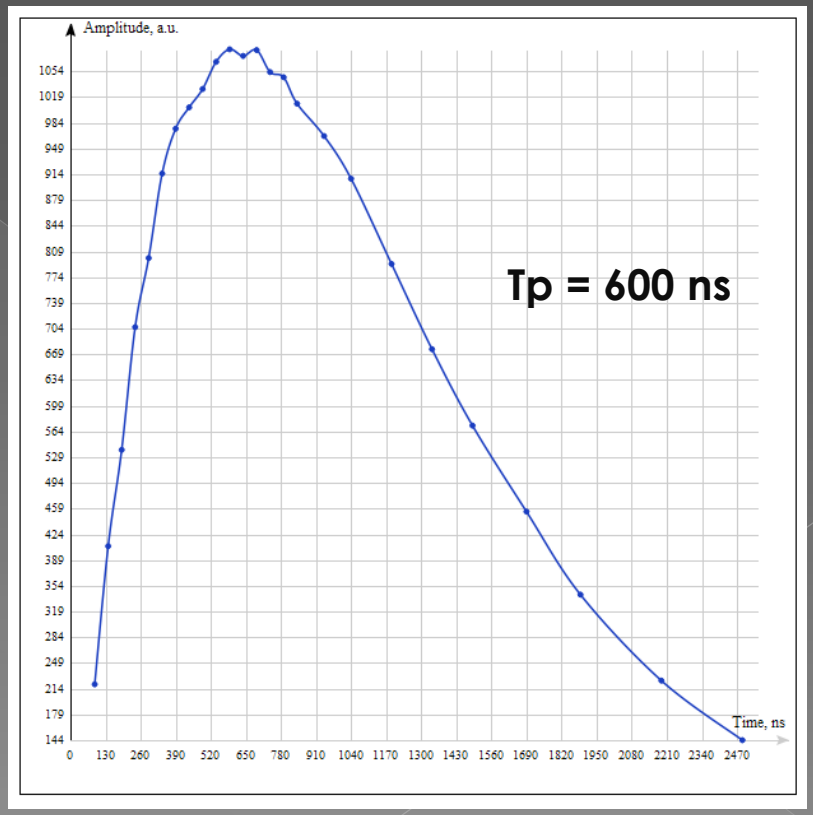
DAQ scheme

FEE peaking time

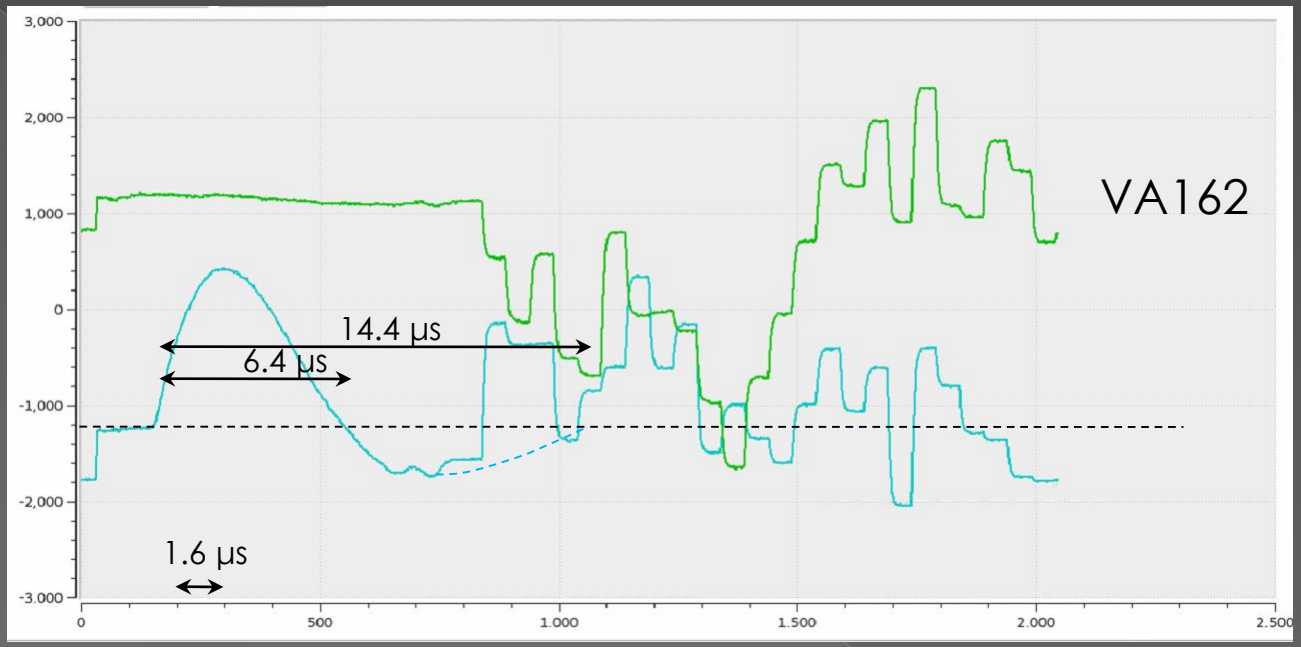
VA 162 test signal

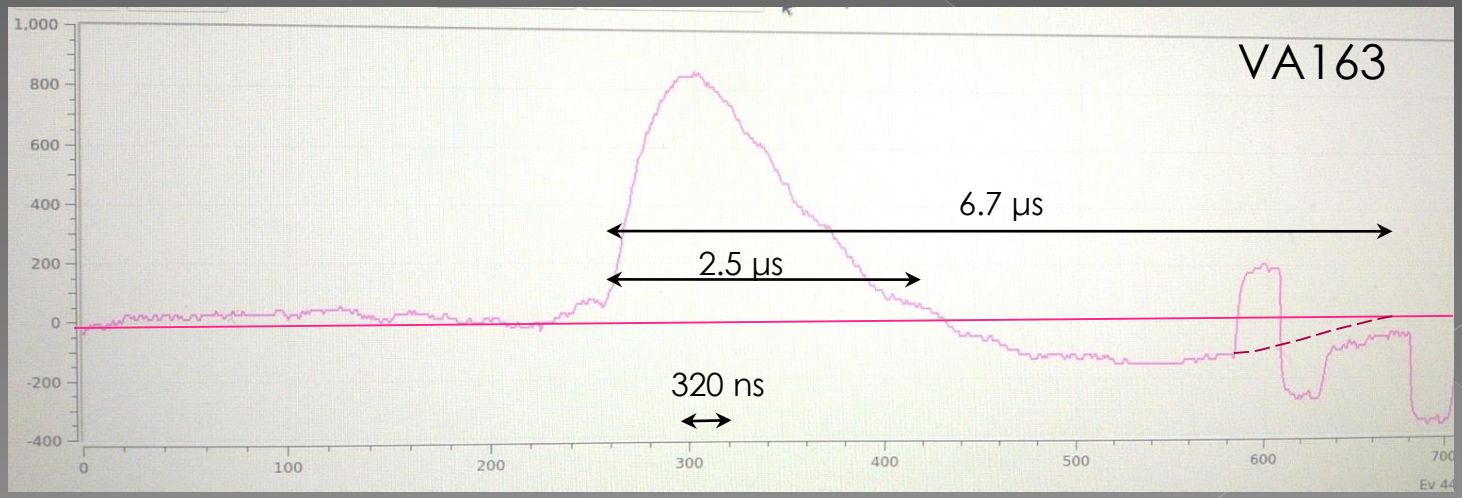


VA163 test signal

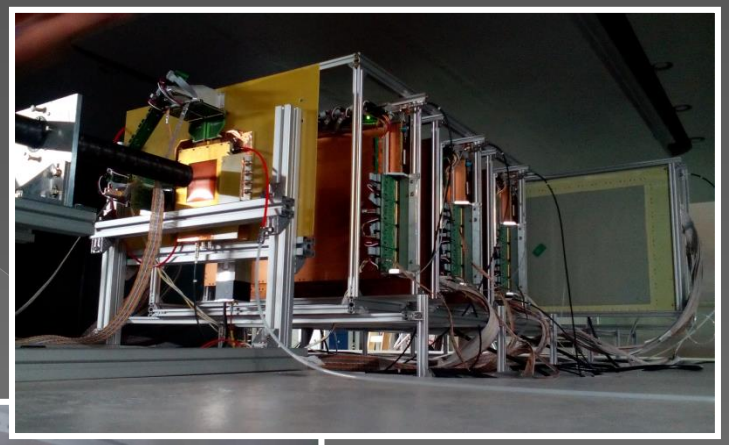


FEE signals


VA162
14.4 µs
6.4 µs
1.6 µs
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
0
500
1.000
1.500
2.000
2.500

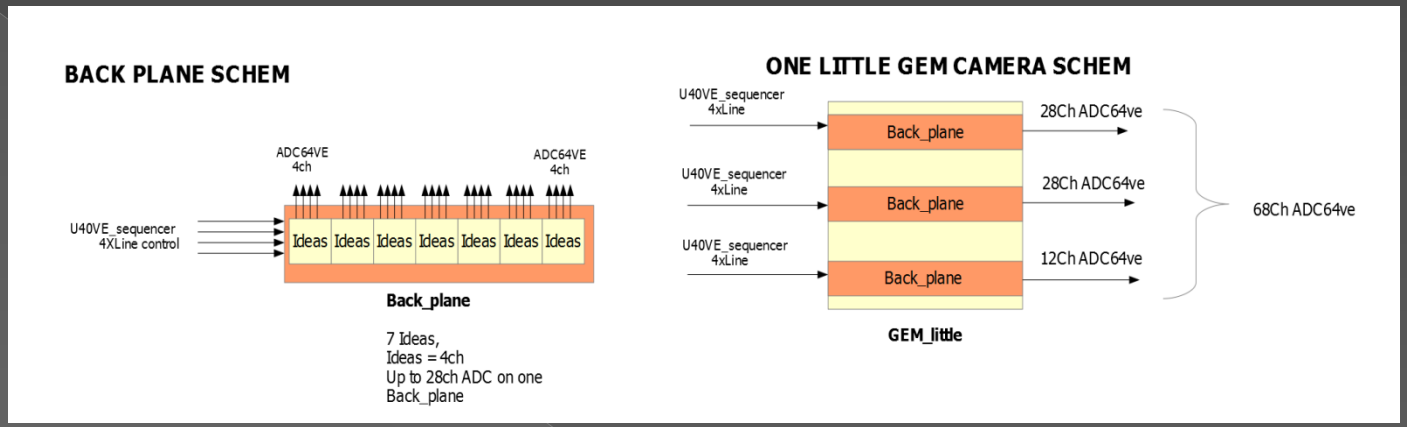

VA163
6.7 µs
2.5 µs
320 ns
1,000
800
600
400
200
0
-200
-400
0
100
200
300
400
500
600

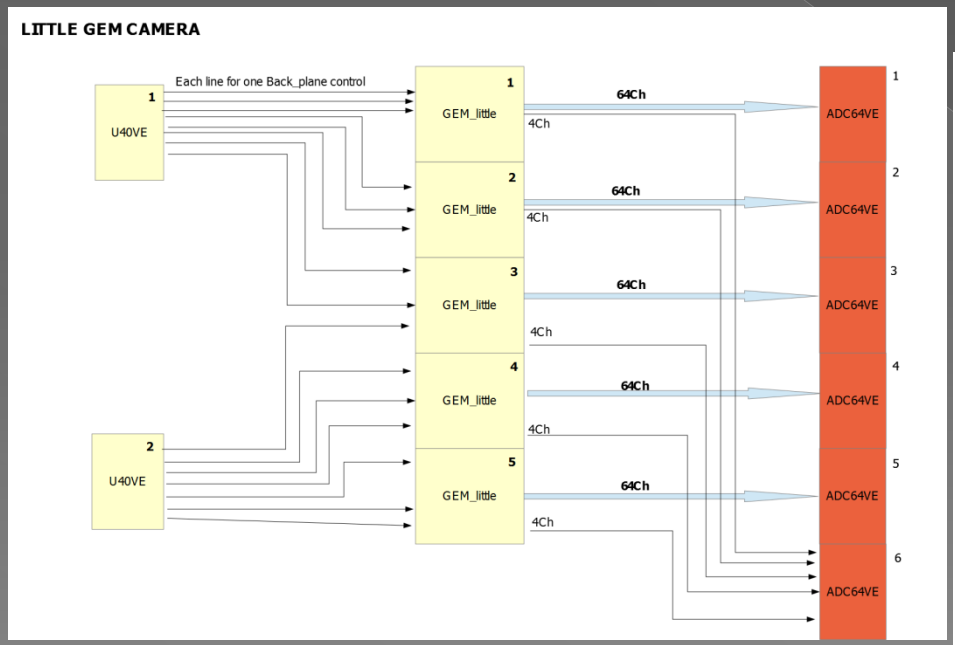
Thank you for your attention!

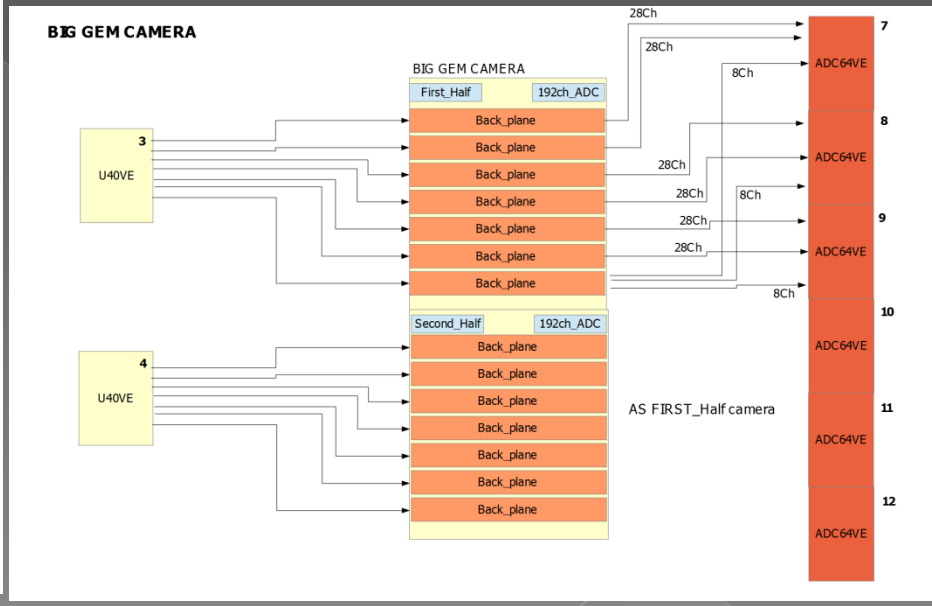


Back-up slides

GEM DAQ Scheme

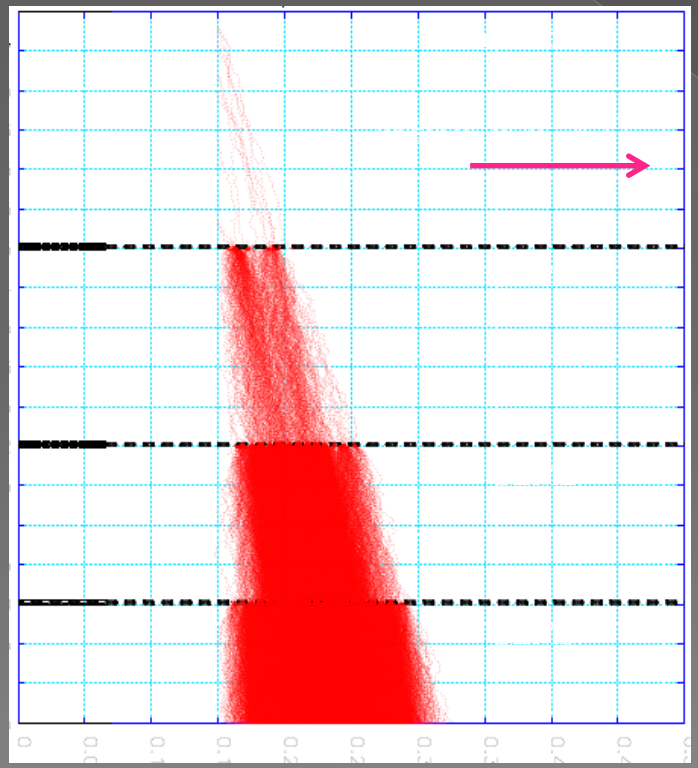




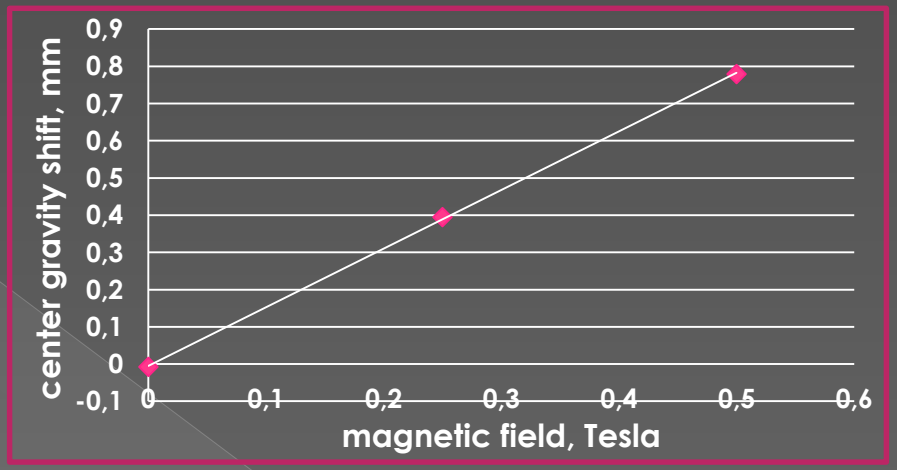


Electrons drift due to magnetic field (Garfield & Maxwell simulations)

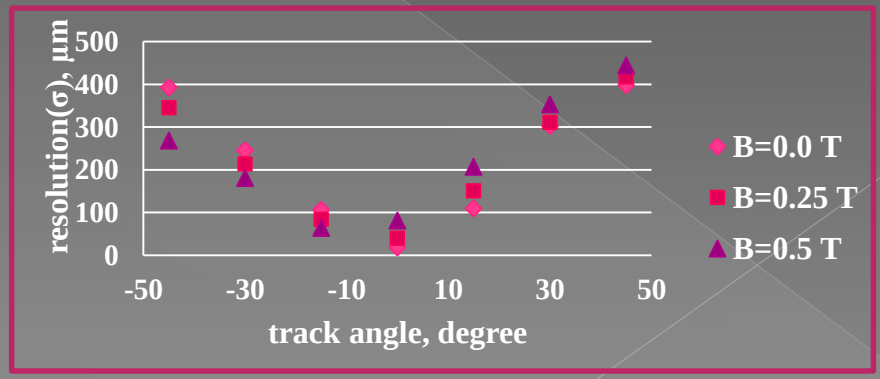
Simulation of electron shift in magnetic field



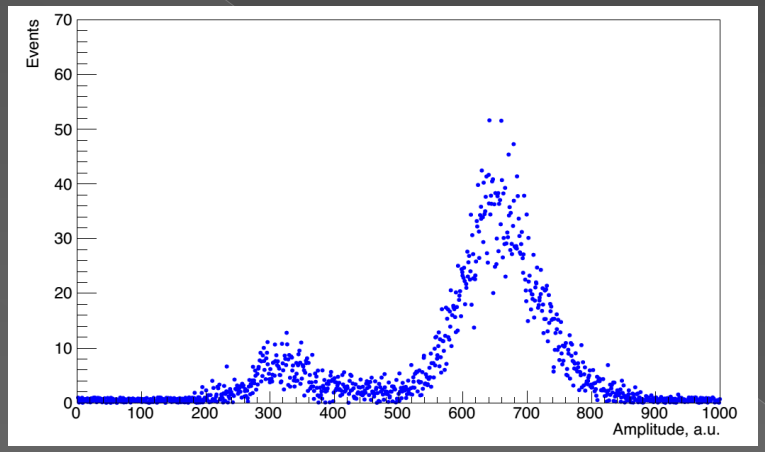
Center gravity shift vs magnetic field



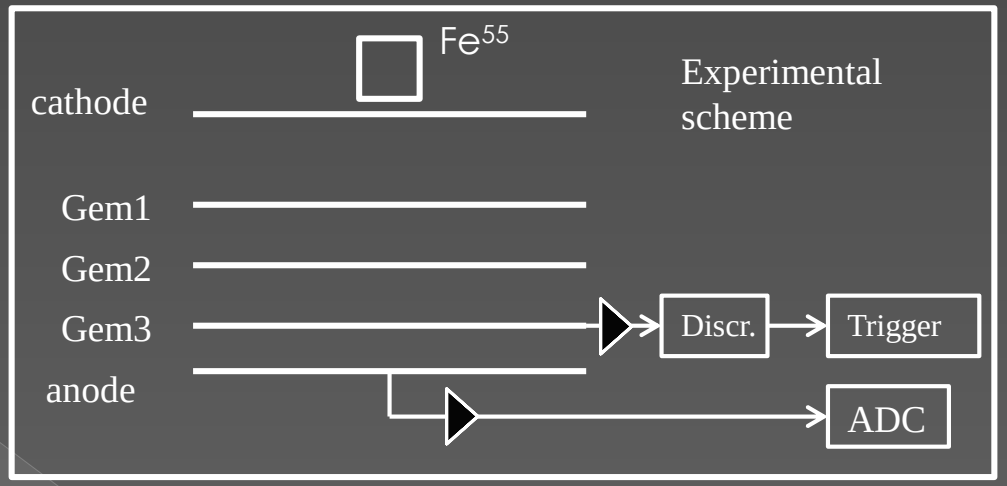
Space resolution vs magnetic field and track angle

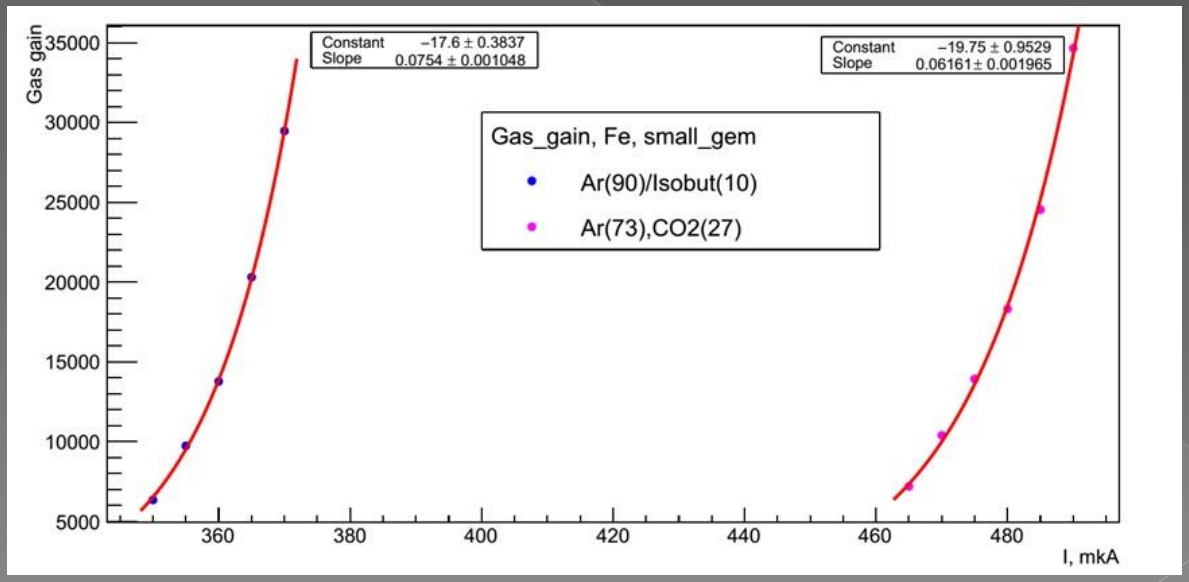


GEM gas gain measurements



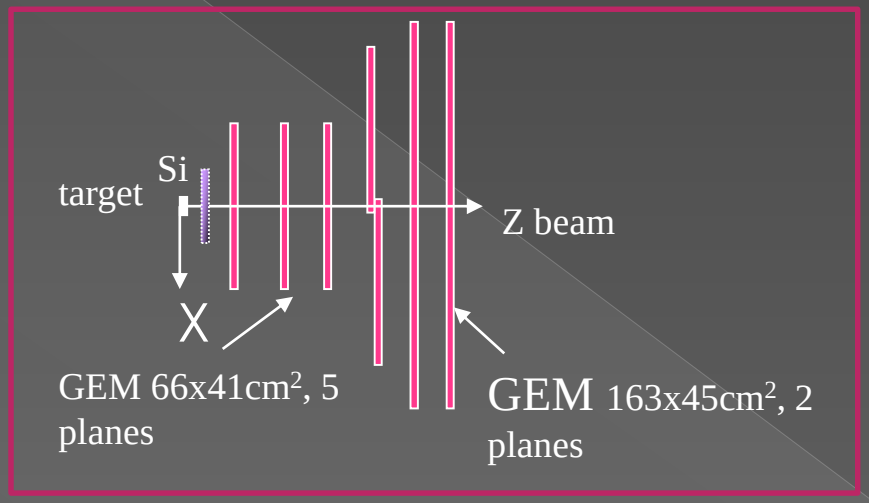
Amplitude distribution, Ar(70)/CO2(30), Fe^{55}



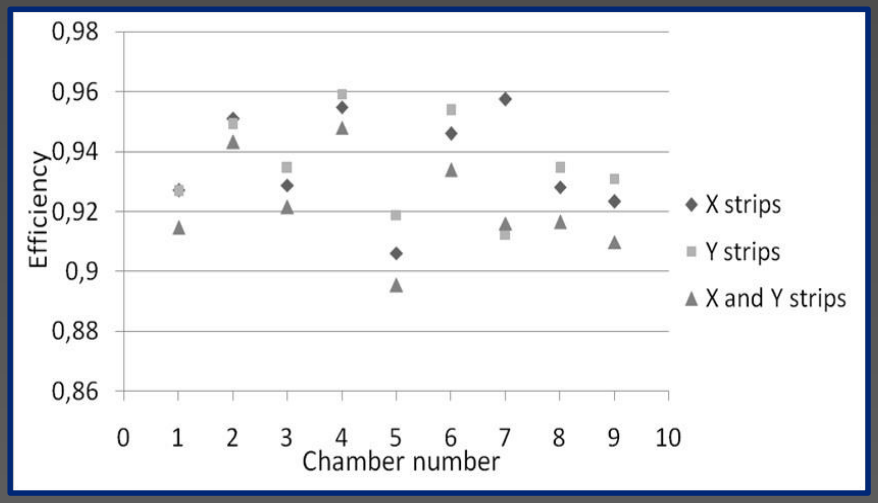


GEM gas gain for Ar(70)/CO2(30) and Ar(90)/Isobutane(10) gas mixtures

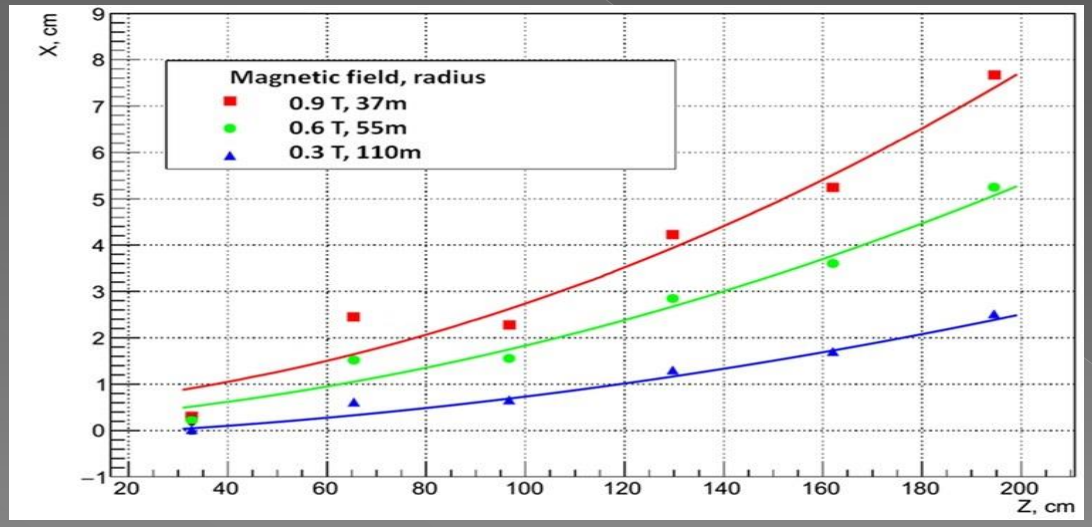
GEM tests at Nuclotron deuteron beam



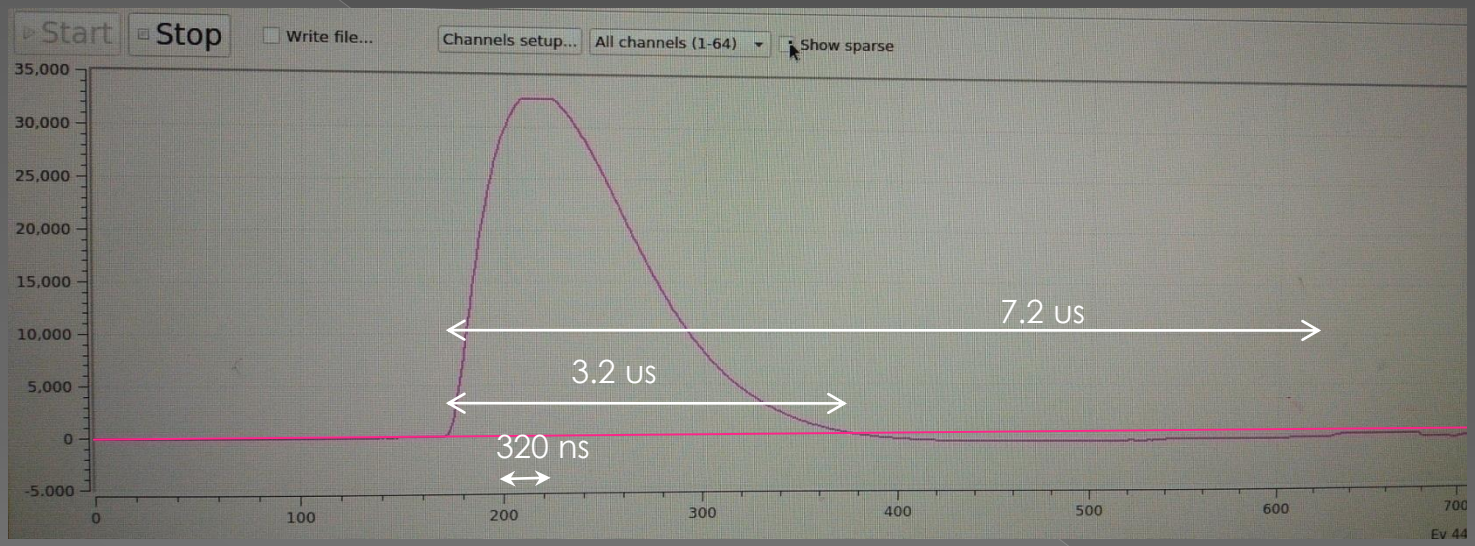
GEM configuration



GEM efficiencies



The average trajectories of the deuteron beam and the average Lorentz shifts of an electron avalanche in 6 GEM planes measured for three values of the magnetic field.


Start
Stop
Write file...
Channels setup...
All channels (1-64)
Show sparse
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
-5,000
0
100
200
300
400
500
600
700
7.2 us
3.2 us
320 ns
Ev 44

GEM assembly at CERN Workshop