STS+GEM hybrid tracker performance studies in simulation

A.Zinchenko, V.Vasendina
VBLHEP, JINR, Dubna, Russia

Joint Institute for Nuclear Research
SCIENCE BRINGING NATIONS TOGETHER

4th Collaboration meeting of the BM@N
14-15 October 2019

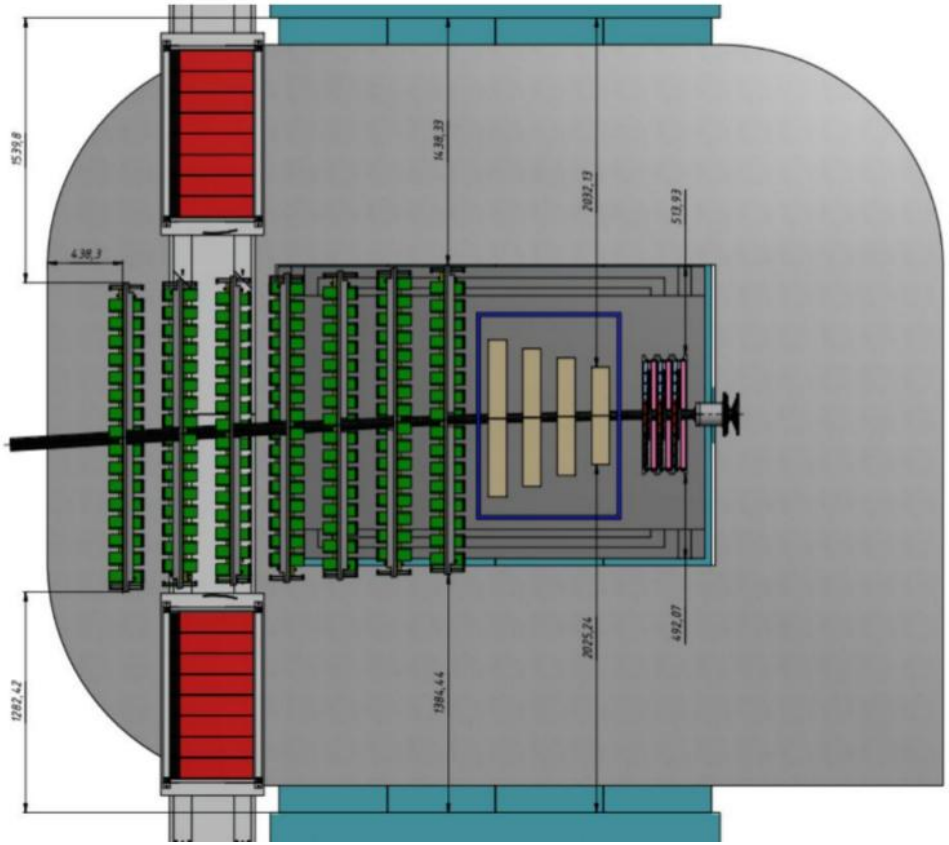
Outline

1. Tracker performance for different magnetic field settings.
2. Development of the fast digitizer for GEMs.

Geometry

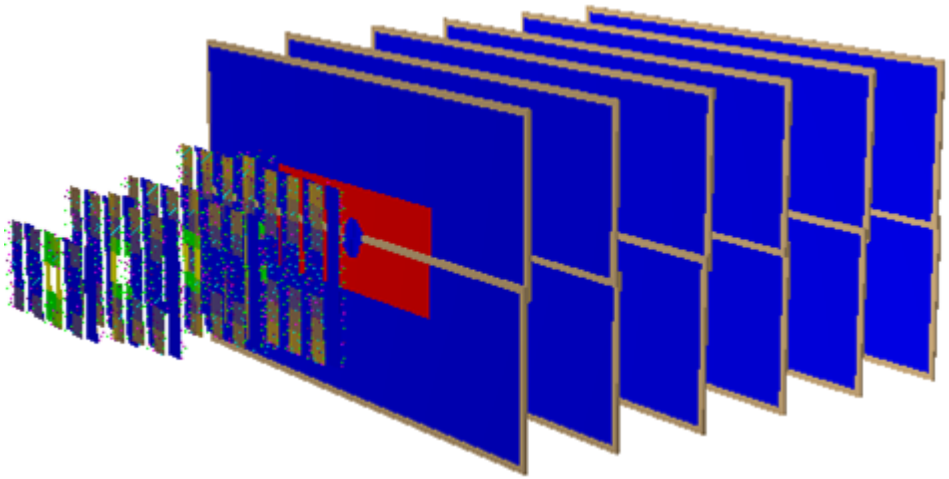
A.Zinchenko

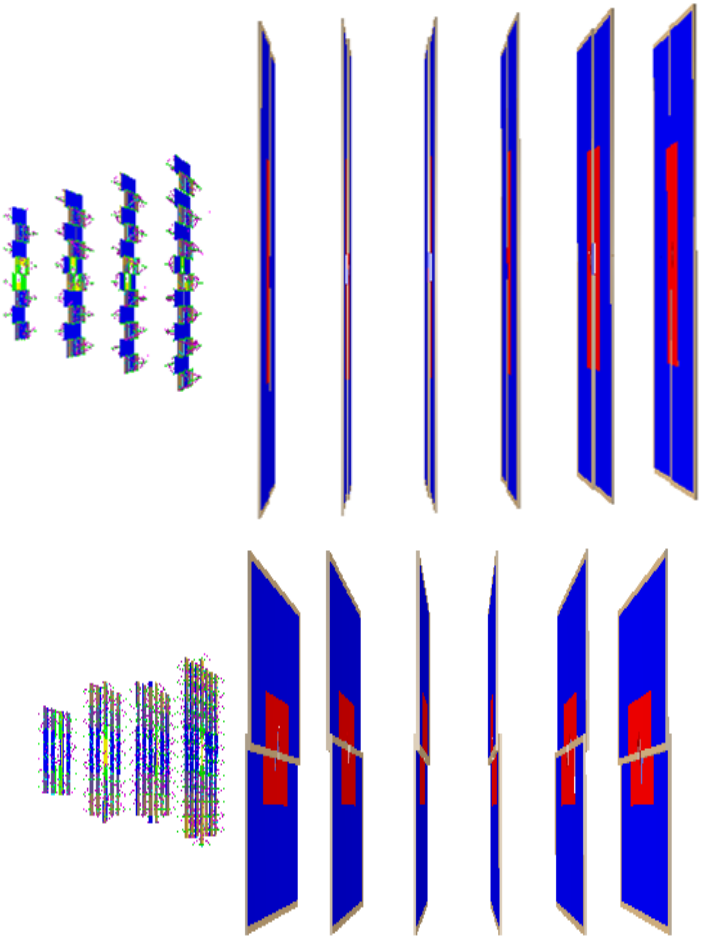
Forward Si+ STS +Gem configuration



Geometry

A.Zinchenko





Stations (target at 0):

Si	30 cm	50 cm	70 cm	90 cm	(version “f” from E. Lavrik)	
GEMs	120 cm	150 cm	180 cm	210 cm	240 cm	270 cm

Field: ~0.8 T

Event sample

Event sample:

5k UrQMD Au+Au central events
at T0 = 1.5, 2.5, 3.5, 4.5 A GeV – for field scan

5k DCM-QGSM Au+Au central events
at T0 = 4 A GeV – for digitizer test

Field settings

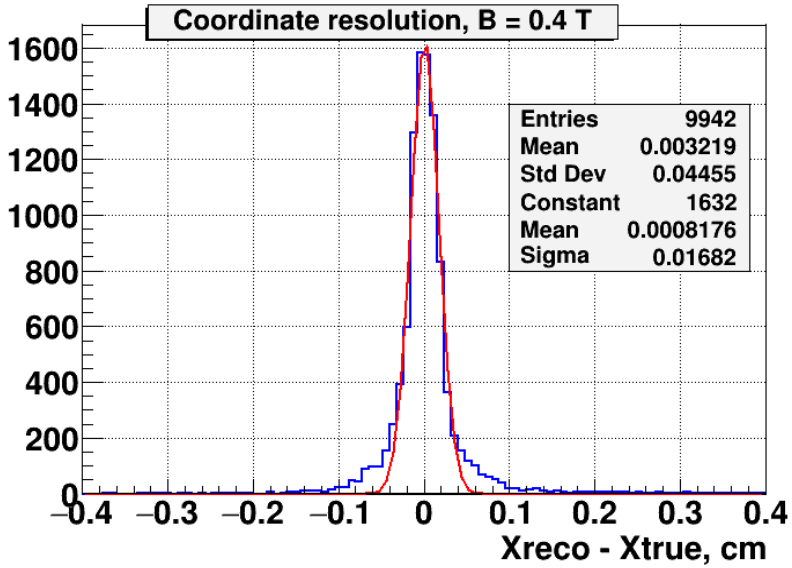
A.Zinchenko

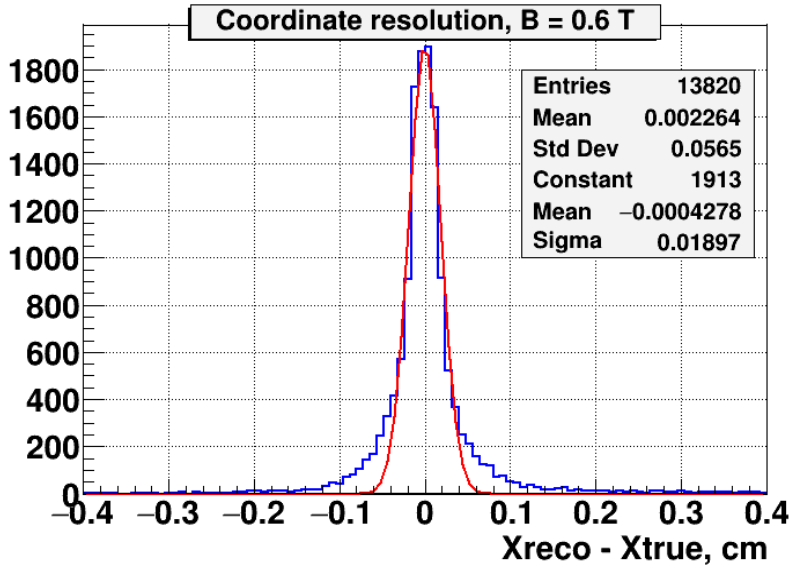
Choose magnetic field to be proportional to the Au beam magnetic rigidity p/Z

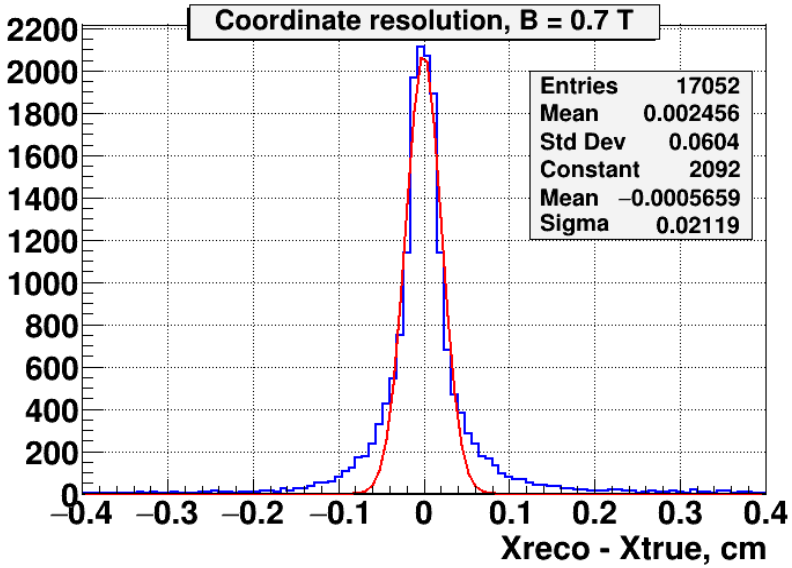
To, AGeV	Rigidity, GeV/c	Max. field, kG
1.5	5.612	3.776
2.5	8.249	5.550
3.5	10.818	7.284
4.5	13.358	8.993

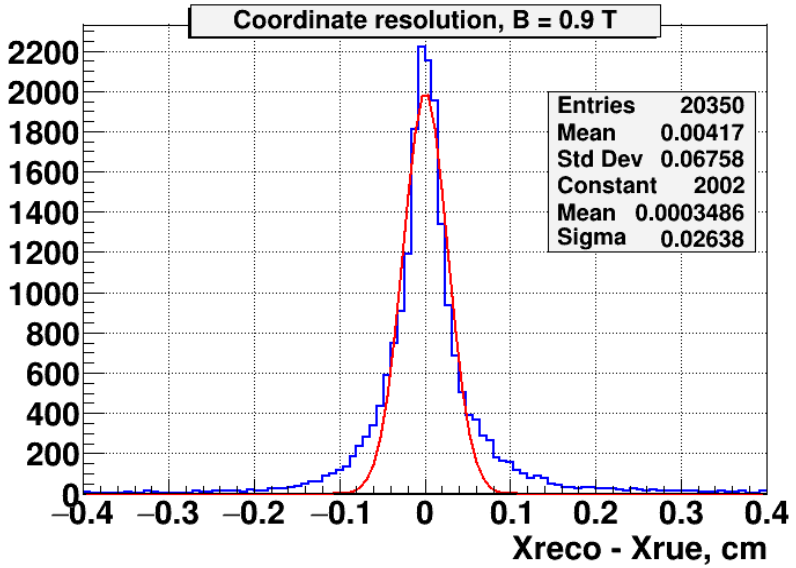
Coordinate resolution for different fields

A.Zinchenko



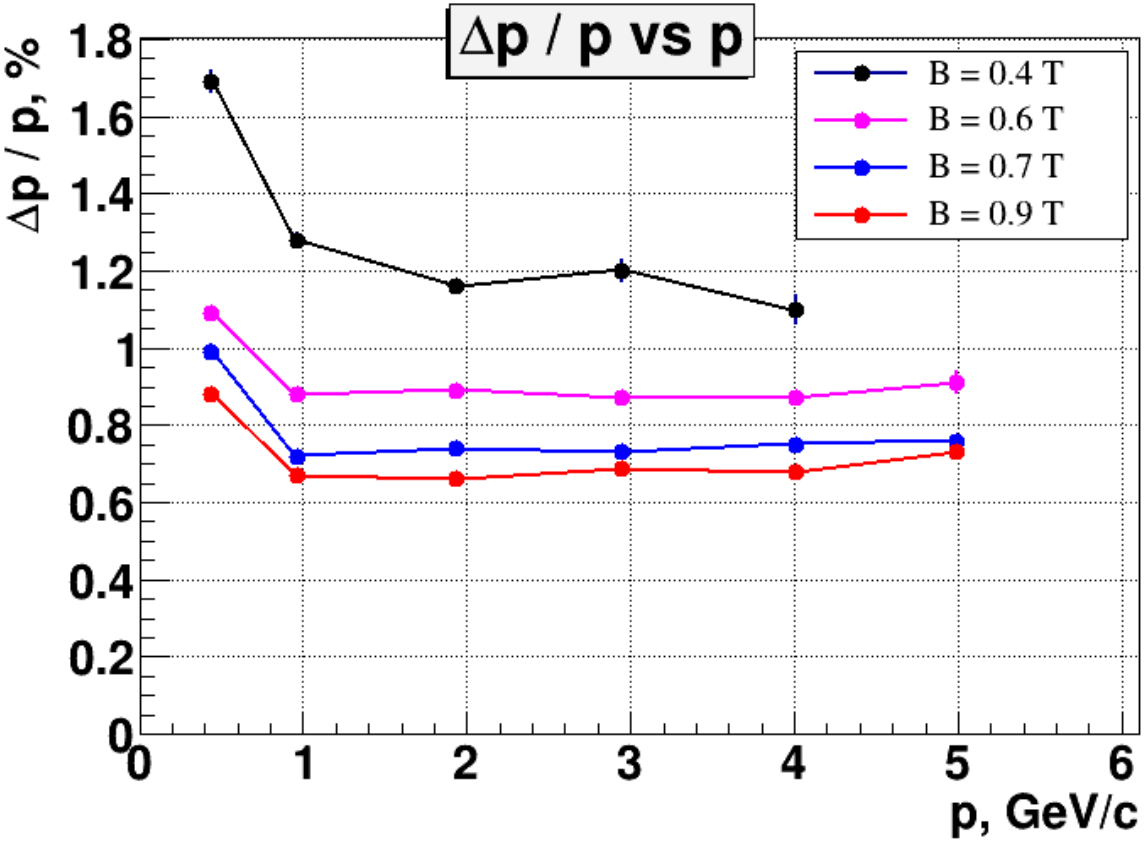






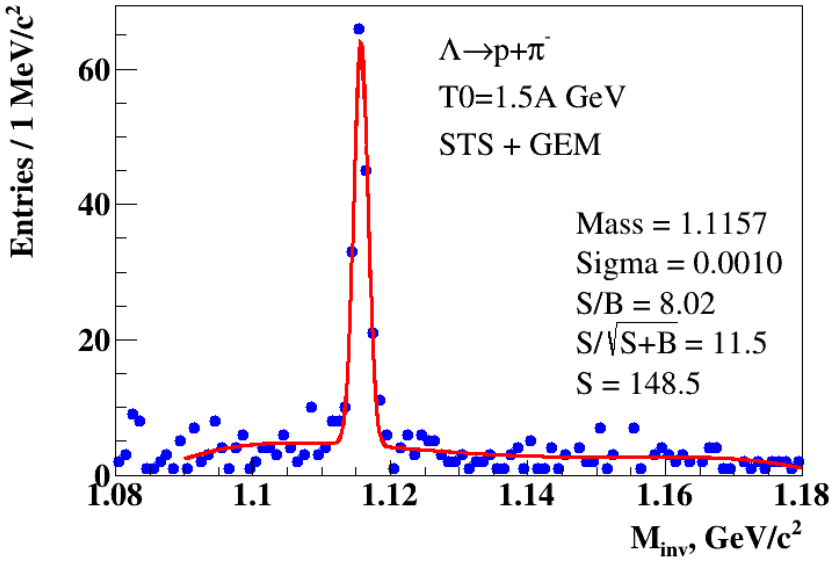
Momentum resolution

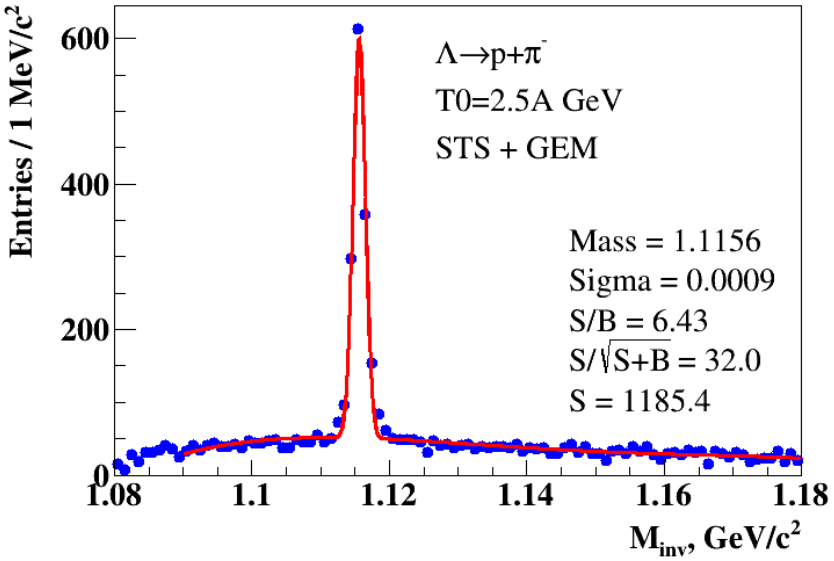
A.Zinchenko

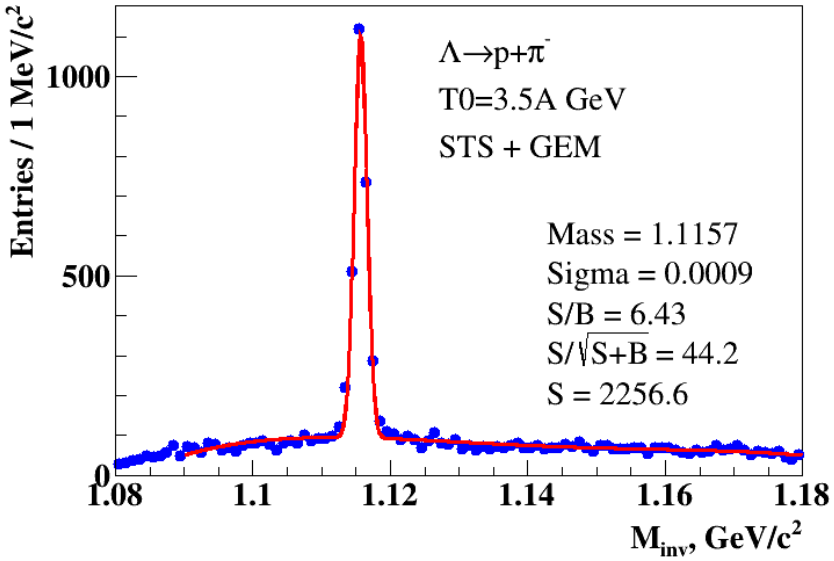


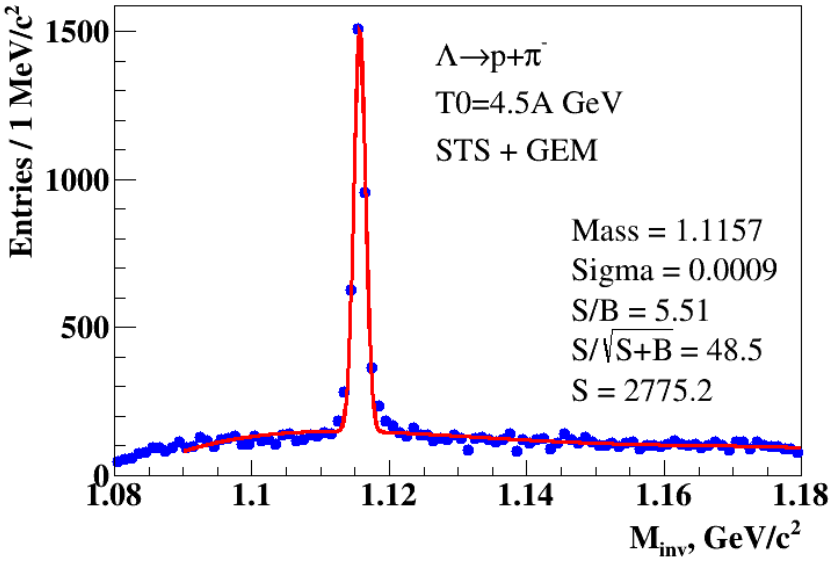
Λ peak for different energies

A.Zinchenko









Fast digitizer based on cluster shape library

A.Zinchenko

Cluster shape library:

10k single track events with p = 1.6 GeV/c (median track momentum in Au+Au @ 4 GeV) at fixed position in station 5 (first GEM station) - clusters from two readout planes.

2-D grid of angles in bending plane (from -60 to +60 deg with a step of 10 deg) and non-bending plane (from -20 to +20 deg with a step of 10 deg).

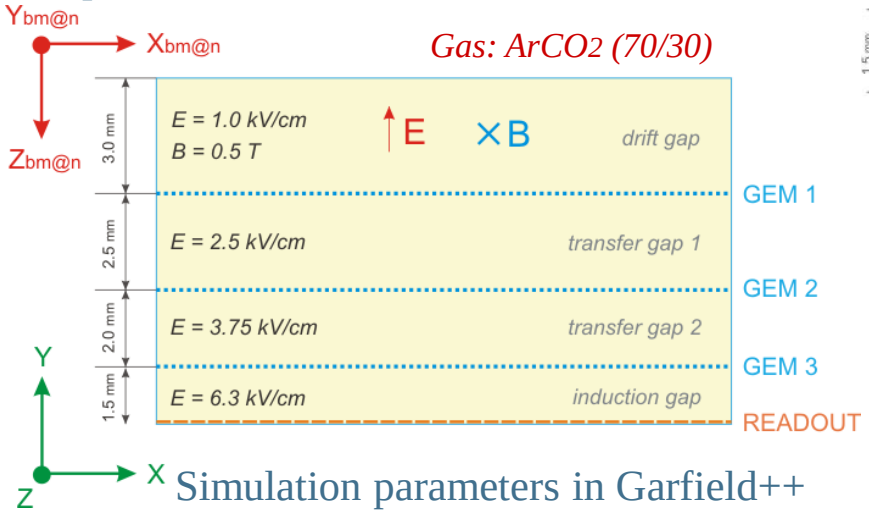
For each angle 2-D correlation plot of COGx' vs COGx.

Simulation of GEM response: Garfield++

Garfield++ - framework for microsimulation of physical processes in the gas detectors.

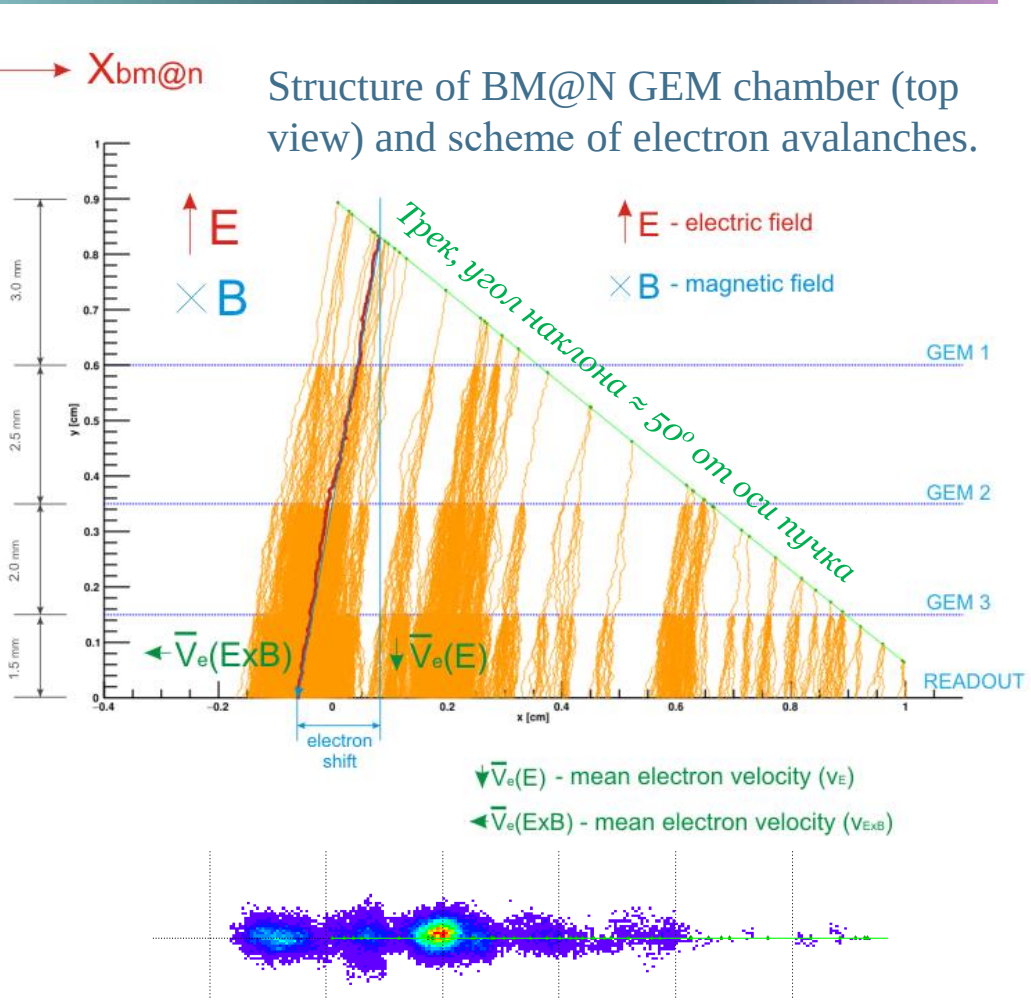
Charged particle passing through the GEM chamber detecting volume ionizes the gas.

The electrons passing through multilayer GEM-cascades form avalanches which drift to the readout-plane and fire the strips on it.



Simulation parameters in Garfield++

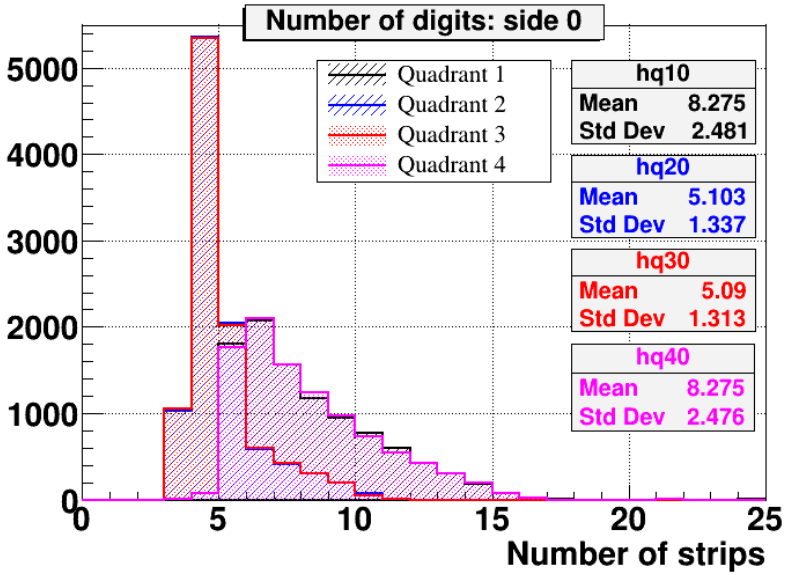
Structure of BM@N GEM chamber (top view) and scheme of electron avalanches.

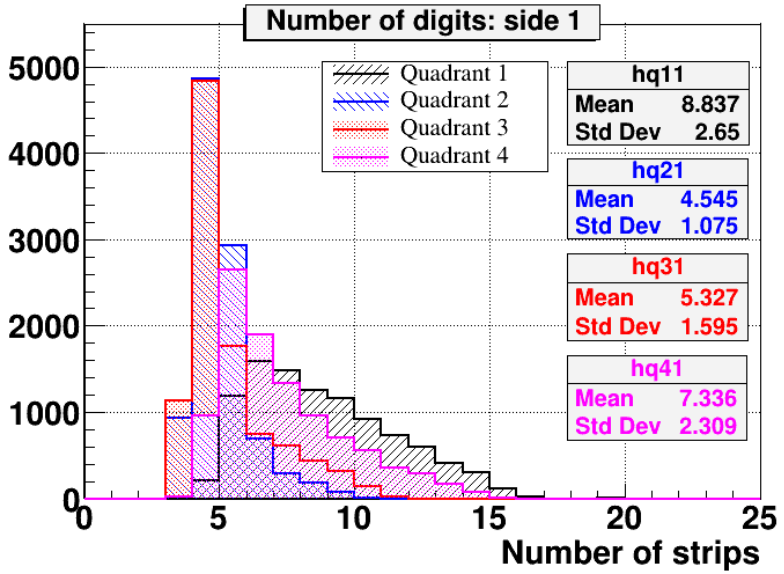


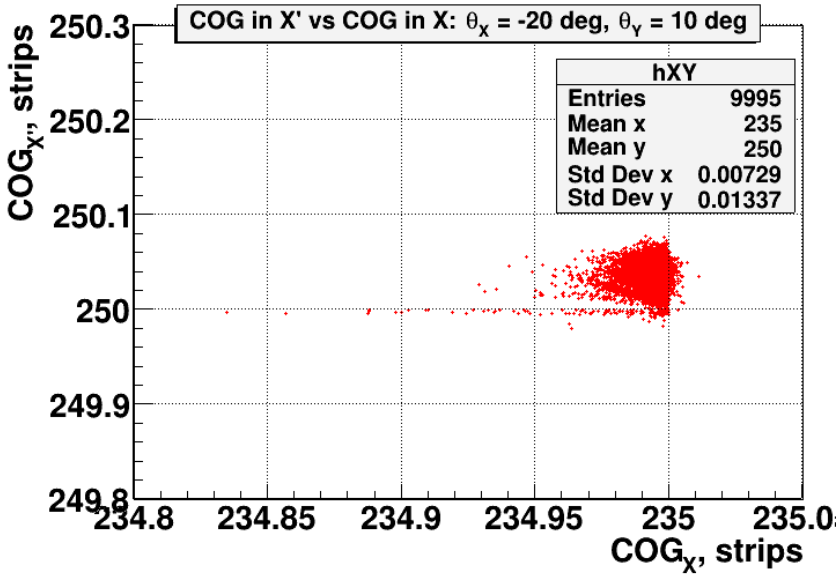
Profile of electron avalanche at the readout-plane (cluster).

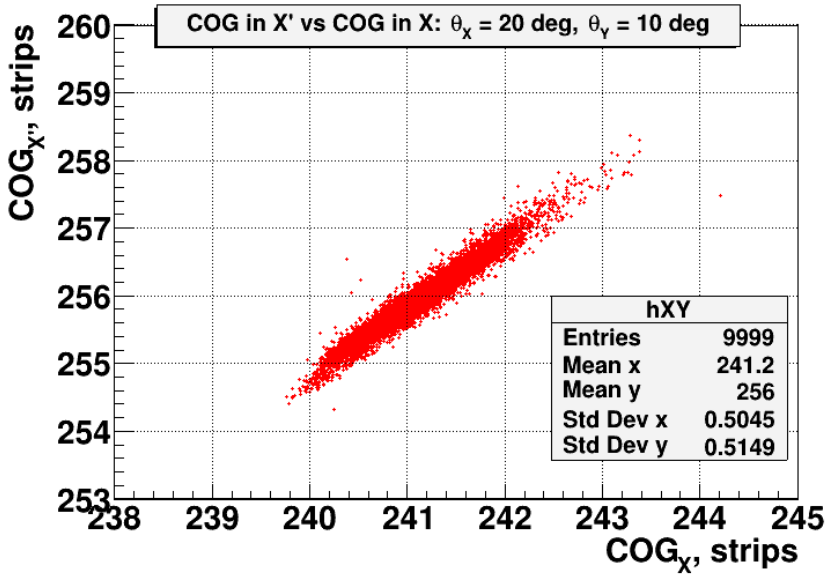
Cluster parameters

A.Zinchenko



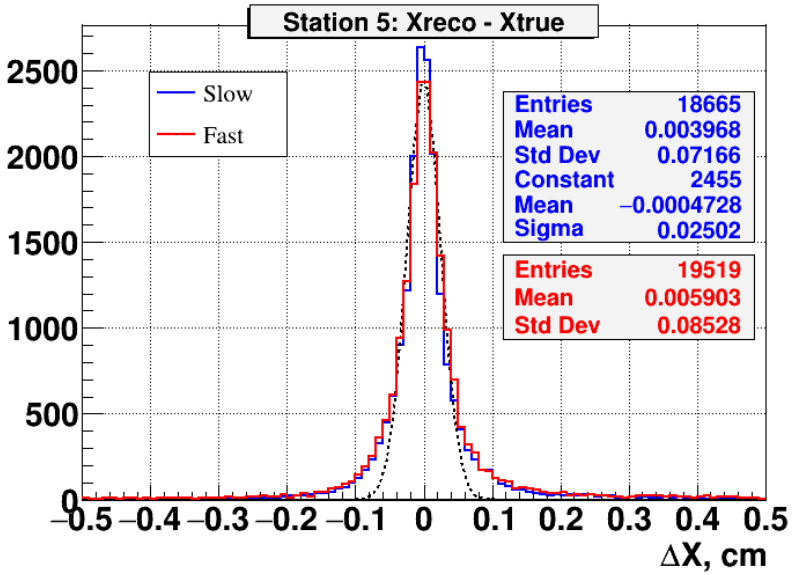


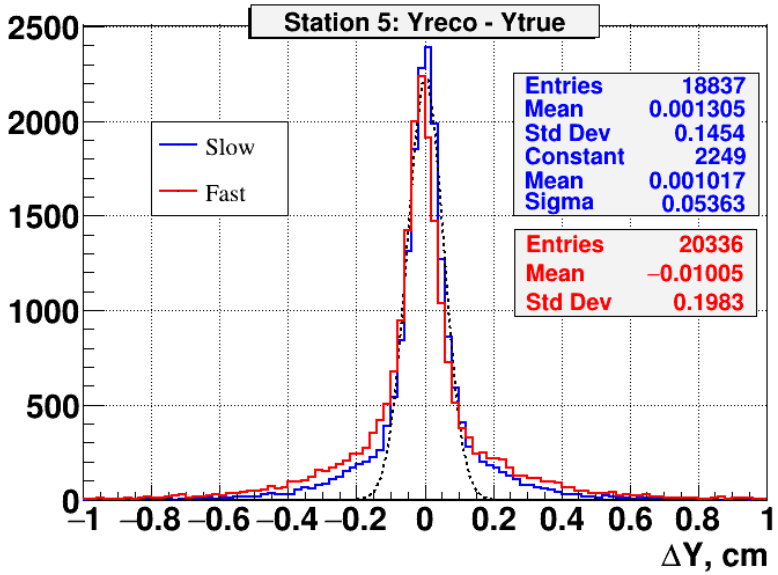


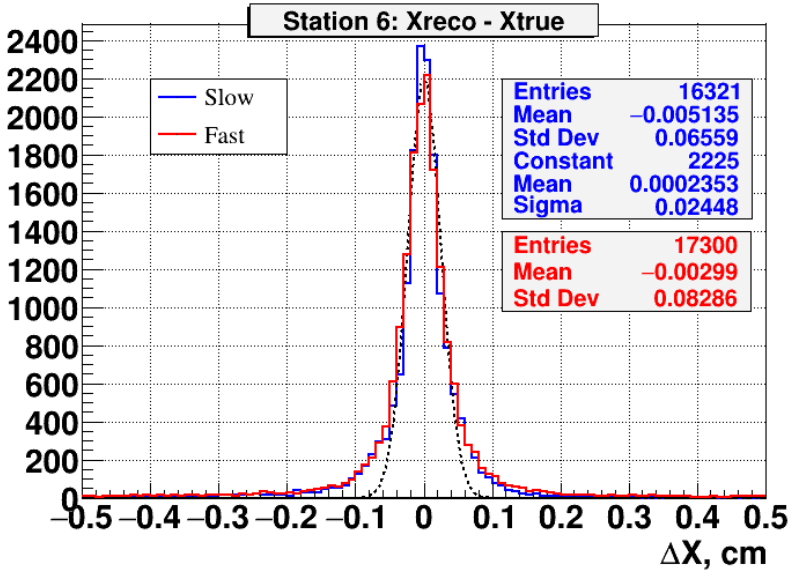


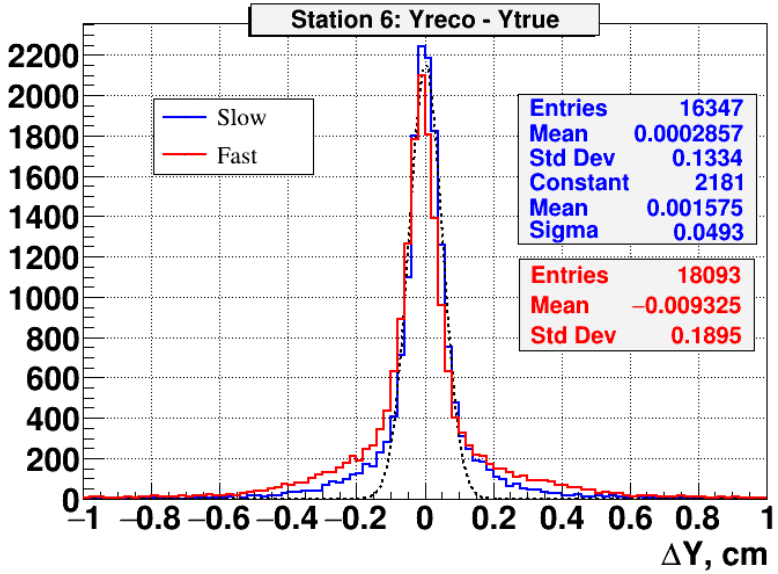
Coordinate residuals

A.Zinchenko



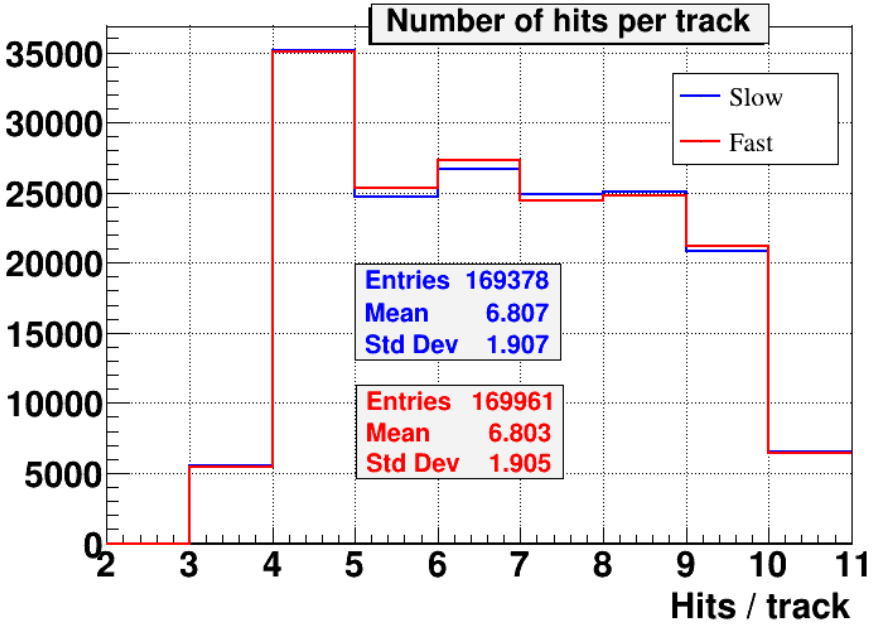


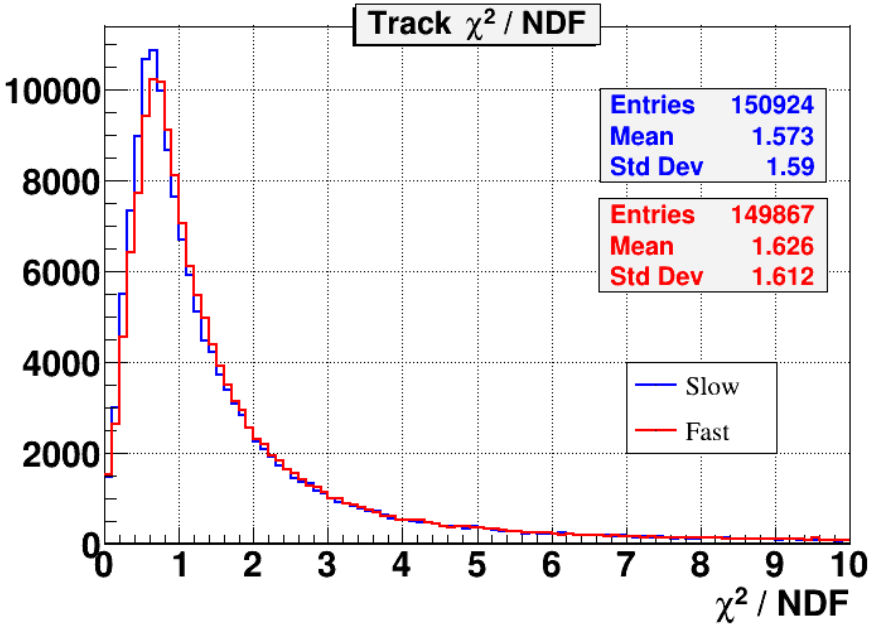




Track reconstruction

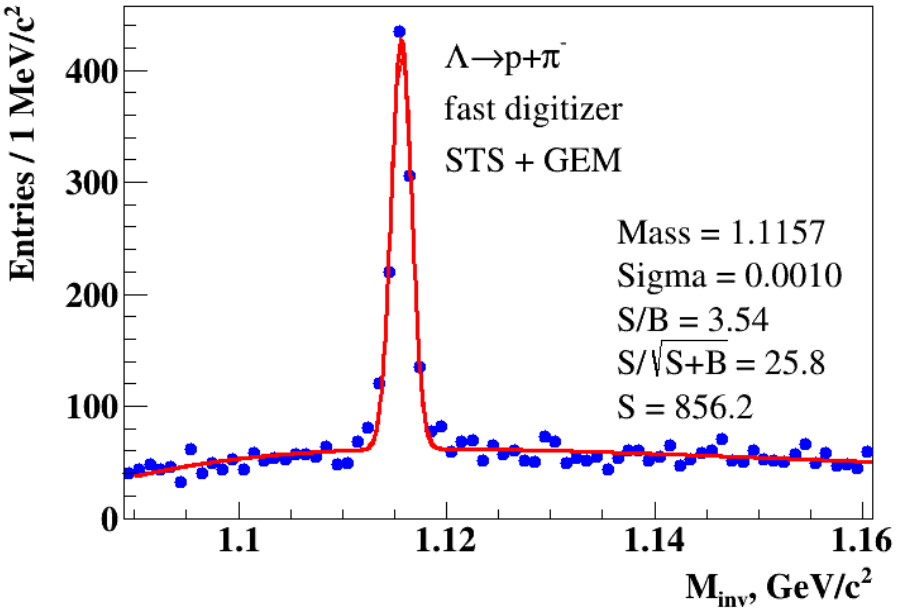
A.Zinchenko

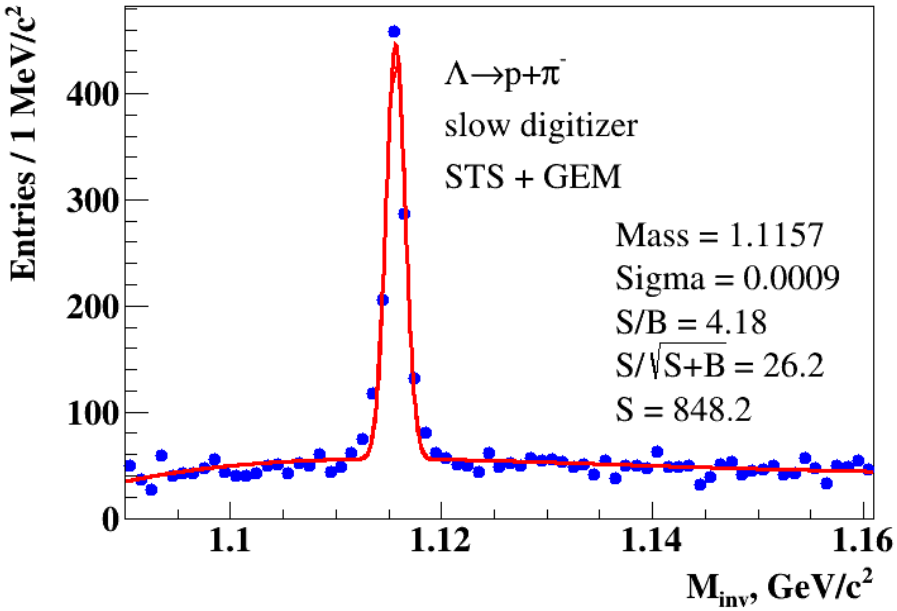




Lambda reconstruction

A.Zinchenko





Summary

Lowering the magnetic field value does not significantly affect the track reconstruction performance.

Fast digitizer accelerates the processing by a factor of ~3.5.