Outer Tracker of the BM@N Experiment

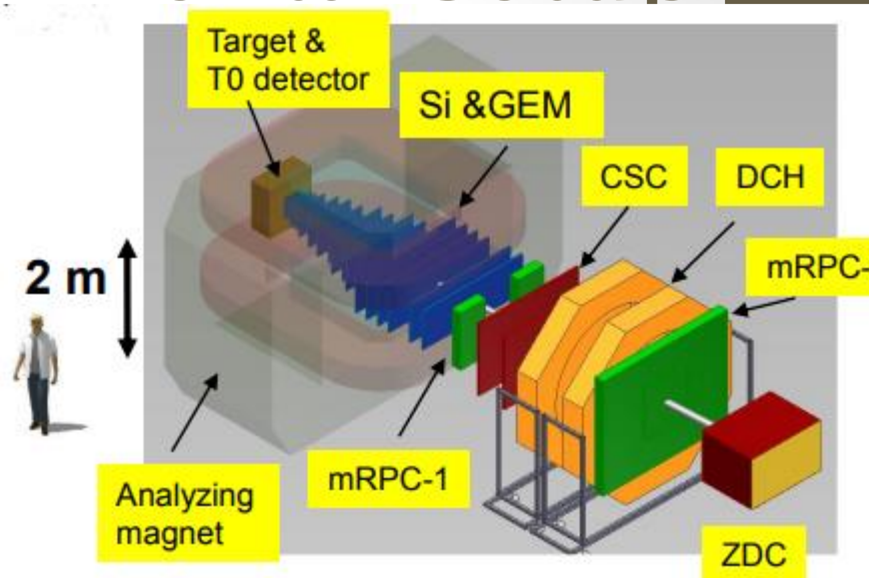
M. Kapishin, V. Lenivenko, V. Palichik, Nikolay Voytishin
JINR, Dubna

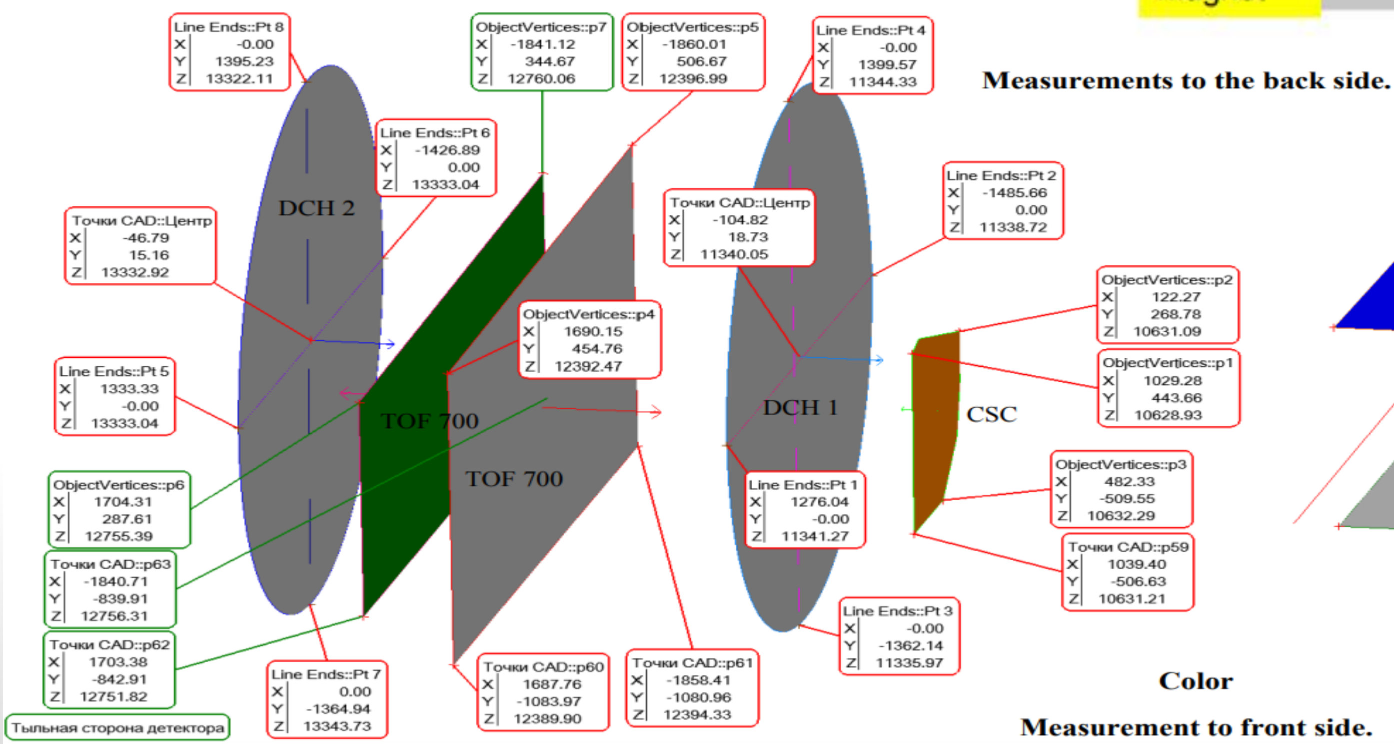
NICA Collaboration Meeting

April 13 , 2018

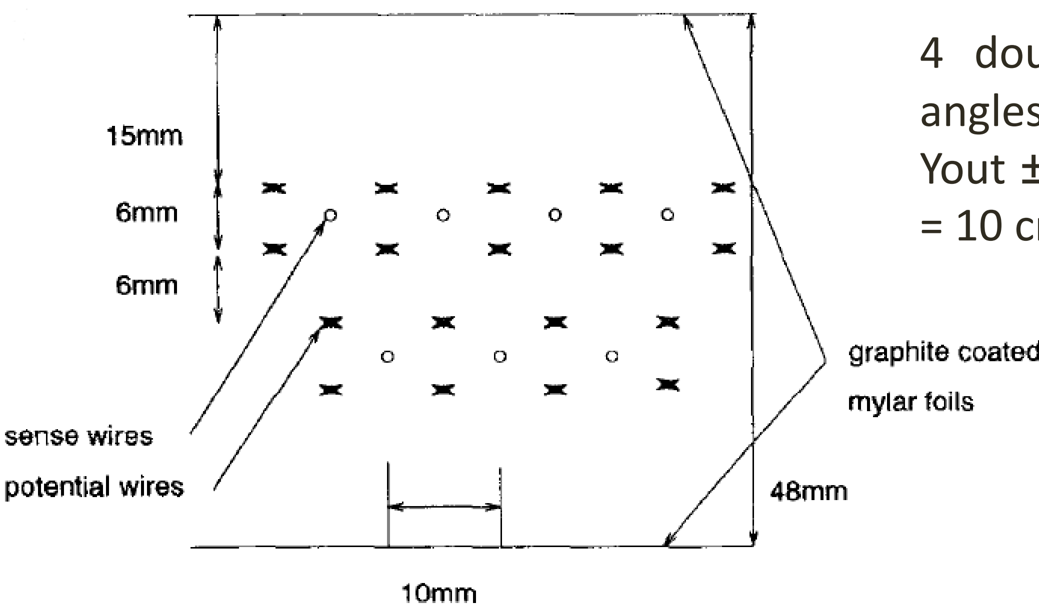
BM@N - 2018 experimental setup

- Central tracker (GEM) - AA interactions reconstruction;
- **Outer tracker** (DCH, CSC) - link central tracks to ToF;
- ToF - hadrons and light nucleus identification;
- ZDC calorimeter - centrality of AA collisions measurement;
- Detectors to form T0, L1 centrality trigger and beam monitors;
- Electromagnetic calorimeter - γ,e+e- detection;
- MWPC – alignment and incoming beam trajectory positioning.





Drift Chamber detector (DCH)

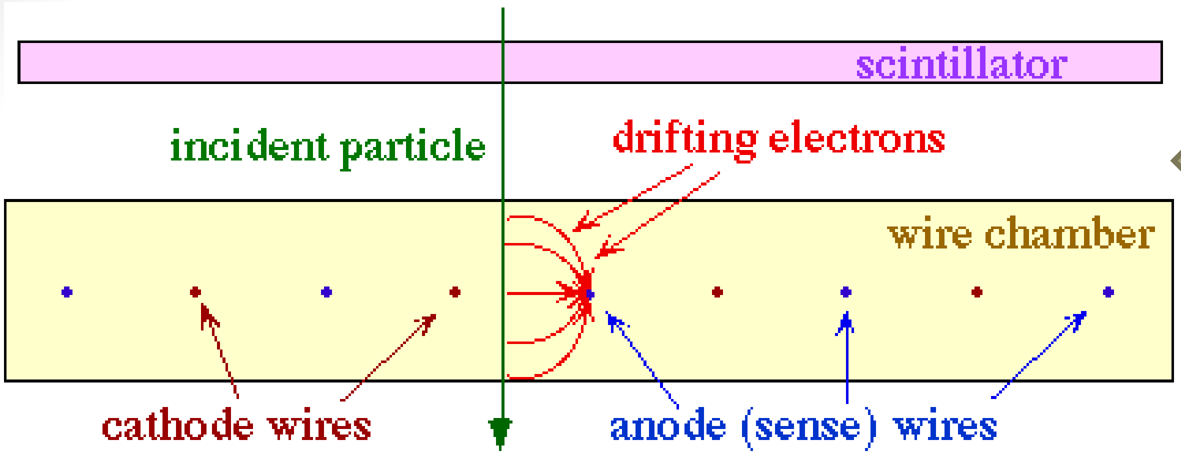


4 double coordinate planes: wire angles 0,90,±45°, wire pitch 10 mm, Yout ± 1.35 m, Xout ± 1.35 m, Rmin = 10 cm, 2048 wires per chamber

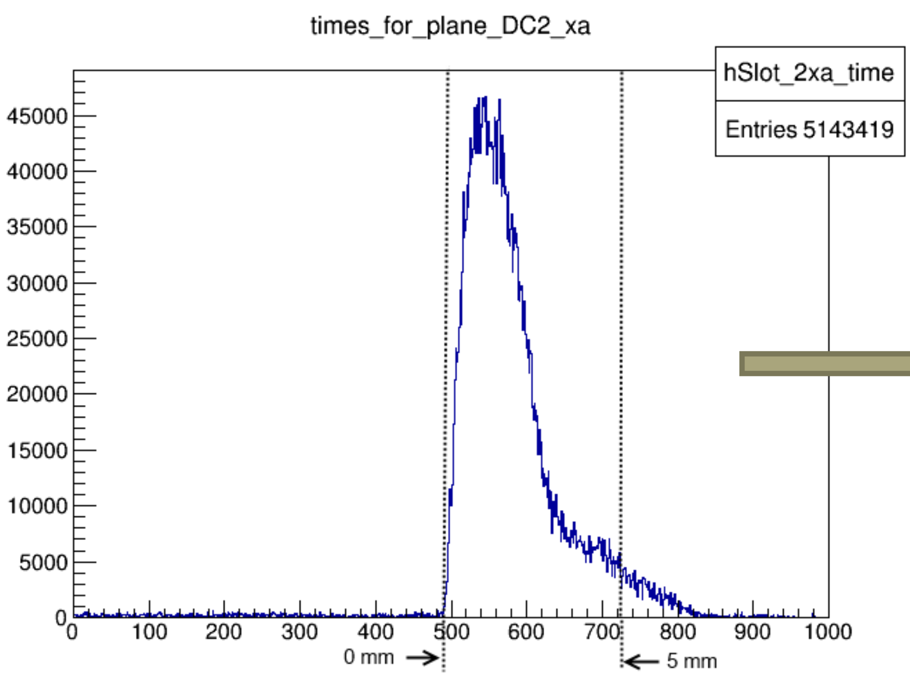
← one DC-plane schematic representation

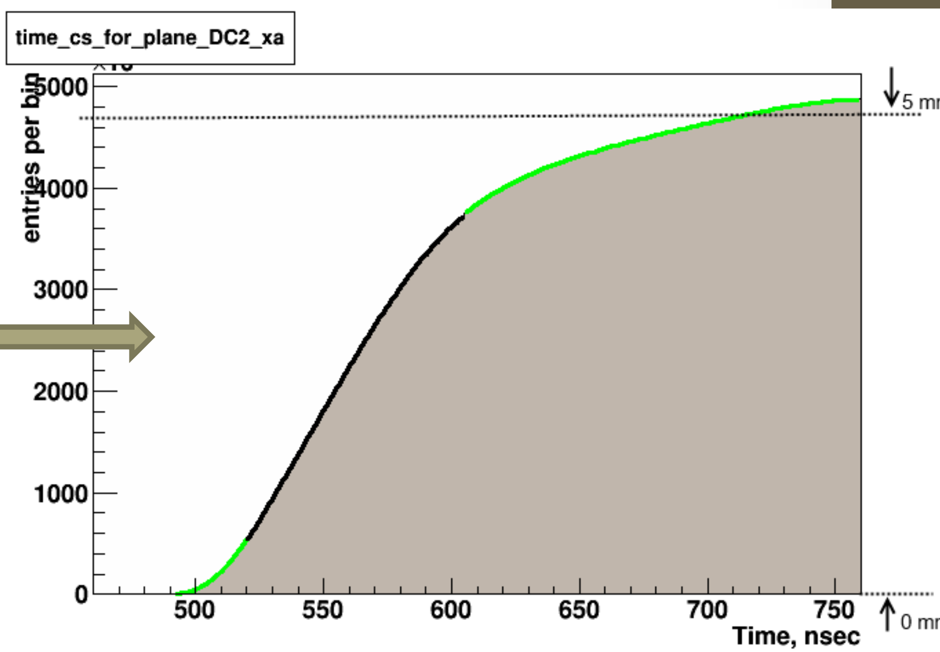
Team: A.Morozov, D.Nikitin, R.Kattabekov, V.Spaskov

DCH coordinate reconstruction

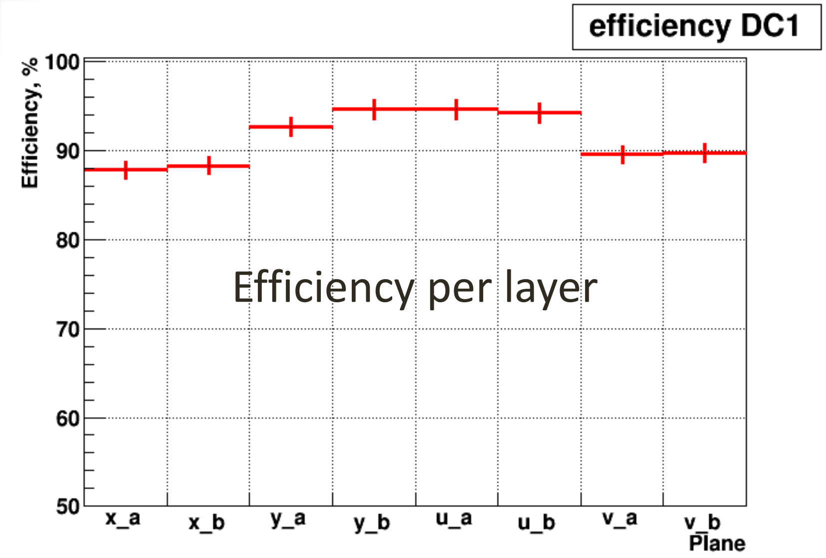


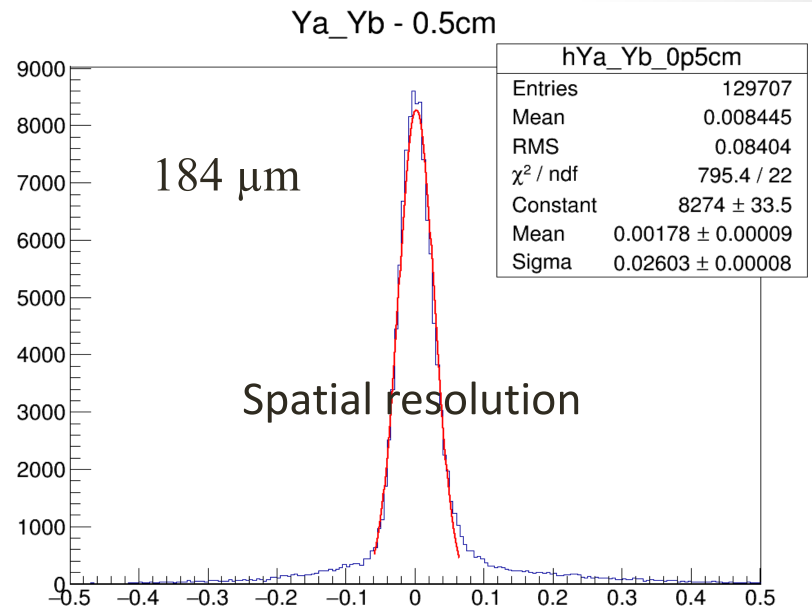
Principle of working of a Drift Camber detector

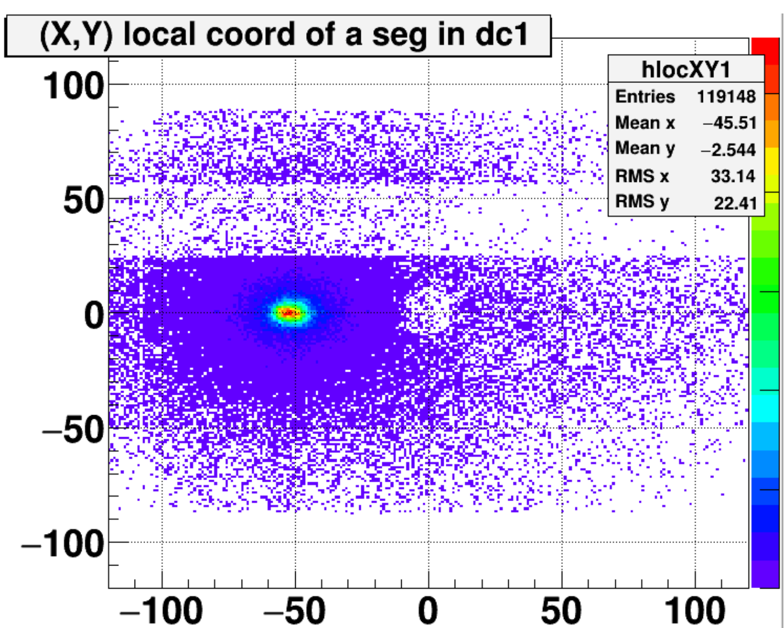


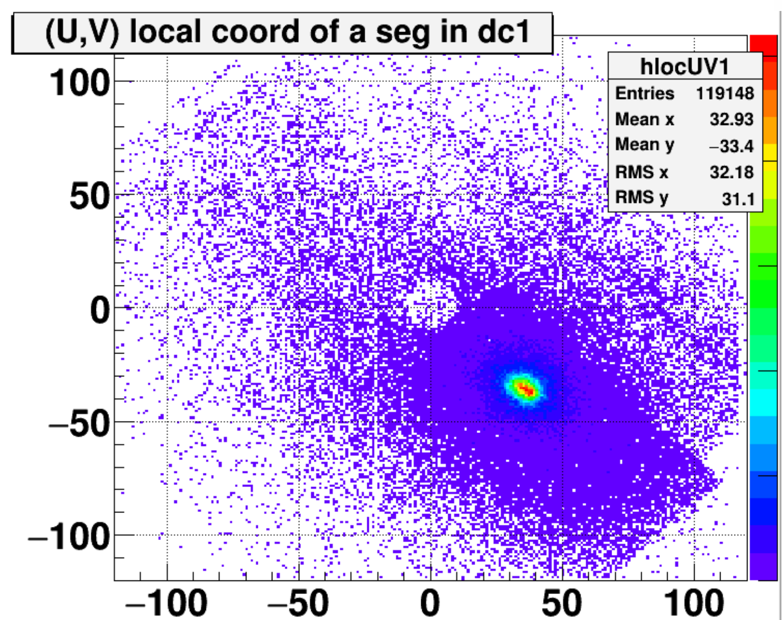


DCH Performance





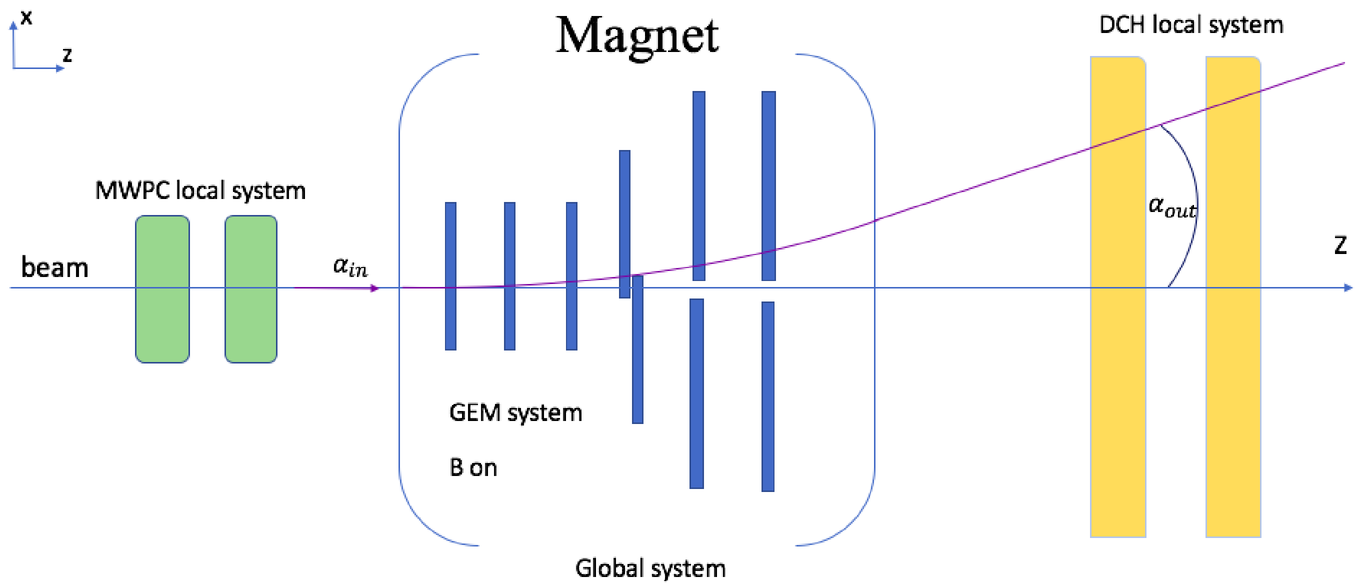




Beam momentum estimation procedure

$$P_{beam(est)} = \frac{0.3 * \int Bdl}{\sin(\alpha_{out}) - \sin(\alpha_{in})}$$

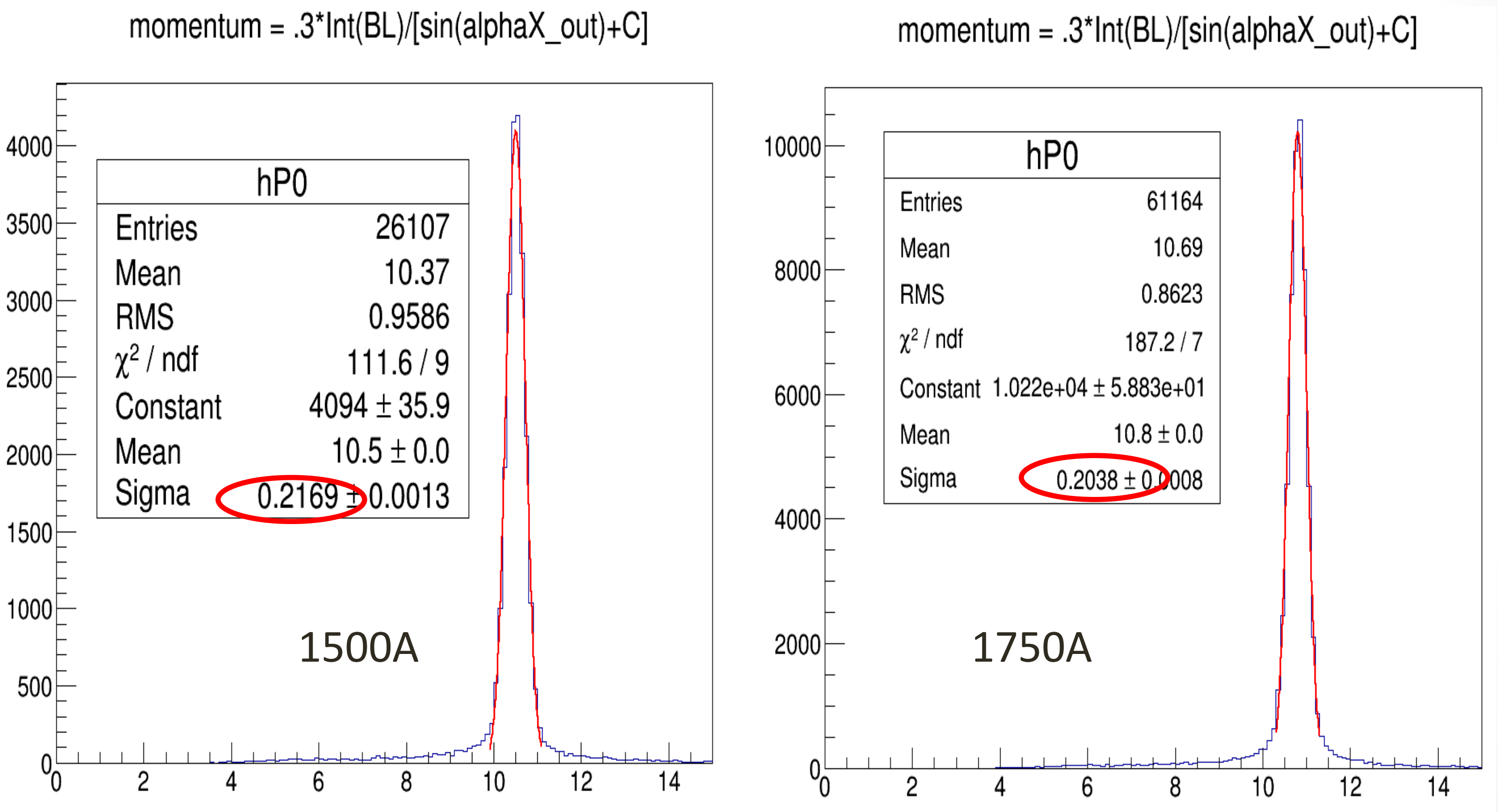
α_{in} - angle of beam before magnet (MWPC);
α_{out} - angles of beam after magnet (DCH);
$\int Bdl$ - magnet field integral [T*m].



$$P_{beam} = \frac{A}{Z} * \sqrt{\left(E/_{n} + M_p\right)^2 - M_p{}^2}$$

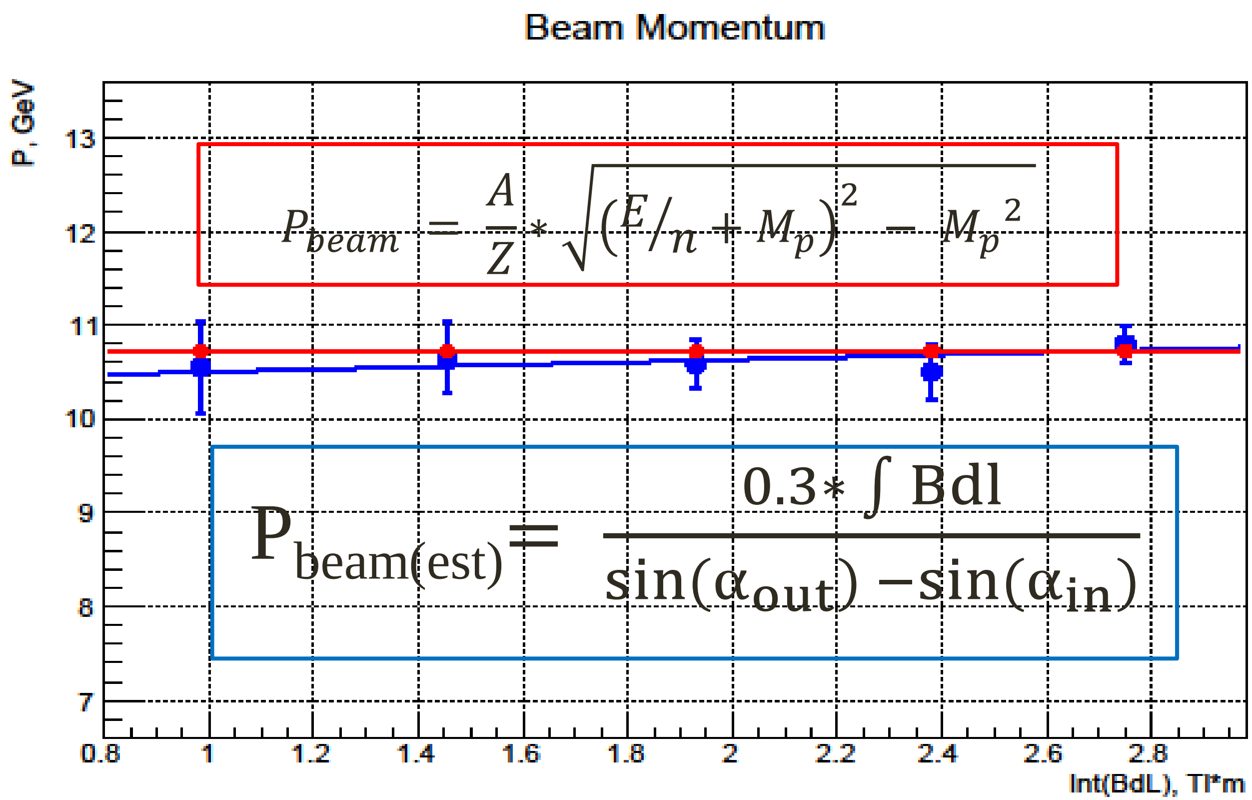
A - mass number;
Z - number of protons;
$E/_{n}$- beam energy per nucleon;
M_p - proton mass.

Momentum estimation for particular magnetic field values



Momentum vs. Int(BdL)

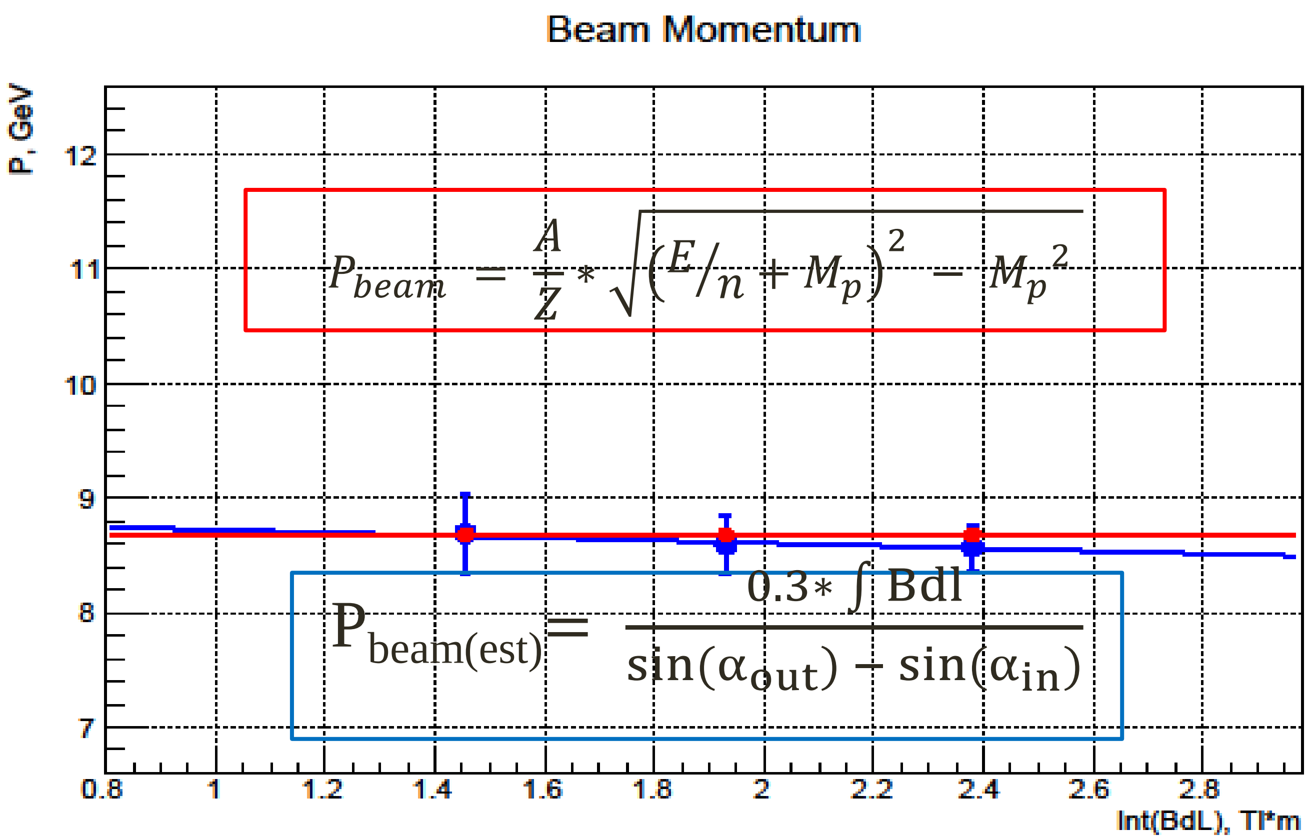
C beam energy 4.5 GeV/nucleon;
Momentum 10.7 GeV/c;



RED – Nuclotron beam momentum;
BLUE – estimated beam momentum.

Momentum vs. Int(BdL)

C beam energy 3.5 GeV/nucleon;
Momentum 8.7 GeV/c;



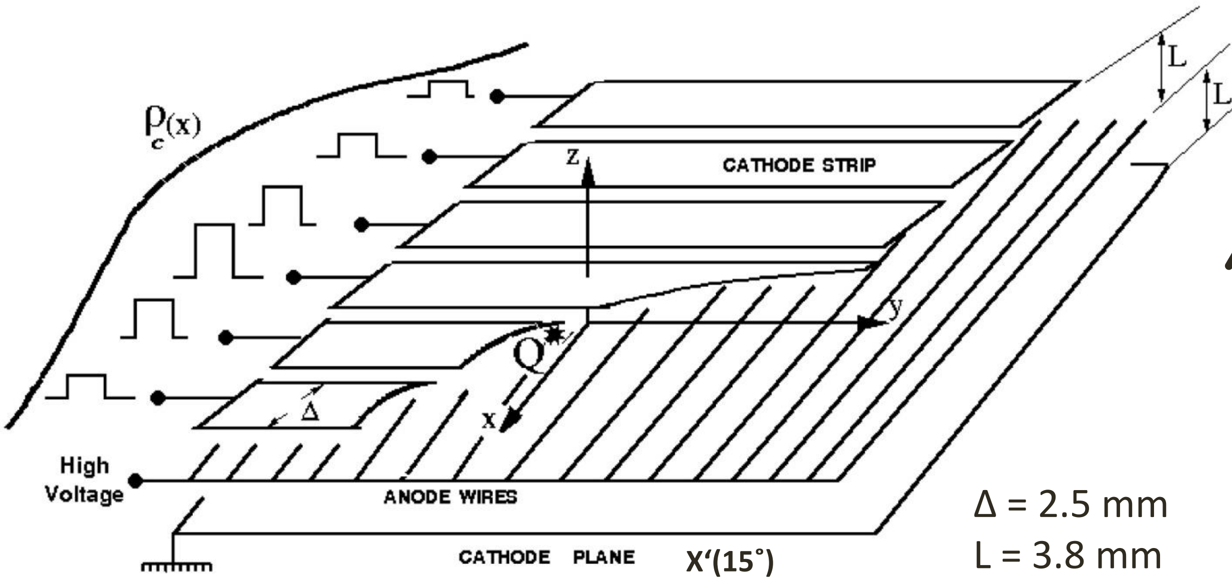
$$P_{beam} = \frac{A}{Z} * \sqrt{\left(E/n + M_p\right)^2 - M_p{}^2}$$

$$P_{beam(est)} = \frac{0.3 * \int Bdl}{\sin(\alpha_{out}) - \sin(\alpha_{in})}$$

RED – Nuclotron beam momentum;
BLUE – estimated beam momentum.

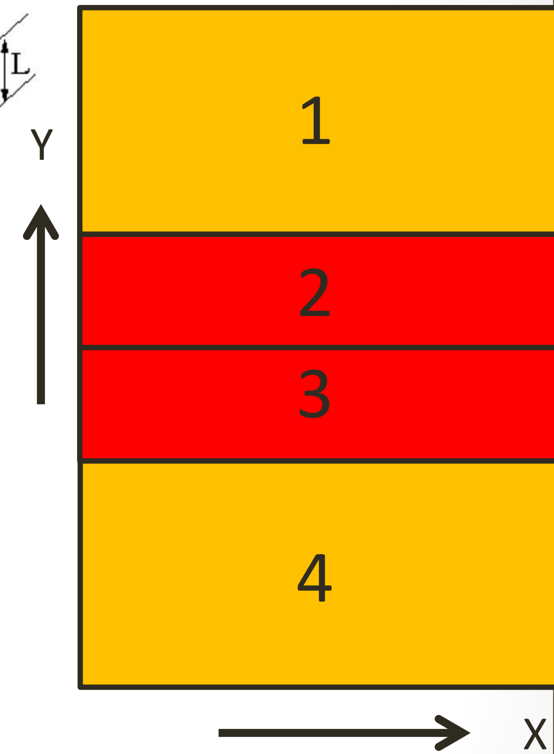
Cathode Strip Chambers (CSC)

The principle of working of cathode strip chambers



Δ = 2.5 mm
L = 3.8 mm

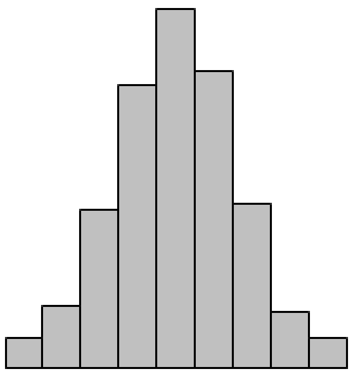
Zones



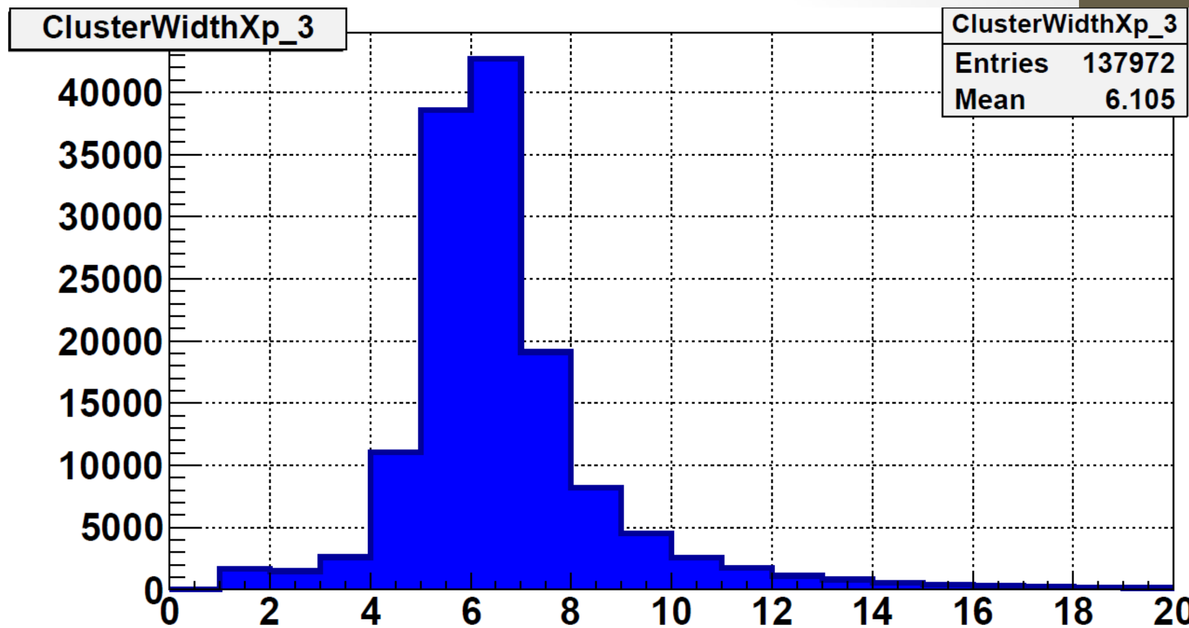
Reconstructed Hit - 2D coordinate of the passing particle on a zone.

Technical developers:
A. Vishnevsky, Yu. Kiryushin;
Team:
A. Makankin, S. Vasiliev, E. Kulish, A. Maksimchuk.

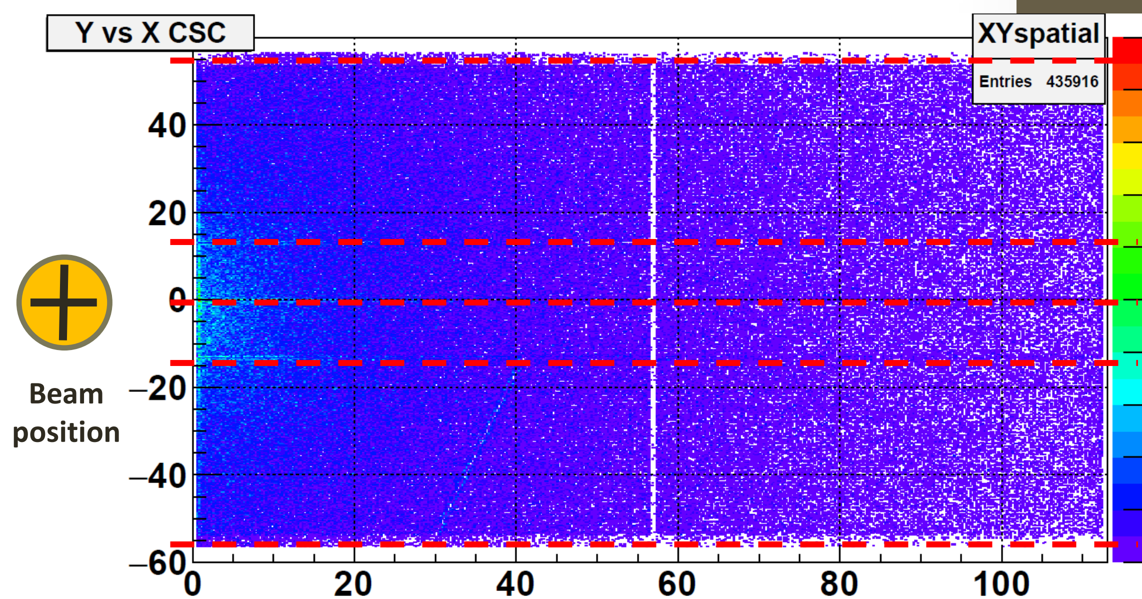
Cathode Strip Chambers



Typical cluster charge distribution on strips

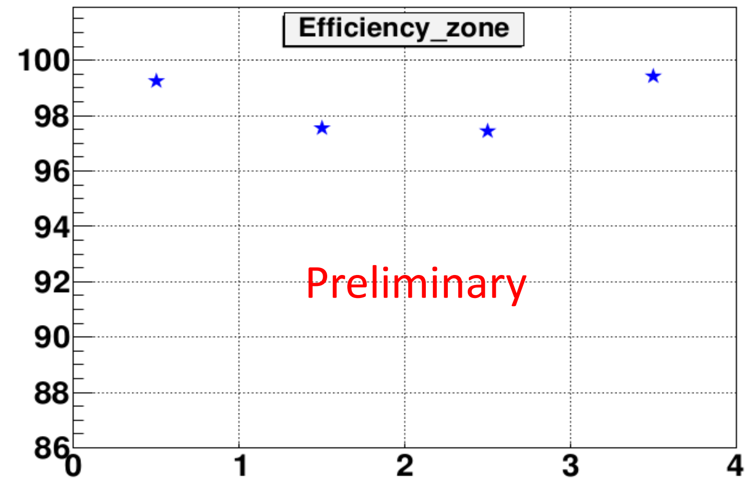


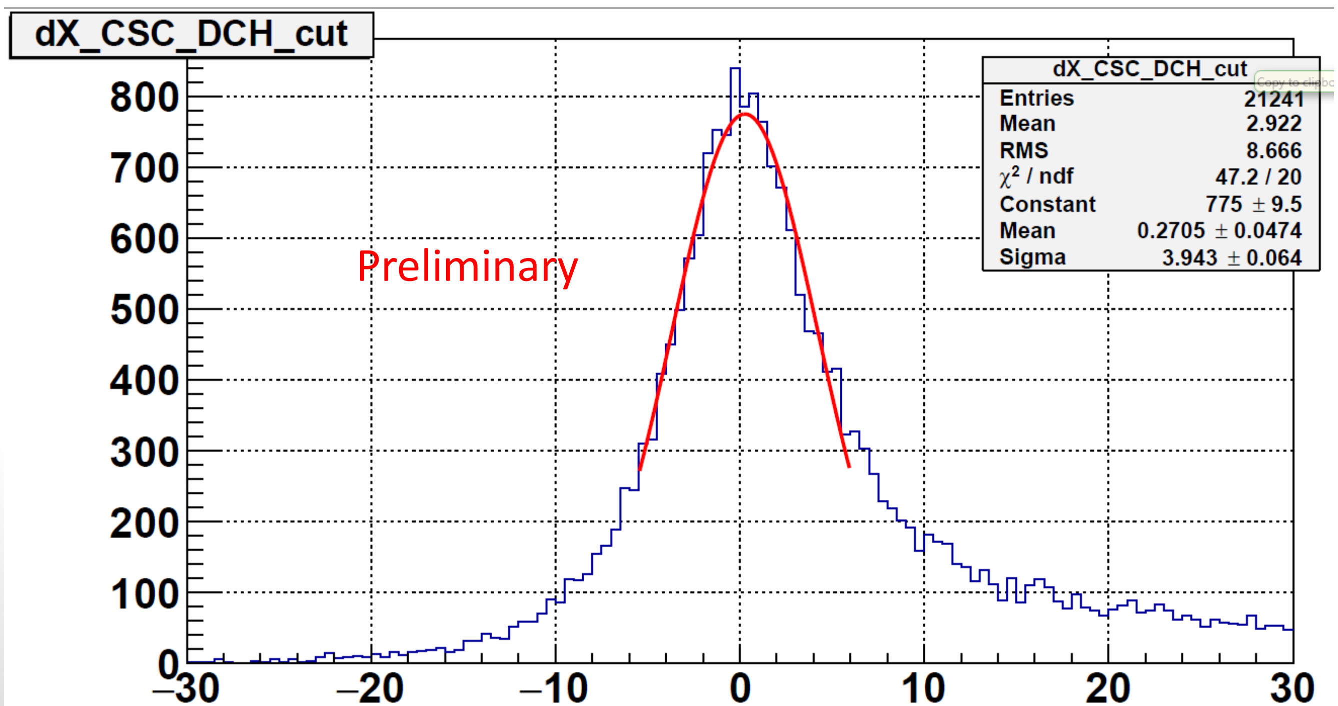
Coordinate calculated by CoG at the moment.
To be fitted by Gatti function in the future.



CSC performance and matching

First look at DCH-CSC matching using Kr beam data (March-April 2018)





Run 4878
(March 2018)
Good CSC-DCH correlation

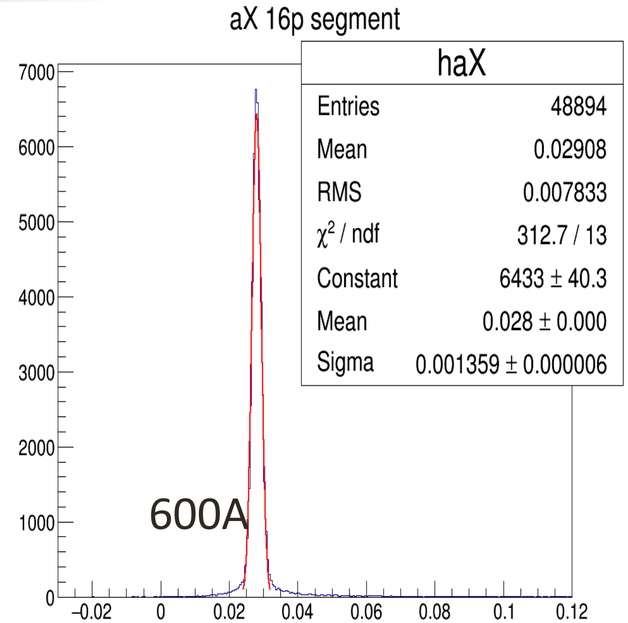
Summary

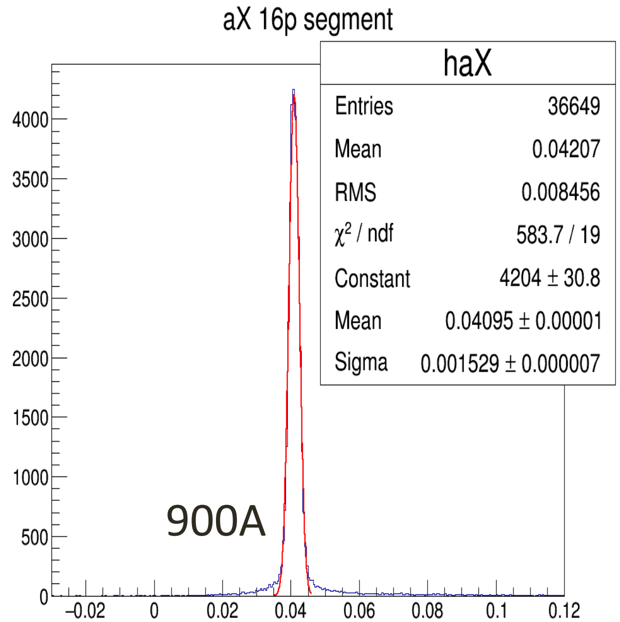
- The software for the MWPC and DCH detector systems was developed and implemented into the official experiment software and the software for CSC is under development;
- The spatial resolution for different layers of the DC chambers varies within 150-200 μm;
- The MWPC and DCH systems give us the possibility to estimate the beam momentum value with a high precision ~2% for the working values of the magnetic field integral;
- The outer tracker detector systems (DCH & CSC) provide a high hit efficiency per layer;
- The first look at CSC spatial hits matching with DCH global tracks shows a good CSC-DCH correlation.

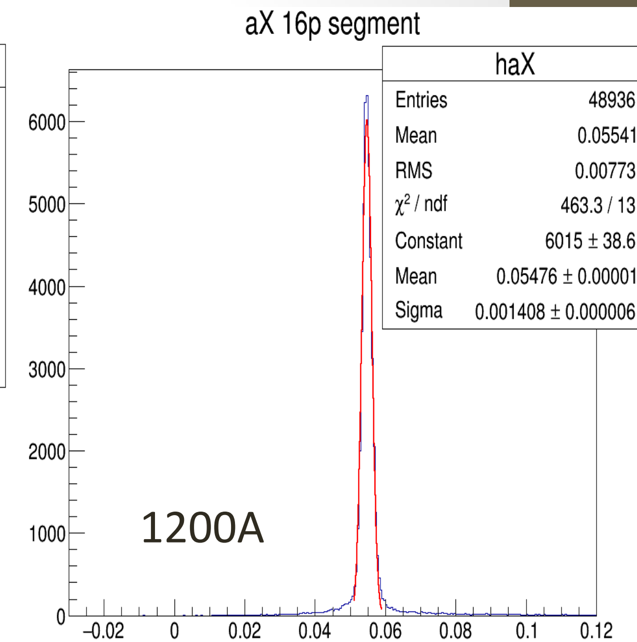
Thank you for your attention!

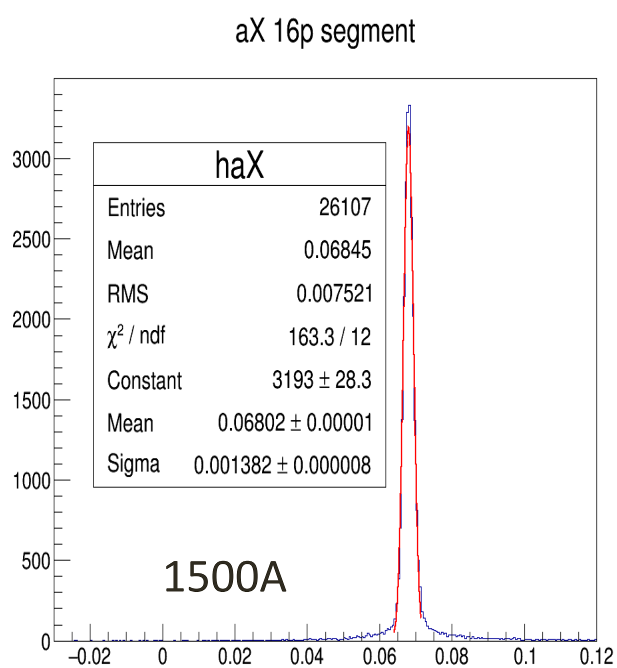
Backup slides

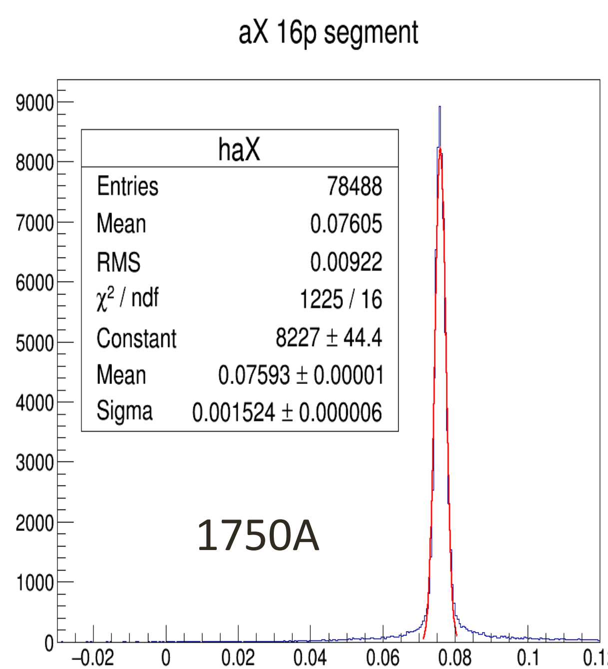
ax slope for beam – C 4.5 GeV/nucl

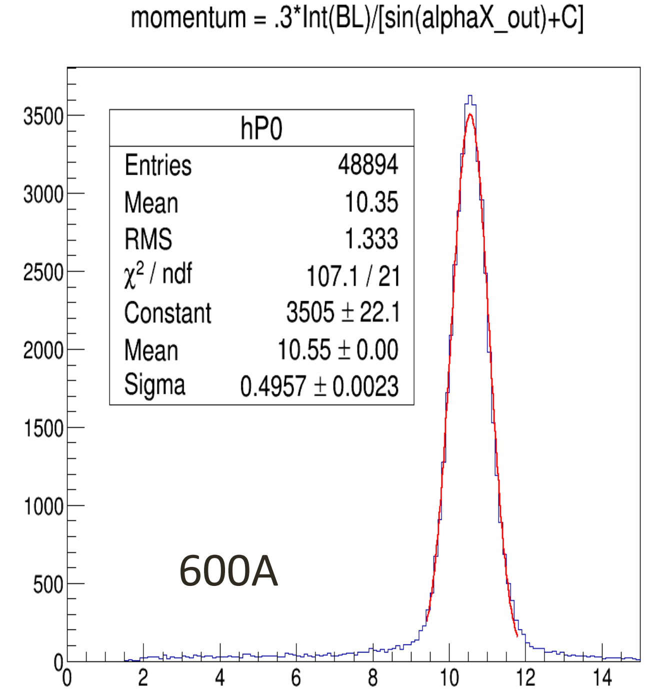


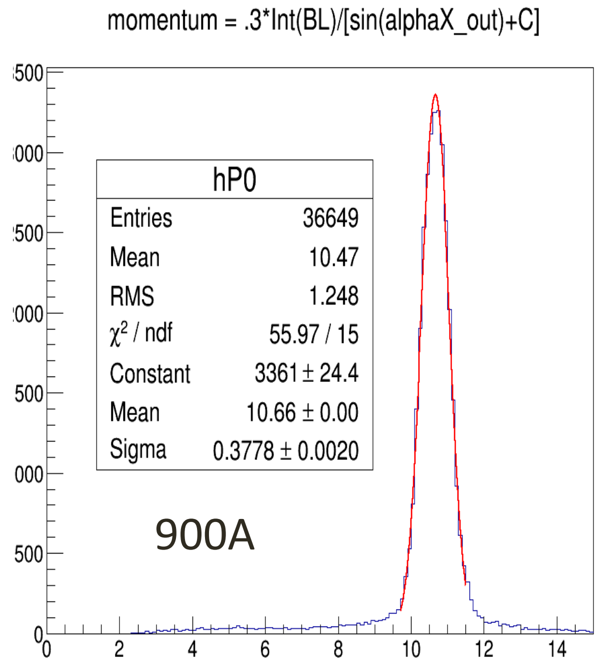


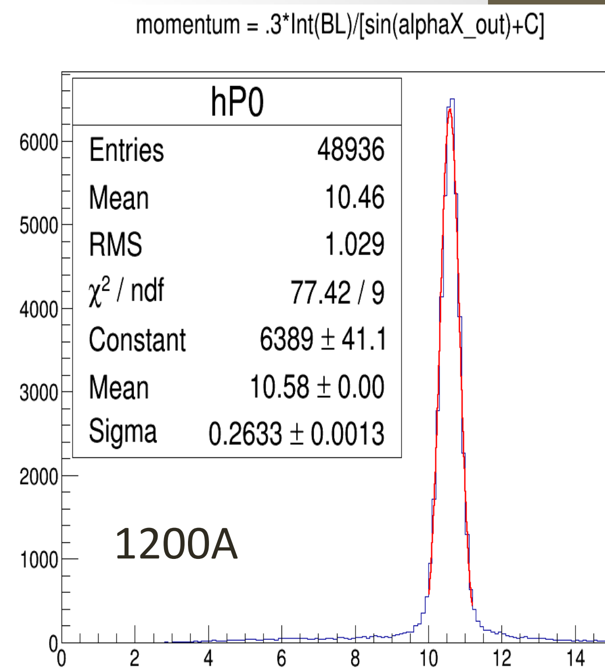




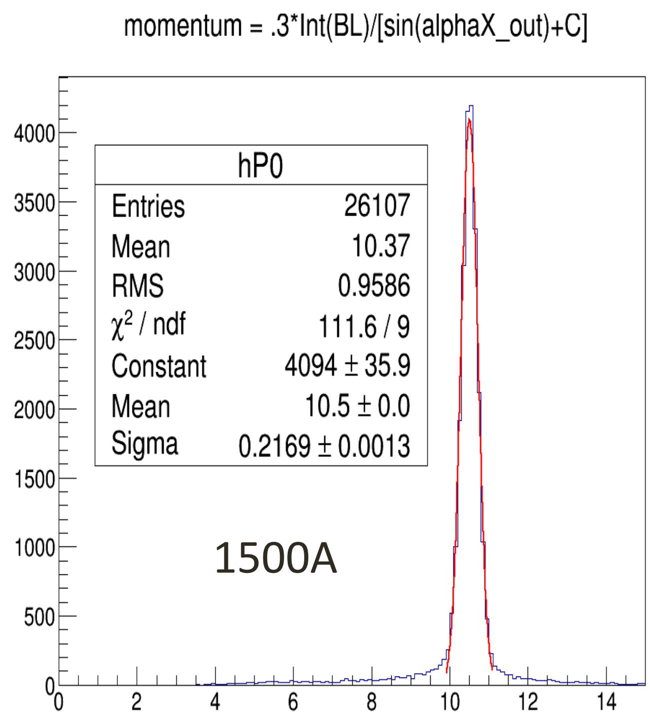


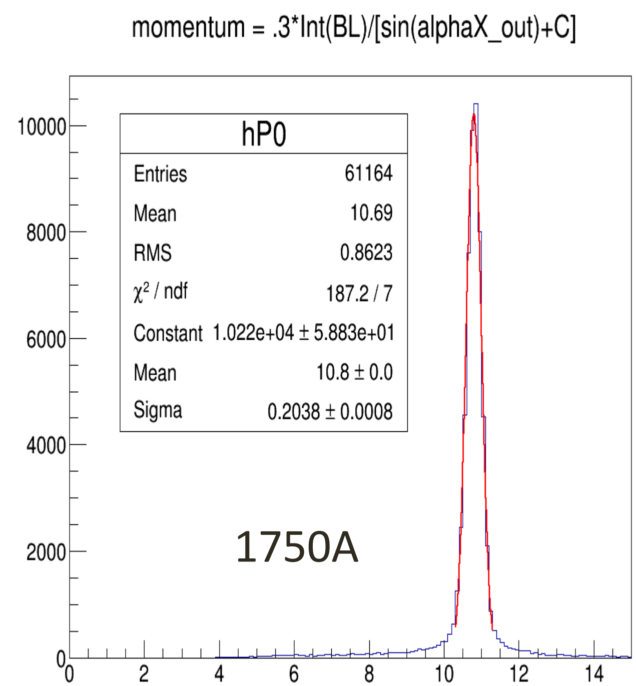






Beam - C 4.5 GeV/nucl





Monitoring detector info (from Makankin)