GEM to CSC to TOF400 matching in simulation

A.Zinchenko, M.Kapishin,
G. Pokatashkin, K. Alishina

for the BM@N collaboration
VBLHEP, JINR, Dubna, Russia

Joint Institute for Nuclear Research
SCIENCE BRINGING NATIONS TOGETHER

5th Collaboration meeting of the BM@N Experiment at the NICA Facility

20.04.2020

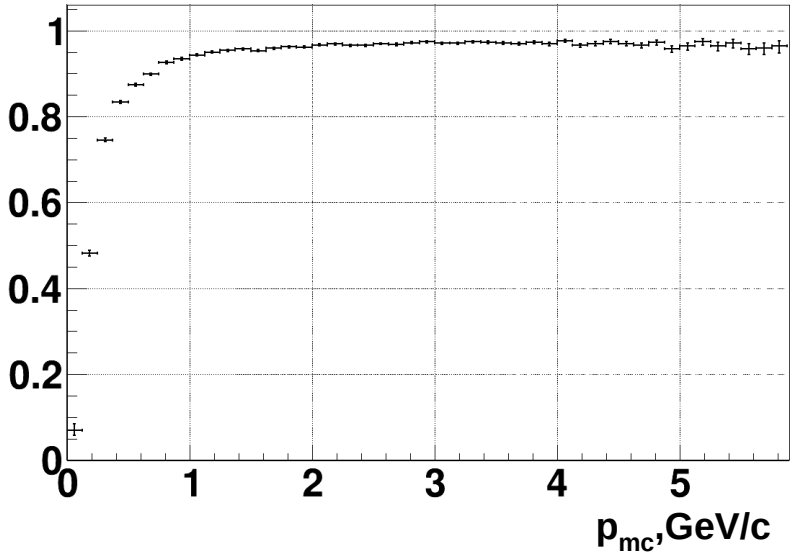
Data set

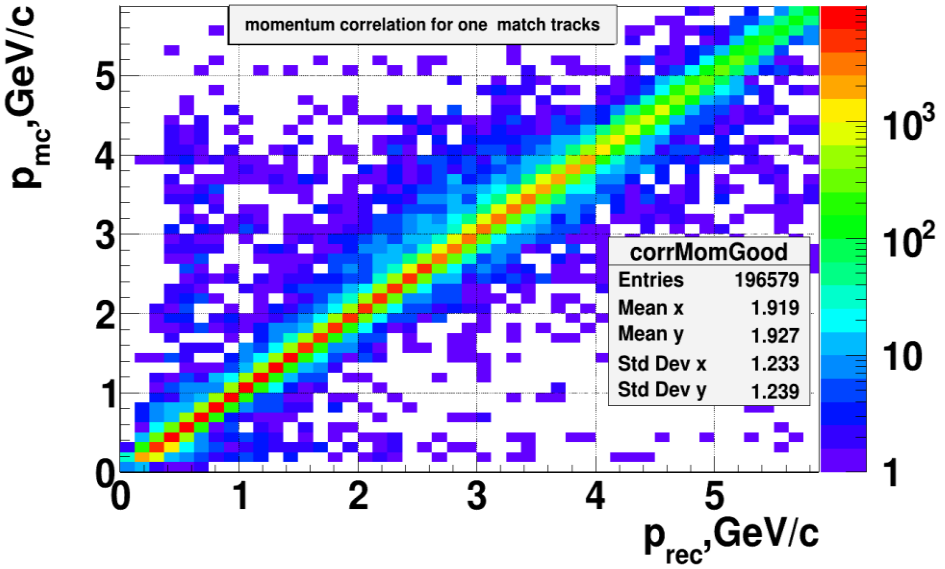
Data used: **Monte – Carlo simulation;**
Generator of nuclear collisions:
DCM - QGSM – created on the basis of Dubna Cascade Model (DCM) and the quark-gluon string model (QGSM).
Parameters simulation:

- **50k minimum bias events(for CSC);**
- **200k minimum bias events(for TOF400);**
- **Ar - beam;**
- **Kinetic energy 3.2 AGeV;**
- **Al – fixed target;**
- **Magnetic field 1200 A**

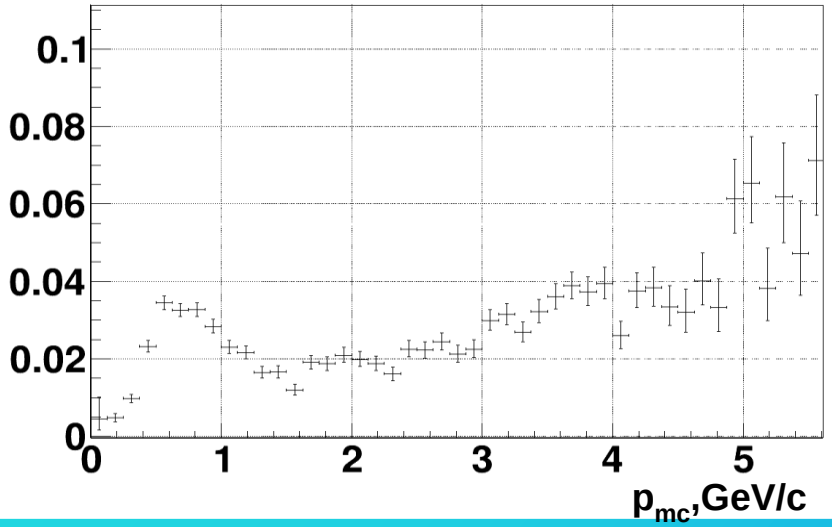
Reconstruction efficiency in central tracker

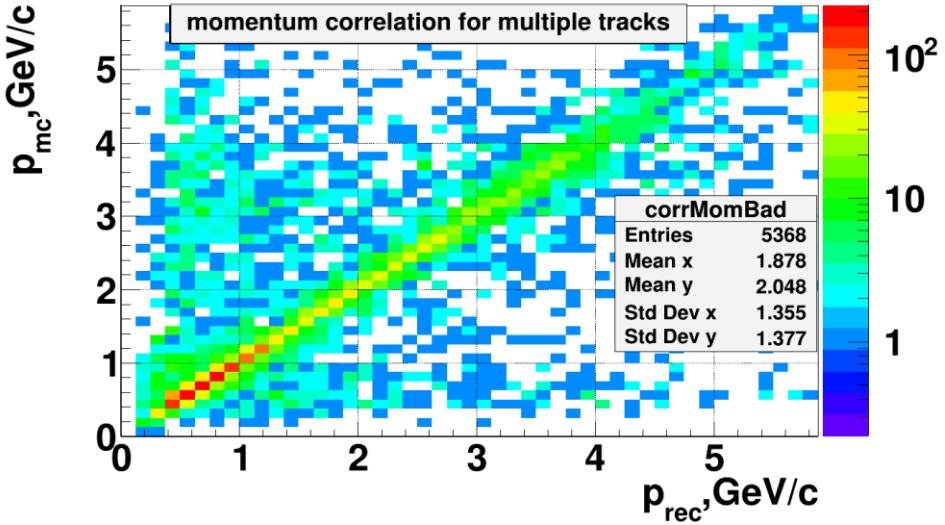
reconstruction efficiency for one match tracks





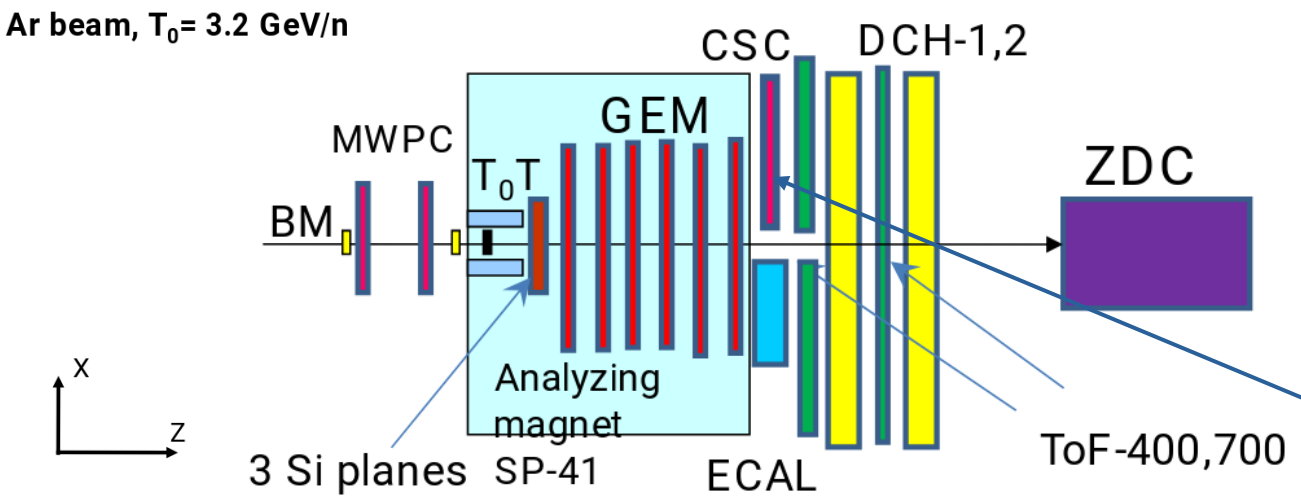
reconstruction efficiency for multiple tracks





CSC matching with GEM+SI

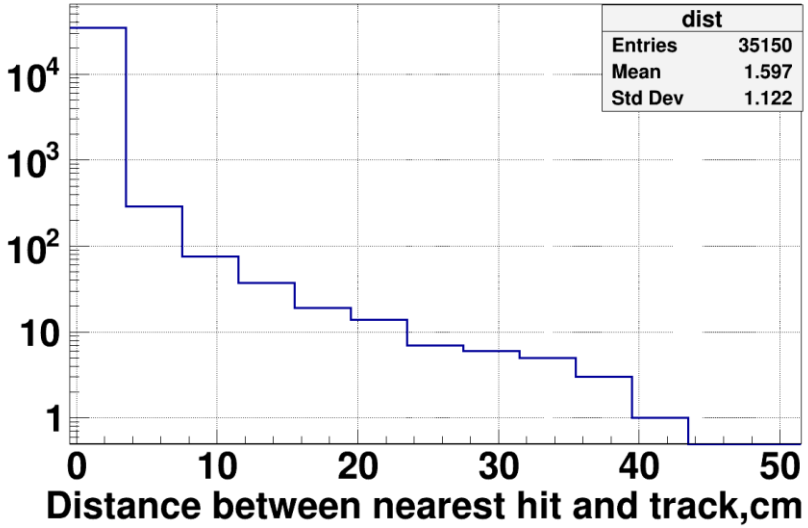
Schematic of the BM@N detector

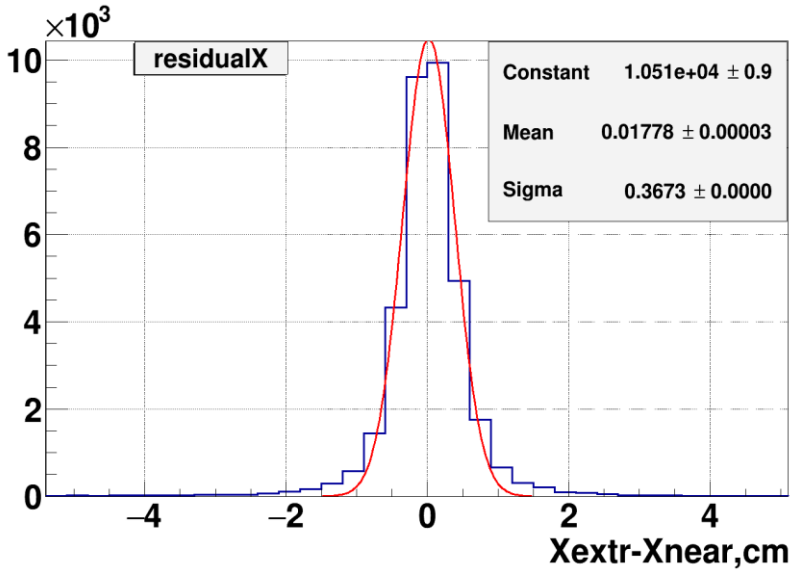


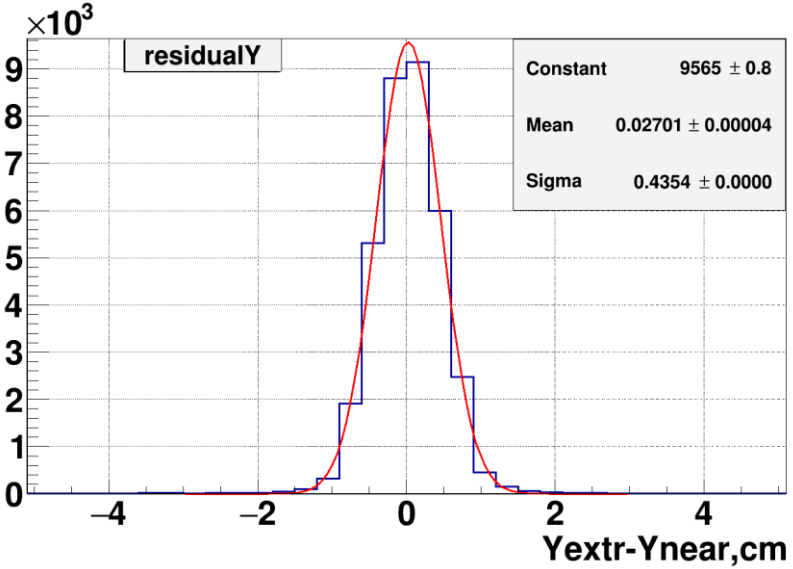
Real CSC det. In the BM@N setup (run 7).

1. Extrapolate track from the central tracker to the Z (413.2 cm) of the CSC.
2. Tracks criteria:
2.1 Point from this track should be in CSC ;
2.2 Extrapolated track should be in acceptance of CSC;
2.3 Selected tracks with ≥ 5 hits;
3. Looking for nearest hit in the fixed gate.
4. Estimate efficiency for true/fake hits.

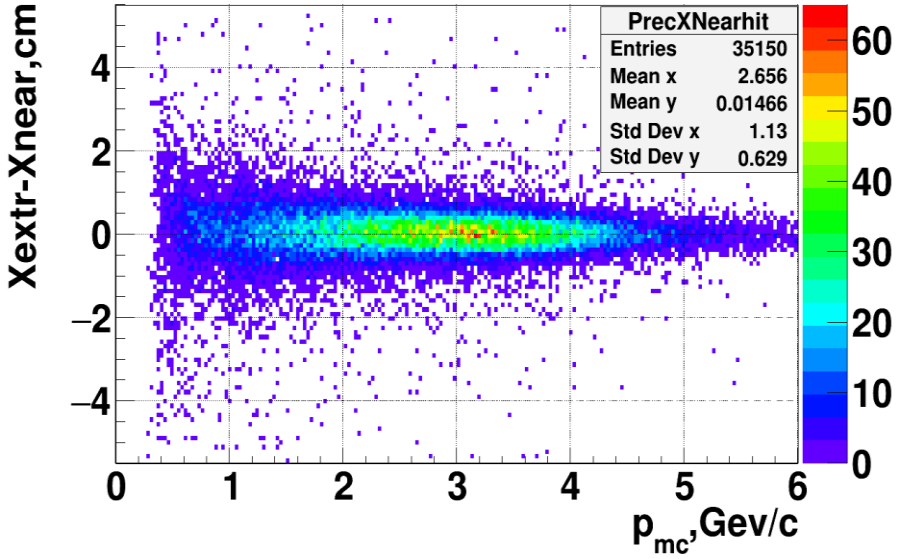
Residuals for nearest hits

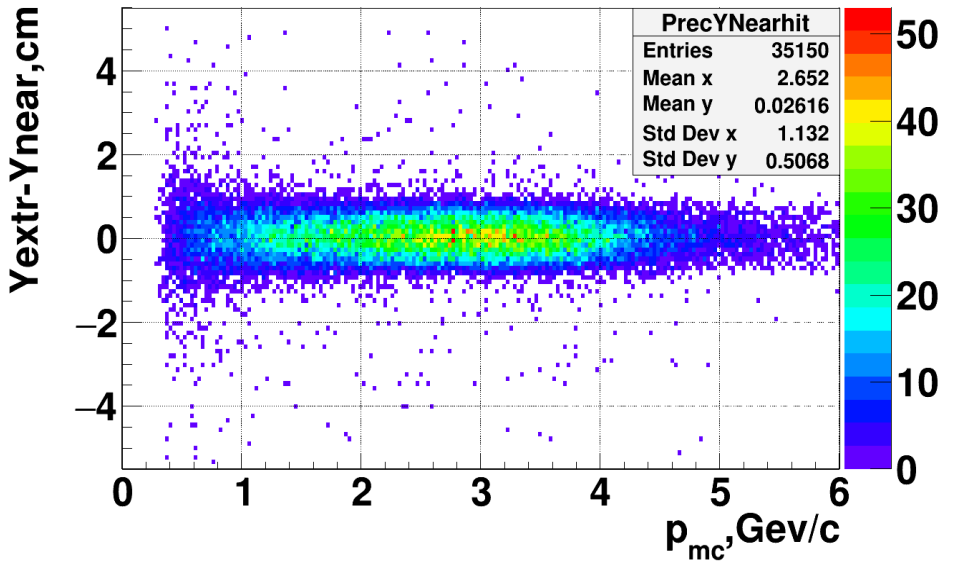


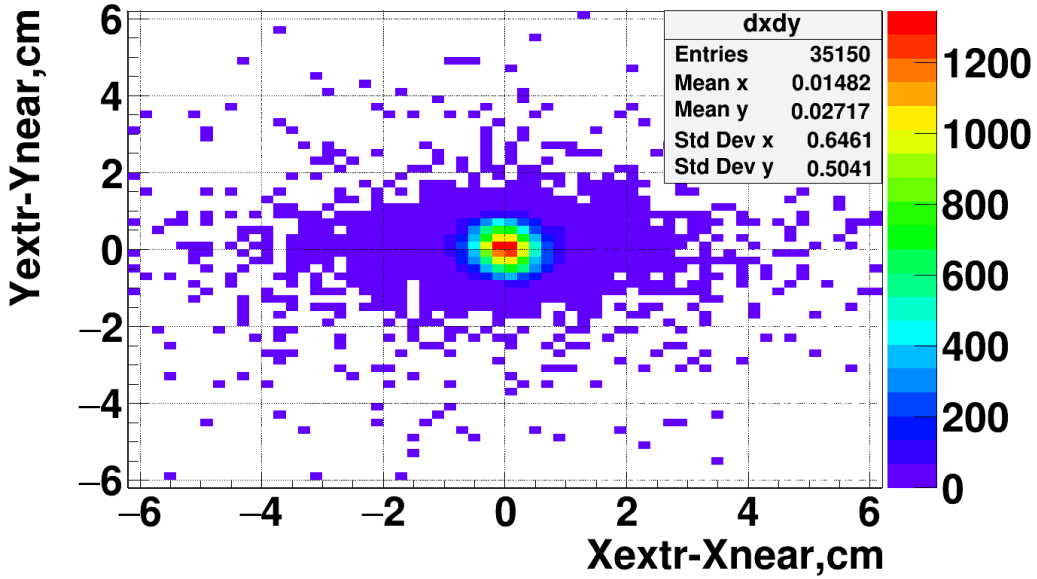




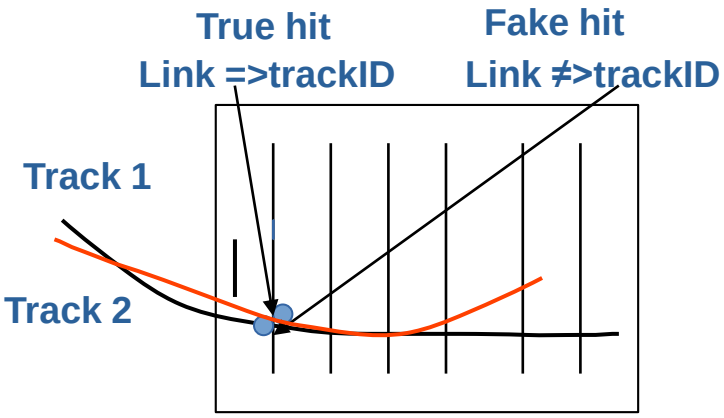
2D – Residuals for nearest hits

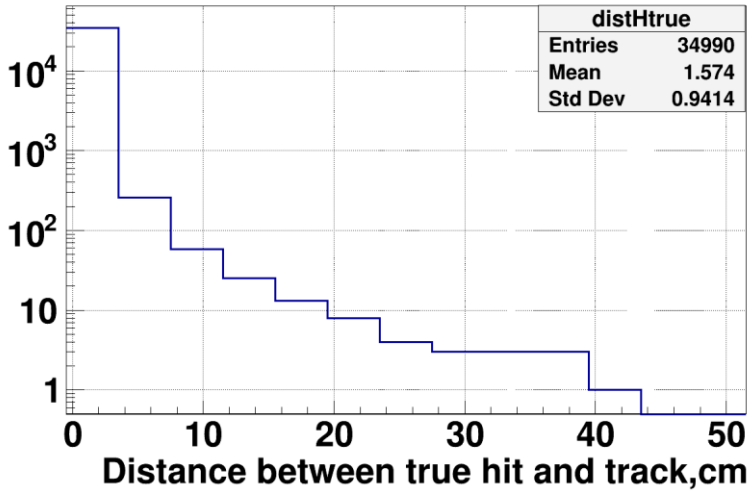


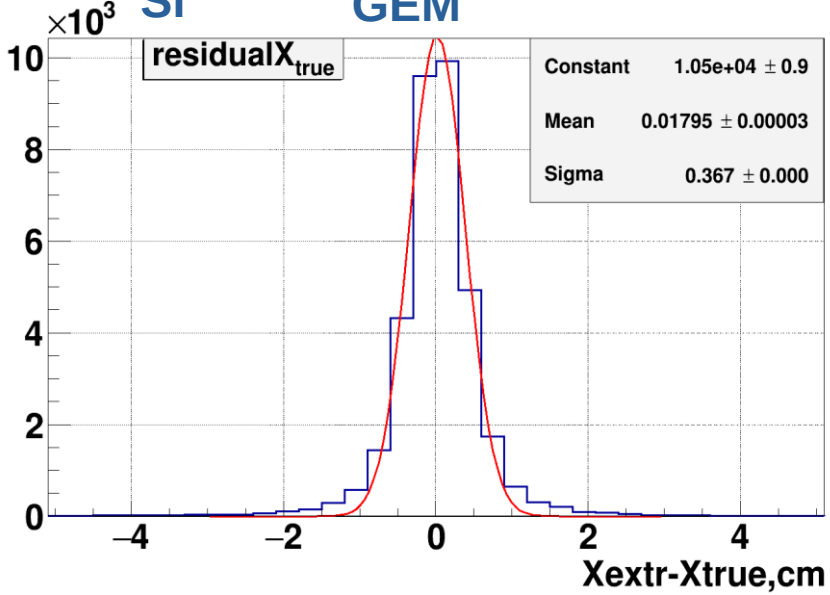


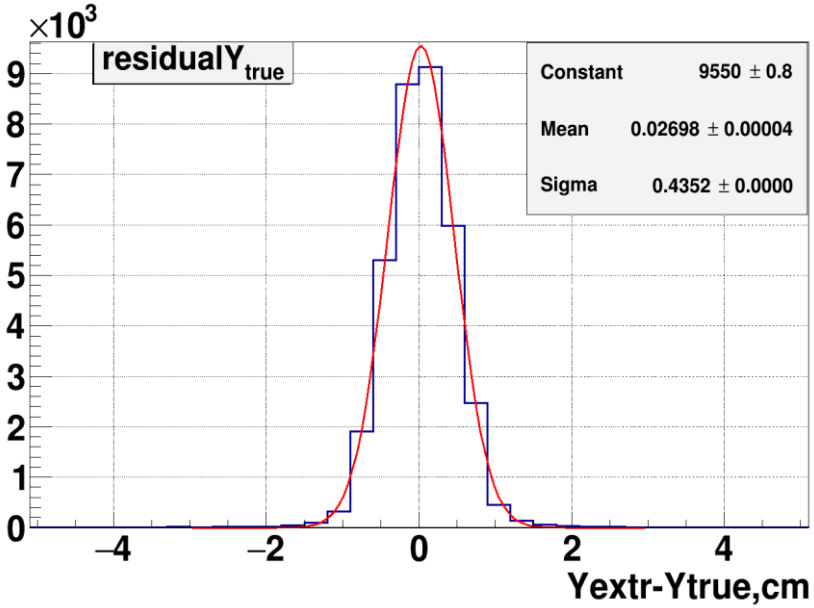


Residuals for true hits

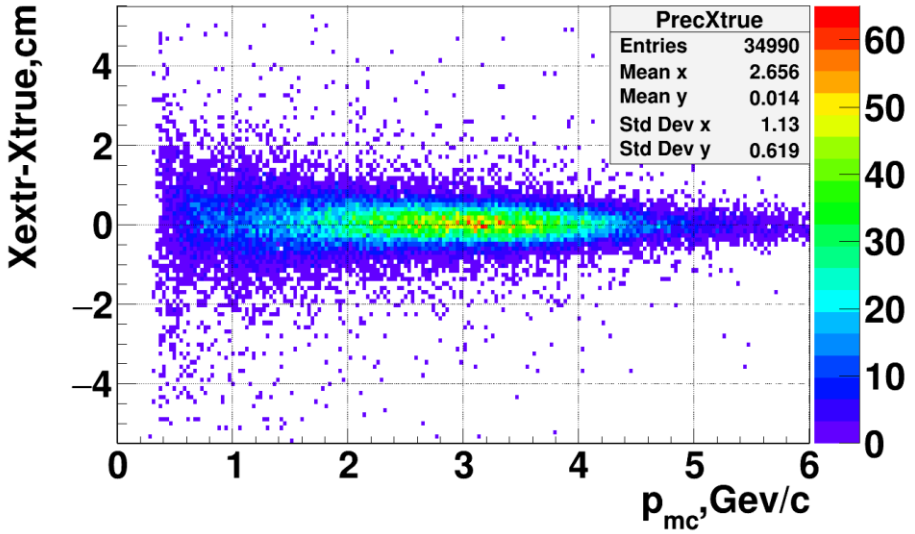


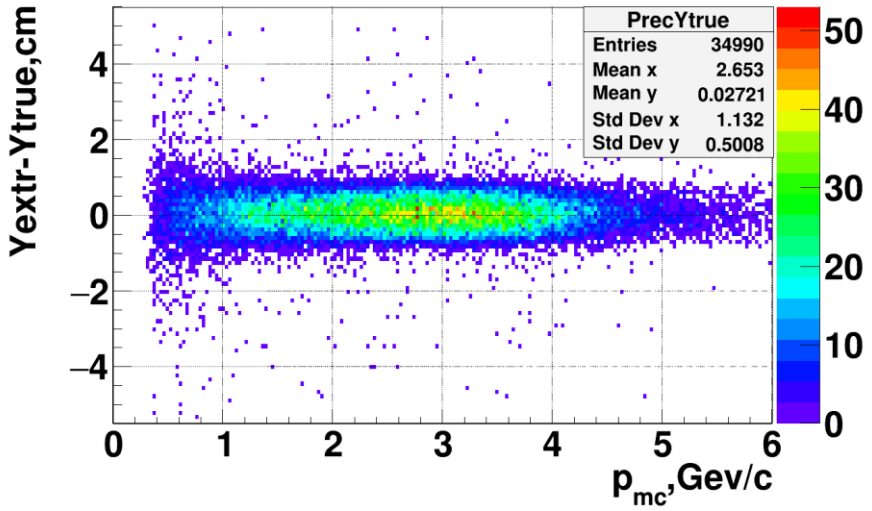


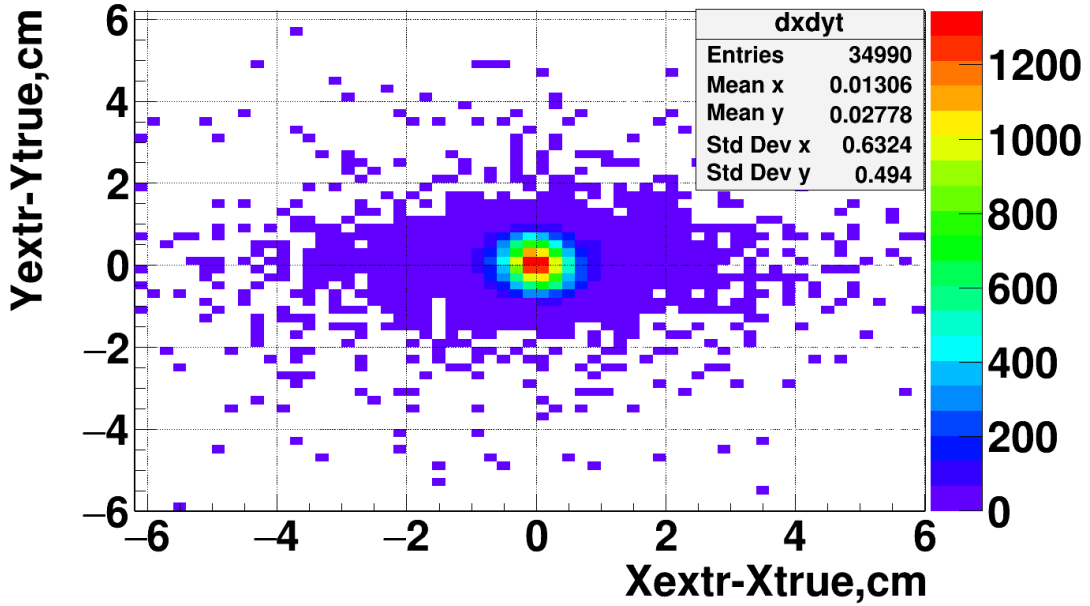




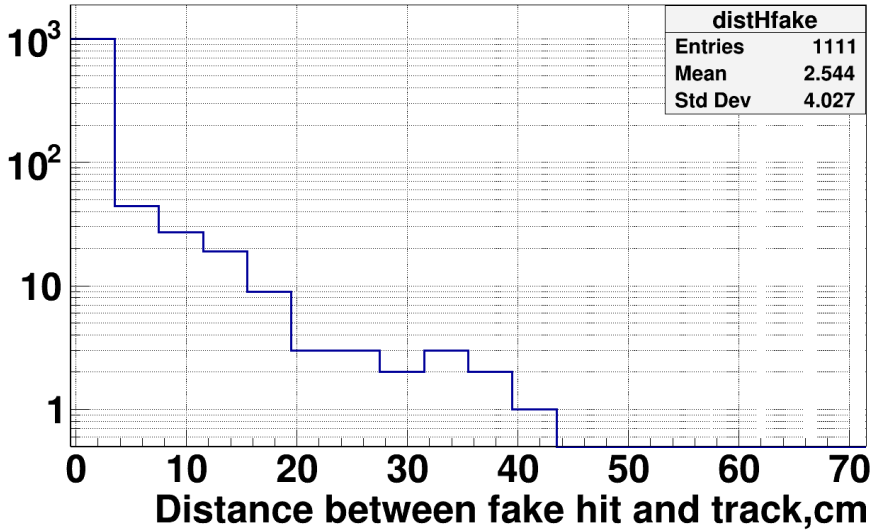
2D – Residuals for true hits

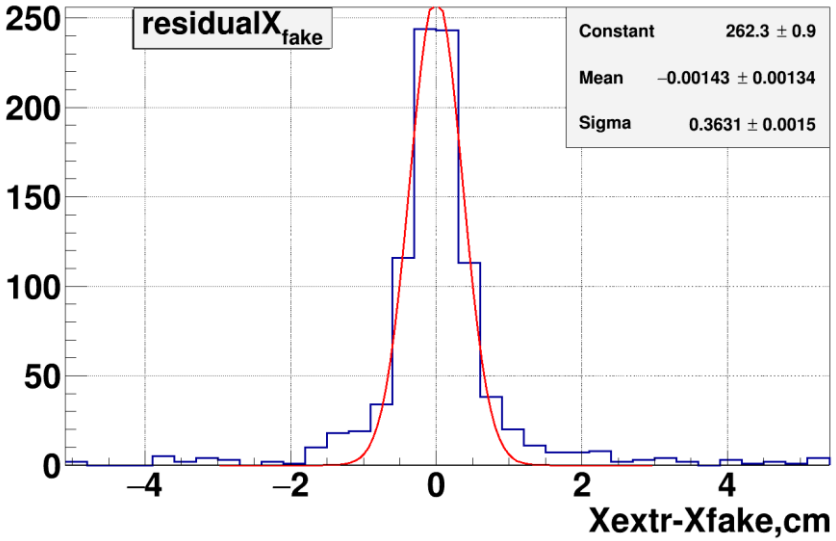


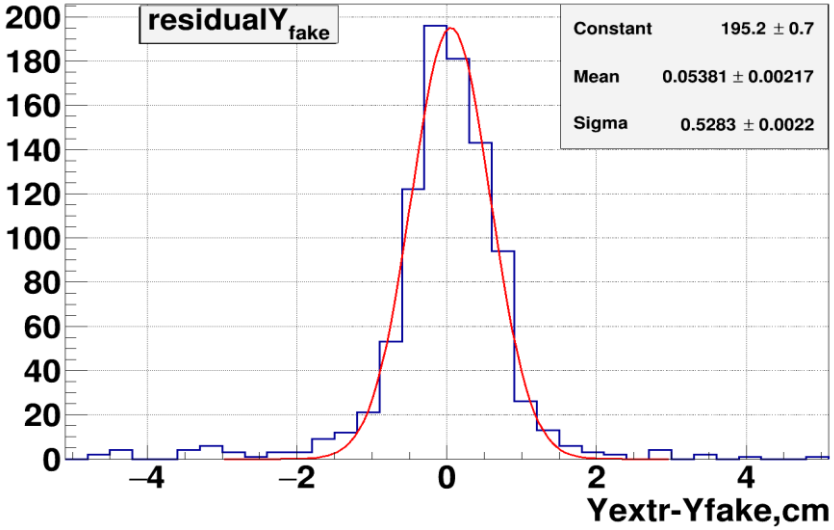




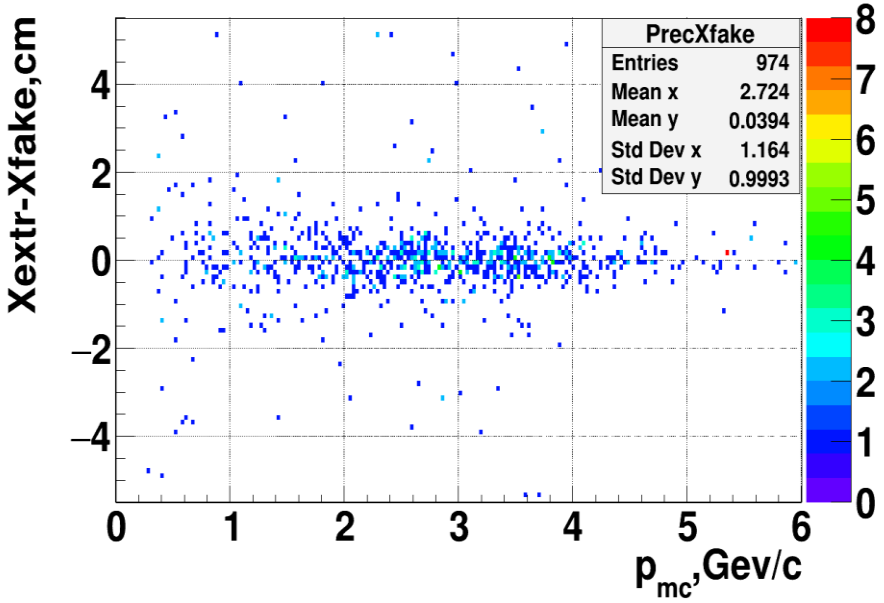
Residuals for fake hits

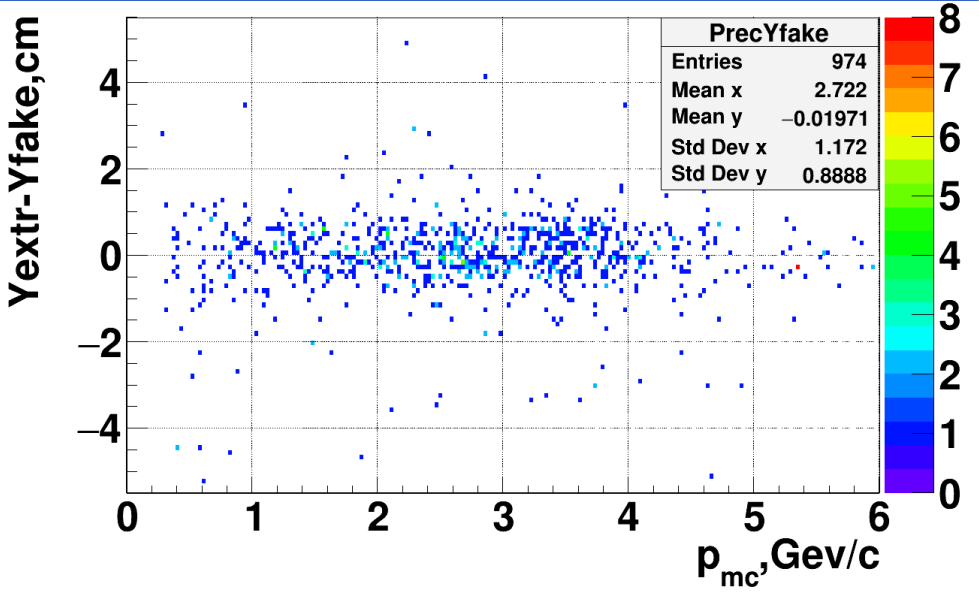


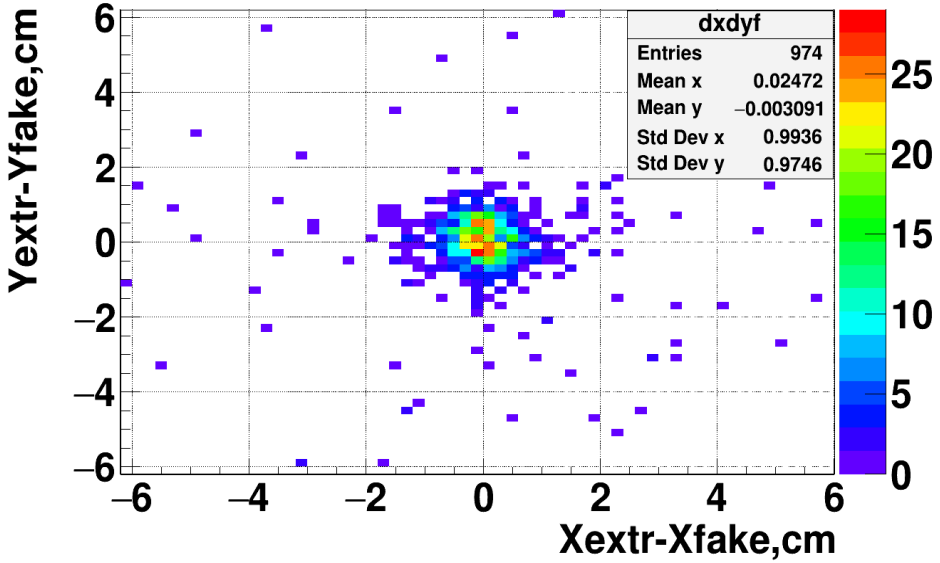




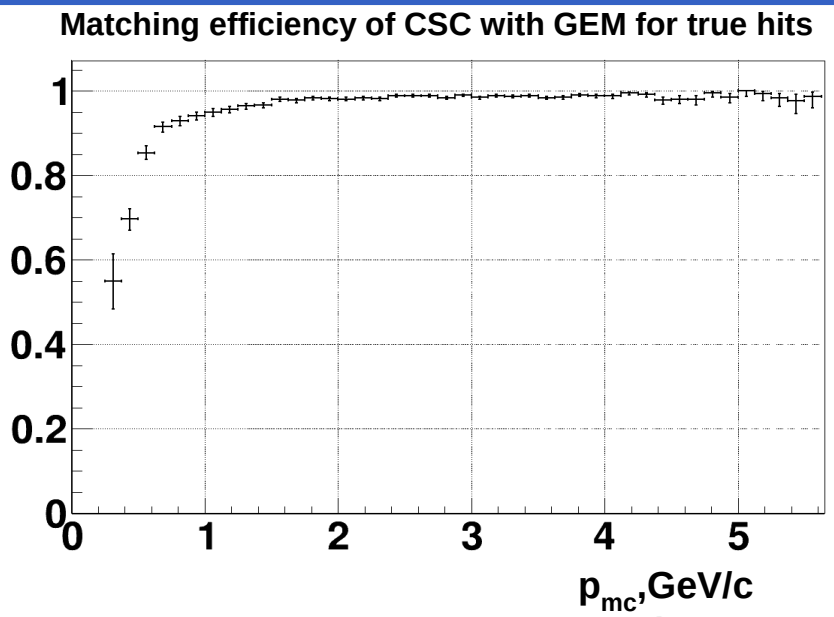
2D-Residual for fake hits

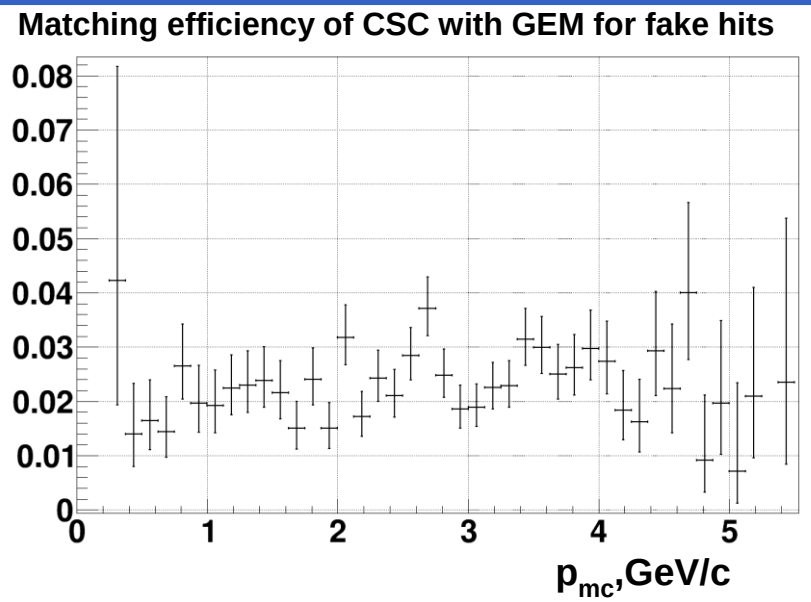






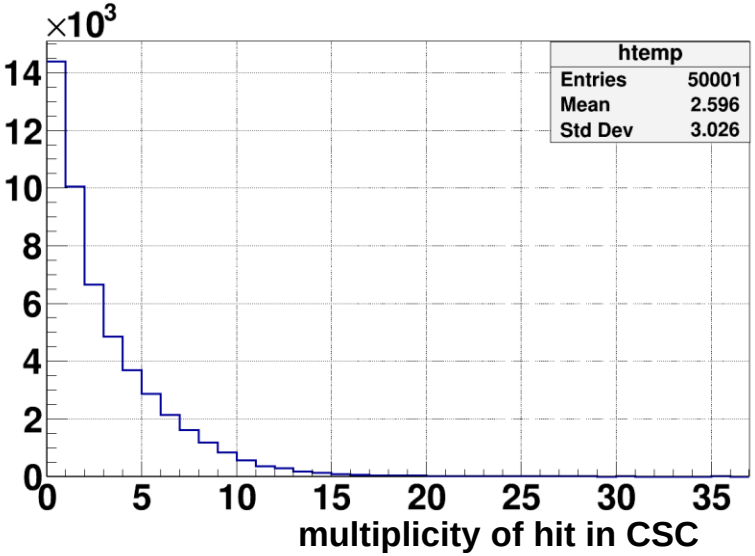
Matching efficiency of CSC with GEM





Hits in gate ±3σ

ε = Nrec/Ngen



TOF- 400 matching with GEM+SI

1. Skip events without tof400 hits
if (TOF400Hit->GetEntries() <= 0)

→ **Event loop**

point_id → RefIndex→ mcID → Track_ID

2. Check on mc point
if (!tof400_hits.count(mc_track_ID))

→ **Tracks loop**

condition that there are minimum 5 reco hits in GEM

3. Extrapolation to the Z(tof-400) – coordinate of the true hit

4. Check if extrapolation goes through the geometry volume
geo filter tof filter ➡ StripActive

5. Gate calculation →

Skipping hits from another station: if(det!=stn)
Distance: dist = sqrt(dx * dx + dy * dy);
All hits within a radius of 50 cm: if(dist >50.0 cm)

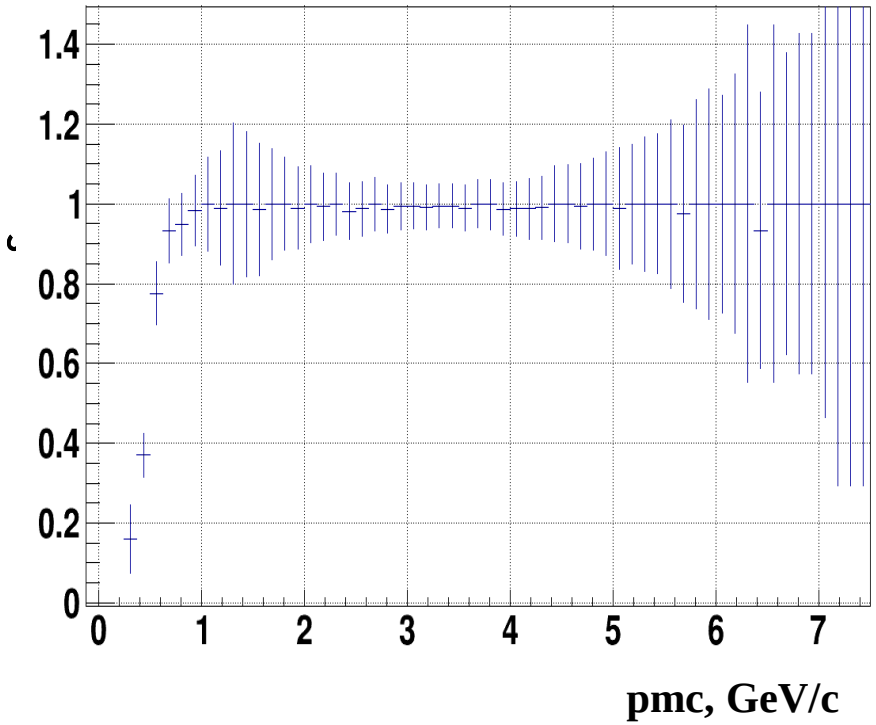
Sorting by distance (dist, tof_hit)

σ→ Fit dx= Xextr - Xhit; dy=Yextr -Yhit;

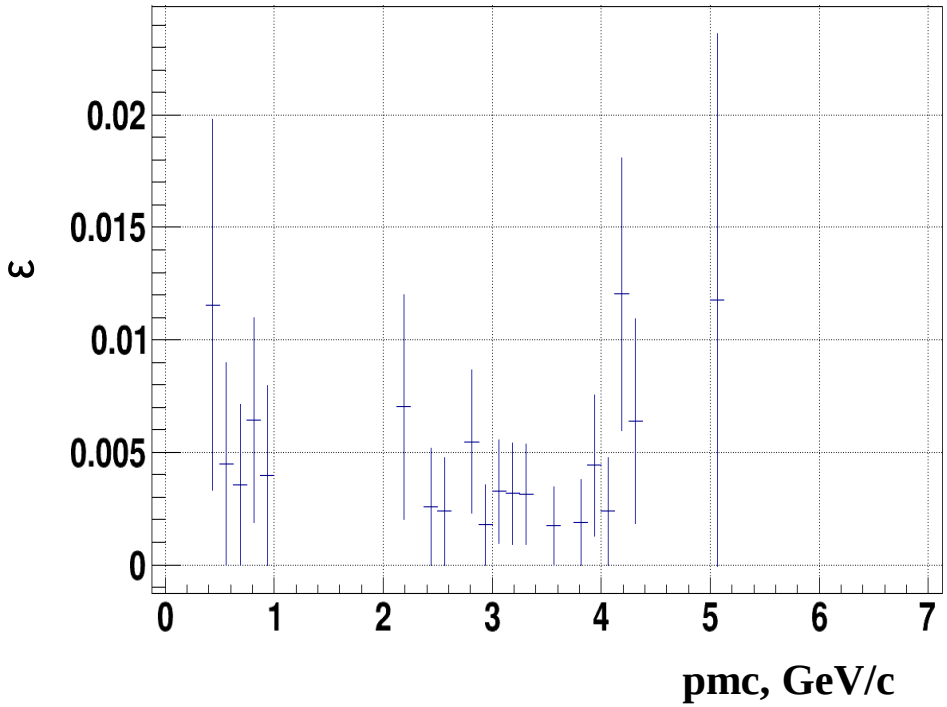
6. Efficiency: $\varepsilon = \langle pmc \rangle \pm 3\sigma/(pmc)$

Matching efficiency of TOF-400 with GEM

Link efficiency between SIGEM and TOF-400 in **plane 4** for true hits



Link efficiency between SIGEM and TOF-400 in **plane 4** for fake hits



ε = <pmc>±3σ/(pmc)

if(mcId ≠ mc_track_ID) → FALSE hit

if(mcId = mc_track_ID) → TRUE hit

minimum 5 reco hits in GEM
if(recble<=5)

Procedure matching approximate to the real data

Event loop

MagScale = 1200/900

STS -Tracks loop

condition that there minimum 5 reco hits in GEM : *reco_Hits_Gems<=5*

Loop by Ztof400 - coordinate

Extrapolation to the Z(tof - 400) – coordinate of the true hit

Check if extrapolation (X, Y, Z) goes through the geometry volume

geo filter tof filter → StripActive

skipping hits from another station: if(det!=stn)

pfull → **Denominator Fill (pfull)**

Efficiency:

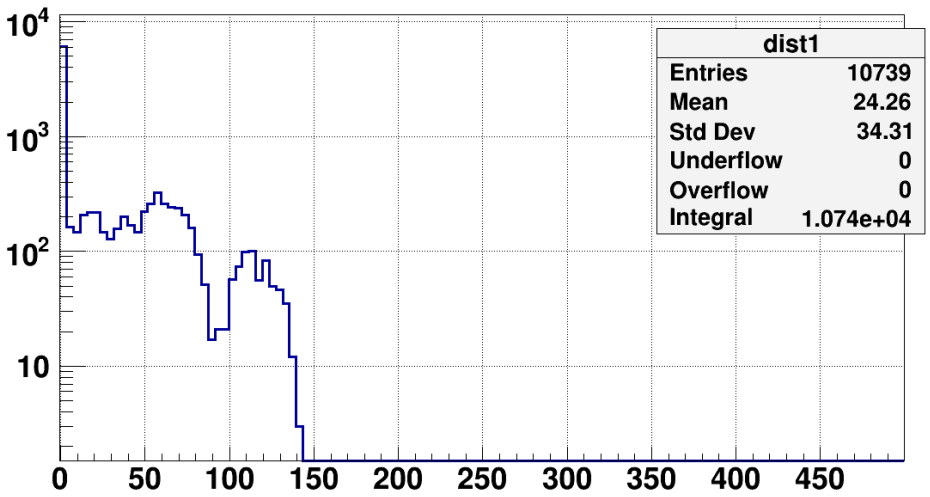
If(distance <= 3σ cm)

numerator Fill(pfull)

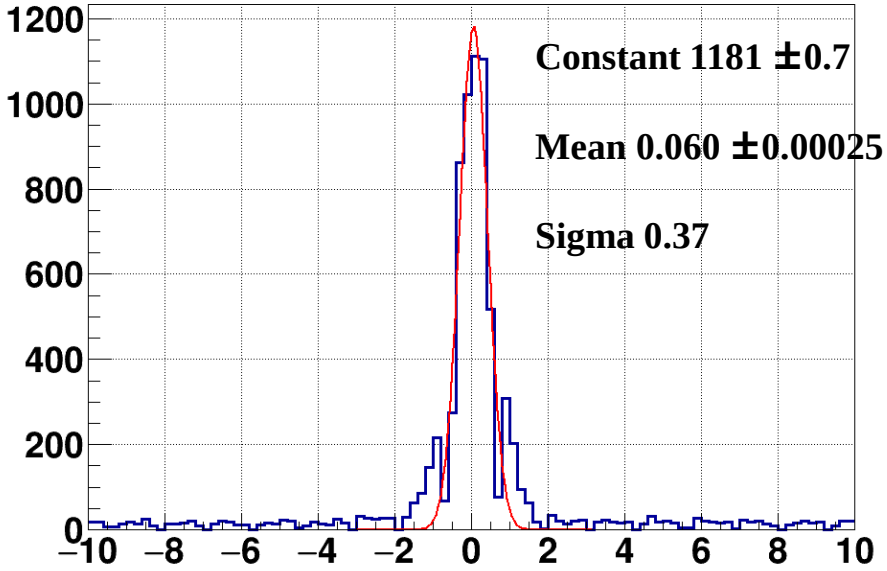
efficiency

Residuals for nearest hits

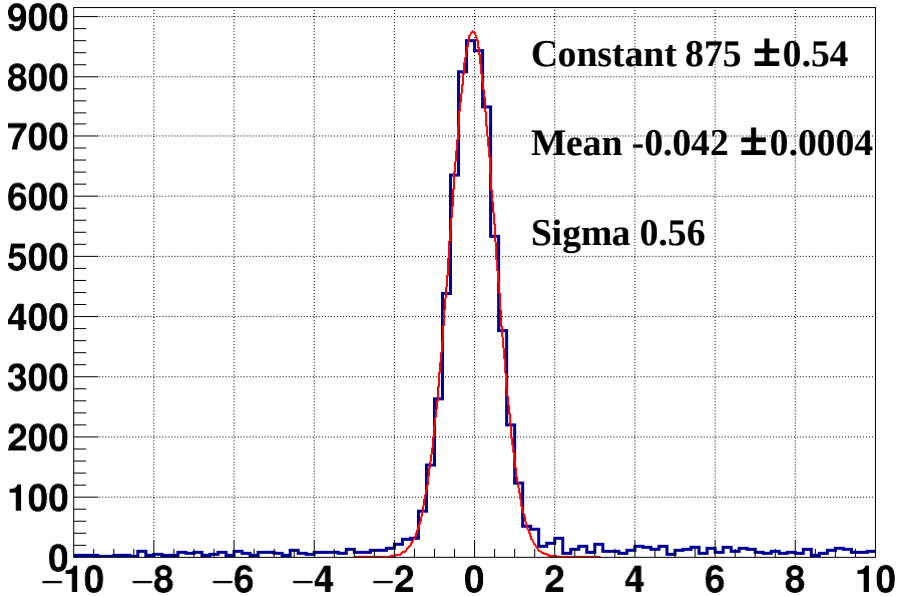
plane 1
Ztof = 431.5 cm



Distance between nearest hit and track, cm



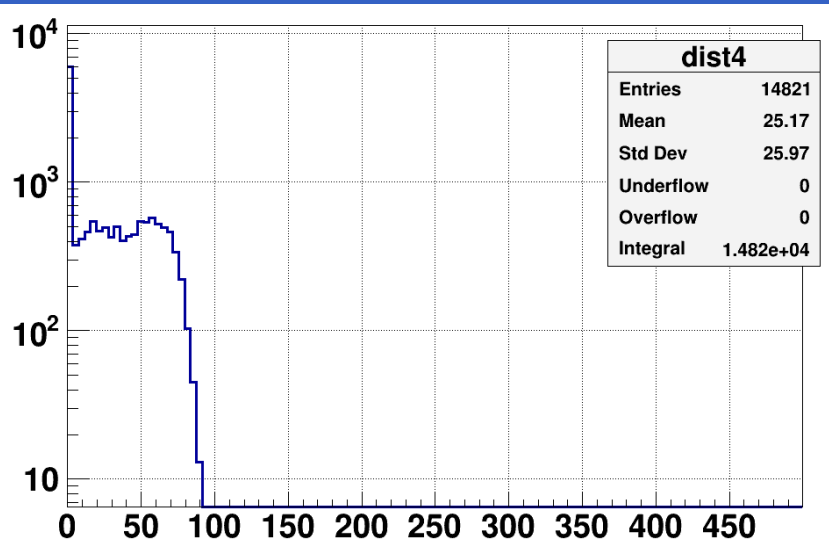
Xextr – Xhit, cm



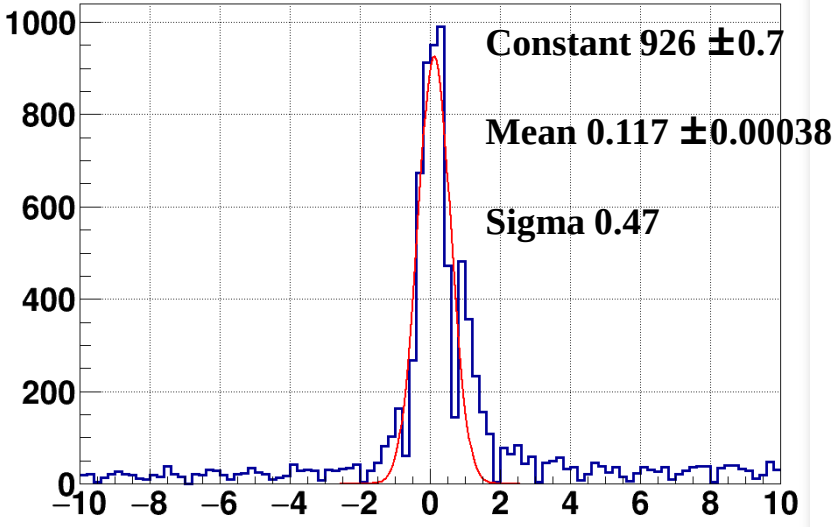
Yextr – Yhit, cm

Residuals for nearest hits

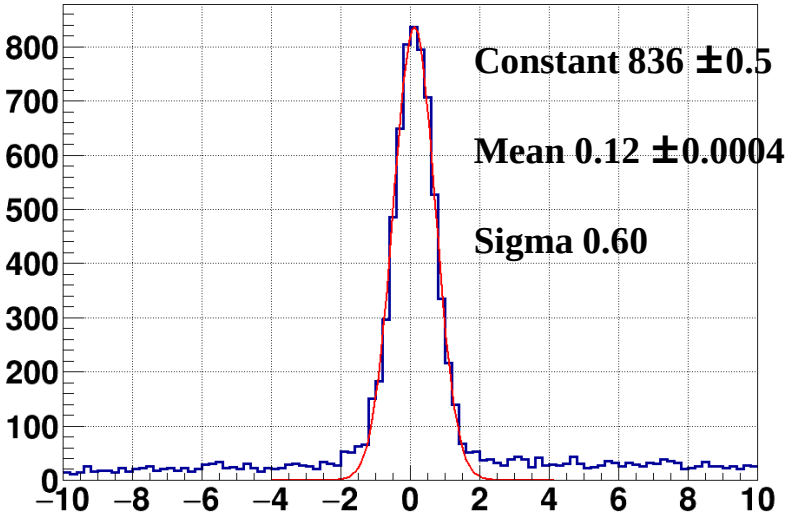
plane 4
Ztof = 437.5 cm



Distance between nearest hit and track, cm



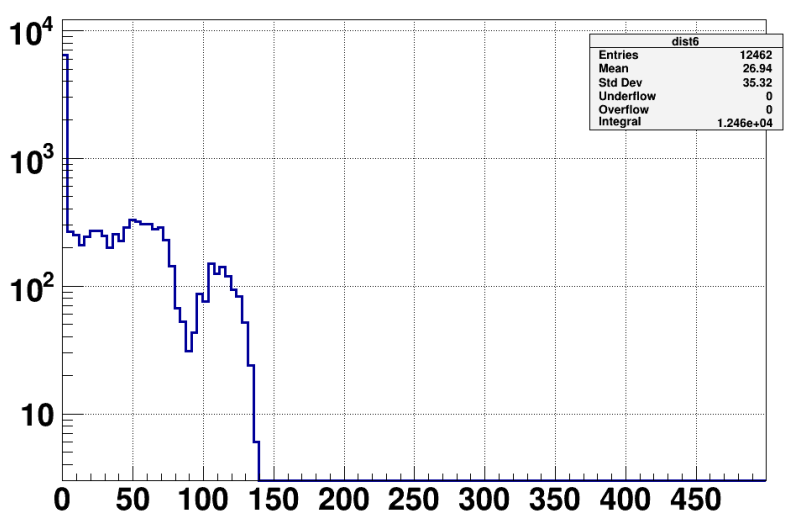
Xextr – Xhit, cm



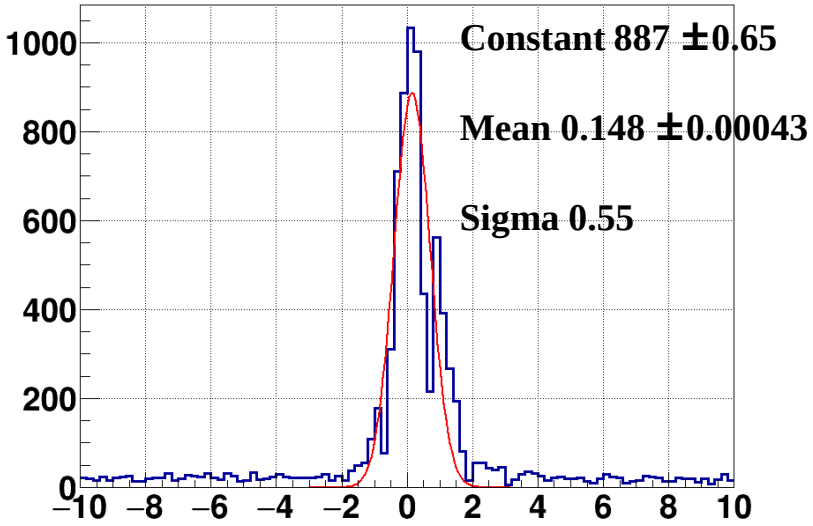
Yextr – Yhit, cm

Residuals for nearest hits

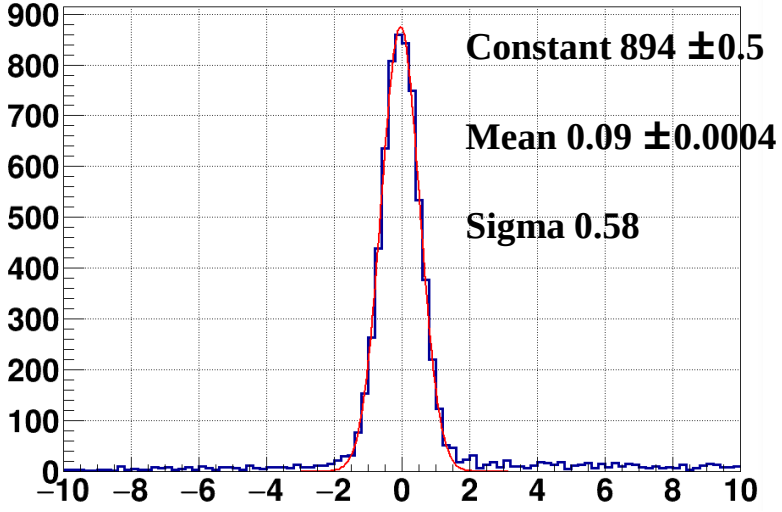
plane 6
Ztof = 442.4 cm



Distance between nearest hit and track, cm

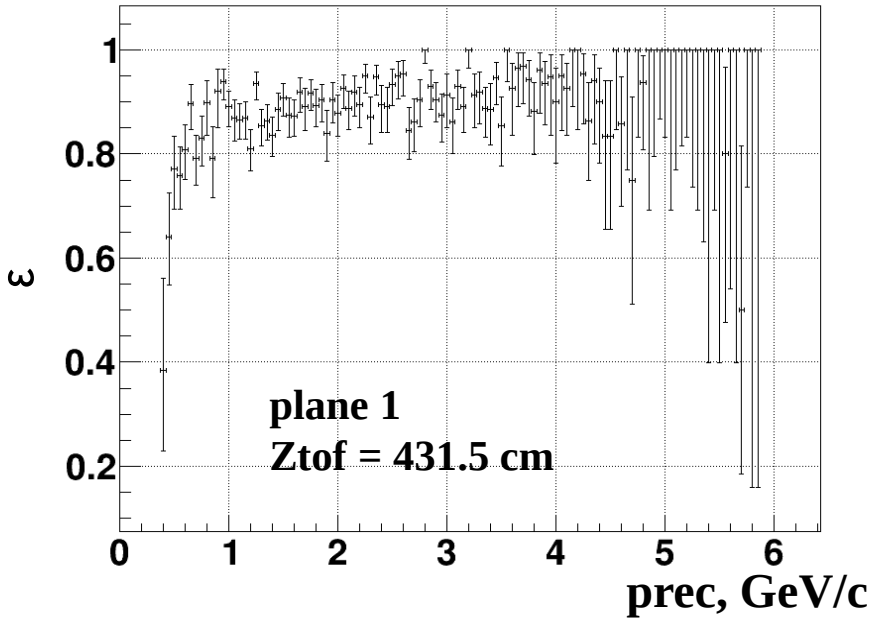


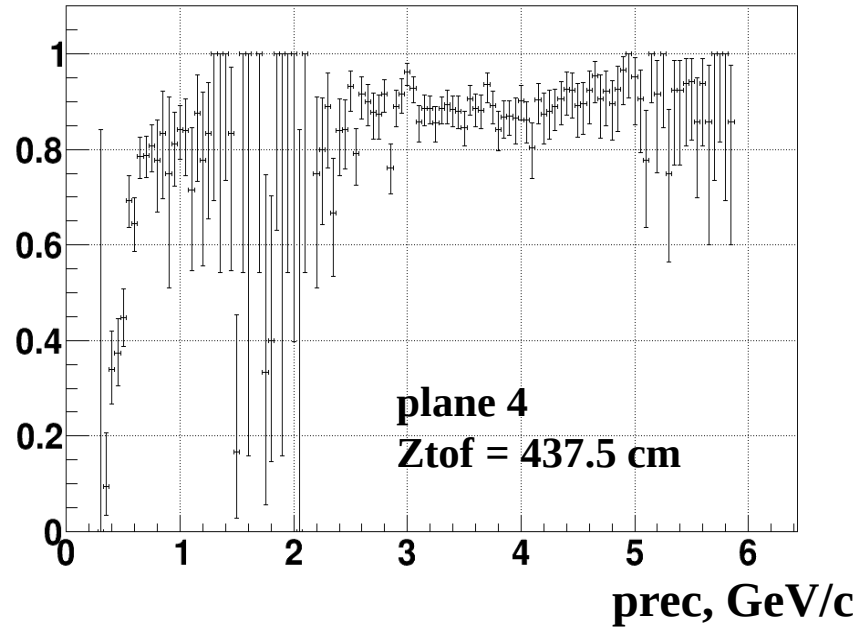
Xextr – Xhit, cm

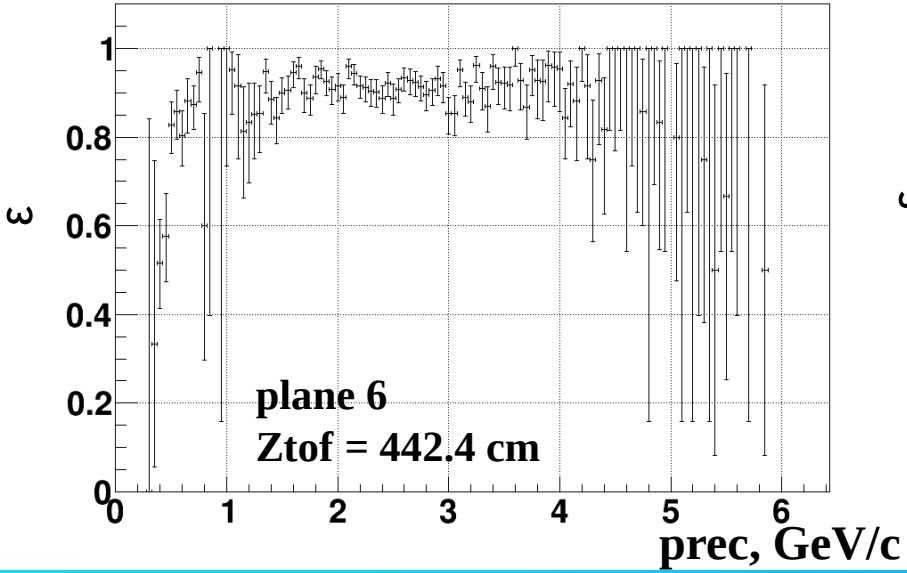


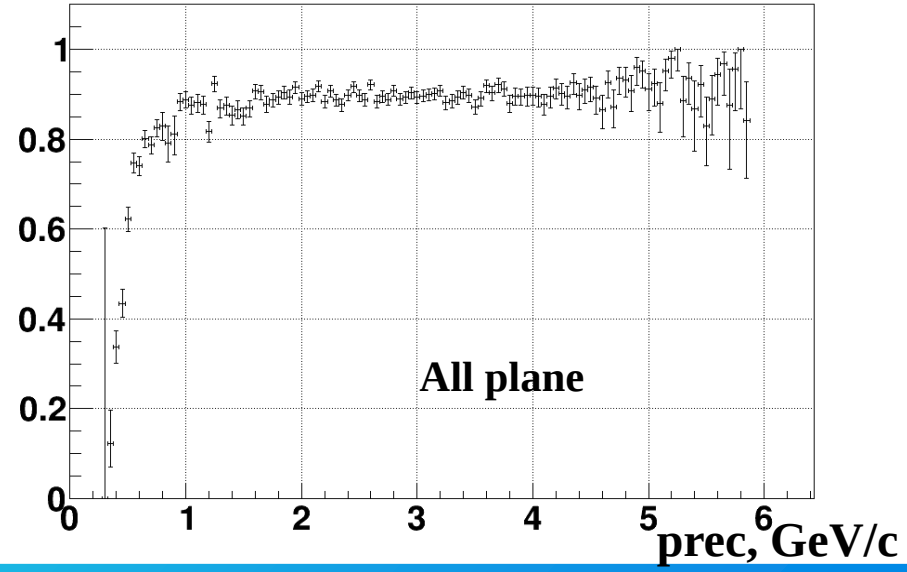
Yextr – Yhit, cm

Matching efficiency of TOF - 400 with GEM









Summary and plans

1. Central tracker (Silicon+GEM) reconstruction efficiency was estimated;
2. Residuals were estimated for the nearest (true/fake) hits;
3. The efficiency of (Silicon+GEM)+CSC matching was obtained;
4. Fake hit efficiency (mismatch rate) was estimated;

5. Residuals were estimated for the nearest hits;
6. The efficiency of (Silicon+GEM)+ TOF400 matching was obtained;

In the plans:

8. Propagate matching (Silicon+GEM+CSC) to the TOF400;
9. Apply the approach to the real data;

Thank you for attention!