MRPC performance studies
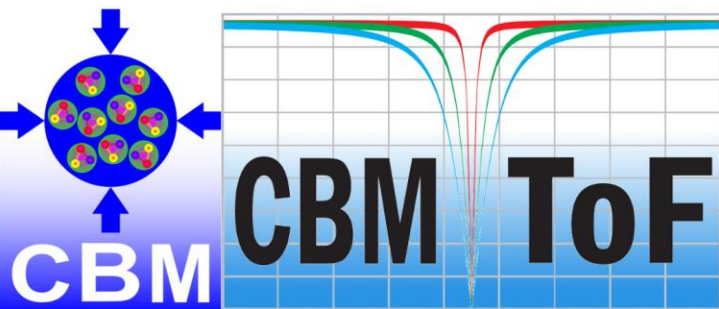# with cosmic muon radiation

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Content

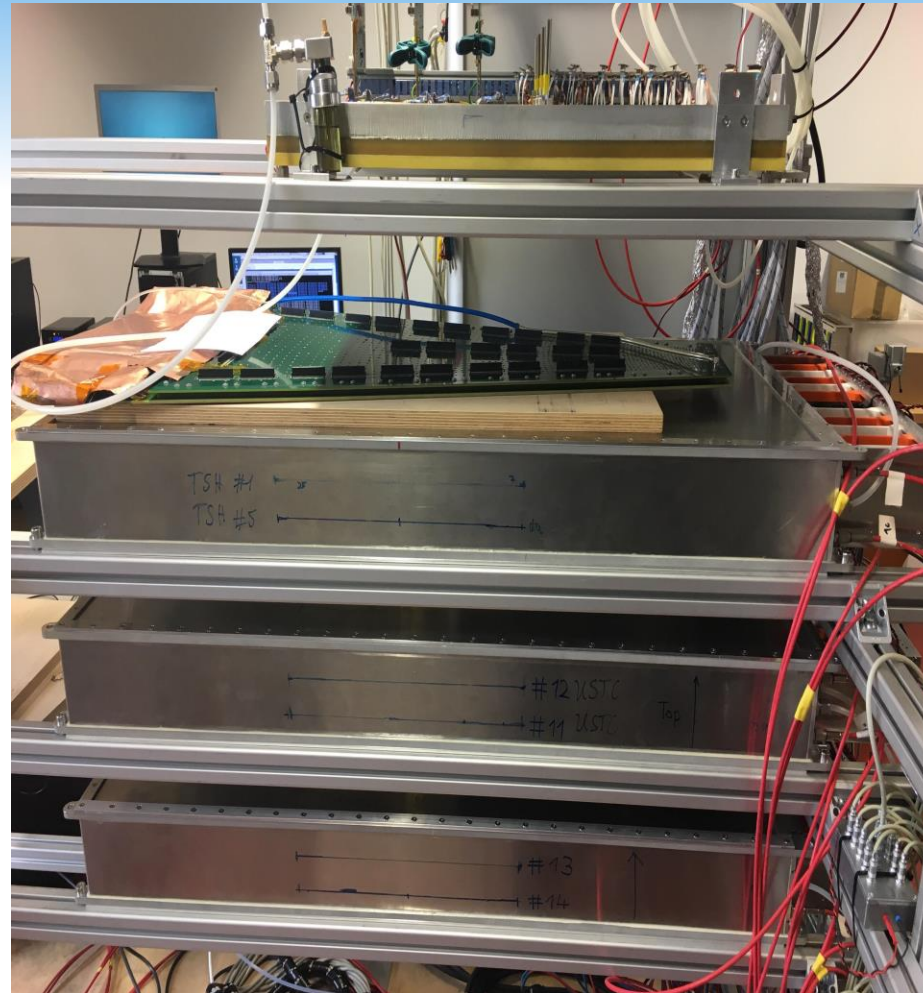High voltage scan for MPRC3 types a and b (already shown)

- efficiency

- time resolution

- mean cluster size

- streamer probability

- rate

Performance of detectors depending on particle track (new)

Phi and Theta angle dependence on...

- time & space resolutions

- cluster size

- ToT

Test setup

3 boxes, 2 detectors each

6 RPCs in a row

PADI Threshold:

-300 mV (Tsinghua)

-165 mV (USTC)

Tsinghua 900

Tsinghua 901

USTC 910

USTC 911

USTC 920

USTC 921

Analysis - Tracking

Tracking with
iter_tracks.sh
ana_trks.C(nEvents, iTrackingSetup, dChi2Lim2,TofGeo)

nEvents = number of events used, iTrackingSetup = see Figure, dChi2Lim2 = acceptance cut for hits,
TofGeo = Geometry version

```
switch (iTrackingSetup){
case 1:
  tofFindTracks->SetMinNofHits(5);
  tofFindTracks->SetNStations(6);
  tofFindTracks->SetNReqStations(6);
  tofFindTracks->SetStation(0, 9, 0, 0);      // THU
  tofFindTracks->SetStation(2, 9, 0, 1);      // THU
  tofFindTracks->SetStation(3, 9, 1, 0);      // USTC
  tofFindTracks->SetStation(4, 9, 1, 1);      // USTC
  tofFindTracks->SetStation(5, 9, 2, 0);      // USTC
  tofFindTracks->SetStation(1, 9, 2, 1);      // USTC
  tofTrackFinder->SetSIGT(0.08);
  break;
```

Minimum number of stations to build a track

Total number of stations present

Required number of stations for "all station tracks"
(if many layers are used)
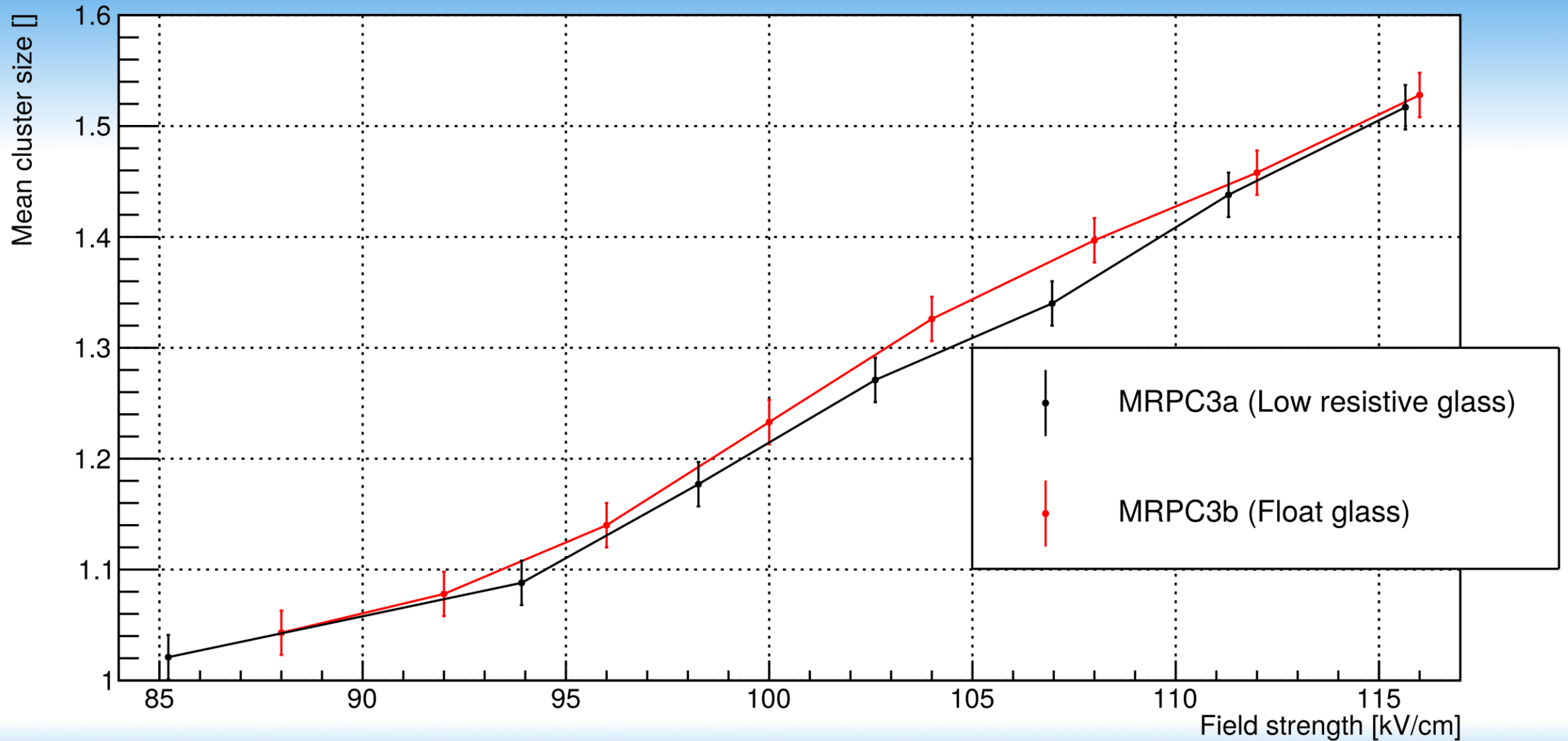
SetStation(TrackOrder,Sm,Box,RPC)

Analysis - Tracking
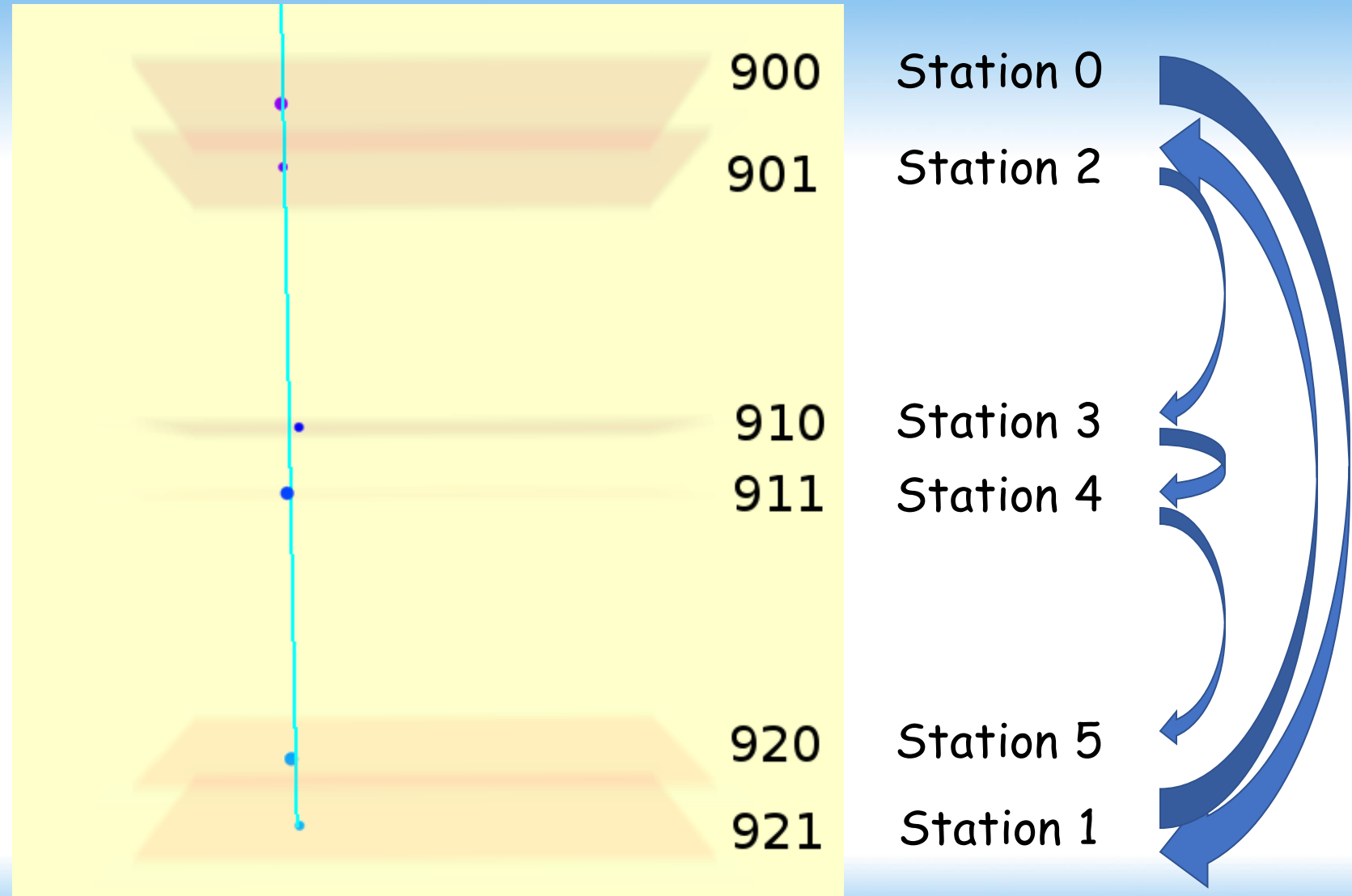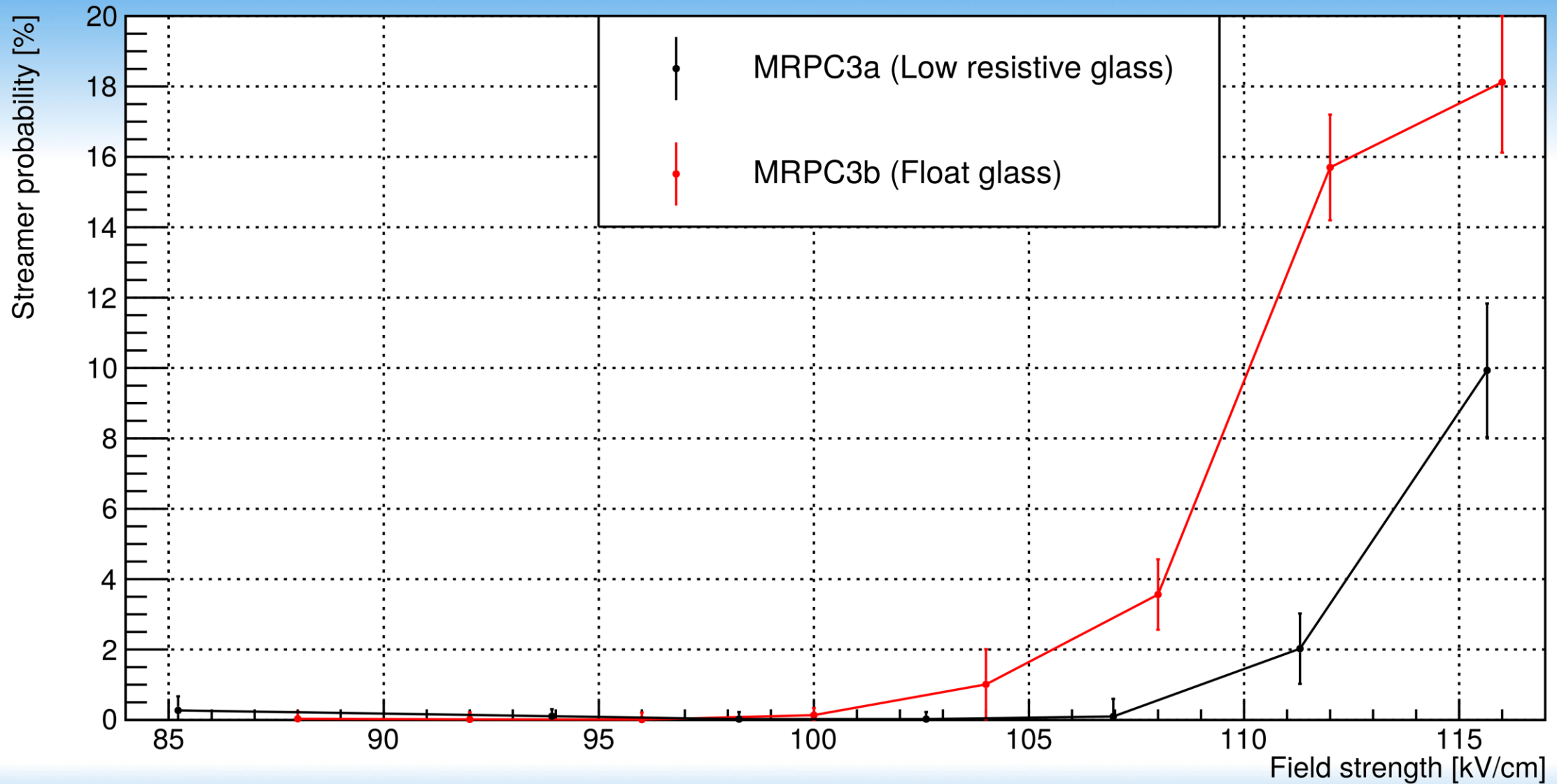
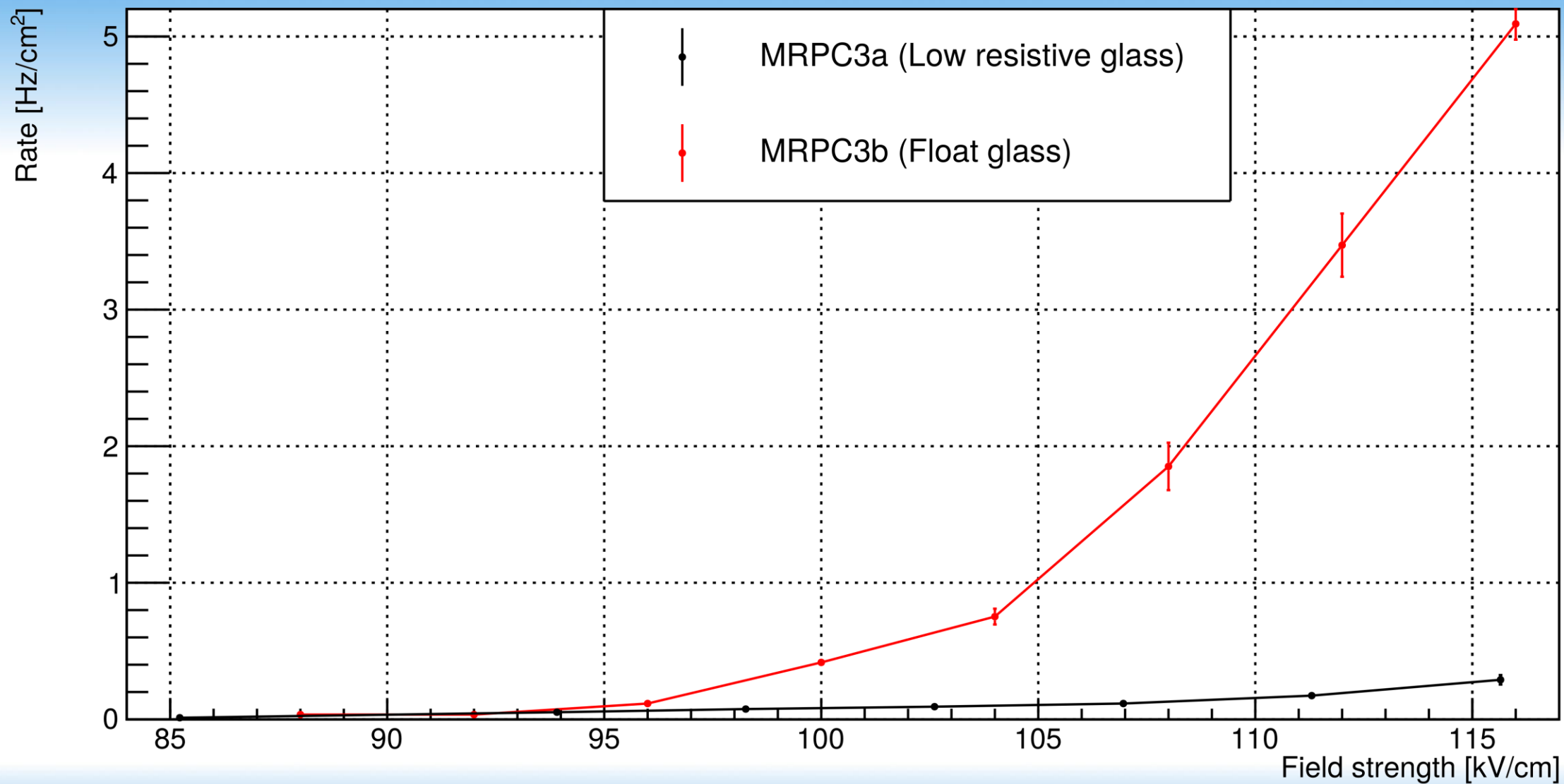Efficiency vs. Field strength
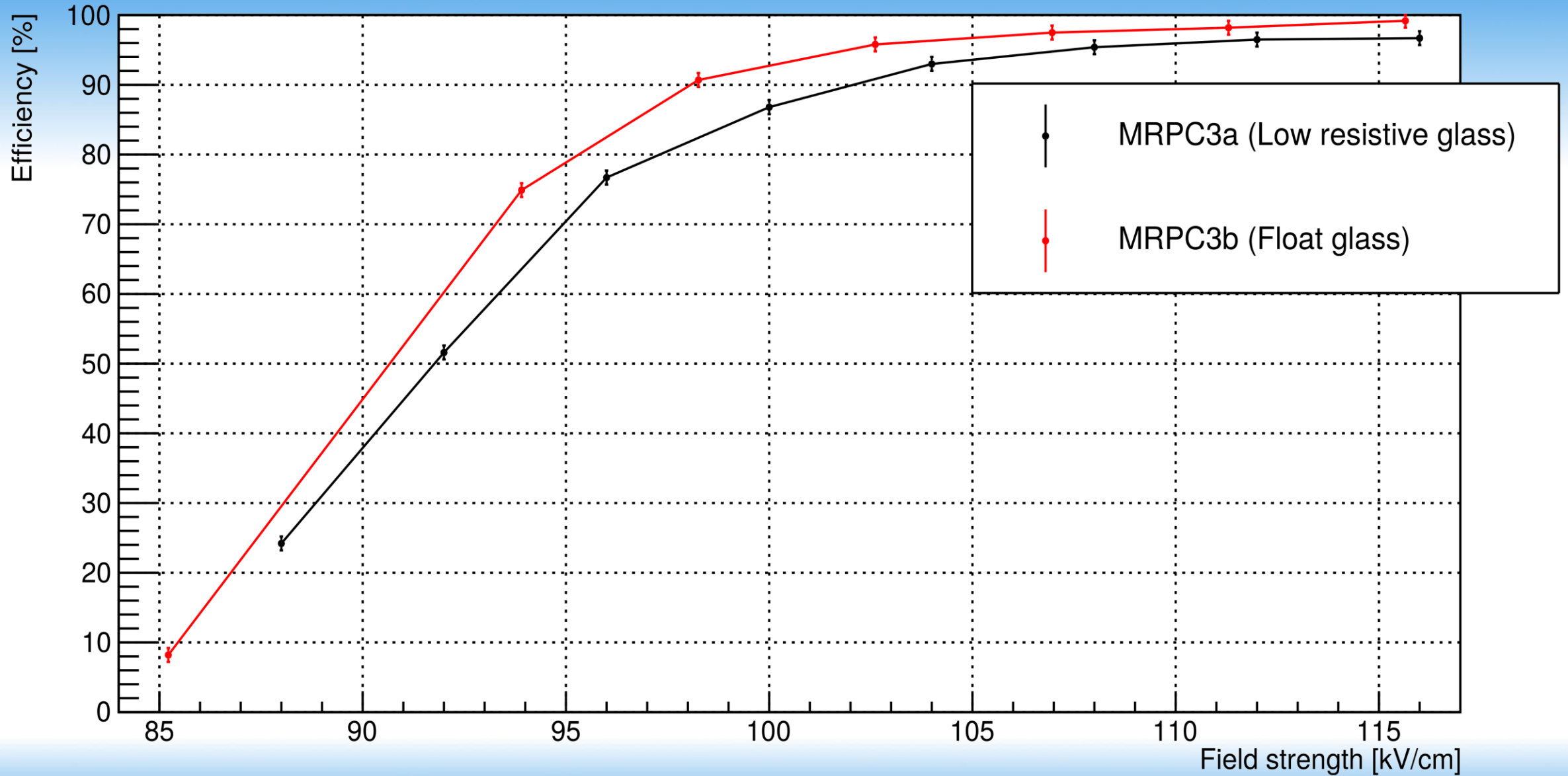
Time resolution vs. Field strength
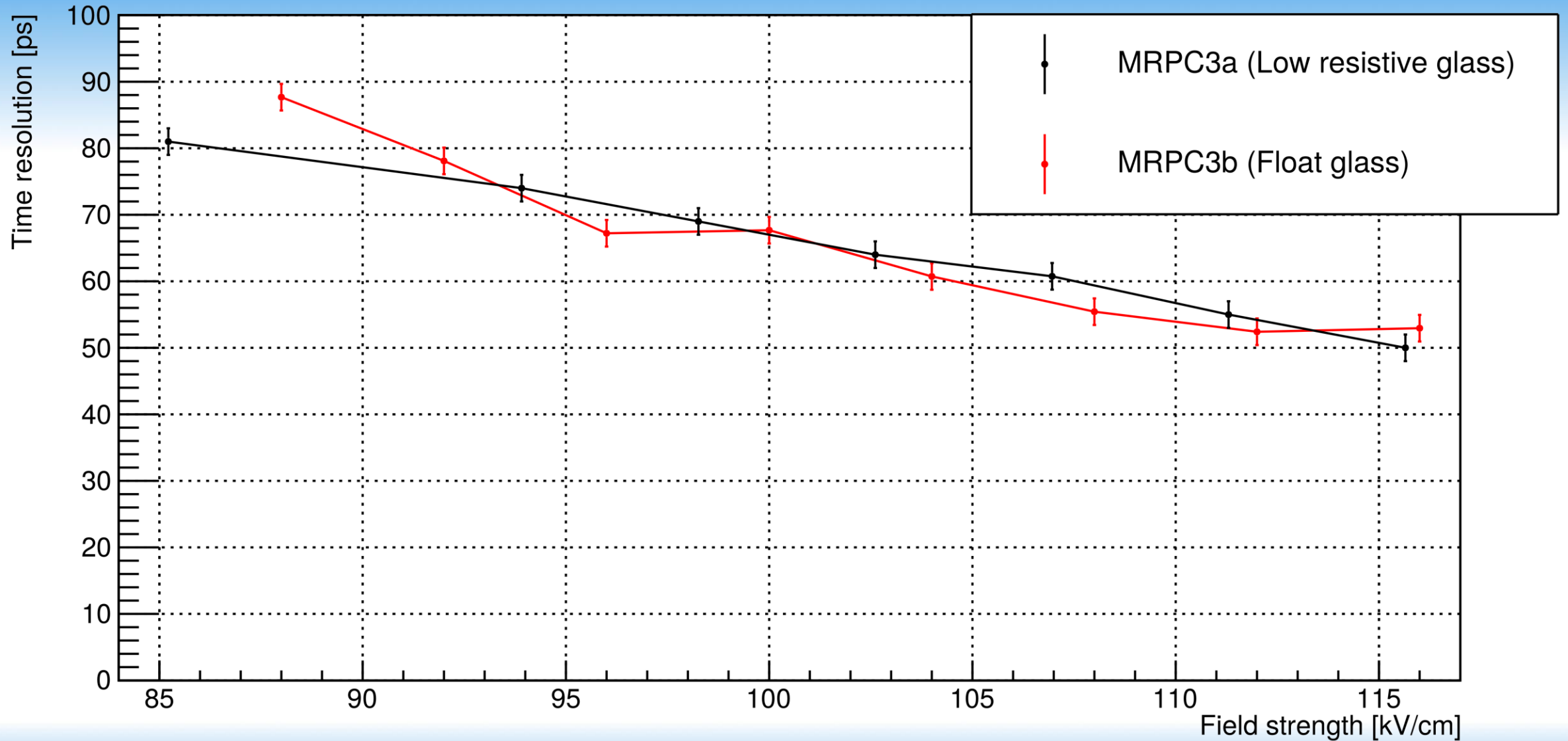
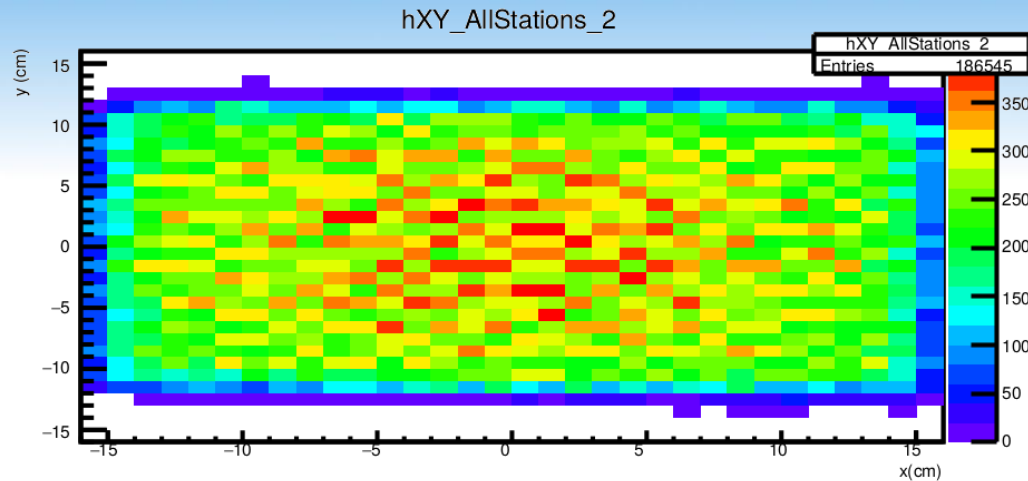# Mean cluster size vs. Field strength

Streamer probability vs. Field strength
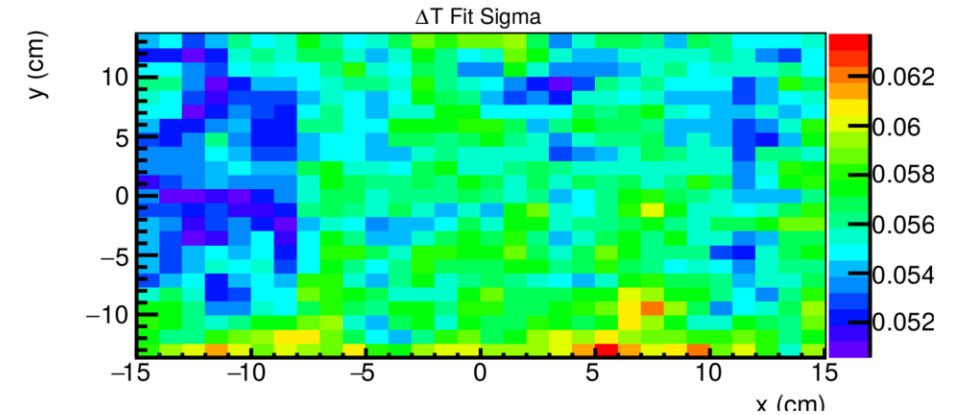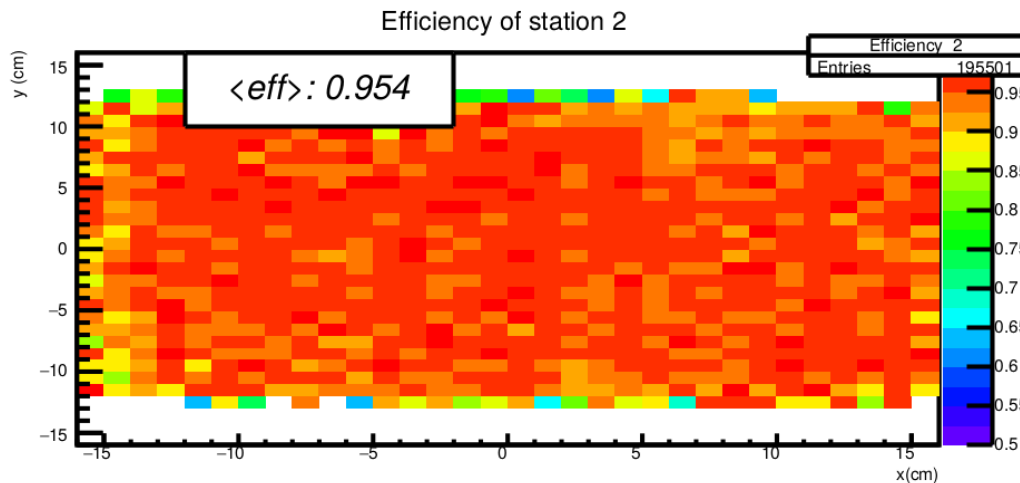
Rate vs. Field strength

Differential Analysis

Tracking allows for spacial differential performance analysis

Example for Tsinghua's Type a RPC

- Upper left: Number of tracks per cm²

- Lower left: efficiency

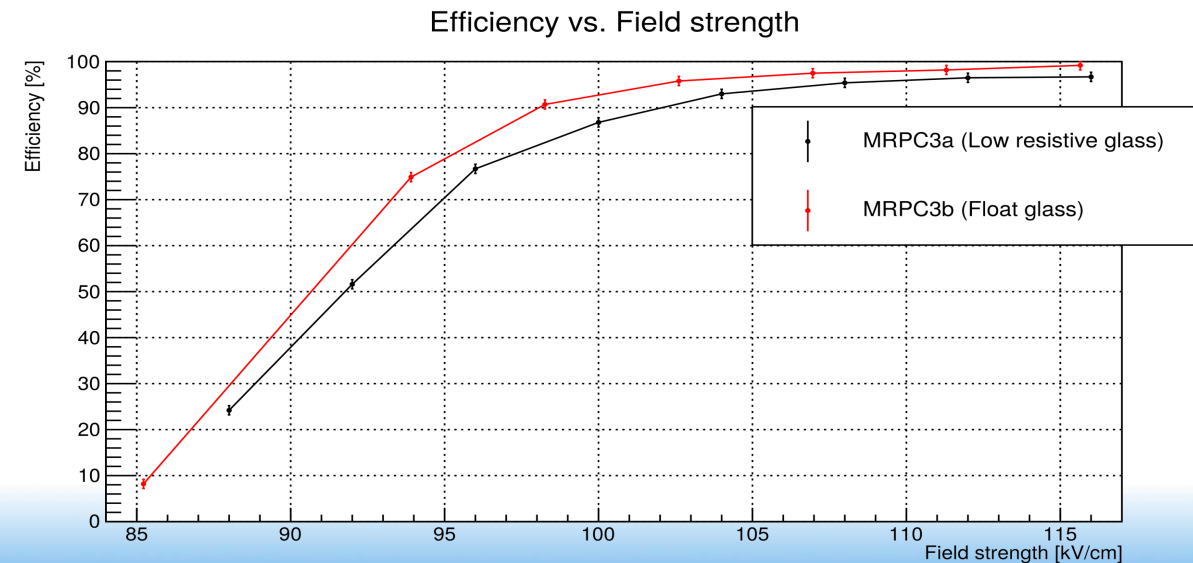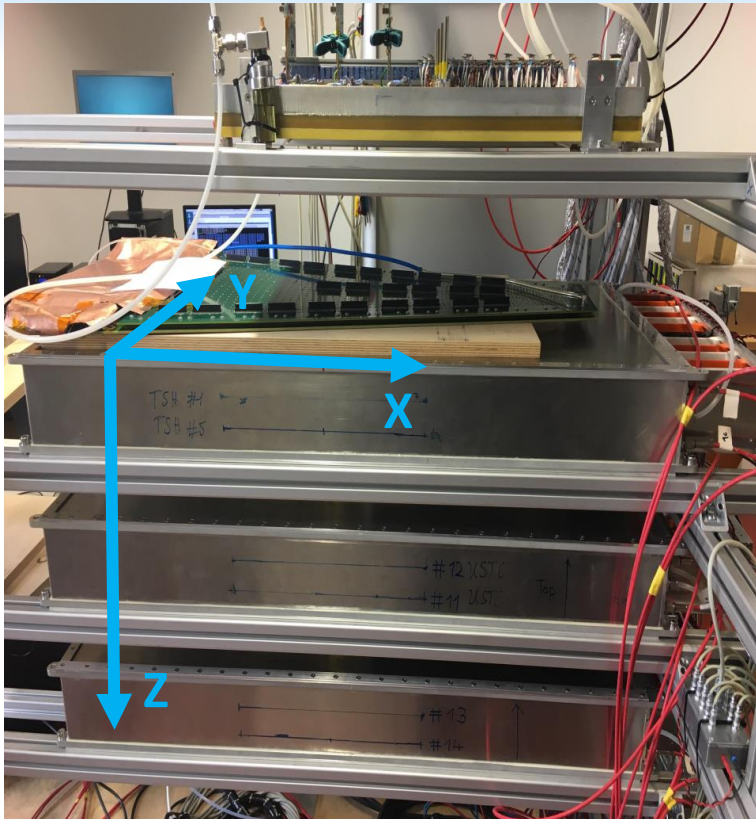- Lower right: time resolution

Test setup

Same setup used as before:

   3 boxes, 2 detectors each → 6 RPCs in a row

Both types at ~112 kV/cm

Threshold at –300 mV (Tsinghua)/ -165 mV (USTC) as before

Tracking acceptance: χ^2=3,5

⇒ hits that are more than 3,5 σ away from
   predicted positions
   are ignored

Efficiency vs. Field strength
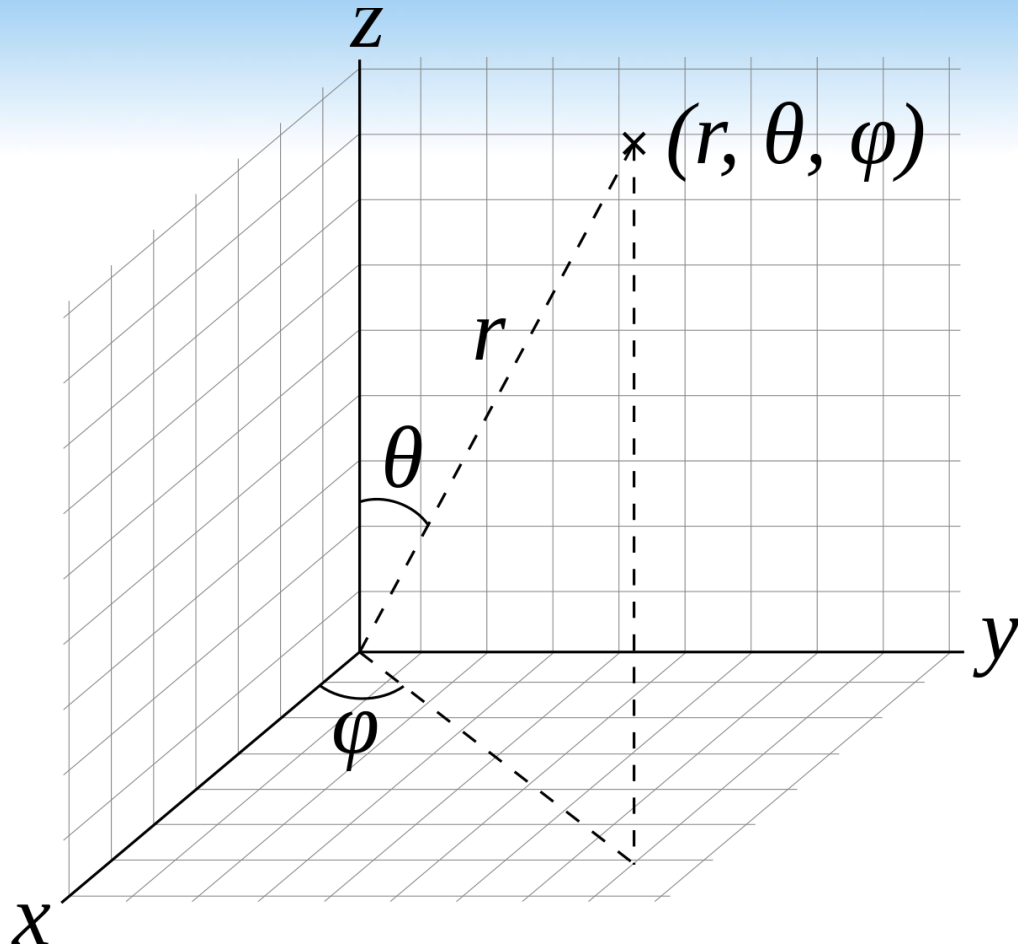
Tracking angles

Tracking allows for extracting trajectory angles of cosmics

φ: pTrk->GetPhi();   rotation in detector plane (x-y)
Θ : pTrk->GetTheta();   angle away from vertical (z-axis)

Range:

$0° \leq φ \leq 2π$

$0° \leq Θ \leq π/2$

φ = 0, π, 2π   trajectory along x-axis (across strips)
φ = π/2, 3π/2   trajectory along y-axis (along strips)

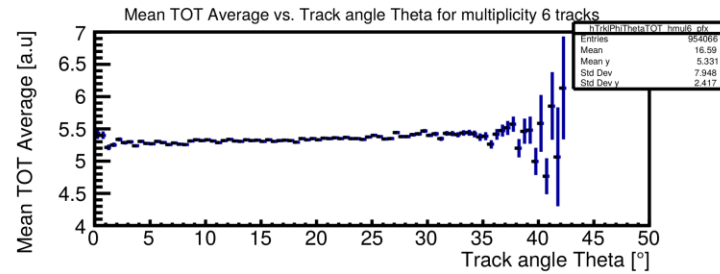Θ = 0   trajectory along z-axis (perpendicular to surface)

$(r, θ, φ)$

Theta & Phi - Cluster size
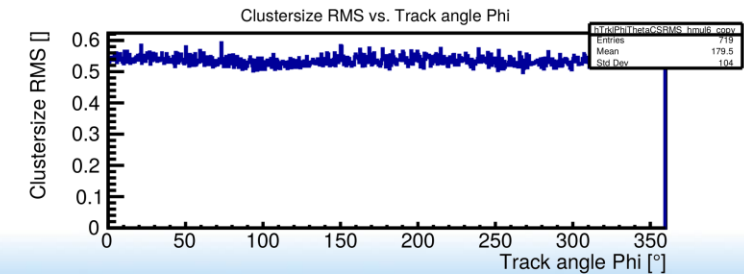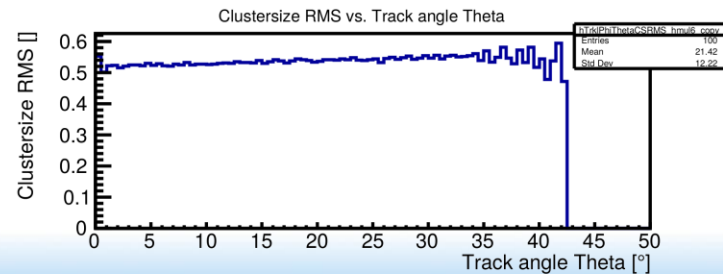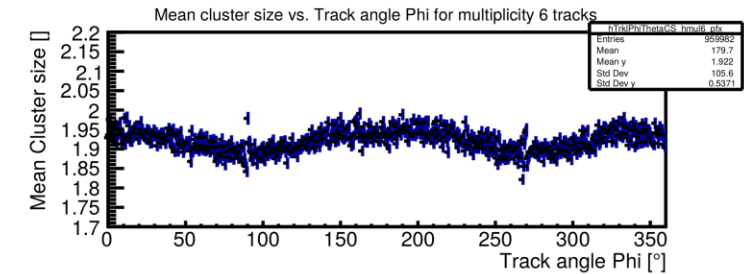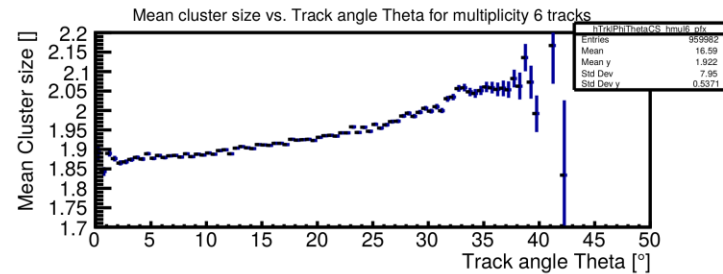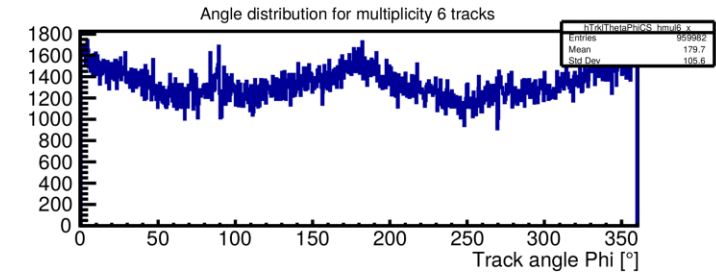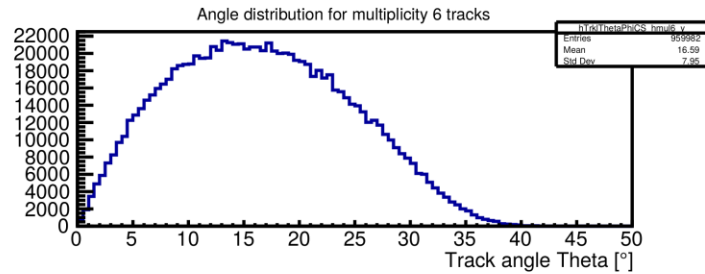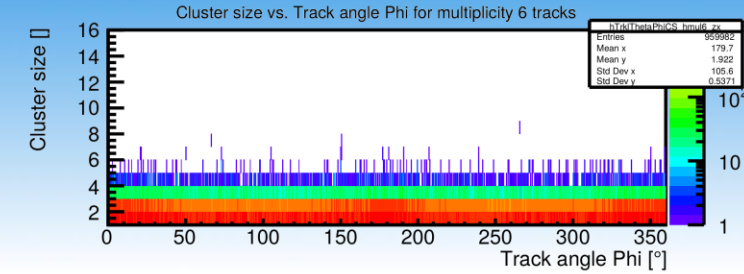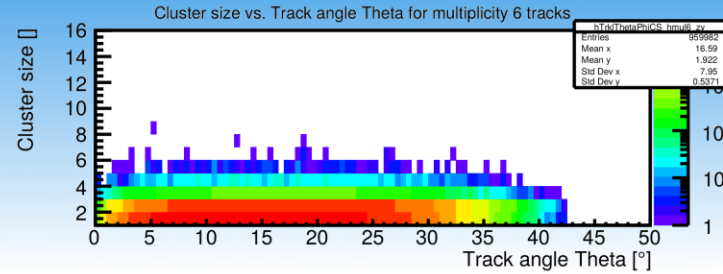
Theta & Phi - ToT
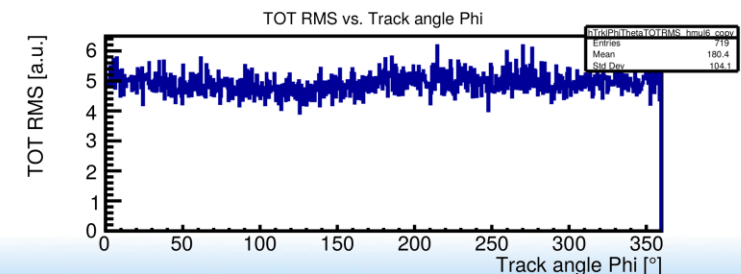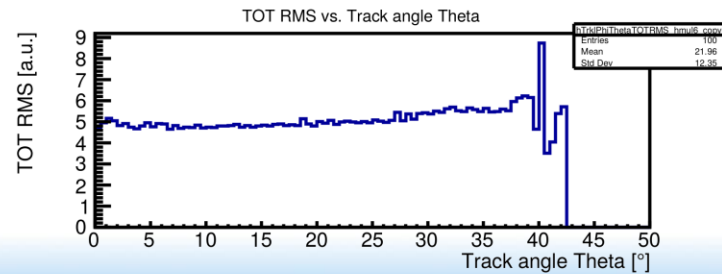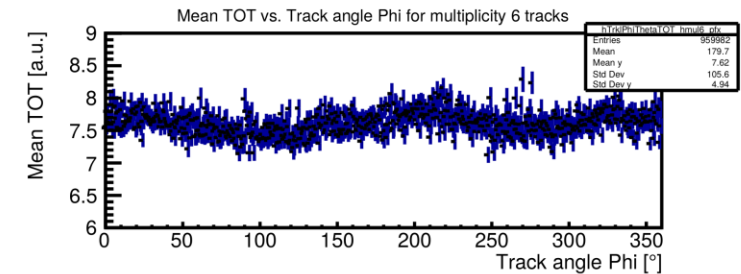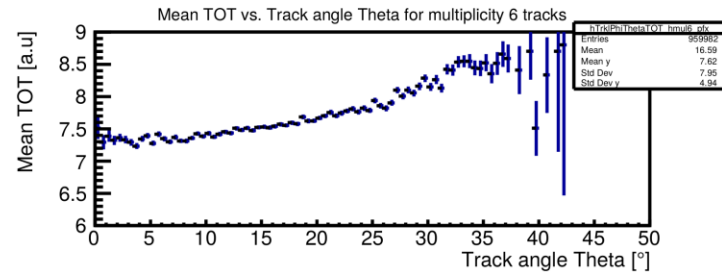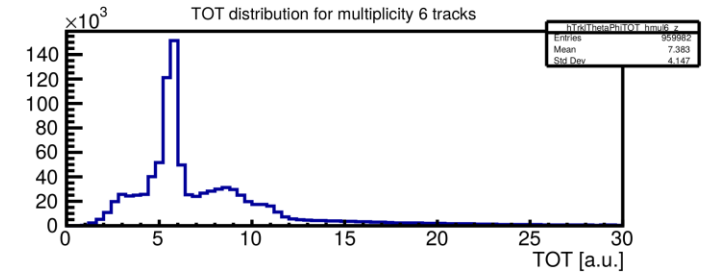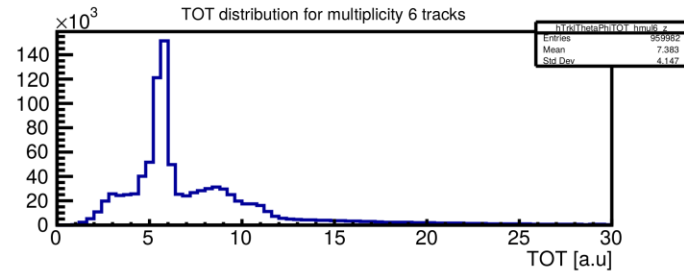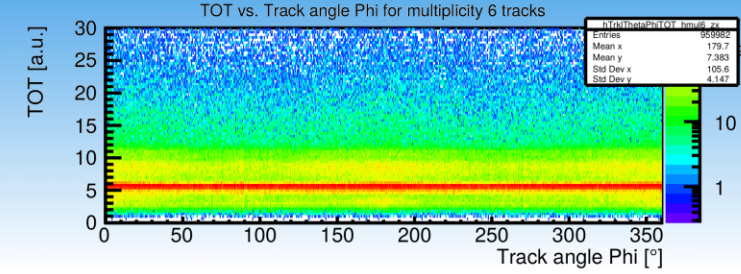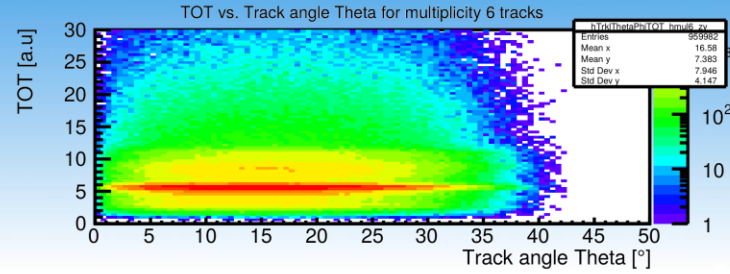
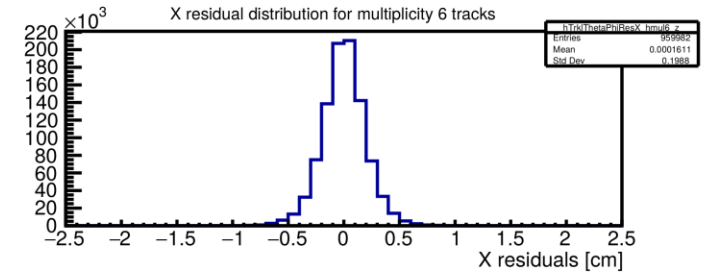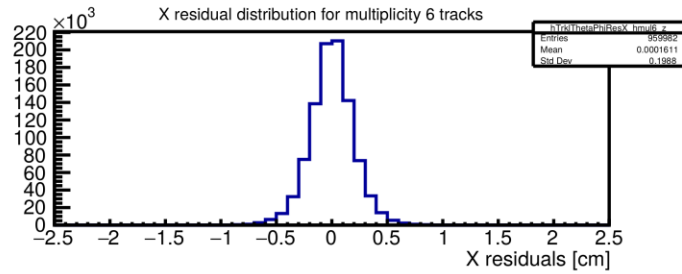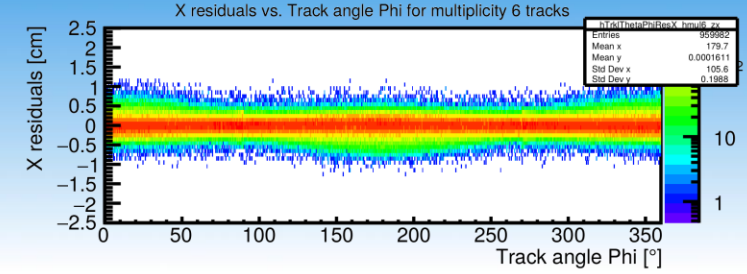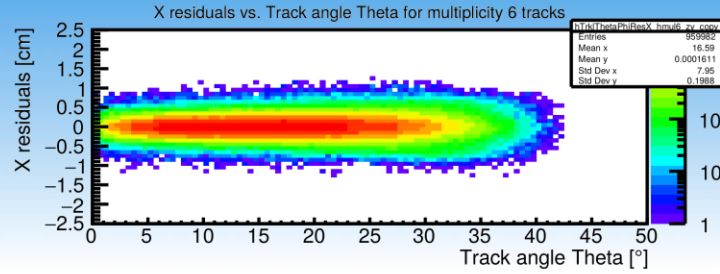# Theta & Phi - Average ToT
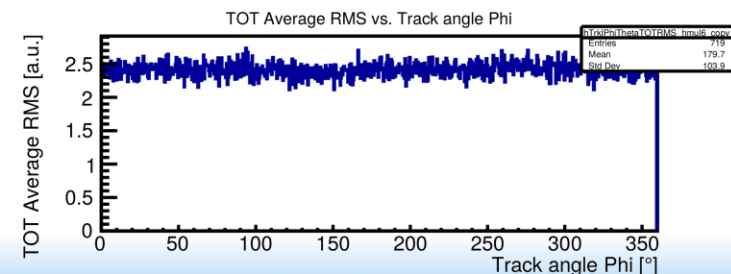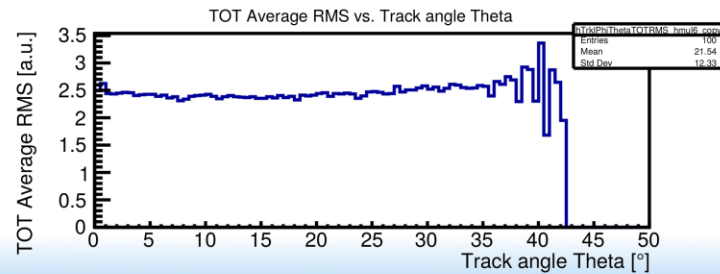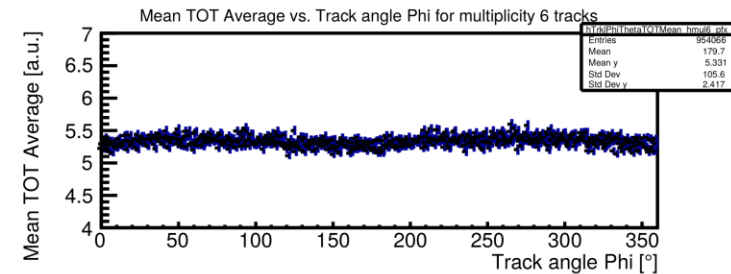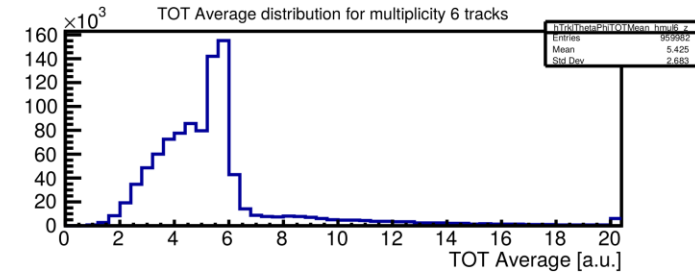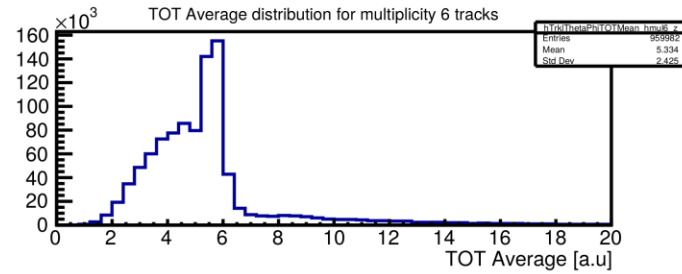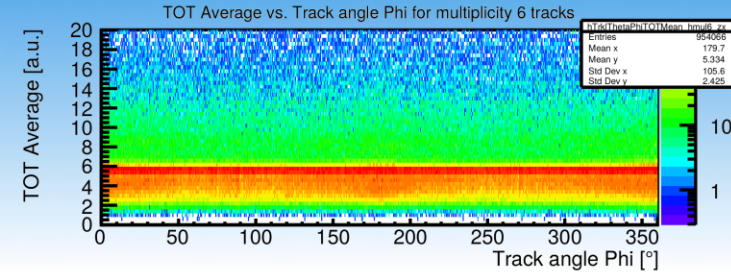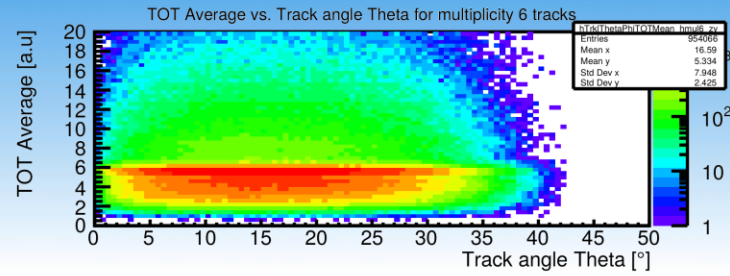
Theta & Phi - Time resolution
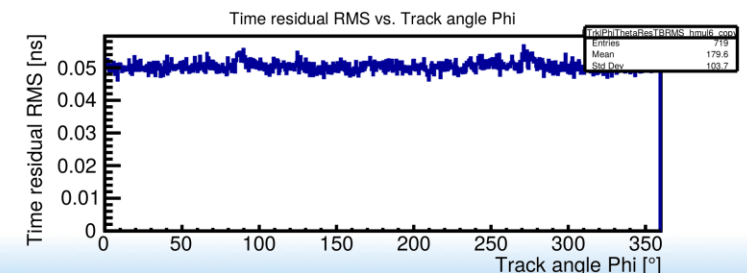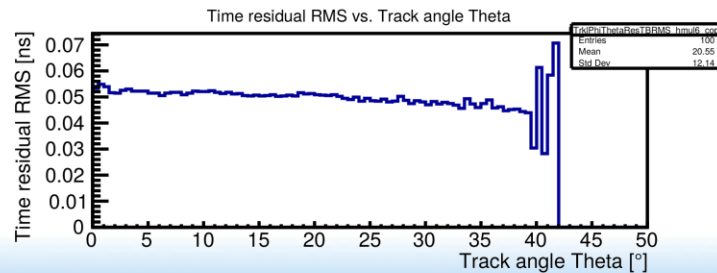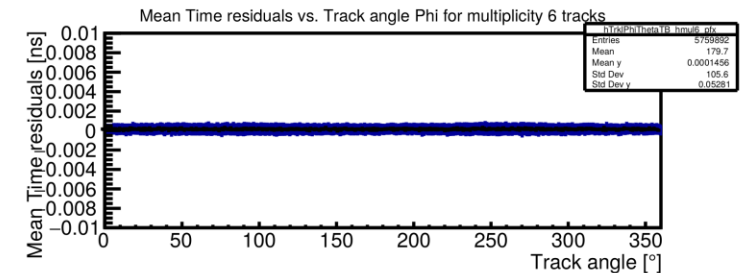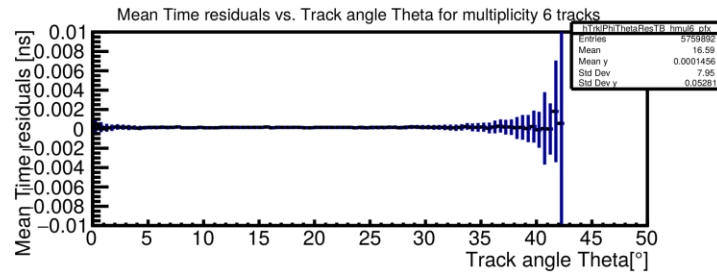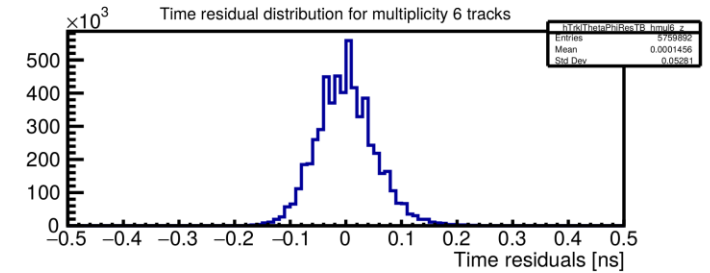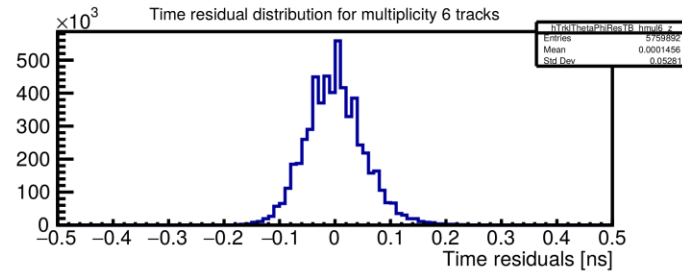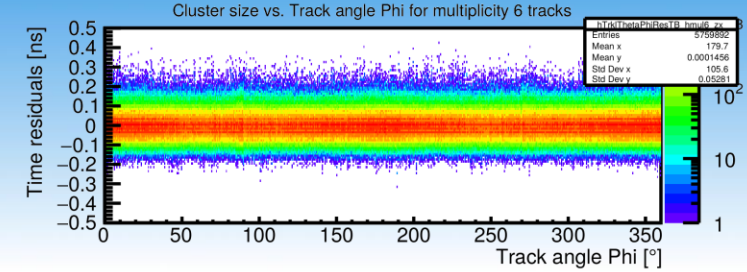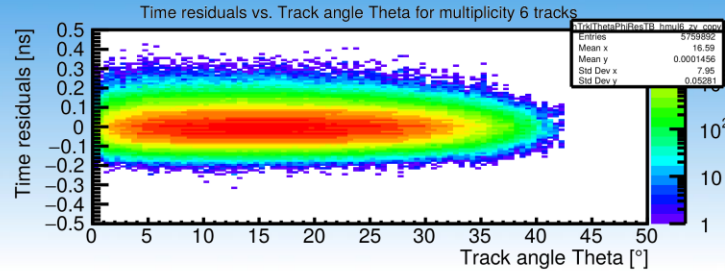
Theta & Phi - X Residual
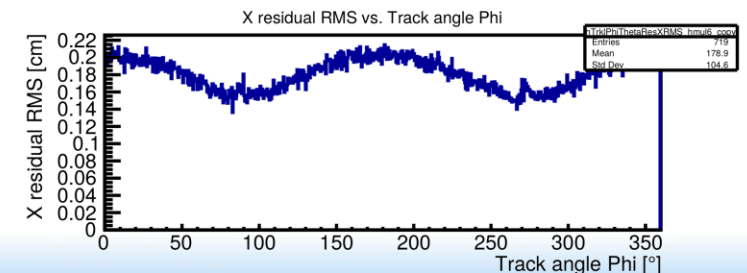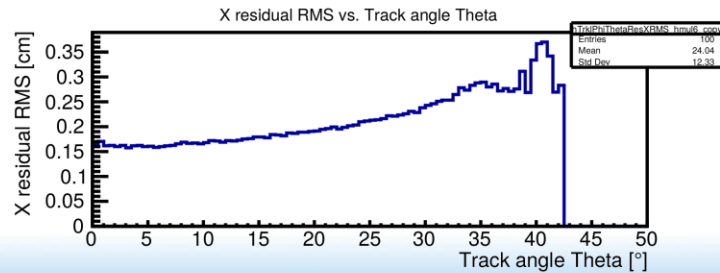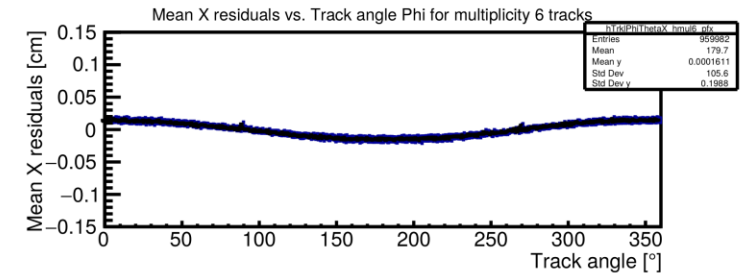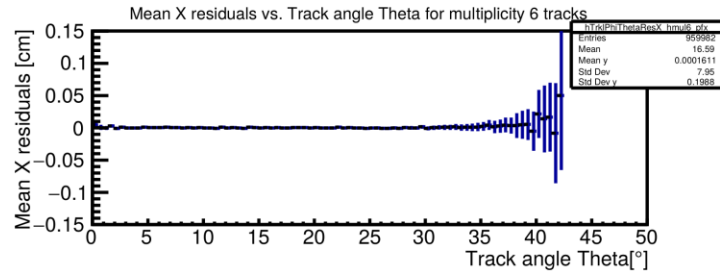
Theta & Phi - Y Residual
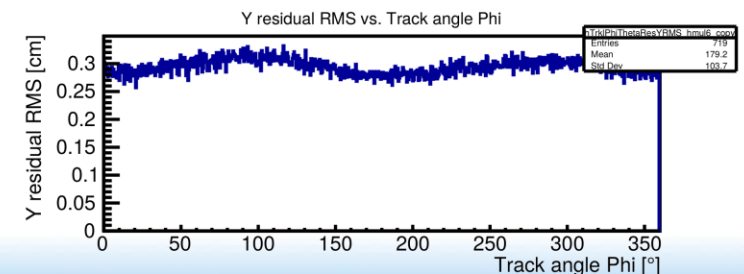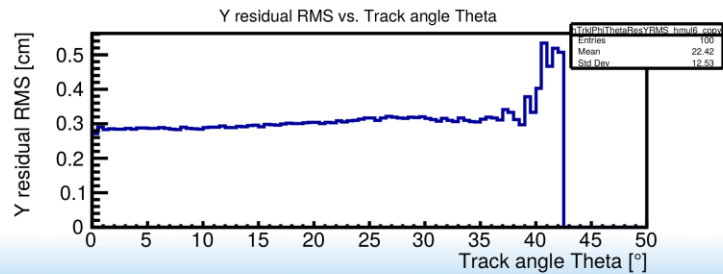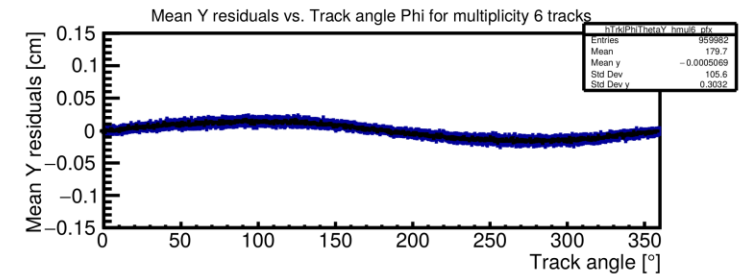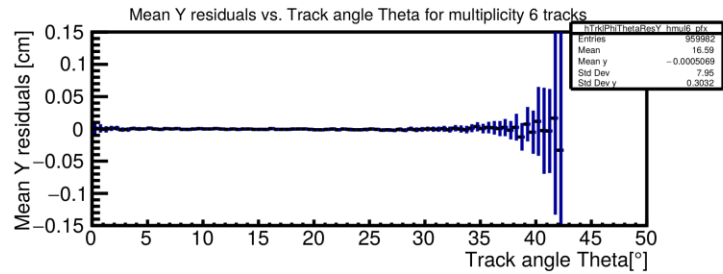
Theta dependencies

Cluster size & TOT:

larger angles create larger clusters and therefore more accumulated TOT

Geometrically reasonable

T, X, Y Residuals:

Time resolution is better for larger angles

X resolution is worse for larger angles
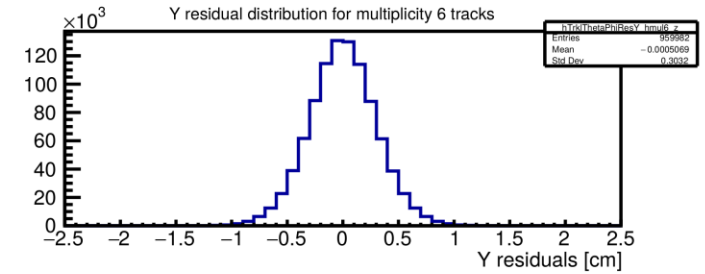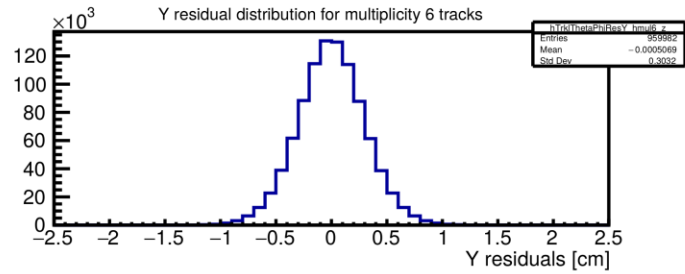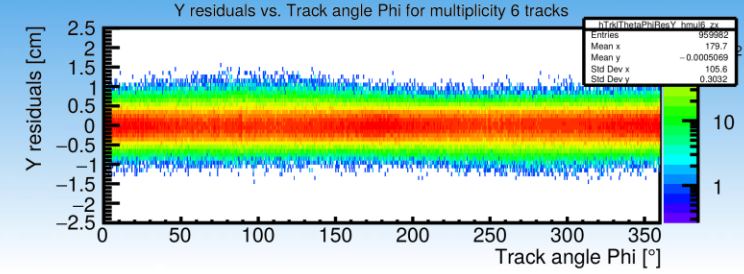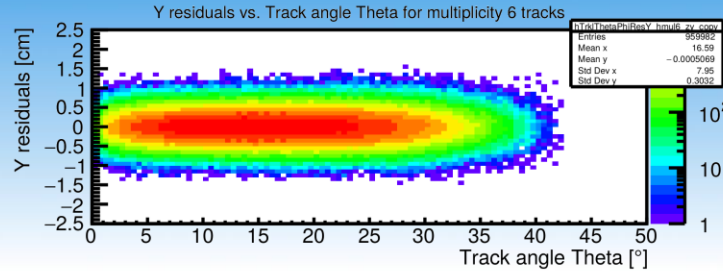
Y resolution is slightly worse for larger angles

Phi dependencies

Everything but time shows phi dependencies

Clusters tend to be bigger for 0°/360° & 180° which points to ± x as more

strips are potentially covered (variation in theta)

TOT follows same trend as mean cluster size

X and Y resolution are worse if trajectory points in respective direction

Thanks for your attention!