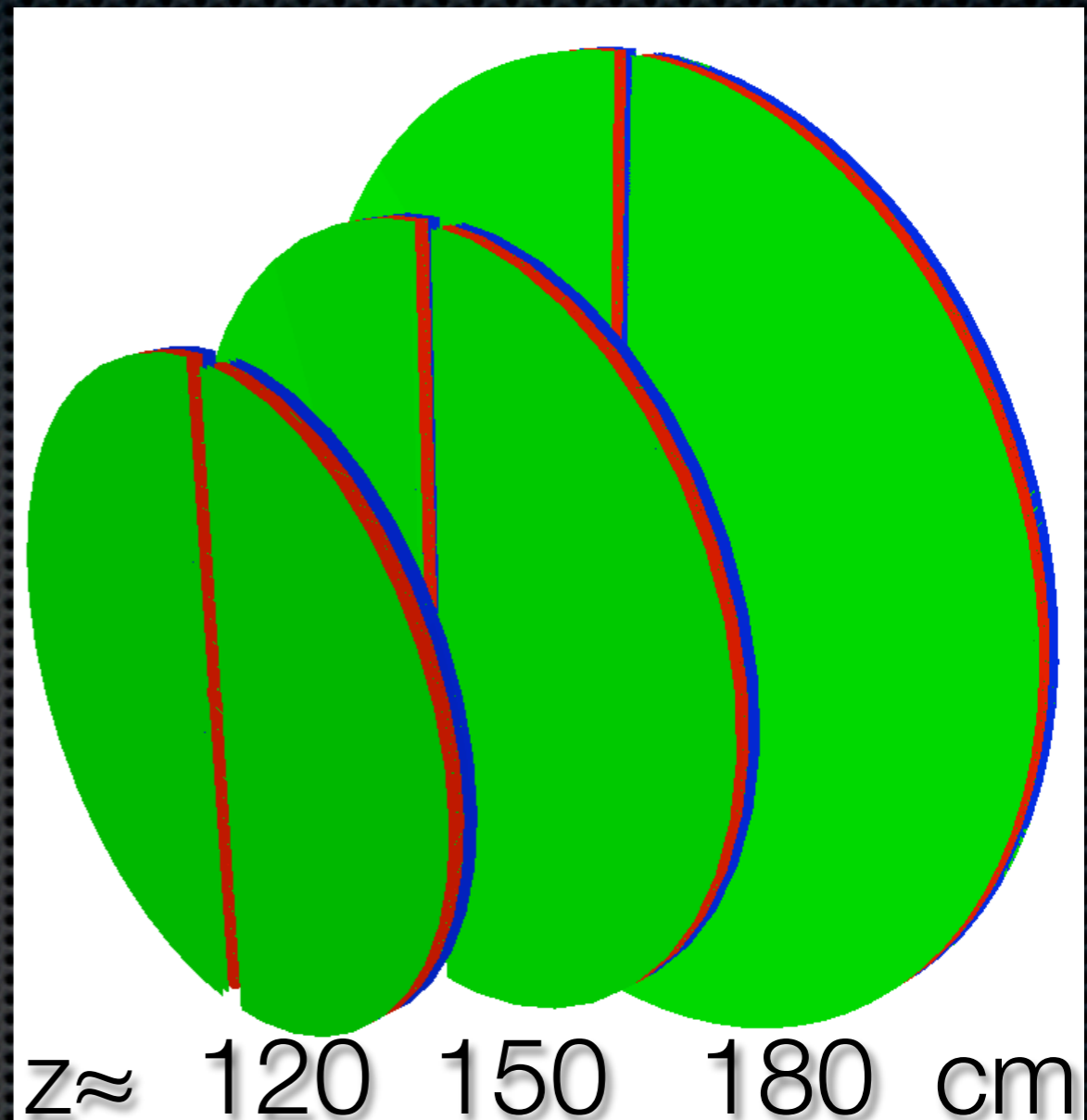# GEM Tracker Status

Radoslaw Karabowicz

GSI
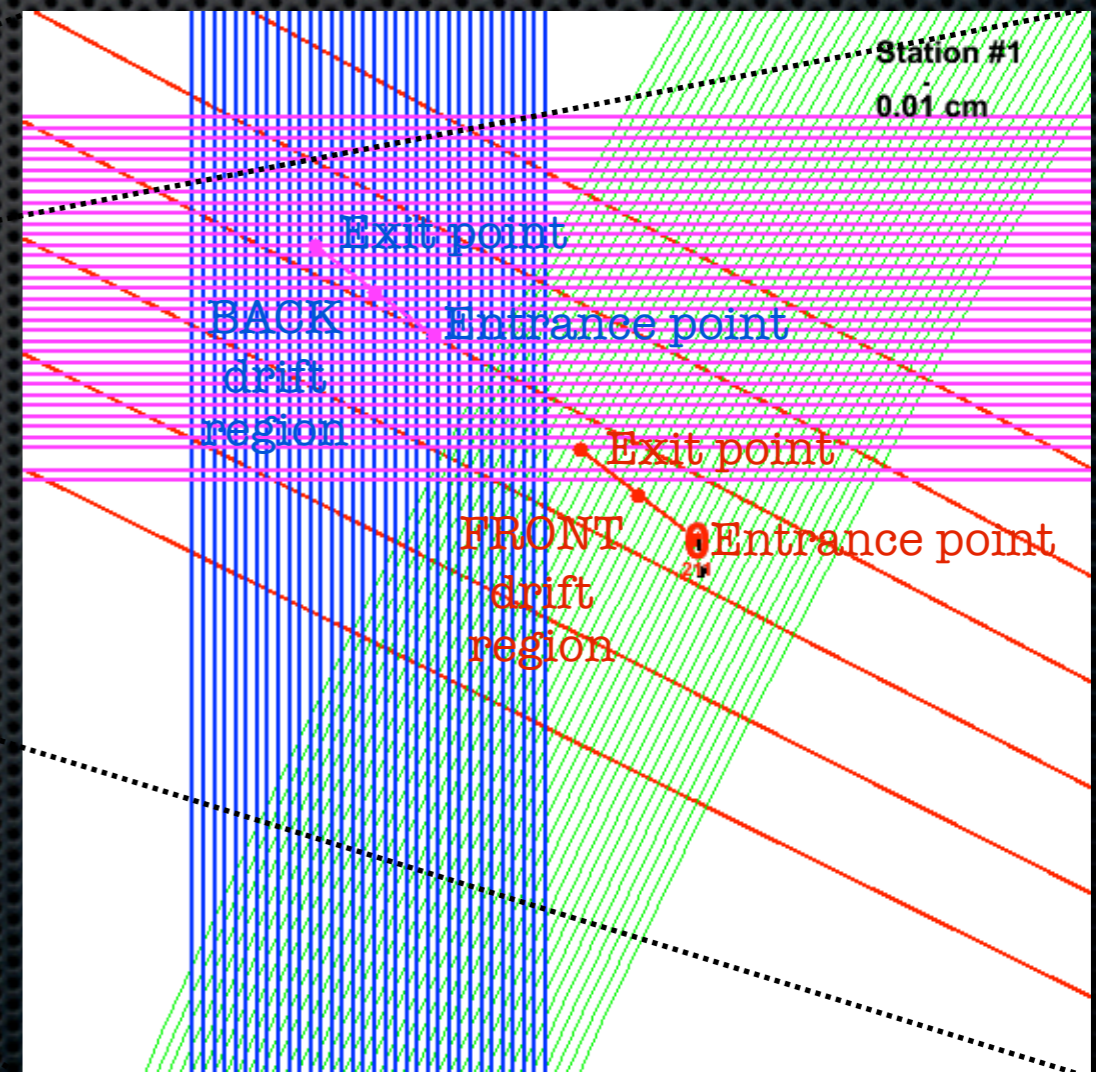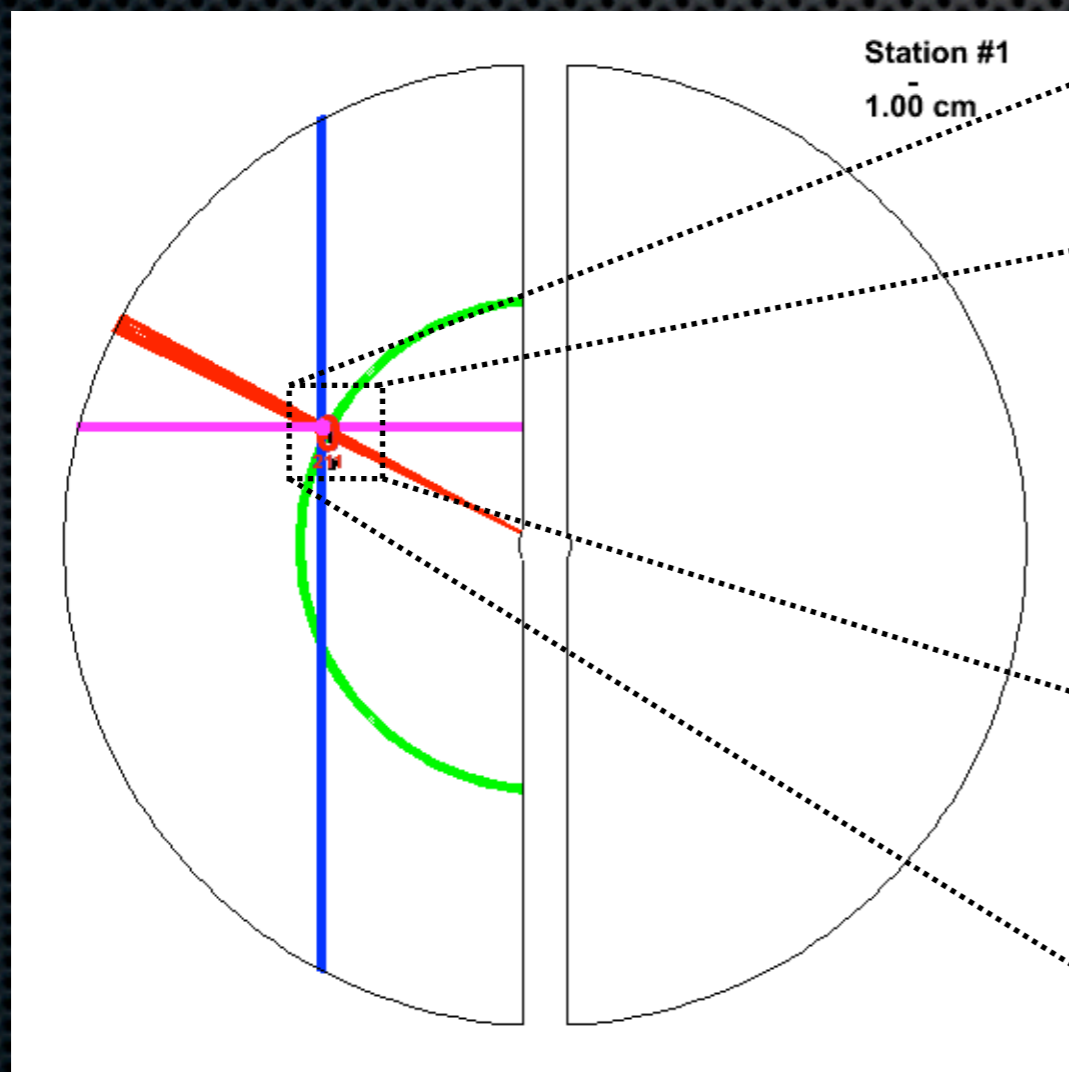
Geometry

z≈ 120 150 180 cm

- GEM - Gas Electron Multiplier

- readout plane divided into strips of 200μm width

- record track position at 3 stations

- two different perpendicular strip orientations per readout plane implemented

- each station has two drift volumes (separated by ~2cm) and two sensitive planes: front and back (and therefore 4 different strip orientations)
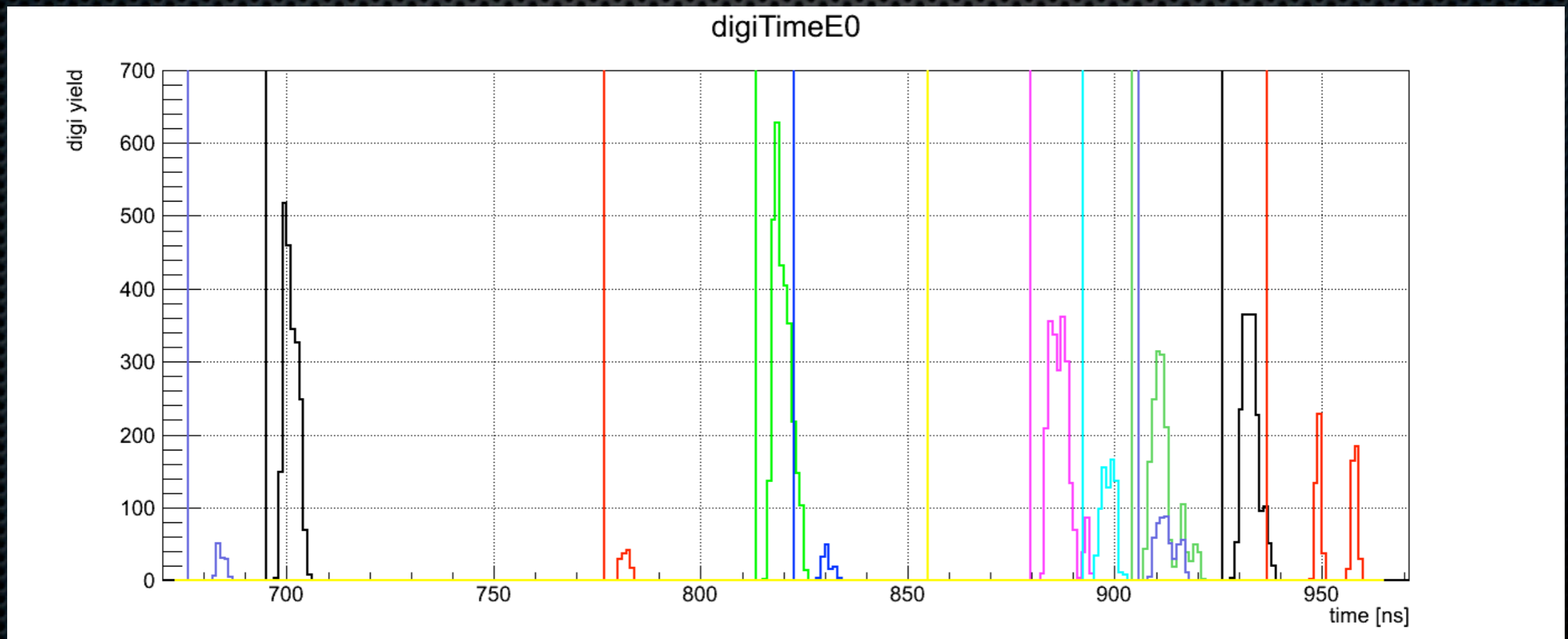
Realistic digitization

- activate strips along the particle trajectory in the drift volume
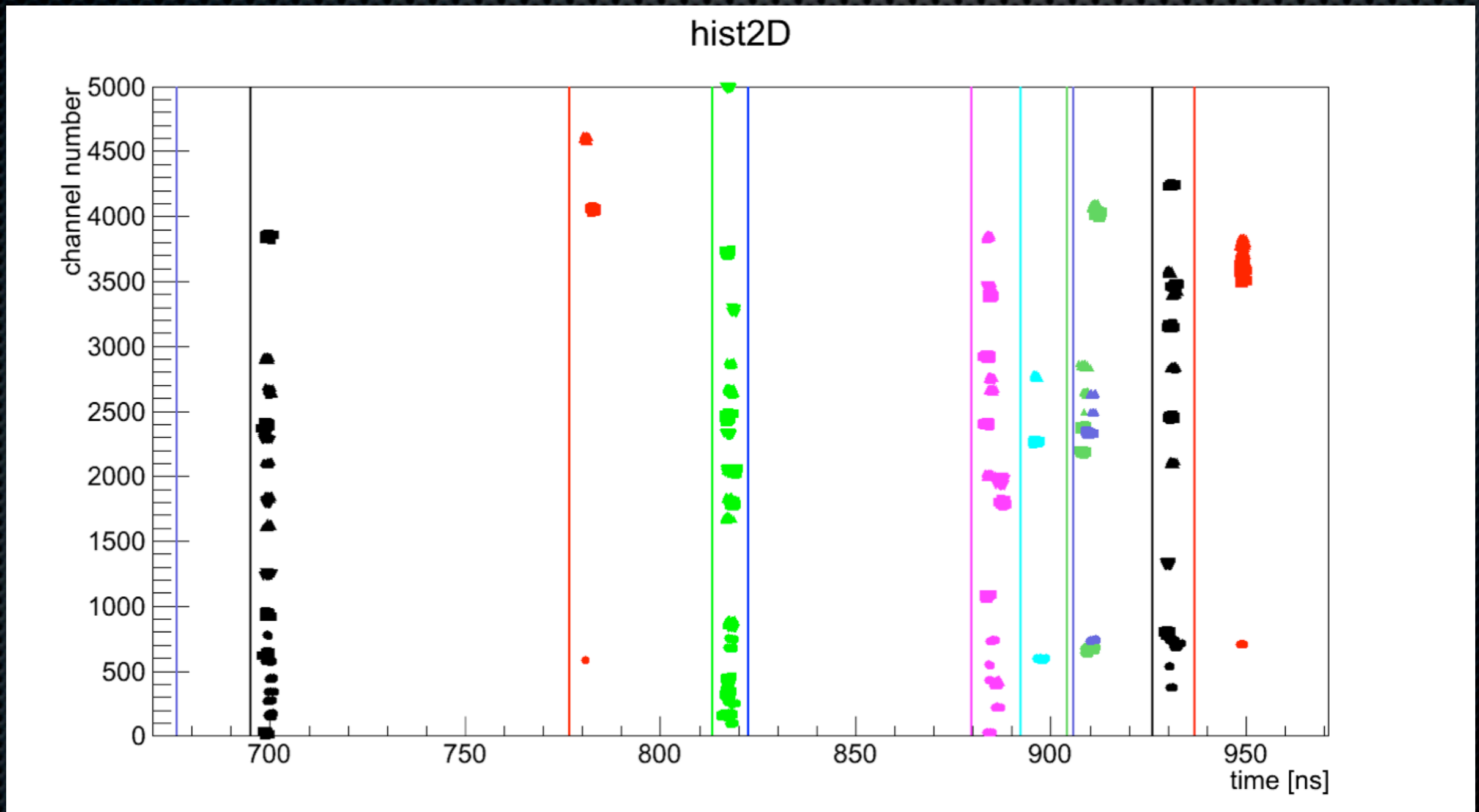
- combined with charge diffusion

Time-based digitization

- digi time = event time + MCpoint time + random

- GEM expected time resolution ~10ns (not implemented)

- dead time of 100 ns implemented

Active channels vs time

DPM events, MVD,STT,GEM

Event-based reconstruction

* Scheme:

  * find clusters of digis in every view

  * find hits on front (radial&concentric strips) and back (horizontal&vertical strips) pad planes (drift volumes ~2 cm away)

  * tracking: combine close hits on front/back pad plane to select 'real' hits. Use only these hits for tracking

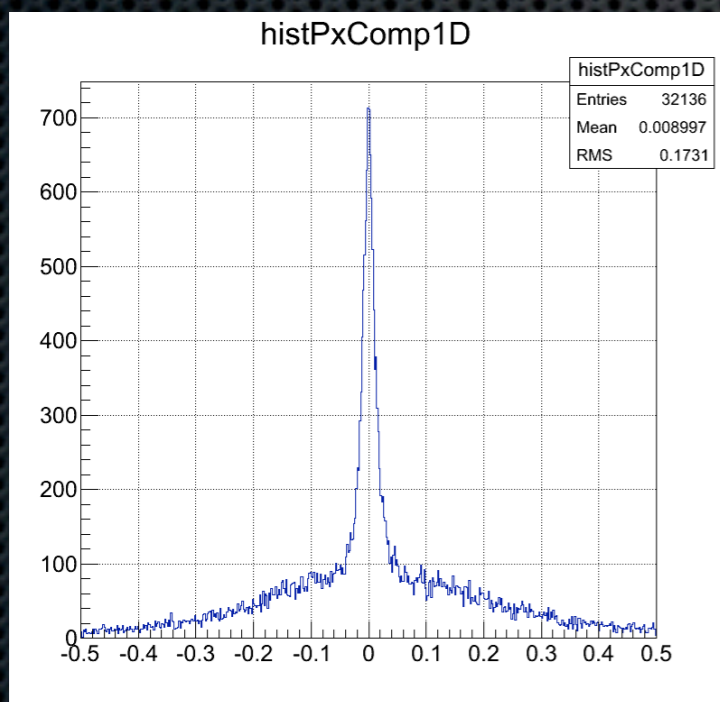* Such approach showed unsatisfactory results with time-based digitization

Event-based reco results

- It's not trivial anymore to compare reconstructed tracks with the simulated MC tracks...

- As a temporary solution, I have created two macros to check the quality of the reconstruction:

  - checkTrackOnlineReconstruction.C (loop over primary MC tracks, check if similar track exists in reconstruction tree)

  - checkEventOnlineReconstruction.C (loop over MC events, check if reconstructed track exists that had creation time corresponding to event MC time)
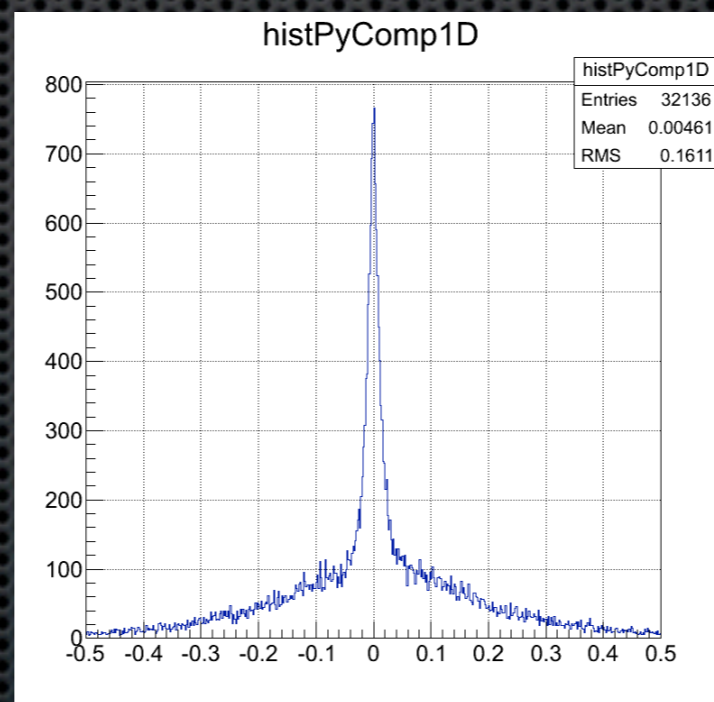
Event-based: track results

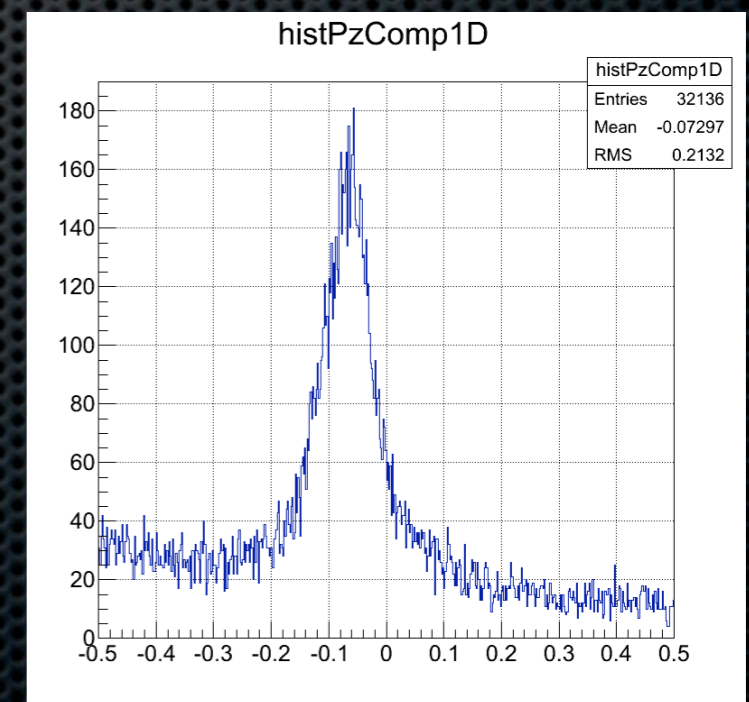- Comparison between reconstructed momentum and MC momentum:

(reco_px-mc_px)/mc_mag   (reco_py-mc_py)/mc_mag   (reco_pz-mc_pz)/mc_mag
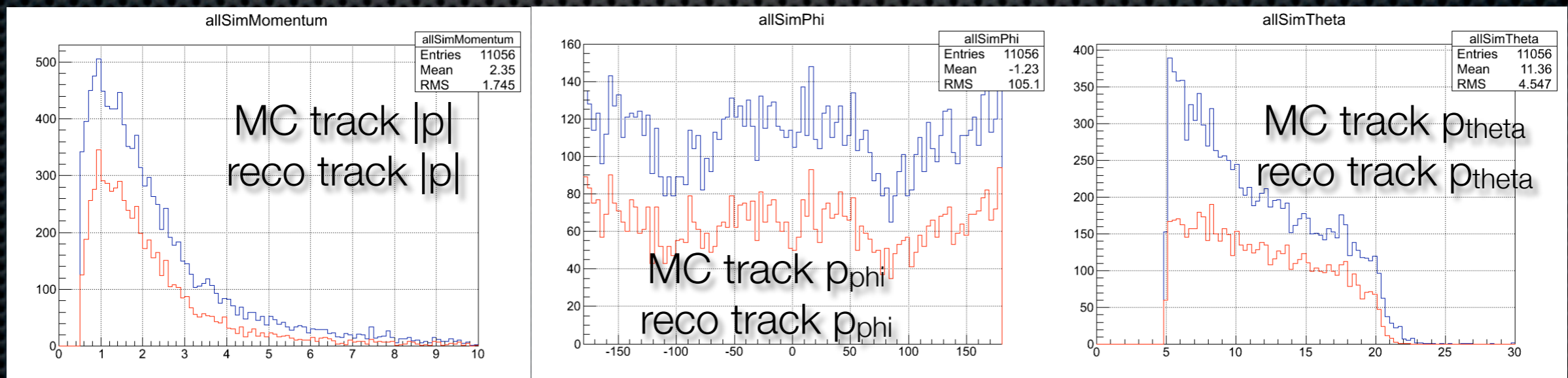
Event-based: track results

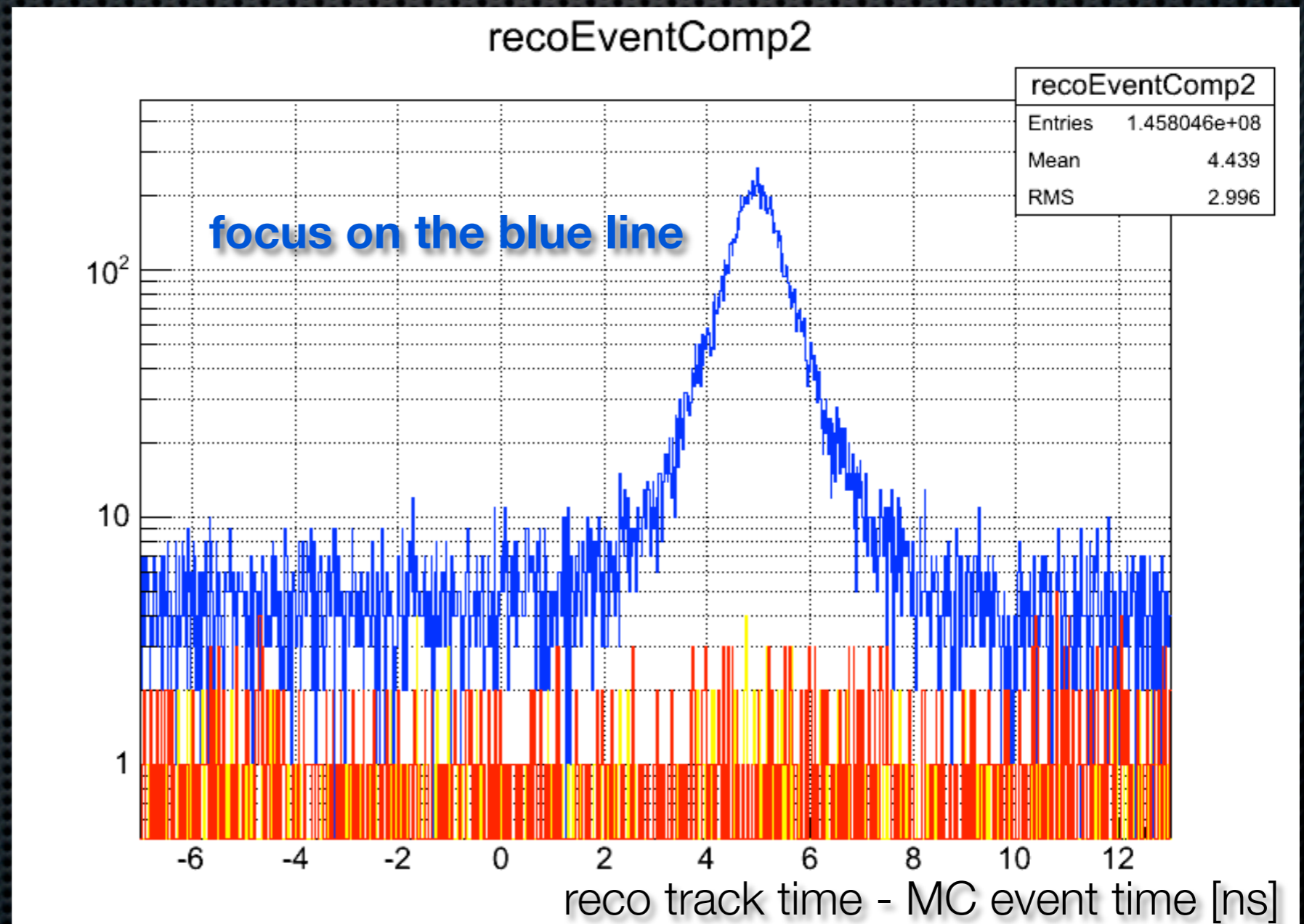- *'Efficiency'* (counting the tracks under the peak):

- reconstructed 6390 out of 11056 (57.79%)

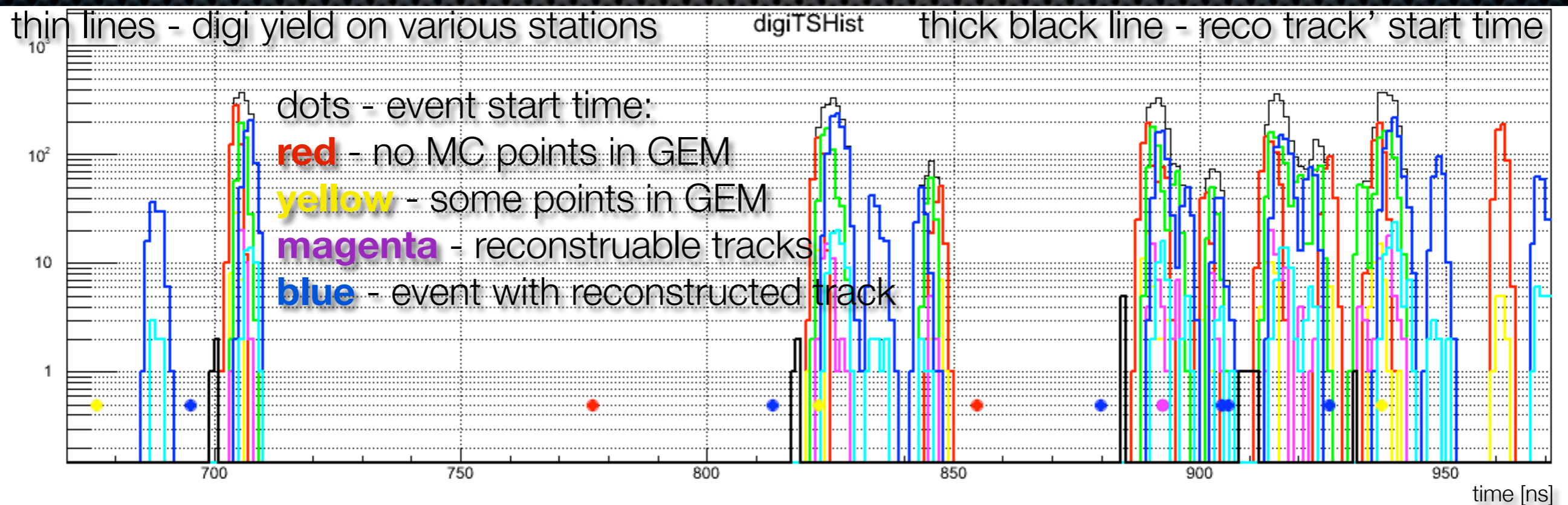# Event-based: event results

- compare the reconstructed tracks' start time with MC event times
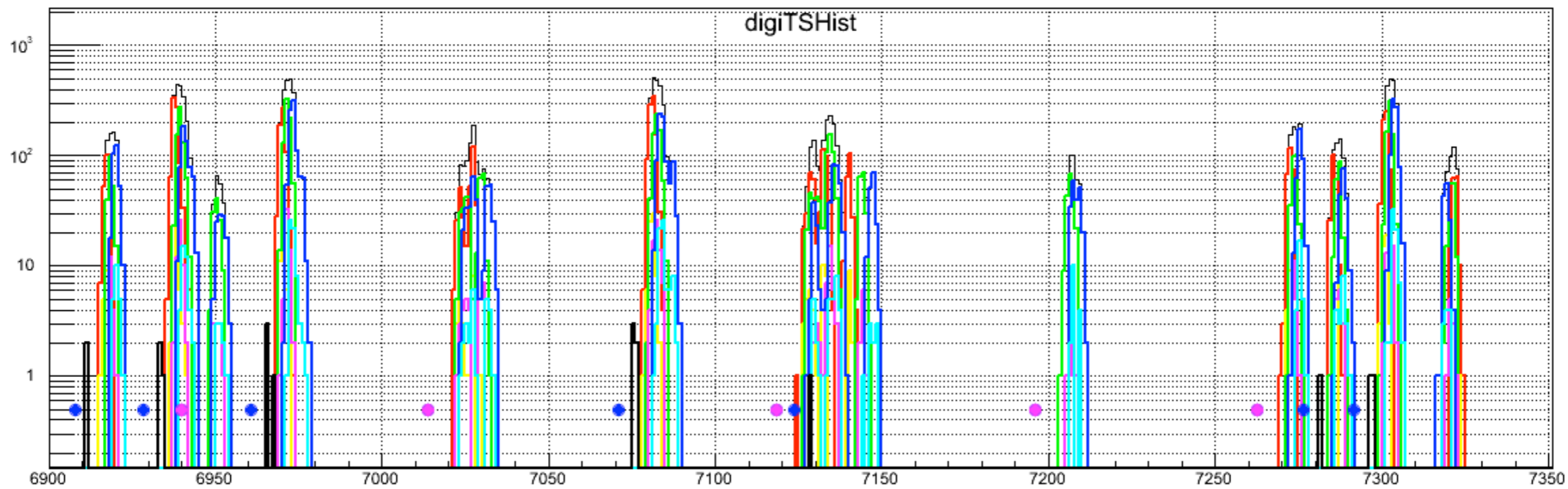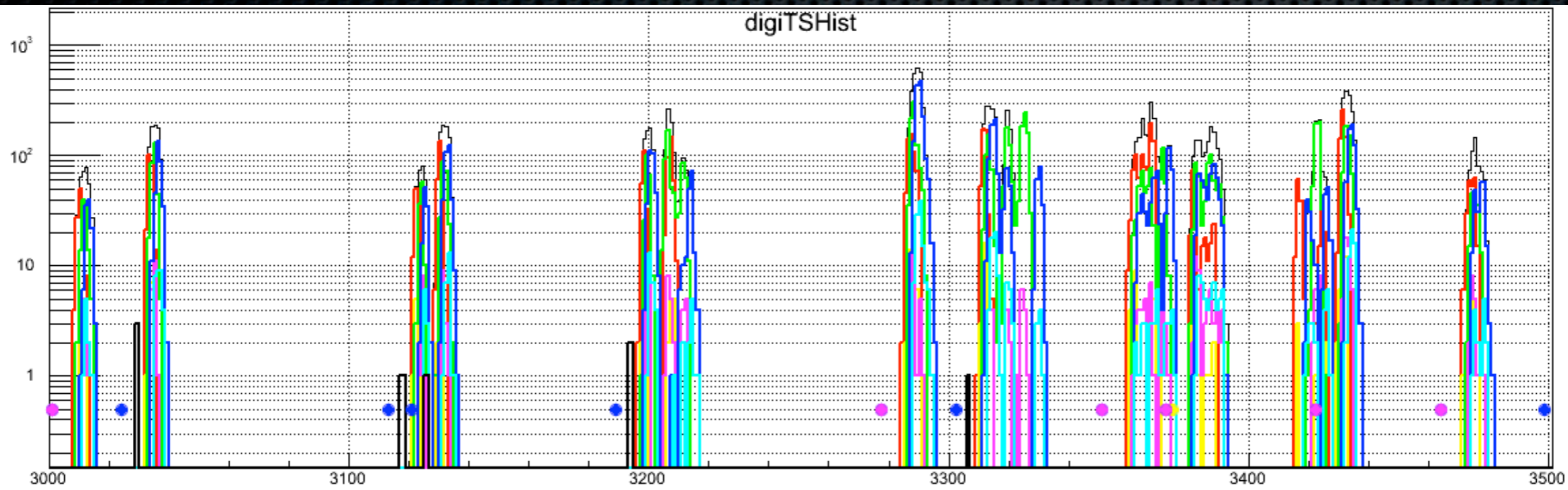
10000 DPM events, MVD,STT,GEM

Event-based: event results

- *'Efficiency'* (counting the events under the peak):

- reconstructed 6577 out of 8165 reconstruable events (80.5511%)

thin lines - digi yield on various stations   digiTSHist   thick black line - reco track' start time

dots - event start time:
red - no MC points in GEM
yellow - some points in GEM
magenta - reconstruable tracks
blue - event with reconstructed track

time [ns]

same time range as on plots in pages 4 & 5

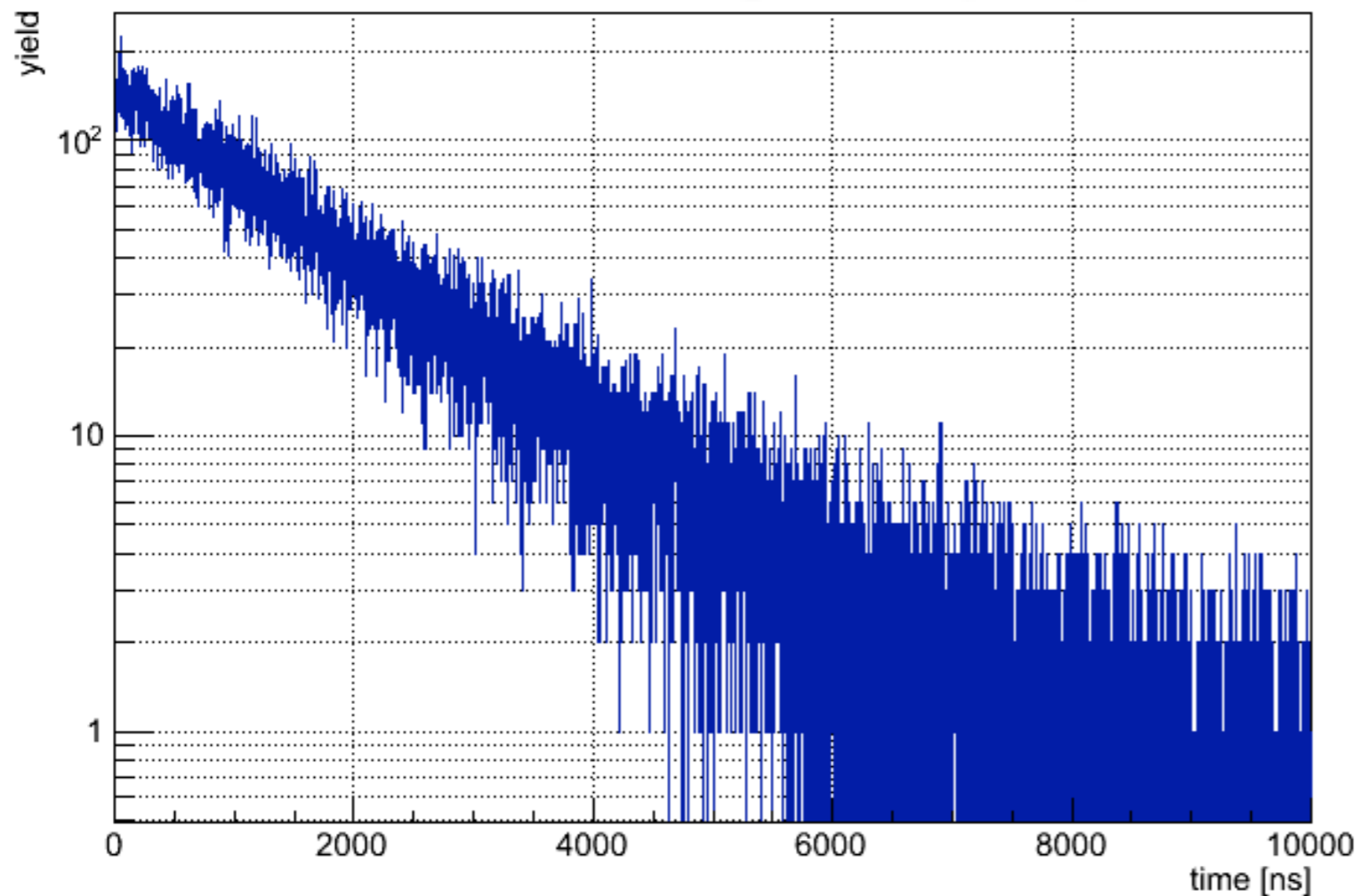DPM events, MVD,STT,GEM

DPM events, MVD,STT,GEM

Low performance reasons

- Event-based reconstruction scheme, again:

  - find clusters of digis in every view

  - find hits on front (radial&concentric strips) and back (horizontal&vertical strips) pad planes (drift volumes ~2 cm away)

  - tracking: combine close hits on front/back pad plane to select 'real' hits. Use only these hits for tracking

- In the tracking, there's only 3 'real' hits (3 stations). To find track, all the 'real' hits have to be found, and therefore all the 6 hits on all pad planes, which fails with even small cluster finding inefficiency

- For 1% clustering inefficiency, ~11% chance of not finding track

- In GEM time-based reconstruction, there's a 3÷4% cluster finding inefficiency

Time between strip activation
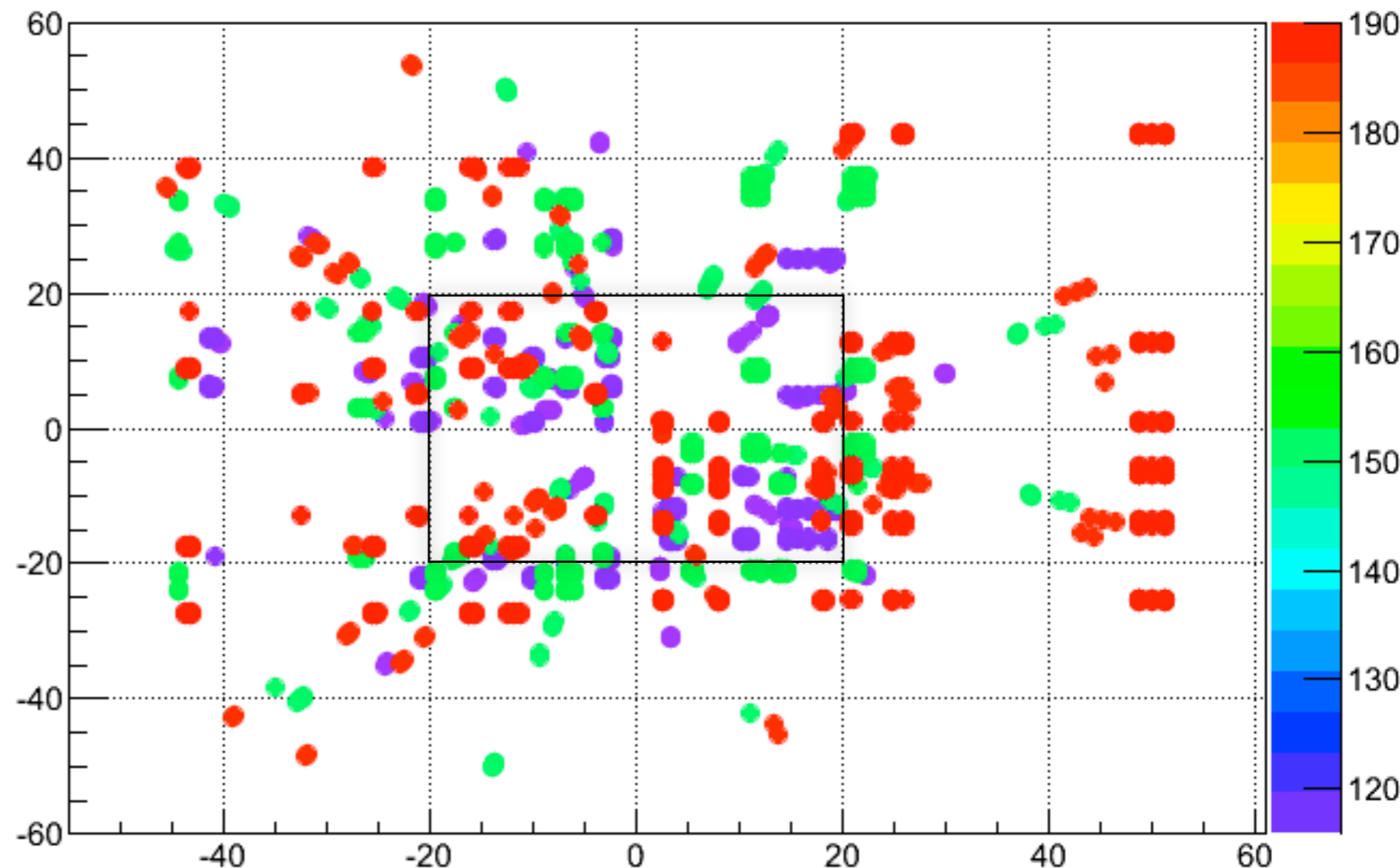

Time between digis on any strip

100000 DPM events, MVD,STT,GEM

- Exponential dependence
- The strips will often (3÷7%) be activated again during the strips' dead time

Time-based reconstruction
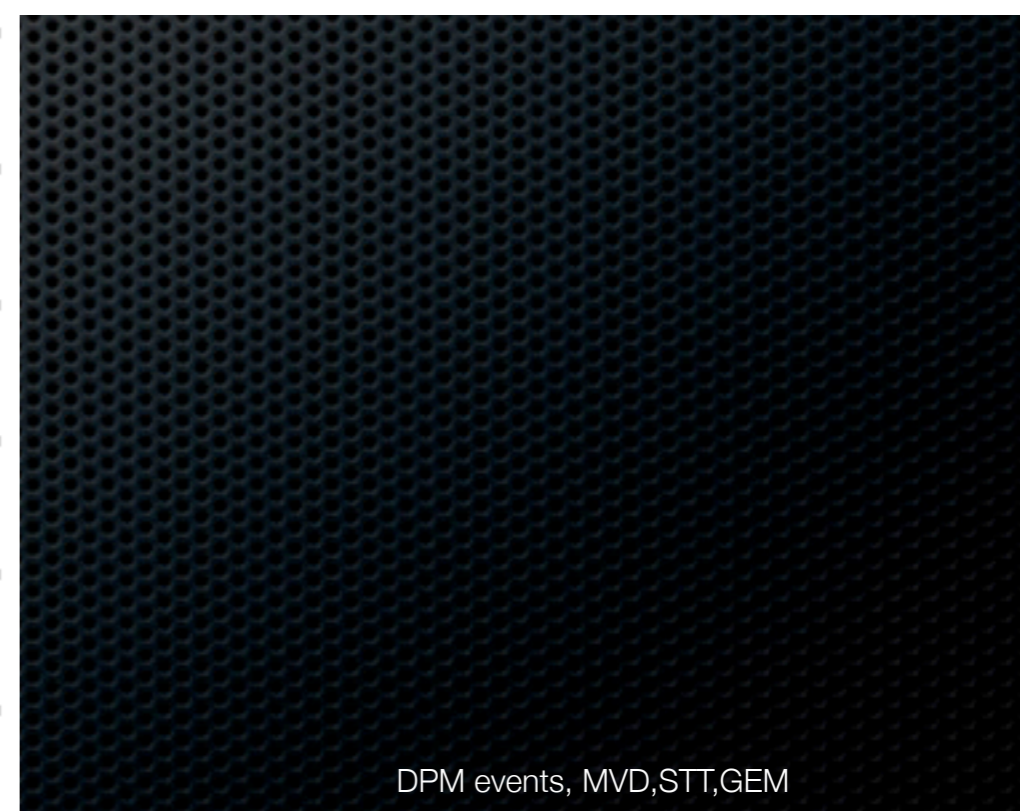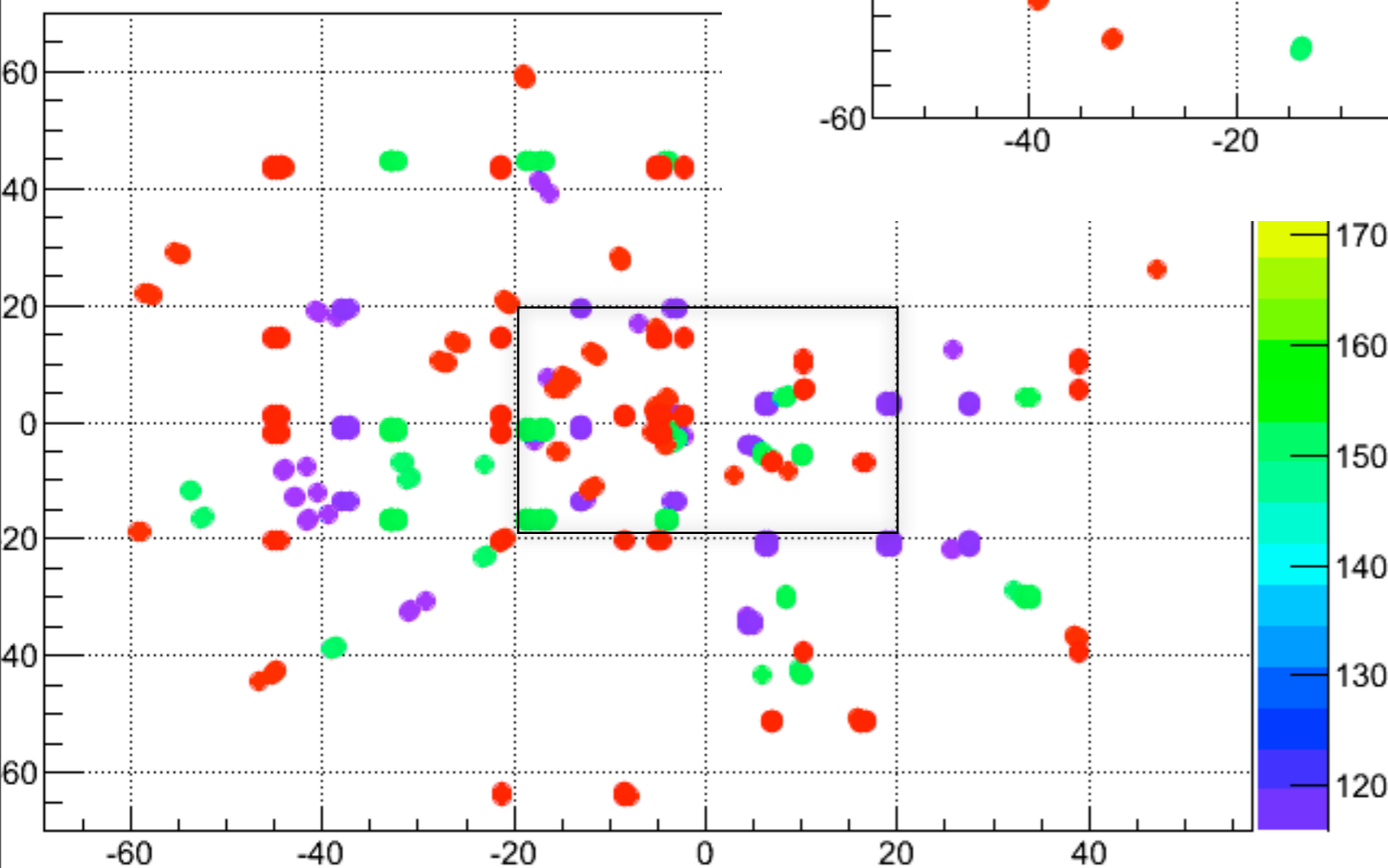
- Changes:

  - very few changes to cluster finder

  - hit finding: find hits on front/back pad plane as before, require confirmation on back/front pad plane (if relevant strips activated in the previous 100 ns - it requires storing information from last events, achieved by introduction of PndGemMonitoring)

  - track finder: use these confirmed hits, and now that the tracks may consist of up to 6 hits, 2 missing hits (on various stations) are allowed.

Event-based: hits used for tracking

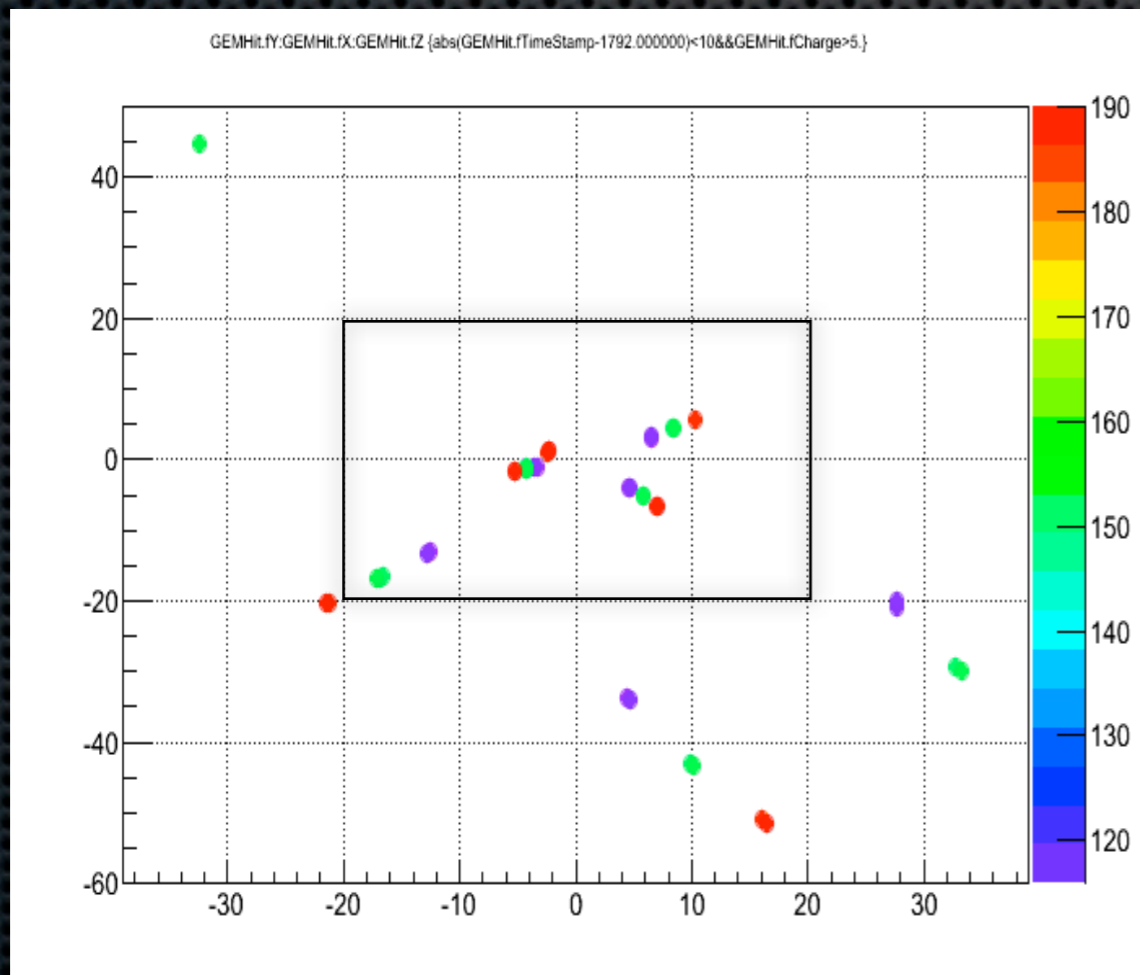GEMHit.fY:GEMHit.fX:GEMHit.fZ {abs(GEMHit.fTimeStamp-1415.000000)<10}
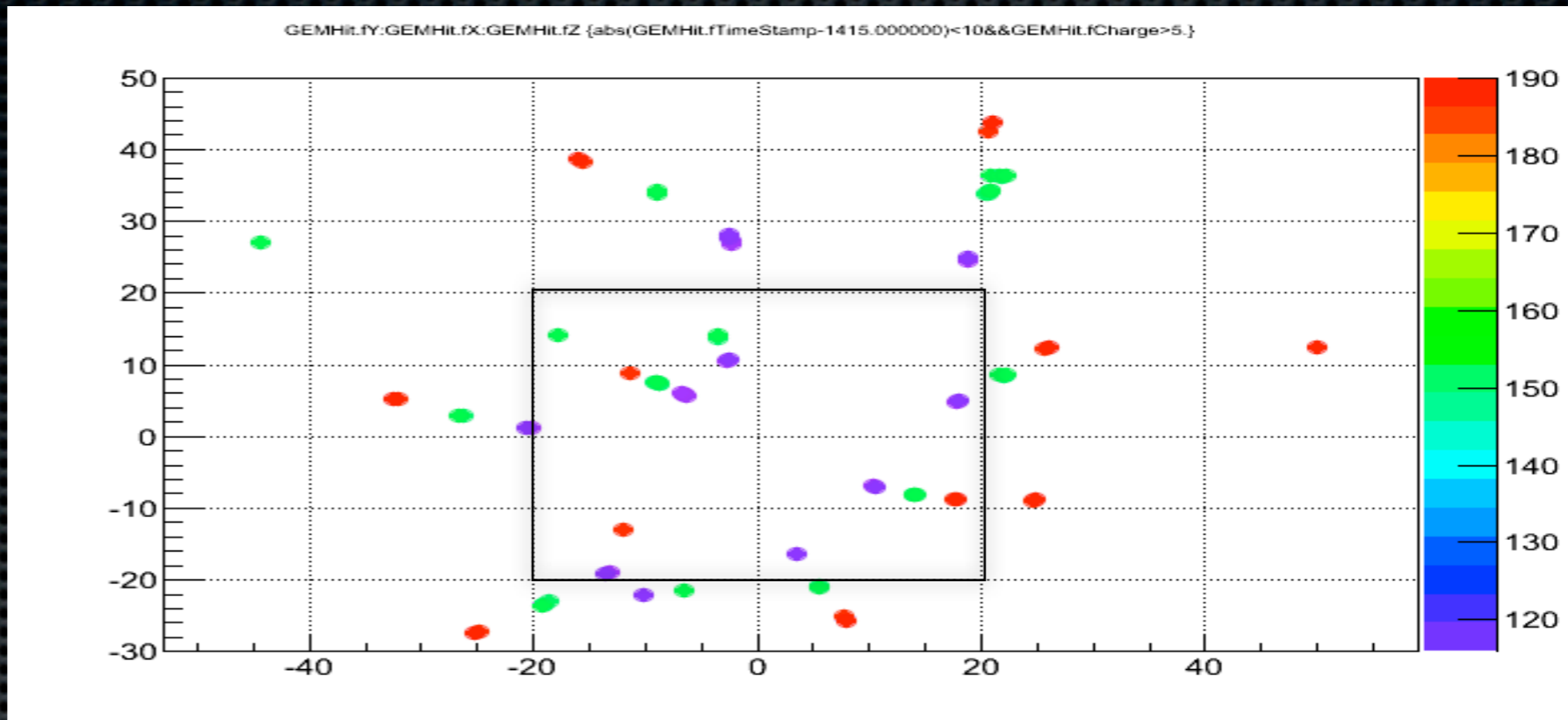
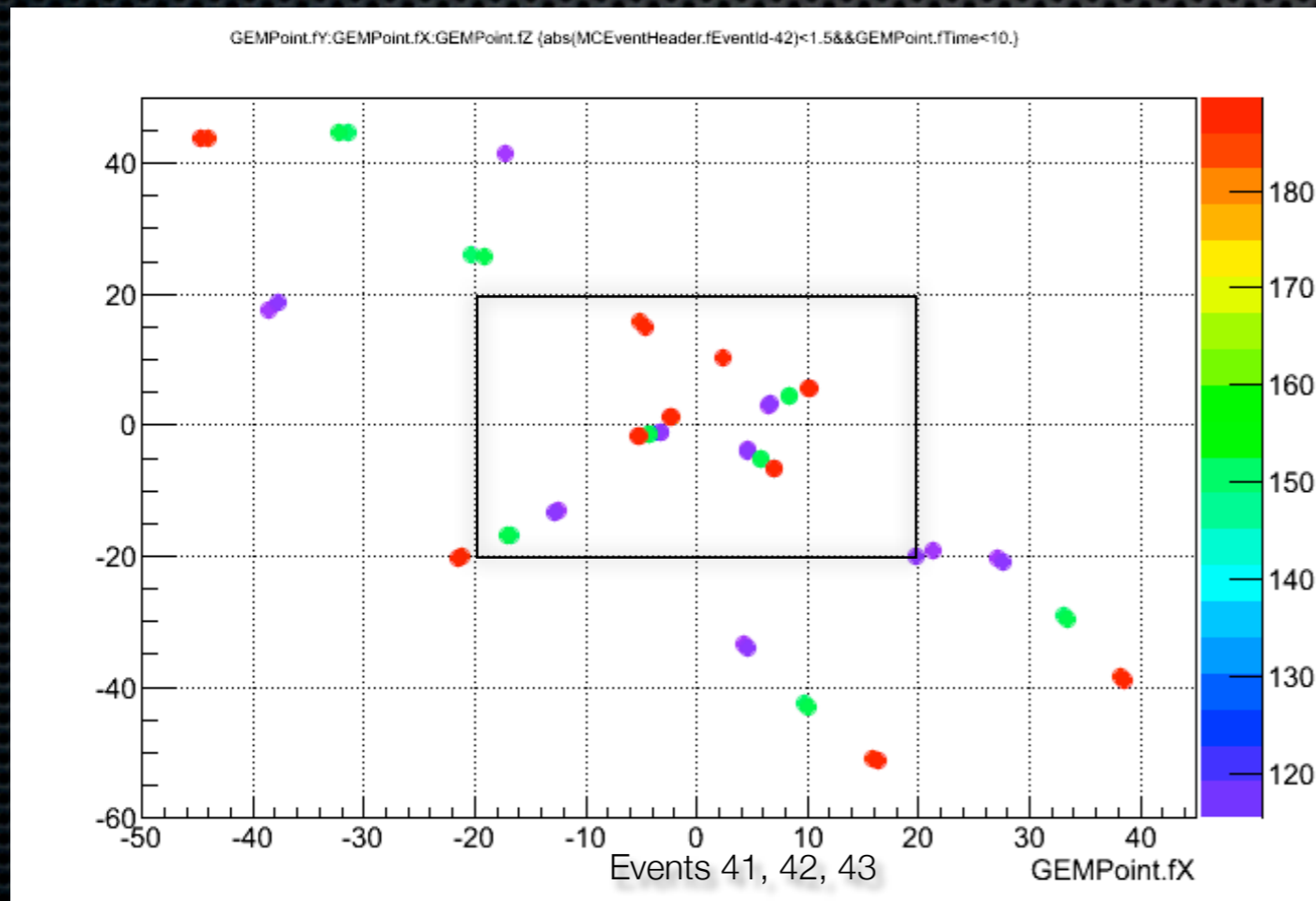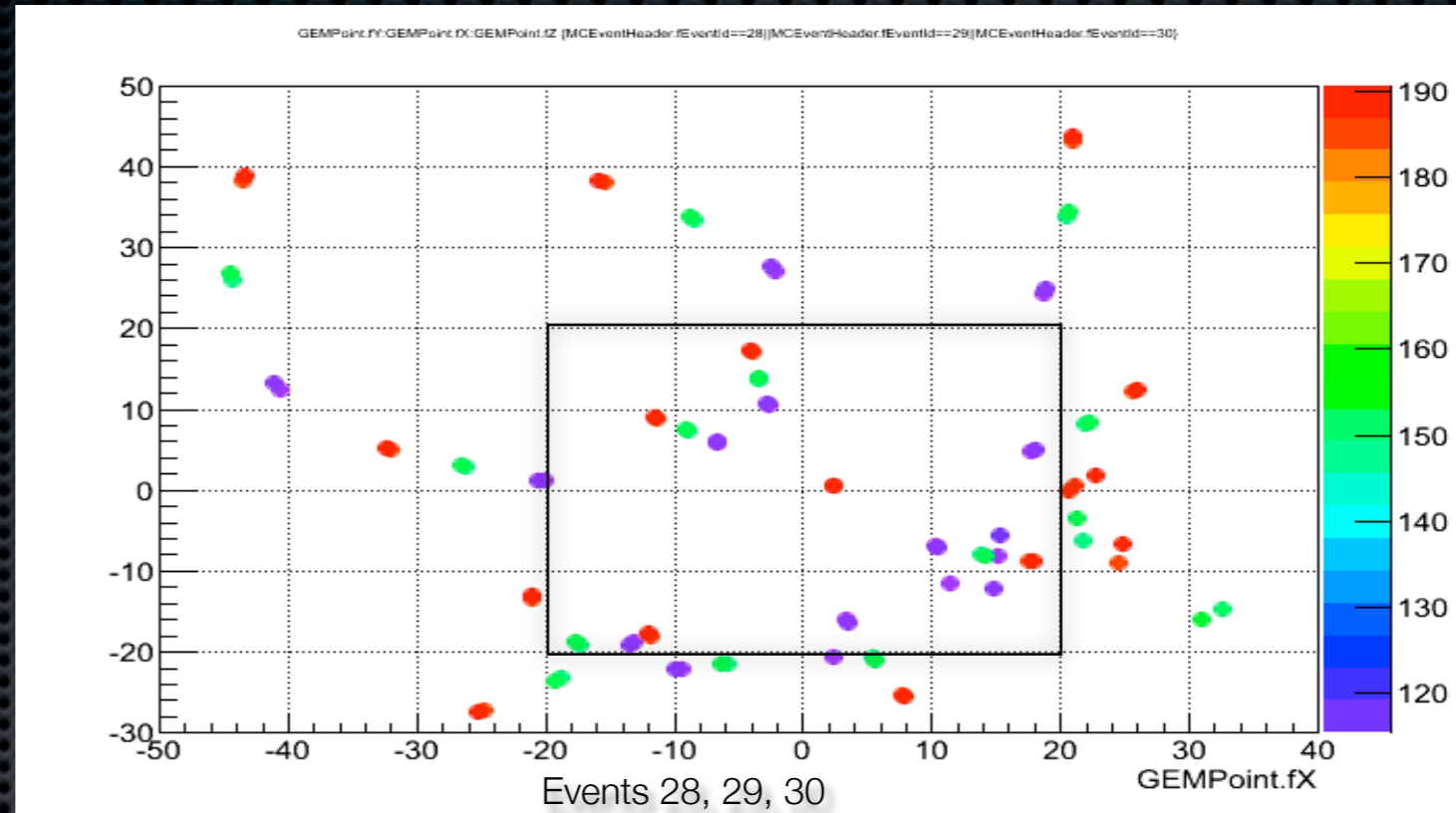GEMHit.fY:GEMHit.fX:GEMHit.fZ {abs(GEMHit.fT

DPM events, MVD,STT,GEM

Time-based: hits used for tracking

For comparison: MC points from 'corresponding' MC events

Events 28, 29, 30

Events 41, 42, 43

DPM events, MVD,STT,GEM

Time-based: track results

- *'Efficiency'* (counting the tracks under the peak):

- reconstructed 9653 out of 11056 (87.31%)

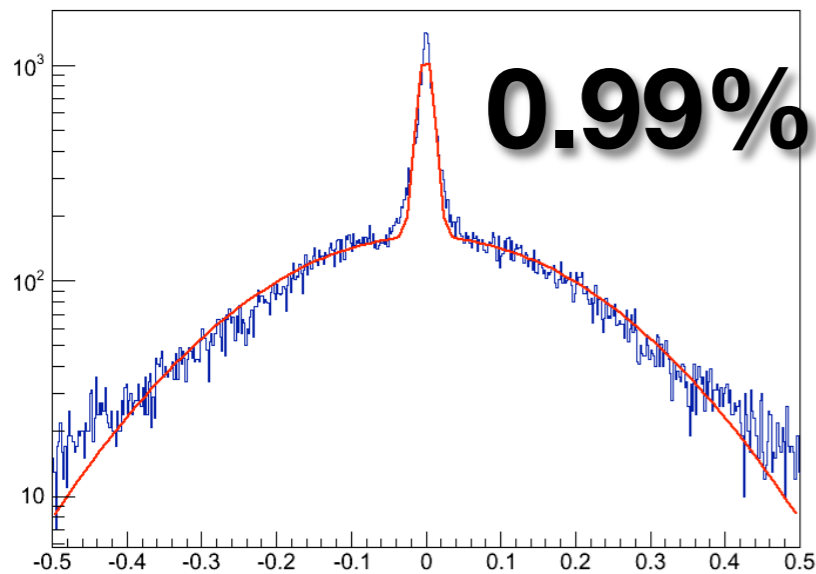
10000 DPM events, MVD,STT,GEM

Time-based: track results

- fitted function: sum of two gaussians

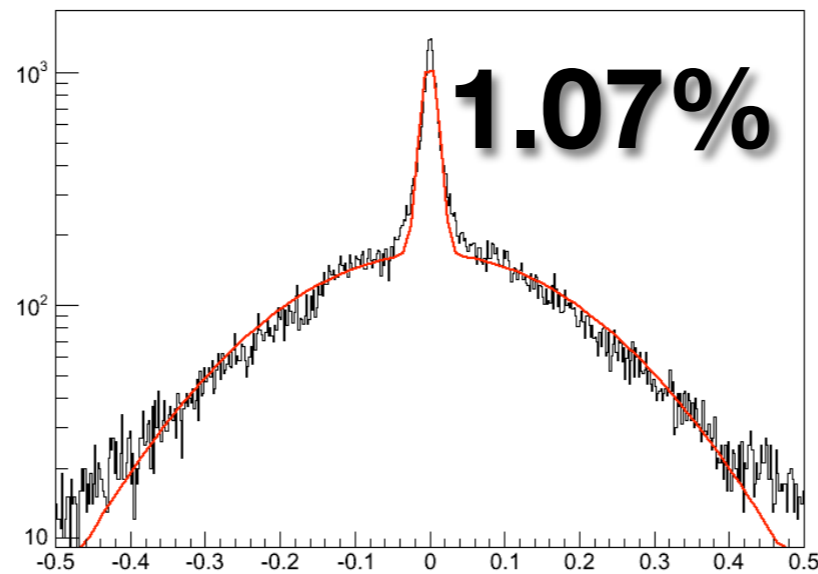- resolutions: sigma of the thin gaussian

(reco_px-mc_px)/mc_mag   (reco_py-mc_py)/mc_mag   (reco_pz-mc_pz)/mc_mag

10000 DPM events, MVD,STT,GEM

Event-based: event results

- *'Efficiency'* (counting the events under the peak):

- reconstructed 7773 out of 8165 reconstruable events (95.199%)
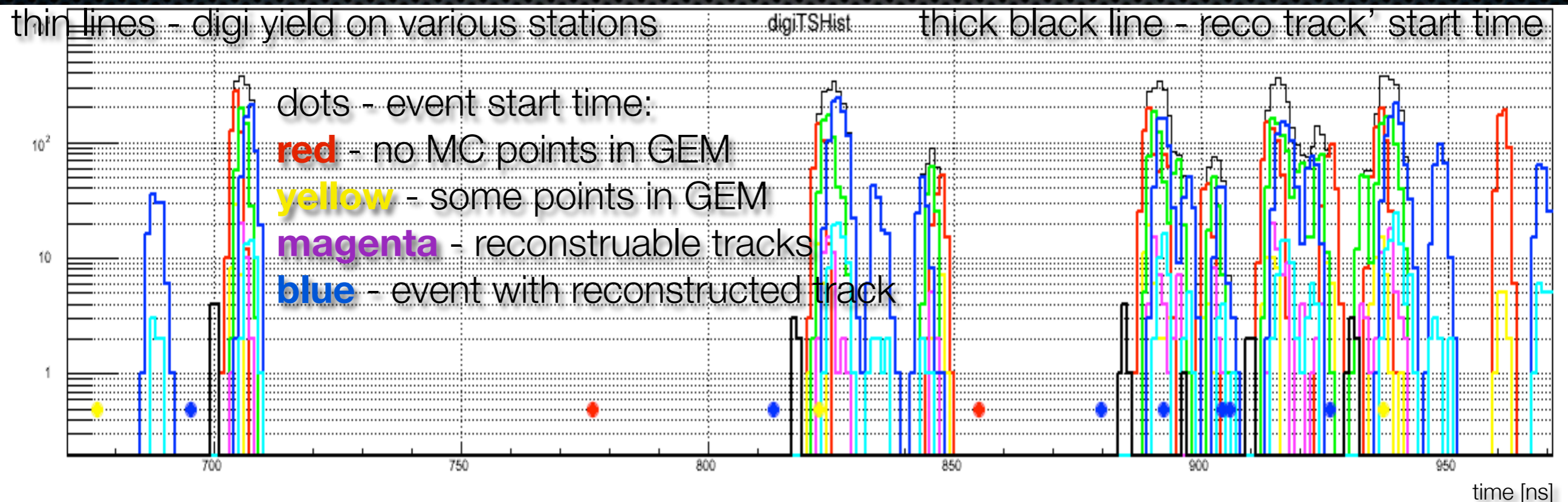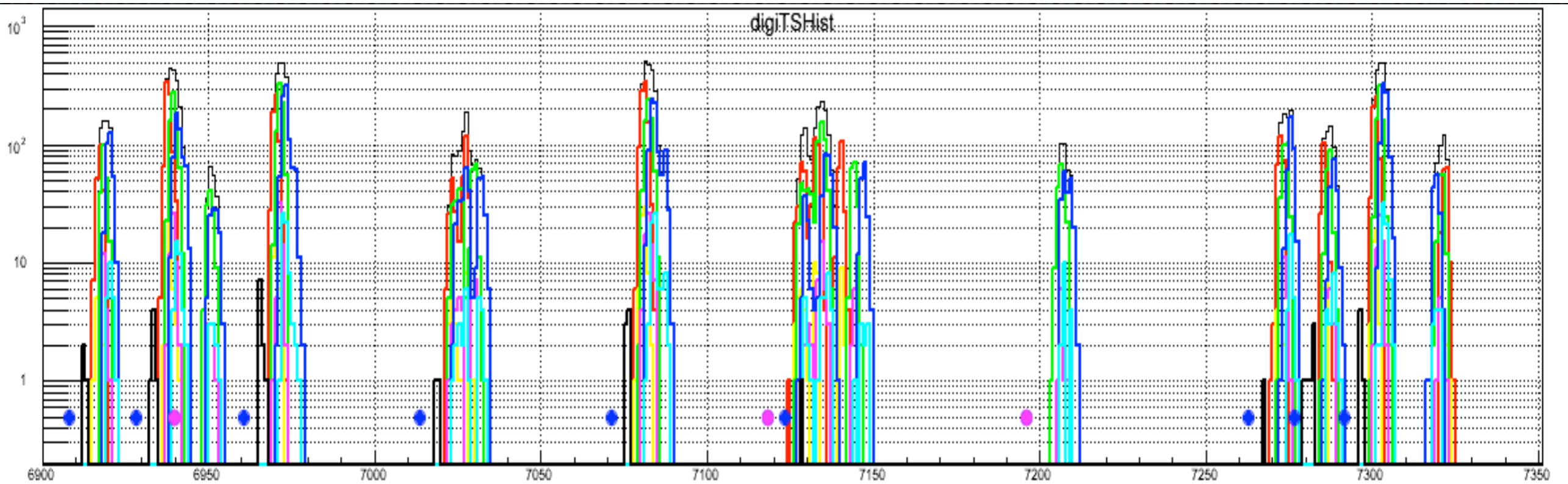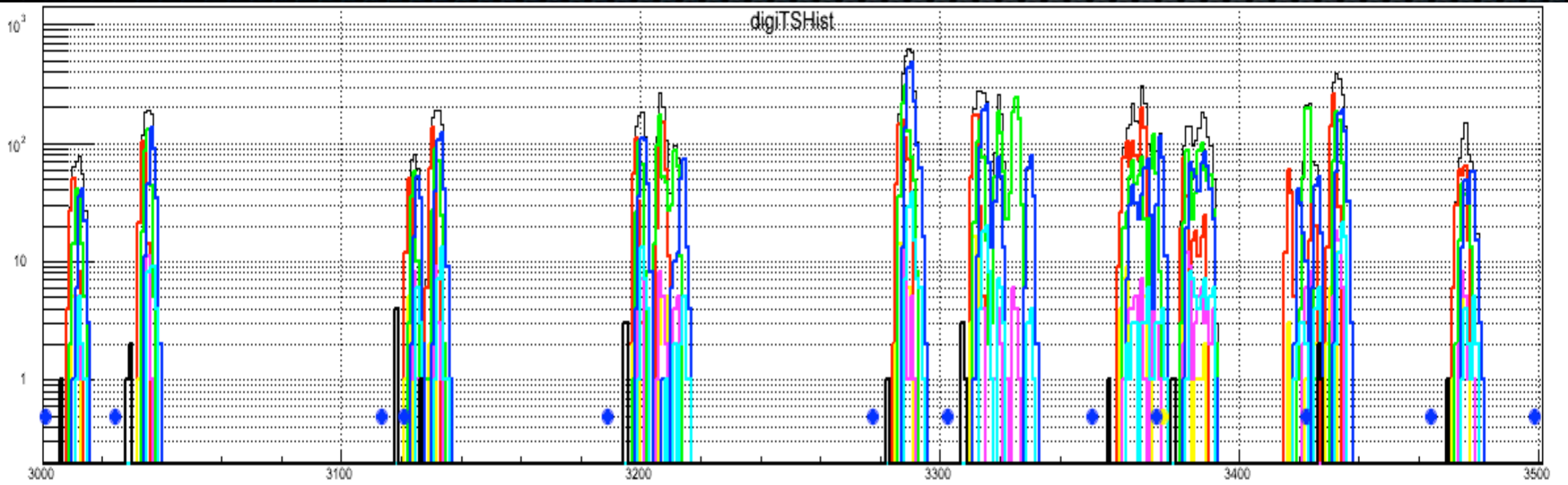
thin lines - digi yield on various stations   digiTSHist   thick black line - reco track' start time

dots - event start time:
red - no MC points in GEM
yellow - some points in GEM
magenta - reconstruable tracks
blue - event with reconstructed track

time [ns]

same time range as on plots in pages 4 & 5

DPM events, MVD,STT,GEM

DPM events, MVD,STT,GEM

Conclusions

* Event-based reconstruction not enough in the time-based reality

* Some changes applied to the reconstruction chain

* Improved results:

  * track finding *'efficiency'*: 57.79% increased to 87.31%

  * event reco   *'efficiency'*: 80.55% increased to 95.20%

* Further improvements still necessary