



# Current status of the TPC simulation and reconstruction

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- Realistic TPC simulation has to include most of the physics effects, including distortions
- Variety of reactions (central and peripheral  $Au+Au$  as well as  $p+p$  collisions) should be studied
- More detailed study of the TPC performance for track reconstruction in high multiplicity events, including two-track resolution, occupancy effects, etc.
- More detailed description of the reconstruction procedure in the TPC TDR
- Physics simulation and performance study should be continued based on the realistic MPD simulation

*In my talk I'll cover and discuss most of these DAC recommendations to TPC simulation.*

*Some results for simulated  $p+p$  collisions will be presented in the talk of K.Shtejer.*



1. The “realistic” TPC simulation (“microsimulation”) procedure
2. Cluster / hit reconstruction method and results
3. Track reconstruction approach and results



1. Primary ionization (ionization clusters)
2. Drift and diffusion of ionization electrons
3. Gas gain fluctuations (Polya distribution)
4. Pad response (charge distribution on pad plane)
5. Electronics shaping
6. Signal digitization (ADC overflow)



# TPC parameters



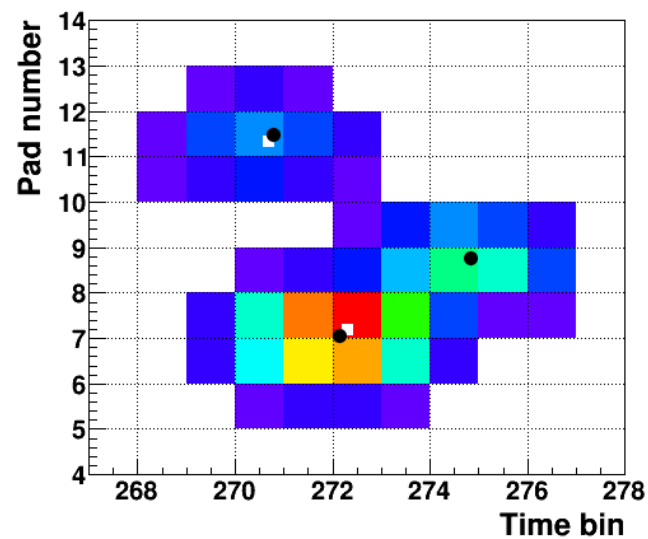
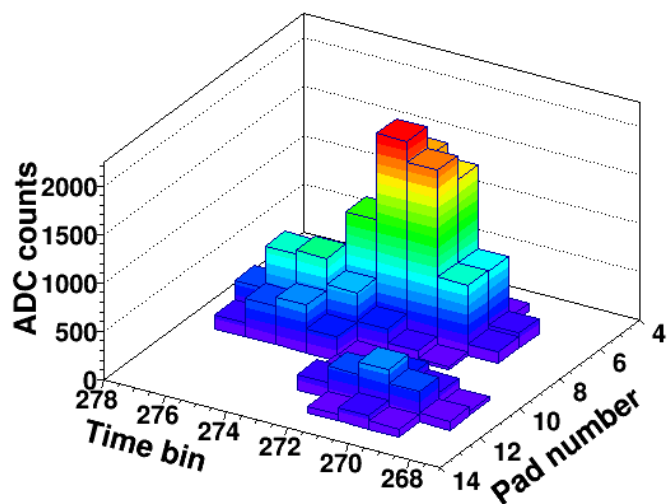
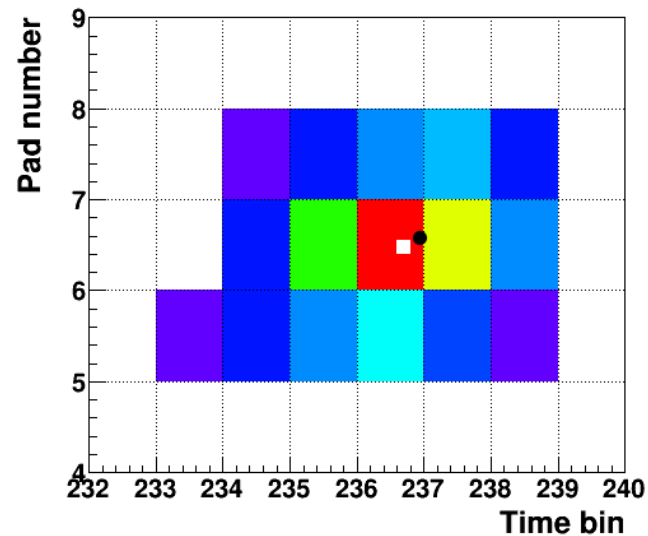
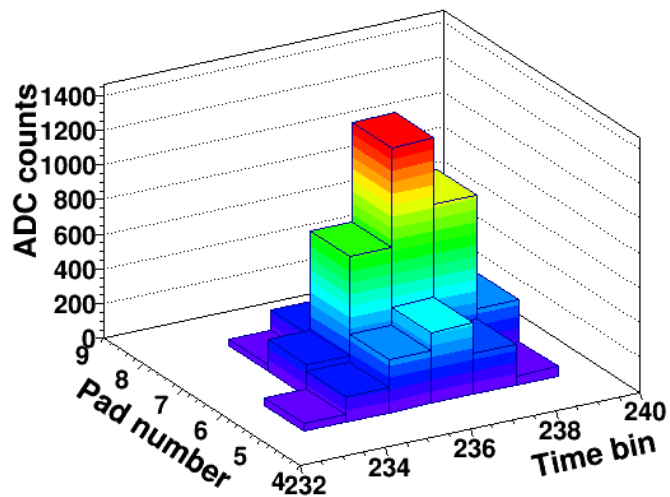
Parameter	Value
Magnetic field	0.5 T
Drift gas	P10 (90% Ar + 10% CH <sub>4</sub> )
Drift velocity	5.45 cm/ $\mu$ s
Transverse diffusion at 0.5 T	185 $\mu$ m/ $\sqrt$ cm
Longitudinal diffusion	320 $\mu$ m/ $\sqrt$ cm
Pad size	5x12 mm <sup>2</sup> (27 rows) + 5x18 mm <sup>2</sup> (26 rows)
Charge spread $\sigma$	0.196 mm
Electronics shaping time	180 ns (FWHM)
ADC dynamic range	12 bits
ADC sampling frequency	10 MHz



1. Precluster finder (group of adjacent pixels in time bin – pad space)
2. Hit finder (“peak-and-valley” algorithm either in time bin – pad space (for simple topologies) or in time-transverse coordinate pixel space after Bayesian unfolding (for more complicated topologies)) → COG around local maxima

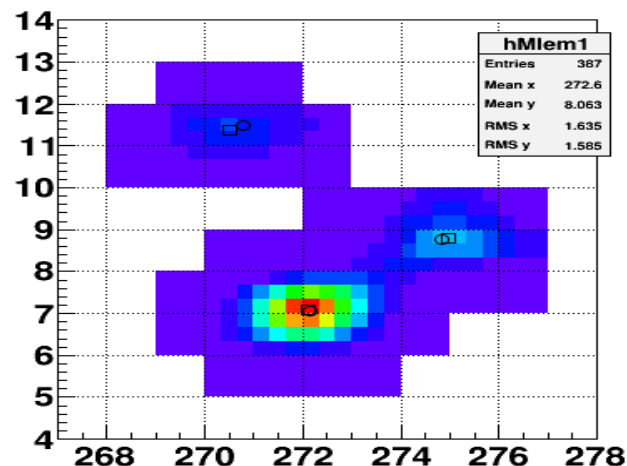
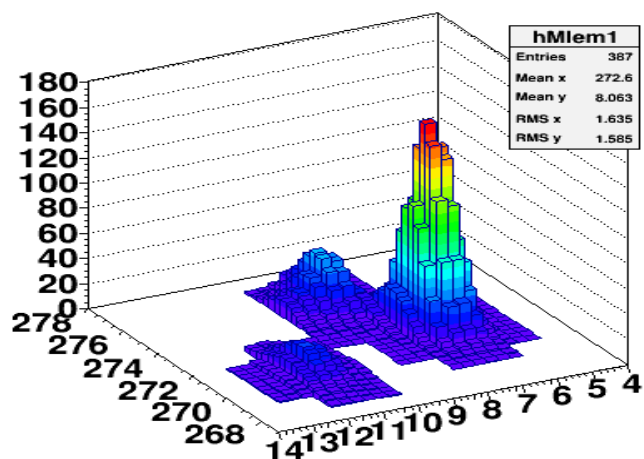
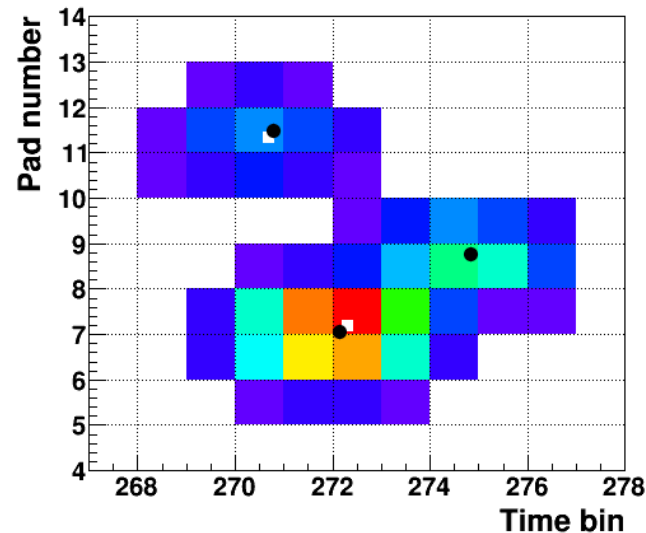
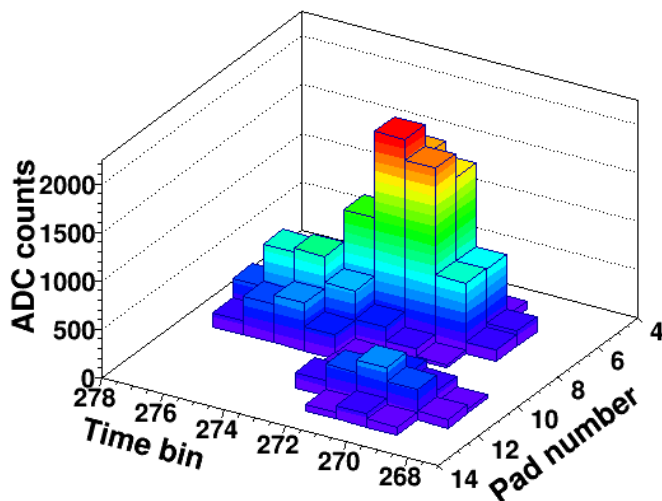


# Cluster topologies





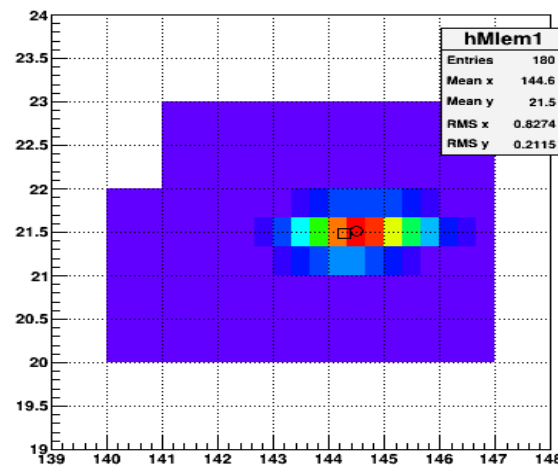
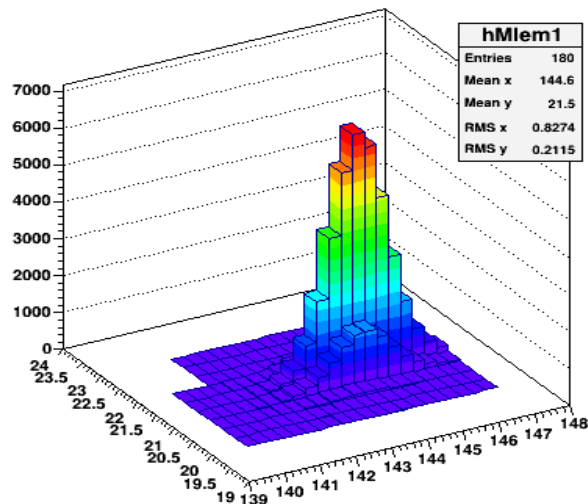
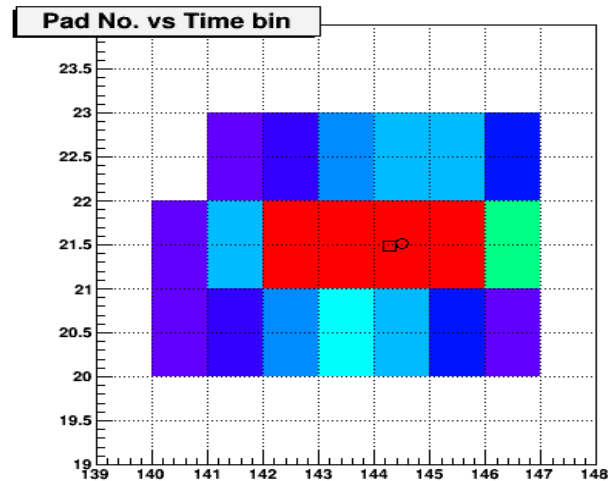
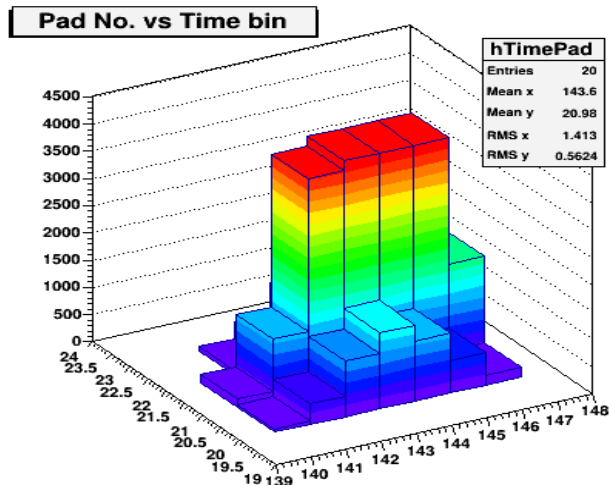
# MLEM procedure (Bayesian unfolding)







# MLEM procedure - information recovery





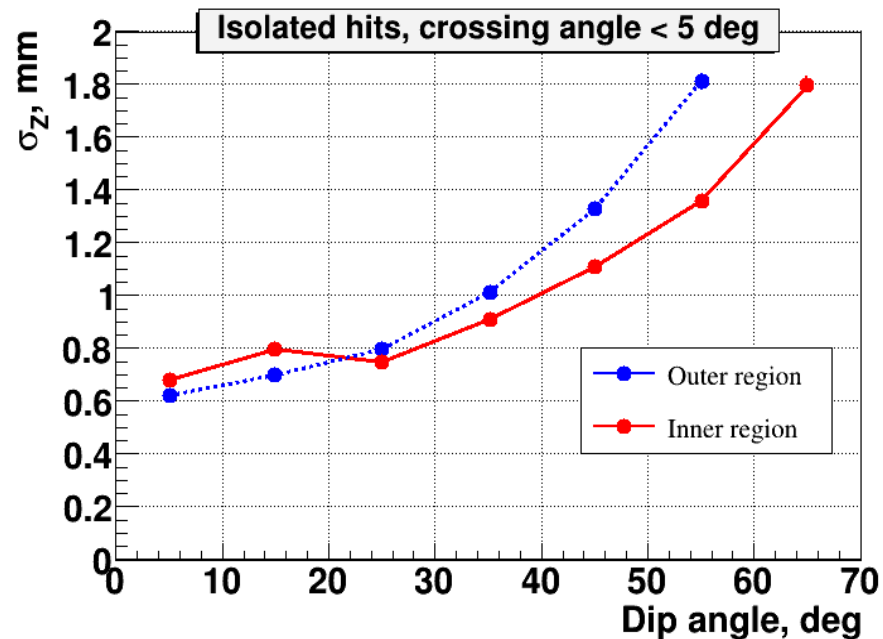
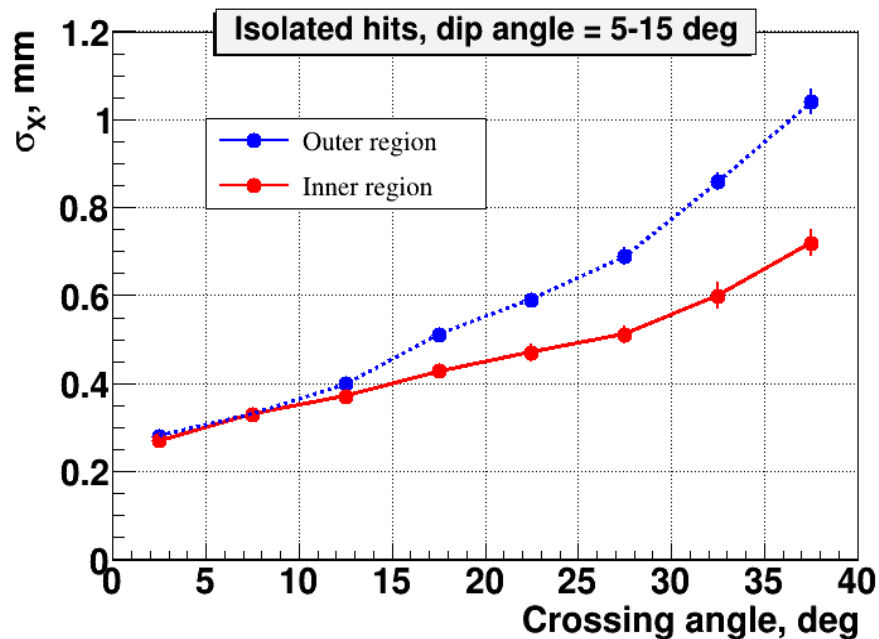
# Event samples



1. UrQMD central (0-3 fm) Au+Au at 9 AGeV
2. DCM-QGSM min. bias (0-8 fm) Au+Au at 9 AGeV

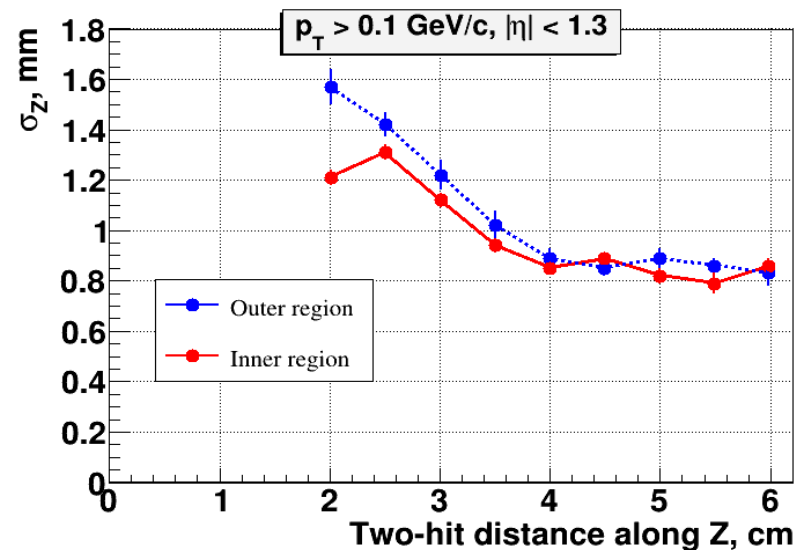
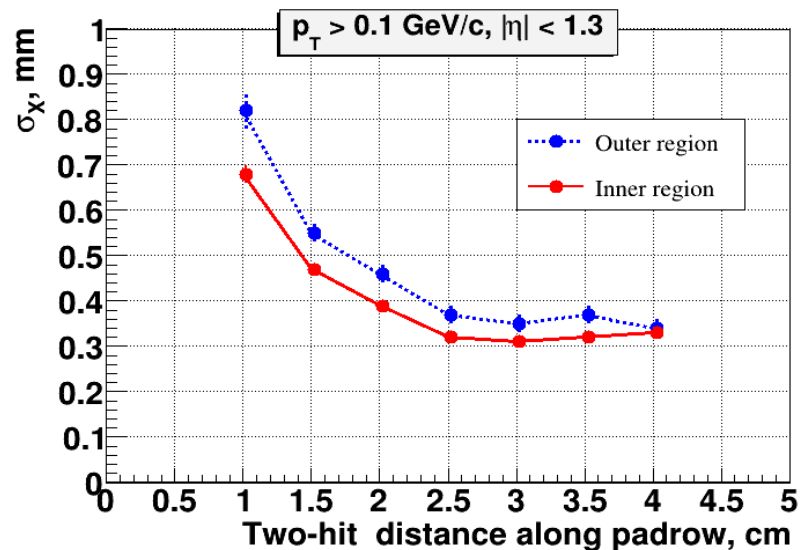
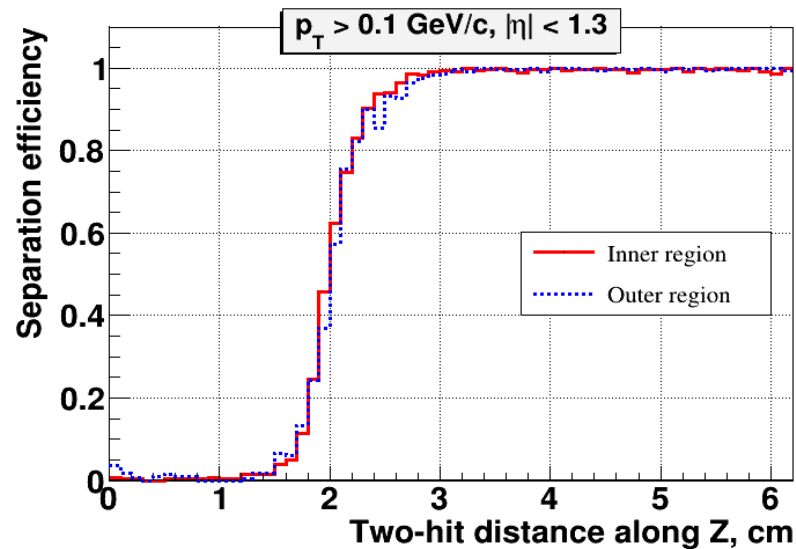
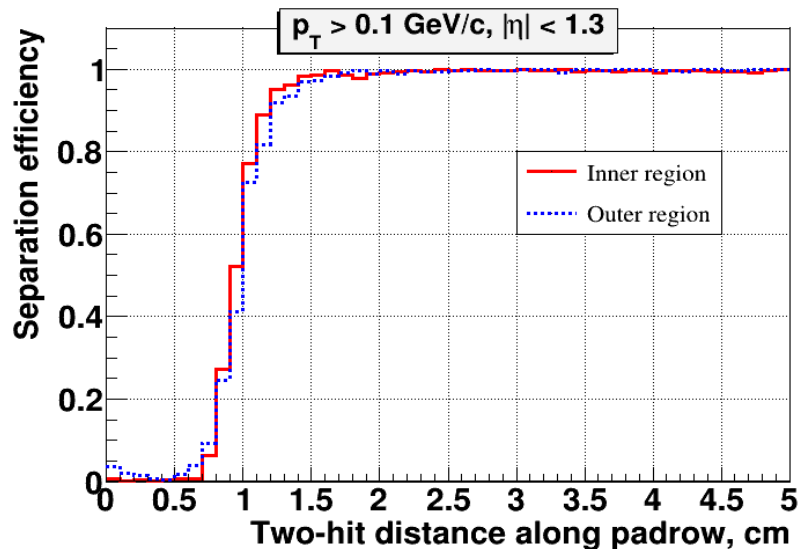


# Coordinate resolution





# Double-hit resolution





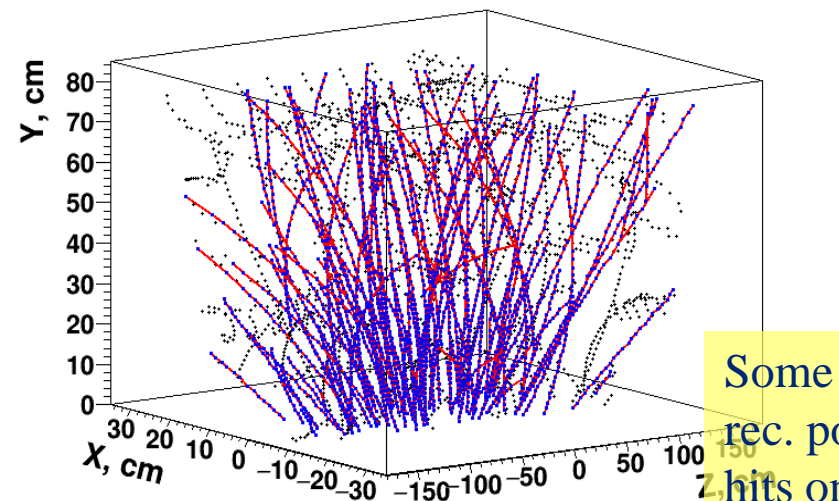
# Track reconstruction



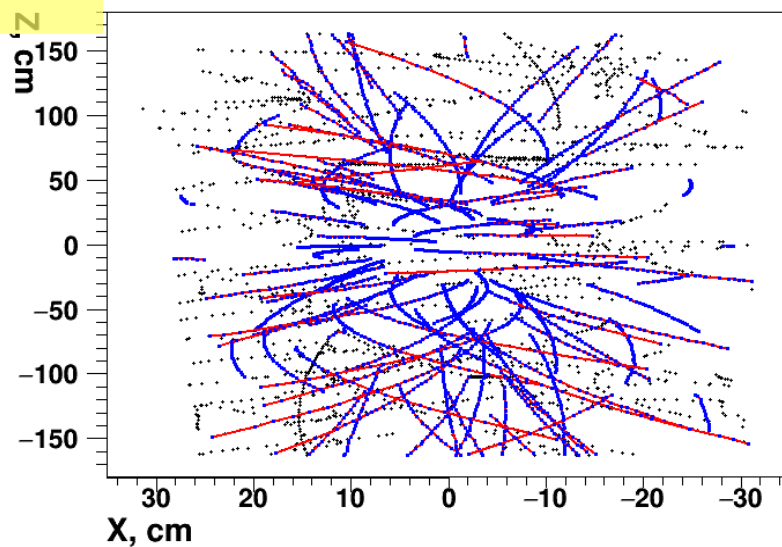
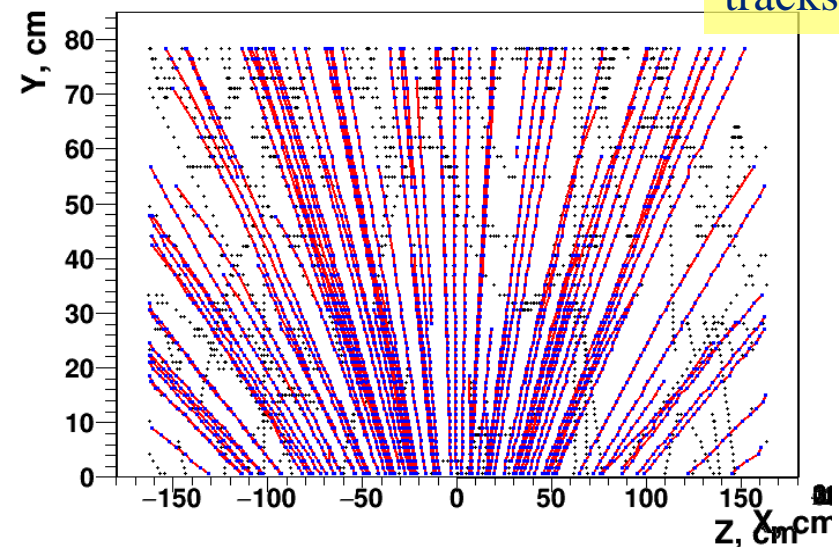
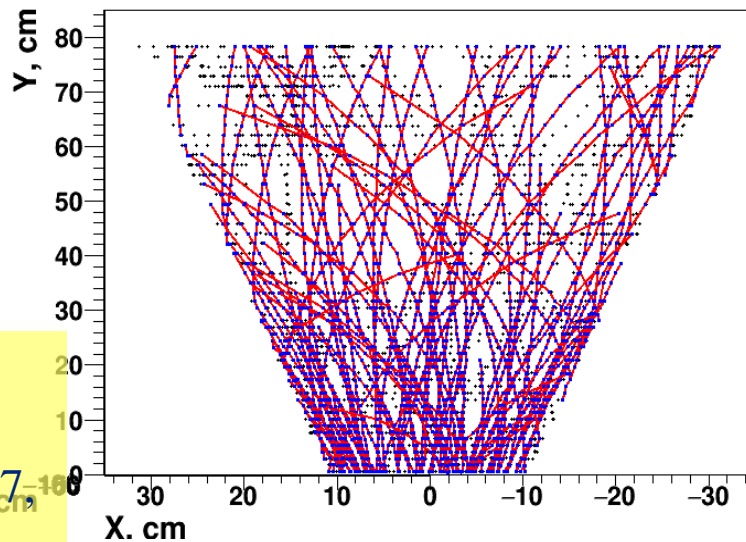
Two-pass Kalman filter with track seeding using outer hits (1<sup>st</sup> pass) or leftover inner hits (2<sup>nd</sup> pass)



# Track reconstruction



Some stats:  
rec. points = 4867,  
hits on tracks = 3127,  
tracks = 102

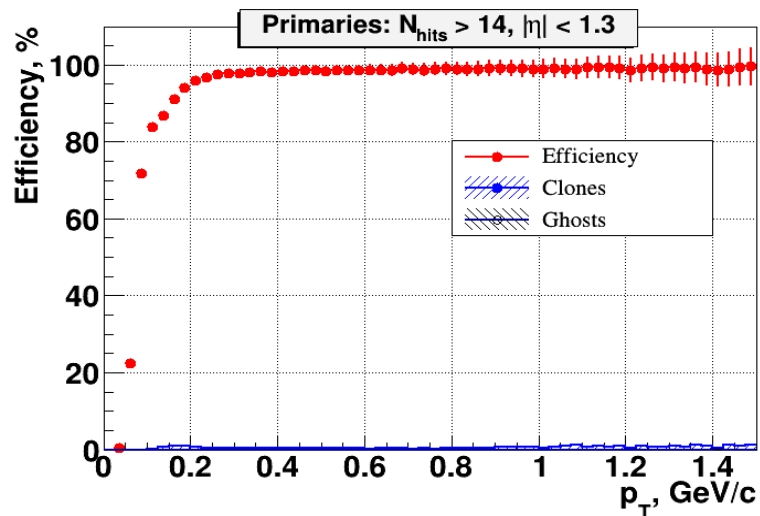




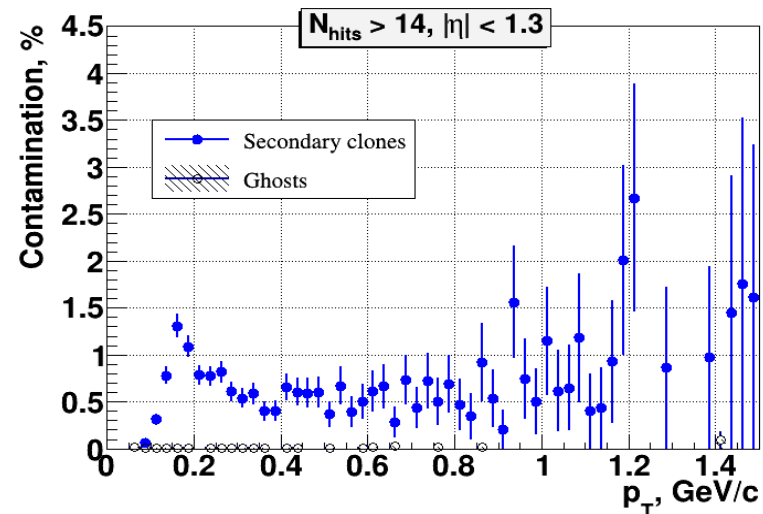
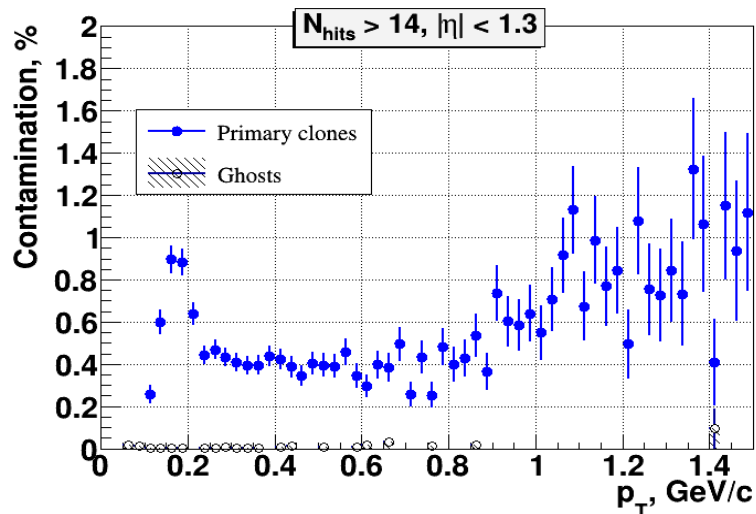
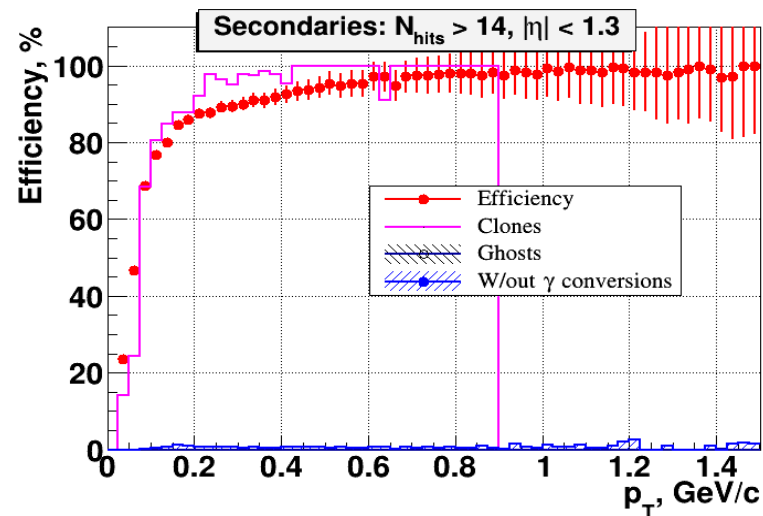
# Track reconstruction efficiency



## Primary



## Secondary

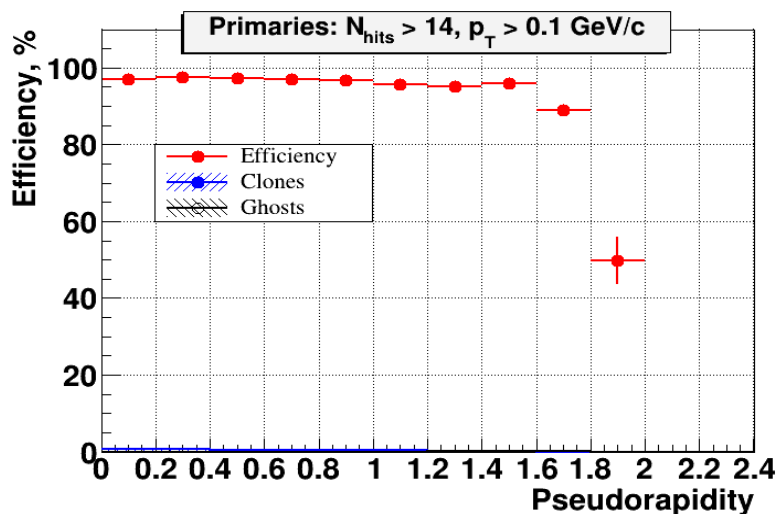




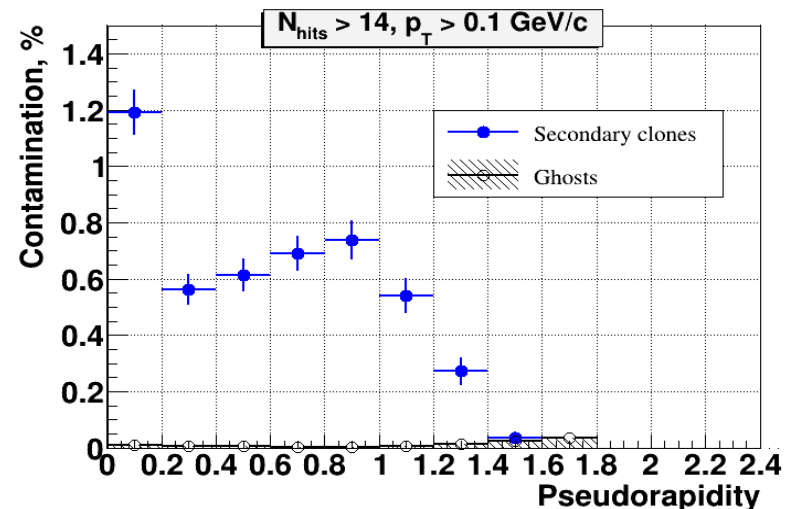
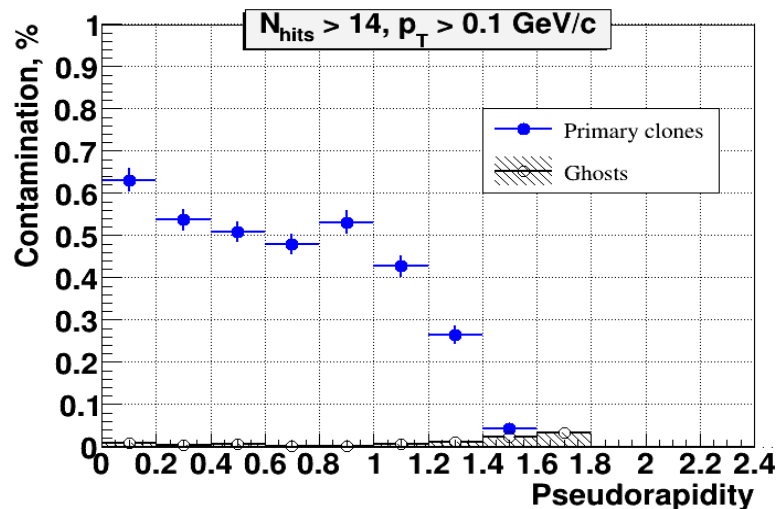
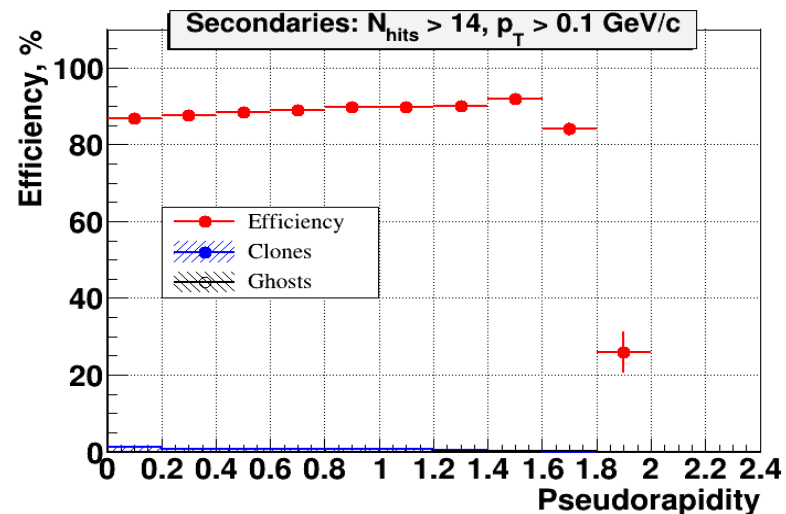
# Track reconstruction efficiency



## Primary



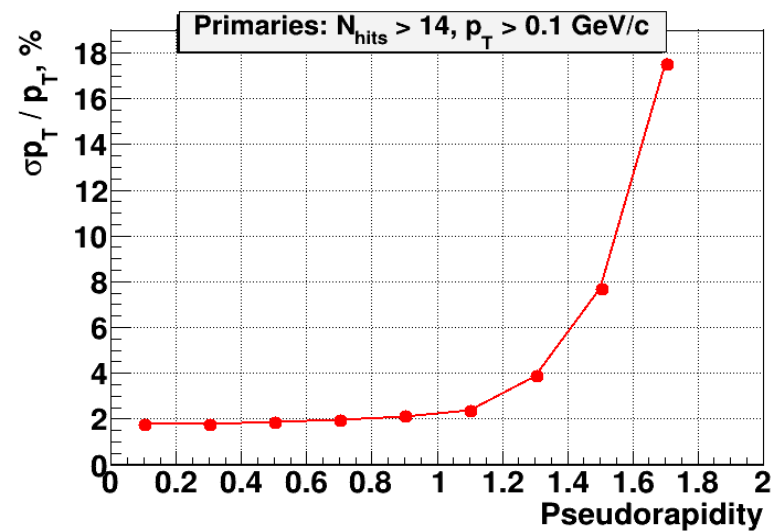
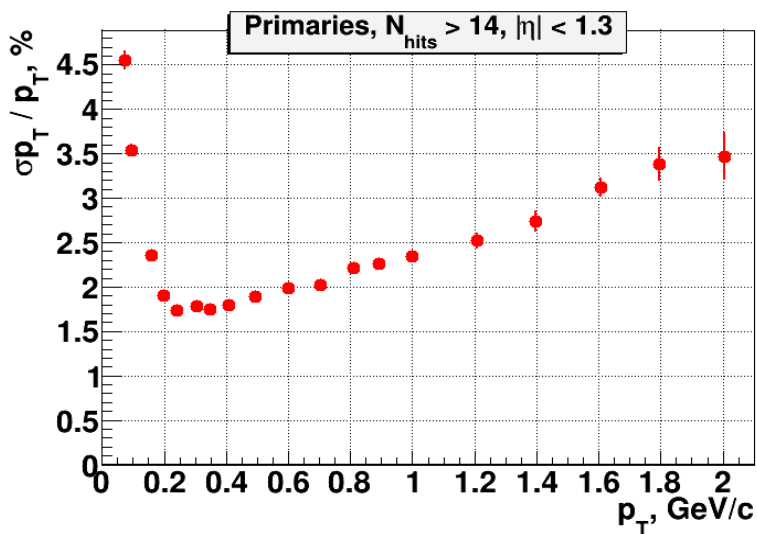
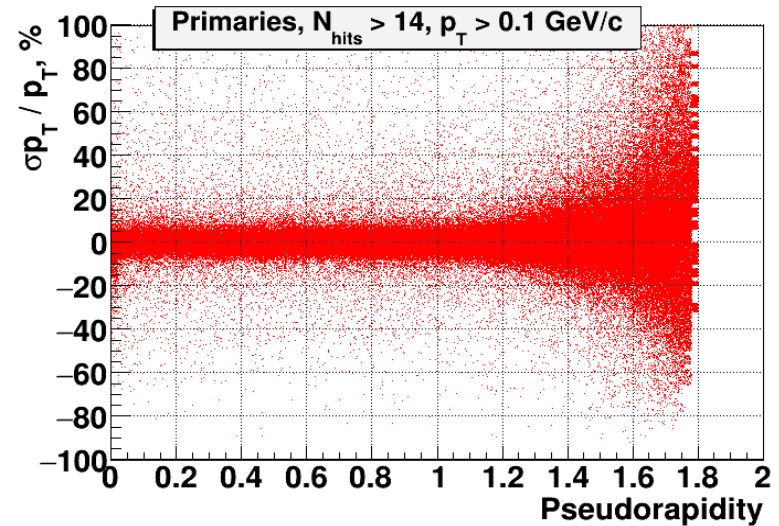
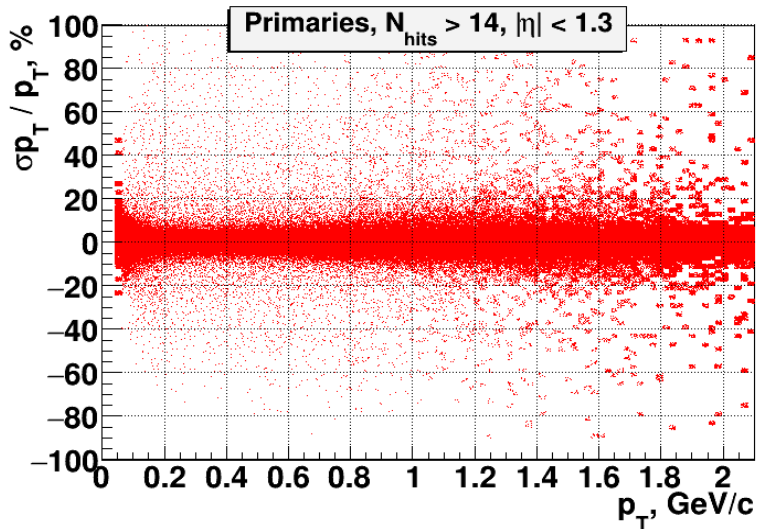
## Secondary





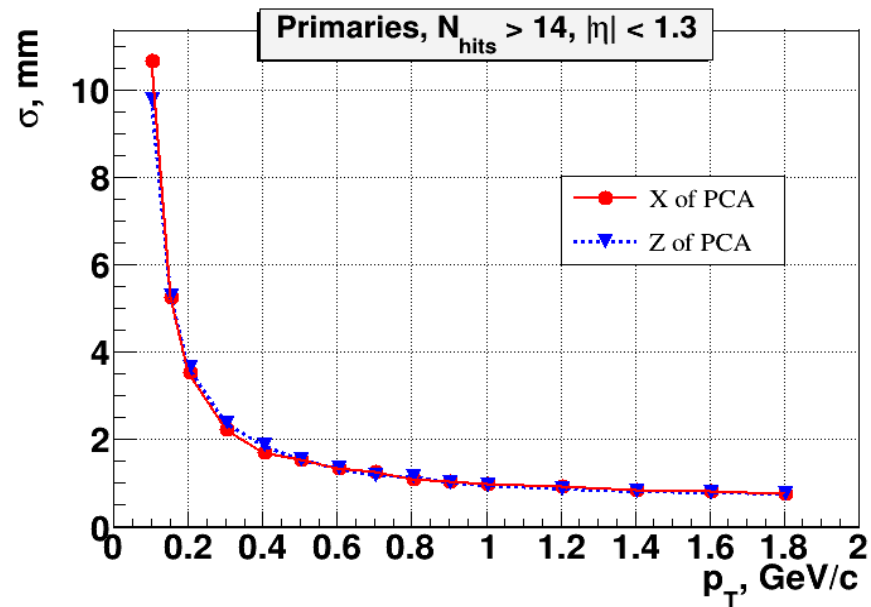
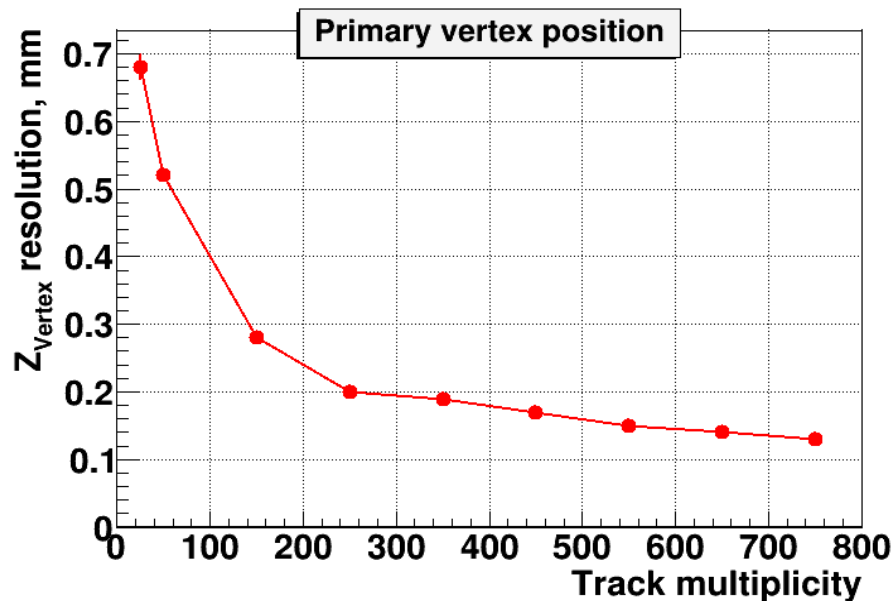


# Momentum resolution



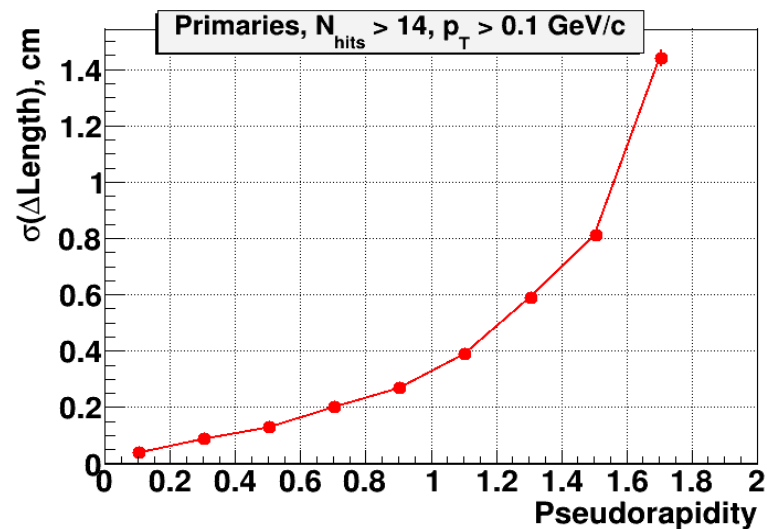
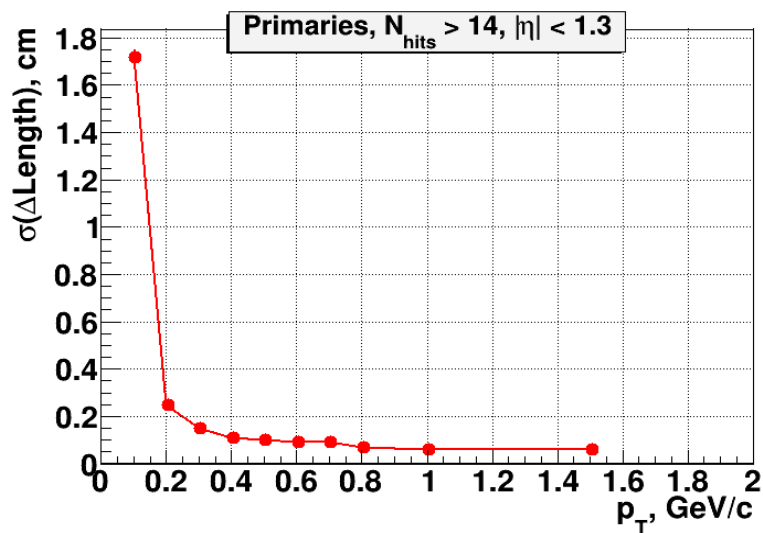
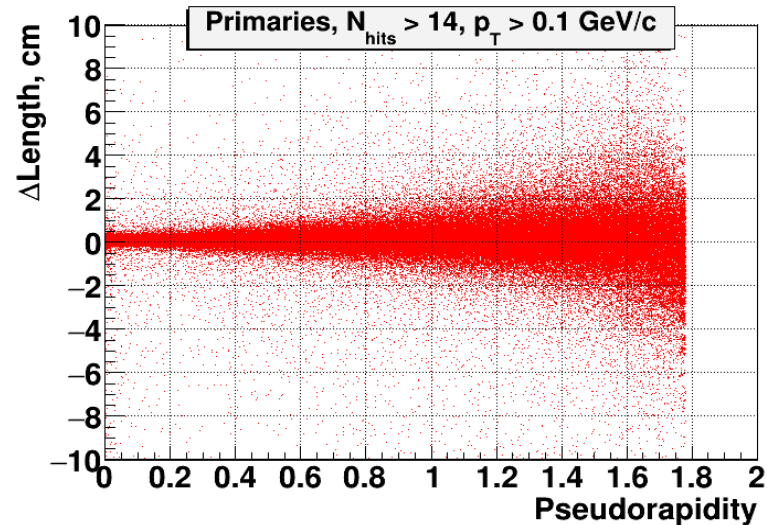
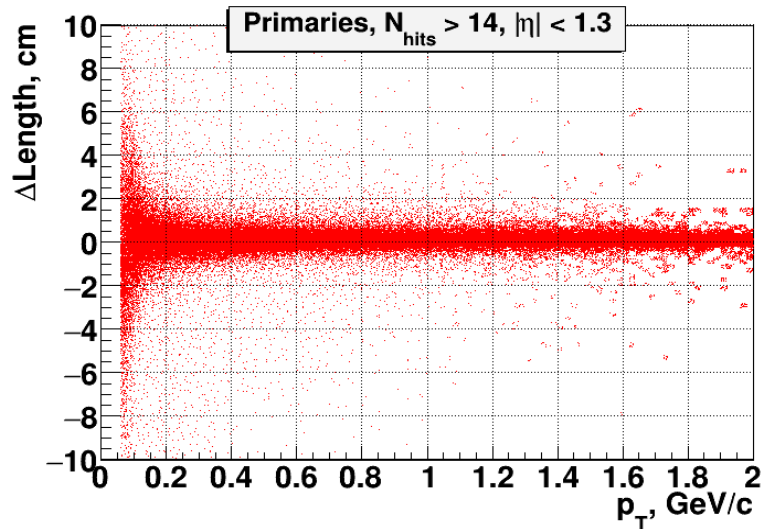


# Track pointing accuracy



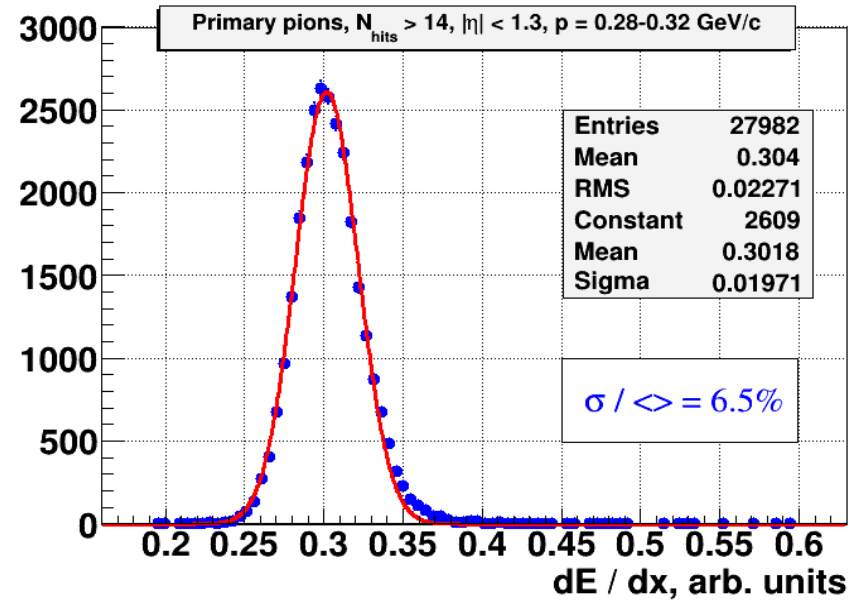
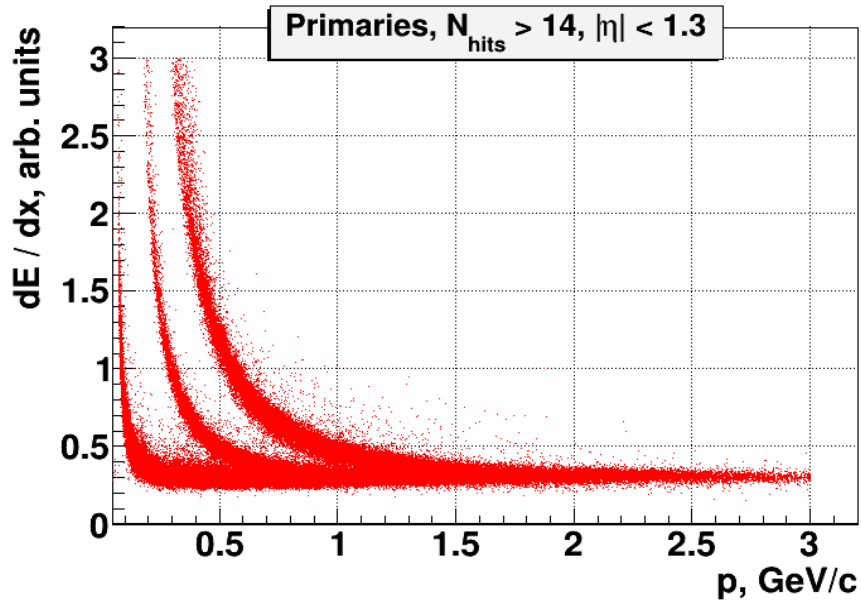


# Track length resolution



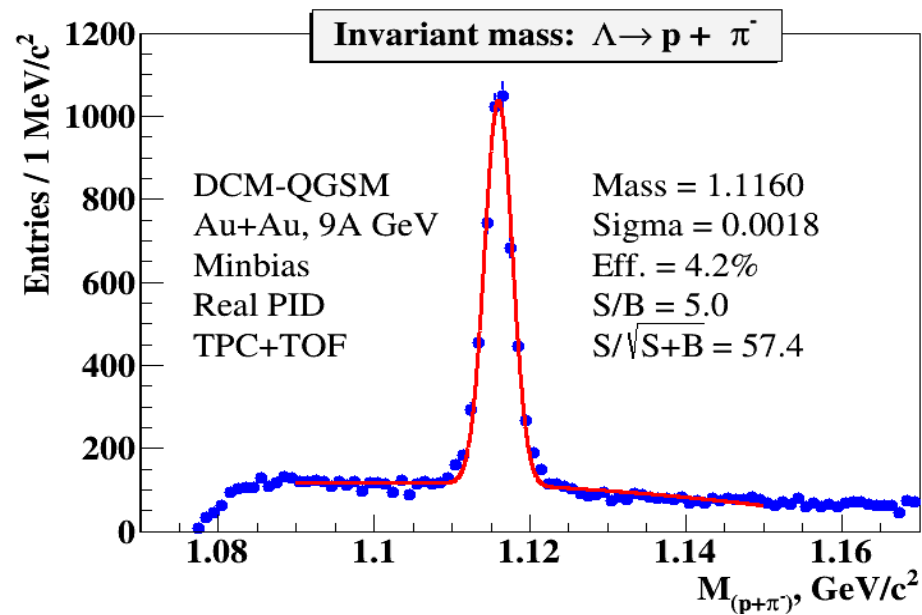
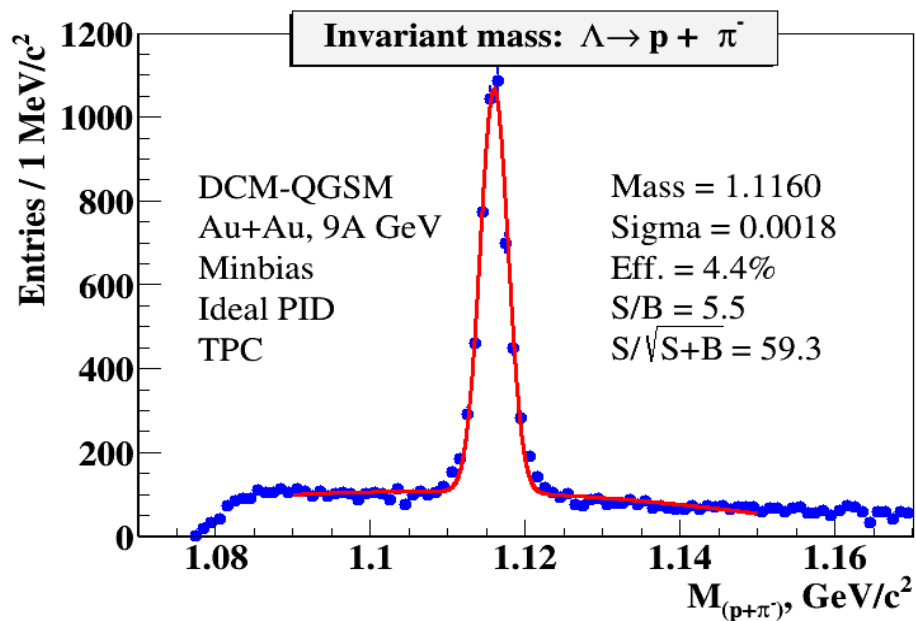


# dE / dx measurement





# Next steps



~1.6 s of data taking



# Summary



- The MPD TPC “realistic” simulation is in operation
- Reconstruction results look reasonable
- Simulation / reconstruction chain can be used for physics analyses