



Current status of the TPC simulation and reconstruction

A.Zinchenko

for the MPD collaboration

VBLHEP, JINR, Dubna, Russia



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



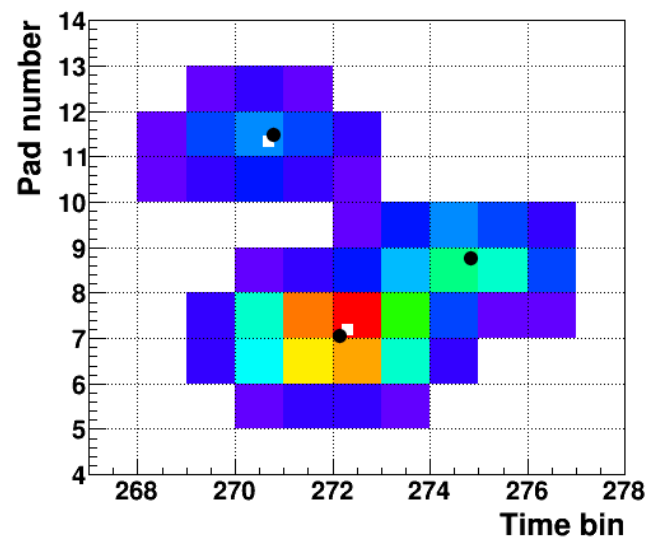
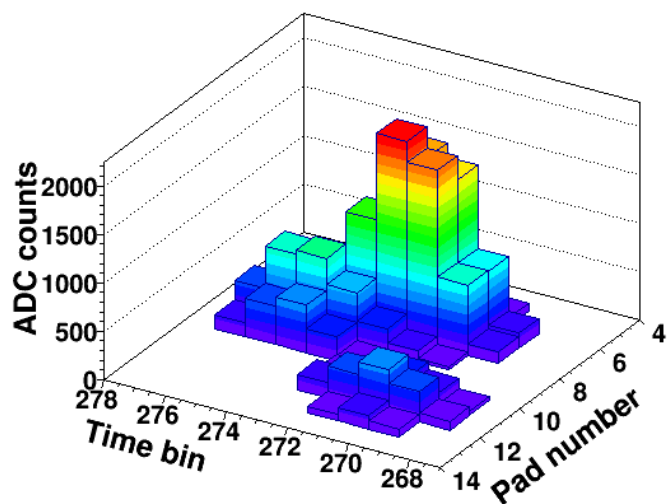
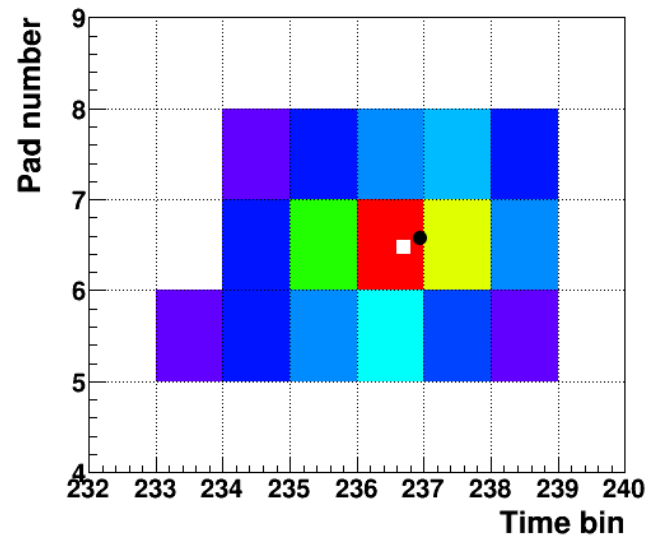
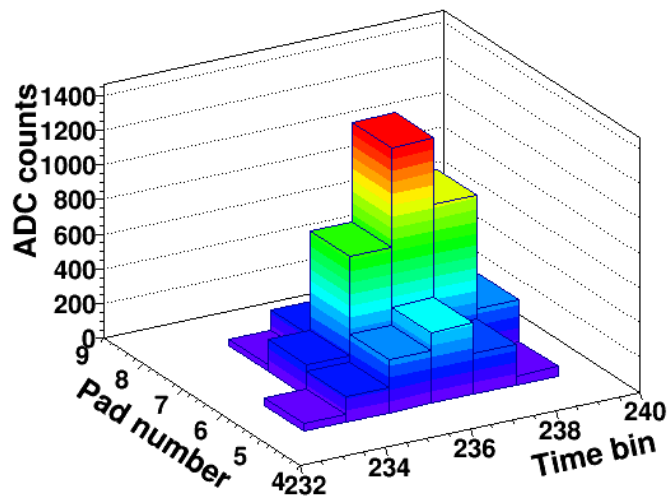
Parameter	Value
Magnetic field	0.5 T
Drift gas	P10 (90% Ar + 10% CH ₄)
Drift velocity	5.45 cm/ μ s
Transverse diffusion at 0.5 T	185 μ m/ \sqrt cm
Longitudinal diffusion	320 μ m/ \sqrt cm
Pad size	5x12 mm ² (27 rows) + 5x18 mm ² (26 rows)
Charge spread σ	0.196 mm
Electronics shaping time	180 ns (FWHM)
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

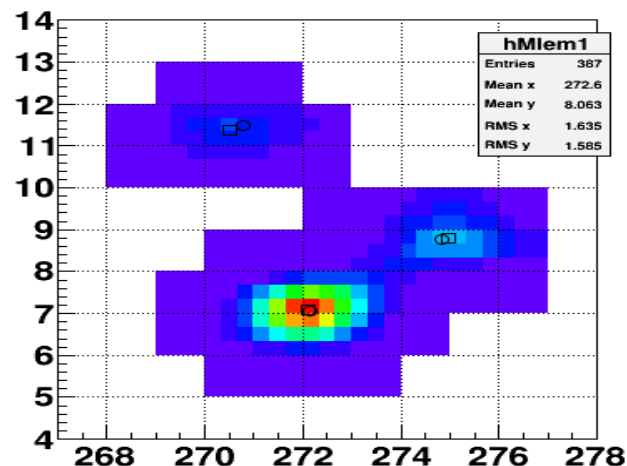
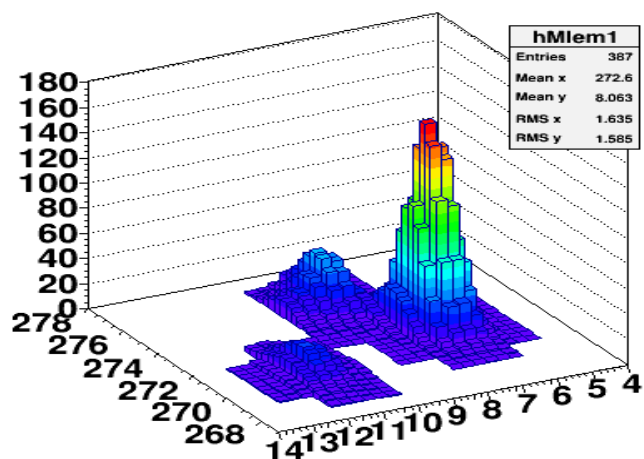
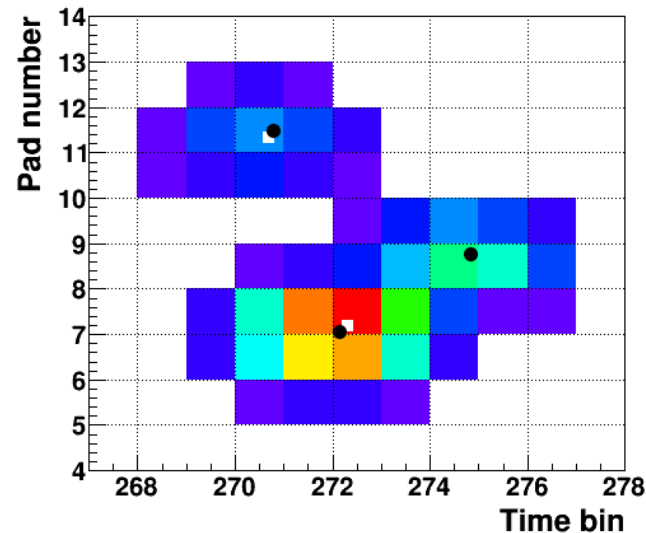
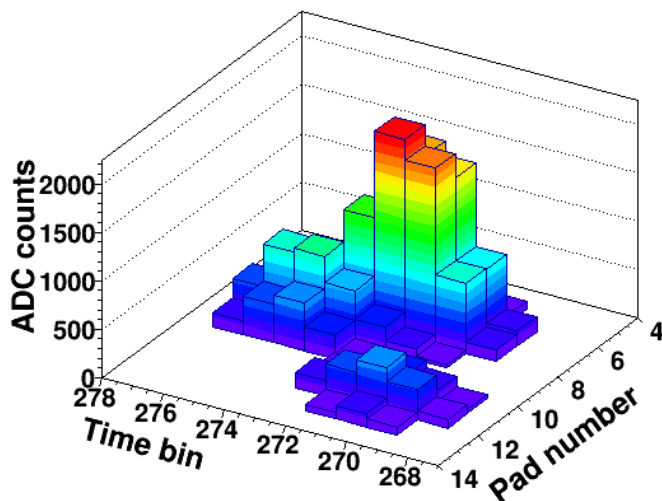


Cluster topologies



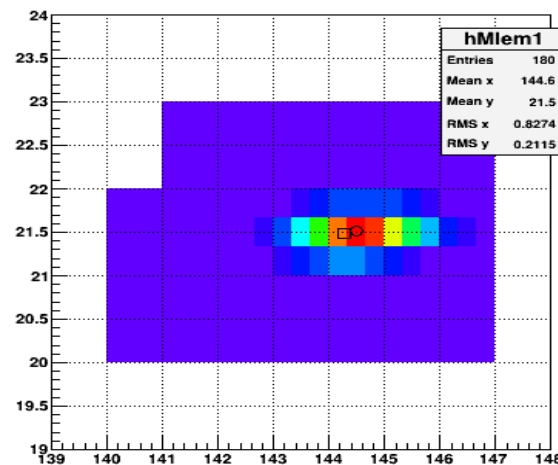
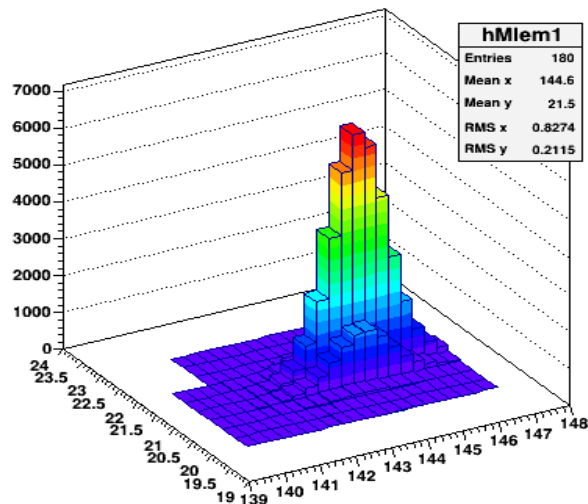
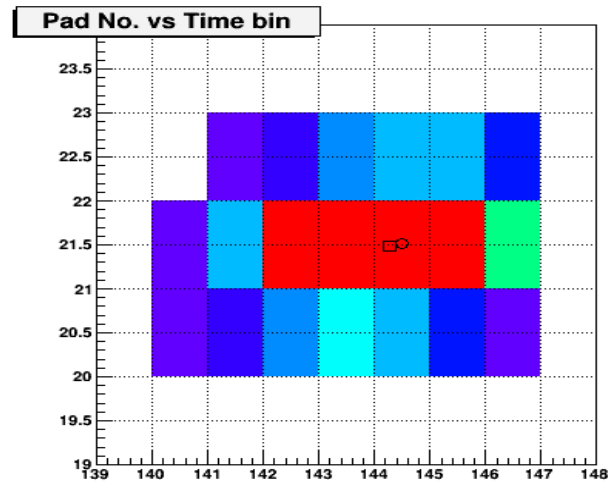
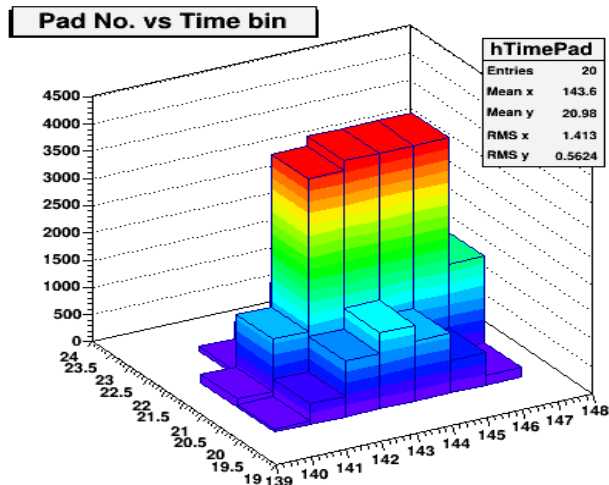


MLEM procedure (Bayesian unfolding)





MLEM procedure - information recovery





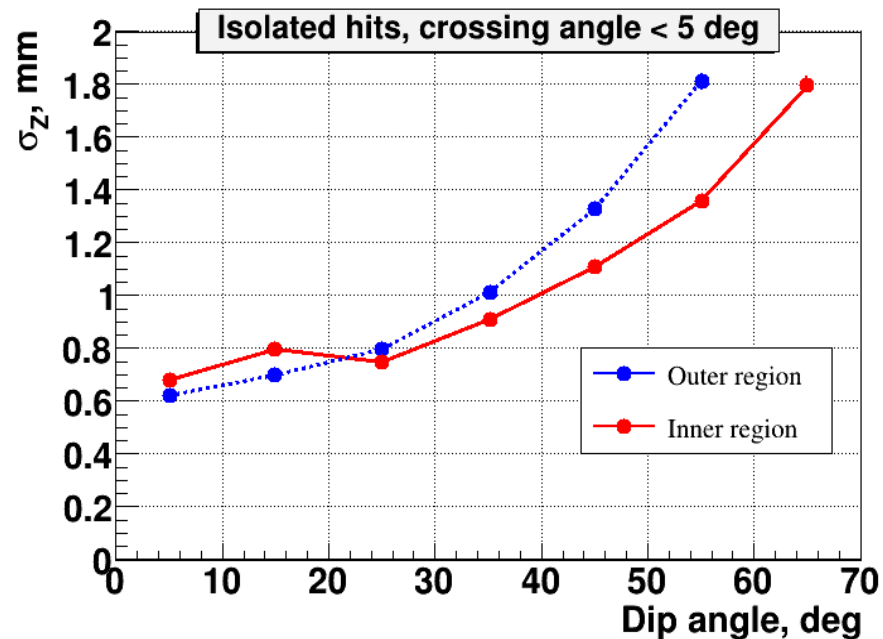
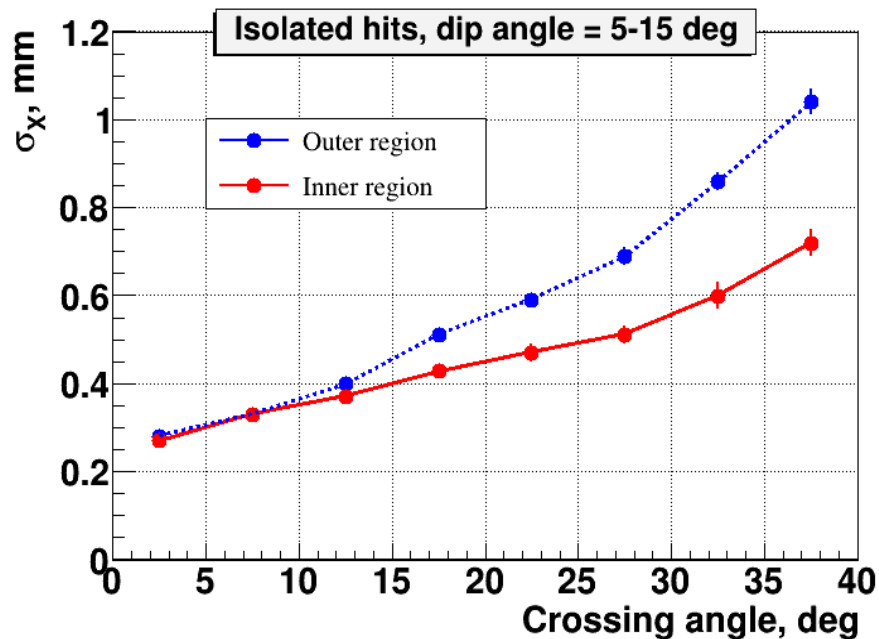
Event samples



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

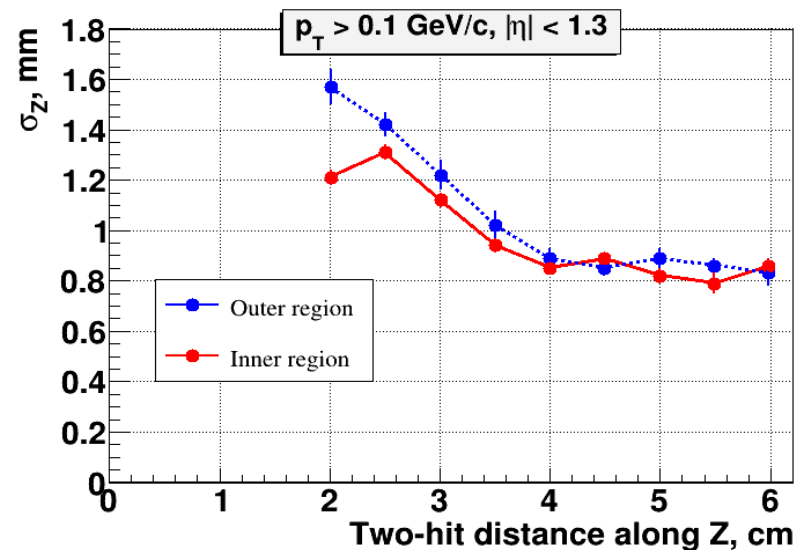
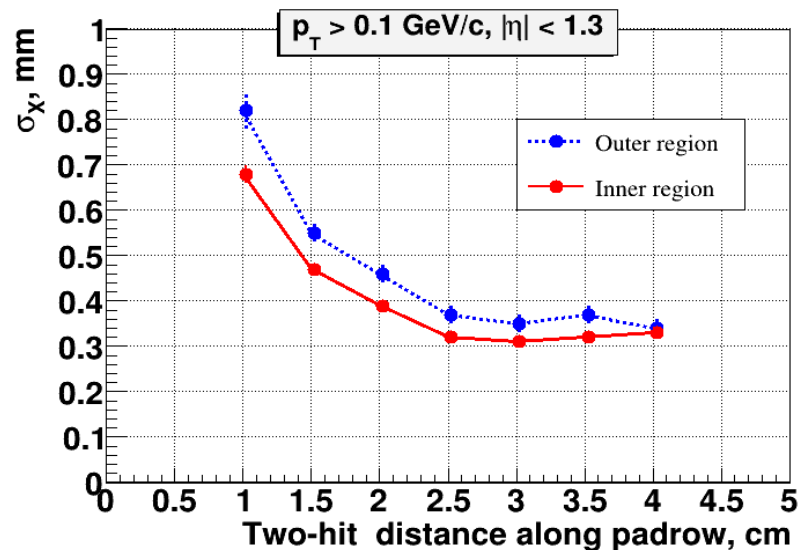
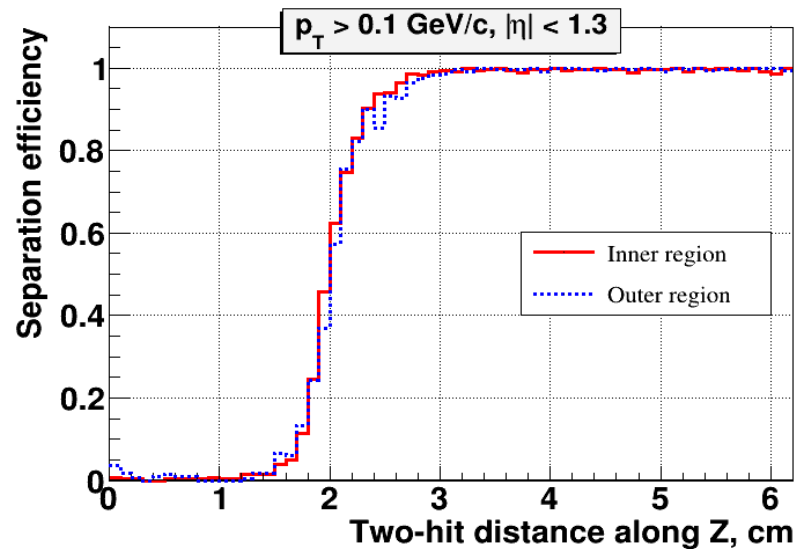
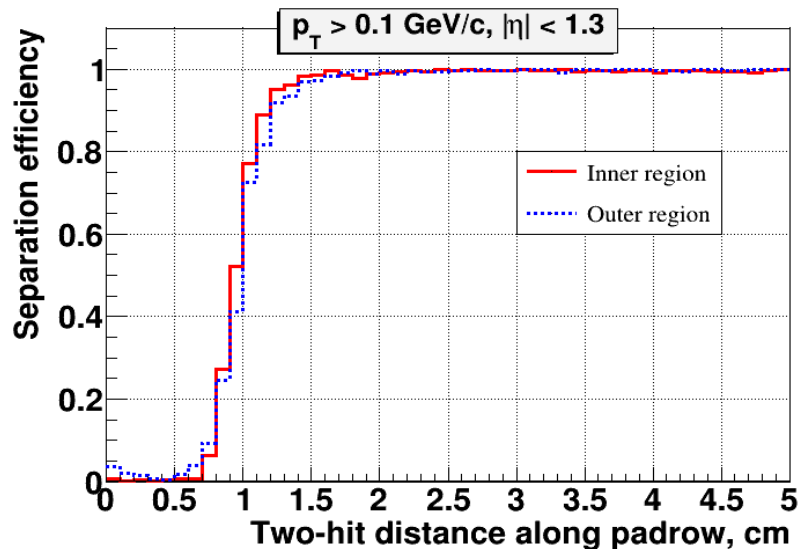


Coordinate resolution





Double-hit resolution





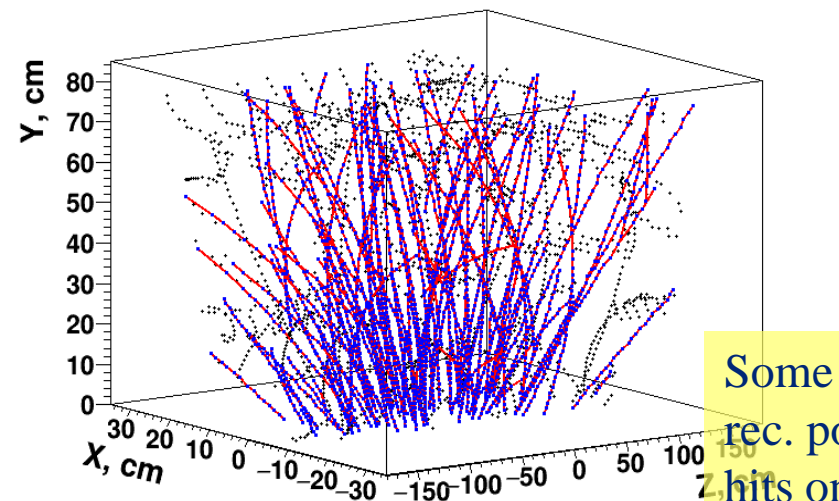
Track reconstruction



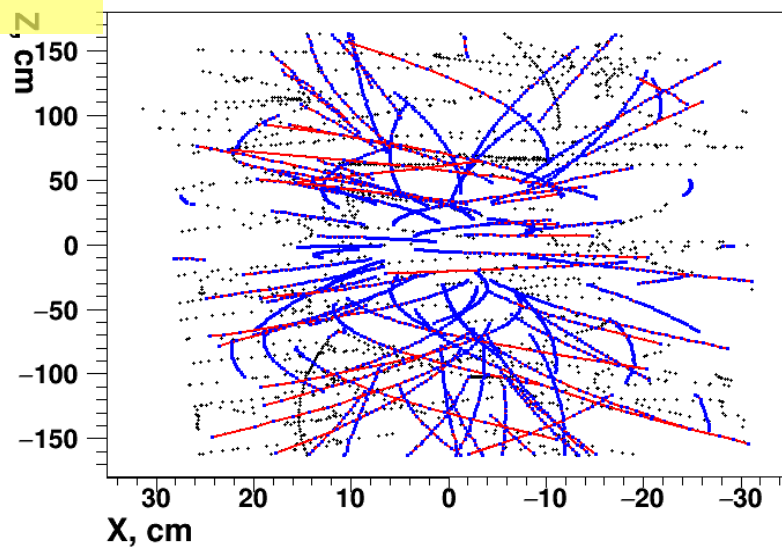
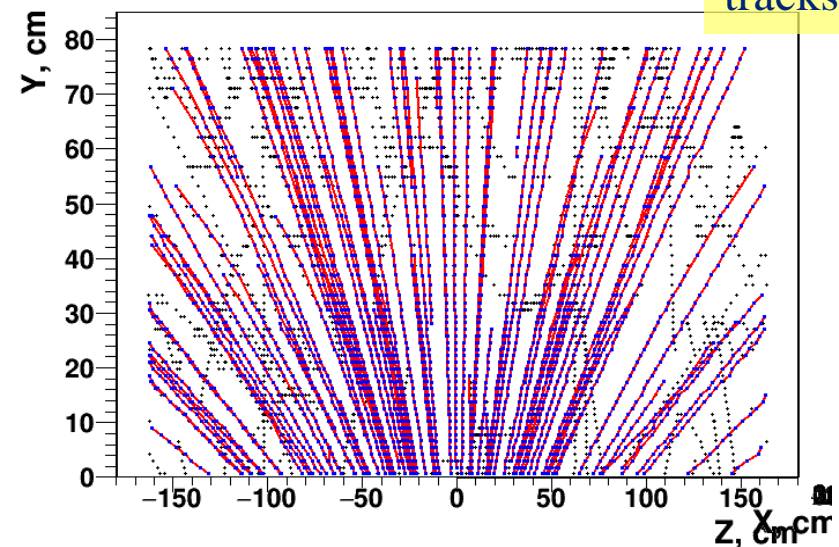
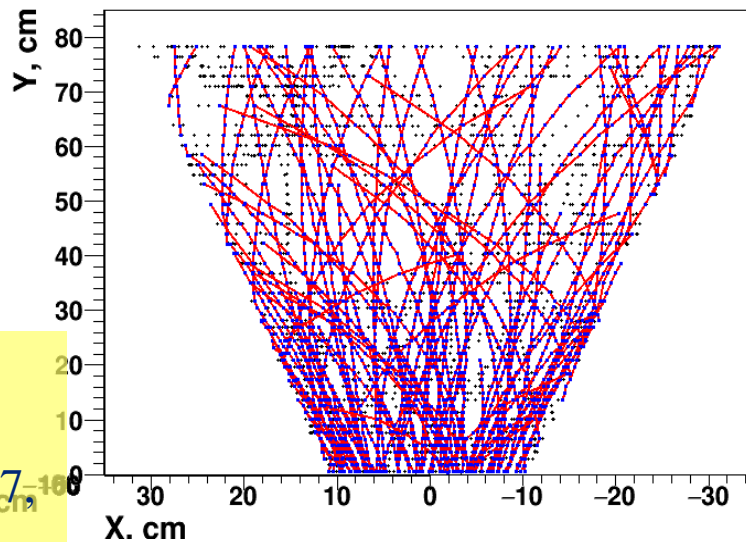
Two-pass Kalman filter with track seeding using outer hits (1st pass) or leftover inner hits (2nd pass)



Track reconstruction



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

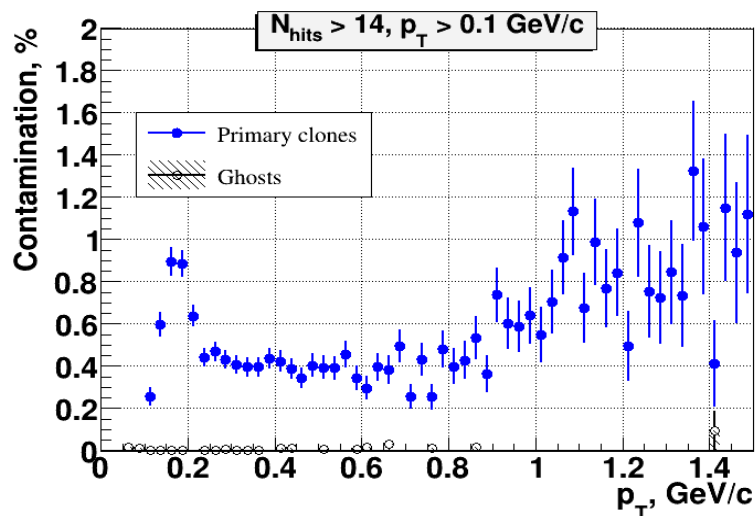
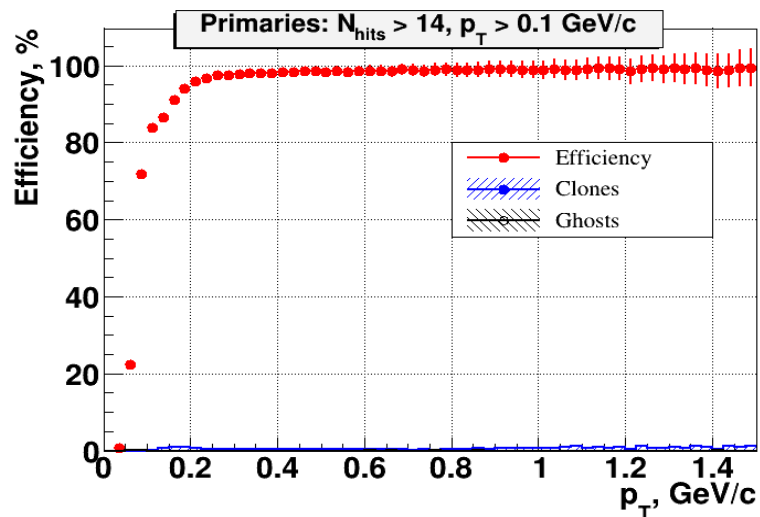




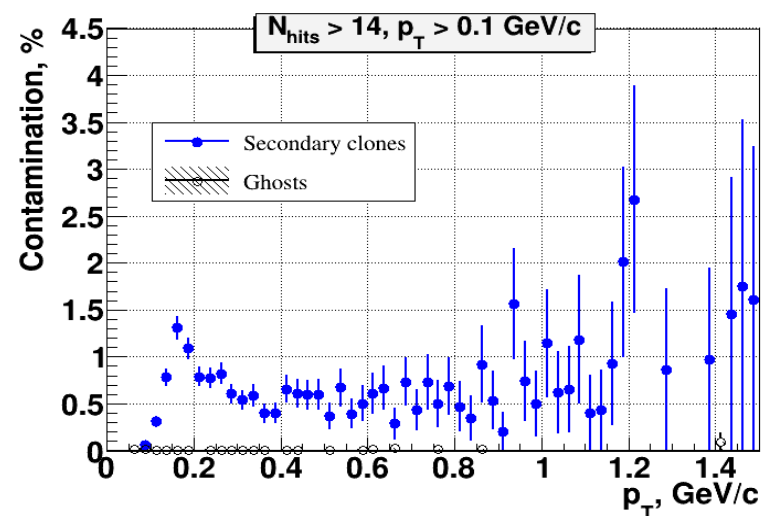
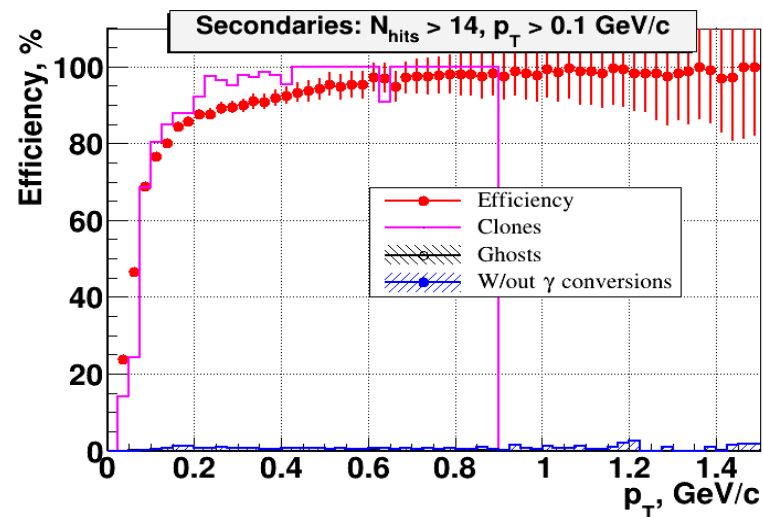
Track reconstruction efficiency



Primary



Secondary

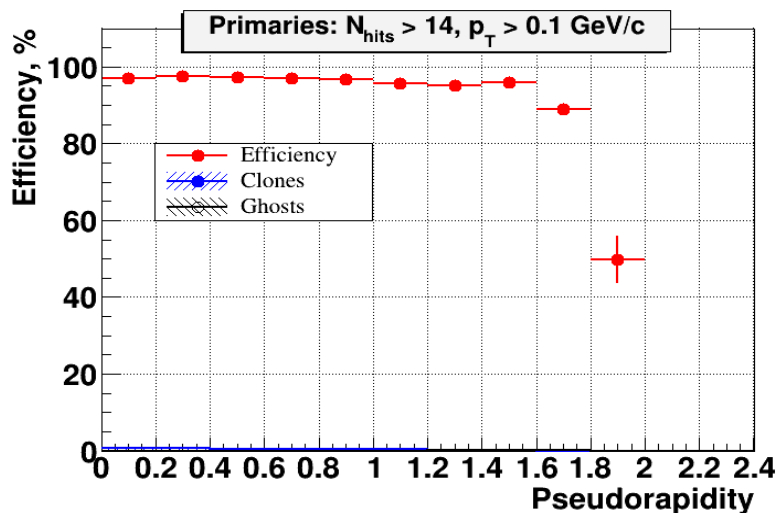




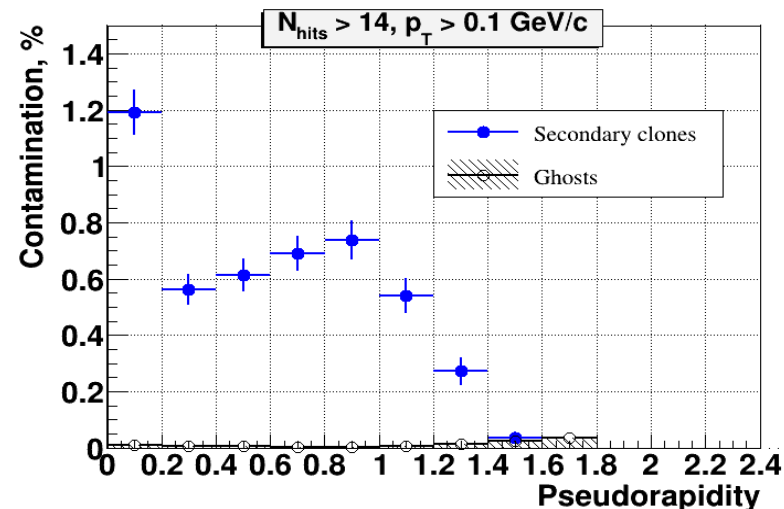
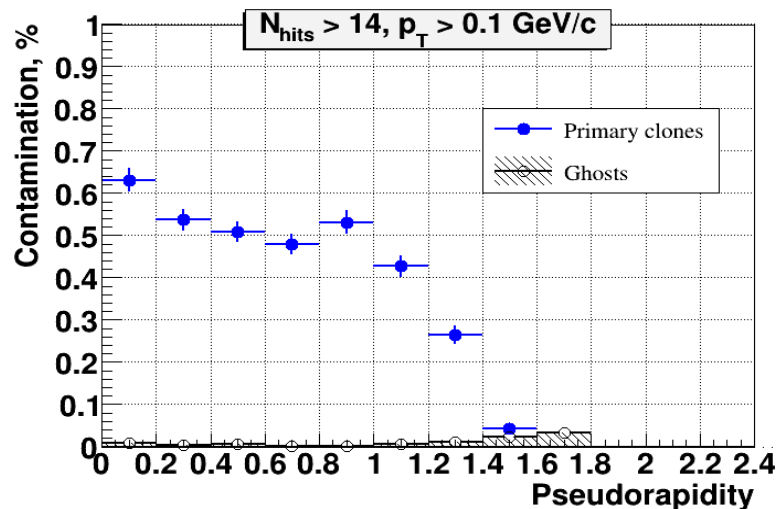
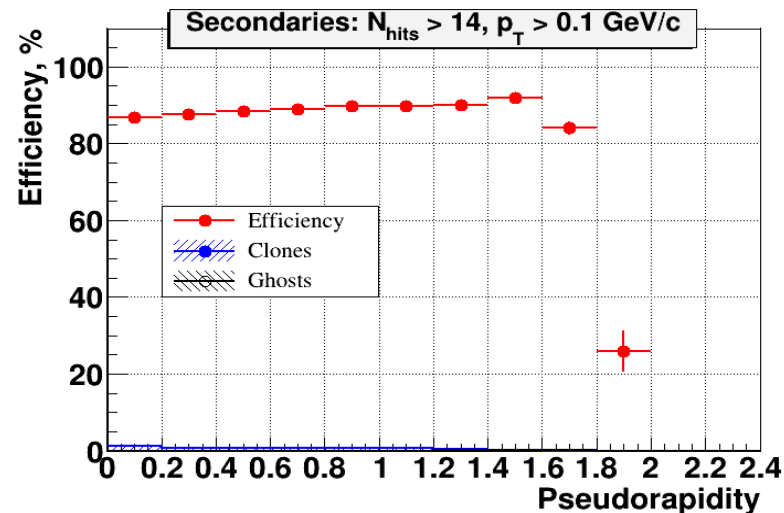
Track reconstruction efficiency



Primary

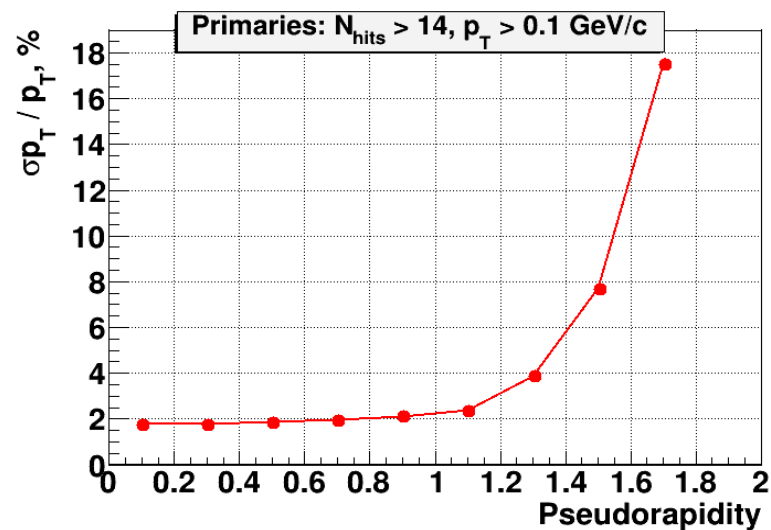
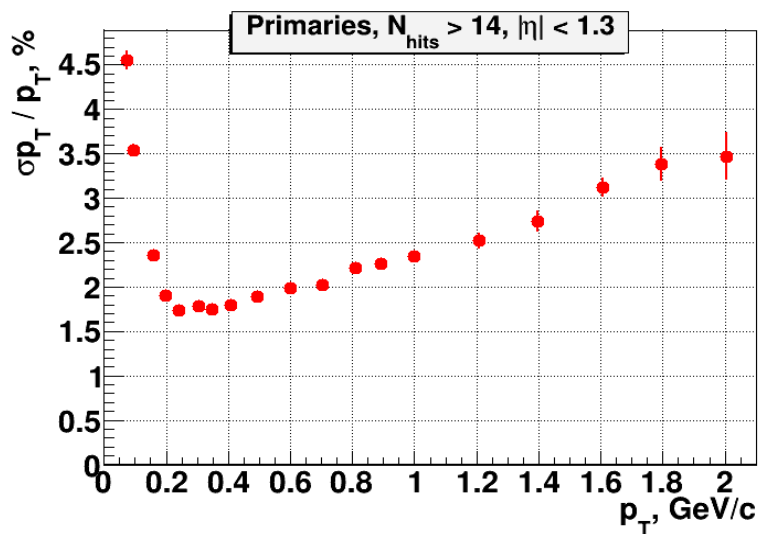
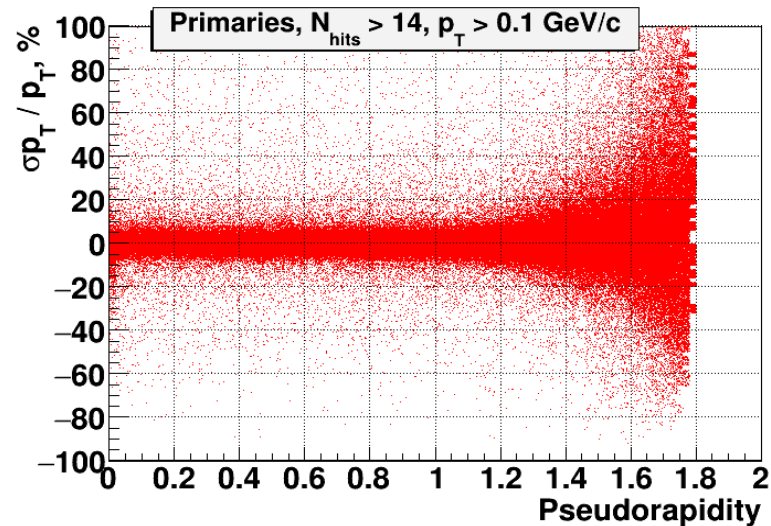
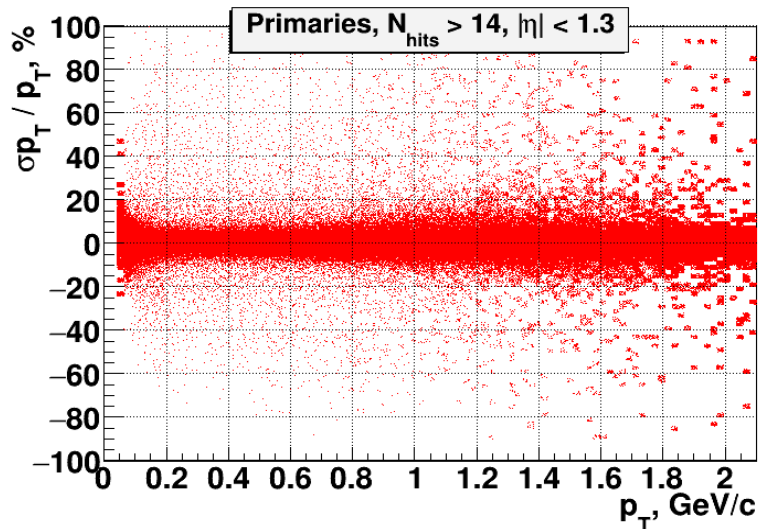


Secondary



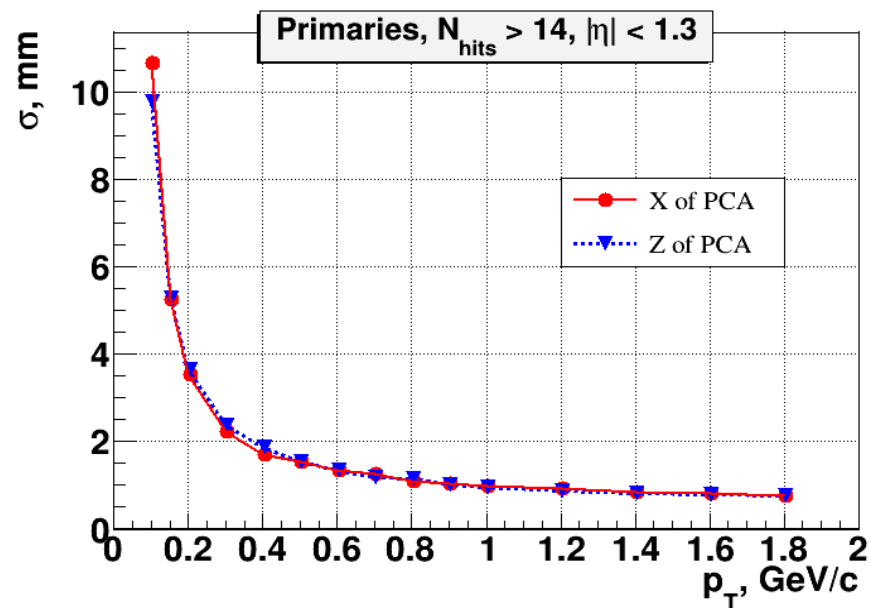
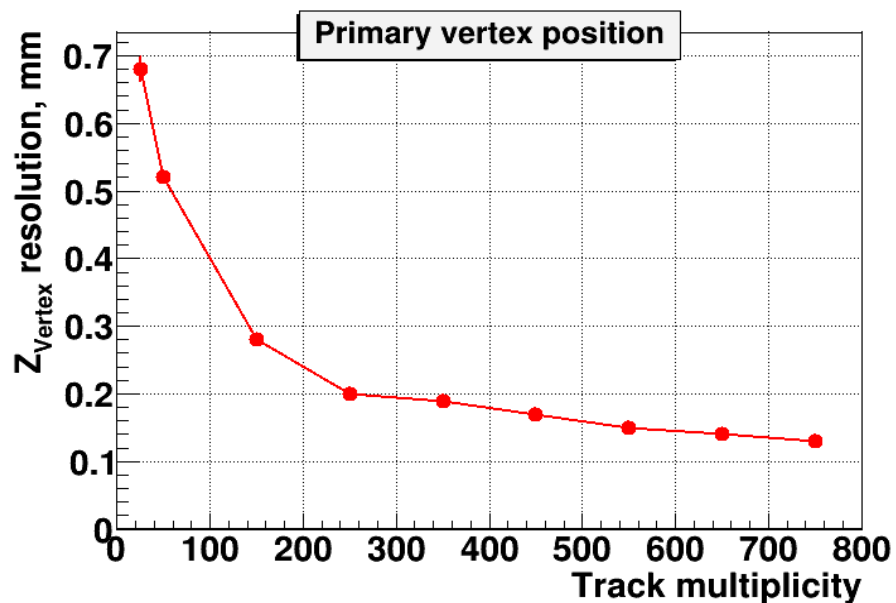


Momentum resolution



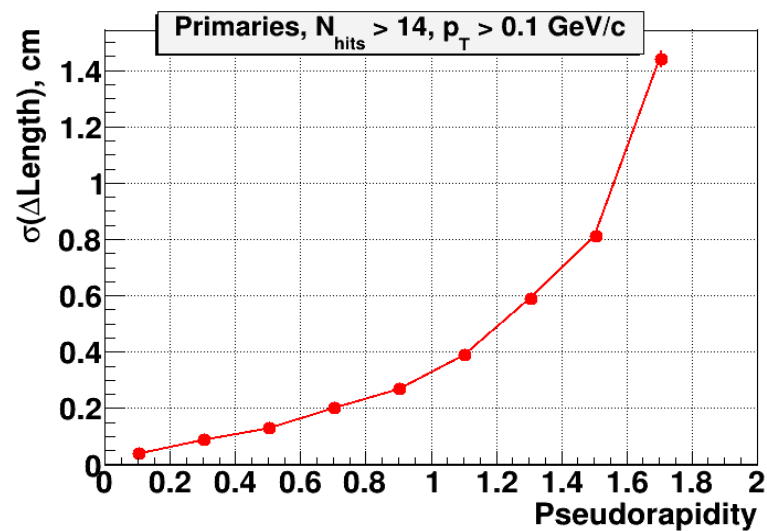
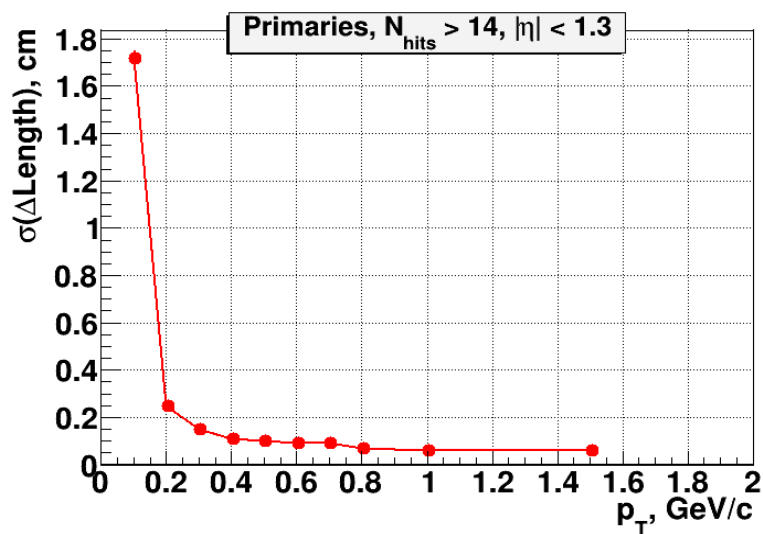
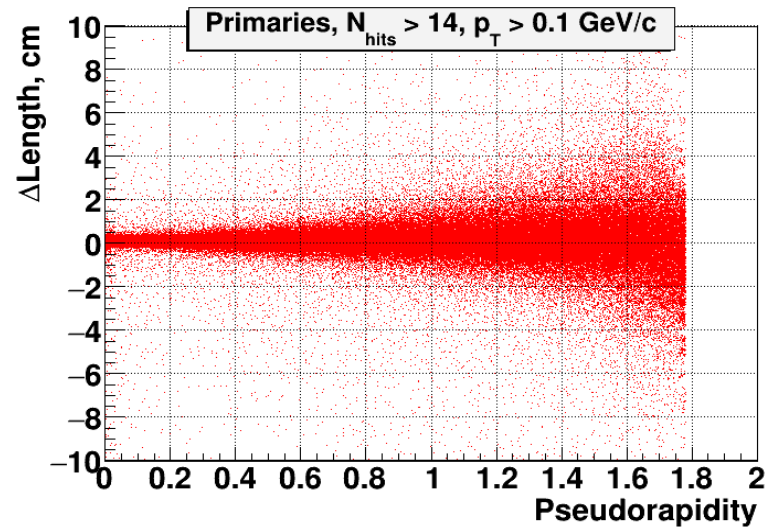
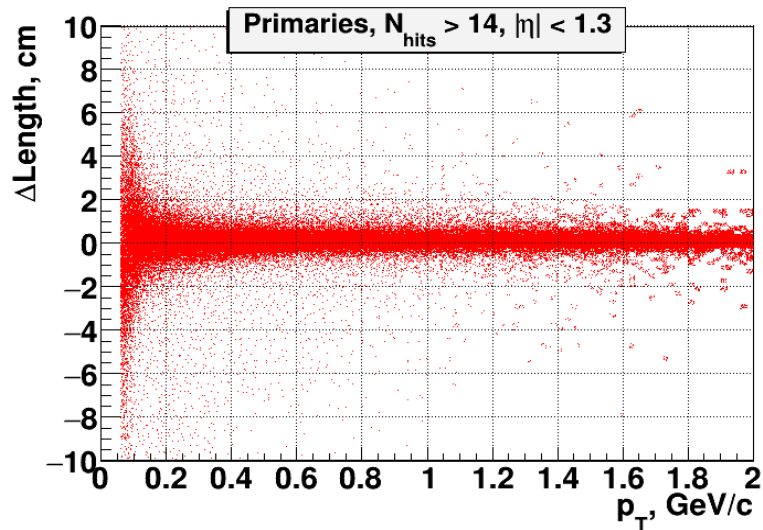


Track pointing accuracy



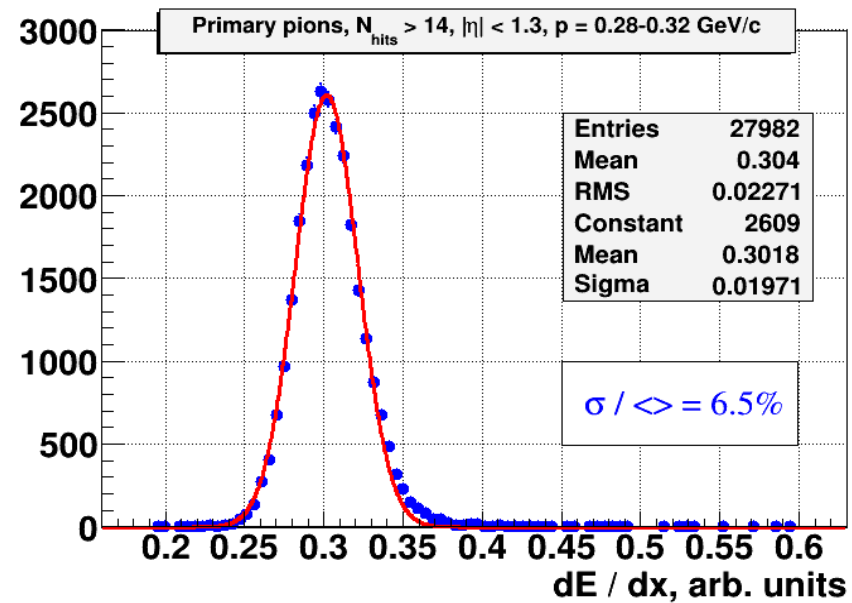
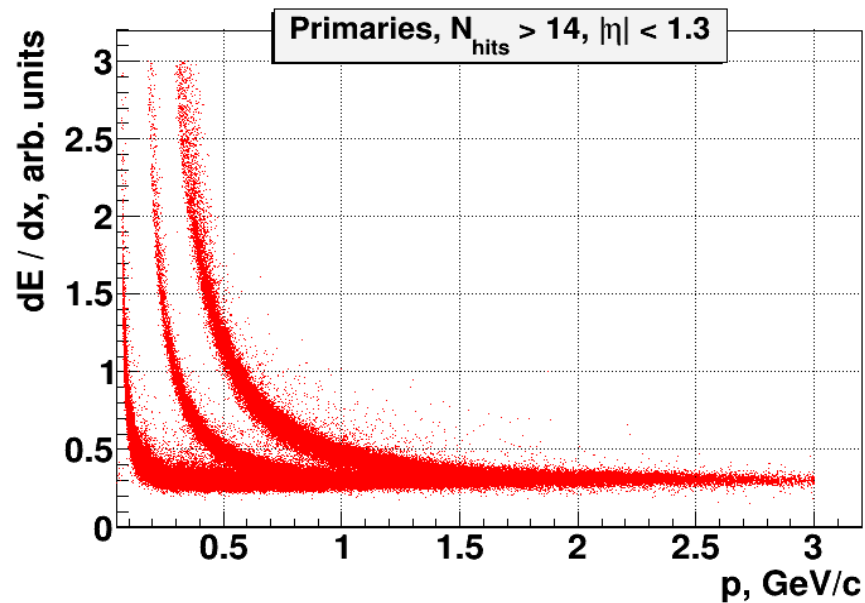


Track length resolution



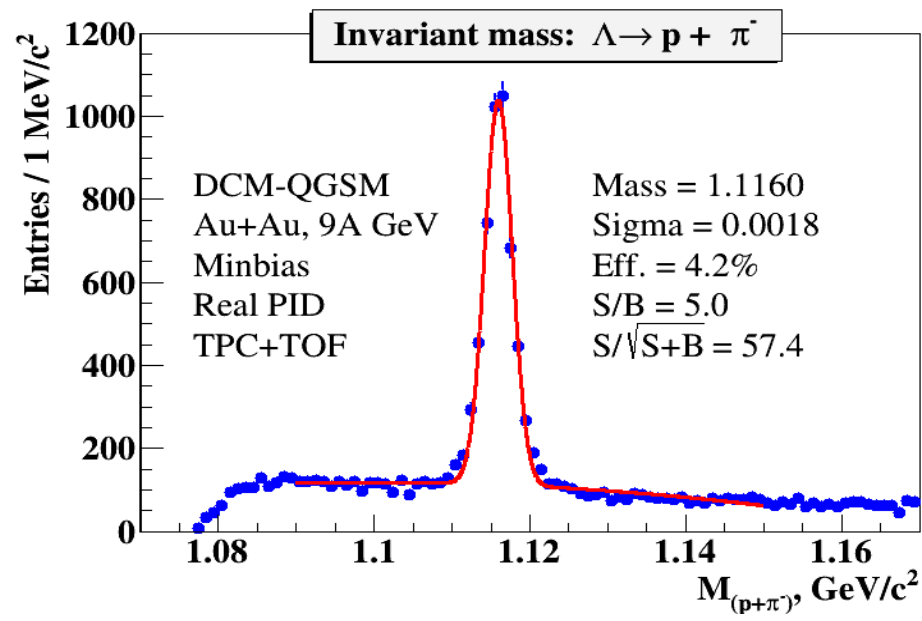
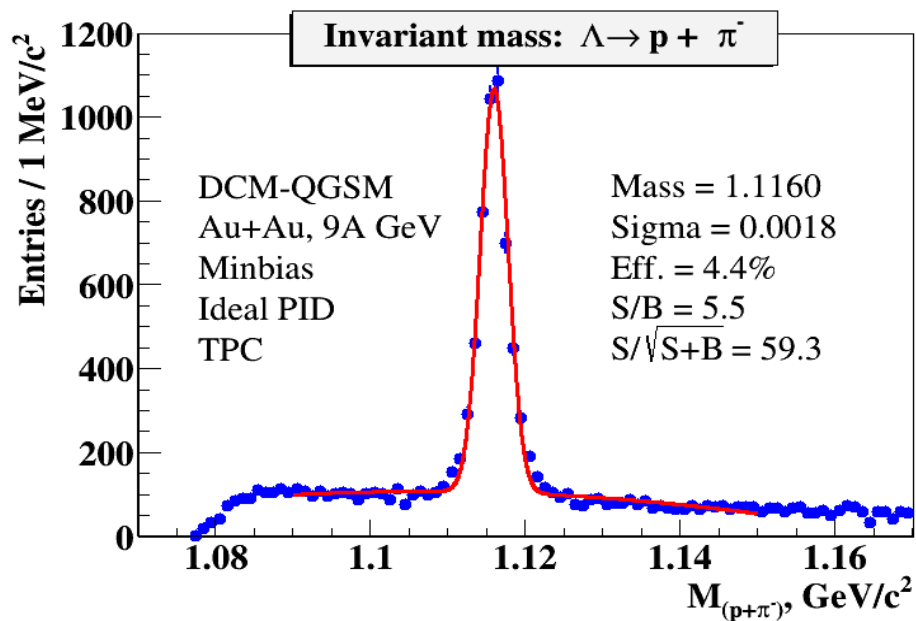


dE / dx measurement





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