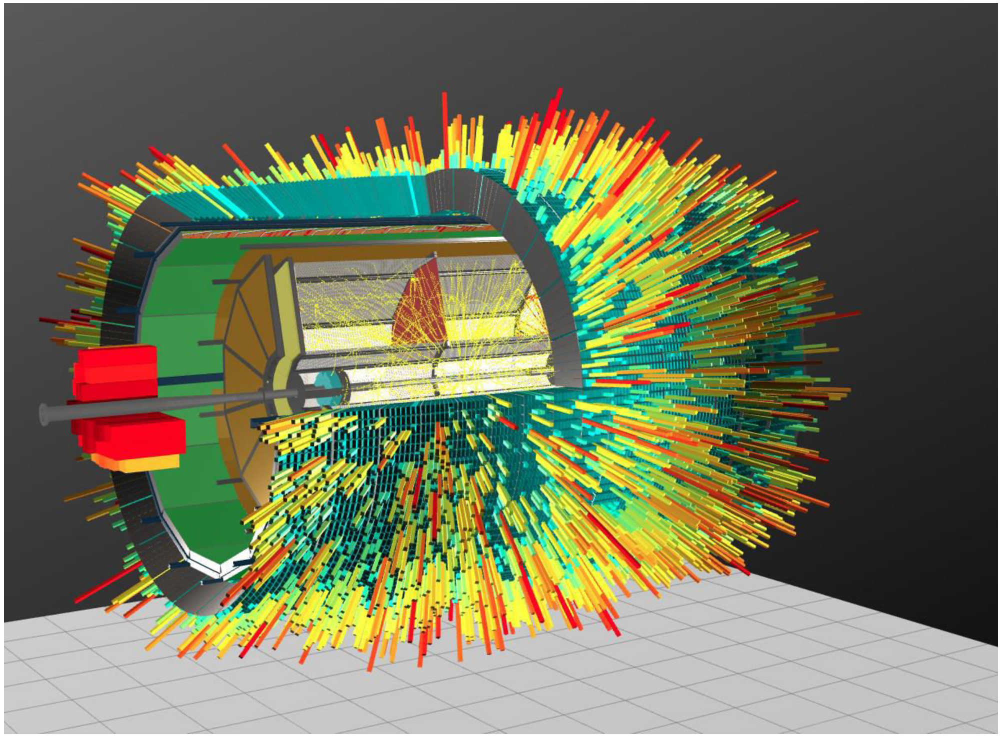
Nuclotron-based
Ion Collider fAcility

PWG4 summary

V. Riabov and C. Yang for the PWG4



Status & structure

- PWG4 scope - electromagnetic probes:
  - ✓ electromagnetic calorimeter (ECAL) reconstruction software
  - ✓ reconstruction of photons and neutral meson
  - ✓ dielectron continuum and LVMs
  - ✓ estimation of direct photon yields and flow
- Conveners: V. Riabov, Chi Yang
- Talk outline: most recent results and activities

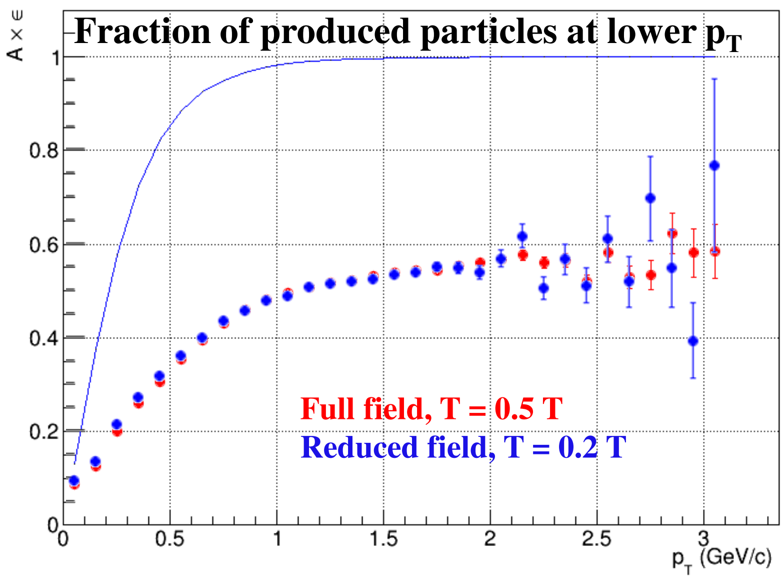
ECAL simulations

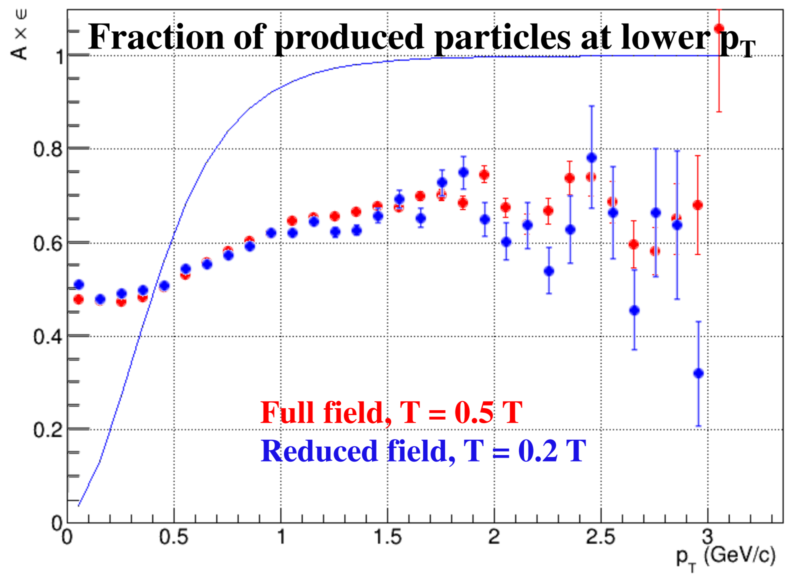
ECAL simulation and reconstruction

- ECAL simulation chain with the latest (v.4) geometry is available in MpdRoot
- ECAL tutorial was released and is available at https://mpdforum.jinr.ru/c/subsystem-software/30
- Reconstruction chain was tested with the latest mass productions (QA samples):
  - ✓ Request 25 → full field (B = 0.5 T)
  - ✓ Request 27 → reduced field (B = 0.2 T)

Neutral mesons: π^0 and η

- Reconstruction efficiencies:
  - ✓ Photons: E > 0 GeV, $T_{reduced}$ < 2 ns
  - ✓ |E1-E2|/(E1+E2) < 0.75
  - ✓ Pairs: |y| < 0.5





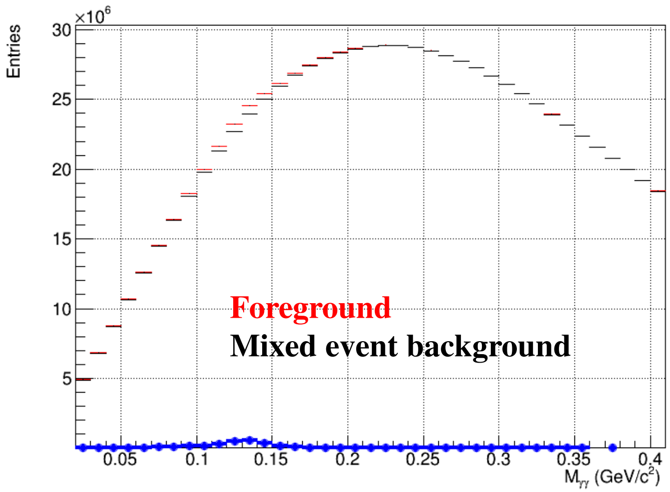
- Efficiency for π^0 is > 10% at p_T > 50 MeV
- Efficiencies are identical at full and reduced magnetic field
- Efficiency is larger for η meson compared to π^0

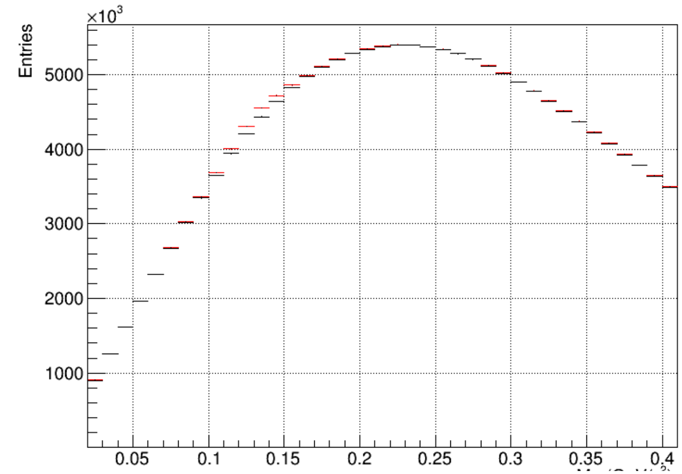
Neutral mesons at low p_T: π^0

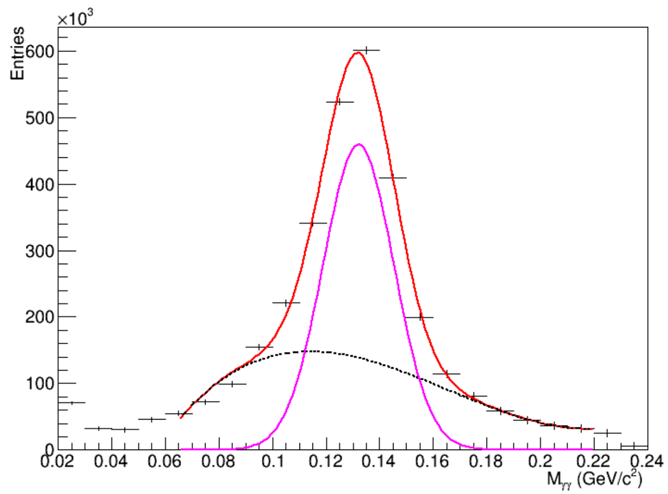
Full field, T = 0.5

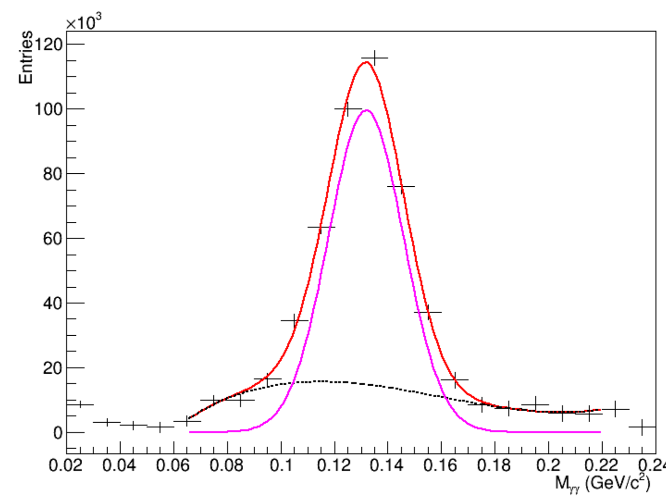
Reduced field, T = 0.2 T

0.025-0.075 GeV/c









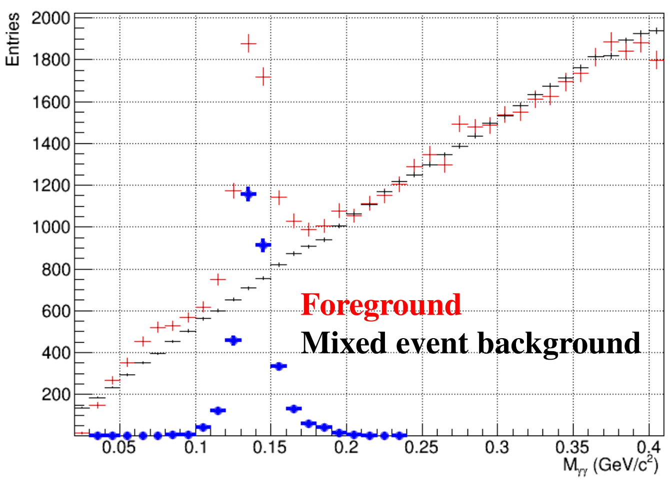
- Signal is measurable from ~ 50 MeV/c
- Similar S/B ratios at two field configuration

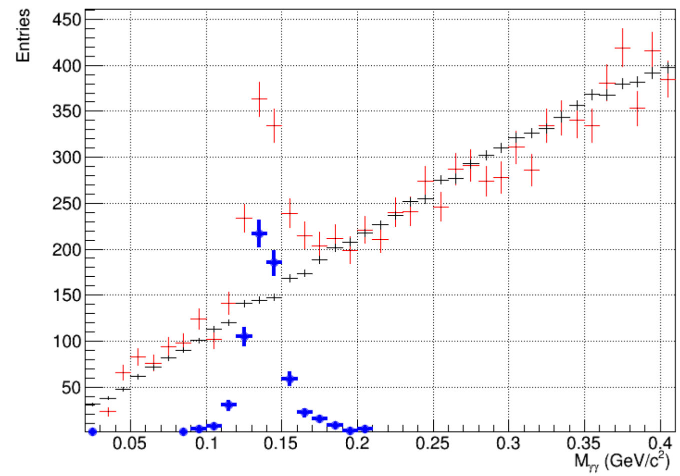
Neutral mesons at high p_T: π^0

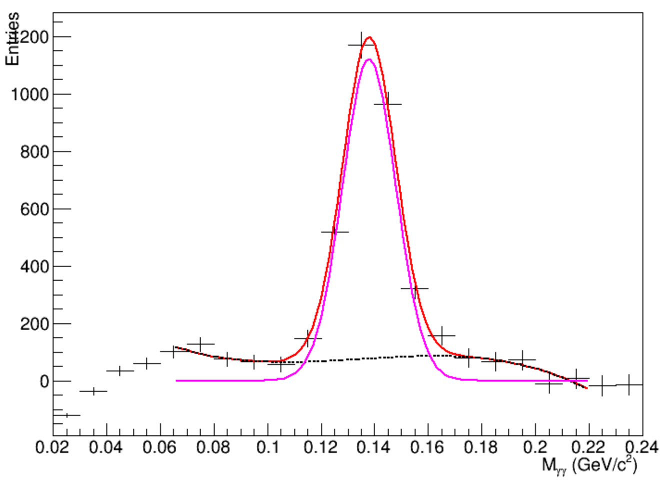
Full field, T = 0.5

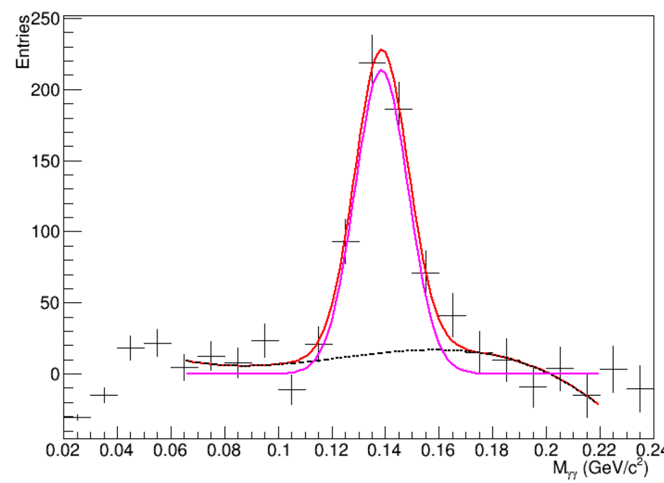
2-3 GeV/c

Reduced field, T = 0.2 T





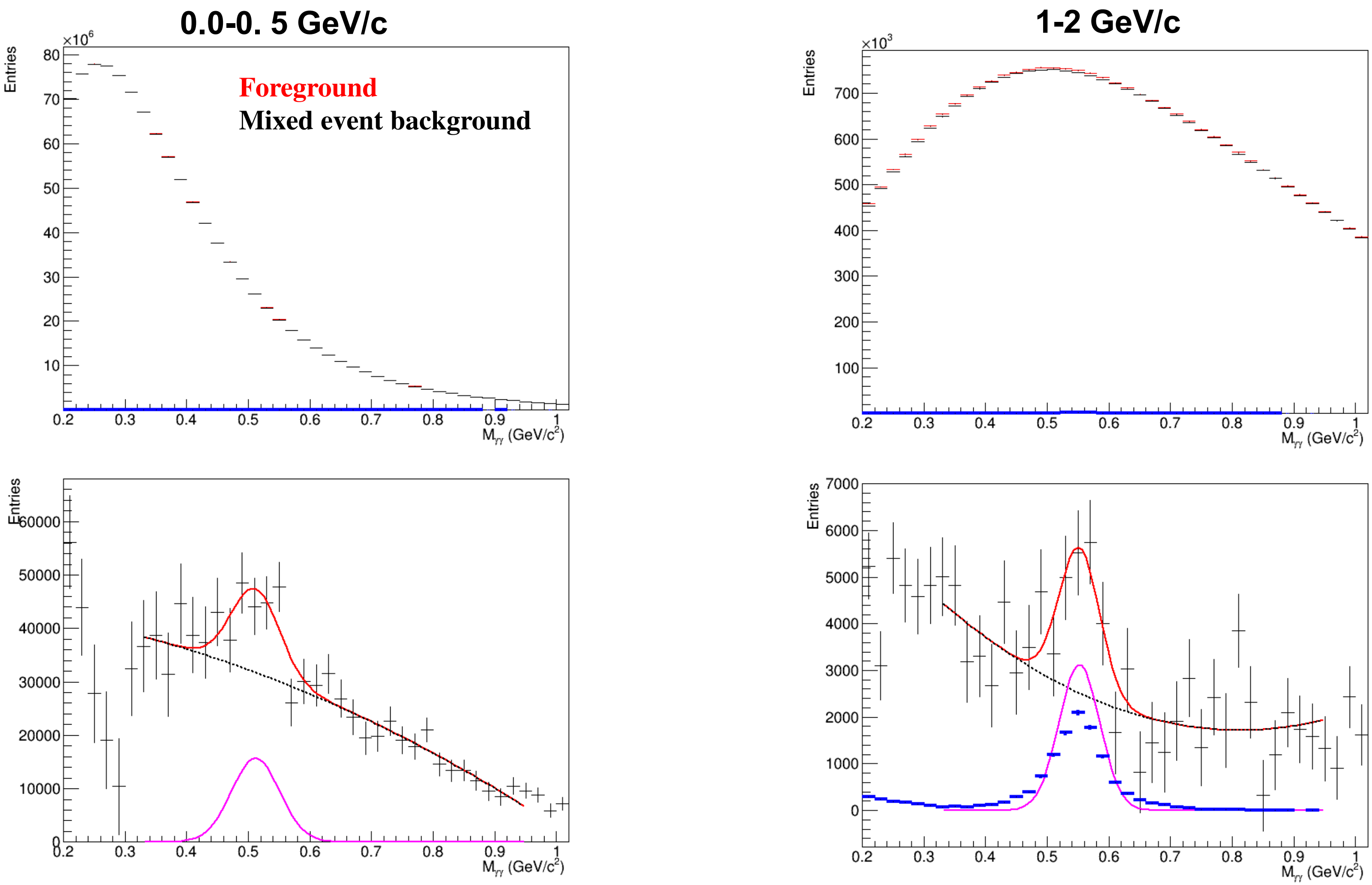




- The peak width decreases with increasing momentum (better energy resolution)
- The S/B improves with increasing momentum; similar S/B ratios

Neutral mesons: η

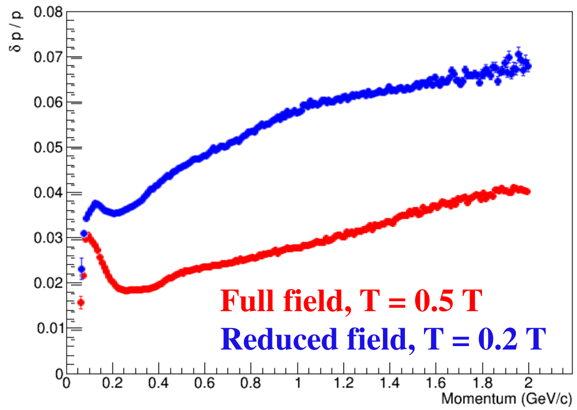
Full field, T = 0.5

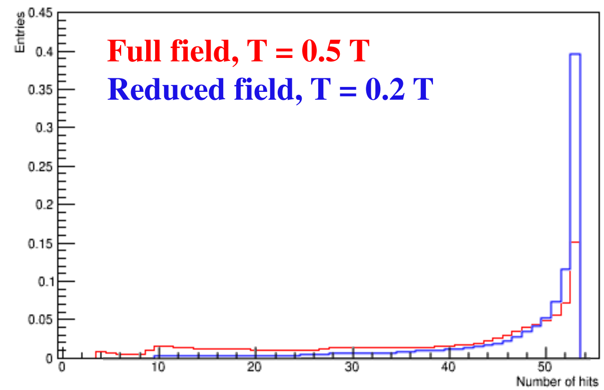


- The peak width decreases with increasing momentum (better energy resolution)
- The S/B improves with increasing momentum

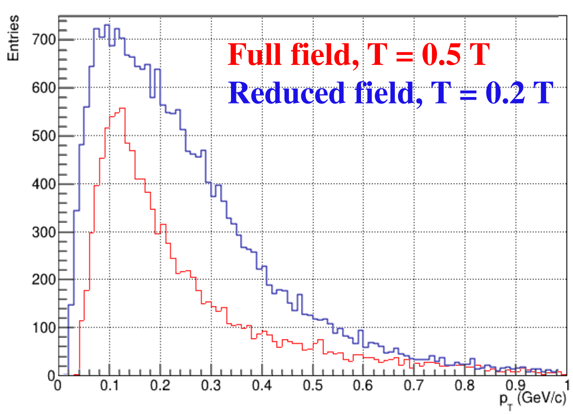
eID: full vs. reduced field

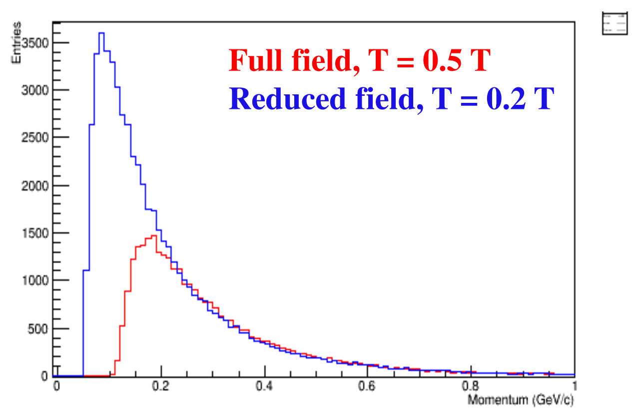
- Worse momentum resolution, larger number of hits





- Better acceptance for electron tracks in TPC (left) and TOF (right)

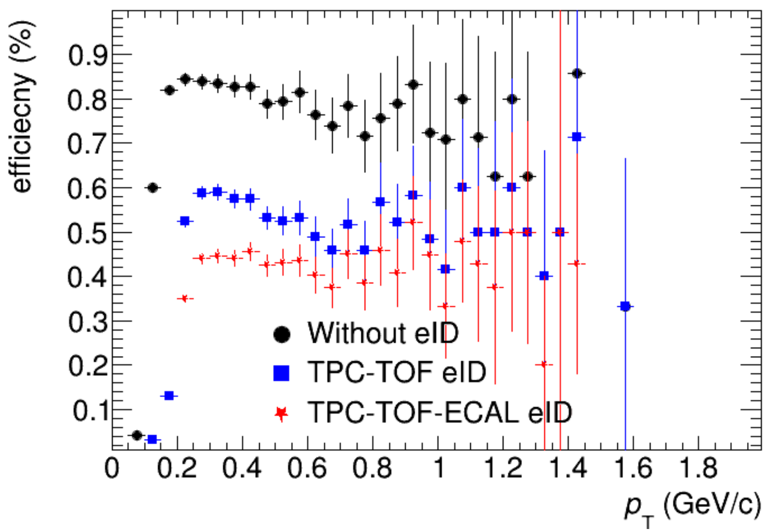


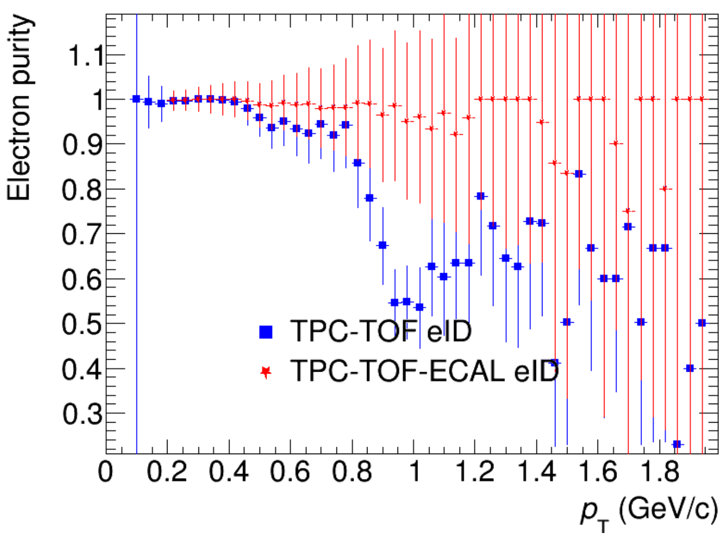


- Good prospects for combinatorial background rejection at lower magnetic field (to be tested with large data sets)

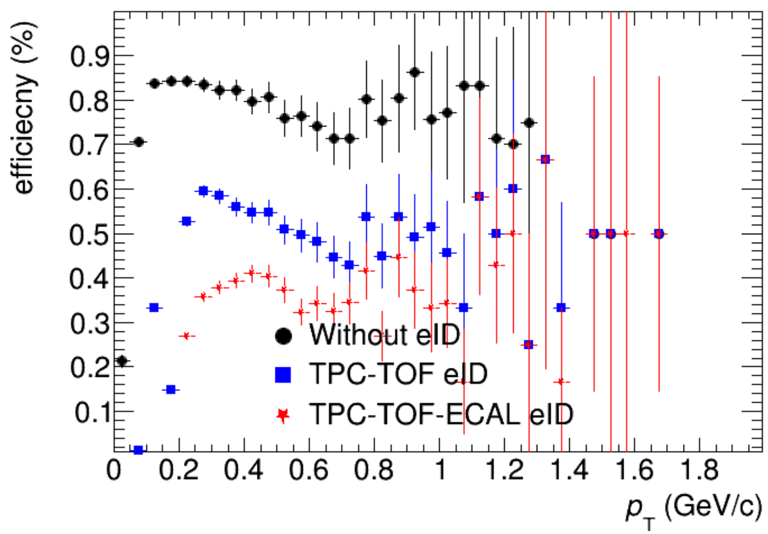
Electron reconstruction efficiency and purity

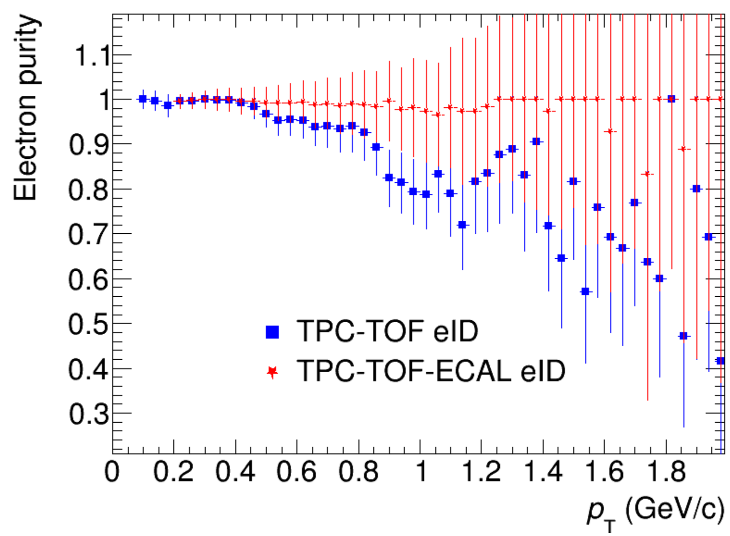
Full field, T = 0.5 T





Reduced field, T = 0.2 T



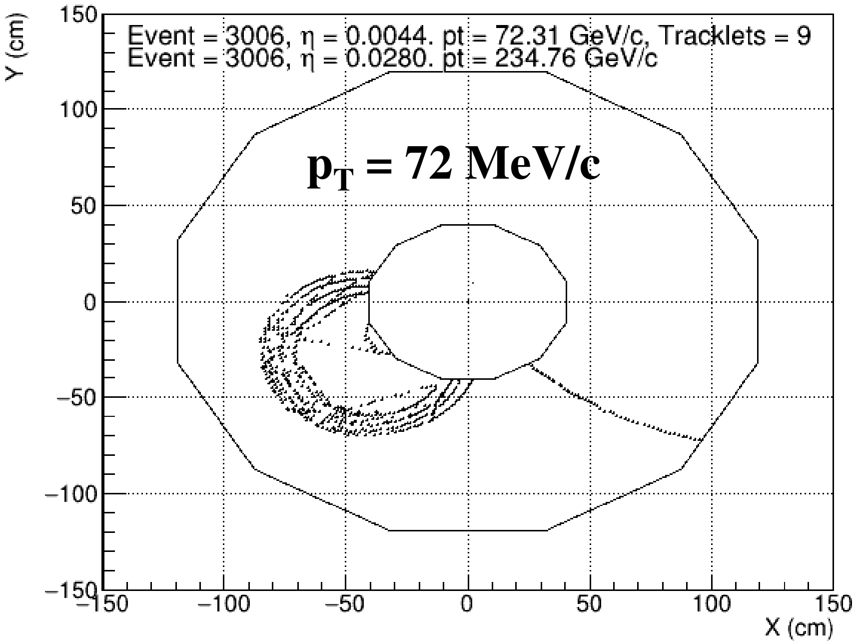


- Comparable electron reconstruction efficiency and better electron purity with the reduced magnetic field

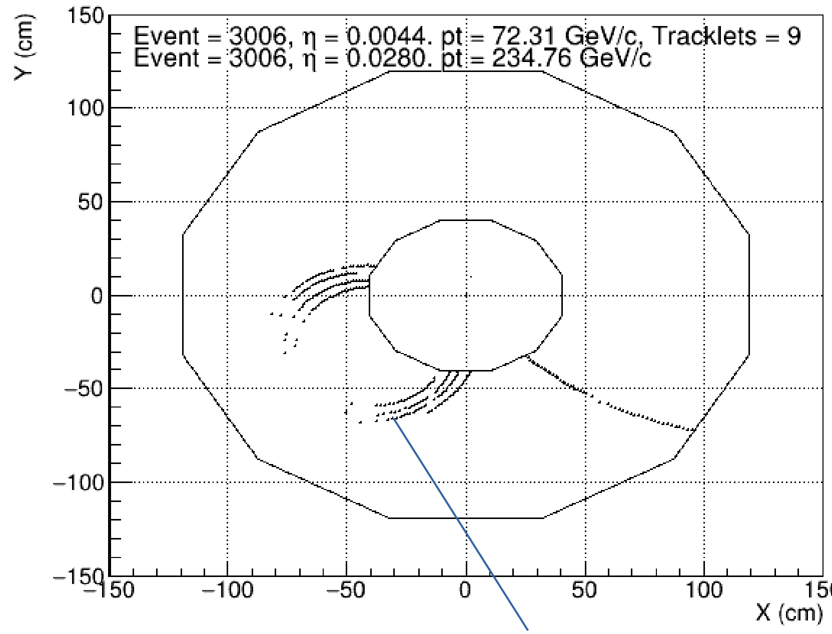
Dielectrons

Low-p_T track reconstruction

Reconstructed hits



Reconstructed tracks

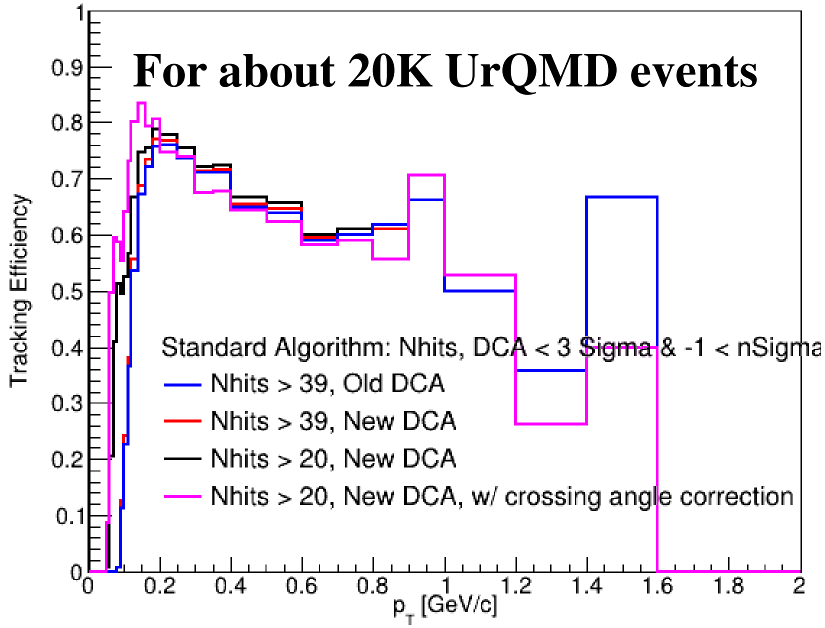


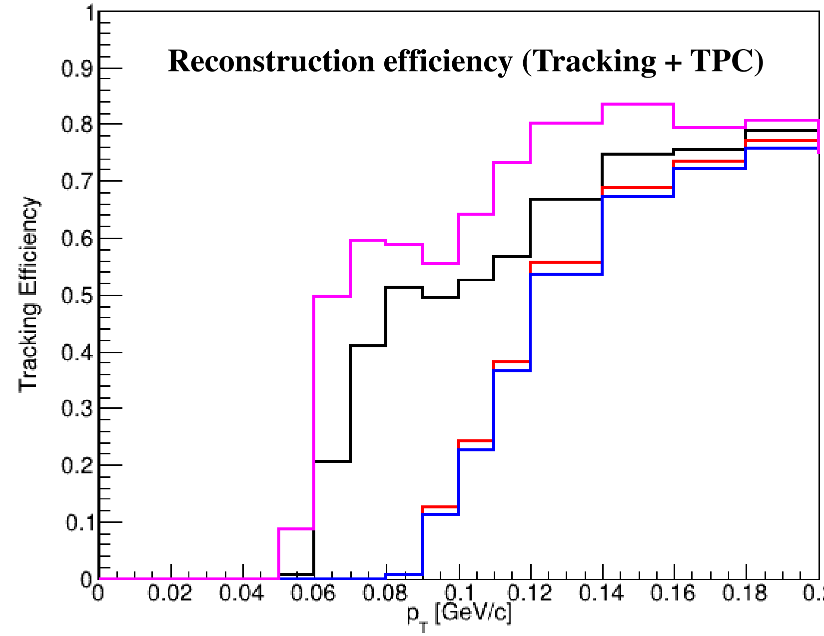
Partially reconstructed spiral track

- With current track reconstruction algorithm, low p_T tracks are not reconstructed properly even though full hit information is available in the detector for tracks with $p_T > 30$ MeV → major source of CB.

- Tracks with $p_T < 100$ MeV do not cross the TPC (hence don't reach TOF → Not defined as fully reconstructed).

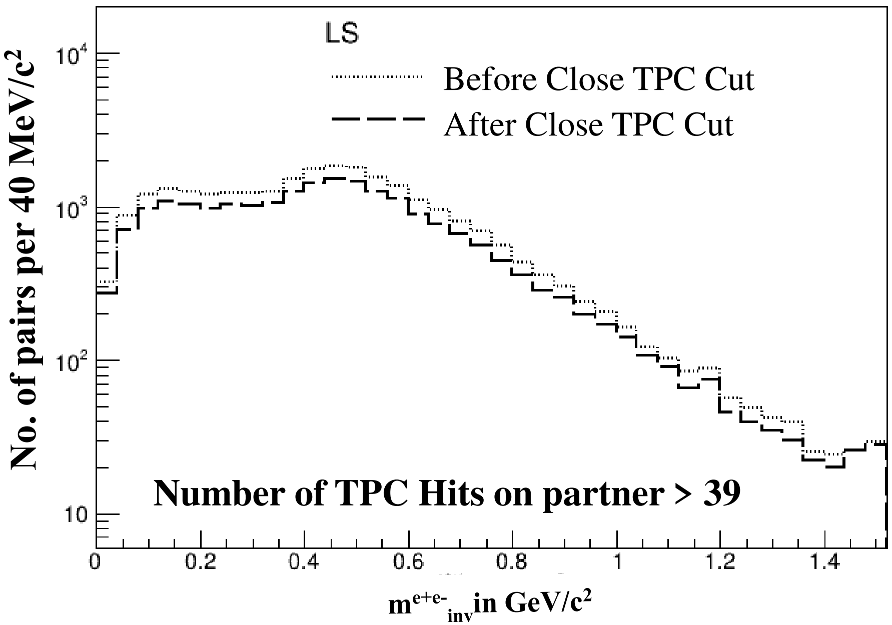
Improvement of electron reconstruction

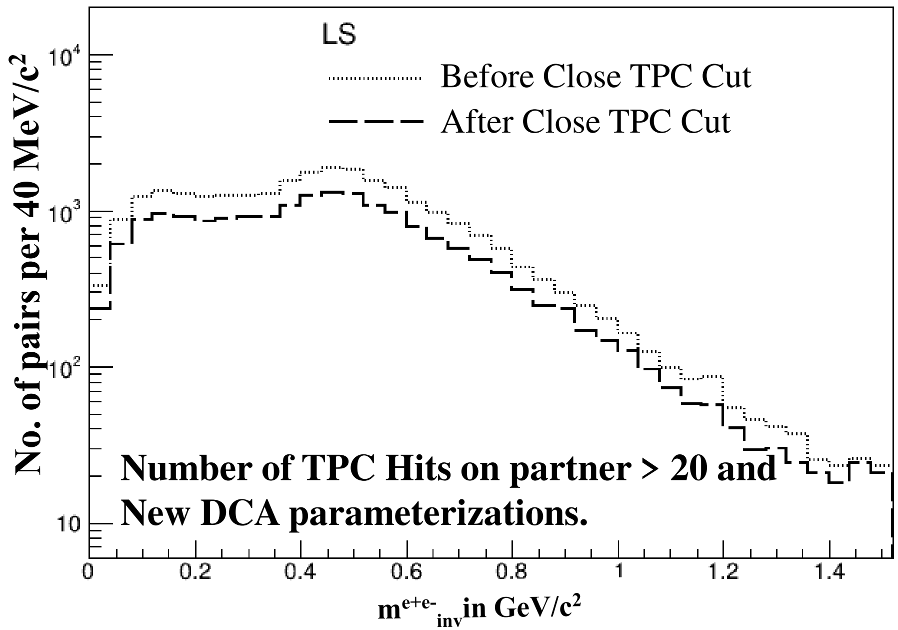




- Loosen the number of hits in TPC cut: $N_{hits} > 39 \rightarrow N_{hits} > 20$
- Better/renewed DCA parametrizations.
- Loosen cut on track χ^2 value during track fitting (suggested by A. Zinchenko) → crossing angle correction
- Improved reconstruction of low-p_T electron tracks

Reduction of combinatorial background



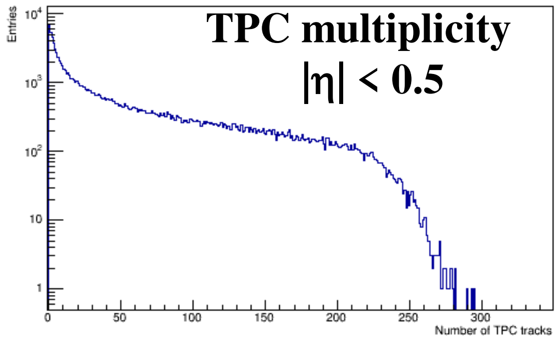


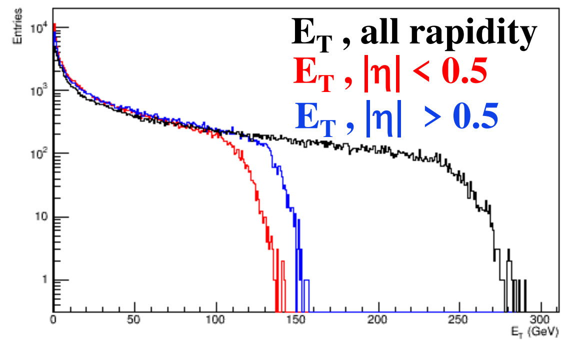
- LS background before and after close TPC cut.
- ~ 30% reduction in combinatorial background after tuning the low p_T track selection
- Clear trend of improvement in CB rejection even using current algorithm.
- Effect due to crossing angle correction is yet to be quantified.
- Expects further improvement once the current algorithm is improved (ongoing).
- Tests with lower-field data samples are ongoing

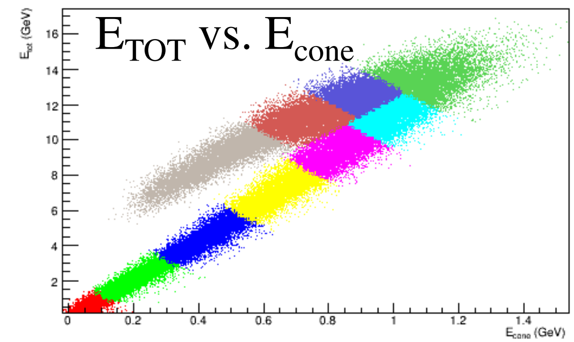
E_T as a measure of centrality

Centrality categorization (DCM-QGSM-SMM)

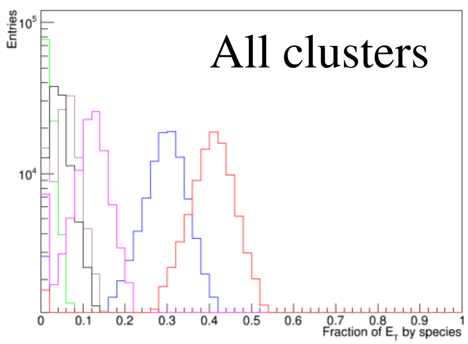
- Use TPC multiplicity, transverse energy E_T and FHCAL energy to determine event centrality

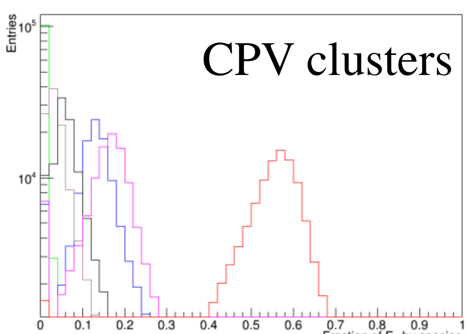




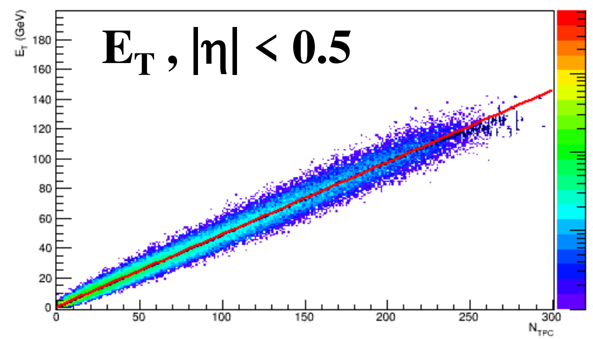


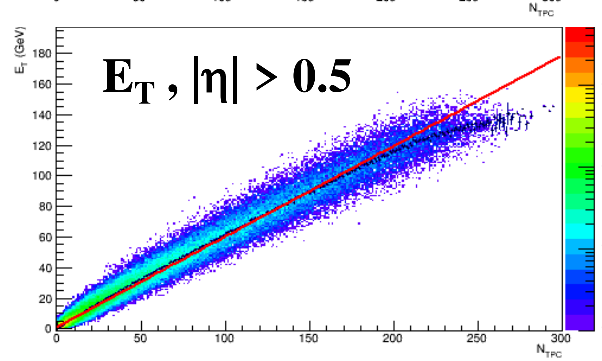
γ, $\pi^{\pm}$, $e^{\pm}$, $K^{\pm}$, $p^{\pm}$, n



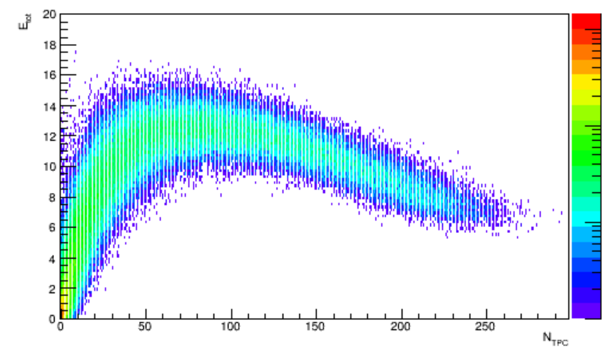


$E_T \sim N_{TPC}$

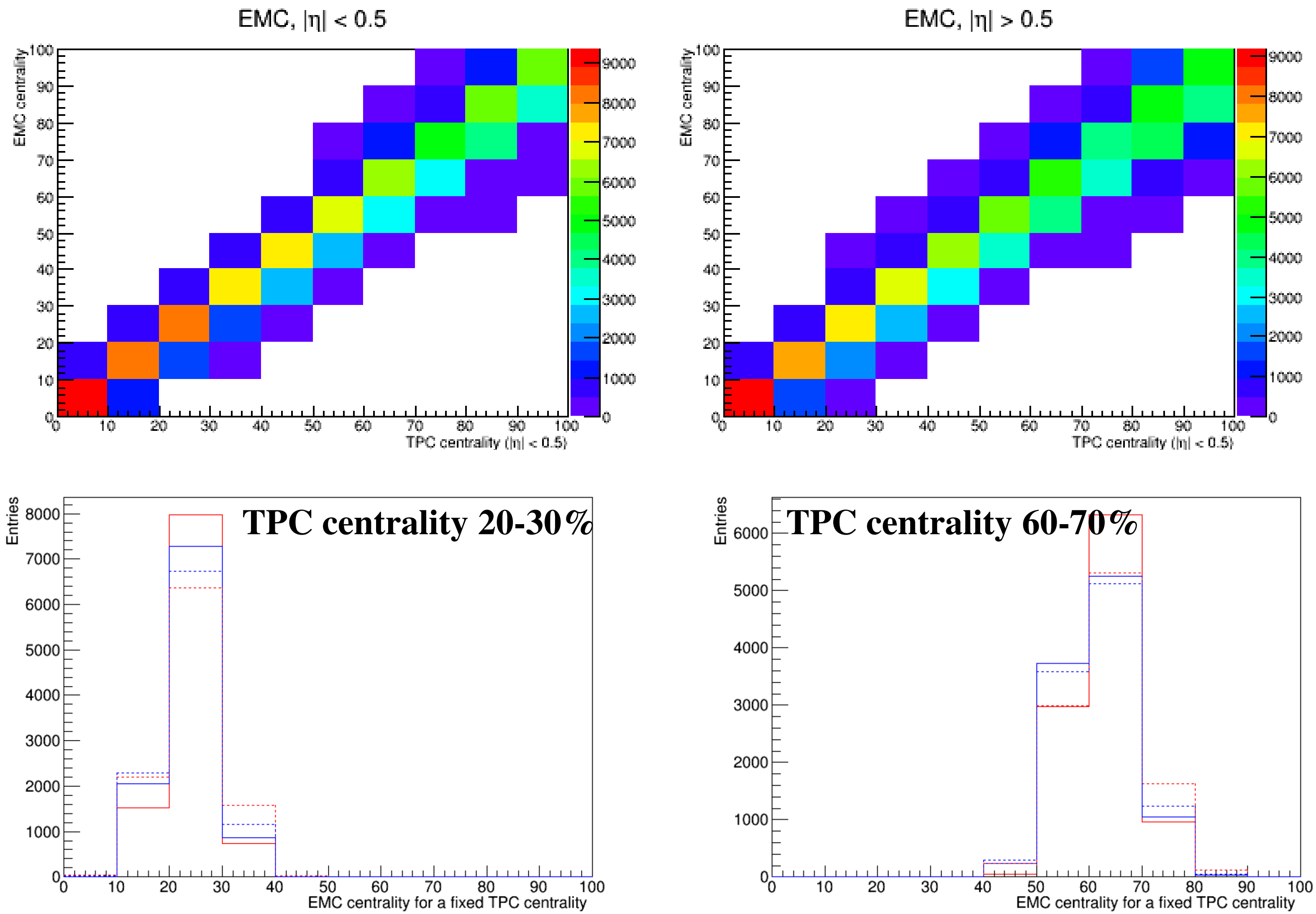




E_{FHCAL} vs. N_{TPC} → ambiguity



Centrality by E_T vs. centrality by TPC



E_T , $|\eta| < 0.5$, all clusters

E_T , $|\eta| > 0.5$, all clusters

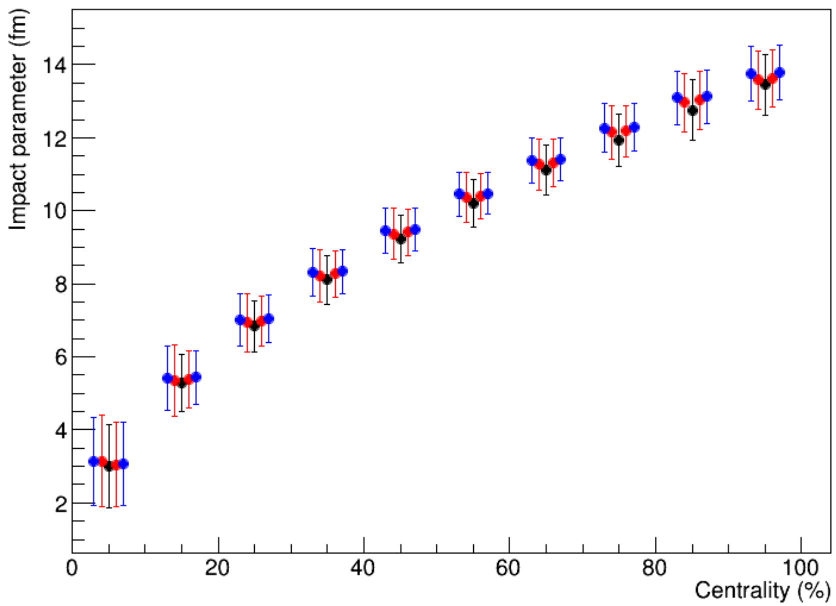
E_T , $|\eta| < 0.5$, CPV clusters

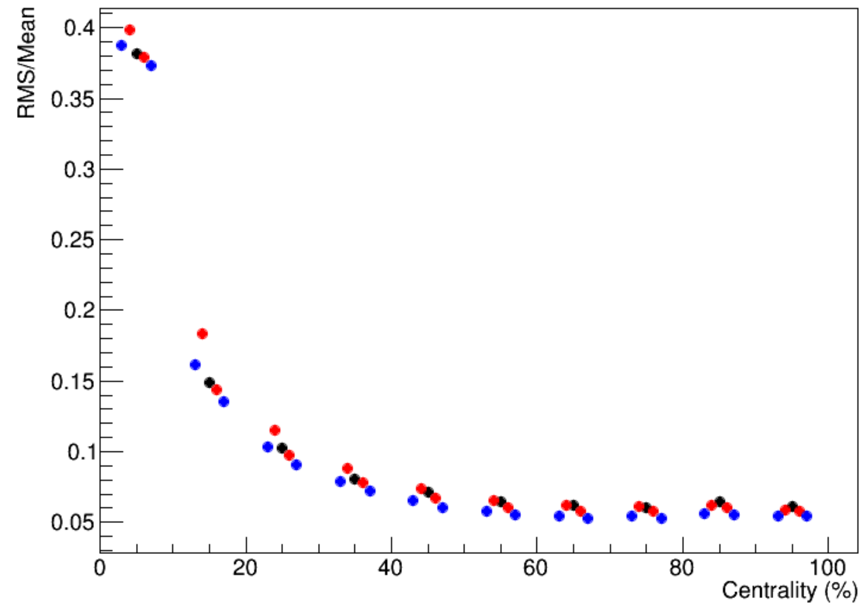
E_T , $|\eta| > 0.5$, CPV clusters

V. Riabov and C. Yang, PWG-4 summary

Sampled impact parameter distributions

E_T-CPV, $|\eta|> 0.5$, E_T-CPV, $|\eta|< 0.5$, TPC centrality, E_T, $|\eta|< 0.5$, E_T $|\eta|> 0.5$

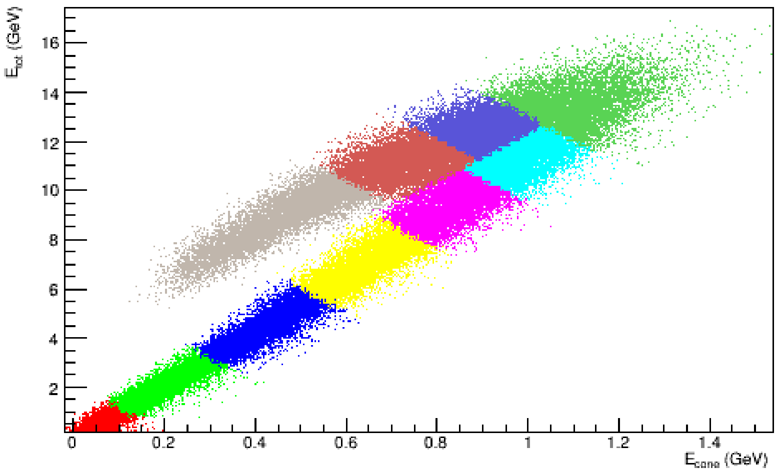


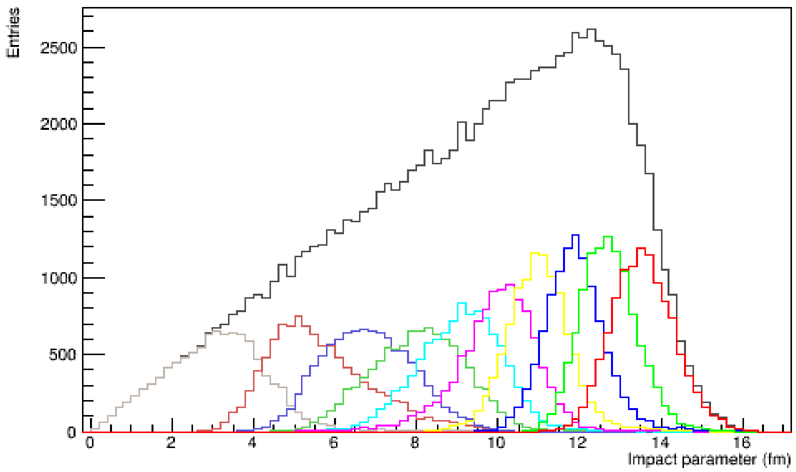


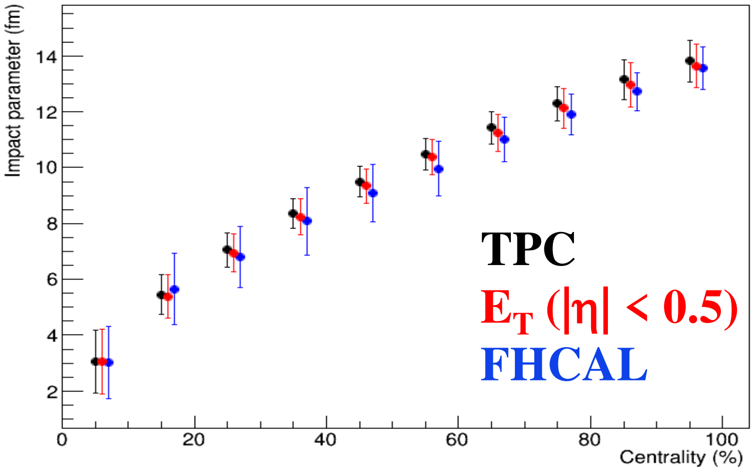
- Sampled impact parameter distributions are similar but event samples are different
- TPC and E_T can be used for centrality measurements, produce similar results

Centrality with FHCAL

E_{TOT} vs. E_{cone}

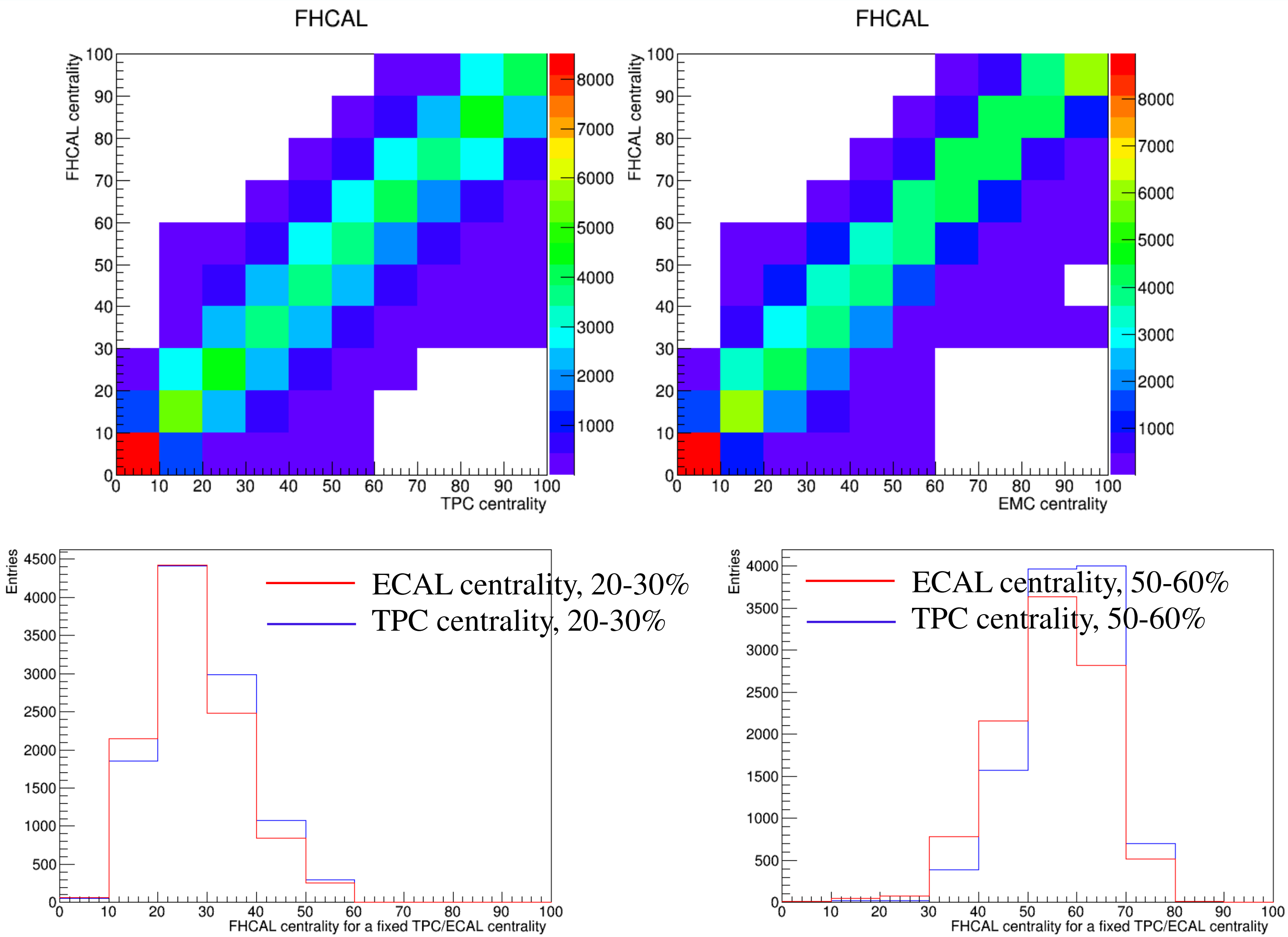






- TPC and ECAL are consistent
- FHCAL returns similar mean impact parameter values with wider spread (RMS) except for peripheral collisions

Centrality by FHCAL vs. centrality by TPC/ECAL



- FHCAL centrality has a very wide correlation with the TPC/E_T centrality
- Resolution by impact parameter is worse

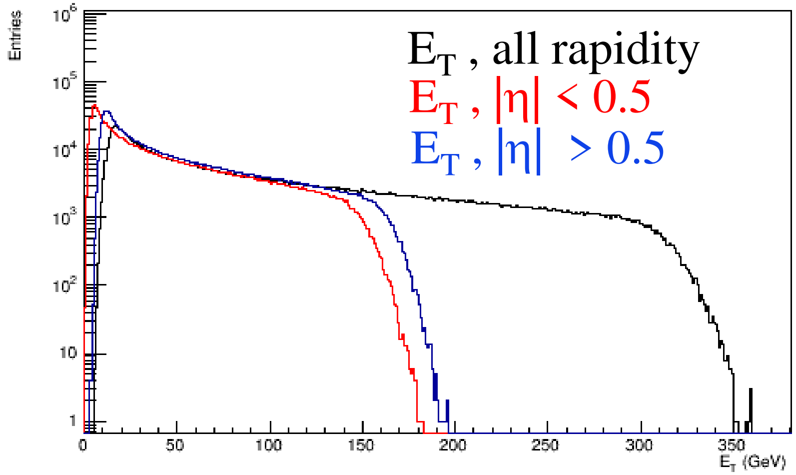
Summary

- PWG4 is active with many studies in progress
- Many vacant tasks, extra man power is needed
- Contact conveners if you wish to join or have any questions

BACKUP

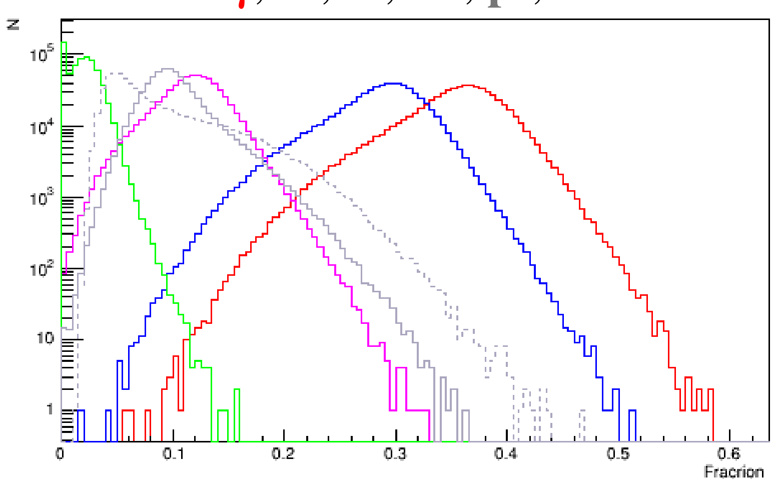
E_T distributions

- Transverse energy E_T



- Contributors:

γ, $\pi^\pm$, $e^\pm$, $K^\pm$, $p^\pm$, n



- Main contributors:
  - ✓ pions (**photons**, $\pi^\pm$)