A follow-up to the DAC discussions

V. Riabov

Outline

- Status and performance of the MPD-ECAL simulation/reconstruction software was presented at the last DAC meeting:
  - ✓ cluster unfolding in ECAL
  - ✓ ECAL space and energy resolution
  - ✓ cluster-to-track matching
  - ✓ electron and gamma PID
  - ✓ π^0 and η reconstruction with ECAL and via conversion
  - ✓ dilepton invariant mass distributions

- Due to time limitations (20 min), presented results missed important details → potentially this could lead to misunderstandings

- The DAC acknowledged significant progress in development of the MPD-ECAL simulation/reconstruction software. However, a number of comments and requests were made to be addressed

DAC recommendations (minutes)

- Since the spectra of produced particles in the NICA energy range are rather steep, and low pt are dominant, the DAC worries about too low efficiency of gammas and mesons at small pT. The DAC recommends to study single particle simulations and compare them to full event simulations (or single particle embedded into full event simulations) in order to assess where the efficiency losses occur.

- The MPD –AC request a simulation based on true test signals of prototypes and signal cuts just above (30%) the pedestal of the detector. This would ensure optimal position resolution and also lowest energy cut of photons or electrons, thus increasing the efficiency at low momenta. It also would shed more accurate light on the population density of hits onto ECAL.

- The DAC would like to see rather quickly a simulation of the $\pi 0$ and eta reconstruction with ECAL and Dilepton invariant mass spectra with these new lower energy cuts.

- The DAC recommends to have dedicated persons working on gamma reconstruction and dileptons.

→ Lets discuss these comments/requests

Minimum energy cut, E_{min}

- **The *M*PD –AC request a simulation based on true test signals of prototypes and signal cuts just above (30%) the pedestal of the detector. This would ensure optimal position resolution and also lowest energy cut of photons or electrons, thus increasing the efficiency at low momenta. It also would shed more accurate light on the population density of hits onto ECAL**

- We do not know yet the true level of noise in electronics and hence the realistic pedestal levels. Input from the production/test team is needed.

- In presented simulations, we used a minimum energy cut of E_{min} > 5 MeV for tower signals. It is a realistic, biased towards optimistic, estimation of the expected pedestal level.
  - ✓ PHENIX, shashlik-type Pb-Sc calorimeter, E_{min} ~ 10 MeV
  - ✓ ALICE, PHOS, E_{min} ~ 5 MeV

Occupancy

Phys. Rev. C 93, 024901

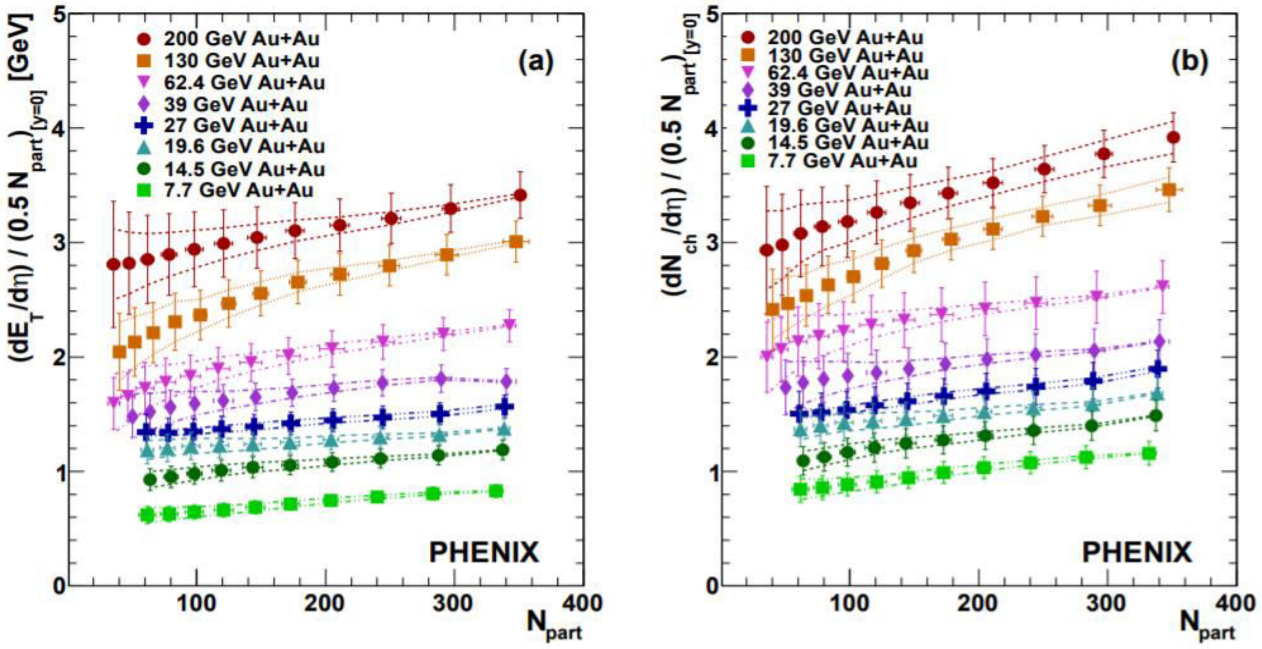


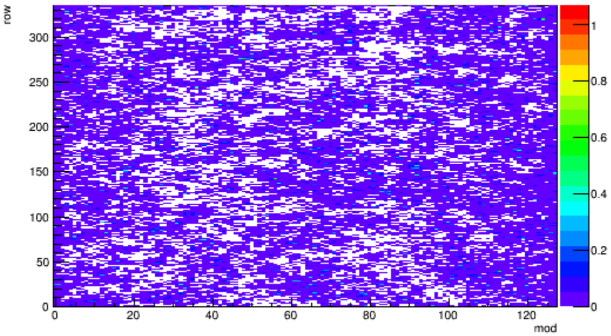
FIG. 2. (Color online) $(dE_T/d\eta)/(0.5N_{\rm part})$ (a) and $(dN_{\rm ch}/d\eta)/(0.5N_{\rm part})$ (b) at midrapidity as a function of $N_{\rm part}$ for Au+Au collisions 200, 130, 62.4, 39, 27, 19.6, 14.5, and 7.7 GeV. The lines bounding the points represent the trigger efficiency uncertainty within which the points can be tilted. The error bars represent the remaining total statistical and systematic uncertainty.

- E_T ~ 400 GeV in the MPD-ECAL acceptance in most central events, E_T is by convention taken as the kinetic energy for baryons, the kinetic energy + 2 m_N for antibaryons, and the total energy for all other particles

- PHENIX Pb-Sc calorimeter measures up to E_{tot}^{raw} ~ 400 GeV in the MPD-ECAL acceptance in 0-5% AuAu@7-14

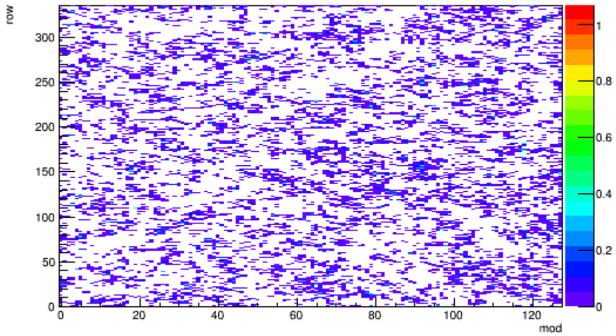
UrQMD, AuAu@11, b ~1 fm

$E_{min} = 0$ MeV



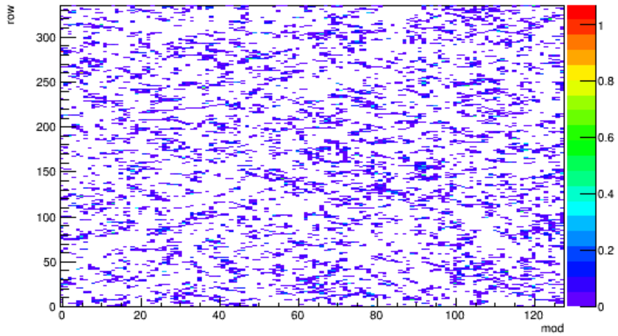
occupancy ~ 0.72

$E_{min} = 5$ MeV



occupancy ~ 0.27, used as default

$E_{min} = 10$ MeV



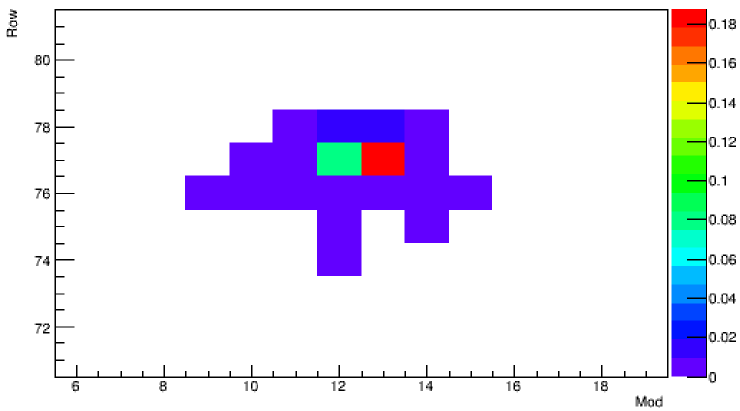
occupancy ~ 0.20

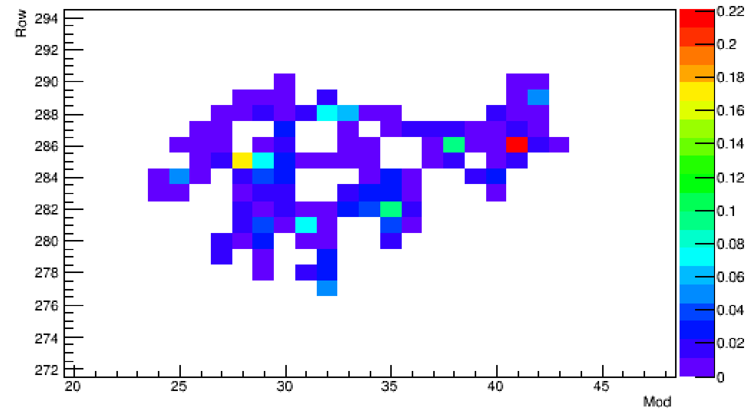
- Occupancy is comparable to that in higher energy heavy-ion experiments
- Average tower energy, E_{tot} / N_{towers} ~ 12 MeV

→ It is very unlikely that the minimum energy cut will decrease

UrQMD, AuAu@11, b ~1 fm

- *Since the spectra of produced particles in the NICA energy range are rather steep, and low pt are dominant, the DAC worries about too low efficiency of gammas and mesons at small pT. The DAC recommends to study single particle simulations and compare them to full event simulations (or single particle embedded into full event simulations) in order to assess where the efficiency losses occur*

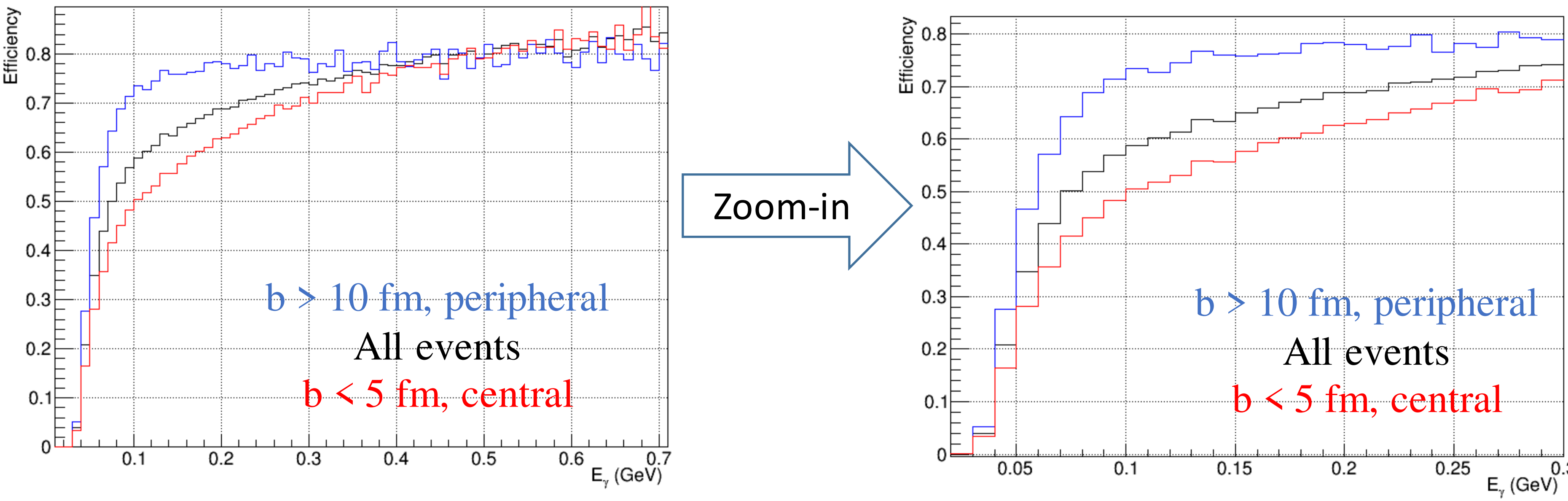




- Cluster is reconstructed as a group of towers surrounding a local maximum (followed by cluster splitting in case of multiple local maxima in the group)
- Seed tower (local maximum candidate) should have $E_{tower} > E_{seed} = 30$ MeV
- Lower E_{seed} cut → fake local maxima due to local energy fluctuations (fake cluster splitting)
- Higher E_{seed} cut → smaller reconstruction efficiency at low E, fake shower merging
- Compromise was to reconstruct clusters with $E\gamma_{min} > 50$ MeV
- Typical PHENIX/ALICE analysis cuts, $E\gamma_{min} > 100\text{-}300$ MeV

Photon reconstruction efficiency

- Efficiency with basic cuts:
  - ✓ Events: UrQMD, |z-vertex| < 20 cm
  - ✓ Photons: |y| < 0.5, T < 2 ns, $N_{towers} \geq 2$ (the latter two have marginal effect on efficiency)

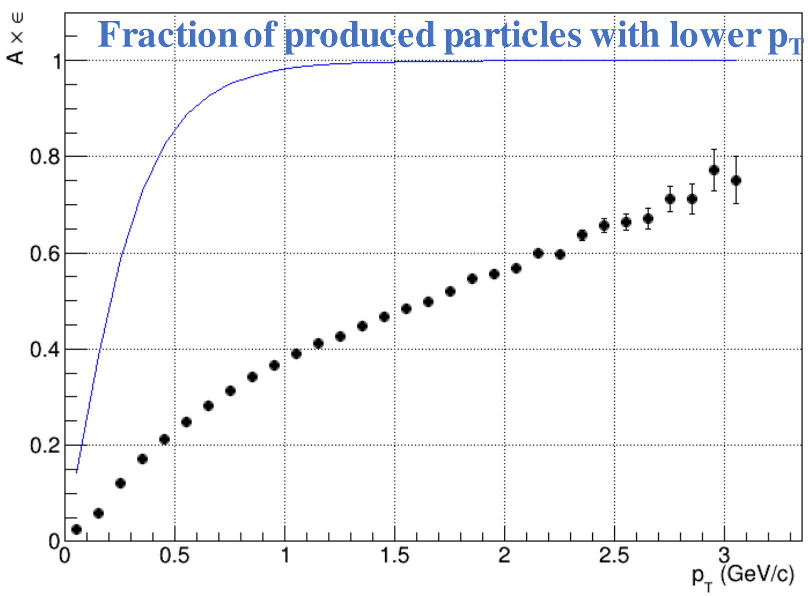


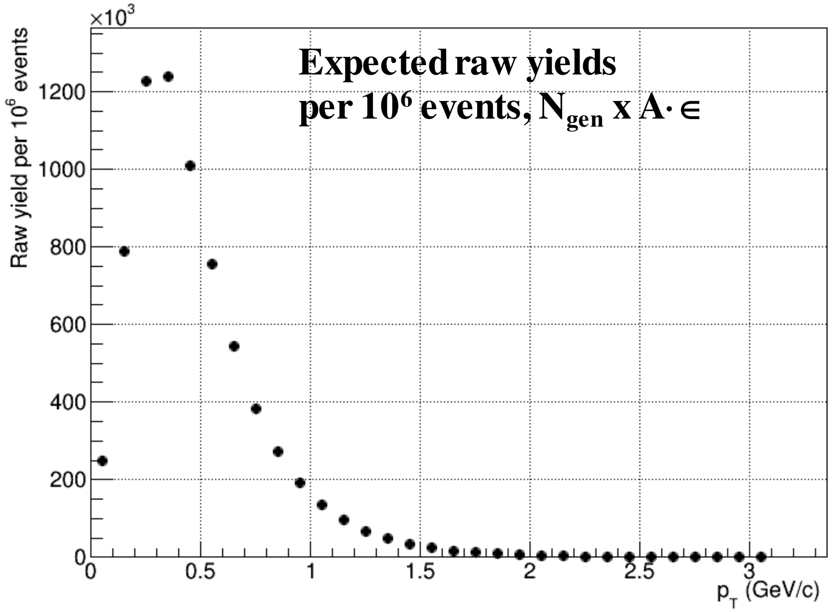
- Peripheral collisions emulate single photons (low overlap probability)
- Efficiency flattens at 80% due to conversion in the TPC/TOF (maximum efficiency is ~ 80%)
- Efficiency decreases at low energy due to cluster splitting and E_{seed} = 30 MeV cut
- Photons with E_{γ} < 30 MeV are not reconstructed, efficiency is > 25% at E_{γ} > 50 MeV
- At E_{γ} < 400 MeV, efficiency is smaller in high-multiplicity events due to cluster merging
- Efficiency is well understood, multiplicity dependence is unavoidable at observed occupancy

Reconstruction of π^0

- *The DAC would like to see rather quickly a simulation of the π0 and eta reconstruction with ECAL and Dilepton invariant mass spectra with these new lower energy cuts*

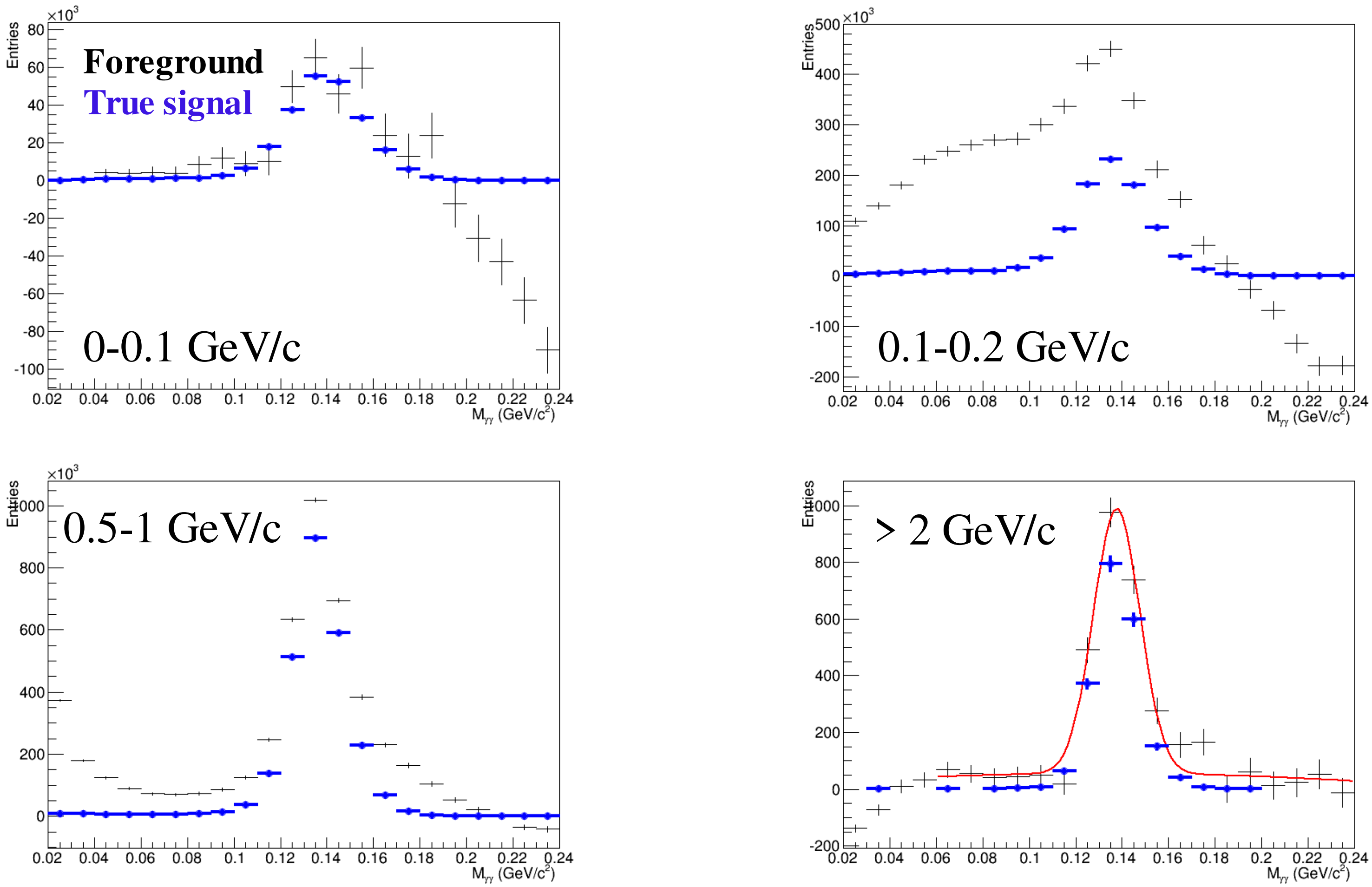
- Loosen cuts to increase efficiency:
  - ✓ Events: UrQMD, $|z\text{-vertex}| < 50$ cm
  - ✓ Photons: $T < 2$ ns, $N_{towers} \geq 2$, $E_{\gamma} > 0$ MeV
  - ✓ Pairs: $|y| < 0.5$





- Efficiency for π^0 increased $\times 2$ at low momentum with basic cuts only
- Signal is seen starting from 0-0.1 GeV/c (next slide)
- Presented efficiency is as high as we can get with a given clusterizer
- The highest raw yield of π^0 is expected at 300-400 MeV/c

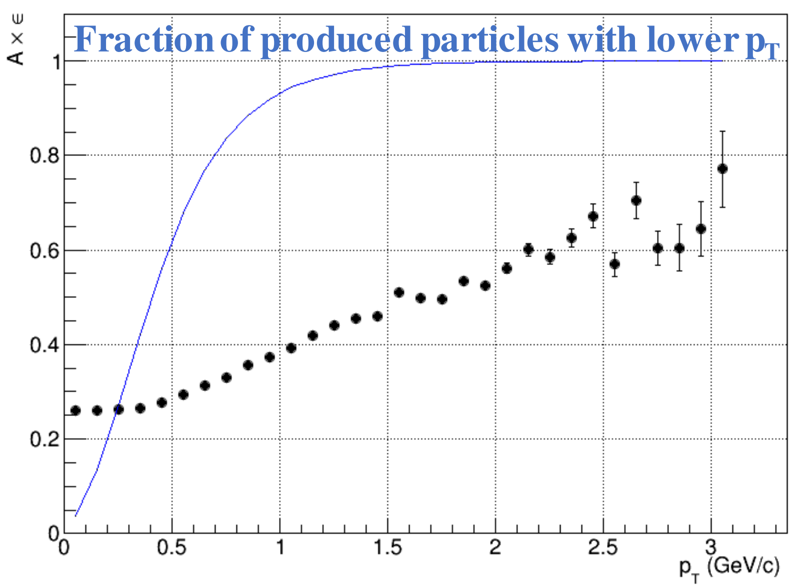
Reconstruction of π^0

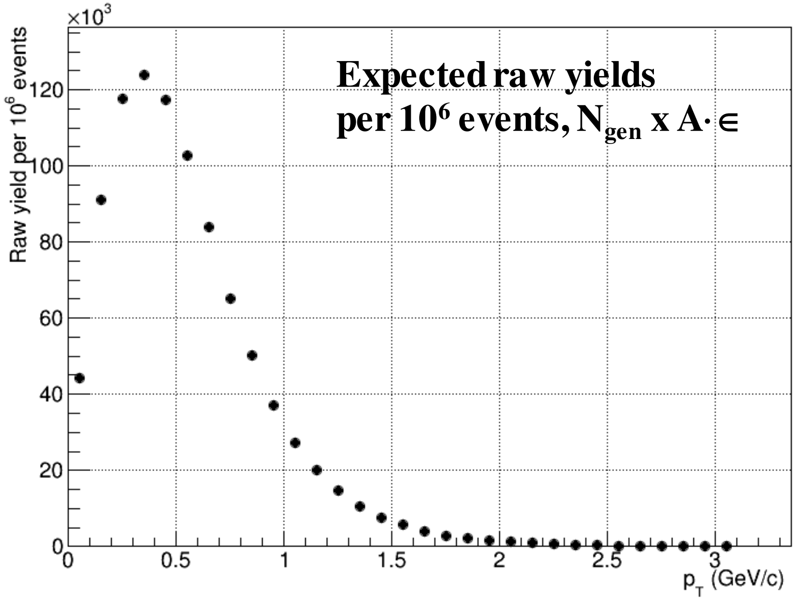


- π^0 can be extracted with basic cuts from zero momentum
- Basic cuts provide the highest efficiency, but not the highest signal significance
- Higher efficiency is not the only parameter, $S/\sqrt{(S+B)}$, peak shape are as important

Reconstruction of η

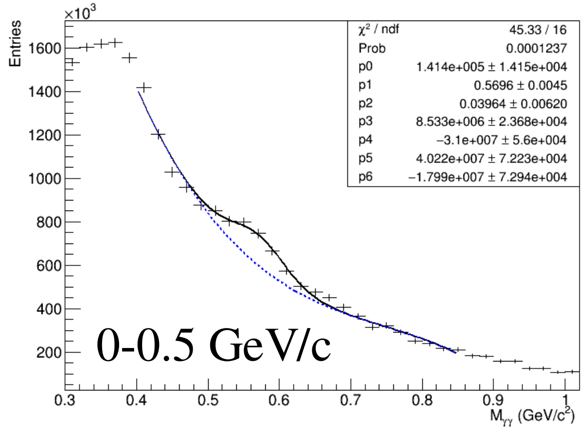
- Efficiency with loose cuts (same as for π^0):
  - ✓ Events: UrQMD, |z-vertex| < 50 cm
  - ✓ Photons: T < 2 ns, $N_{towers} \geq 2$, $E_\gamma > 0$ MeV
  - ✓ Pairs: |y| < 0.5

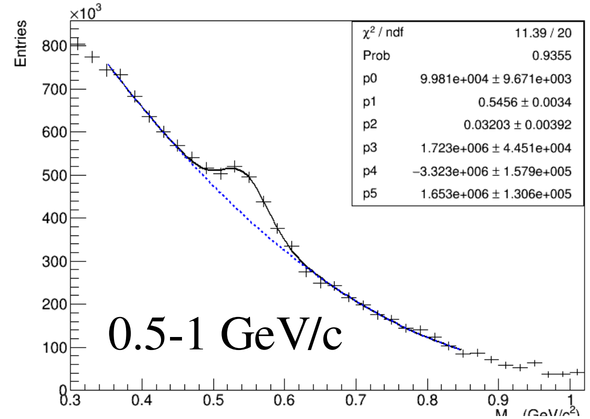


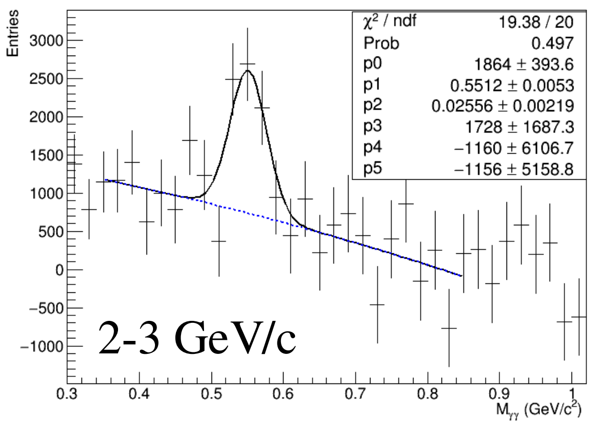


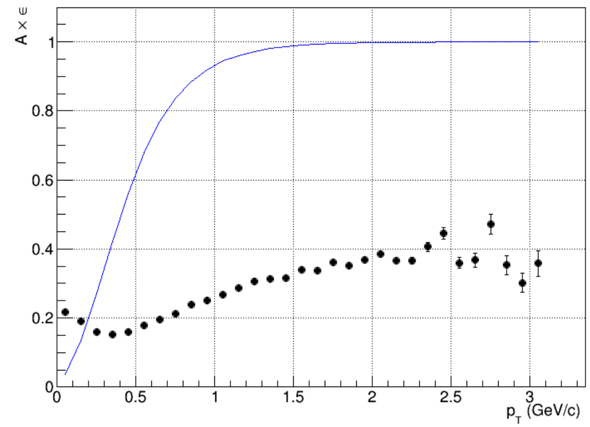
- Efficiency for η increased with basic cuts only, but not as much as for pions
- Presented efficiency is as high as we can get with a given version of the clusterizer
- The highest raw yield of η is expected at 300-400 MeV/c

Reconstruction of η









- η can not be reconstructed with basic cuts !!!
  → higher efficiency does not necessarily means better signal extraction
- η can be reconstructed from nearly zero momentum with tighter cuts:

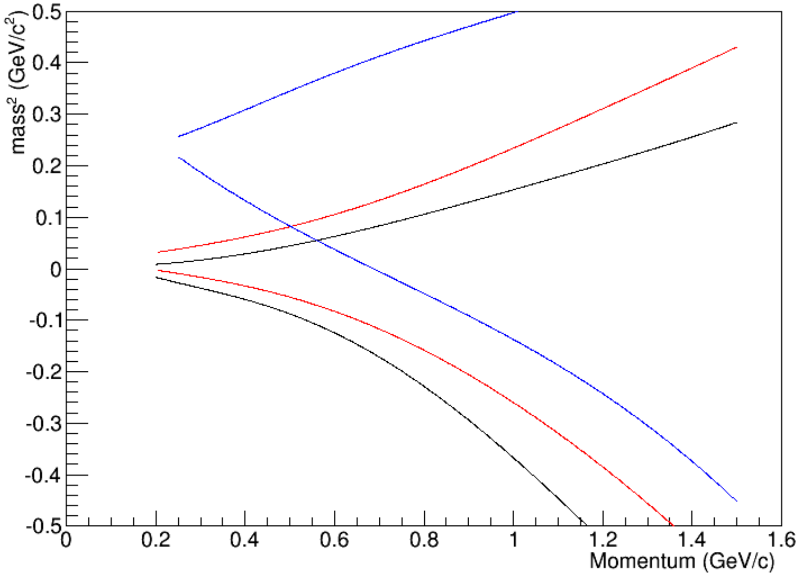
  ✓ Photons: T < 2 ns, $N_{towers} \geq 2$ + $E_{\gamma} > 0.2$ GeV, charged track veto, Chi2/NDF < 4
  ✓ Efficiency is 1-2 times smaller with tighter cuts

(Di)electrons

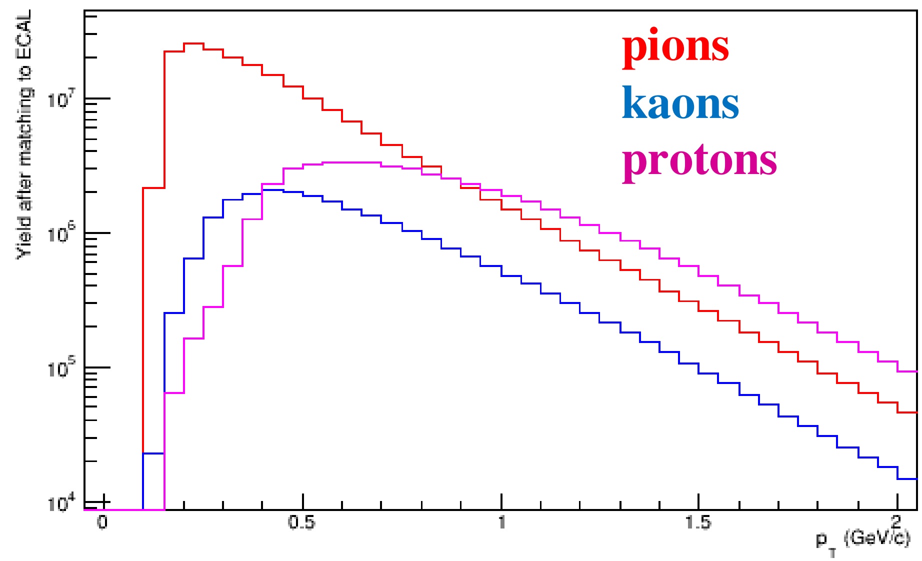
- The main complaint was about low electron detection efficiency with the ECAL
- Higher electron efficiency can be reached by releasing the analysis cuts (mostly E/p cut in ECAL). However, it worsens e/h rejection → no real gain
- Lets additionally use ECAL-TOF measurements for hadron rejection. Two ‘soft’ cuts on ECAL-TOF and E/p can be more efficient than a single ‘tight’ E/p cut, at the same time preserving e/h rejection at acceptable levels
- Simulation of hadron TOF in the ECAL is not reliable and time resolution is usually tuned to data → additional smearing of simulated cluster-times by 500 ps (typical resolution for hadrons)

ECAL-TOF

2σ m^2-bands for $e^{\pm}$, $\pi^{\pm}$ and $K^{\pm}$



Reconstructed particle spectra with ECAL matching

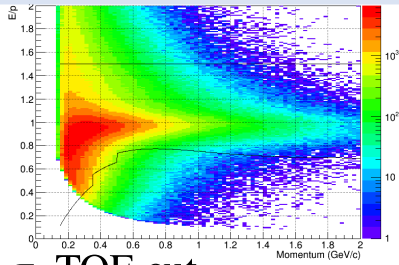


- MPD-ECAL can not fully separate pons and electrons by TOF:
  - ✓ e/π rejection is efficient only at very low momentum
- However, it well separates electrons from kaons and protons:
  - ✓ at $p_T \sim 0.5$ GeV/c, yield of pions is equal to yield of (kaons+protons)
  - ✓ at $p_T > 0.7$ GeV/c, yield of pions becomes smaller than yield of (kaons+protons)

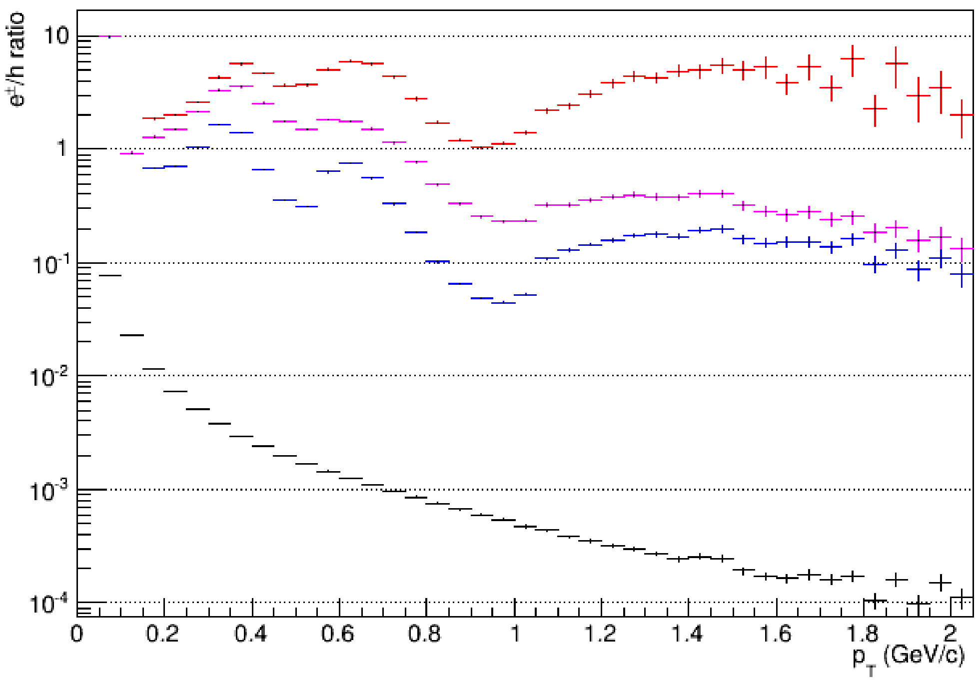
→ ECAL-TOF rejection should be efficient at low-to-intermediate momenta with p_T-dependent e/h rejection

Electron efficiency and e/h rejection

- AuAu@11 (UrQMD), realistic vertex distribution
- Track selections and PID cuts:
  - ✓ reconstructed tracks: nTPC_hits > 24, DCA_xyz < 2σ
  - ✓ TPC-TOF eID: eID_probability > 0.9
  - ✓ ECAL eID: tracks matched to ECAl within 2σ; E/p > 3-4-5σ && E/p < 1.5; 2 σ TOF cut



Reconstructed tracks, e/h ratio

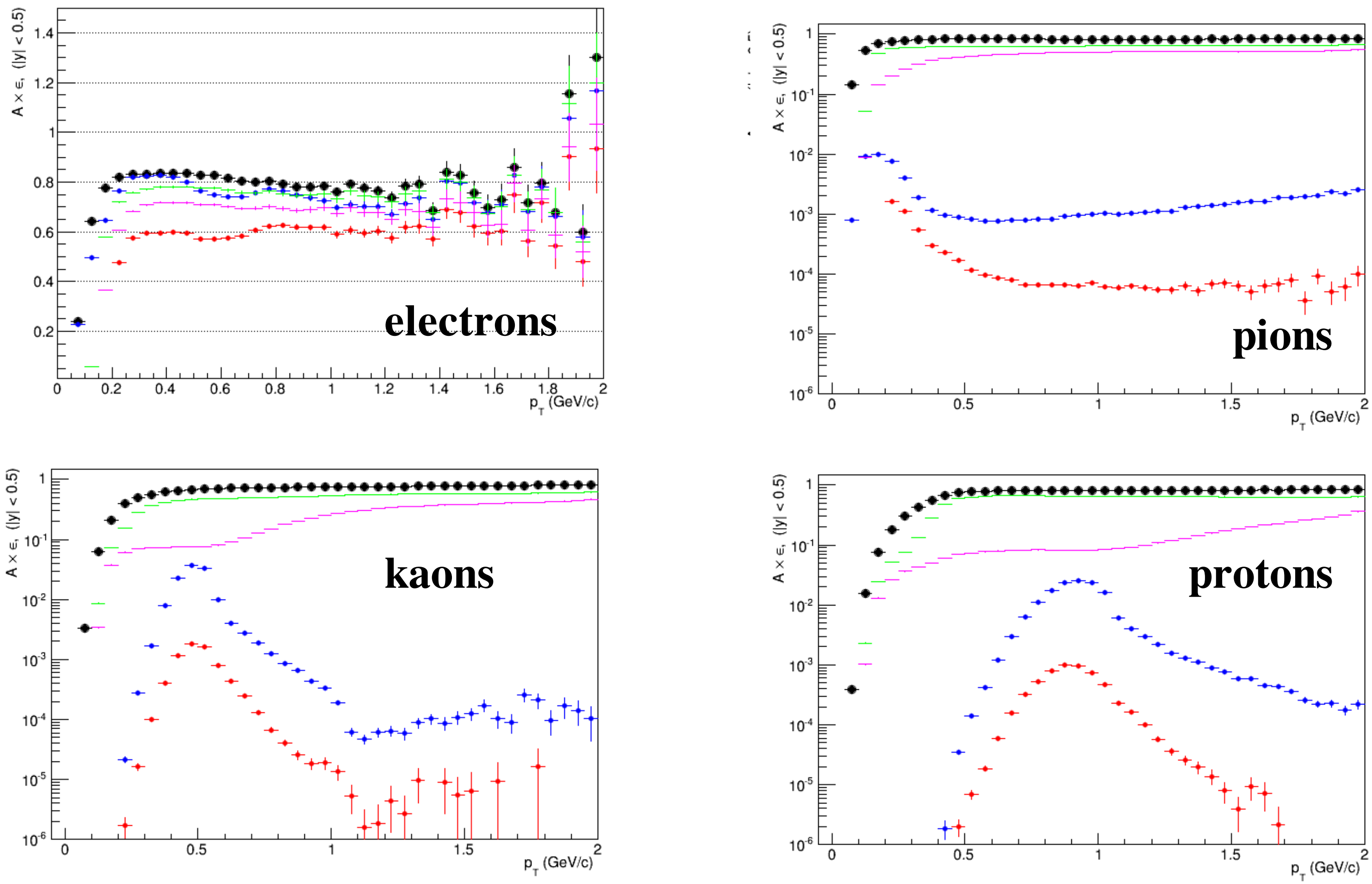


All tracks
Tracks + TPC-TOF
Tracks + TPC-TOF + ECAL-TOF
Tracks + TPC-TOF + ECAL-TOF + ECAL-EtoP

- With the ECAL-TOF + ‘soft’ ECAL-EtoP cuts we achieve better e/h rejection at low momentum compared to a ‘tight’ ECAL-EtoP cut. What about efficiency?

Electron efficiency and e/h rejection

- Acceptance x efficiency (|y| < 0.5)

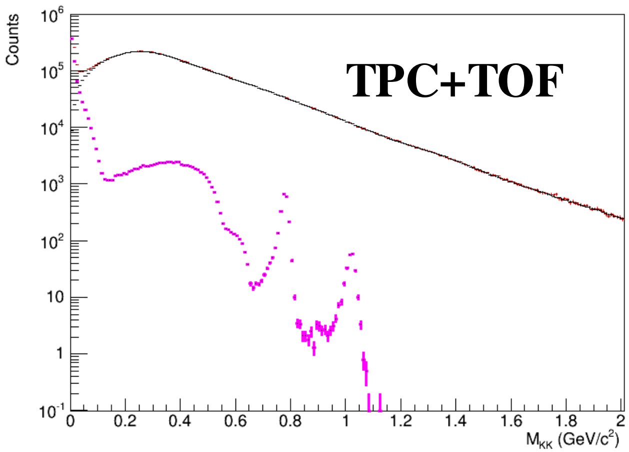


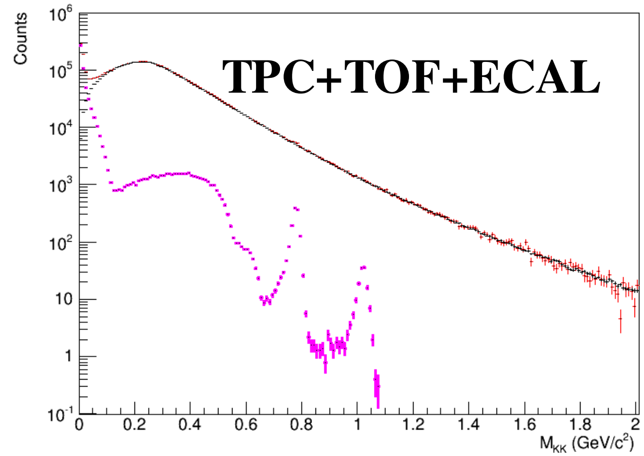
- Electron detection efficiency is higher !!!
- ECAL-TOF is very useful for hadron rejection at low and intermediate momenta

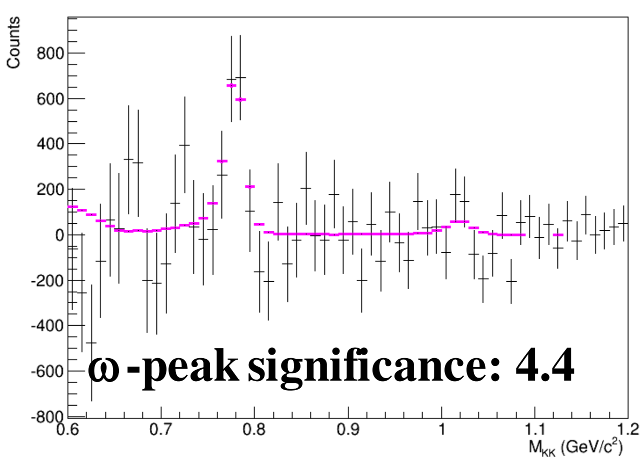
All tracks
Tracks + ECAL-matching
Tracks + ECAL-TOF
Tracks + TPC-TOF
Tracks + TPC-TOF + ECAL-TOF + ECAL-EtoP

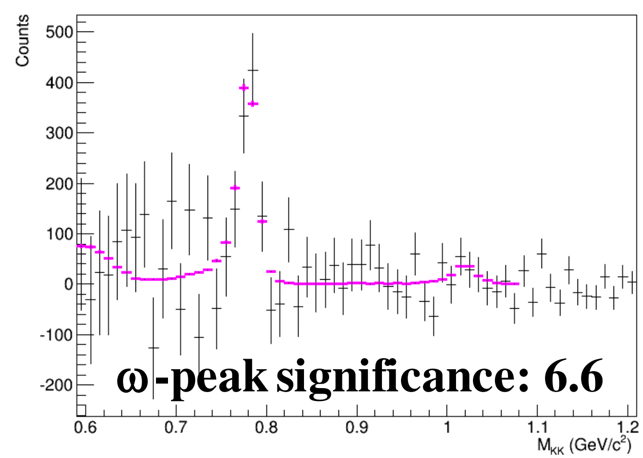
Dielectrons with ECAL

- AuAu@11 (UrQMD), realistic vertex distribution, LVM are generated with zero width:
  - ✓ reconstructed tracks: nTPC_hits > 24, DCA_xyz < 2σ
  - ✓ TPC-TOF eID: eID_probability > 0.9
  - ✓ ECAL eID: tracks matched to ECAl within 2σ; E/p > 3-4-5σ && E/p < 1.5; 2 σ TOF cut
  - ✓ Conversion cut (decay plane wrt to magnetic field)



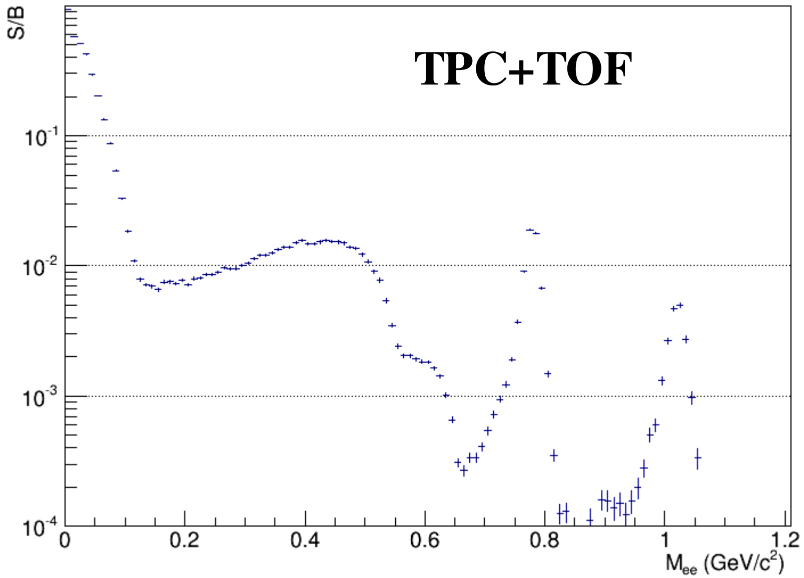


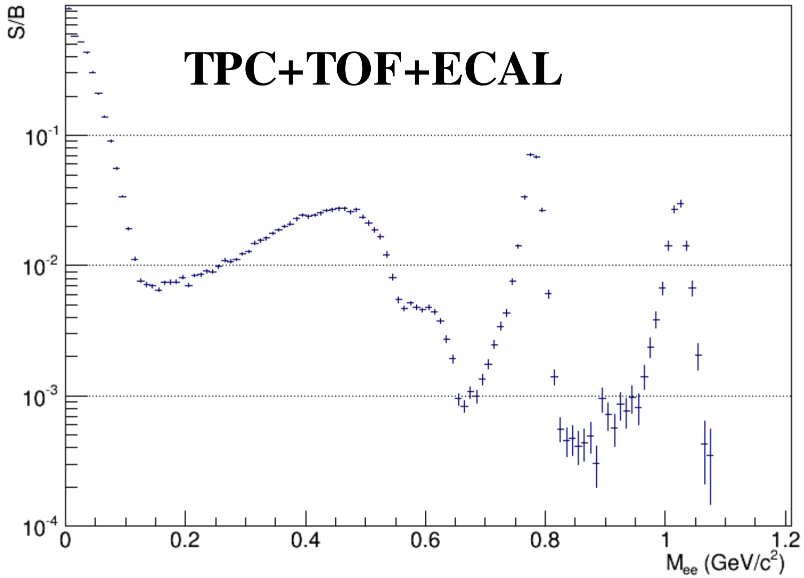




Dielectrons, S/B

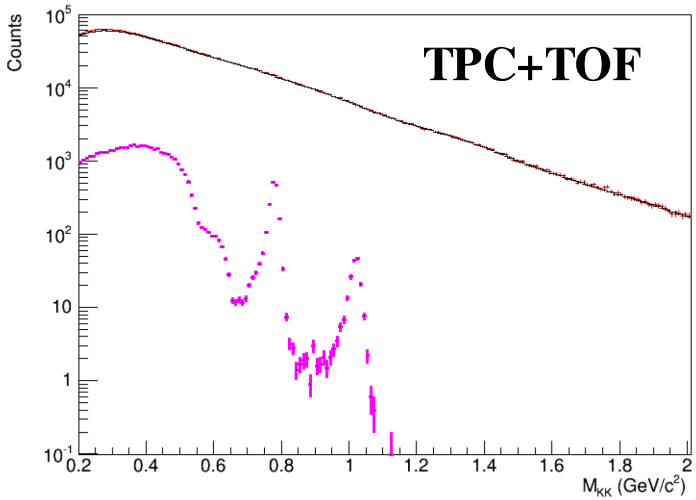
- p_T - integrated S/B ratios vs. M_{ee}
- ECAL significantly improves S/B, effect is larger at higher momenta and masses

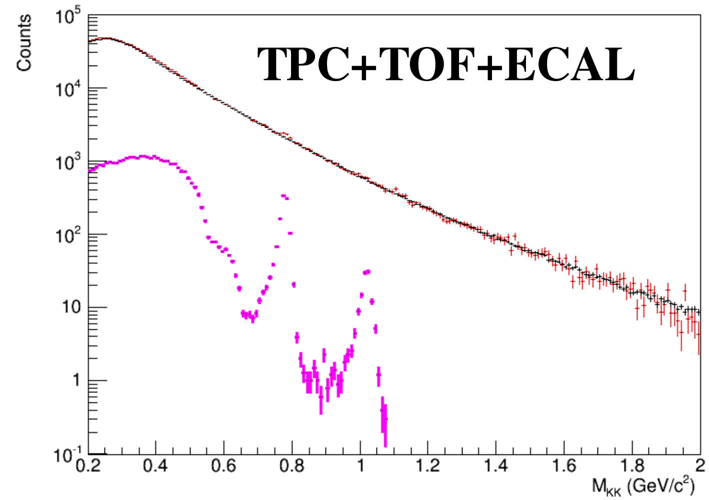


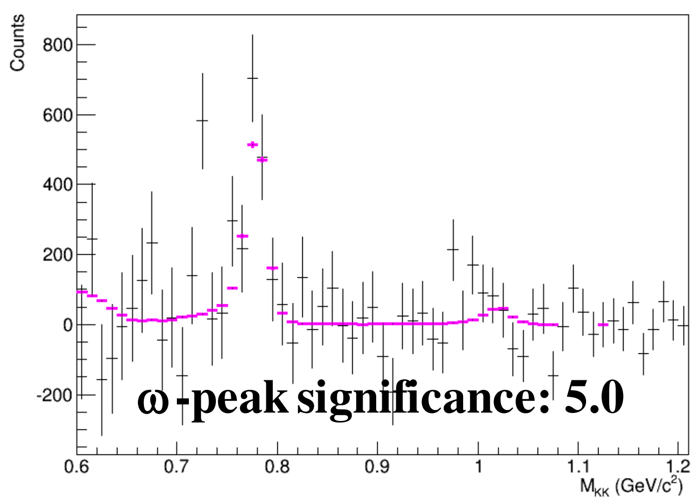


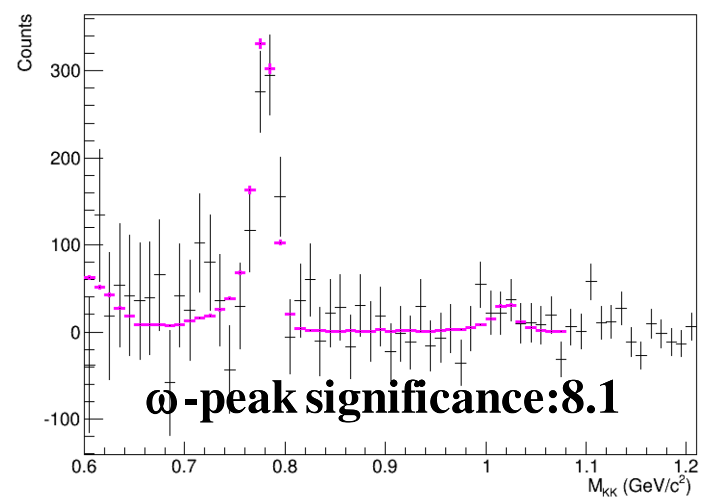
Dielectrons with ECAL

- Additional rejection of electron candidates that make up $M_{inv} < 0.2$ GeV/c^2 with any other electron candidate in the event → bad cut with multiplicity and detector dependent efficiency



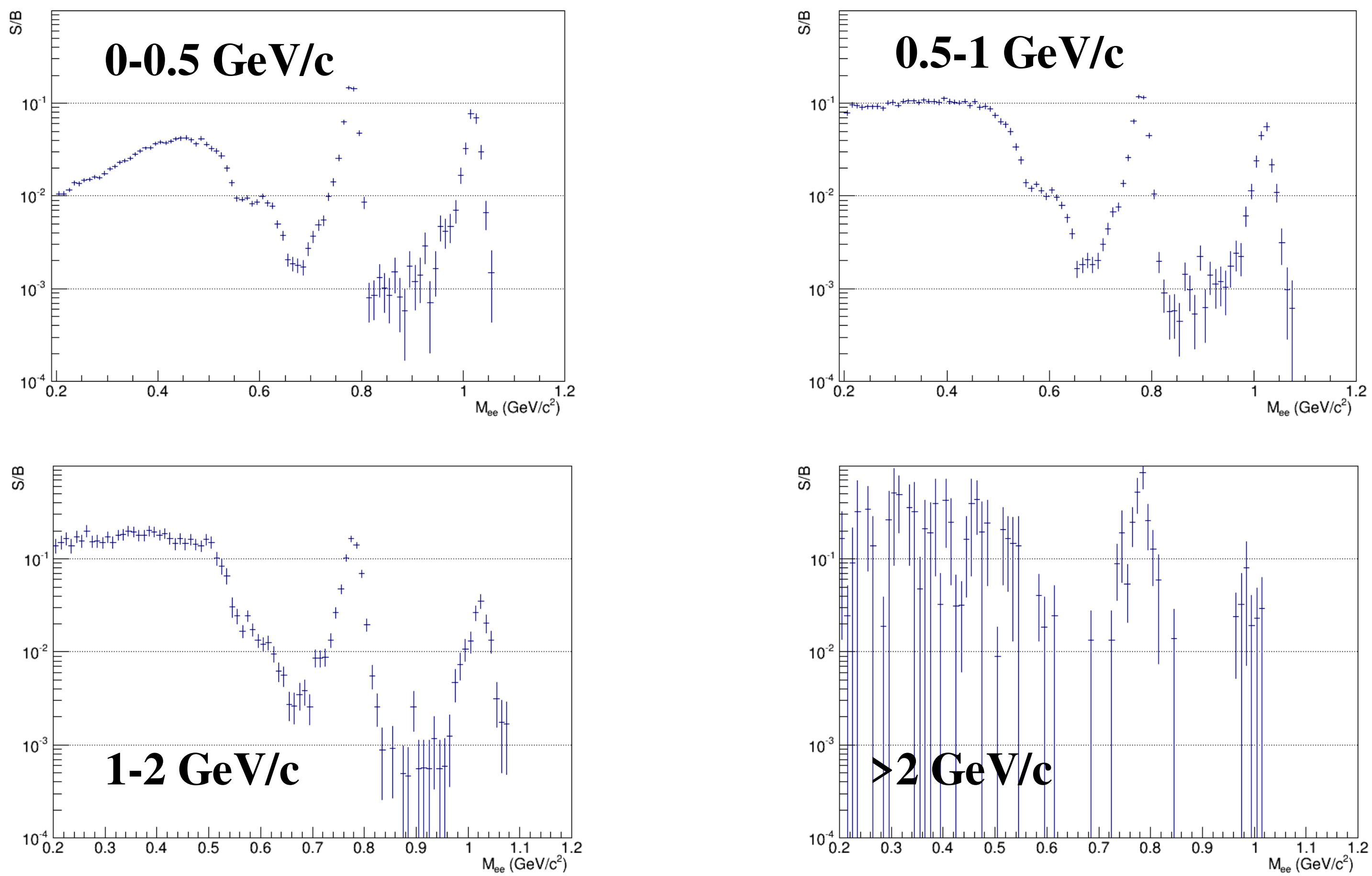






Dielectrons, S/B vs. p_T

- Additional rejection of electron candidates that make up $M_{inv} < 0.2$ GeV/c^2 with any other electron candidate in the event → bad cut with multiplicity and detector dependent efficiency
- With ECAL, the best achieved so far …
- No strong dependence on momentum up to ~ 2 GeV/c



Collective work

- ***The DAC recommends to have dedicated persons working on gamma reconstruction and dileptons***

- Everyone is welcome ….
- Centralized Monte Carlo production with LVMs and ECAL response in preparation
- This is a cross-WG activity, ECAL Software Group && PWG4

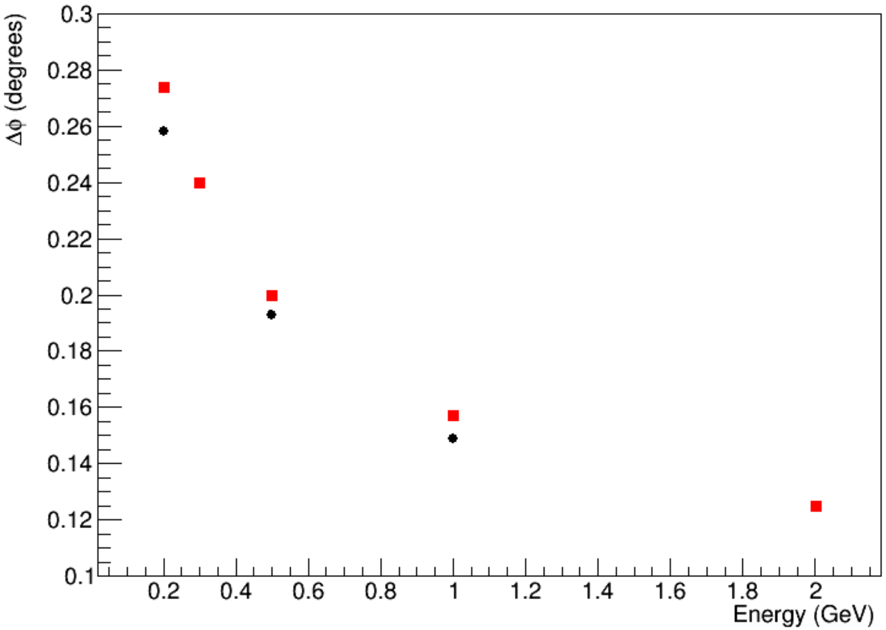
Conclusions

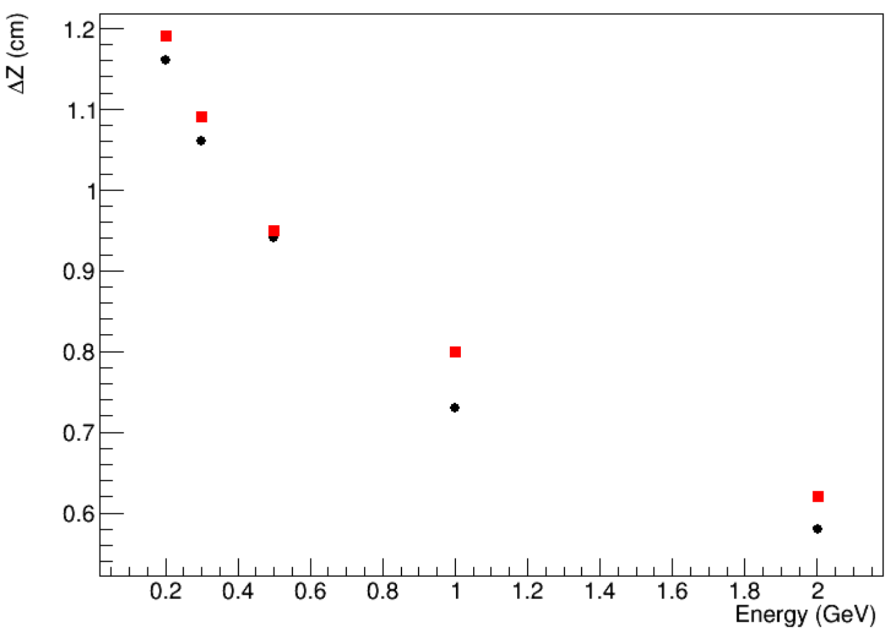
- ECAL performance is well understood
- Low efficiency for photons at low energy is caused by E_{seed} = 30 MeV and cluster splitting
- Neutral mesons will be reconstructed from near zero momentum
- Dilepton measurements will be possible with statistics > 10^8 events … work in progress
- ECAL simulation needs to be made more realistic:
  - ✓ new geometry is in preparation by ITEP team based on the latest JINR drawings
  - ✓ consistency checks with prototype tests

BACKUP

Spatial resolution: MPD-ECAL

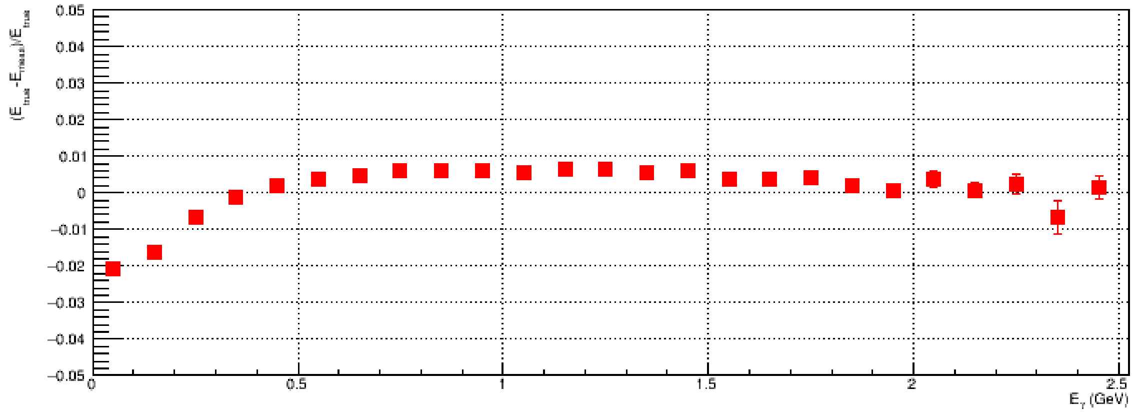
- Black markers – single photons (one per event), realistic vertex distribution
- Red markers – UrQMD, minbias AuAu@11, realistic vertex distribution
- High occupancy worsens the spatial resolution, but not dramatically

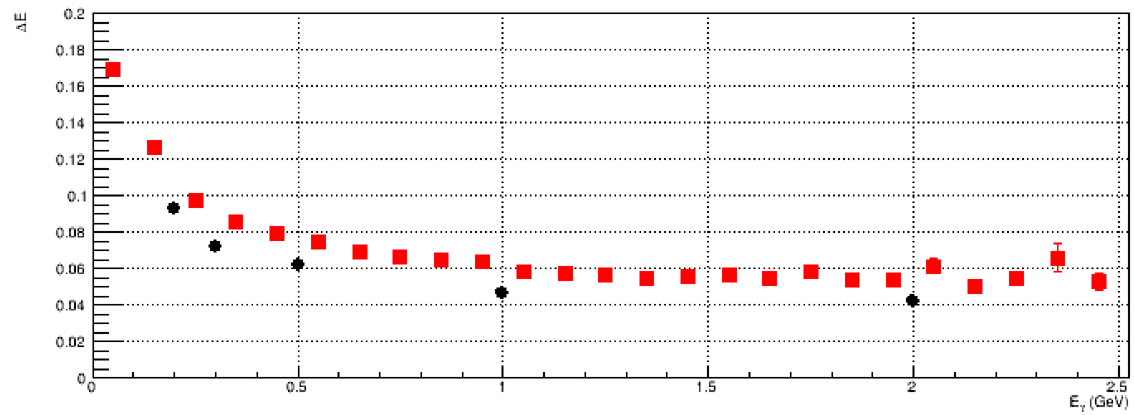




Energy resolution: MPD-ECAL

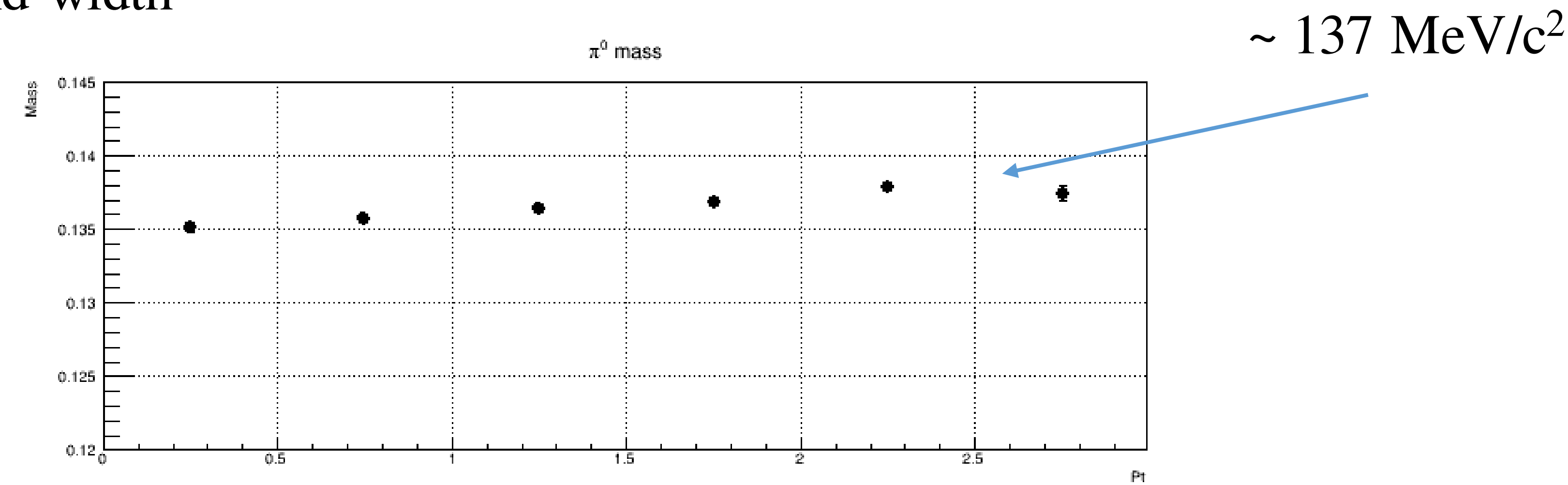
- Black markers – single photons (one per event) , realistic vertex distribution
- Red markers – UrQMD, minbias AuAu@11, realistic vertex distribution
- Non-linearity < 2% → can be corrected
- Energy resolution is significantly affected by multiplicity (constant term?)

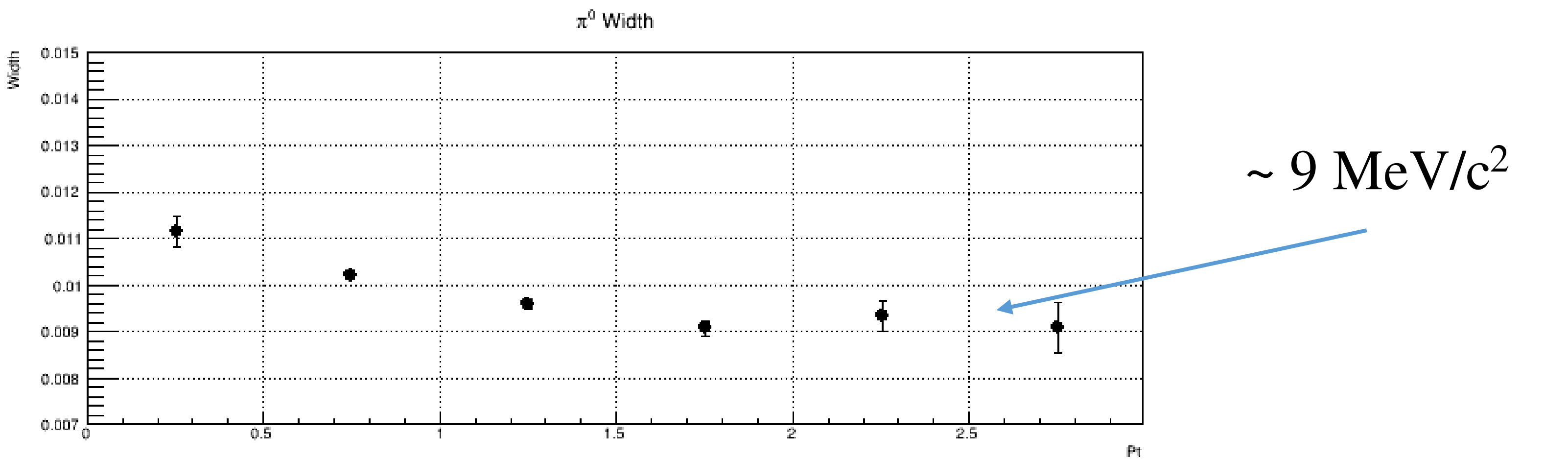




Detector performance: π^0

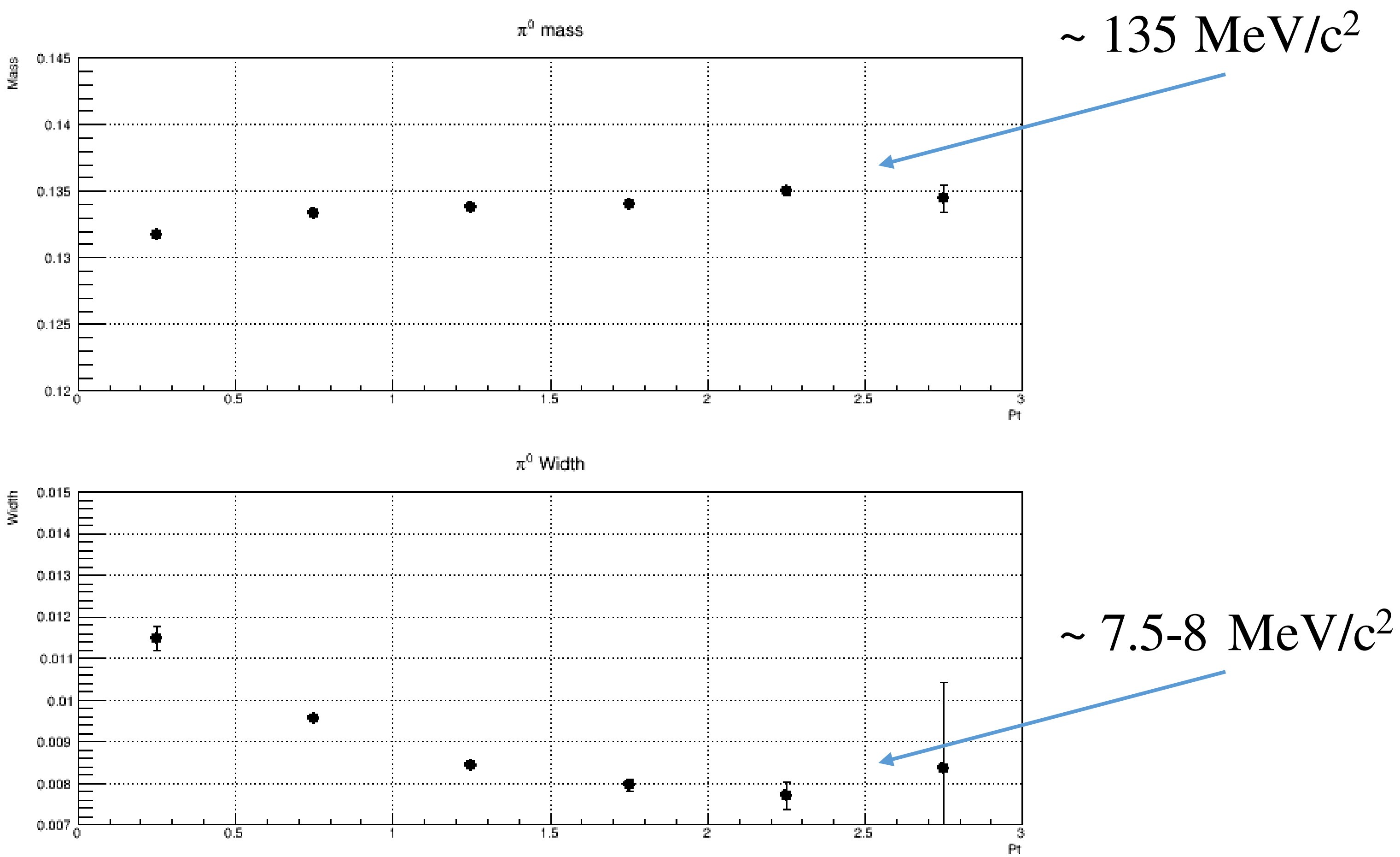
- UrQMD, ***minbias*** AuAu@11, realistic vertex distribution
- Mass and width





Detector performance: π^0

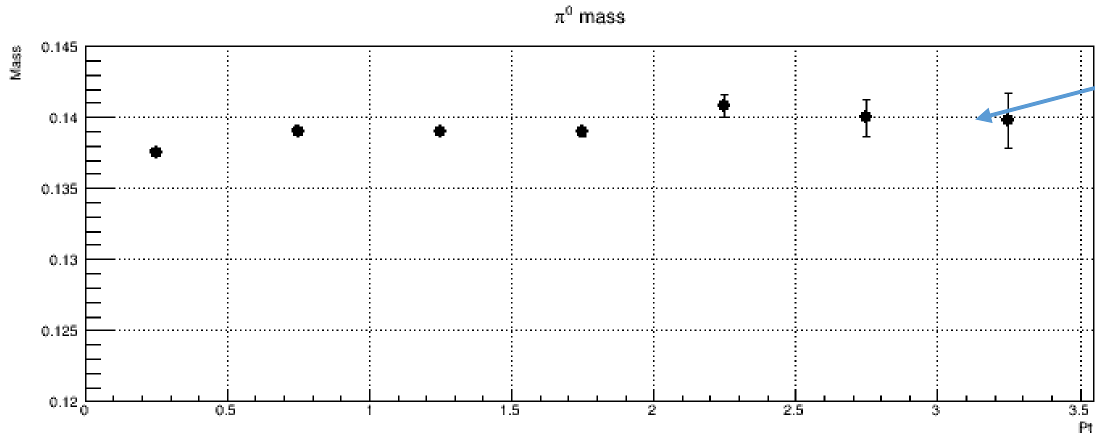
- UrQMD, ***peripheral*** AuAu@11 (ip > 10 fm), realistic vertex distribution
- Mass and width



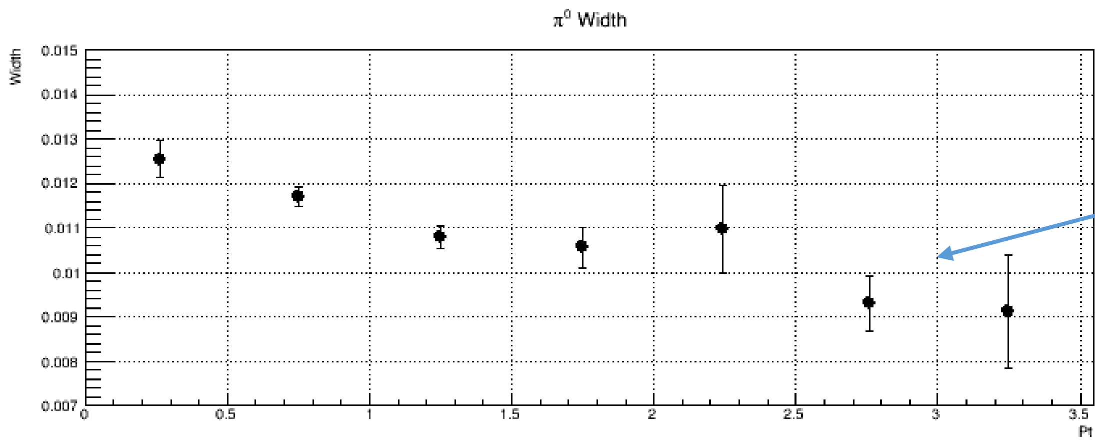
Detector performance: π^0

- UrQMD, ***central*** AuAu@11 (ip < 5 fm), realistic vertex distribution
- Mass and width

~ 140 MeV/c^2

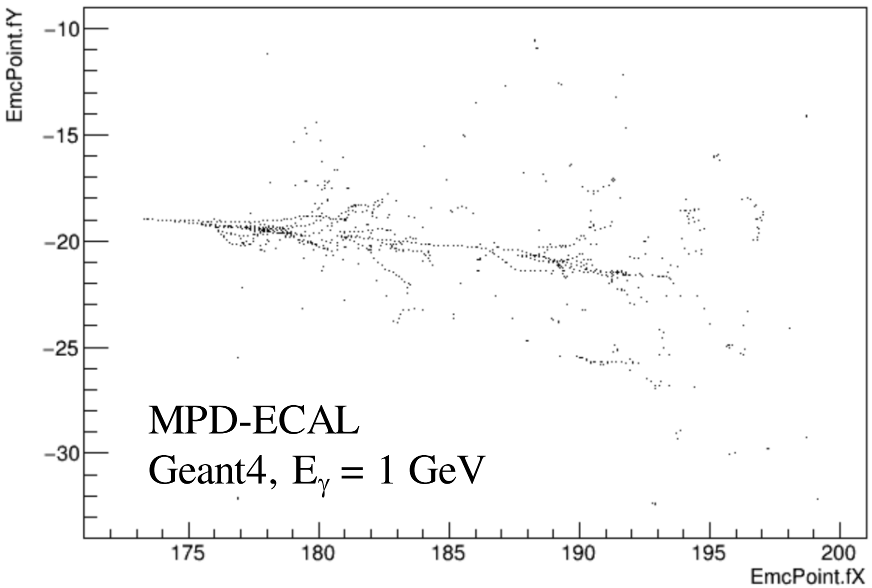


~ 10 MeV/c^2



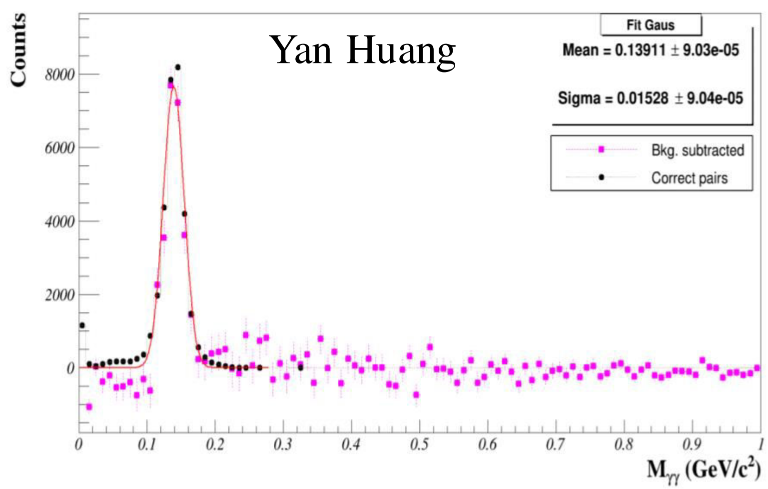
Progress in ECAL simulation

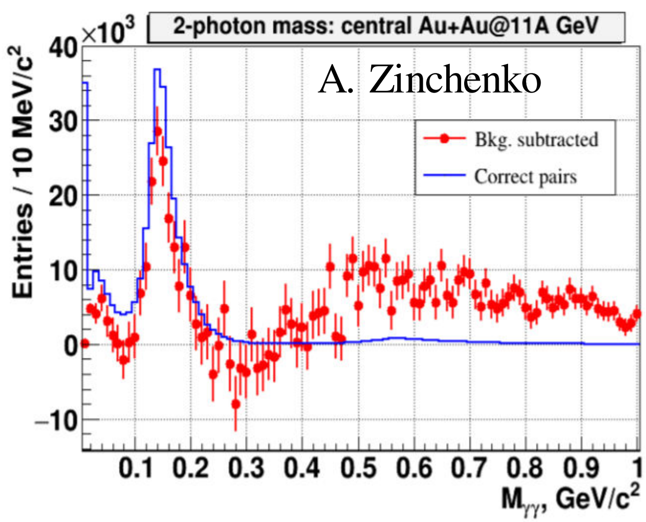
V. Riabov for the MPD-ECAL Group



Status on January, 23

- Projective geometry in Geant v.3,4 (ITEF)
- Two versions of digitizer-clusterizer:
  - ✓ by Maxim Martemyanov (ITEF) → basic study of ECAL performance for single photons, not applicable for high multiplicity events
  - ✓ by Alexander Zinchenko (JINR) → study of ECAL performance in realistic multiplicity environment, reconstruction of π^0 mesons in central AuAu@11 (UrQMD)





- Missing parts:
  - ✓ signal unfolding in high multiplicity events, tuning of signal selection and PID cuts
  - ✓ realistic performance and physics studies

MPD-ECAL program

- Photons (yield, flow, HBT):
  - ✓ inclusive
  - ✓ direct

- Neutral mesons (yield, flow):
  - ✓ $\pi^0(\eta) \rightarrow \gamma\gamma$
  - ✓ $K_s \rightarrow \pi^0\pi^0$, $\omega \rightarrow \pi^0\gamma$

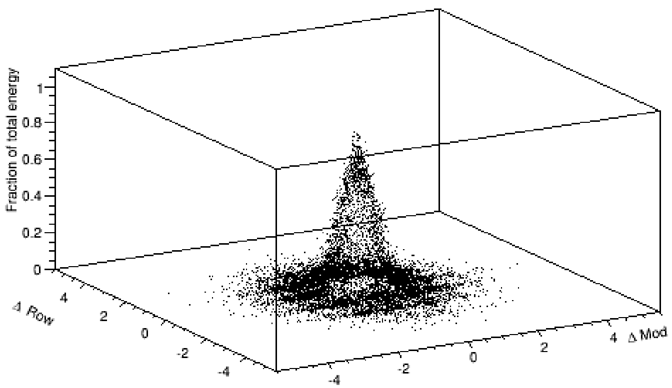
- Electron identification, E/p ~ 1:
  - ✓ e^+e^- continuum at low/intermediate mass
  - ✓ LVM (ρ, ω, ϕ) $\rightarrow e^+e^-$
  - ✓ e_{HF}
  - ✓ conversion pairs (alternative reconstruction of photons)
  - ✓ charmonia

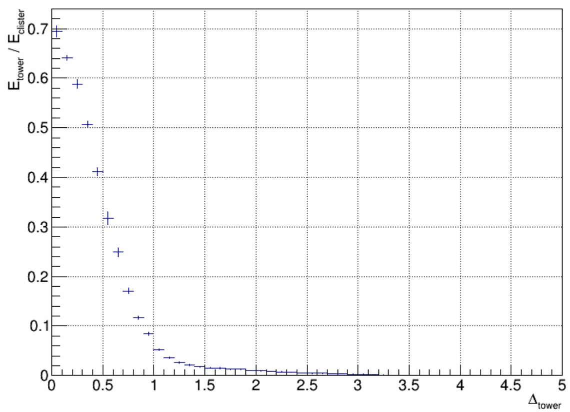
Recent progress

- ECAL Software Group formed in February, 2019:
  - ✓ regular meetings with remote access by Vidyo and public agenda on indico, https://indico.jinr.ru/category/276/
  - ✓ everyone interested is welcome to join (contact me)
- Main tasks:
  - ✓ actual detector geometry
  - ✓ reconstruction and unfolding of electromagnetic clusters
  - ✓ cluster matching to reconstructed charged tracks
  - ✓ association of clusters with Monte Carlo contributors
  - ✓ guidance for prototype tests (feedback)
- Final destination:
  - ✓ fast reconstruction software with friendly interface integrated to 'mpdroot'
  - ✓ documentation, recommendation and examples of use for easy start
  - ✓ basic physics/feasibility studies (to be advanced by Collaboration/PWGs)

Cluster unfolding

- Based on 'known' shape of electromagnetic clusters in the MPD-ECAL:
  - ✓ simulated for single photons: $E_i/\sum E_i$: ΔMod : ΔRow
  - ✓ shower shape shows weak energy dependence





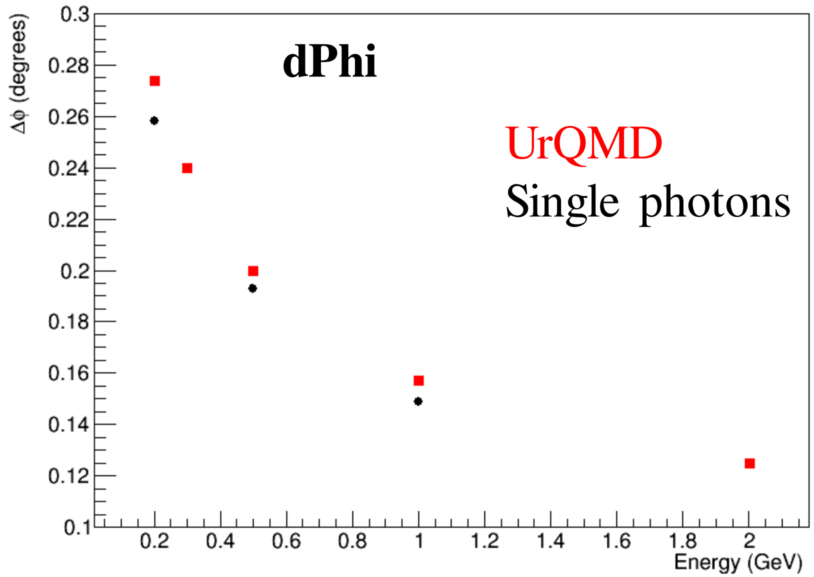
- Provides higher efficiency of cluster reconstruction and better energy/spatial resolution in high multiplicity environment

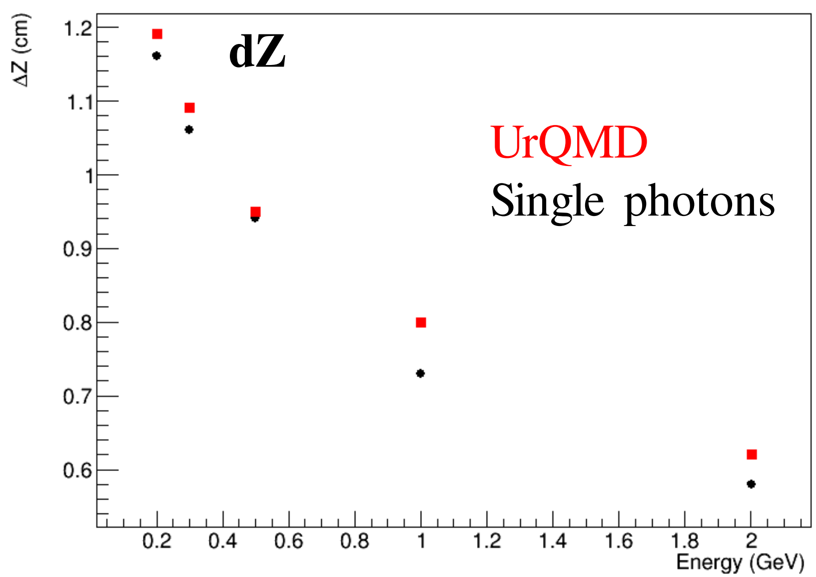
- Same shower shape is used for shower shape analysis ($\gamma/e^{\pm}$ PID)

$$\text{Chi2} = \sum_i \frac{\left(E_i^{measured} - E_i^{expected}\right)^2}{\sigma_i^2} \qquad \sigma_i^2 = 0.008 \cdot E_i^{expected} \cdot \left(1 - \frac{E_i^{expected}}{E}\right)$$

Spatial resolution

- Signal averaging: $w_i = \max\left\{0, \left[w_0 + ln\left(\frac{E_i}{E_T}\right)\right]\right\}$, $w_0 = 3.0$
- Spatial resolution for single photons (black markers)
- Spatial resolution for photons in AuAu@11 simulated by UrQMD (red markers)

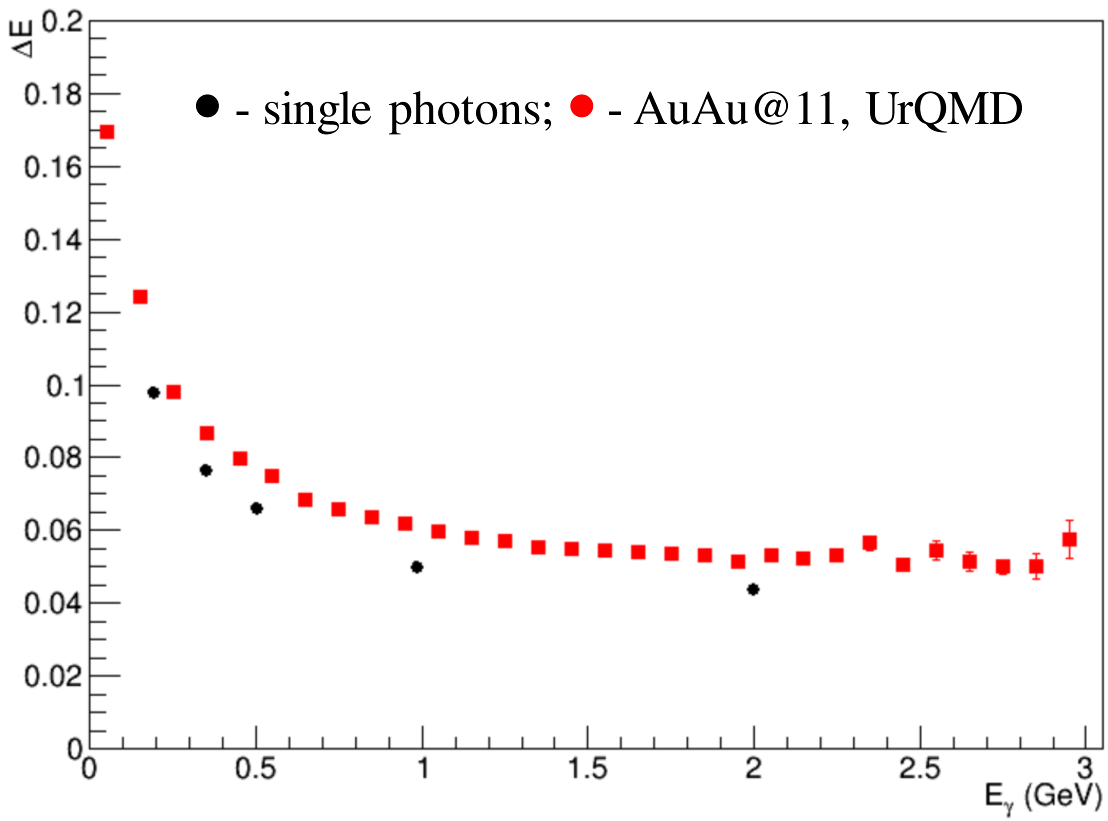




- Spatial resolution shows weak multiplicity dependence

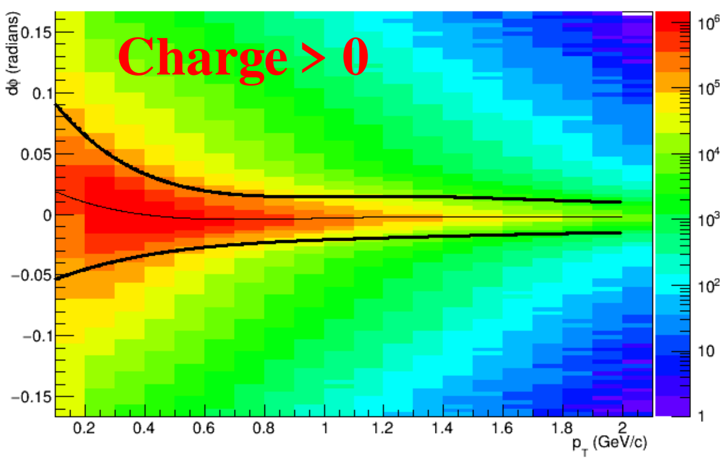
Energy resolution

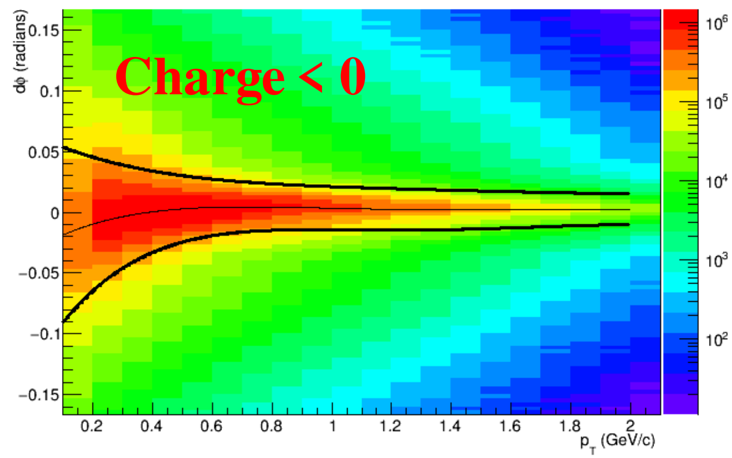
- Energy resolution for single photons and photons in AuAu@11 (UrQMD)
- Energy resolution shows significant multiplicity dependence → underlying event serves as noise for reconstructed electromagnetic clusters



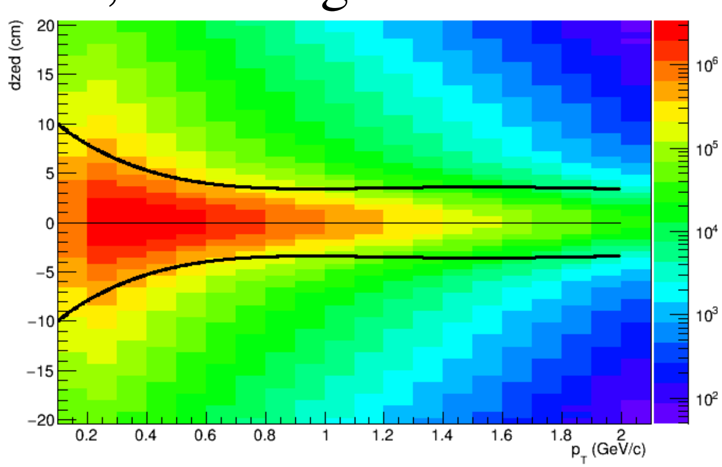
Cluster-to-track matching

- Association of clusters with closest tracks (dPhi, dZ, track index)
- Low-p_T tracks, p_T < 100 MeV/c, hardly reach the ECAL surface
- dPhi shows charge-dependent shift at low p_T (incidence angle, response to hadrons)





- dZ, not charge sensitive



- Note Logz() scale
- Matchings are parametrized as a function of p_T and charge (black lines in plots are $\pm$ 2.0 σ)

Photon ID

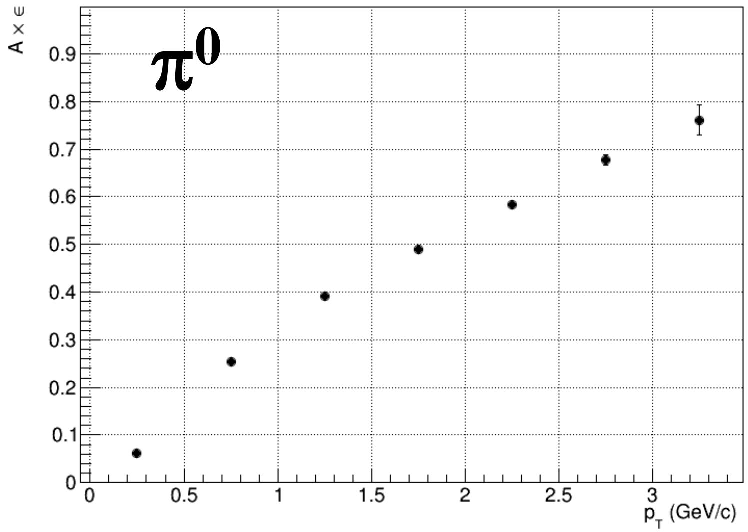
- Identification of photonic signals in the MPD-ECAL:
  - ✓ charged track veto → no tracks in 2-3σ vicinity of a cluster
  - ✓ time-of-flight → TOF – L/c ~ 0 for photons (< 2 ns, conservative cut)
  - ✓ shower shape → electromagnetic shape of clusters, also works for electrons!

- All three methods are well developed and tested for the MPD-ECAL
- Methods proved to be very efficient for selection of electromagnetic signals
- Efficiency and rejection factors of the cuts are comparable
- Methods are not additive (correlated), best combination of PID cuts is to be decided for each physical analysis

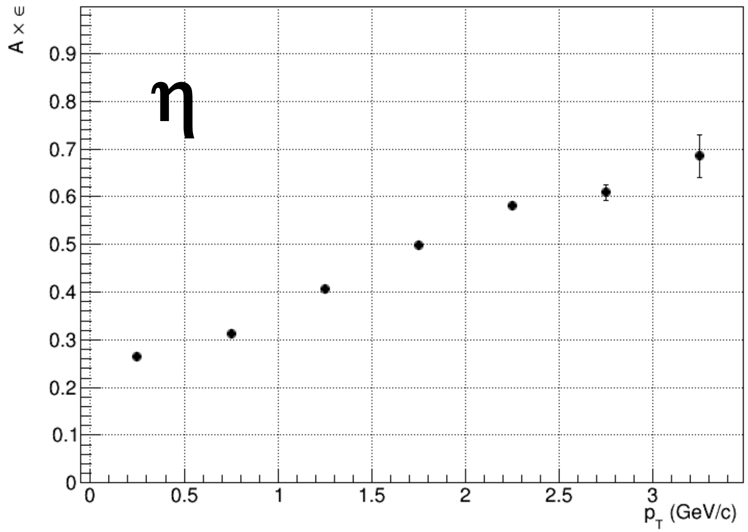
π^0, η reconstruction

- $\pi^0 \rightarrow \gamma\gamma$ (BR ~ 99%)
- $\eta \rightarrow \gamma\gamma$ (BR ~ 39%)
- Event selection:
  - ✓ minbias AuAu@11 by UrQMD3.4
  - ✓ $|Z_{vrtx}|$ < 50 cm
- Photon selection:
  - ✓ clusterizer with unfolding
  - ✓ $E\gamma$ > 0.1 GeV
  - ✓ number of towers > 2
  - ✓ TOF < 2 ns
- Pair cuts:
  - ✓ $|y|$ < 0.5

π^0 reconstruction efficiency ($|y|$<0.5)

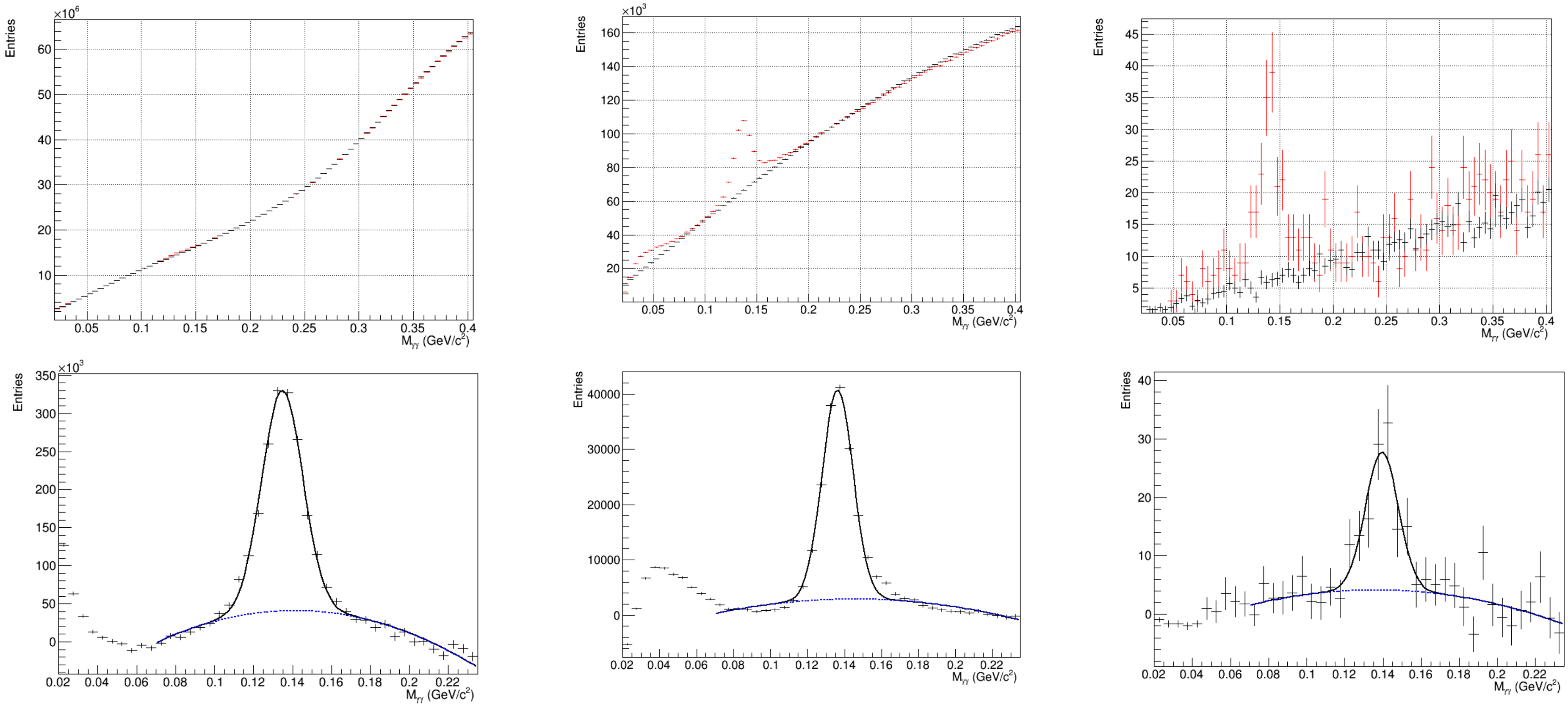


η reconstruction efficiency ($|y|$<0.5)



π^0, reconstructed peaks

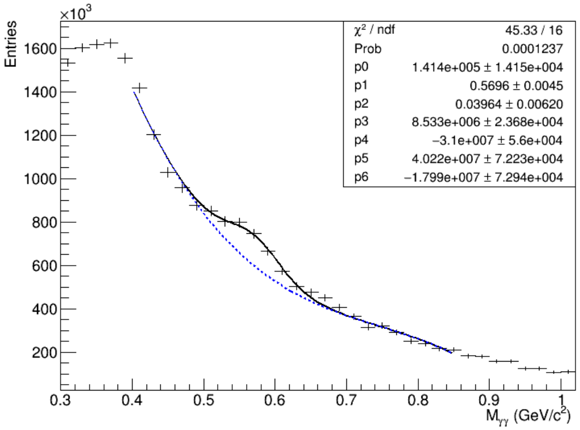
0-0.5 GeV/c **1.5-2.0 GeV/c** **4-5 GeV/c**



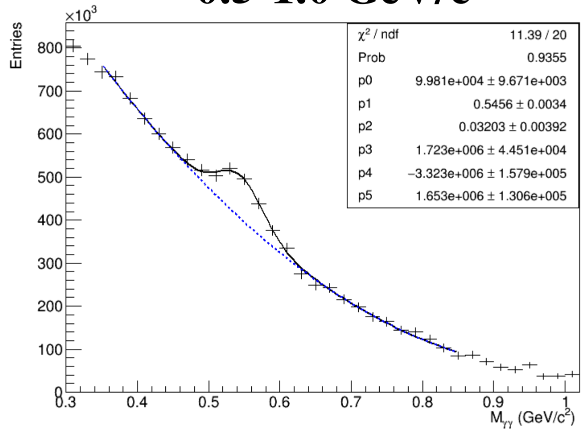
- Combinatorial background is estimated using event mixing
- Signal can be reconstructed from low momentum, ~ 0.25 GeV, at all centralities
- Cluster merging starts at ~ 6 GeV/c

η, reconstructed peaks

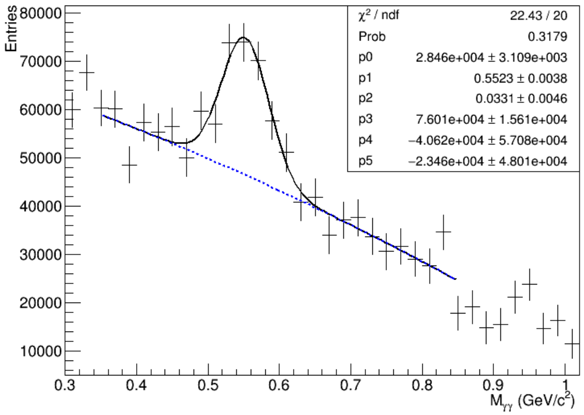
0-0.5 GeV/c



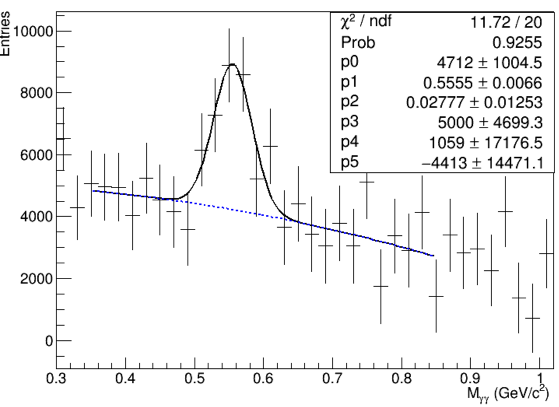
0.5-1.0 GeV/c



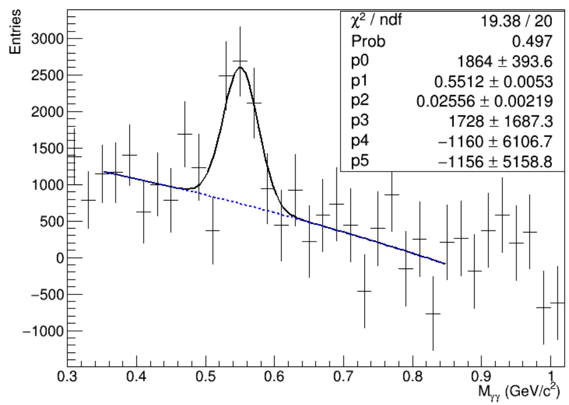
1-1.5 GeV/c



1.5-2 GeV/c



2-3 GeV/c

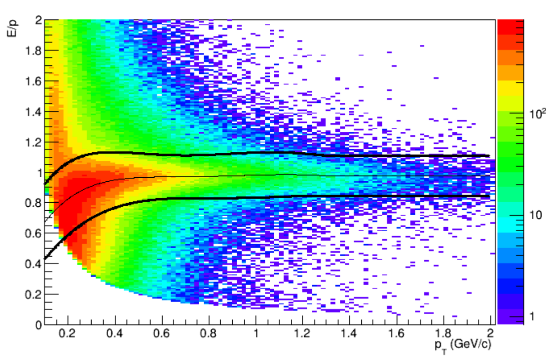


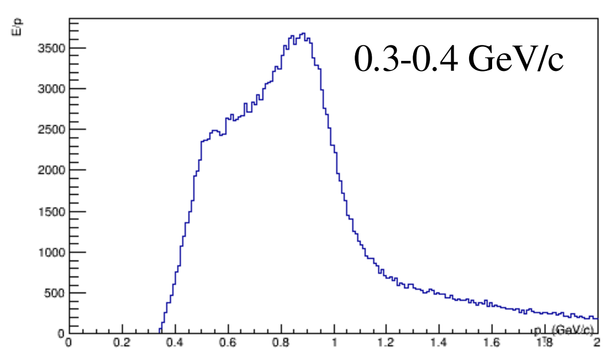
- Mass ~ 0.55 GeV/c^2
- Width ~ 30 MeV/c^2

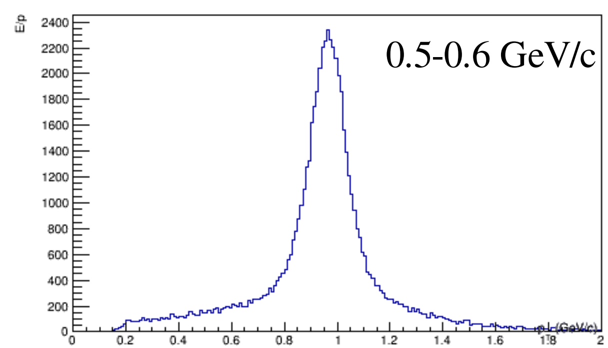
- Combinatorial background is estimated using event mixing
- Signal can be reconstructed from low momentum, ~ 0.25 GeV, at all centralities
- High-p_T reach is limited by available statistics

Electron ID

- Primary e-ID detectors are the TPC and TOF
- MPD-ECAL can help to clean up sample of selected electrons:
  - ✓ tracks matched to ECAl within 2-3σ
  - ✓ E/p ~ 1.0
- Limitations of the MPD-ECAL for e-ID:
  - ✓ low-p_T tracks do not reach ECAL, $p_T < 0.1$ GeV/c
  - ✓ MIP hadrons leave ~ 0.2 GeV in the ECAL → low-pT hadrons tend to have E/p ~ 1
  - ✓ showers from low-p_T electrons often split up in several sub-clusters and have elongated shape (can not be identified as electromagnetic showers by shape analysis)
- ECAL becomes effective at $p_T > 0.2$-0.3 GeV/c



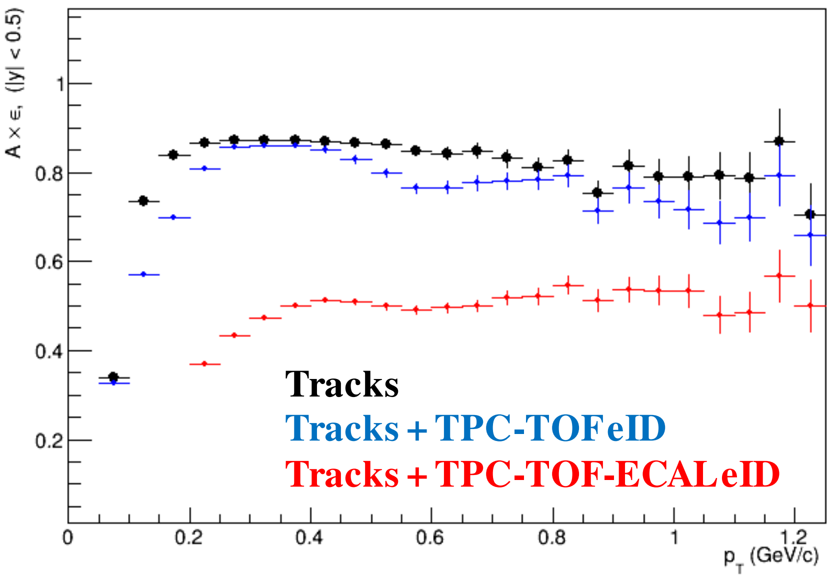




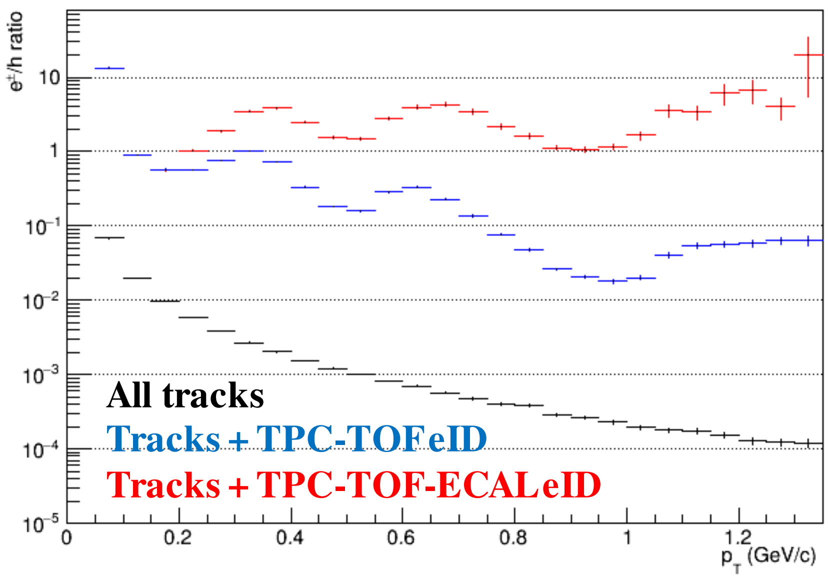
Electron ID, efficiency

- AuAu@11 (UrQMD), realistic vertex distribution
- Track selections and PID cuts:
  - ✓ reconstructed tracks: nTPC_hits > 39, DCA_xyz < 3σ
  - ✓ TPC-TOF eID: eID_probability > 0.75
  - ✓ ECAL eID: tracks matched to ECAl within 3σ + E/p, 3σ cut (Gaussian main peak)

Acceptance x efficiency (|y| < 0.5)



Reconstructed tracks, e/h ratio

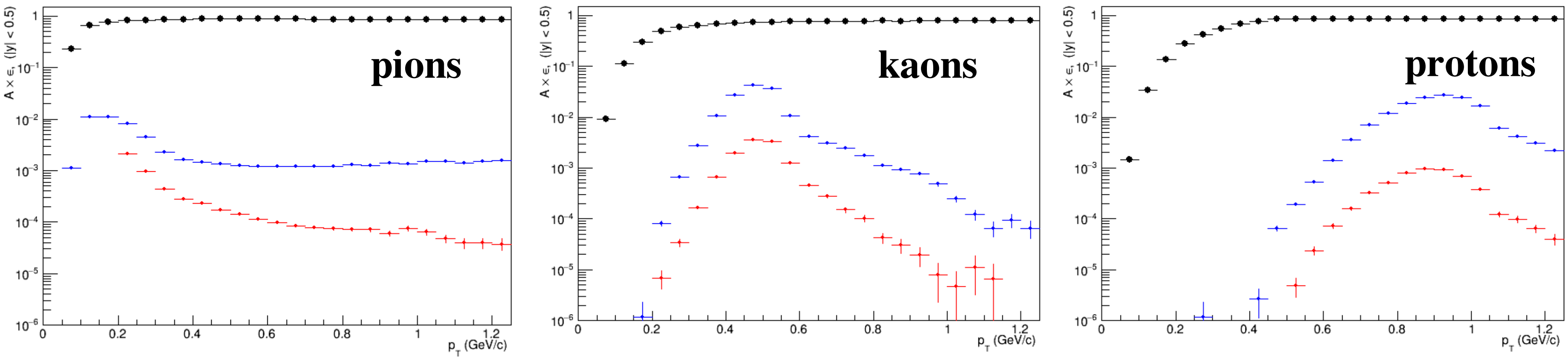


- Efficiency drops by × 0.5 (cluster missassociation, wide E/p ratio)
- With ECAL eID, ratio e/h increases by × 10 at 0.5 GeV/c and by × 100 at 1.2 GeV/c

Electron ID, efficiency for hadrons

- AuAu@11 (UrQMD), realistic vertex distribution
- Track selections and PID cuts: same as in previous slide

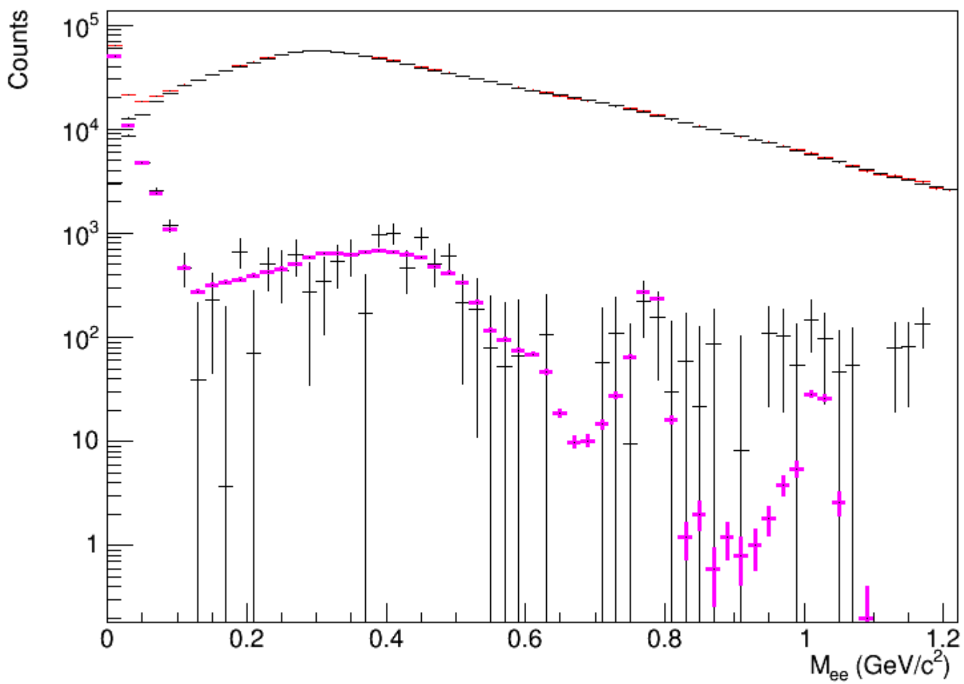
Acceptance x efficiency (|y| < 0.5)



Tracks
Tracks + TPC-TOF eID
Tracks + TPC-TOF-ECAL eID

Di-electron spectrum, first look

- AuAu@11 (UrQMD), realistic vertex distribution, 1.5 M events
- LVM → e^+e^-, vector mesons are weighted to have zero generated width (to be seen)
- Track selections and PID cuts:
  - ✓ reconstructed tracks: nTPC_hits > 39, DCA_xyz < 3σ, pair conversion cuts
  - ✓ TPC-TOF eID: eID_probability > 0.75
  - ✓ ECAL eID: tracks matched to ECAl within 3σ + E/p, 3σ cut (Gaussian main peak)



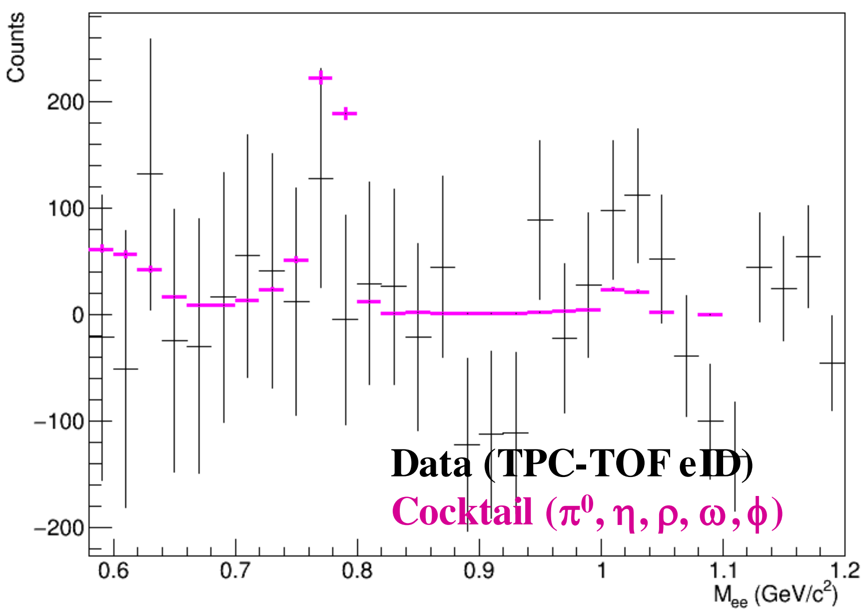
Data (TPC-TOF eID)

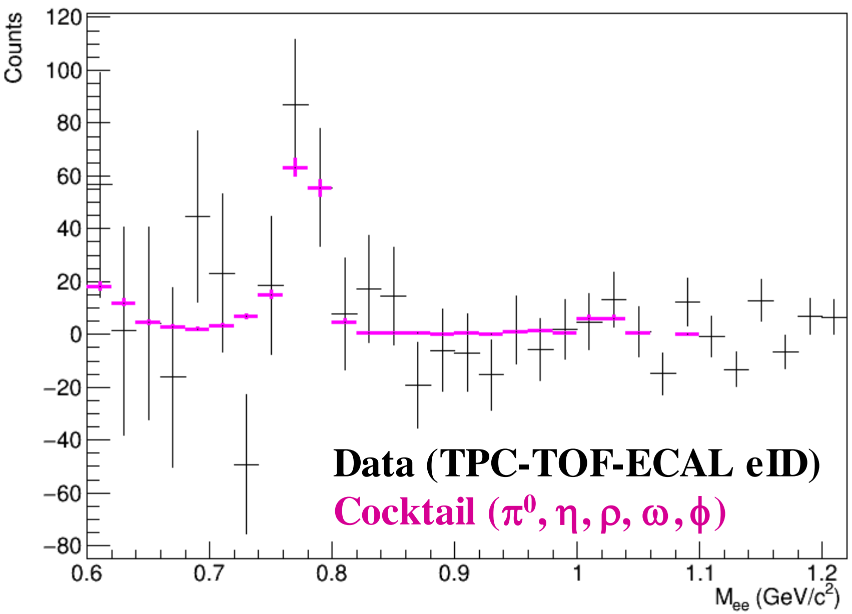
Mixed event background

True cocktail (π^0, η, ρ, ω, ϕ)

Di-electron spectrum, first look

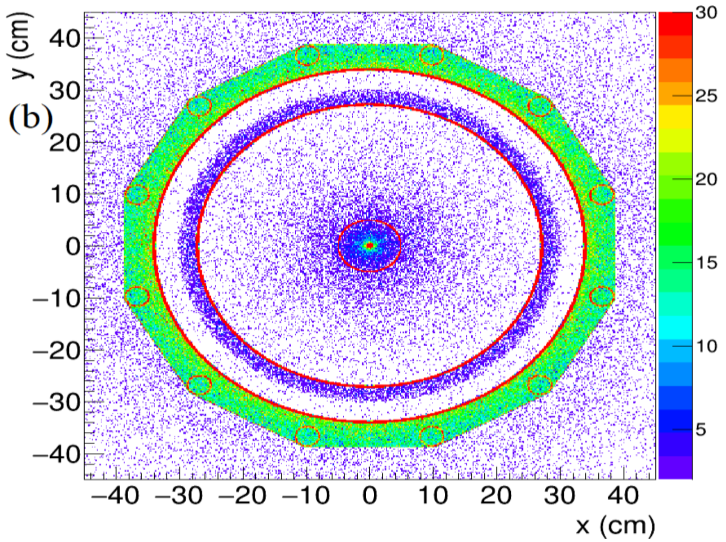
- AuAu@11 (UrQMD), realistic vertex distribution, 1.5 M events
- LVM → e^+e^-, vector mesons are weighted to have zero generated width (to be seen)
- Track selections and PID cuts: same as in previous slide
- ECAL improves S/B ratio for LVM by a factor of 5 for p_T-integrated M_{ee} spectrum
- 10M events is a minimum data sample for detailed study of e^+e^- continuum

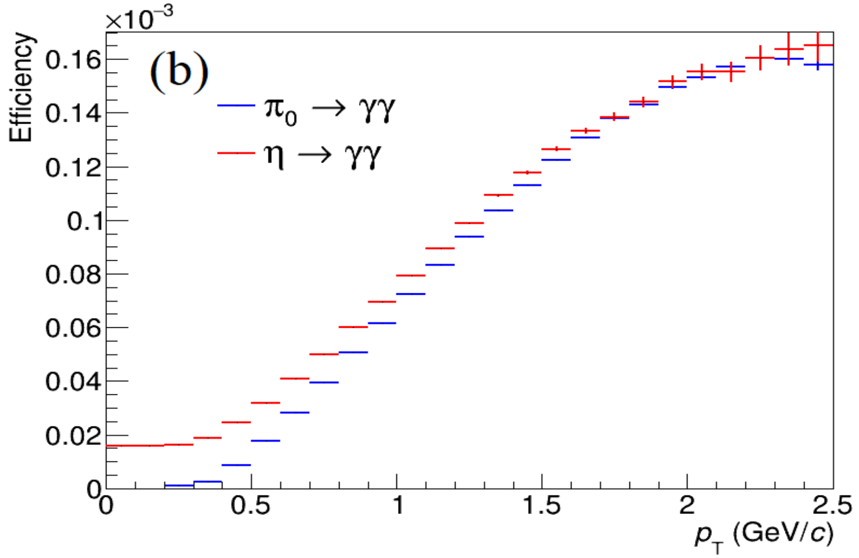




Conversion

- UrQMD, minbias AuAu@11, realistic vertex distribution, 10M events
- Conversions on the beam pipe and inner TPC vessels can be used to collect a clean sample of photons
- Competing method of γ, π^0 and η reconstruction, especially at low momentum
- Performance can be further improved by using ECAL ePID

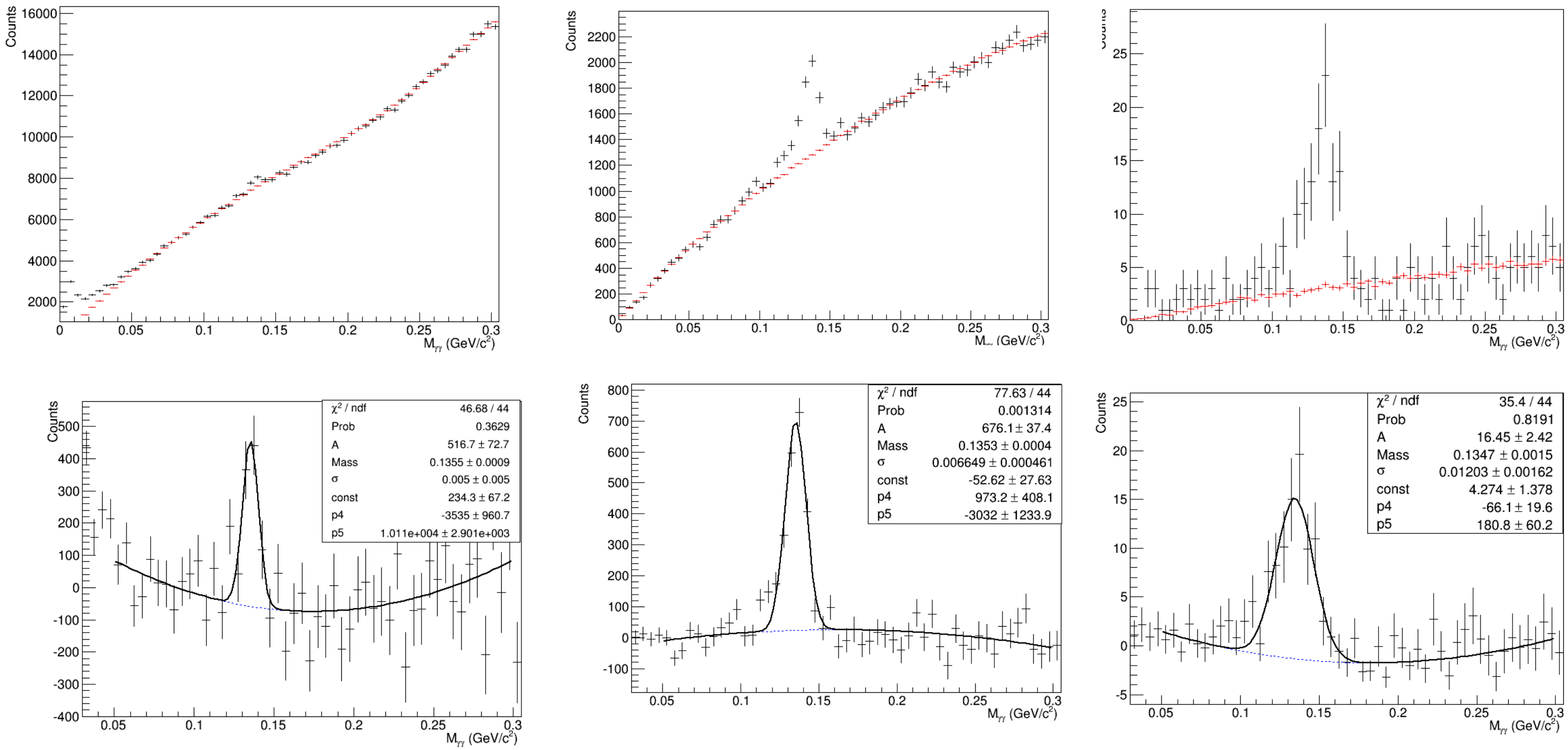




Neutral mesons through conversion, π^0

- minbias AuAu@11, UrQMD; $\pi^0 \rightarrow \gamma\gamma \rightarrow (e^+e^-)(e^+e^-)$
- Smaller peak width (better energy resolution) and S/B at low momentum

0-0.5 GeV/c **1.0-1.5 GeV/c** **2.5-3.0 GeV/c**



Near future

- New and more realistic MPD-ECAL geometry:
  - ✓ new tower shapes based on two milling angles, new geometrical sizes and positions
  - ✓ solid containers for ECAL modules made from carbon composite medium (total number equal to 25)
  - ✓ new power frame to mount ECAL containers
  - ✓ expected in a month

- New geometry will need new digitizer and tuning of the clusterizer

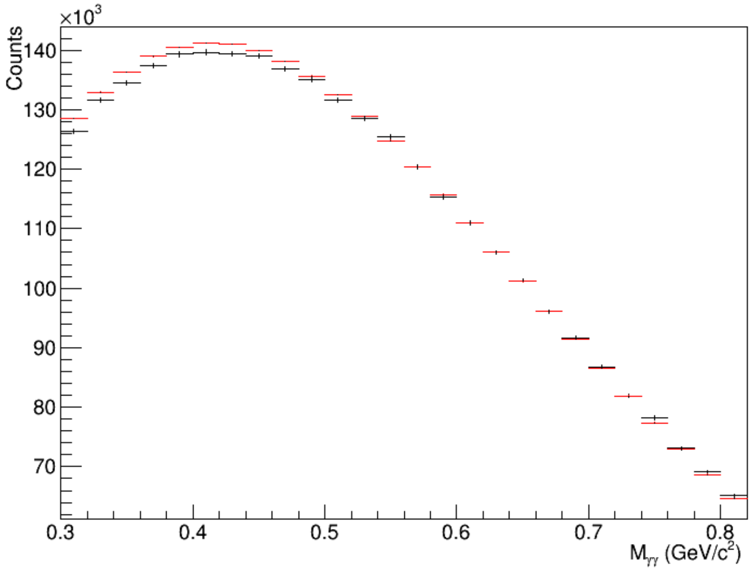
Conclusions

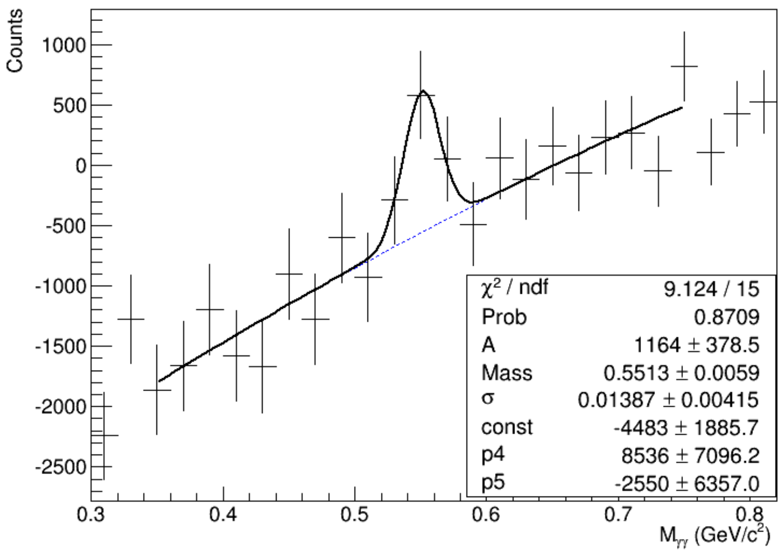
- ECAL enhances physical program of the MPD experiment
- ECAL Software Group is operational and productive
- Basic physical studies will be performed in the Group, others will be advanced by PWGs
- Cross-check of the simulated detector parameters with the beam test results is important

BACKUP

Neutral mesons through conversion, η

- minbias AuAu@11, UrQMD; $\eta \rightarrow \gamma\gamma \rightarrow (e^+e^-)(e^+e^-)$
- first observation of η signal (3σ bump)





π^0, mass and width

- Mass and width are multiplicity dependent
- Cluster merging starts at ~ 6 GeV/c → increasing masses and widths
- Reconstruction efficiency drops to ~ 0 at 15 GeV/c