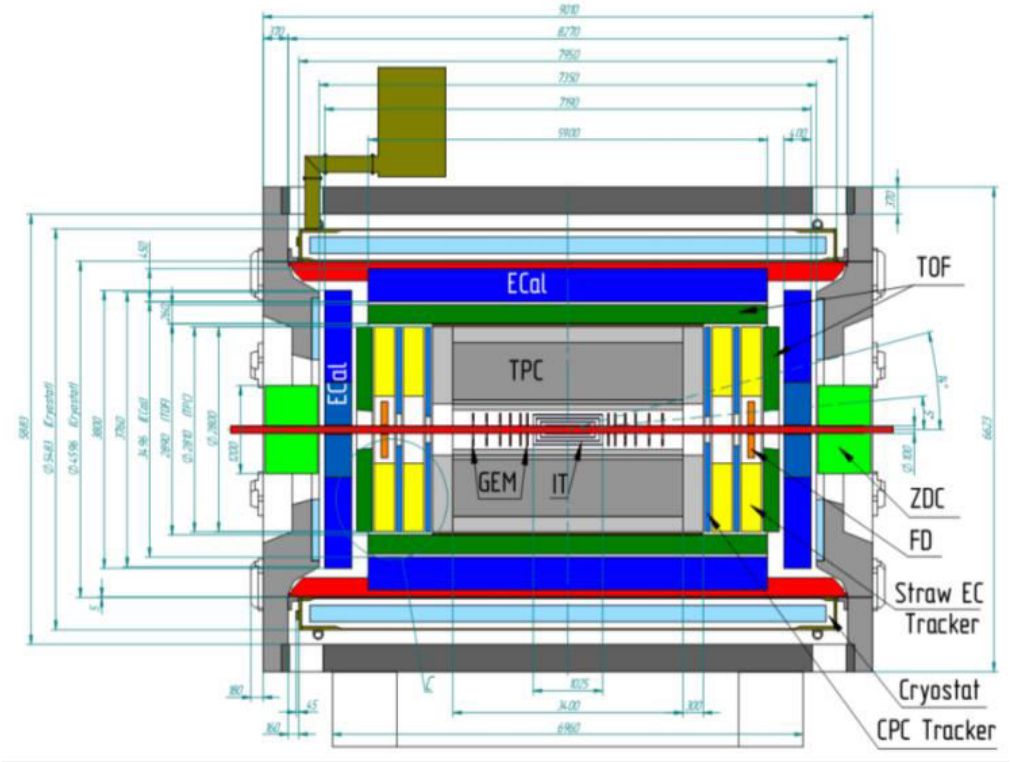
ECAL reconstruction and analysis

V. Riabov for the MPD Collaboration



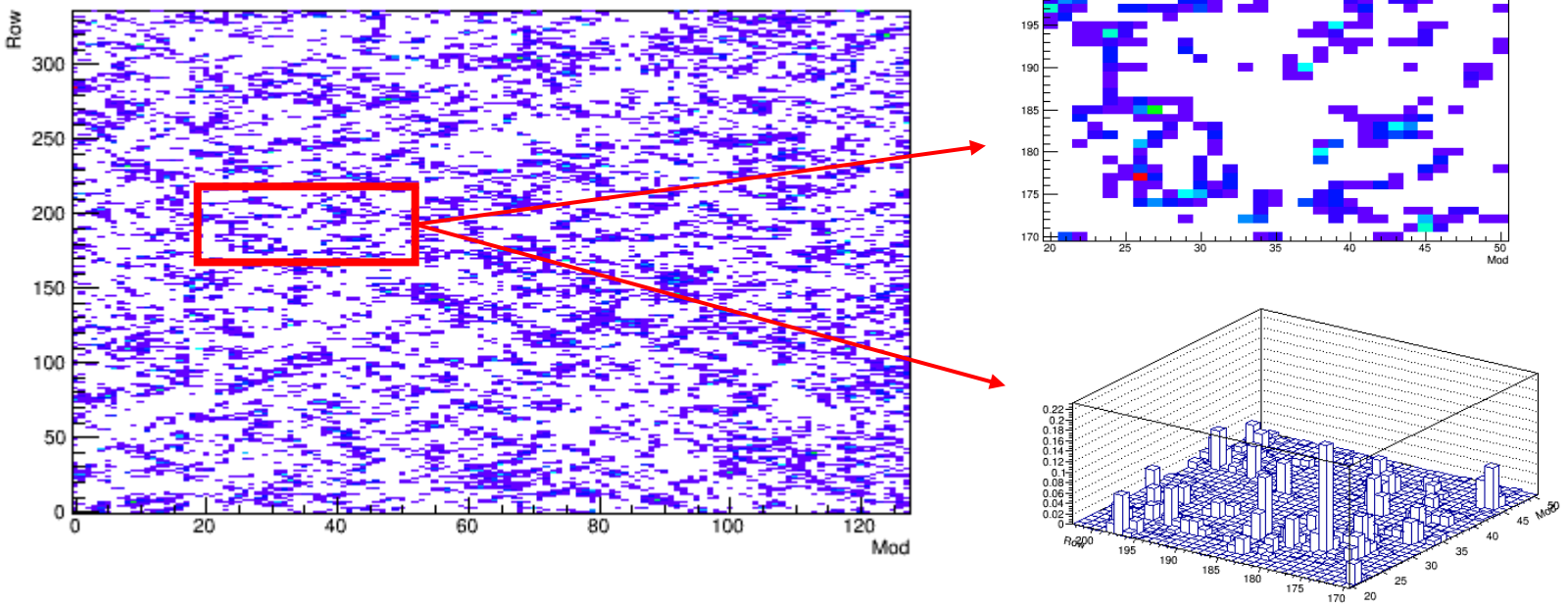
Physical program

- 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 (for the future)
- Triggering in pp/pA

MPD-ECAL

- High multiplicity of electromagnetic and hadronic signals
- Compared to other heavy-ion experiments (RHIC, LHC):
  - ✓ softer particles, $\sigma(E) \sim 1/\sqrt{E}$
  - ✓ smaller radius (~ 2 m vs. ~5 m) → density of signals, space resolution
- Reconstruction software should deal with high density of signals and extensive shower overlaps

UrQMD, AuAu@11, E_{tower} > 5 МэВ



ECAL Software Group

- Formed in February, 2019
- Regular public meetings, https://indico.jinr.ru/categoryDisplay.py?categId=276
- Everyone interested to follow or contribute → contact me to join
- Main tasks:
  - ✓ 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'
  - ✓ estimation of basic performance parameters
  - ✓ documentation, recommendation and examples of use for easy start
  - ✓ basic physics/feasibility studies (to be advanced by Collaboration/PWGs)

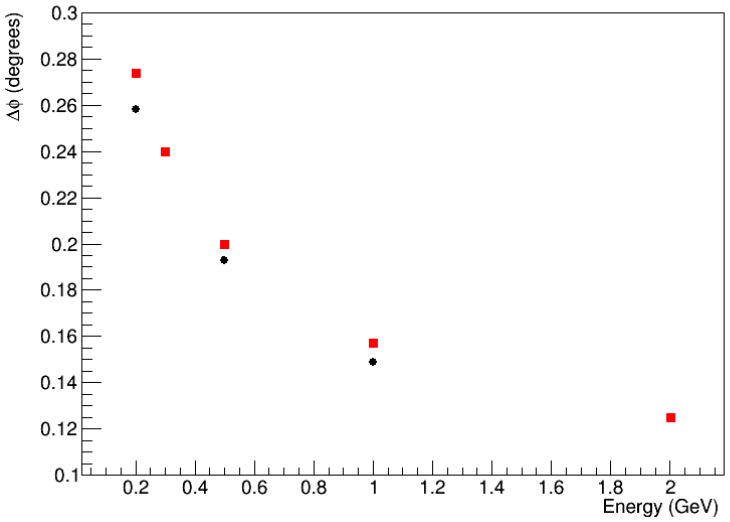
→ release to Collaboration

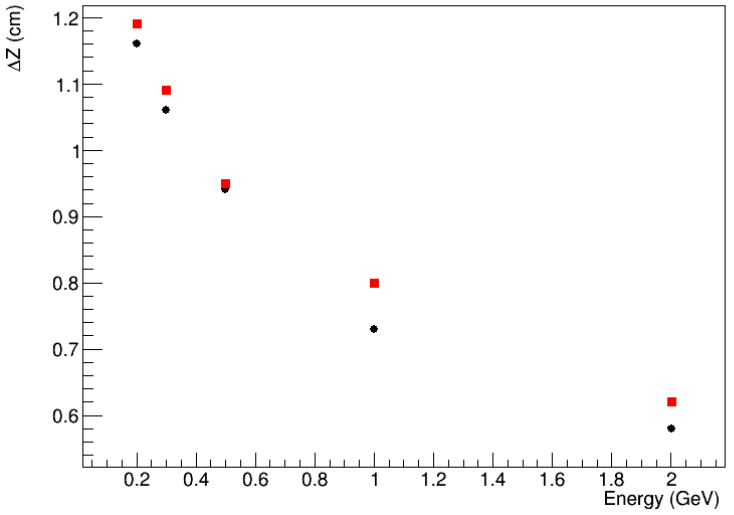
Current status

- Reconstruction software with signal unfolding is basically ready
- Remaining tasks:
  - ✓ tuning of reconstruction algorithms for better spatial/energy resolution and efficiency
  - ✓ development and tests of algorithms for rejection of hadronic signals (apart from charged track veto)
  - ✓ code cleaning
  - ✓ tuning for new (more realistic) geometry when available
- Performance studies

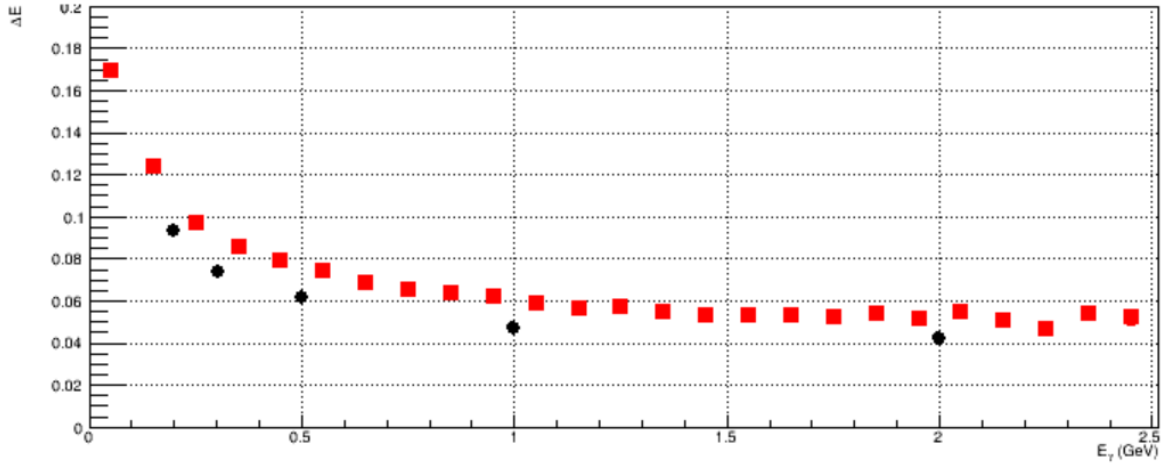
ECAL resolution

- Spatial resolution (● - single photons; ● - AuAu@11, UrQMD)





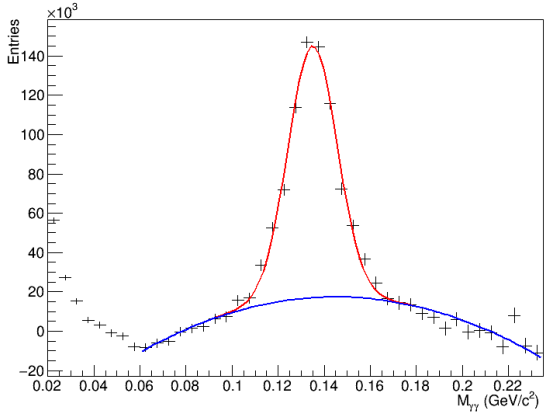
- Energy resolution (● - single photons; ● - AuAu@11, UrQMD)



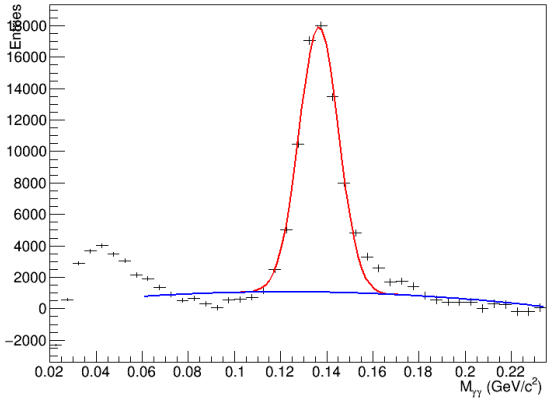
π^0 reconstruction

- AuAu@11, UrQMD, realistic vertex distribution

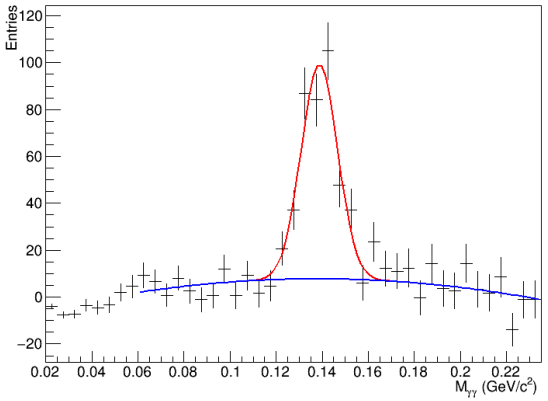
$0 < p_T\,(GeV/c) < 0.5$



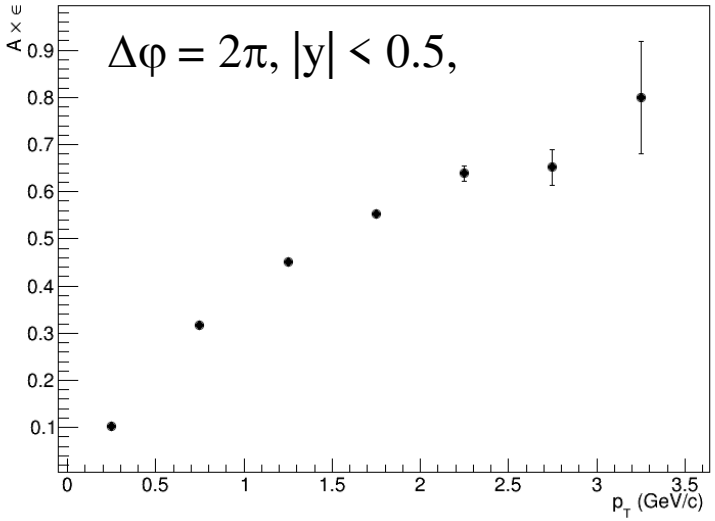
$1.5 < p_T\,(GeV/c) < 2$



$p_T\,(GeV/c) > 3$



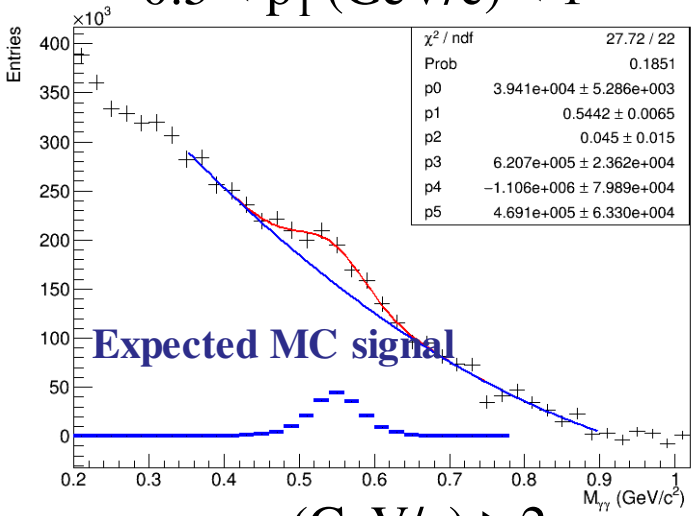
- A x ε - reconstruction efficiency: AuAu@11, UrQMD



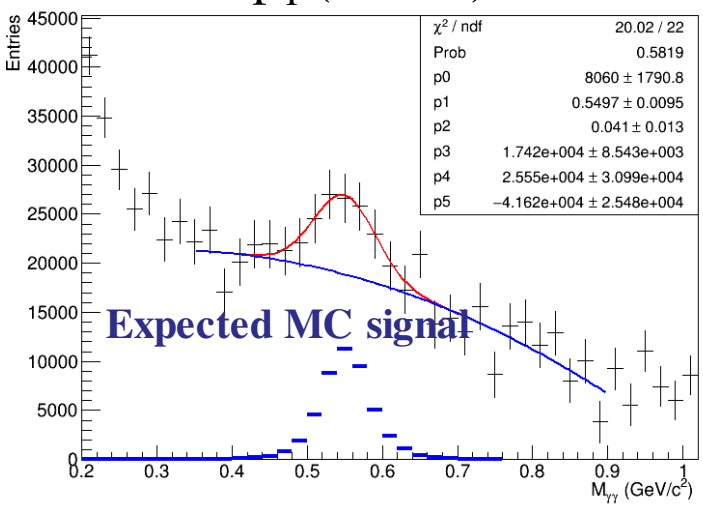
η reconstruction

- AuAu@11, UrQMD, realistic vertex distribution
- Observe η signal starting from ~ 0.5 GeV/c

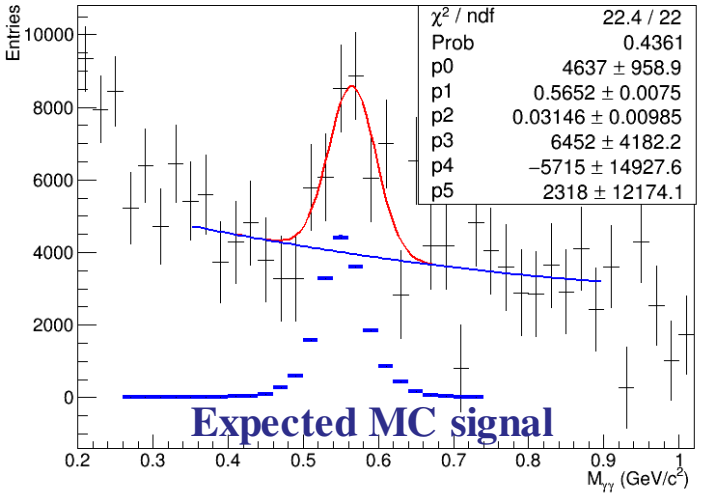
$0.5 < p_T\,(\mathrm{GeV/c}) < 1$



$1 < p_T\,(\mathrm{GeV/c}) < 2$



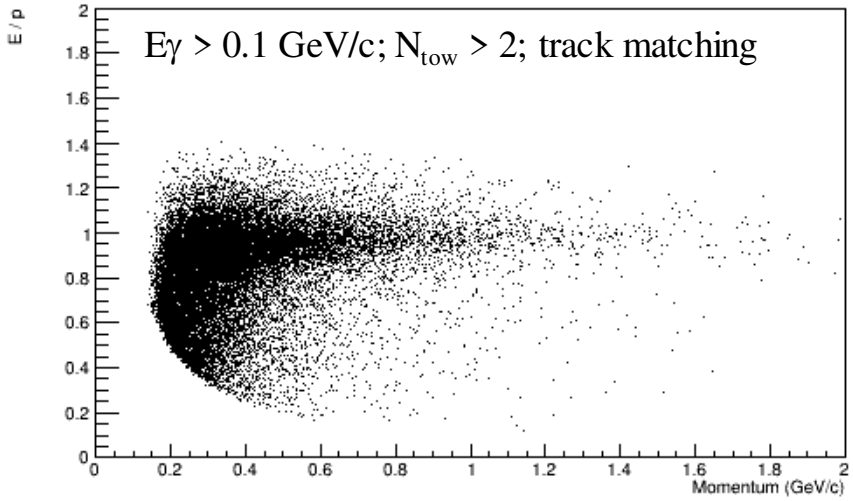
$p_T\,(\mathrm{GeV/c}) > 2$



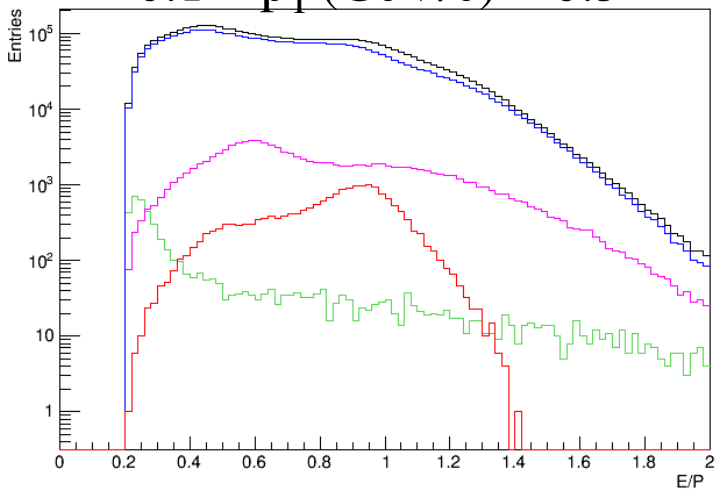
$e^{\pm}$/h rejection

- UrQMD, minbias AuAu@11, realistic vertex distribution

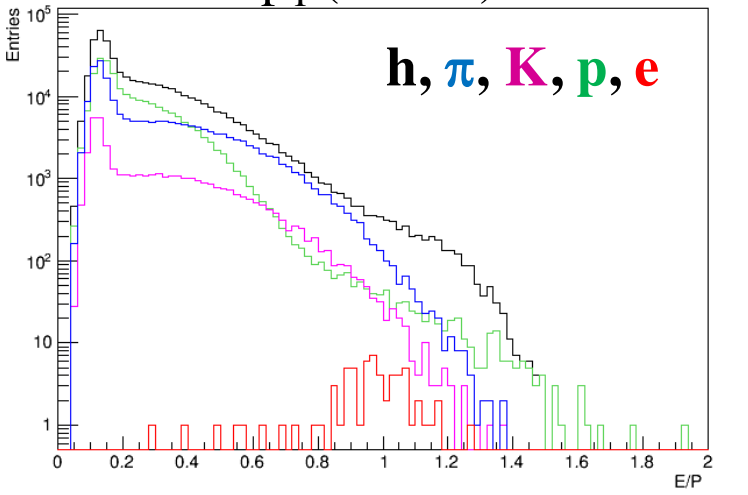
- E – reconstructed cluster energy
- P – simulated (true) momentum
- E/P ~ 1 at p_T > 0.5 GeV/c, lower energy signals break up in smaller clusters due to large incident angles (magnetic field)
- h/e separation power (0.8 < E/p <1.1):
  - ✓ 0.1-0.5 GeV/c → 0.5 (eff ~ 60%)
  - ✓ 0.5-1.0 GeV/c → 0.1 (eff ~ 75%)
  - ✓ 1.0-1.5 GeV/c → 0.04 (eff ~ 80%)
  - ✓ 1.5-2.0 GeV/c → 0.02 (eff ~ 85%)



0.1 < p_T (GeV/c) < 0.5

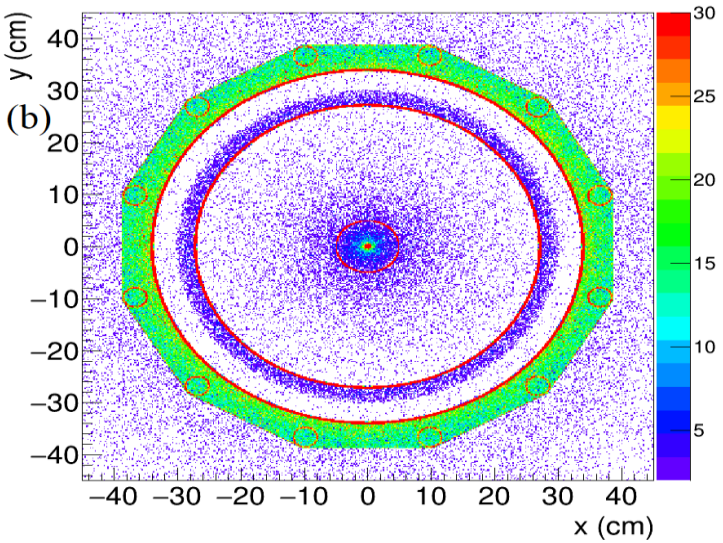


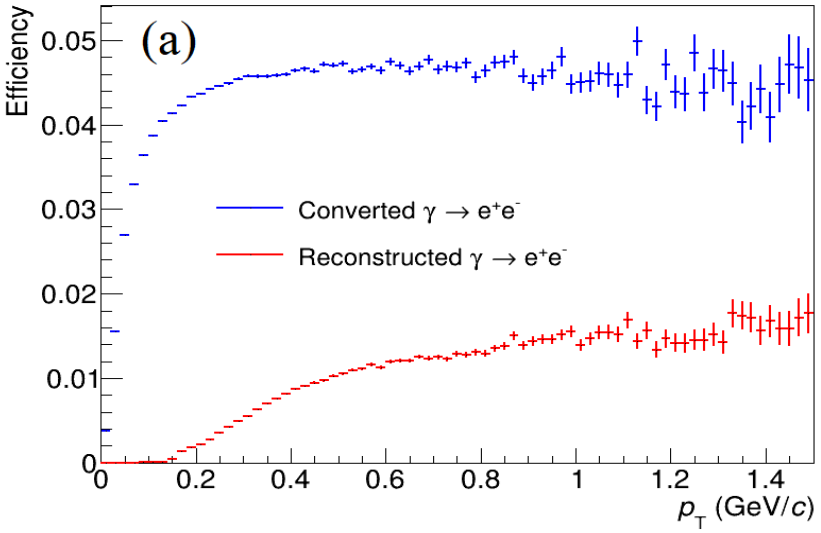
1.5 < p_T (GeV/c) < 2.0

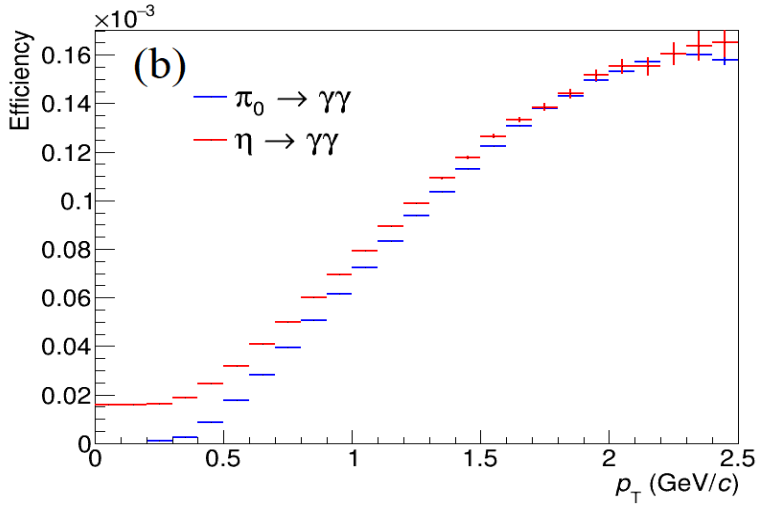


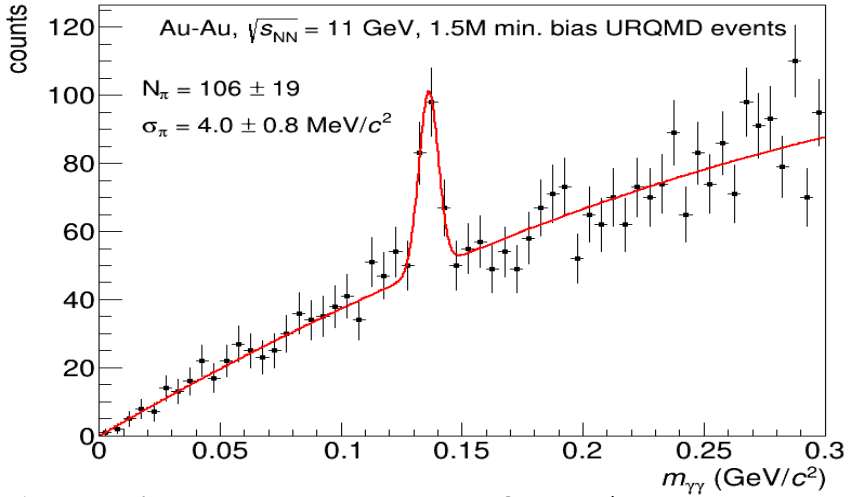
Conversion

- D. Ivanishchev, D. Kotov, E. Kryshen, M. Malaev, V. Riabov, Yu. Ryabov, RFBR18-02-40038
- UrQMD, minbias AuAu@11, realistic vertex distribution









- Performance can be further improved by using ECAL-PID for $e^{\pm}$

Problems

- Many tasks → manpower !!! Welcome to join the group if interested!
- CPU and disk storage → need centralized productions with common access
- Communication issues, mails are spammed → mail-lists with an easy sign-up
- Address at user@jinr.ru, write access to Git → does not work for outsiders, takes months to resolve
- Documentation storage (technical & notes) → need storage with an easy search/indexing and retrieve possibilities
- Coordination between PWGs (for the future)

Conclusions

- ECAL software group is productive and successful
- Release to Collaboration → fall of 2019 (mostly defined by new geometry)