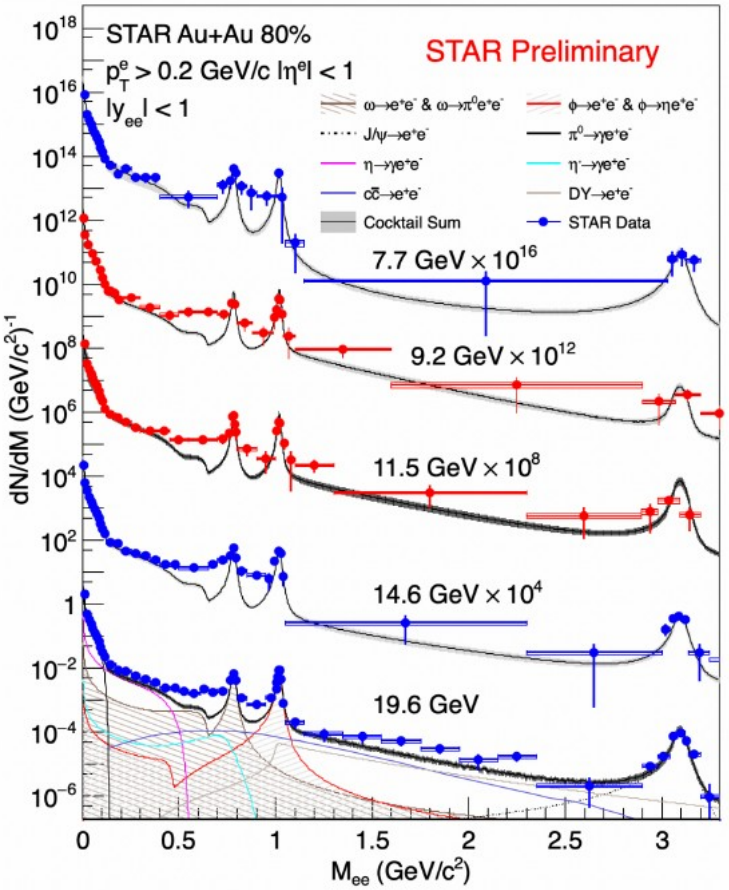
Updates in PWG4
Electromagnetic signals

D.Peresunko and C. Yang for the PWG4

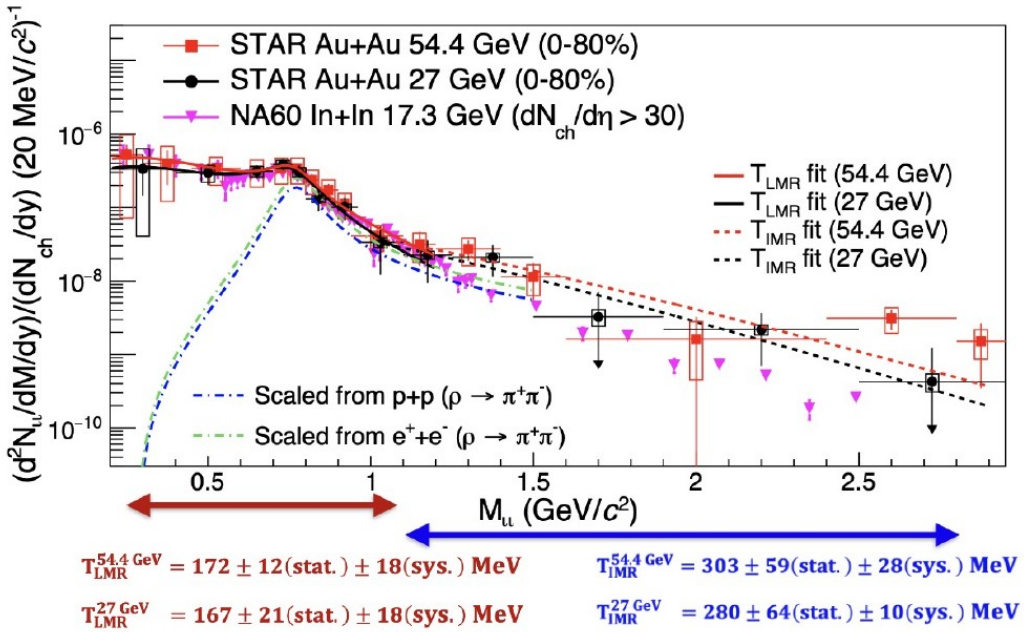
PWG4: goals and organization

- Conveners: Chi Yang, Dmitri Peresunko
- Physics objectives
  - Neutral meson rapidity, spectra, flow
  - Direct photon rapidity, spectra, flow, interferometry
  - Dileptons: mass distributions, spectra
  - Antineutrons
- Talk overview
  - Recent experimental results and theoretical predictions
  - Software development
  - Ongoing analyses

Temperature measurements via di-leptons



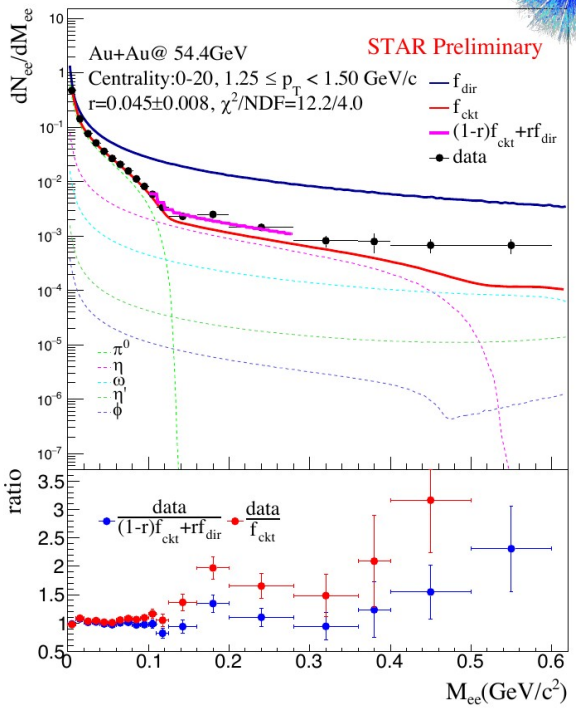
Chenliang Jin @ Hard Probes'24



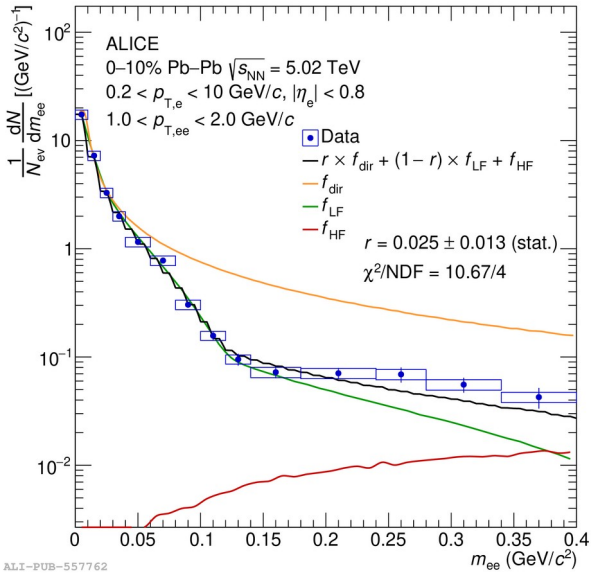
Unsertainties due to rho broadening at Low Mass Region
Uncertainties due to heavy flavour decays in Intermediate mass Region

Di-lepton analysis in STAR, ALICE

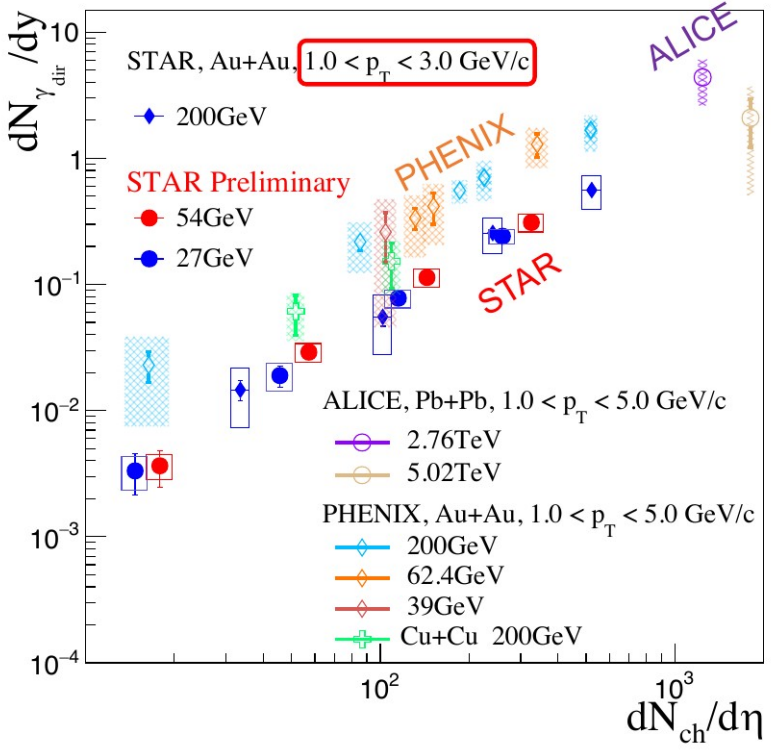
Xianwen Bao @ Hard Probes'24



D.Peresunko @ Hard Probes'24



Xianwen Bao @ Hard Probes'24



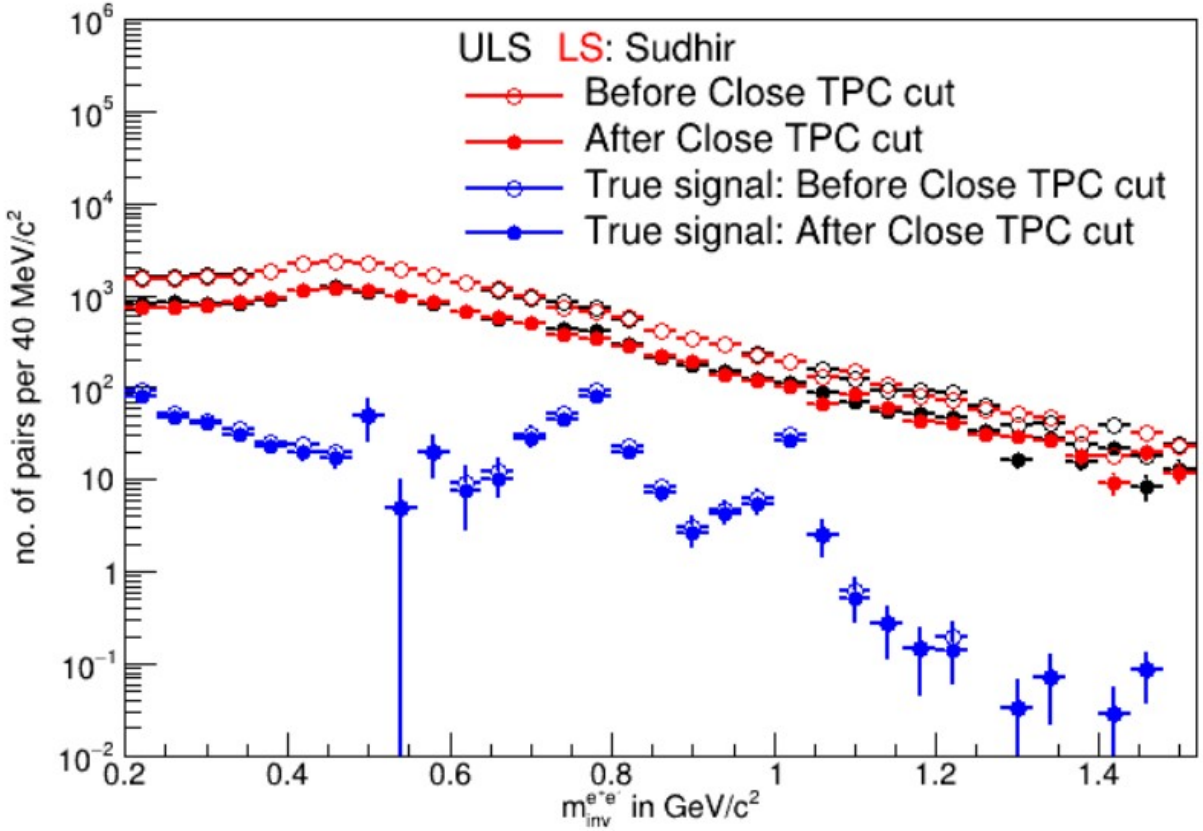
STAR and ALICE presented extraction of real photon yield from low mass dileptons via Croll-Wada formula

Tension between PHENIX and STAR (and probably ALICE) still persists

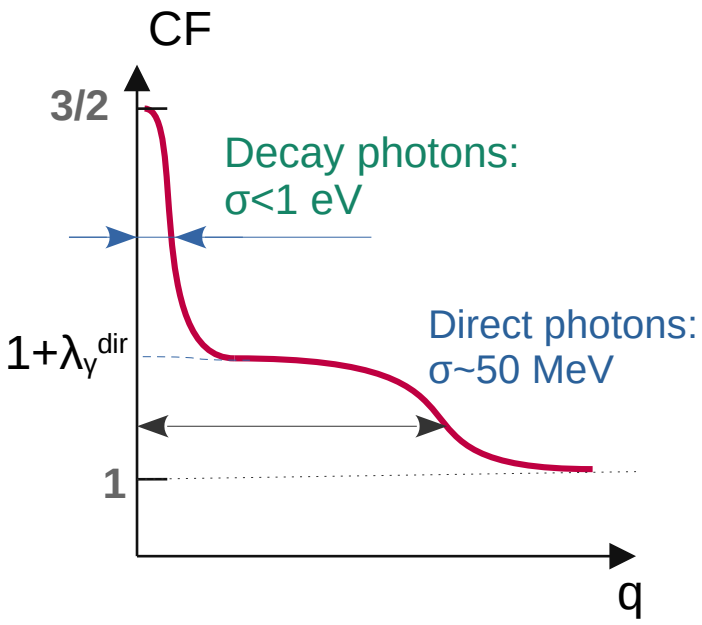
Dileptons in MPD

Sudhir Pandurang Rode

- Controll of low-p_T tracks
- Electon PID improved with ML
- …
  - See Sadhir's presentation for details



Direct photon interferometry



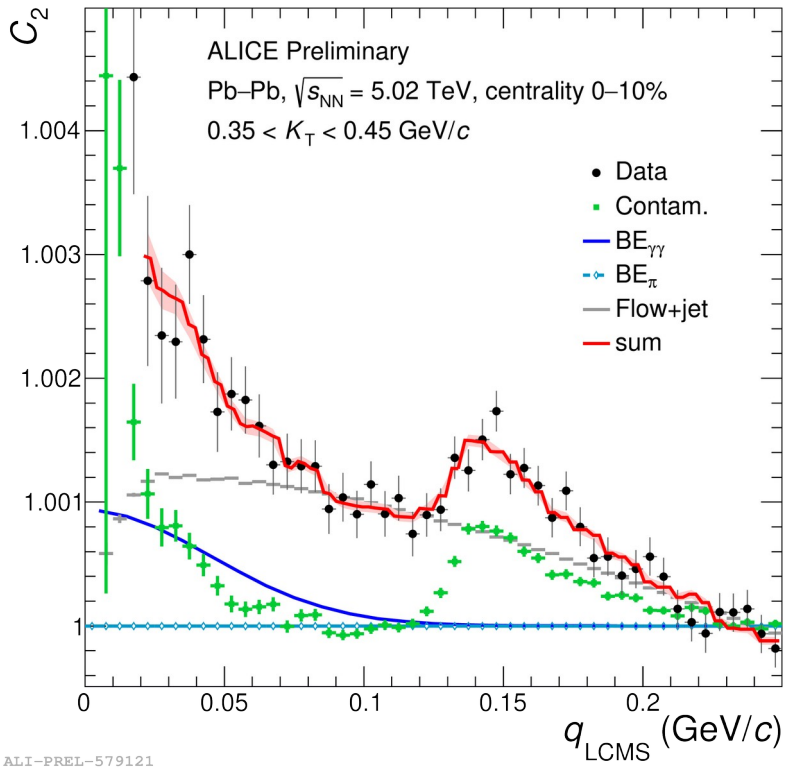
- No need to select direct photons:
  - Decay-decay, decay-direct correlations have tiny width (~1 eV) and not visible
  - Correlation stength reflects proportion of direct photons

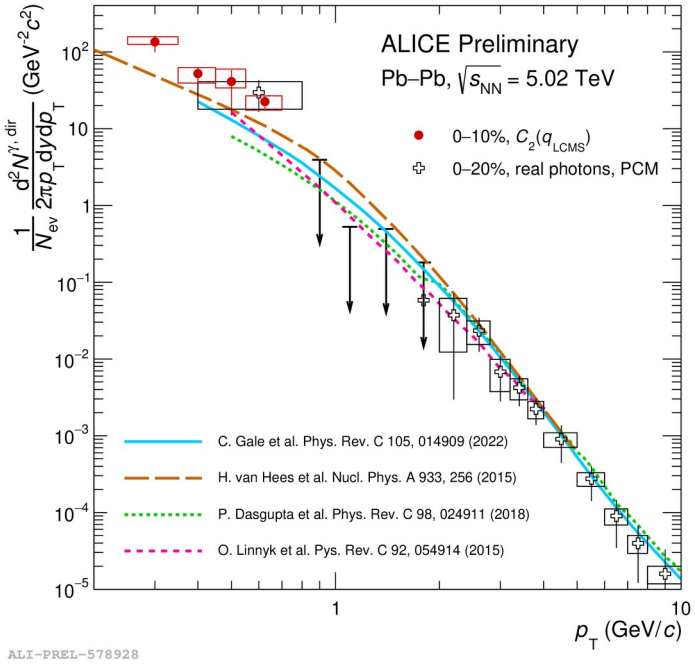
$$\lambda_{\gamma}^{dir} \approx \frac{1}{2}\left(\frac{N_{\gamma}^{dir}}{N_{\gamma}^{incl}}\right)^2 \sim 10^{-3}$$

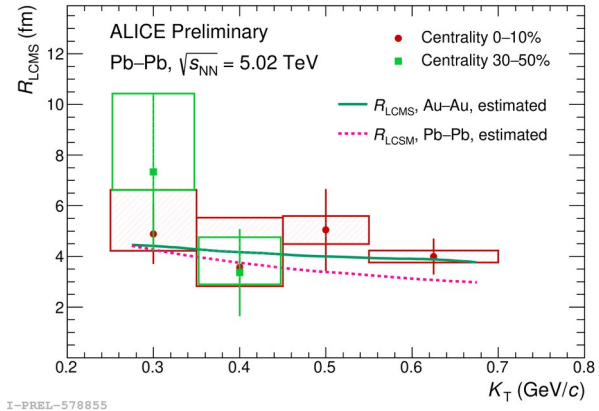
Variables: $K_T = \frac{1}{2}(\vec{p}_1 + \vec{p}_2)_T$ $q_{LCMS} = |\vec{p}_1 - \vec{p}_2|$ in Longitudinally Co-Moving System

Direct photon BE correlations at ALICE

D.Peresunko @ Hard Probes'24







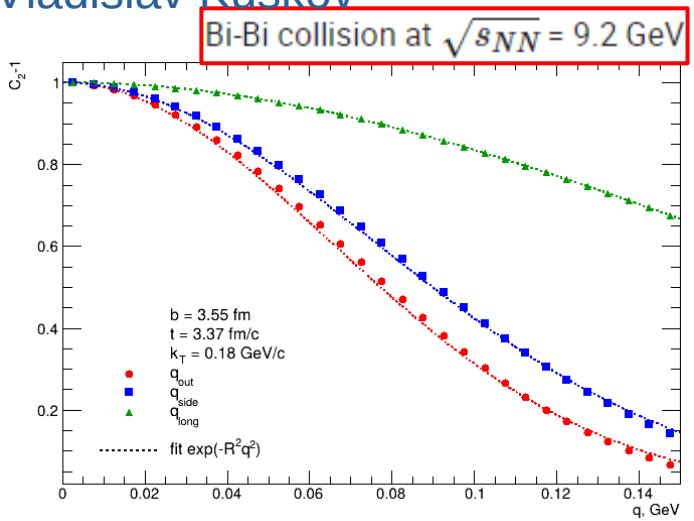
Direct photon Bose-Einstein correlations extracted in Pb-Pb collisions at LHC
Direct photon yield was measured at 250<pT<700 MeV/c with high precision

Photon BE correlations at NICA

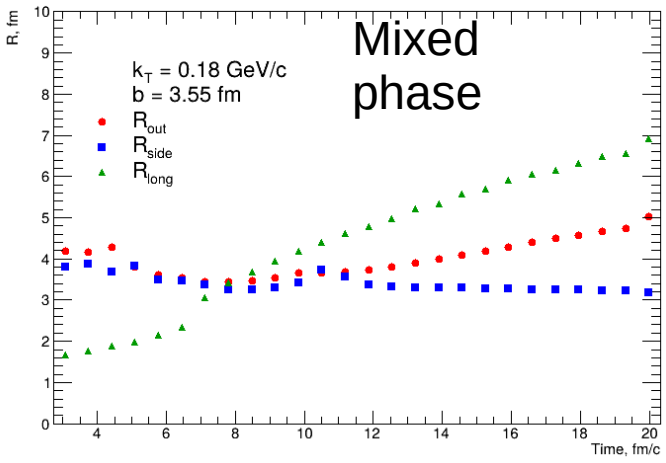
Vladislav Kuskov

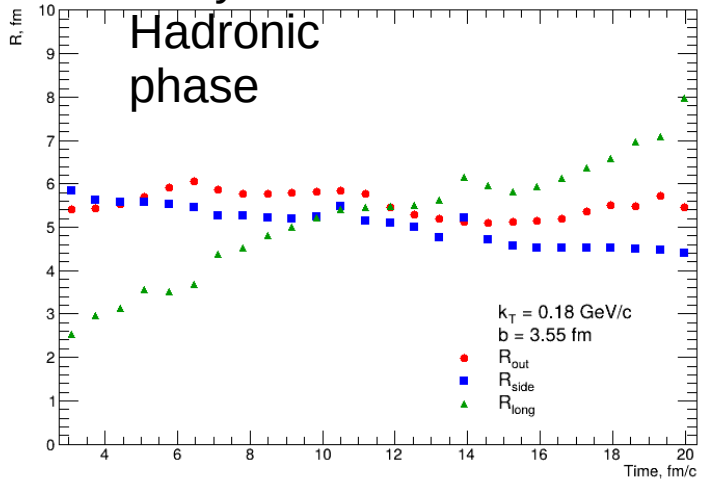
$$C_2(q,K) = 1 + \lambda \frac{\left| \int d^4x S(x,K) e^{iqx} \right|^2}{\left| \int d^4x S(x,K) \right|^2}$$

Wigner probability density of photon emissin S(x,K) estimated from UrQMD model



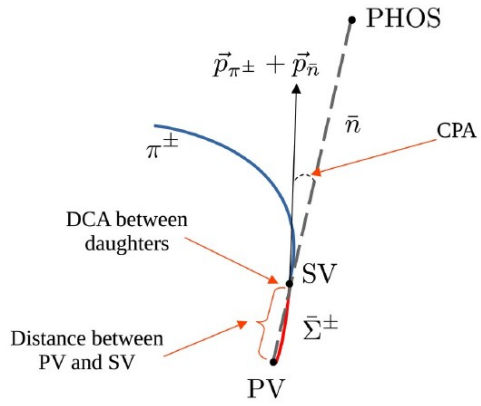
Correlation radii measured for photons emitted from different phases as a function of time from the start of hydro simulation





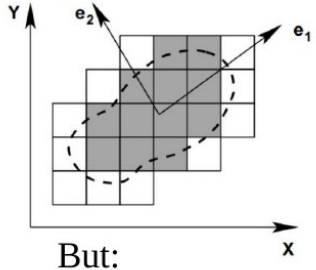
Anti-neutron registration in EM calorimeter (ALICE)

Pavel Gordeev @ SQM'24



How can we identify antineutrons?

- Deposited energy of annihilation
- Neutrality (charged particle veto)
- Dispersion of cluster (M20, M02 – eigenvalues of S matrix)



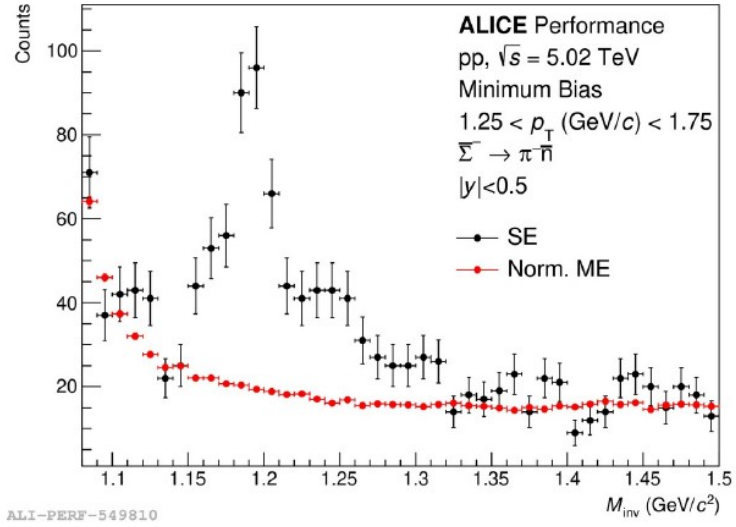
$$S = \begin{pmatrix} s_{xx} & s_{xz} \\ s_{zx} & s_{zz} \end{pmatrix}$$

$$s_{xx} = \langle (x - \bar{x})^2 \rangle$$

$$s_{xz} = \langle (x - \bar{x})(z - \bar{z}) \rangle$$

But:

- Cannot measure momentum based on deposited energy
- Use time-of-flight information from PHOS to reconstruct antineutron momentum



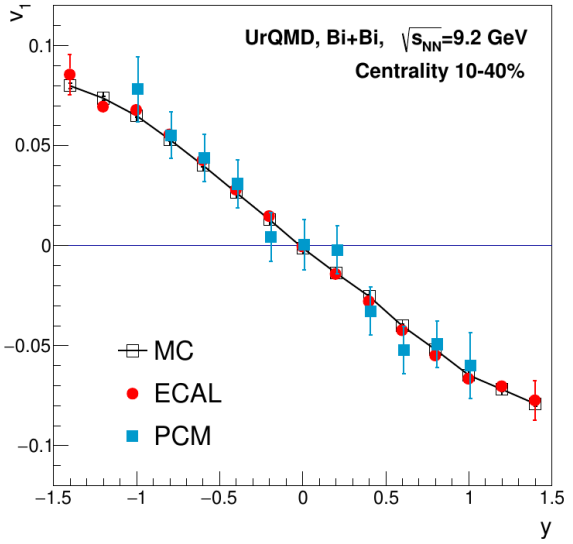
mpdroot development

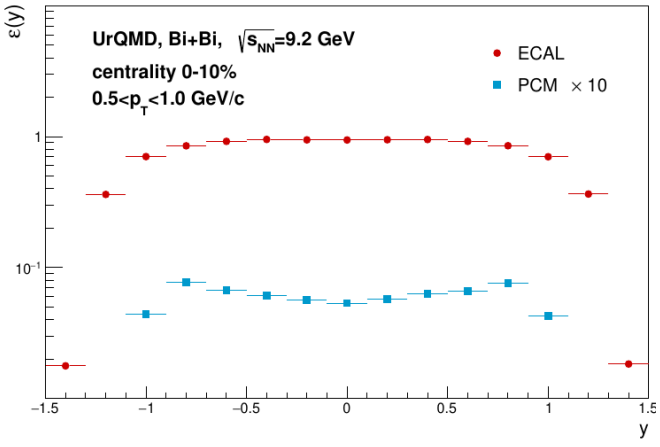
- A class for re-cluserization
  - Change (de-)calibration
  - Change reconstructin parameters without requesting another pass of reconstruction

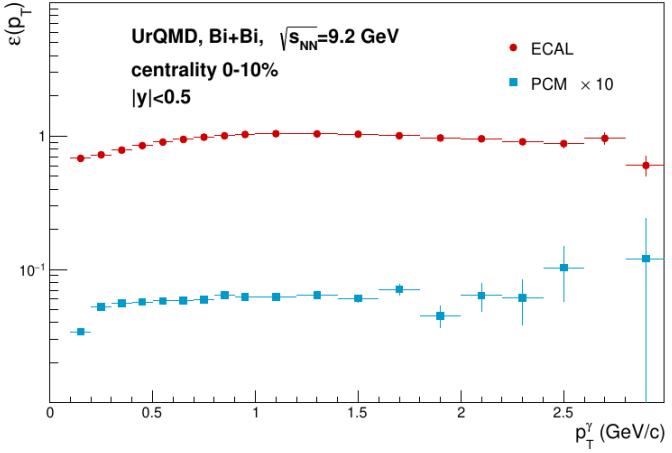
```
MpdAnalysisManager man("ManagerAnalysis", nEvents) ;
man.ReadBranches("MCTrack,TpcKalmanTrack,Vertex,MPDEvent,ZdcDigi,TOFMatching,EmcDigit,MCEventHeader") ;
….
MpdEmcSimParams * fSimParams = MpdEmcSimParams::GetInstance();
fSimParams->fLogWeight = 5.;                    //Weight to calculate position and dispersion
fSimParams->fLocalMaximumCut = 0.050;   //Local maxima calculation for unfolding
….
//New de-calibration
MpdEmcCalibParams * calib = new MpdEmcCalibParams();
int NCHANNELS = 38400;
for(int i=0; i<NCHANNELS; i++)calib→SetGain(i,1.);   //So far: do not change calibration/de-calibration
….
MpdReclusterizer reclu;              //Class to run re-clusterization
reclu.SetCalibParams(calib);
man.AddTask(&reclu);
….
MpdConvPi0 pi0_loose20("pi0_loose", "pi0_loose");  //Analyze re-clusterized data as ususal
man.AddTask(&pi0_loose20);
```

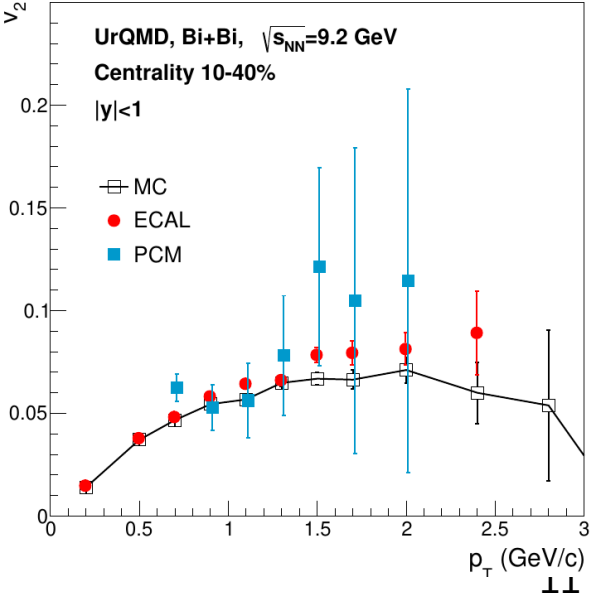
Inclusive photon spectra and flow

- Fixes in MpdConvPi0
  - Better primary assignment
- Reconstruction with larger local max threshold 50 MeV
- Inclusive photon reconstruction efficiency close to unity
- Collective flow of reconstructed clusters with photon primary close to generated photons in both methods





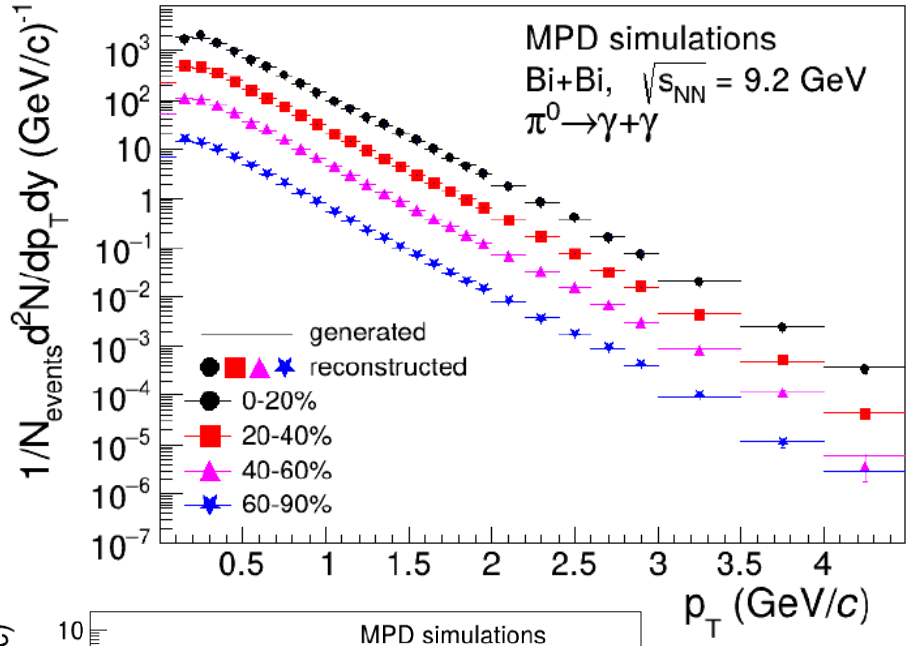


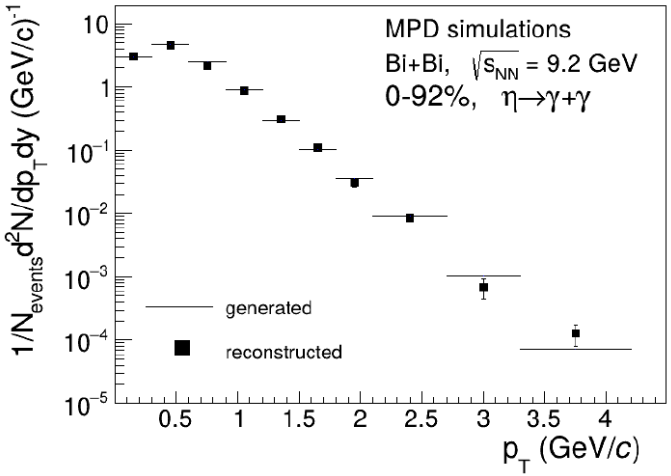


Yonghong Wang

Neutral mesons

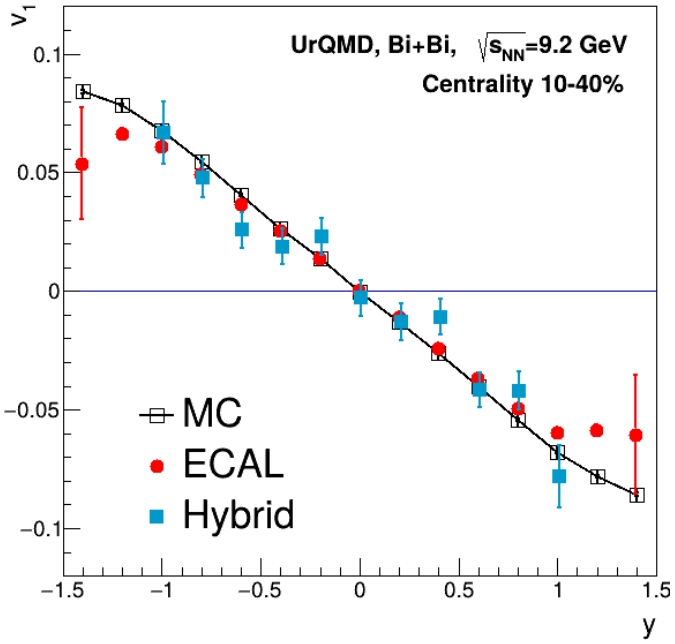
- Another wagon deloped
  - pairGG
- 100 M events analyzed
  - Production 25+production 35
- Closure test shows agreement within 2-5% of reconstructed spectra

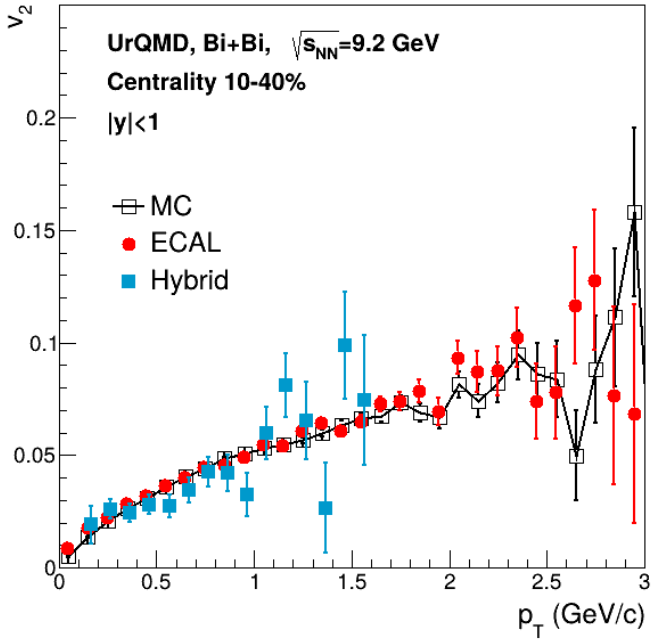




Neutral meson flow

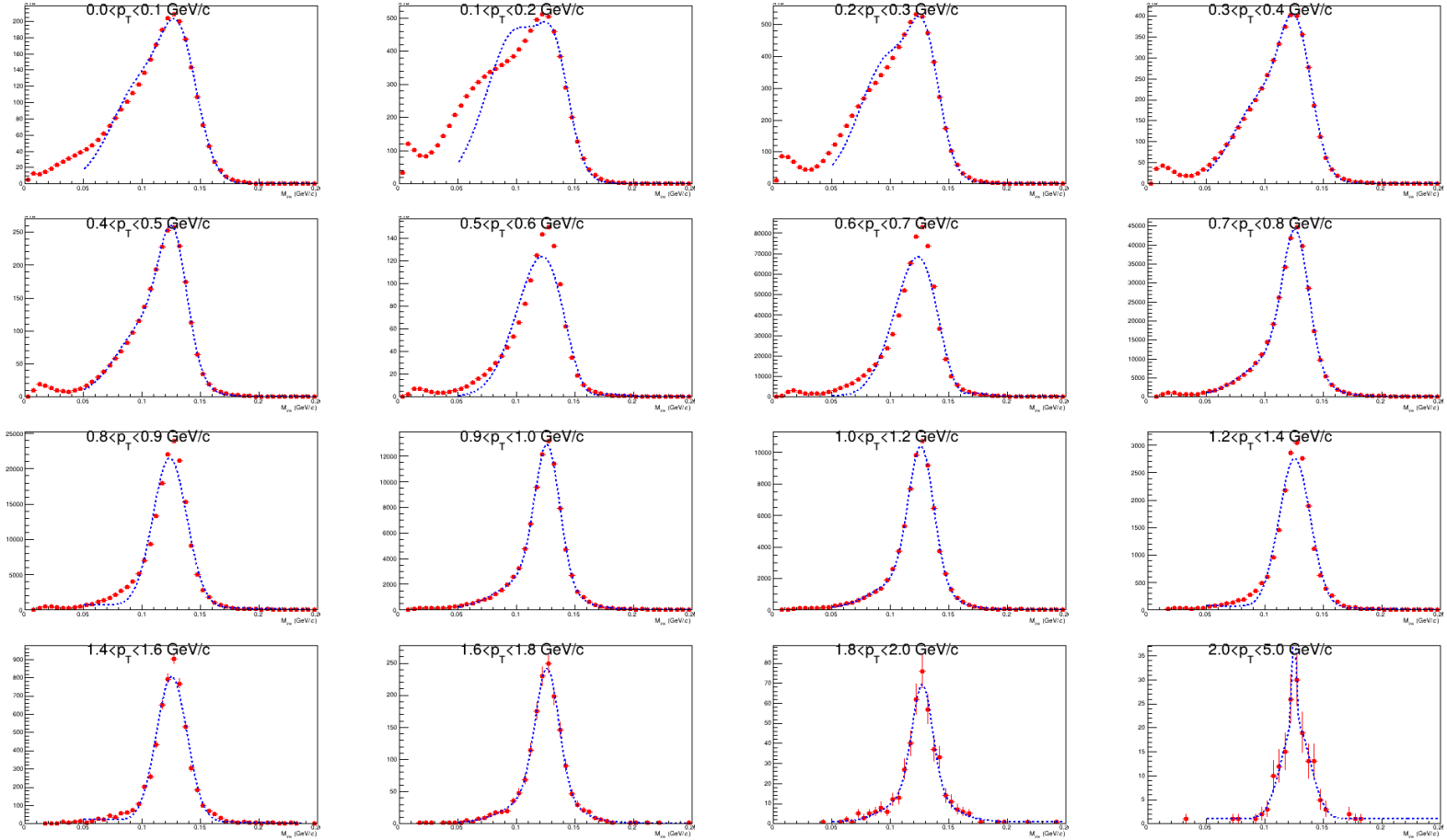
Oleg Golosov





Wagon MpdConvPi0
5M events analyzed Production 25
Good agreement between flow of reconstructed clusters originated from π^0 photons and primary π^0 flow on generator level. Both methods (ECAL and Hybrid) agree

Fixed Target: inv mass of clusters with π^0 parent



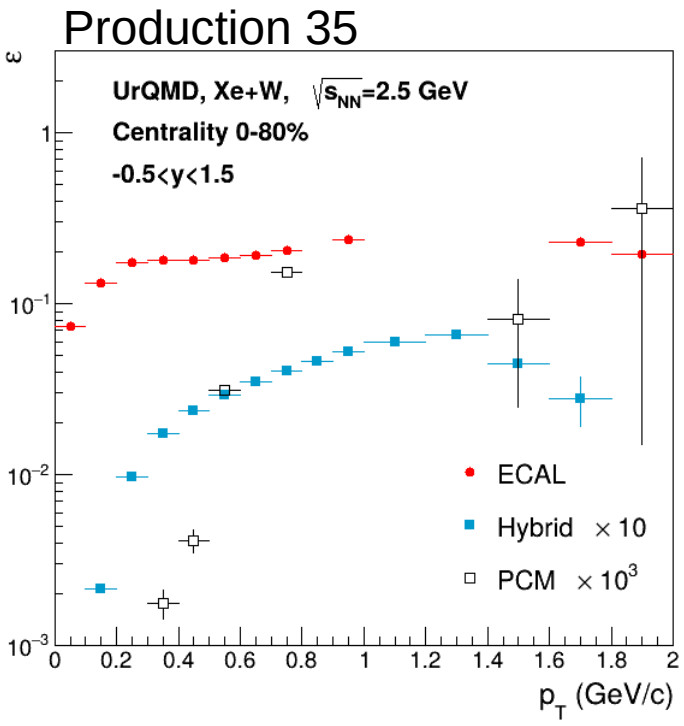
Projective geometry may result in large distortions in π^0 peak in case of off-designed-vertex creation

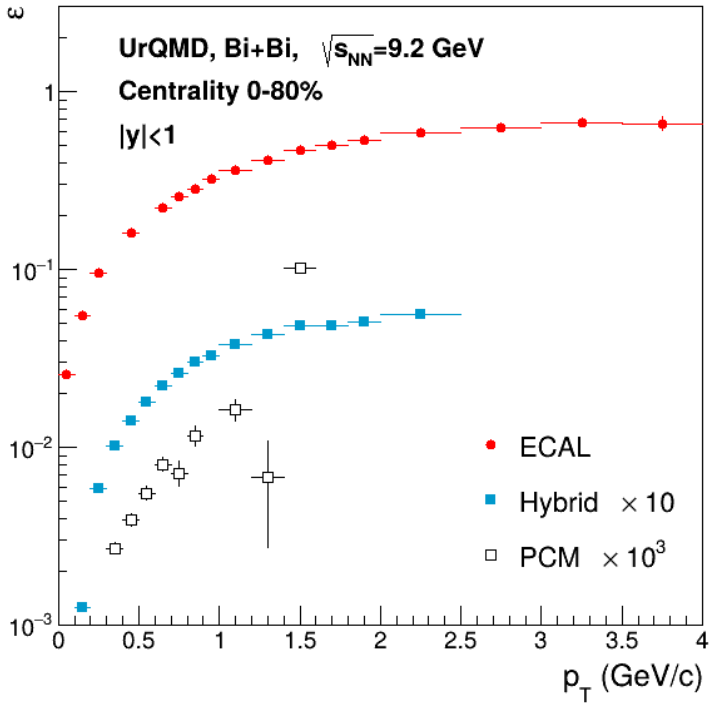
Large distortions of π^0 shape at p_T<200 MeV/c

Additional peak at zero mass (conversion?)

Good shapes at higher p_T

Collider vs FXT modes





In Fixed Target mode effissinenly in general somewhat smaller, but does not drop as fast at small p_T

Conclusions

- Analysis software is being developped
- Basic analyses started
  - revealed some points in ECAL reconstruction requiring optimisation
    - Event mixing
    - Photon and electron ID still can be optimized
- Much more analyses in pipeline
  - $\pi/\eta \to \gamma(e^+e^-)$
  - $K_s^0 \to \pi^0\pi^0$
  - $\pi \to \pi^0\gamma$, $\pi^0\pi^+\pi^-$
  - $\eta' \to \eta\pi^+\pi^-$
  - $\Sigma^0 \to \Lambda\gamma$, $\Sigma^0 \to \Lambda(e^+e^-)$, $\Sigma^+ \to p\pi^0$, $\overline{\Sigma}^{\pm} \to \overline{n}\pi^{\pm}$
  - Dielectron continuum, LVMs
  - Single e_{HF}
  - Fluctuations $<\pi^0,\pi^{\pm}>$
  - ….