Measurement of low-momentum direct photons in Cu+Au collisions at 200 GeV

Direct Photons are a widely used probe to study the properties and evolution of Quark-Gluon-Plasma (QGP) produced in high-energy heavy-ion collisions.

A universal scaling of the direct photon yield with charged particle multiplicity is observed for a wide range of collision systems at different center of mass energies. The same measurement suggests that QGP turn off/on transition region may exist between large and small system collisions.

In this poster, the analysis status of the low transverse momentum direct photon production in Cu+Au collisions at 200 GeV using external conversion method with the PHENIX detector is presented which will eventually help in providing more information about the transition region.

Observable and Method

$$R_\gamma = \frac{\gamma^{incl}}{\gamma^{hadron}} = \frac{\frac{\gamma^{incl}}{\gamma^{\pi^0}}}{\frac{\gamma^{hadron}}{\gamma^{\pi^0}}} = \frac{\langle \epsilon f \rangle \left(\frac{N_\gamma^{incl}}{N_\gamma^{\pi^0}}\right)_{Data}}{\left(\frac{\gamma^{hadron}}{\gamma^{\pi^0}}\right)_{Sim}}$$

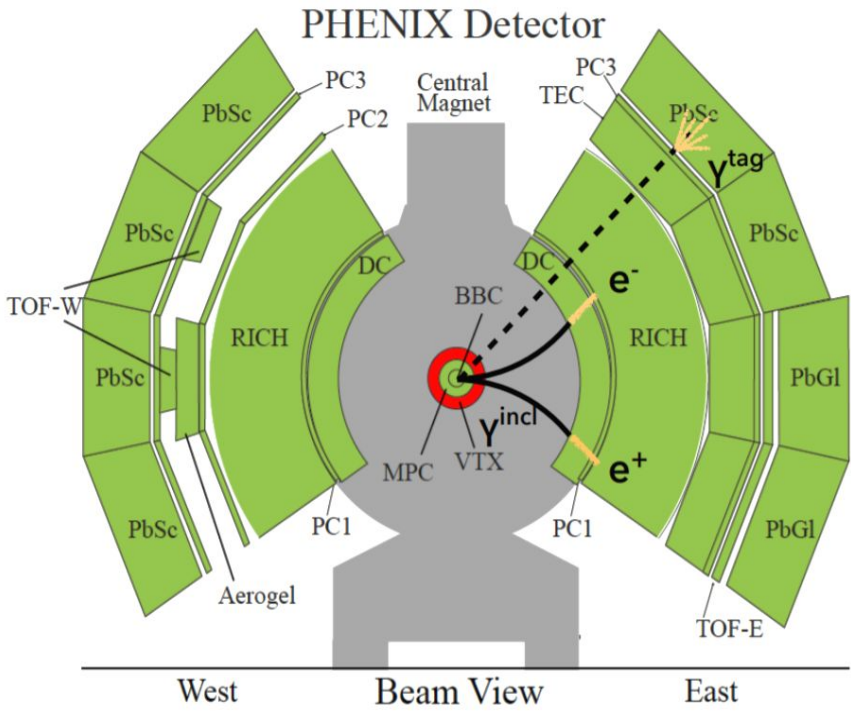
$N_{inclusive}$: Number of photons that convert to e^+e^- pair within the detector acceptance

$N^{tag}_{\pi 0}$: Number of converted photons that can be tagged as a π^0 decay

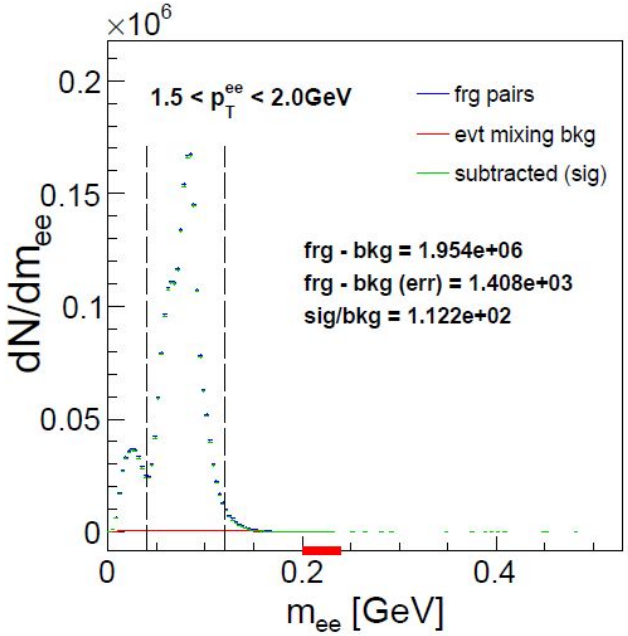
<εf> : detector efficiency and acceptance

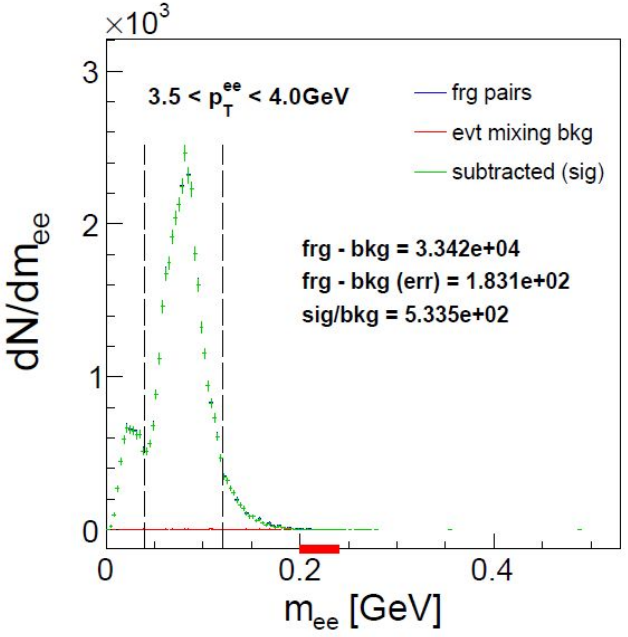
Cocktail ratio : ratio of photons coming from all hadrons to those coming only from π^0 decays

$$\gamma^{\text{direct}} = (R_\gamma - 1)\gamma^{\text{hadron}}$$



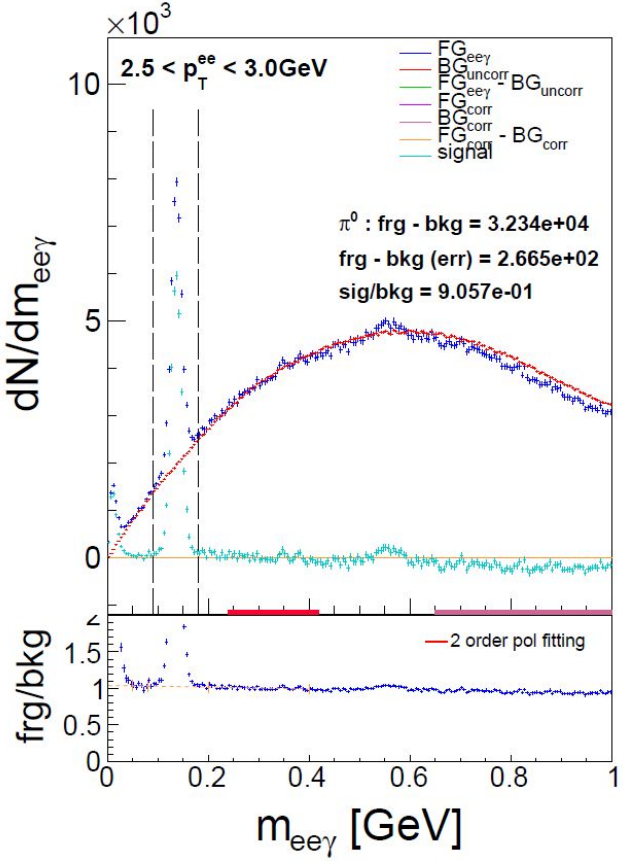
Distributions for N_{incl}

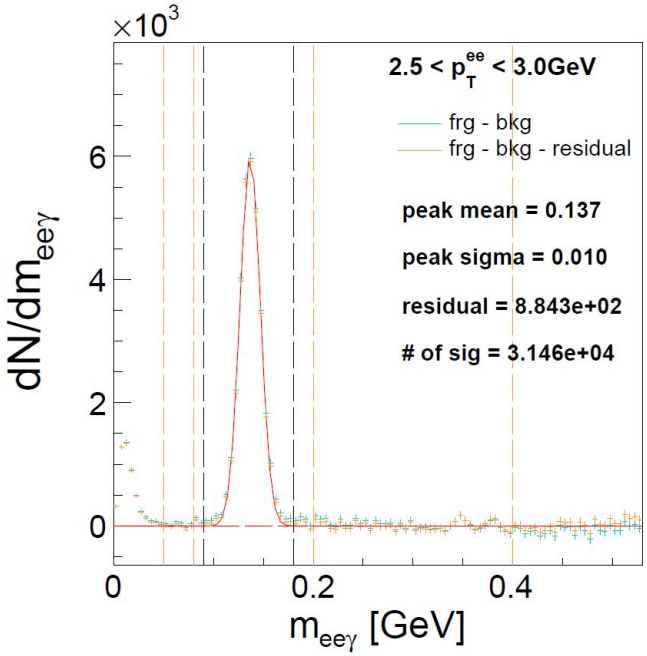




These figures show the foreground and the event mixing background distributions for N_{incl} in two different p_T windows. The thick red band (▬) shows the normalization window for the event mixing background.

Distributions for N_{tag}

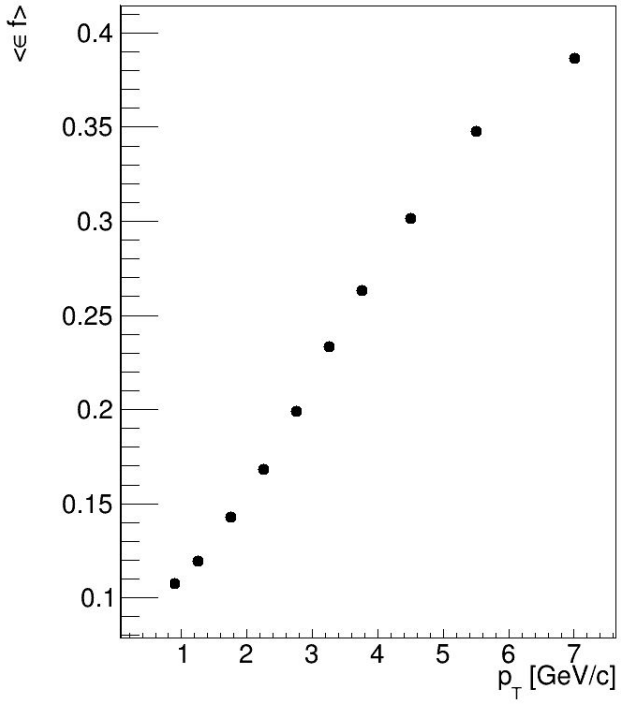




(▬) & (▬) shows the normalization window for the uncorrelated background in $FG_{ee\gamma}$ and correlated background in FG_{corr} respectively.

The dashed black lines indicate the π^0 counting window. The dashed orange lines indicate the residual background extraction windows.

Conditional Acceptance and Efficiency



<Ɛf > is the conditional probability of tagging the second photon from π^0 .

Next Steps

- Generate sufficient embedding statistics.
- Evaluate systematic uncertainties.
- Calculate R_γ and γ_{direct}.
- Investigate centrality dependence.