photon/π^0-hadron correlation analysis in ALICE

ALICE实验中光子及中性π介子与强子的关联测量研究

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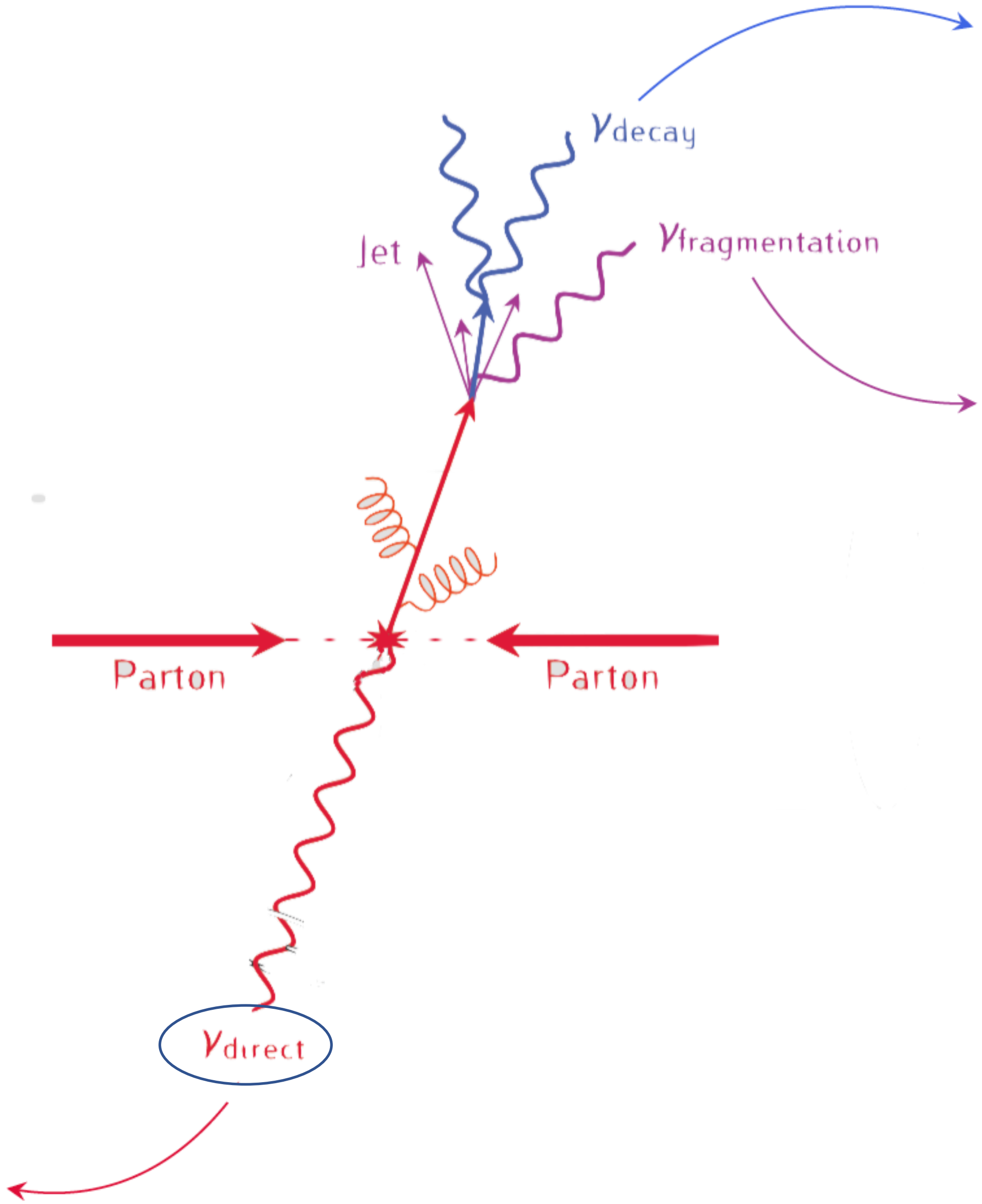
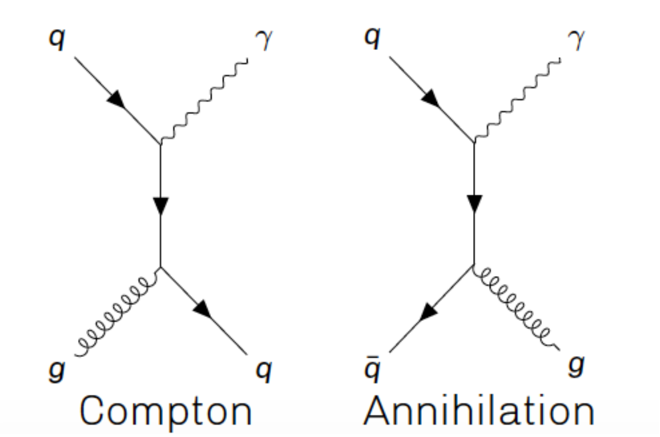
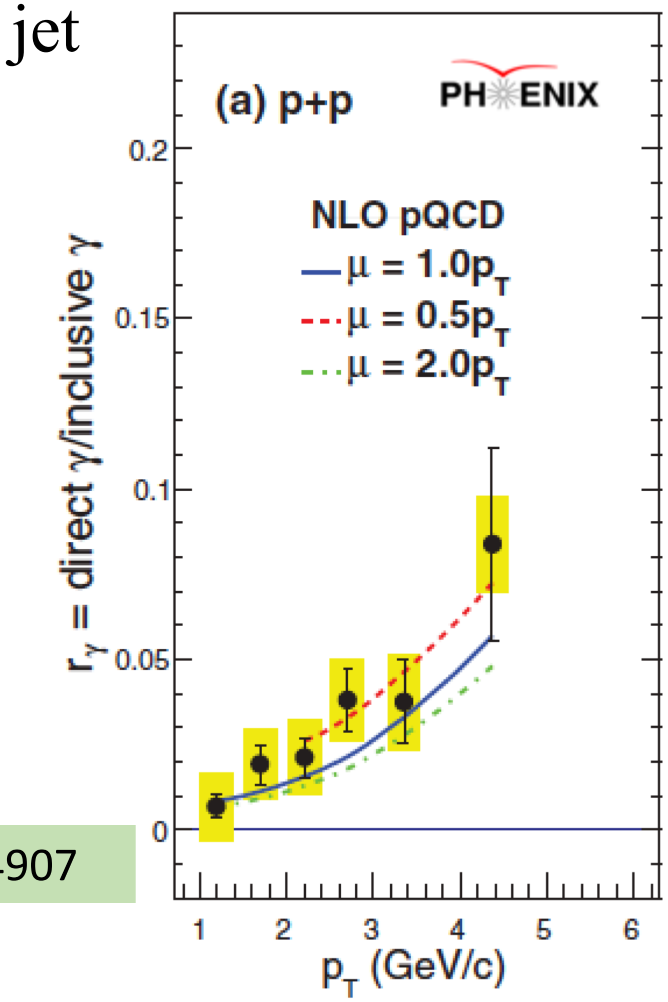
Photon source



coming from hadrons (mainly π^0 and η decay)

from a parton fragmentation into a jet





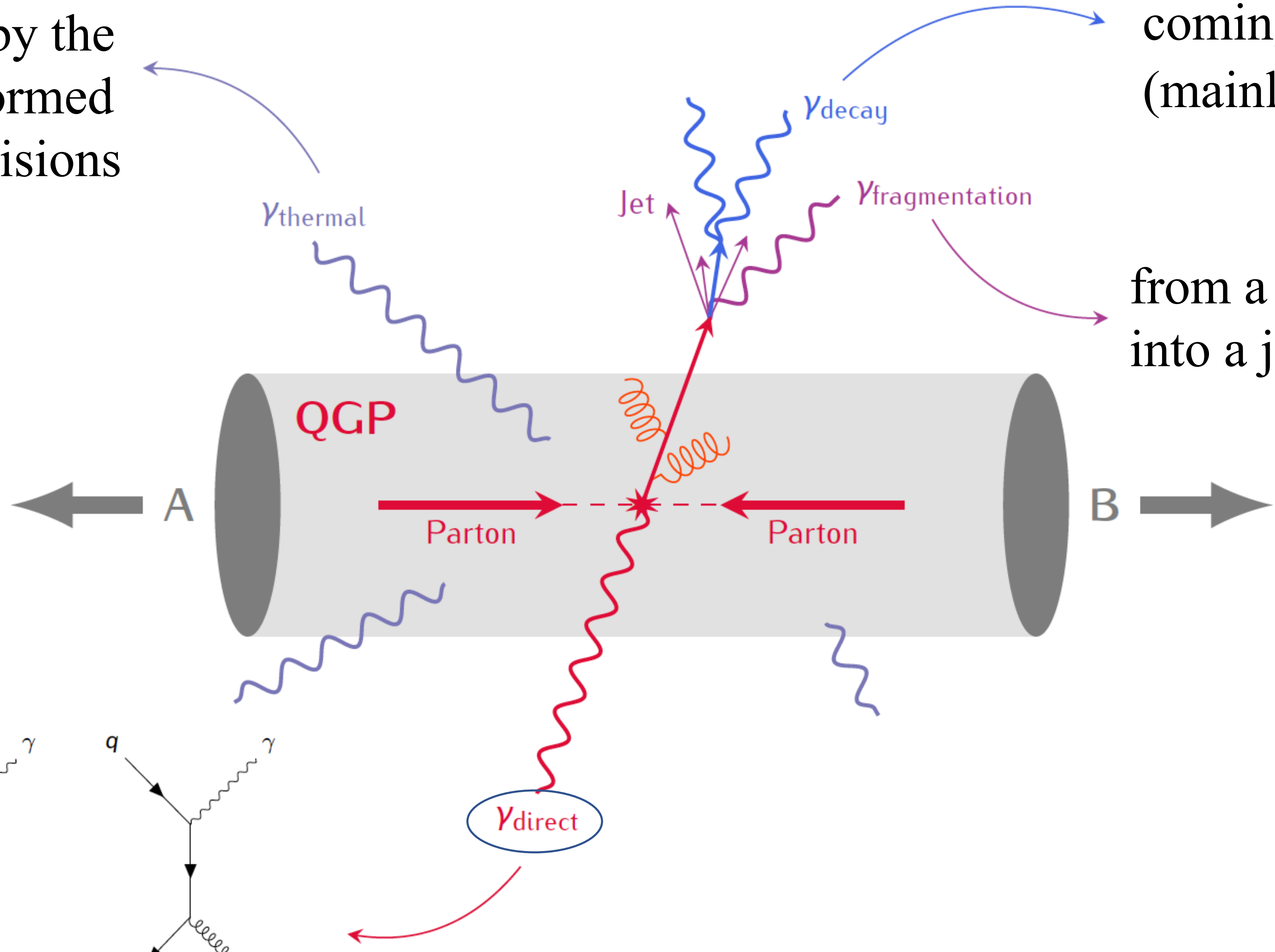
PRC87 (2013) 054907

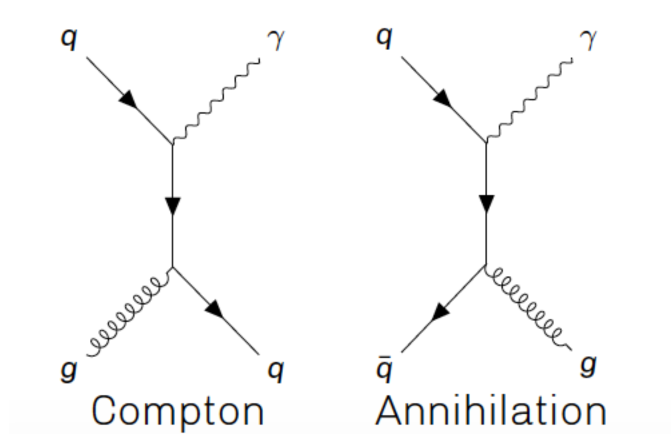
Photon source

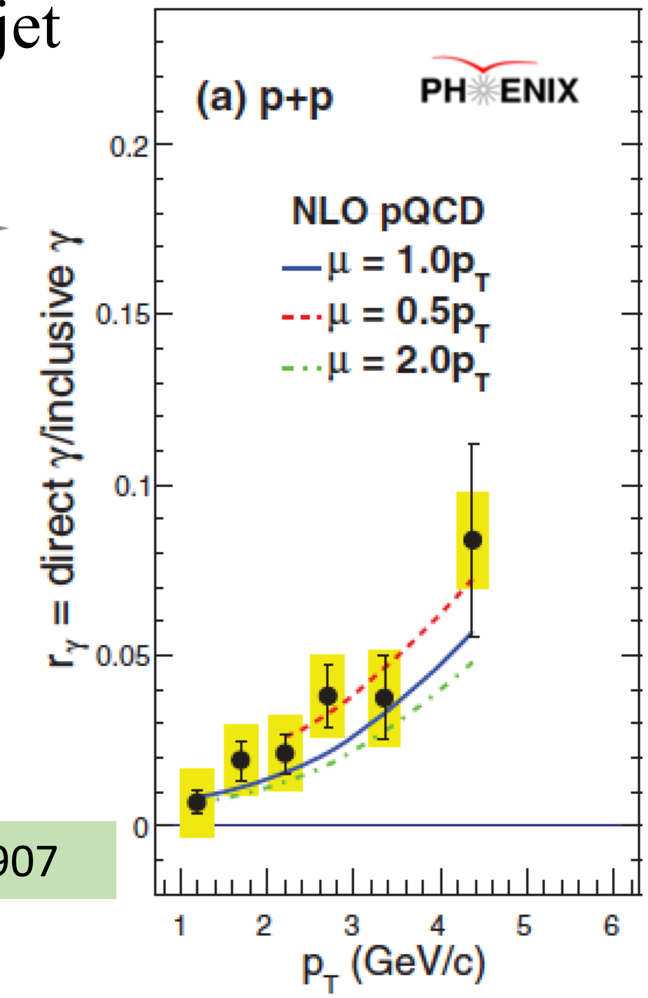
produced by the medium formed in NN collisions

coming from hadrons (mainly π^0 and η decay)

from a parton fragmentation into a jet







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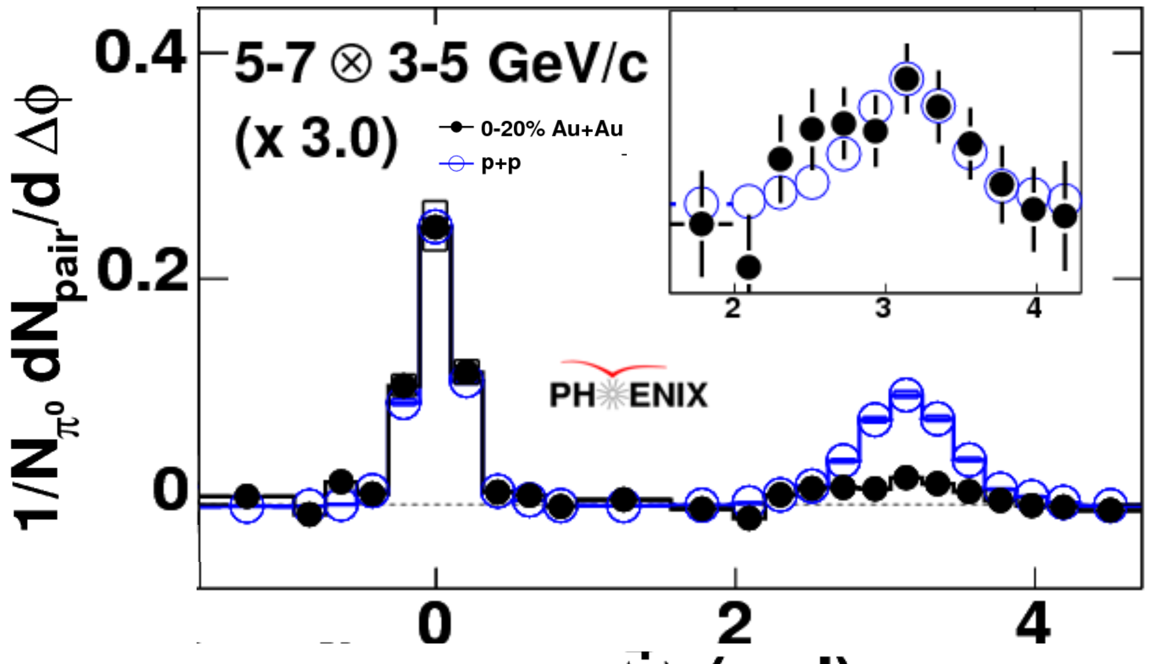
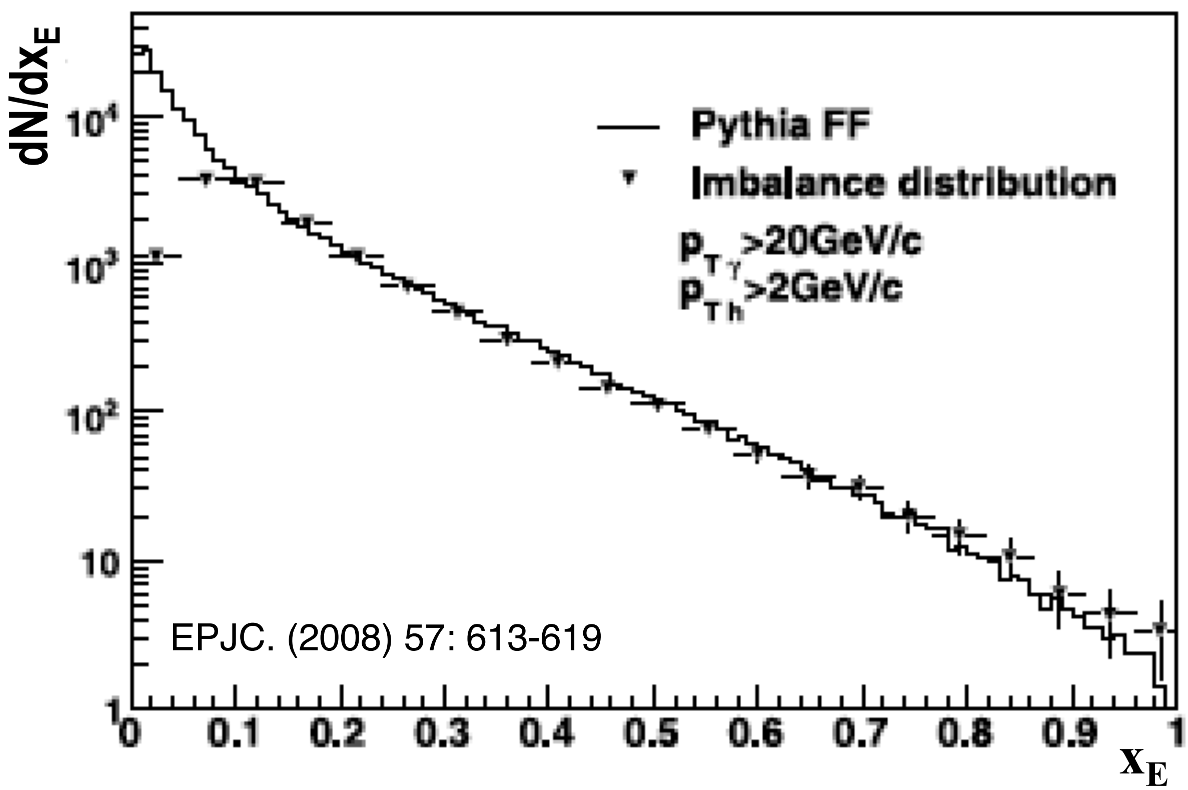
Why correlation

- Study di-jet property using trigger-hadron correlation
- Good approximation of the fragmentation function (FF) with the x_E distribution

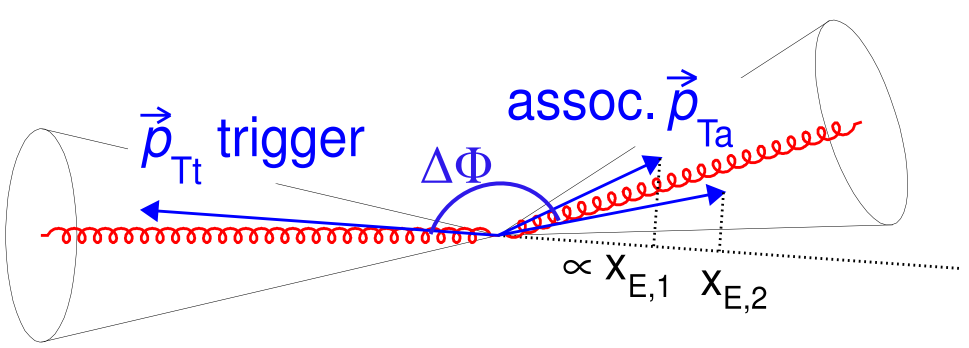


PRL. 104 (2010) 252

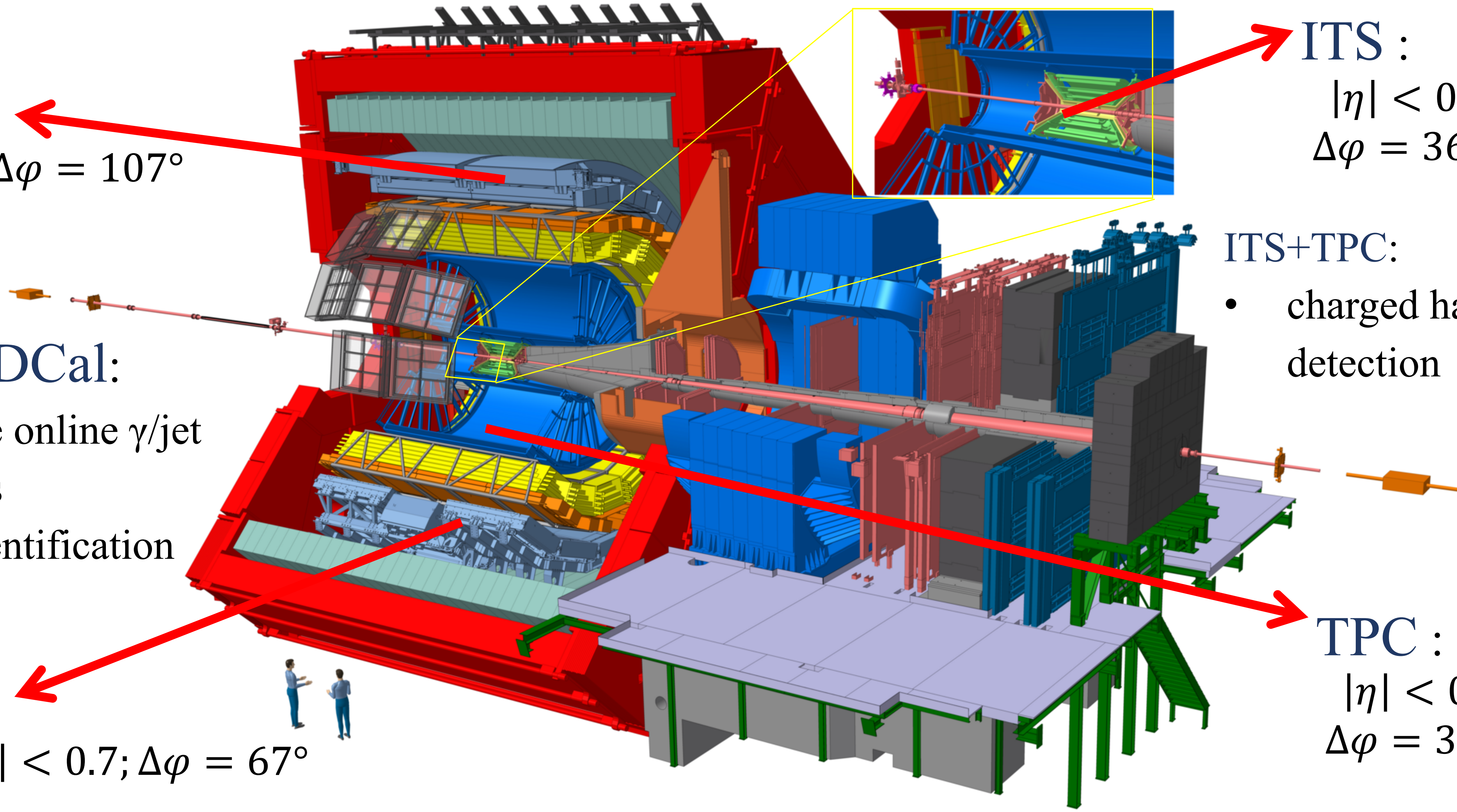


EPJC. (2008) 57: 613-619

$$x_E = -\frac{\overrightarrow{p_T^{\gamma}} \cdot \overrightarrow{p_T^{h}}}{\left|p_T^{\gamma}\right|^2} = \frac{p_T^h}{p_T^{\gamma}} \cos(\Delta\phi) \approx Z_T = \frac{p_T^h}{p_T^{jet}}$$



ALICE detector



ITS :
$|\eta| < 0.9$
$\Delta\varphi = 360°$

EMCal :
$|\eta| < 0.7; \Delta\varphi = 107°$

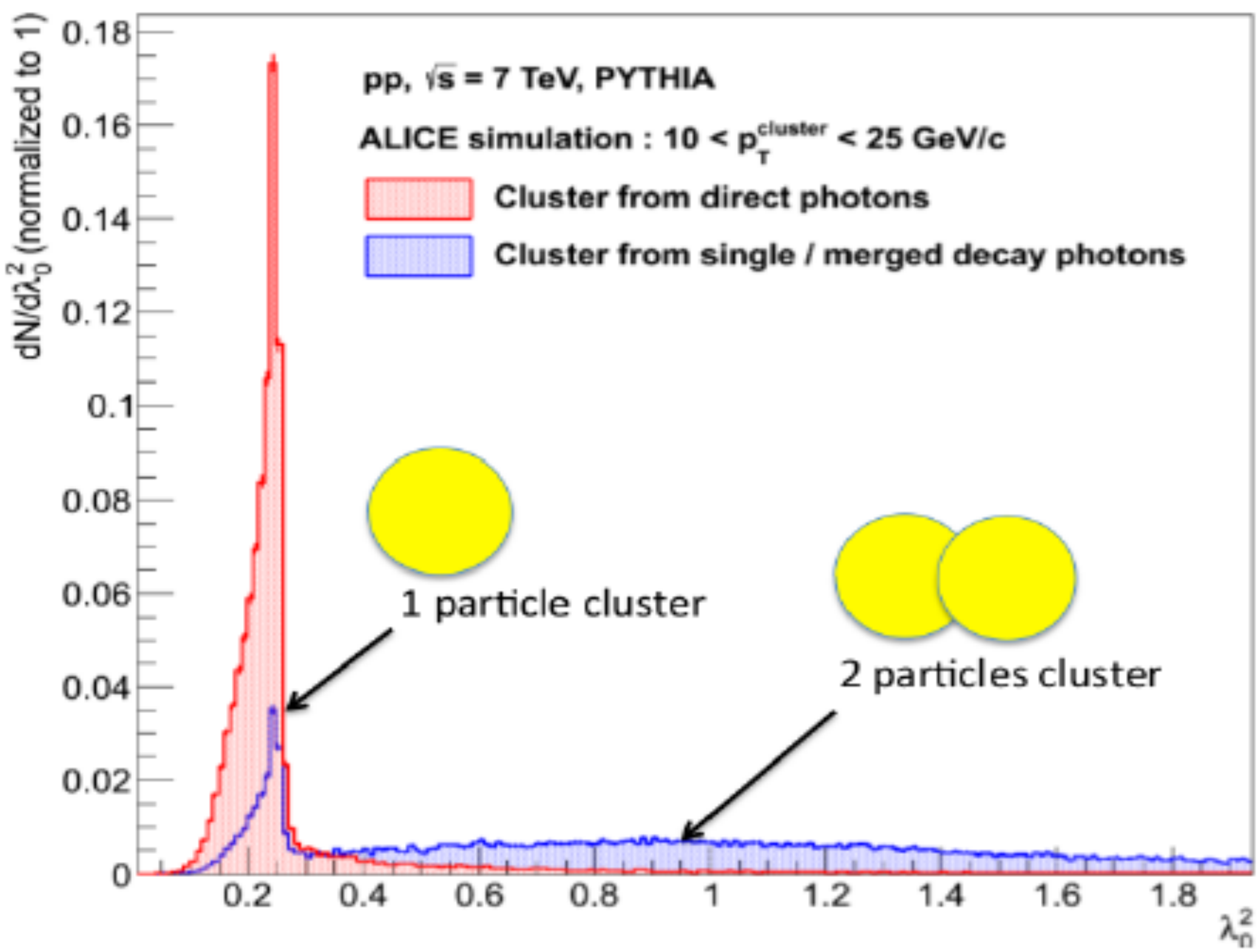
ITS+TPC:
- charged hadron detection

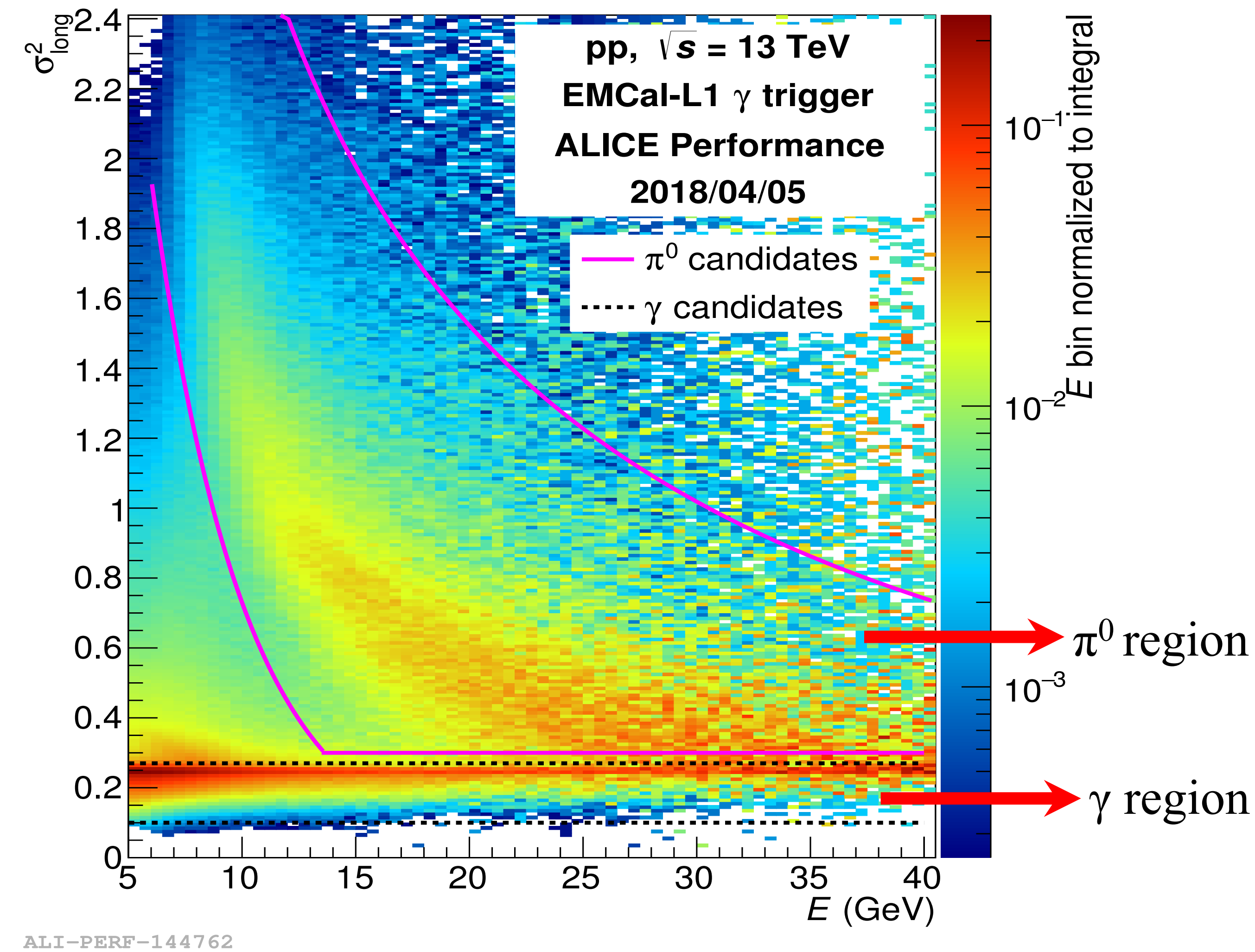
EMCal/DCal:
- provide online γ/jet triggers
- γ/π^0 identification

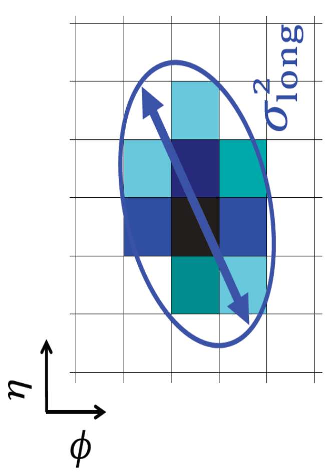
TPC :
$|\eta| < 0.9$
$\Delta\varphi = 360°$

DCal:
$0.22 < |\eta| < 0.7; \Delta\varphi = 67°$

Photon ID: shower shape



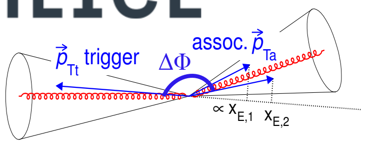




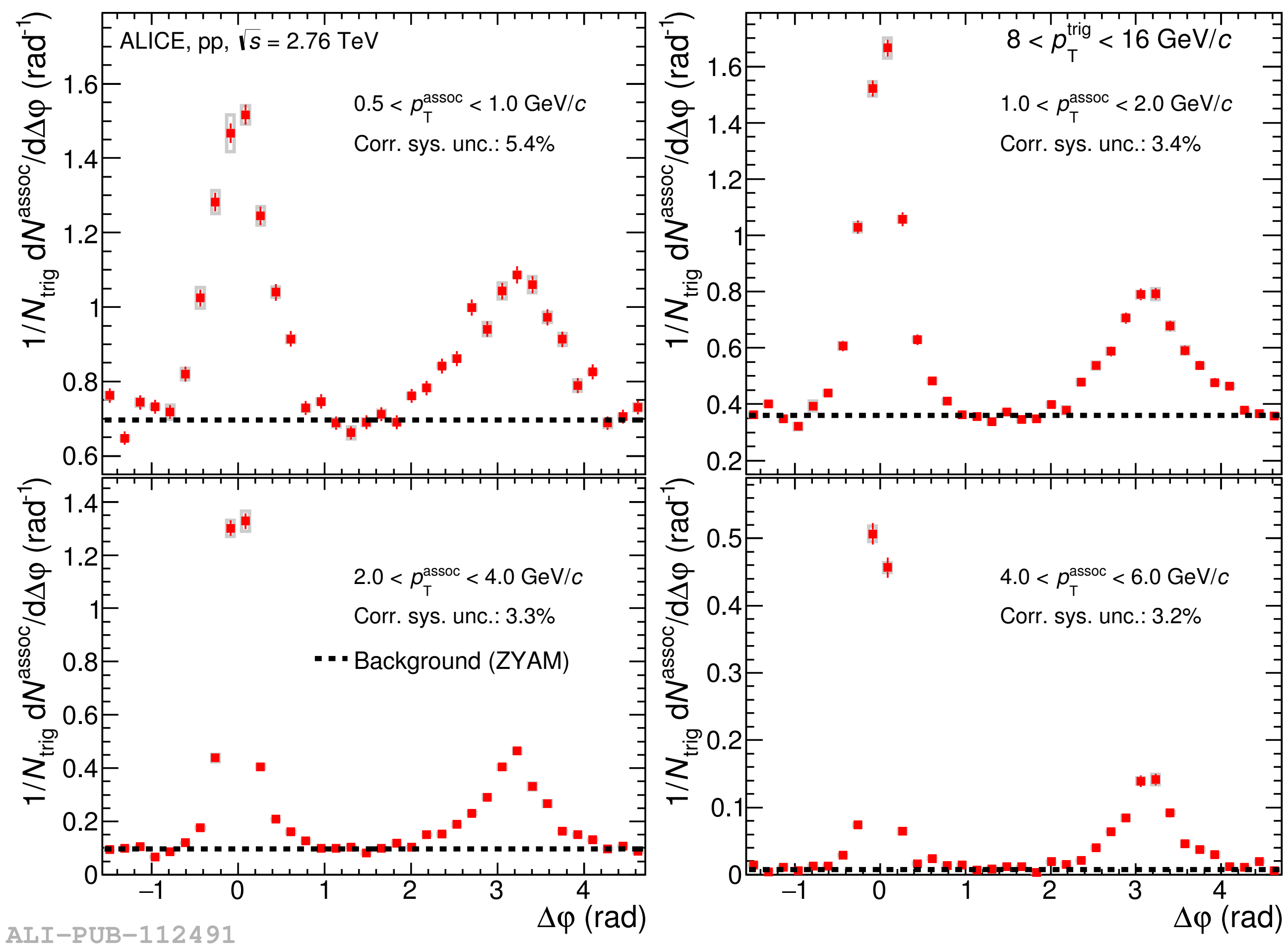
- Cluster shape described by σ^2_{long} .
  - Photon signal with small σ^2_{long} $(0.1 < \sigma^2_{long} < 0.27)$
  - Background π^0 selection with energy dependent cut on σ^2_{long} $(0.3 < \sigma^2_{long} < 5.0)$

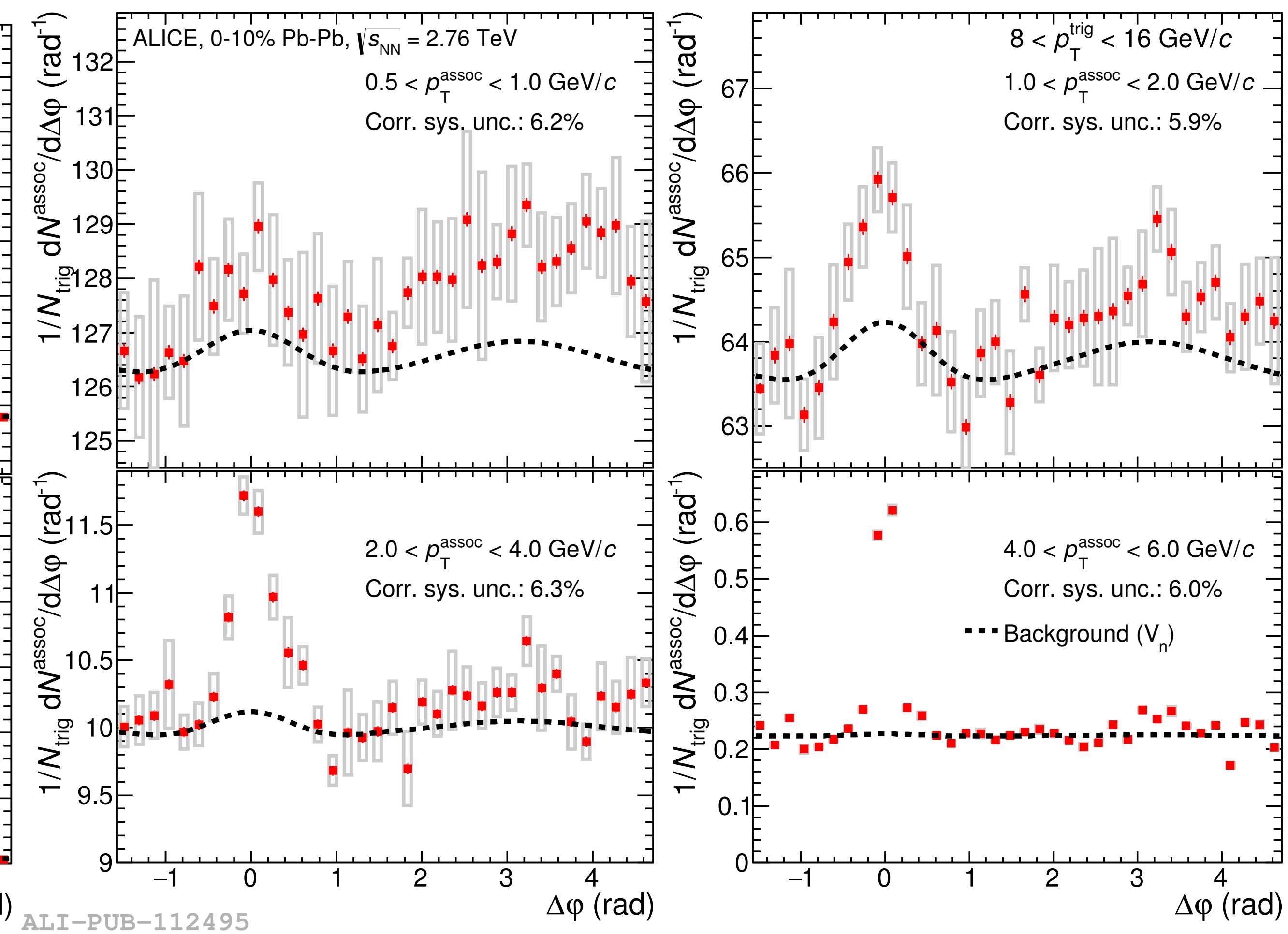
(larger major axis due to opening angle between the two decay photons)

π^0-h azimuthal correlation



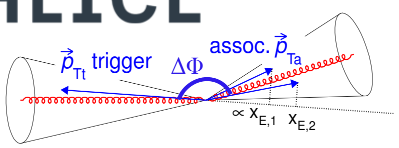
pp PLB 763 (2016) 238 PbPb





- ➢ Double peaks observed → di-jet structure
- ➢ Near side peak width broader in PbPb compared to pp → jet broadening
- ➢ Away side peak in central PbPb collision is strongly suppressed → jet quenching

π^0-h correlation medium factor



$$I_{AA} = \frac{Y_{\text{Pb-Pb}}}{Y_{pp}} \quad Y = \int \frac{dN_{assoc}}{d\Delta\varphi} d\Delta\varphi$$

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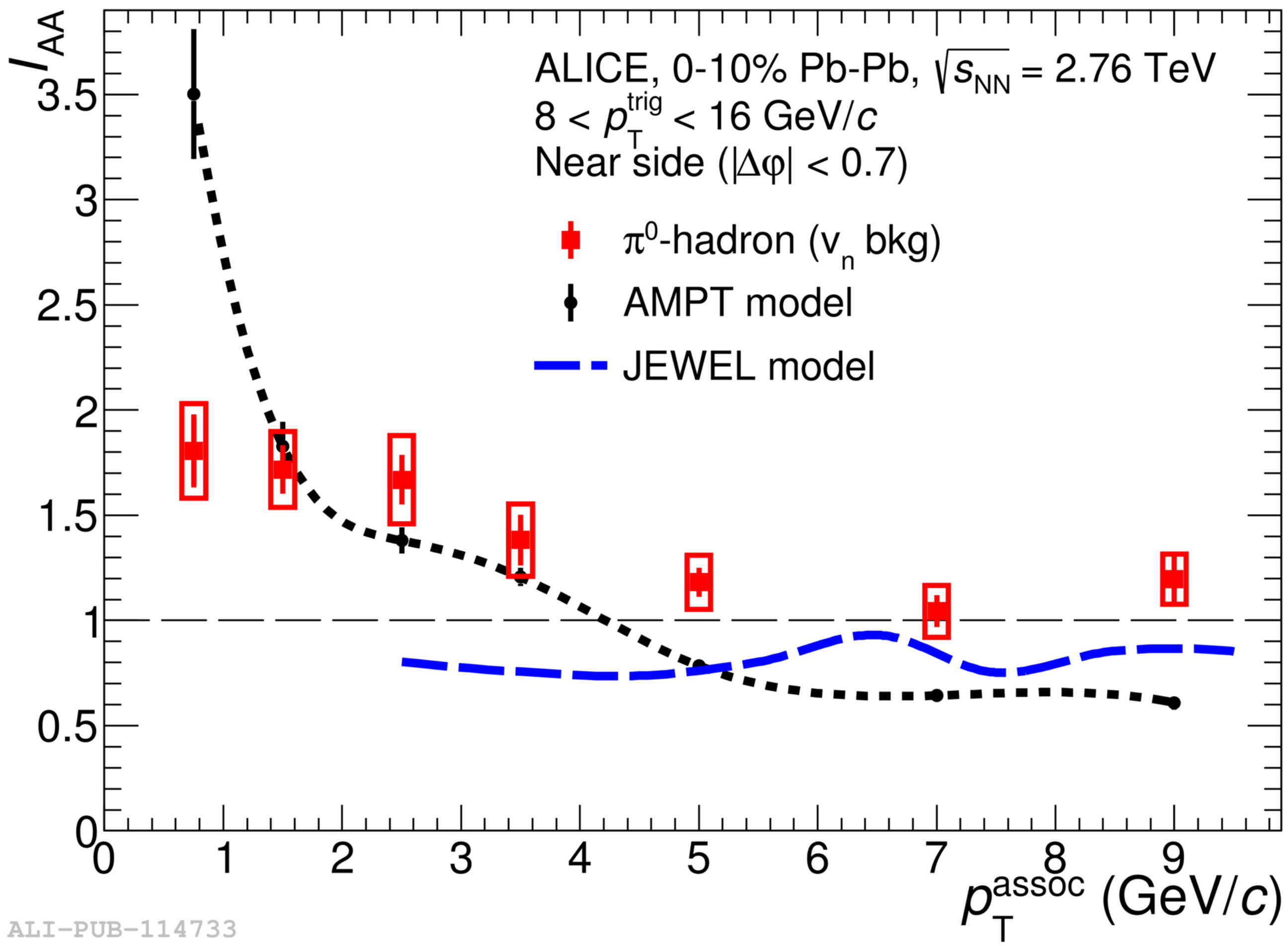
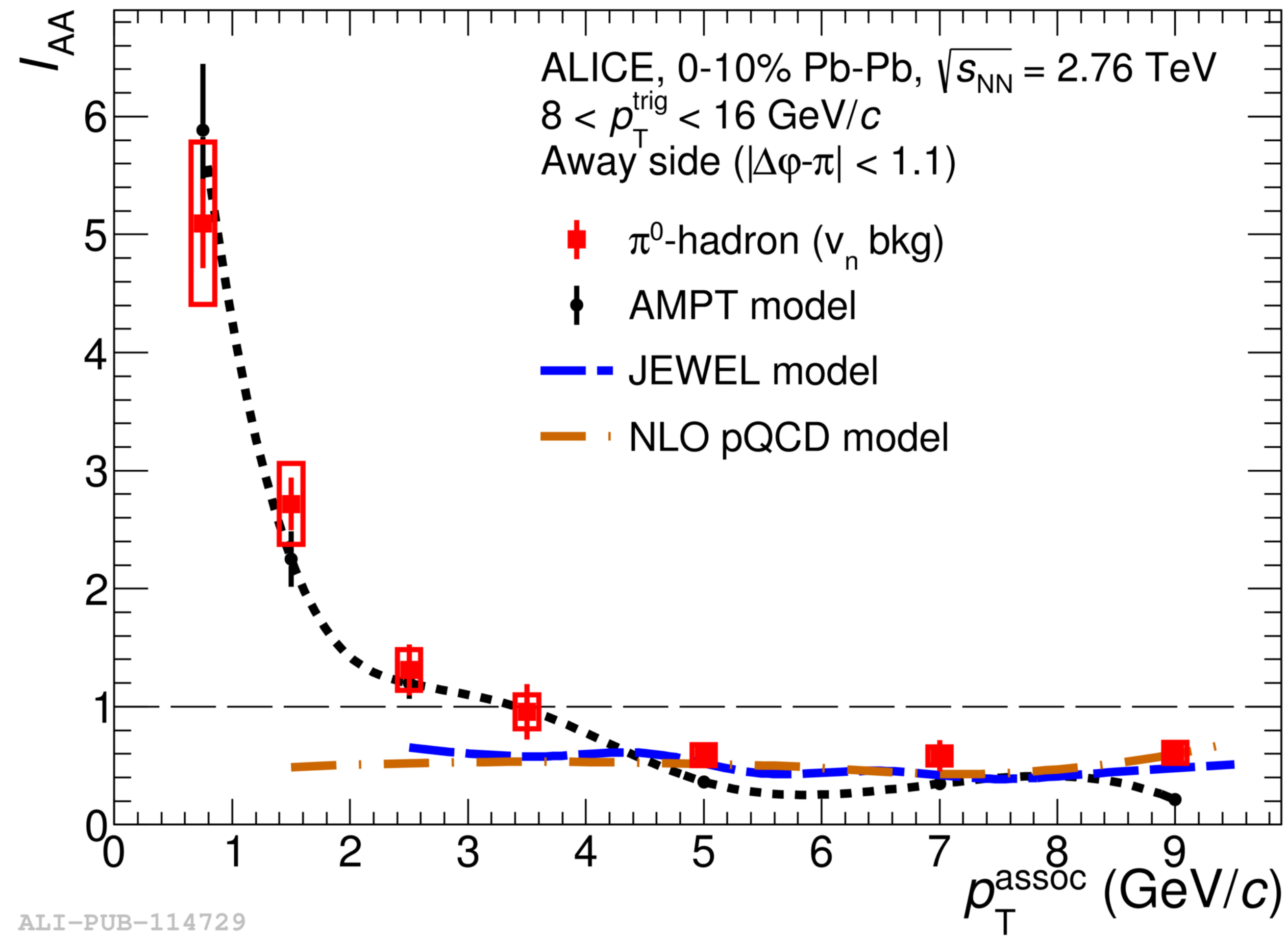
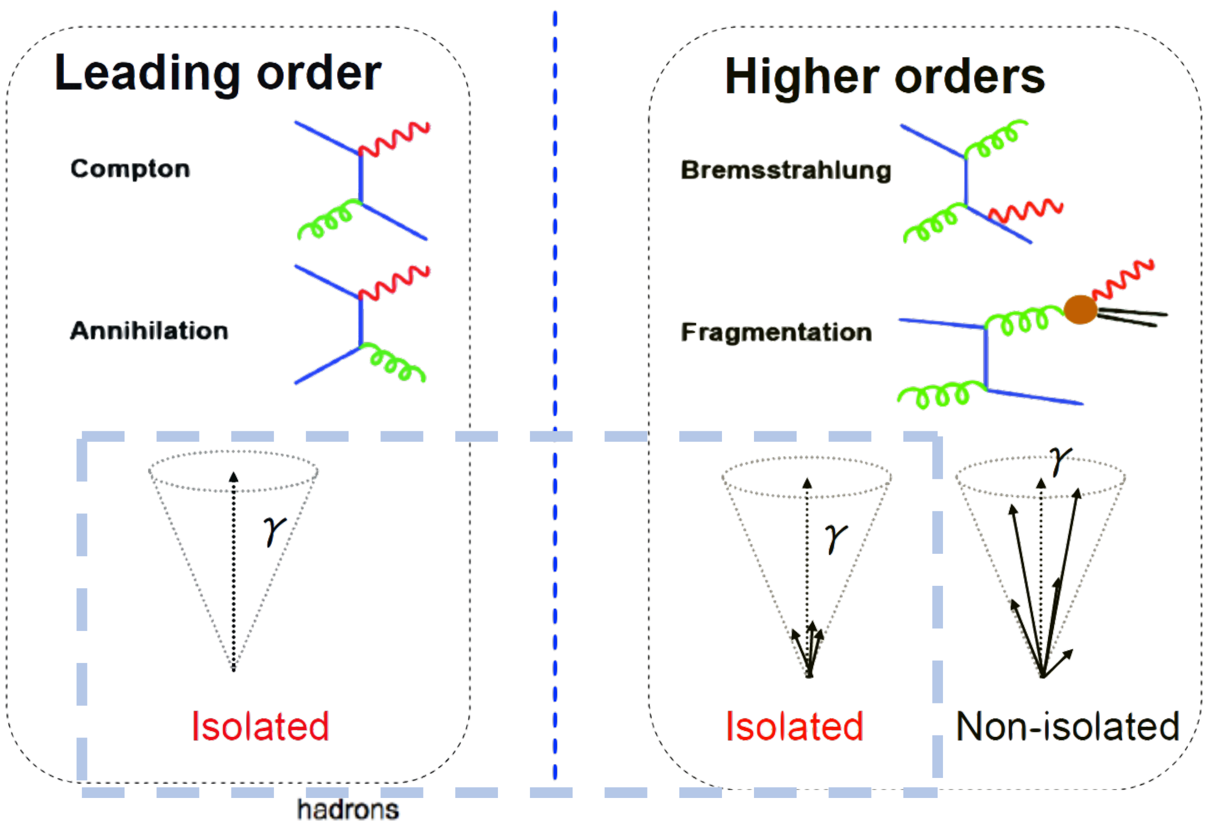
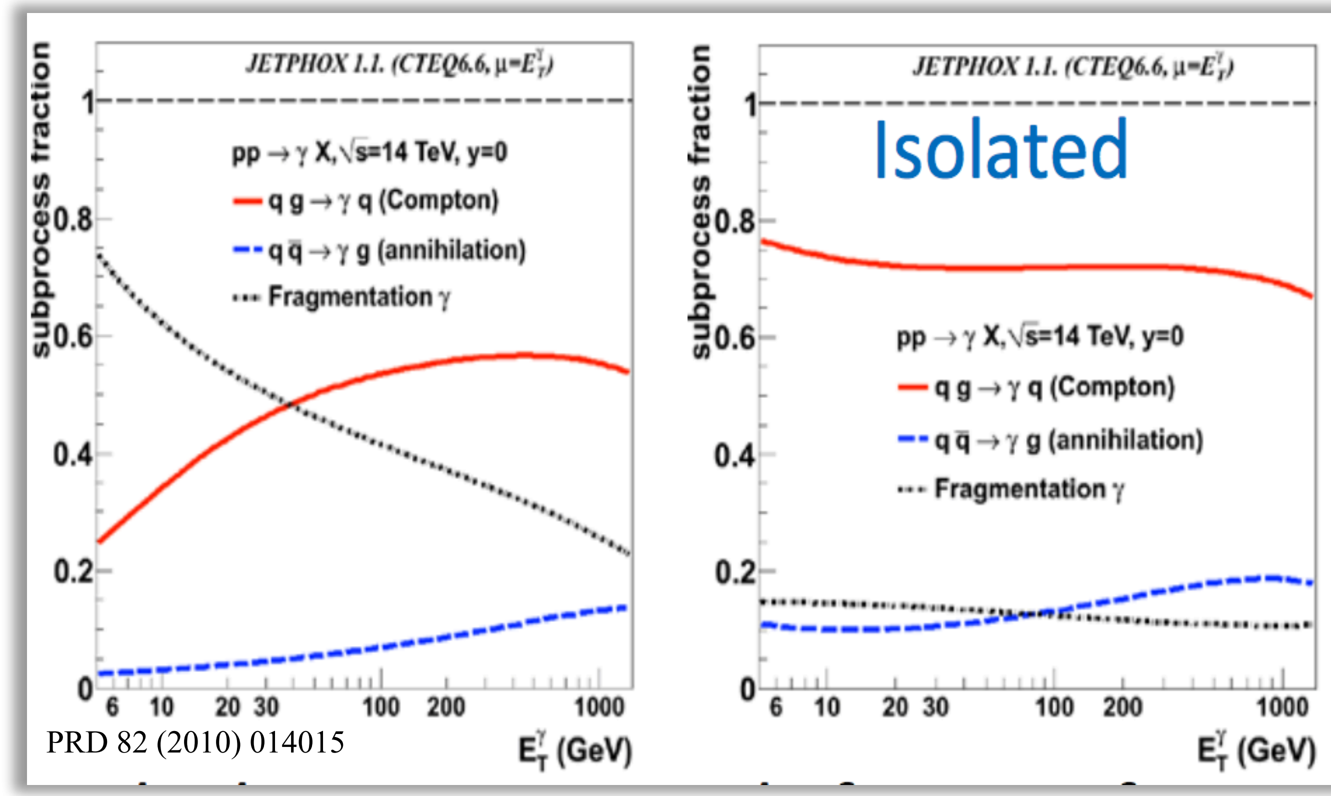


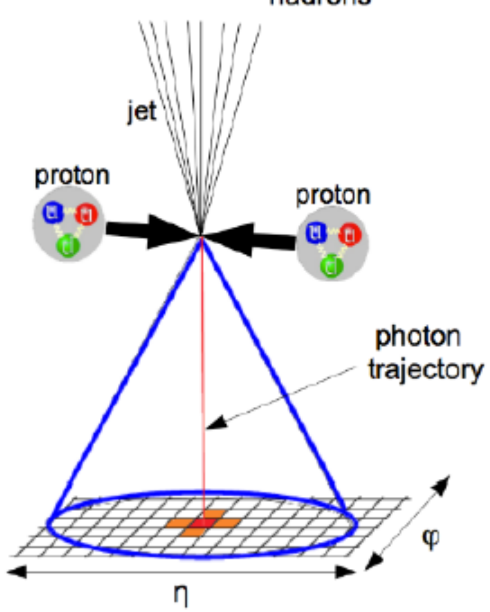


- Enhancement at very low p_T, indicating extra particles excess → consistent with low p_T broadening
- Suppression on the away side for high p_T → consistent with jet quenching

Photon ID: isolation

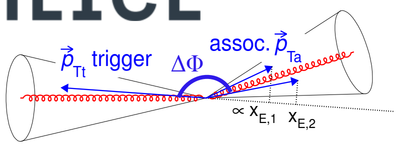






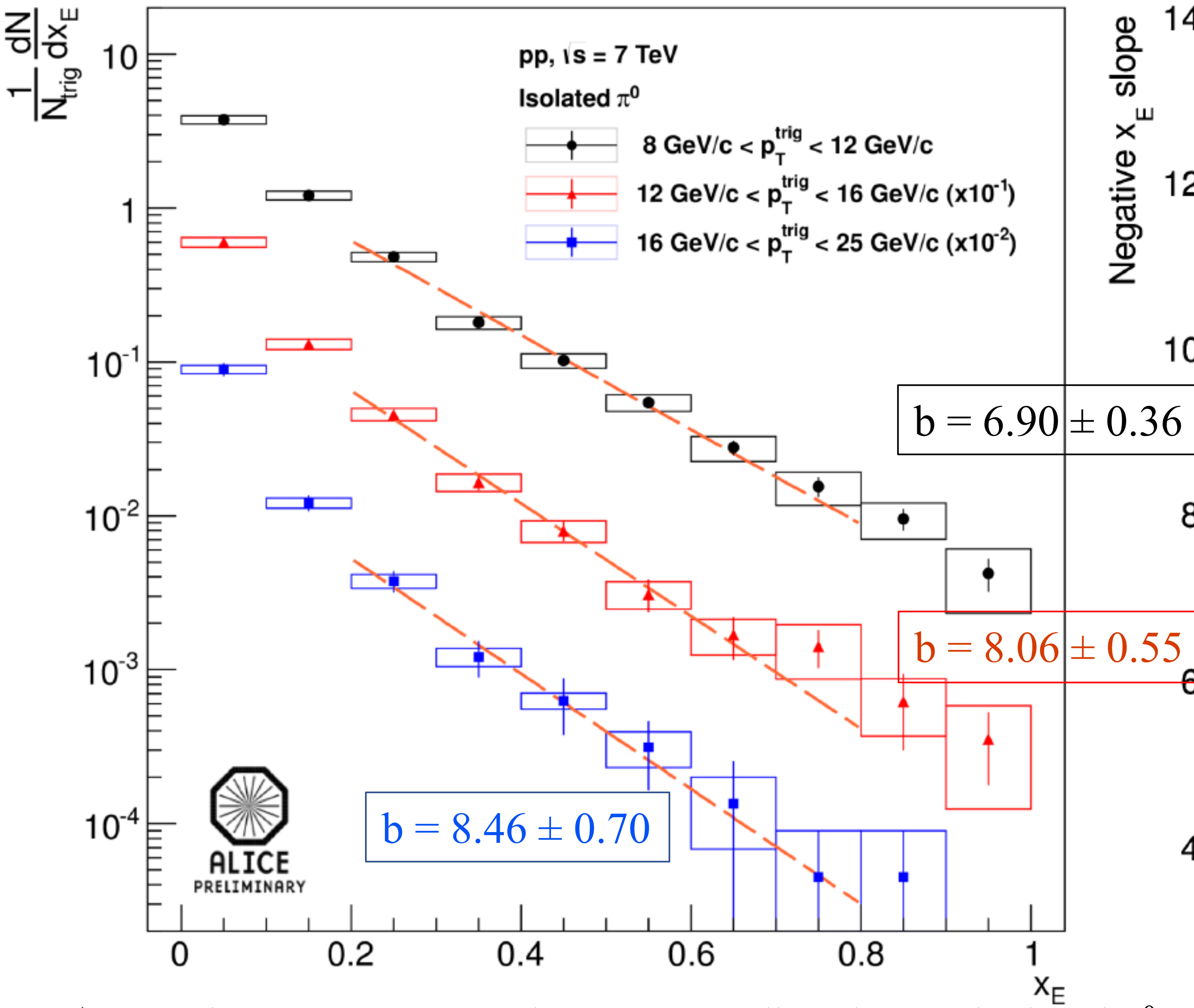
- Estimate hadronic activity around the trigger candidate
- Enrich the trigger sample with $\langle z_T \rangle \rightarrow 1$
  - Fraction of direct photons are largely increased (~80%)
  - Most of background (π^0, γ_{frag}) are strongly suppressed

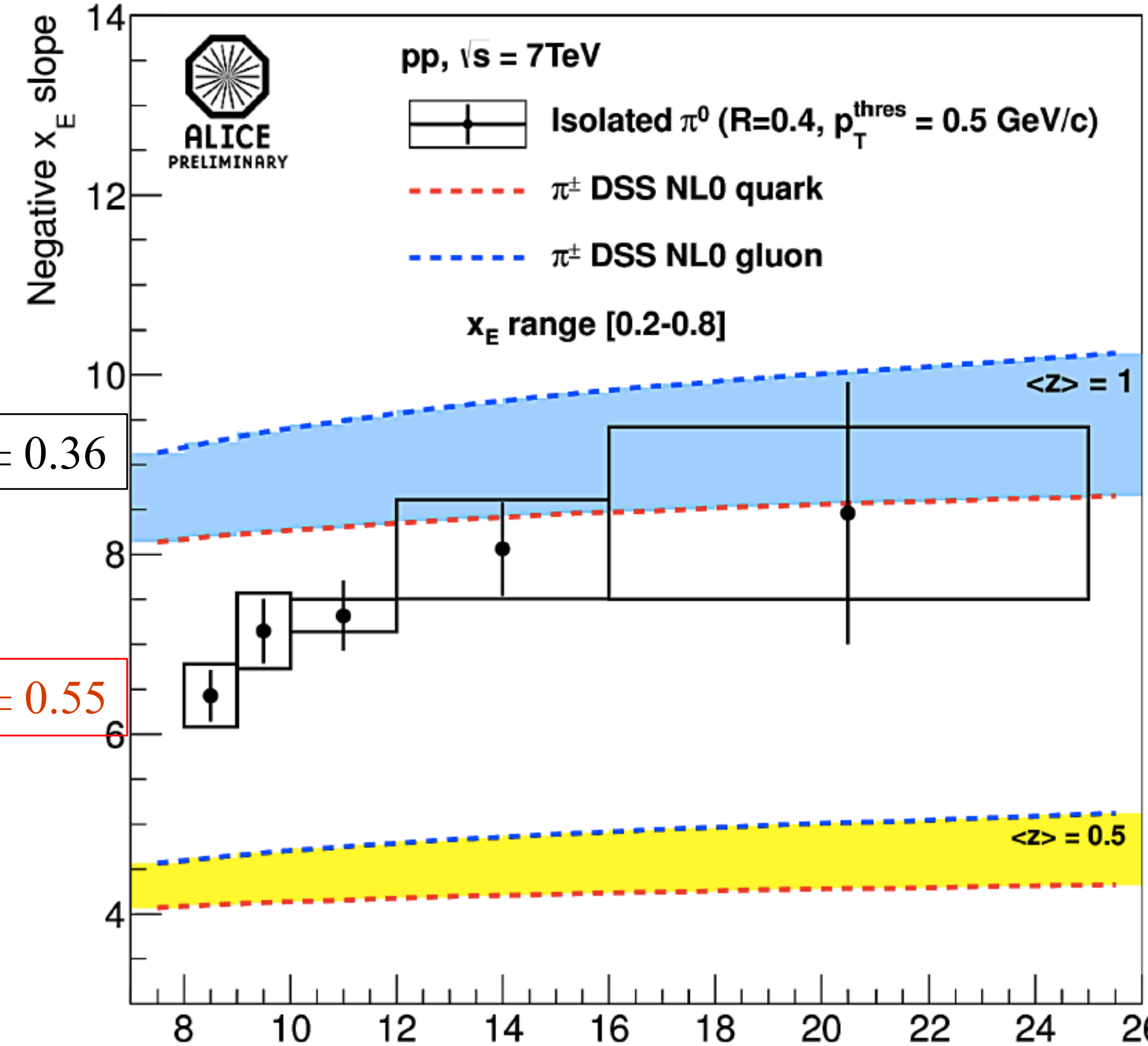
Isolated π^0-h x_E distribution



$$x_E = -\frac{\overrightarrow{p_{Tt}} * \overrightarrow{p_{ta}}}{|\overrightarrow{p_T}|^2}(cos(\Delta\phi))$$

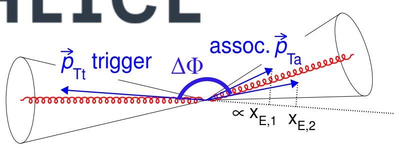
$$\frac{dN}{dx_E} = Ne^{-bx_E}$$





- ➢ x_E slope moves towards to <z> =1 direction → isolated π^0 samples a large fraction of jet energy.
- ➢ Very limited statistics and large uncertainties from Run1 analysis.

Isolated γ-h x_E distribution



$$x_E = -\frac{\overrightarrow{p_{Tt}} * \overrightarrow{p_{ta}}}{|\overrightarrow{p_T}|^2}(cos(\Delta\phi))$$

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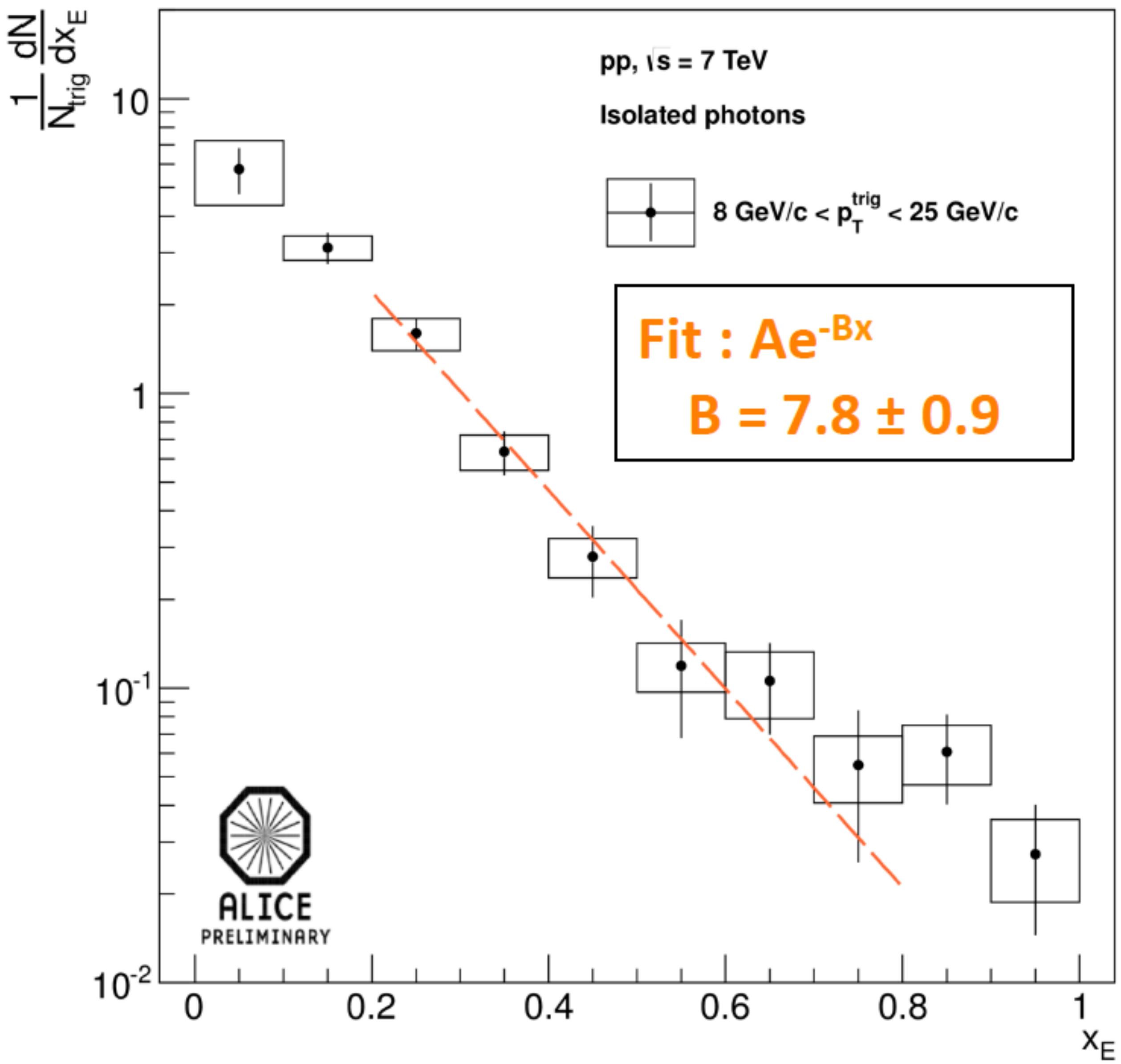
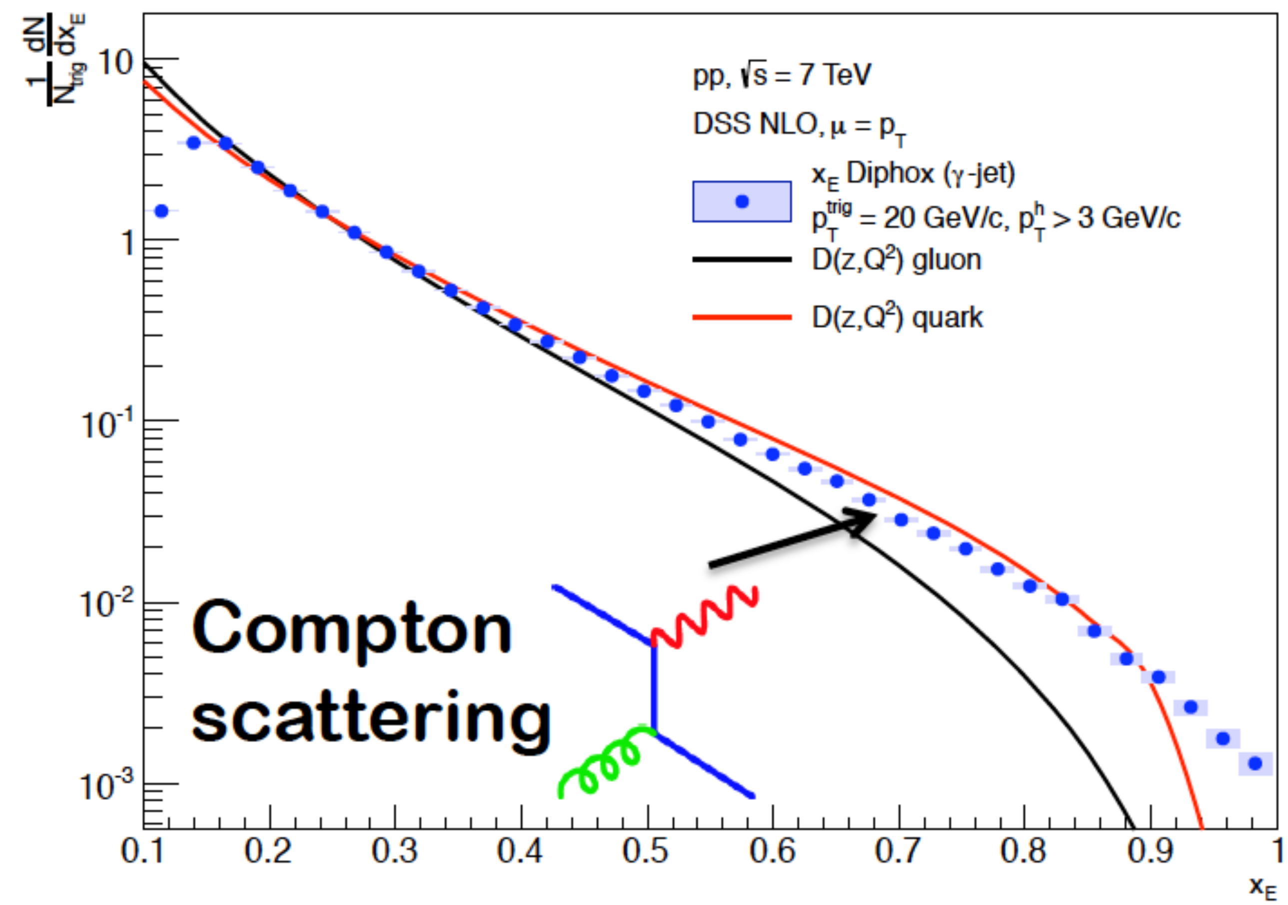
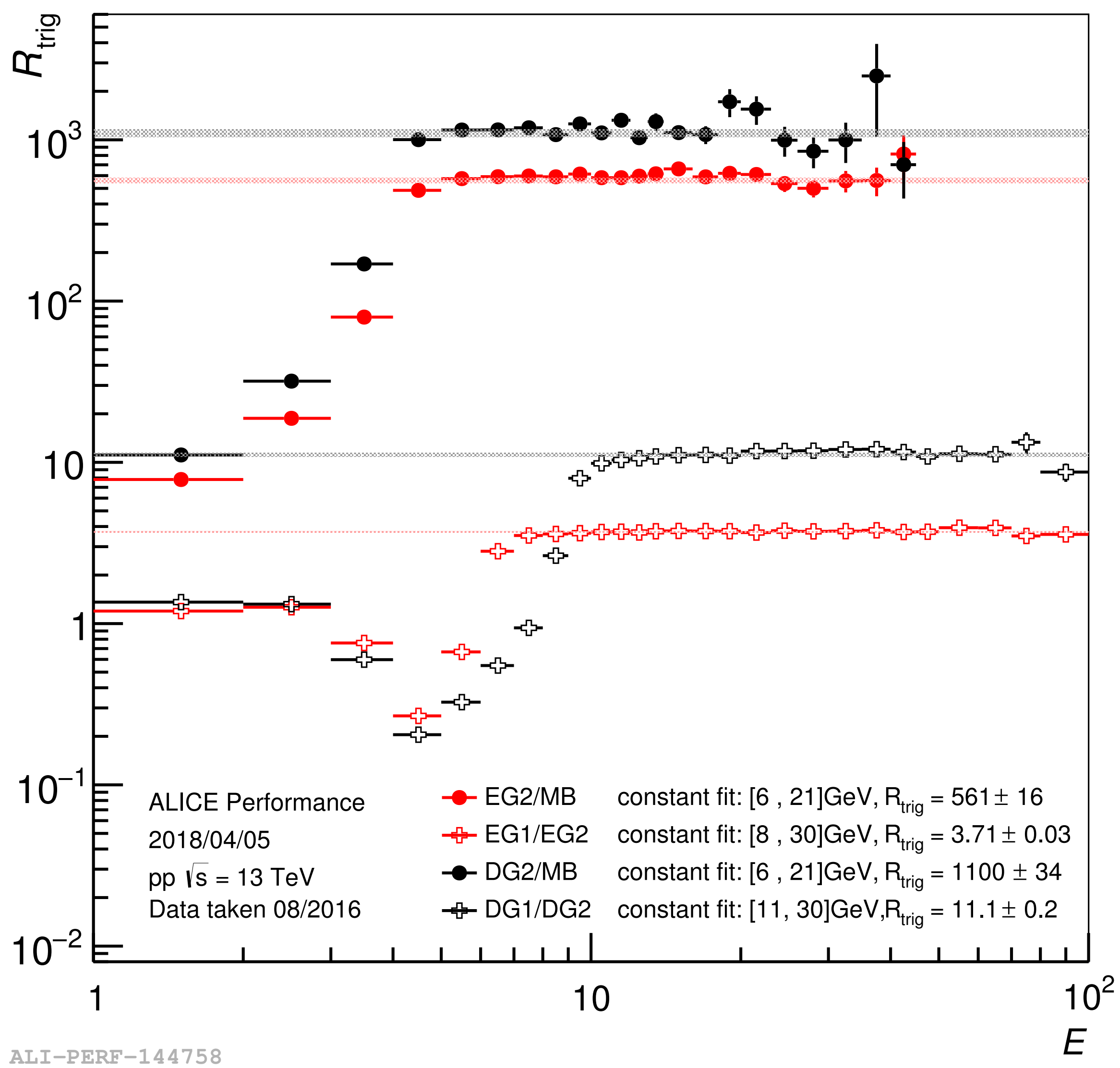
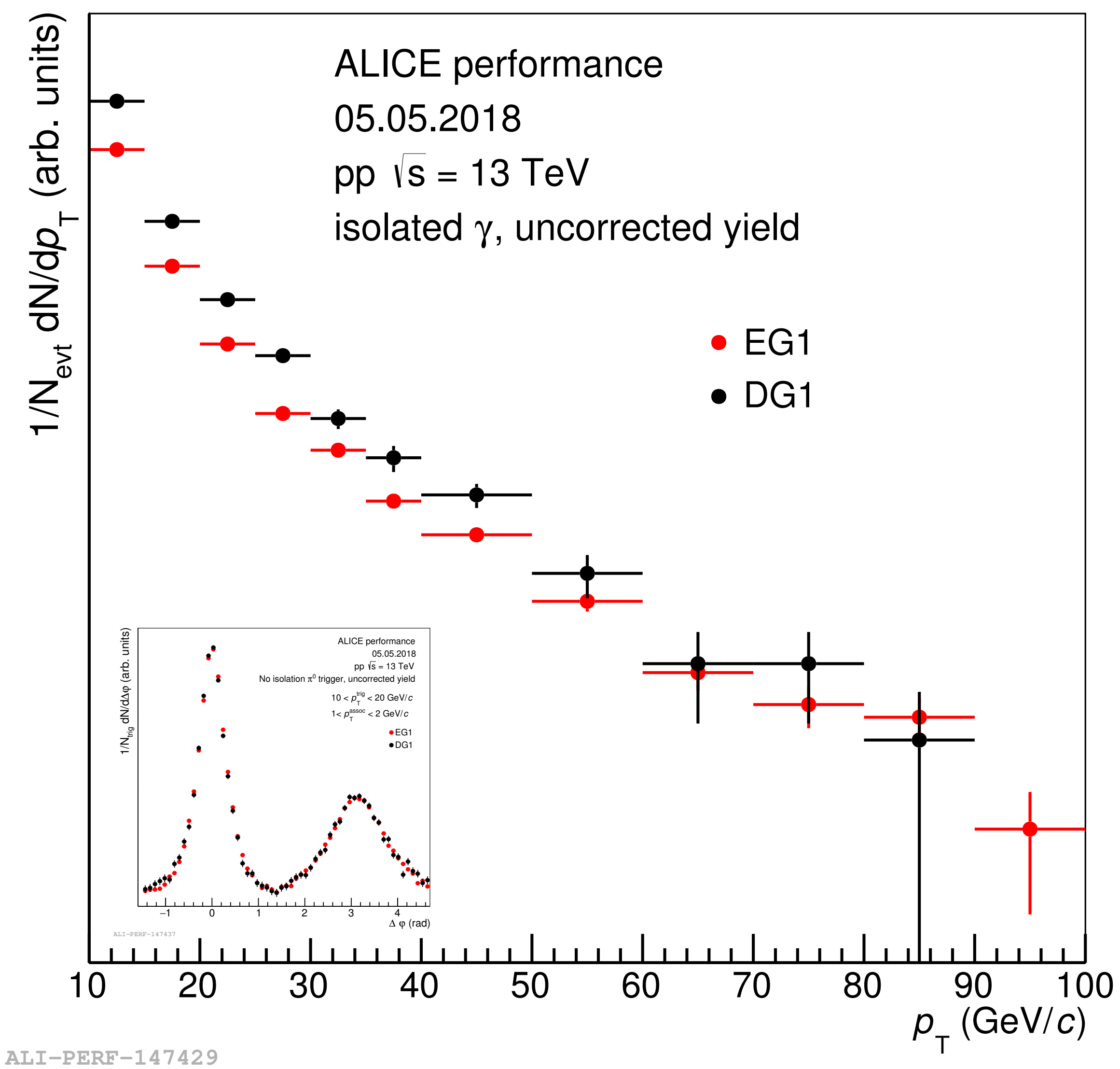




- ➢ Isolated γ-hadron x_E distributions in favour of quark jet FF
- ➢ Unable to perform such tagging study due to limited statistics in Run1.

Data enriched by Run2 triggers





- With Run2 calorimeter triggers, the statistic is increase by ~ 1000 times
- Using triggered sample, isolated γ trigger can go to very high p_T (~ 100 GeV/c)
- Different detector triggers performs the same way

→ Promising results in view of Run2 data analysis is ongoing

Summary and outlook

➢ Summary

- Measurents π^0-hadron correlations in pp and PbPb collisions at $\sqrt{s_{NN}}$ =2.76 TeV .
  - Low p_T enhancement observed for both near and away side correlation
  - High p_T suppression on away side correlations.
- Isolated trigger-hadron correlations in $\sqrt{S}$ =7 TeV pp collisions.
  - π^0 background trigger is strongly suppressed by the isolation method.
  - isolated γ-hadron x_E distribution favors in quark jet.

➢ Outlook

- Study of isolated γ/ π^0-hadron correlations in pp 13TeV with calorimeter triggered samples ongoing, we expect:
  - More precise results compare to Run I with statistics increase.
  - More differential studies can be pursued, such as multiplicity dependent analysis.

Thanks for your listening