STUDY OF TWO-PARTICLE CORRELATIONS WITH PHOTON AND PION TRIGGERS IN PP COLLISIONS AT 13 TEV WITH ALICE AT THE LHC

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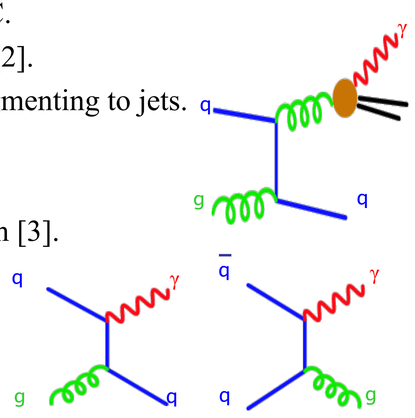
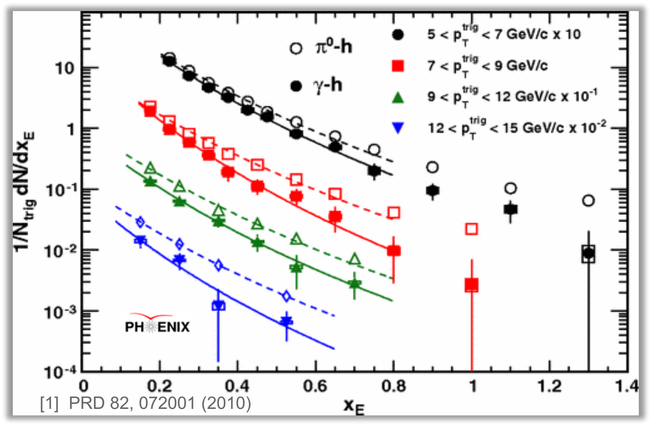
MOTIVATION

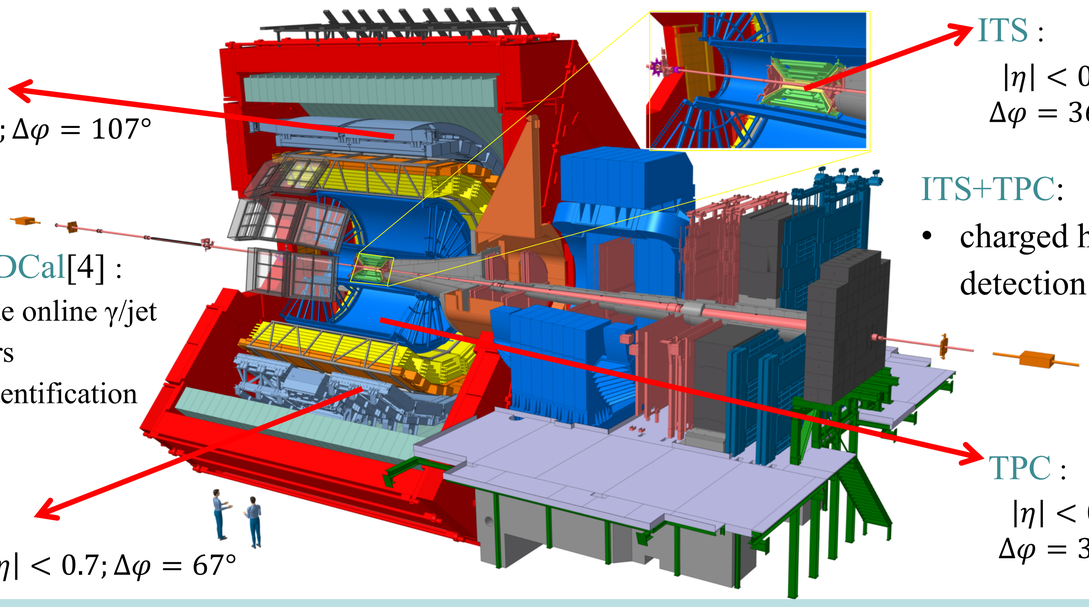
- The quark-gluon plasma is a strongly interacting medium, which is produced in Pb-Pb collisions at the LHC.
- Recent measurements in pp collisions show similar behavior in high multiplicity events as in Pb-Pb events [2].
- Hot quark-gluon matter properties can be studied by hard partons propagating through it and ultimately fragmenting to jets.
- Direct photons do not interact strongly in the QGP and can be used to tag parton energy.
- Direct photons at high p_T are produced mainly in Compton and annihilation hard processes.
- Correlation with hadrons and jets informs us of the medium-induced modifications of partons in the medium [3].
- Same measurements in pp collisions are necessary as a baseline for AA collisions.
- Study the fragmentation of quark or gluon jets comparing direct photon - jet/hadron correlations (mainly quark jets) or π^0 -hadron/jet correlations (mainly gluon jets).





[1] PRD 82, 072001 (2010)

ALICE APPARATUS

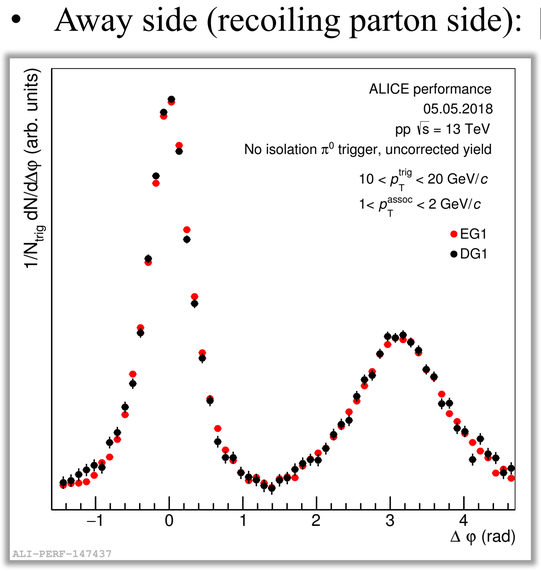


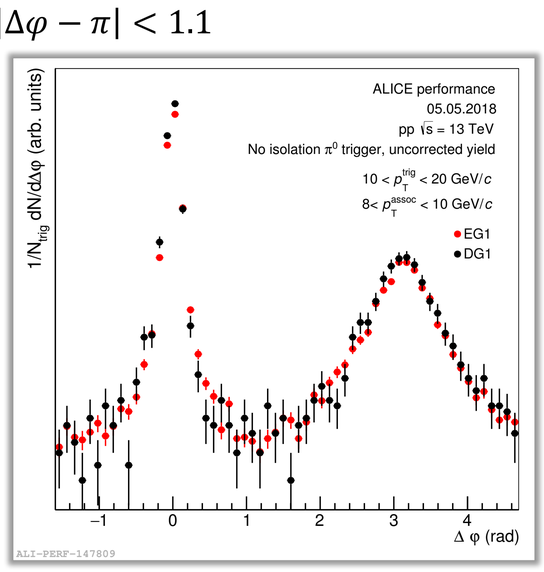
AZIMUTHAL CORRELATION

- Observable: azimuthal correlations between triggers and associated hadrons.

$$\Delta\varphi = \varphi^{trig} - \varphi^{hadron}$$

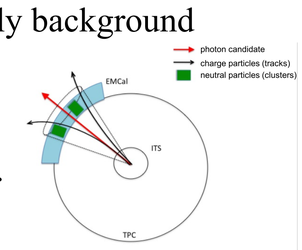
- Interested in per-trigger yield $J(\Delta\varphi) = C(\Delta\varphi) - B(\Delta\varphi)$ in two regions [3]:
  - Near side (trigger side): $|\Delta\varphi| < 0.7$
  - Away side (recoiling parton side): $|\Delta\varphi - \pi| < 1.1$

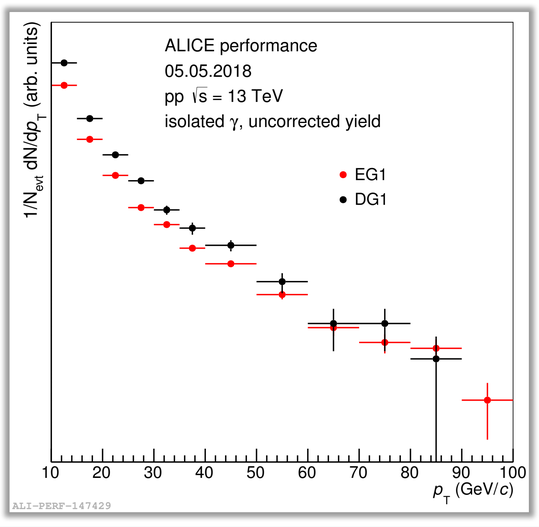


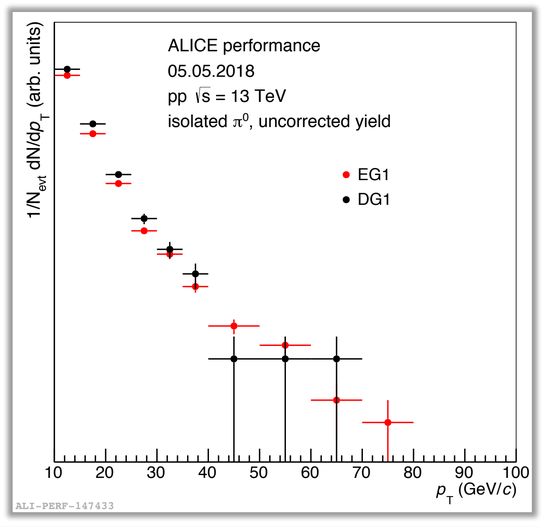


ISOLATION METHOD

- Direct photons are isolated, no hadronic activity near the photon in hard process [5].
- High p_T π^0 shape similar with direct photon and dominate mainly background contribution.
- Isolation for both neutral and charged
  - the candidate is isolated if $\sum p_T^{in\ cone} < p_T^{thres}$ $(p_T^{thres} = 1\ \mathrm{GeV}/c)$.
  - within $R = \sqrt{(\Delta\varphi)^2 + (\Delta\eta)^2}$ $(R = 0.4)$.

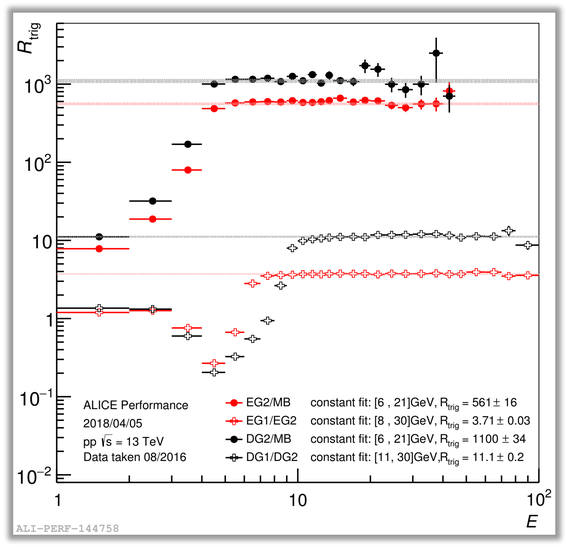




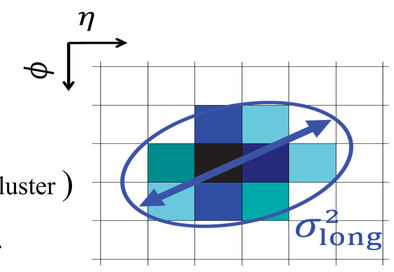


π⁰/γ IDENTIFICATION IN EMCAL/DCAL

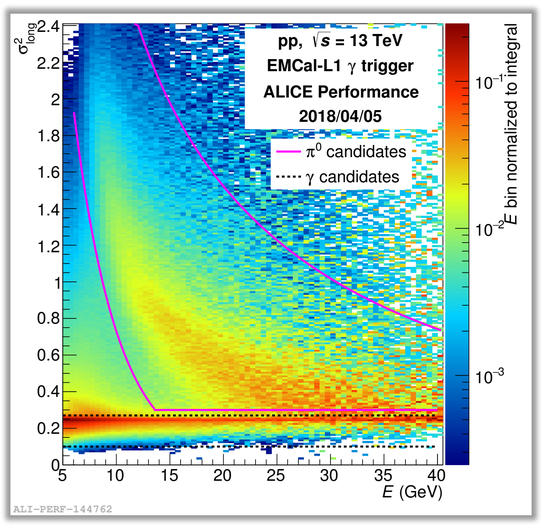
- Significant enhancement at high p_T via Level 1 online triggers

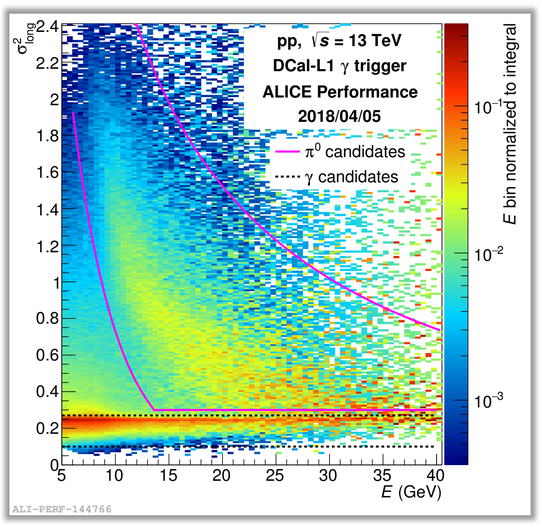


EG2:
p_T > 4 GeV/c in EMCal
EG1:
p_T > 6 GeV/c in EMCal
DG2:
p_T > 4 GeV/c in DCal
DG1:
p_T > 9 GeV/c in DCal



- Cluster shape described by σ^2_{long}.
  (larger semi-major axis of the 2D dispersion matrix of a cluster)
- π^0 selection with energy dependent cut on σ^2_{long}.
  (larger major axis due to opening angle between the two decay photons)
- Photon selection with small σ^2_{long}.

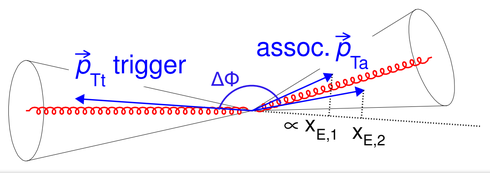


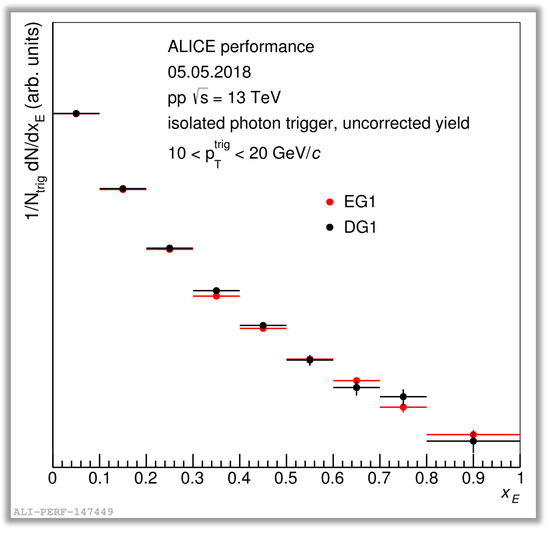


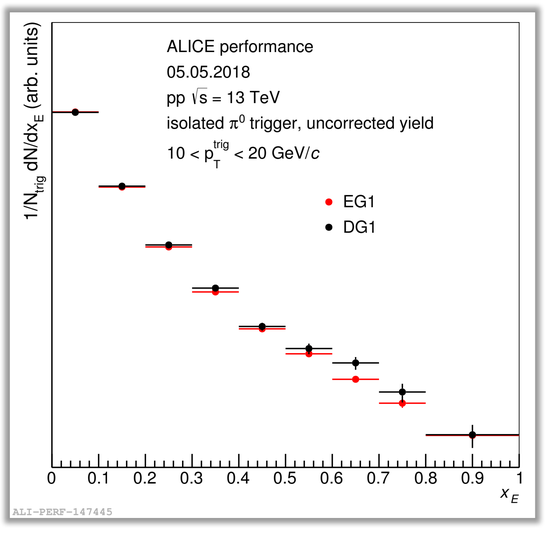
ISOLATED PARTICLE CORRELATION

- Observable: x_E distribution to approach the fragmentation function [1].

$$x_E = -\frac{\vec{p}_{Tt} \cdot \vec{p}_{Ta}}{\left|\vec{p}_{Tt}\right|^2} = -\frac{p_{Ta}}{p_{Tt}}\cos(\Delta\phi)$$







SUMMARY AND OUTLOOK

- ALICE can measure the π^0 and direct photons $\Delta\varphi$ and x_E distribution in pp collisions with sufficiently high precision by using new triggered data taken in RUN2.
- Such kind of correlation measurement provides a powerful approach to measure medium effects in heavy-ion collisions.
- In future:
  - Correction and systematics for γ/ π^0 -hadron correlations.
  - Perform same measurements in high multiplicity pp events.

REFERENCES

[1] PHENIX Collaboration. Phys. Rev. D 82, 072001 (2010).
[2] ALICE Collaboration. Nature Physics 13, 535 (2017).
[3] ALICE Collaboration. Phys. Lett. B 763, 238250 (2016).
[4] Allen. J et al. CERN-LHCC-2010-011 ; ALICE-TDR-14-add-1.
[5] Ichou. R and d'Enterria. D. Phys. Rev. D 82, 014015 (2010).

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