# $D^0$ meson production in dependence on the transverse activity classifier $R_T$ in pp collisions at $\sqrt{s}$=13 TeV with the ALICE experiment

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# Collectivity in high-energy collisions

Collective phenomena, due to the presence of the **quark-gluon plasma (QGP) phase**, are observed in high-energy heavy-ion collisions.

Indication of collective-like behaviour is also observed in small systems **(pp, p-Pb)** with high final-state multiplicity.

Goal: investigate the interplay between possible collective effects and more mundane vacuum QCD phenomena.
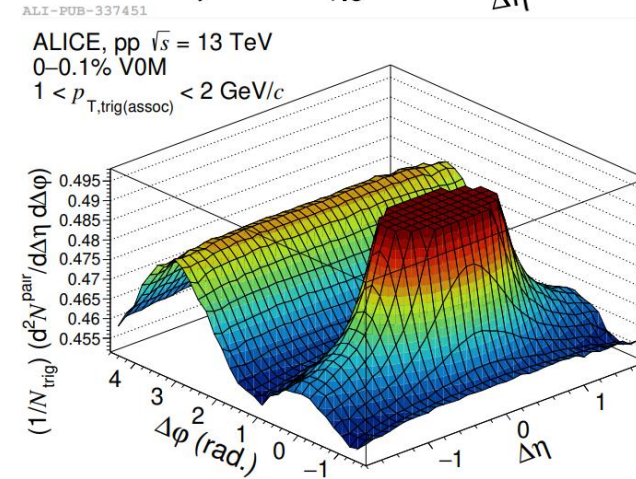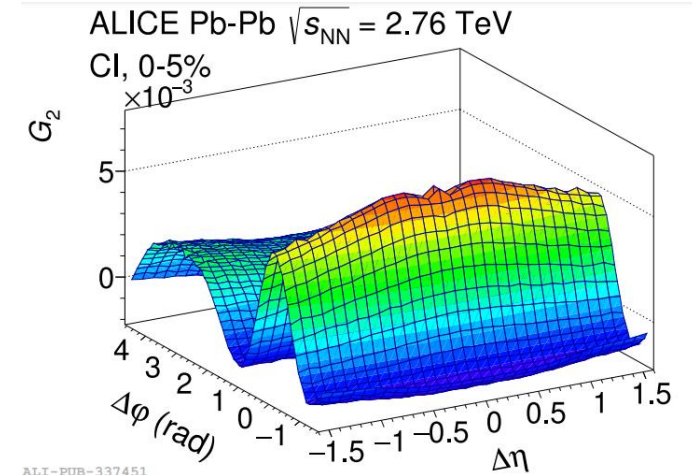


Two-particle angular correlations in Pb-Pb events (upper panel) [1] and high-multiplicity pp events (lower panel) [2]

[1] ALICE Collaboration, PLB **804** (2020) 135375
[2] ALICE Collaboration, JHEP **05** (2021) 290

# Heavy-flavour measurements at the ALICE experiment

High-precision (down to ≈100 μm) Inner Tracking System allows for accurate reconstruction of secondary vertices of heavy-flavour decays.
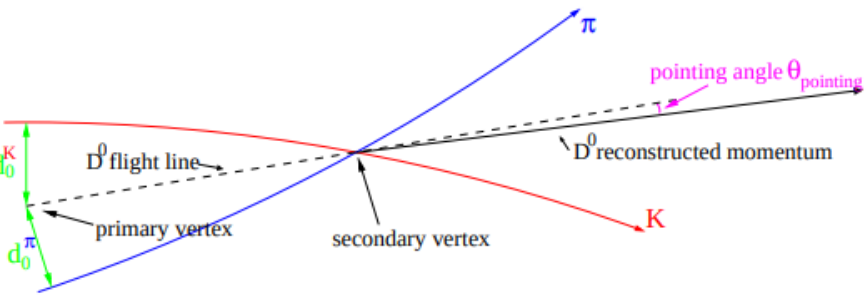
Reconstruction of D mesons is performed via their decays into kaons and pions.

Heavy-flavour allows for the direct investigation of the initial hard process, as well as to investigate the colour-charge and mass dependence of parton production.
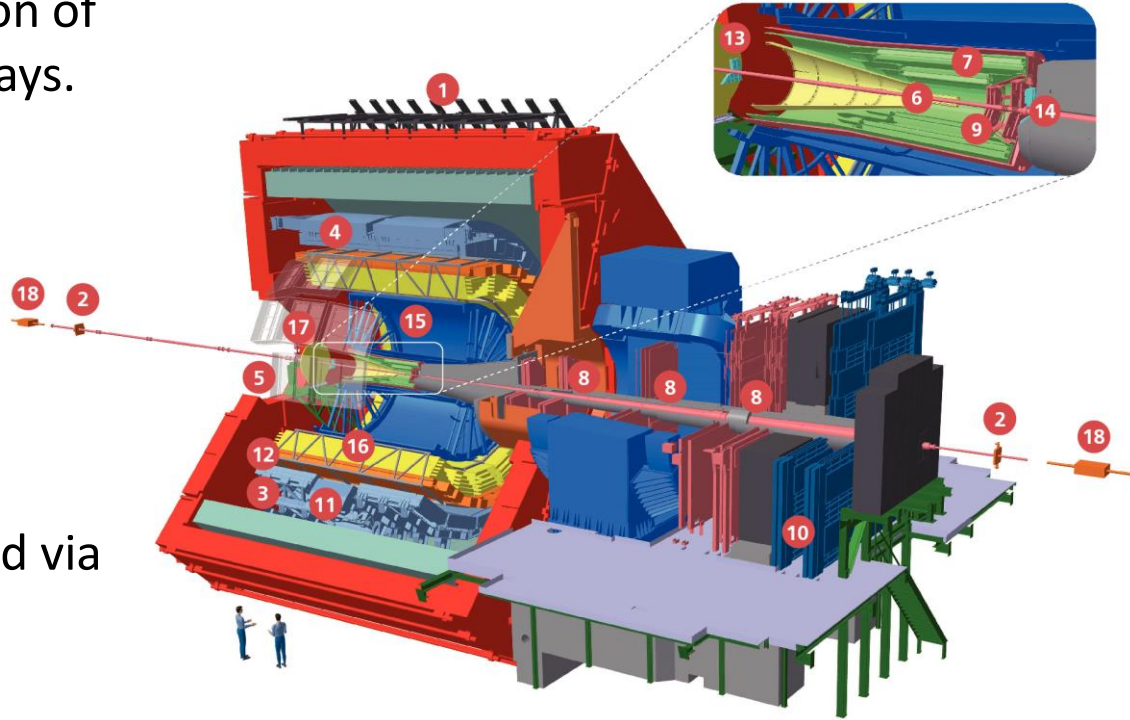


| | | |
|---|---|---|
| 1 | ACORDE | ALICE Cosmic Rays Detector |
| 2 | AD | ALICE Diffractive Detector |
| 3 | DCal | Di-jet Calorimeter |
| 4 | EMCal | Electromagnetic Calorimeter |
| 5 | HMPID | High Momentum Particle Identification Detector |
| 6 | ITS-IB | Inner Tracking System - Inner Barrel |
| 7 | ITS-OB | Inner Tracking System - Outer Barrel |
| 8 | MCH | Muon Tracking Chambers |
| 9 | MFT | Muon Forward Tracker |
| 10 | MID | Muon Identifier |
| 11 | PHOS / CPV | Photon Spectrometer |
| 12 | TOF | Time Of Flight |
| 13 | T0+A | Tzero + A |
| 14 | T0+C | Tzero + C |
| 15 | TPC | Time Projection Chamber |
| 16 | TRD | Transition Radiation Detector |
| 17 | V0+ | Vzero + Detector |
| 18 | ZDC | Zero Degree Calorimeter |

# Transverse activity classifier $R_T$

In events with a high-energy trigger particle, processes in the transverse region exhibit a behaviour which is independent from the hard scattering.
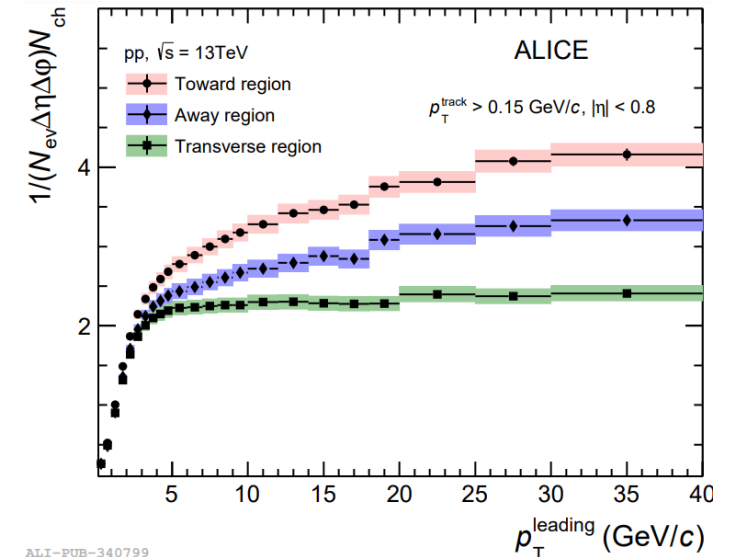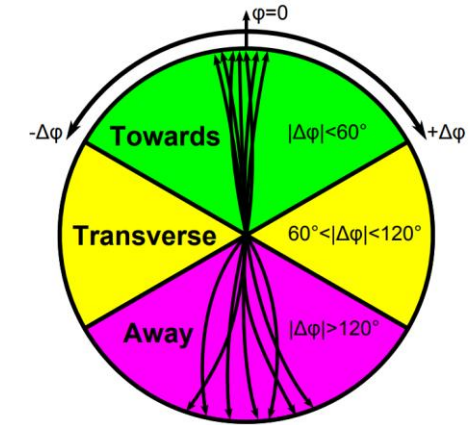
Measure hard particle production in the leading process in terms of Underlying Event activity:
- find the highest-$p_T$ charged hadron (trigger),
- define the relative transverse event activity perpendicular to the trigger in azimuth plane:

$$R_T = \frac{N_{ch,transverse}}{< N_{ch,transverse} >}$$

$R_T$ is strongly correlated to MPI in models. [3]

Experiments: Underlying Event activity is independent from trigger having $p_T > 5$ GeV/$c$.



Particle production in different azimuthal regions [4]. A distinct plateau can be seen in the transverse region for events with trigger particle having $p_T > 5$ GeV/$c$

[3] T. Martin et al, EPJC **76(5)** (2016) 1-12
[4] ALICE Collaboration, JHEP **04** (2020) 192

# $R_T$-dependent production of light-flavoured particles

$R_T$-differential measurements of identified light-flavoured particles show the production is sensitive to particle species, as well as their transverse momentum.

→ production of light flavour is influenced by the Underlying Event.
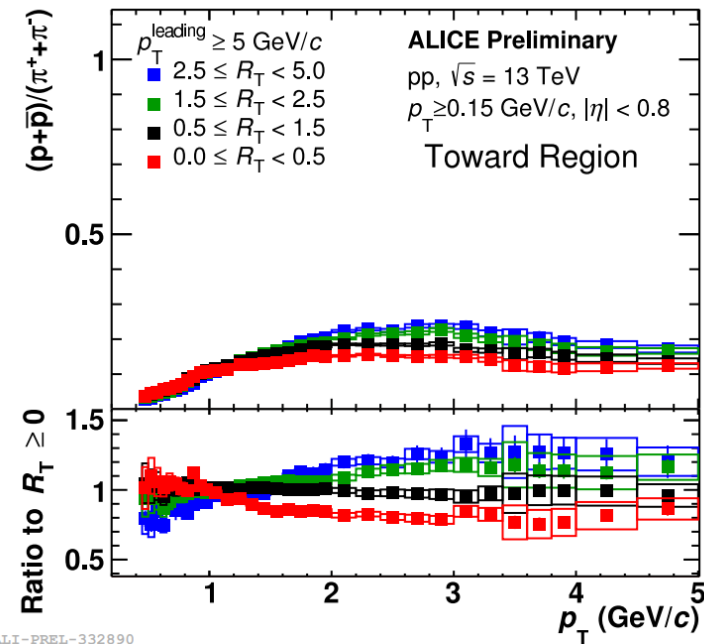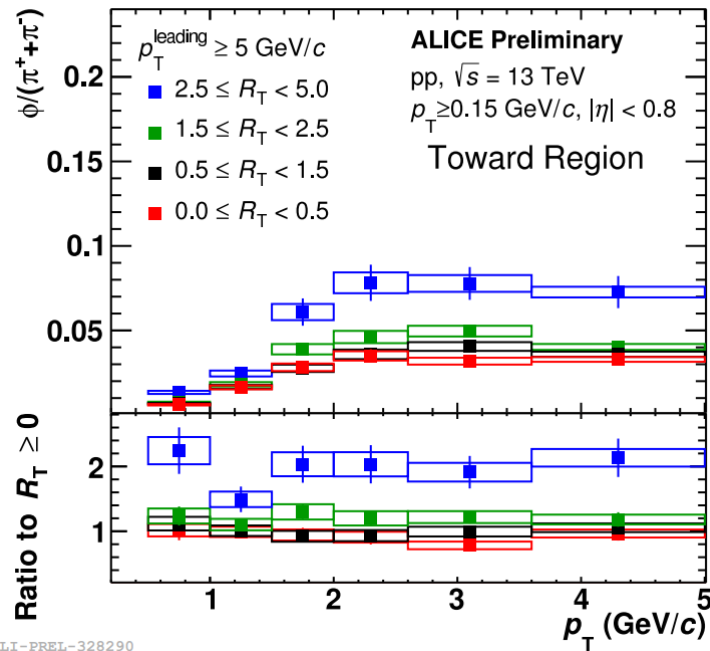


**Can we connect the hard processes directly to the Underlying Event?**

# Conclusion

- Studies of leading processes and their correlation to the Underlying Event properties can help in understanding the interplay between soft and hard particle production.

- $R_T$ tends to be independent from the leading hard processes → good measure for the Underlying Event activity.

- Measurements for $R_T$-dependent production of light-flavoured particles had already been performed.

- In order to investigate the connection between initial hard processes and Underlying Event, $R_T$-dependent measurements of $D^0$ meson production are underway in ALICE. Stay tuned for updates.