LHCC poster session (virtual only, 2021)

Underlying event (UE) studies and search for jet-like modifications in pp and p–Pb collisions with ALICE at the LHC

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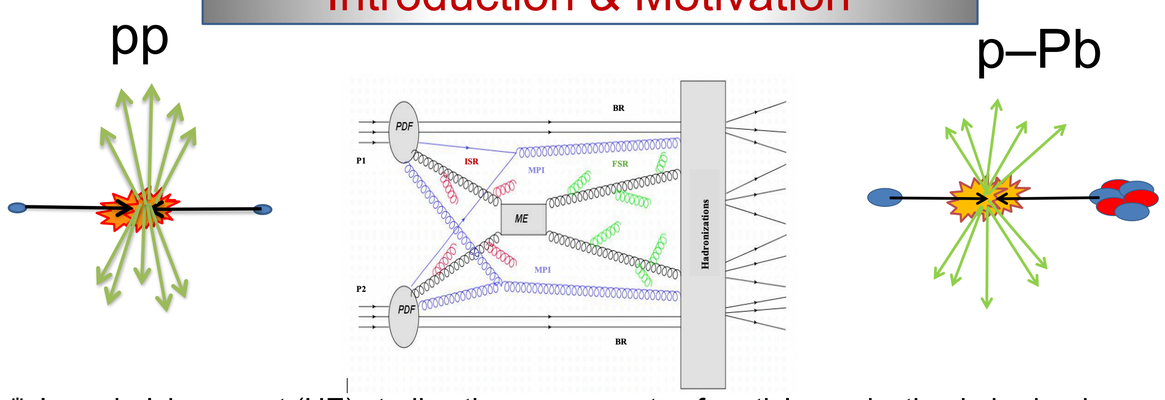
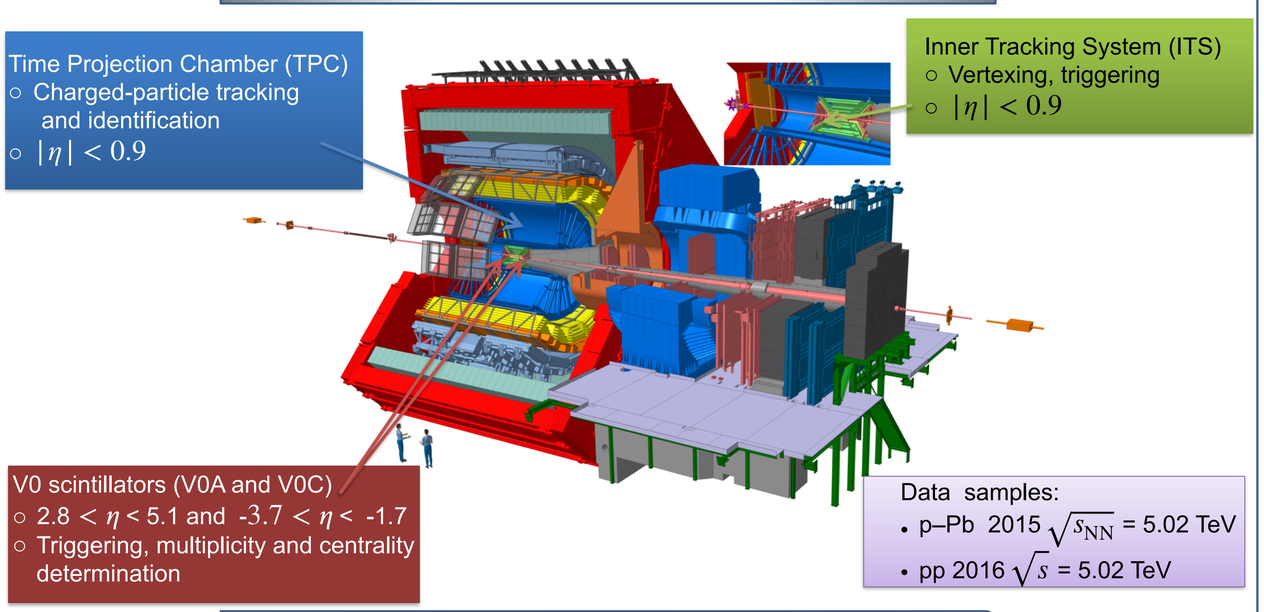
Introduction & Motivation



- In underlying event (UE) studies the components of particle production in hadronic interactions, which are not directly related to the hardest interaction, are studied.
- These results are valuable inputs to tune Monte Carlo event generators, e.g., to describe the uncorrelated background in jet studies
- Due to the composite nature of nucleons, multi-partonic scatterings becomes common at high energies.
- Control the underlying-event activity by varying $p_{\mathrm{T}}^{\mathrm{leading}}$.
- Compare the particle production in pp and p–Pb collisions with same $\sqrt{s_{\mathrm{NN}}}$ and $p_{\mathrm{T}}^{\mathrm{leading}}$,

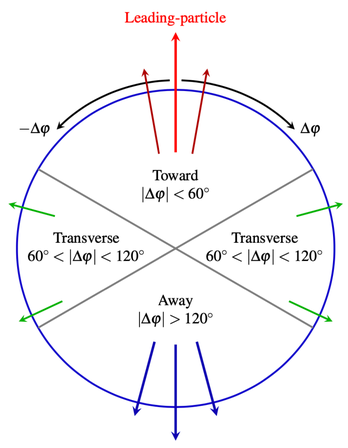
Where $p_{\mathrm{T}}^{\mathrm{leading}}$ is the track with the highest transverse momentum in the event.

ALICE detector setup

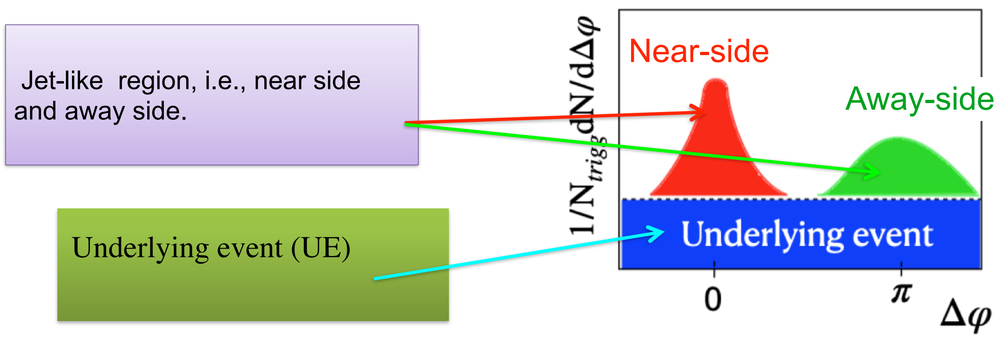


Topological regions

- Measurements are carried out in three topological regions. [1]
- Toward $|\Delta\phi| < 1/3\pi$.
- Transverse $1/3\pi < |\Delta\phi| < 2/3\pi$.
- Away $|\Delta\phi| > 2/3\pi$.
- The transverse side is more sensitive to underlying event.



- For jet-like modifications we subtract transverse side from jet-like region.



UE observables

- **Number density**

$$\left\langle \frac{\mathrm{d}^2 N_{\mathrm{ch}}}{\mathrm{d}\eta \mathrm{d}\varphi} \right\rangle (p_{\mathrm{T}}^{\mathrm{leading}}) = \frac{1}{\Delta\eta\Delta\varphi} \frac{1}{N_{\mathrm{ev}}(p_{\mathrm{T}}^{\mathrm{leading}})} N_{\mathrm{ch}}(p_{\mathrm{T}}^{\mathrm{leading}}).$$

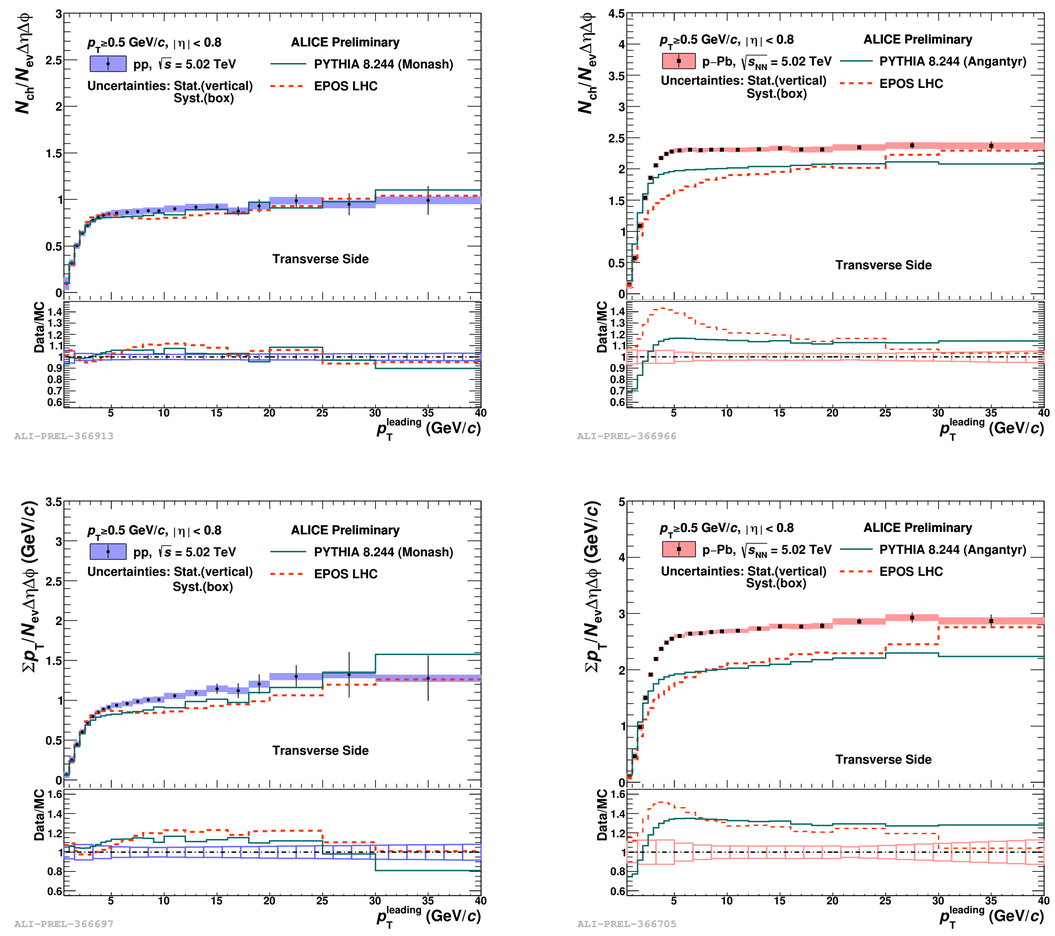
- **Sum p_{T} density**

$$\left\langle \frac{\mathrm{d}^2 \sum p_{\mathrm{T}}}{\mathrm{d}\eta \mathrm{d}\varphi} \right\rangle (p_{\mathrm{T}}^{\mathrm{leading}}) = \frac{1}{\Delta\eta\Delta\varphi} \frac{1}{N_{\mathrm{ev}}(p_{\mathrm{T}}^{\mathrm{leading}})} \sum p_{\mathrm{T}}(p_{\mathrm{T}}^{\mathrm{leading}}).$$

- **Jet-like modifications**

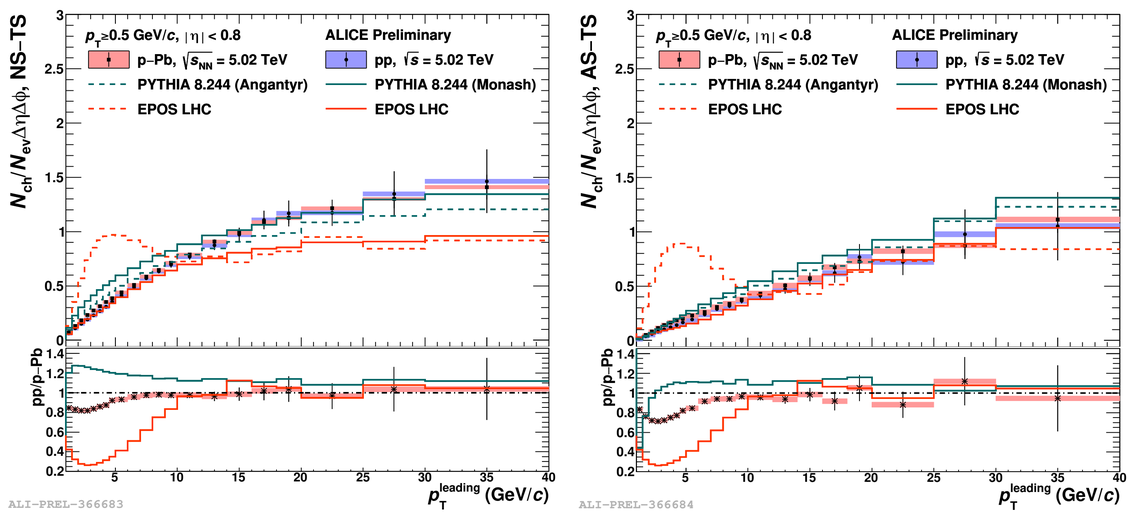
$$\left\langle \frac{\mathrm{d}^2 N_{\mathrm{ch}}}{\mathrm{d}\eta \mathrm{d}\varphi} \right\rangle^{\mathrm{jet\ toward(away)}} = \left[\left\langle \frac{\mathrm{d}^2 N_{\mathrm{ch}}}{\mathrm{d}\eta \mathrm{d}\varphi} \right\rangle^{\mathrm{toward(away)}} - \left\langle \frac{\mathrm{d}^2 N_{\mathrm{ch}}}{\mathrm{d}\eta \mathrm{d}\varphi} \right\rangle^{\mathrm{transverse}} \right] (p_{\mathrm{T}}^{\mathrm{leading}}).$$

UE activity in TS



- Larger UE activity is observed in p–Pb collisions as compared to pp collisions.
- Number density and sum p_{T} density as a function of $p_{\mathrm{T}}^{\mathrm{leading}}$ in transverse region (TS, transverse side).
- Both number density and sum p_{T} density show steep rise for $p_{\mathrm{T}}^{\mathrm{leading}}$ < 5 Gev/c. The number density saturates at high $p_{\mathrm{T}}^{\mathrm{leading}}$ while sum p_{T} increases.
- EPOS LHC underestimates the densities at high $p_{\mathrm{T}}^{\mathrm{leading}}$. Pythia 8 describes data in pp collisions while underestimates (overestimates) the low (high) $p_{\mathrm{T}}^{\mathrm{leading}}$ part.

Jet-like modifications



- To investigate jet-like modifications, the transverse region (transverse side, TS) is subtracted from near region (near side, NS) and away region (away side, AS).
- At high $p_{\mathrm{T}}^{\mathrm{leading}}$, pp and p–Pb data are in agreement suggesting the absence of medium effects.
- At low $p_{\mathrm{T}}^{\mathrm{leading}}$, small difference is observed which is possibly due to the effect of flow.

Summary

- Qualitatively similar behavior in pp and p–Pb collisions is observed, but the underlying-event activity is larger in p–Pb collisions.
- In the search for jet-like modifications, a similar number density in pp and p–Pb collisions at high $p_{\mathrm{T}}^{\mathrm{leading}}$ values is observed.
- The results suggest that the underlying event activity in p–Pb collisions share the same features as observed for pp collisions.

Reference

1. ALICE Collaboration, S. Acharya et al,. "*Underlying Event properties in pp collisions at* $\sqrt{s} = 13$ Tev *with Alice at LHC*", JHEP 04 2020.

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