Measurement of Underlying Event in pp collisions at √s = 13TeV with the ALICE experiment at the LHC

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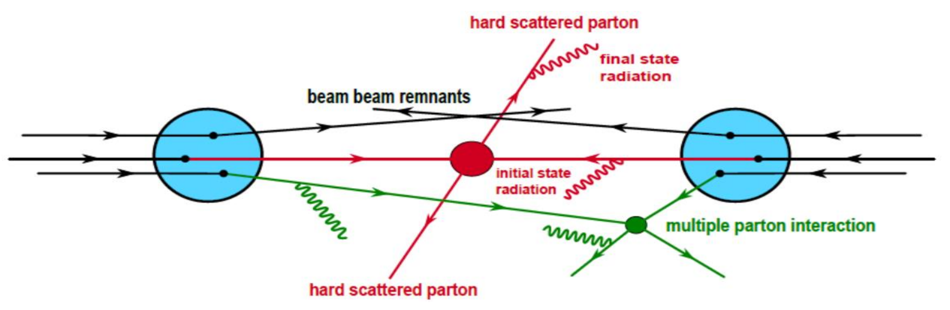
Motivation

● **Underlying Event: everything in single particle collision except the hard process of interest.**

➢ MPI, initial and final state radiations, beam remnants etc.



● **Why it is important to study underlying events?**

➢ Underlying Event measurement is a basic step of event characterization process.

➢ The UE allows to access deep information of the hadronic structure, it has also impact on isolations, jet pedestals, etc.

➢ While searching for energetic particles produced in the collision, we must have good idea about the ambient activity in the event.

Analysis Strategy

● **Traditional UE measurement**: according to the azimuthal direction of leading particle, we define three distinct topological regions,

➢ Toward $|\Delta\Phi|<\pi/3$.

➢ Away $|\Delta\Phi|<2\pi/3$.

➢ Transverse $\pi/3<|\Delta\Phi|<2\pi/3$.

✓ Maximal: the fragmentation products of the semi-hard final state radiation.

✓ Minimal: soft component of the UE, such as beam remnants, MPI.

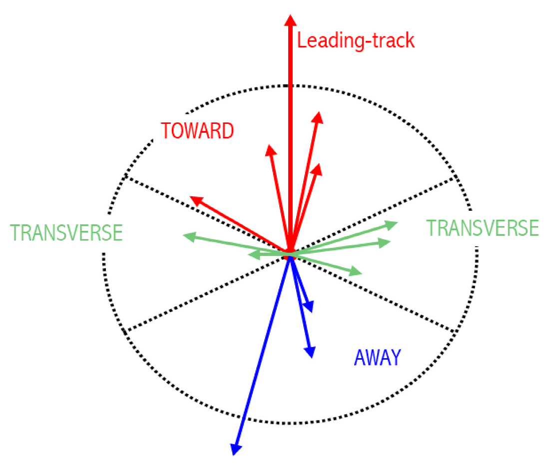
● **The main observables in Underlying Event measurement.**

➢ Average charged particles density vs. leading track p_T.

$$\frac{1}{\Delta\eta.\Delta\Phi}\frac{1}{N_{ev}\left(p_{T,lead}\right)}N_{ch}\left(p_{T,lead}\right)$$

➢ Average sum (p_T) density vs. leading track p_T.

$$\frac{1}{\Delta\eta.\Delta\Phi}\frac{1}{N_{ev}\left(p_{T,lead}\right)}\sum p_T\left(p_{T,lead}\right)$$



● **Four correction procedures**.

➢ **Leading track misidentification**: leading track misidentification result in two biases, bin migration and topological rotation of overall event.

✓ Two methods: data driven or pure Monte-Carlo.

✓ Data driven: reject reconstructed tracks according to tracking efficiency.

✓ Monte-Carlo method: if the MC label of the generated leading track and reconstructed leading track are same, the real leading track of the event is reconstructed.

✓ Data driven method is used to correct the measured results, pure Monte-Carlo method is considered as a main systematic uncertainty sources.

➢ **Tracking efficiency**: undetected particles due to the insensitive regions of the detector.

➢ **Track contamination**: remove the tracks from secondaries.

✓ Monte-Carlo cannot reproduce data due to the difference of secondaries from strangeness in data and Monte-Carlo.

✓ A factor account for the difference of secondaries from strangeness in data and Monte-Carlo need to be evaluated firstly.

✓ With strangeness correction factor: used to correct the measured results.

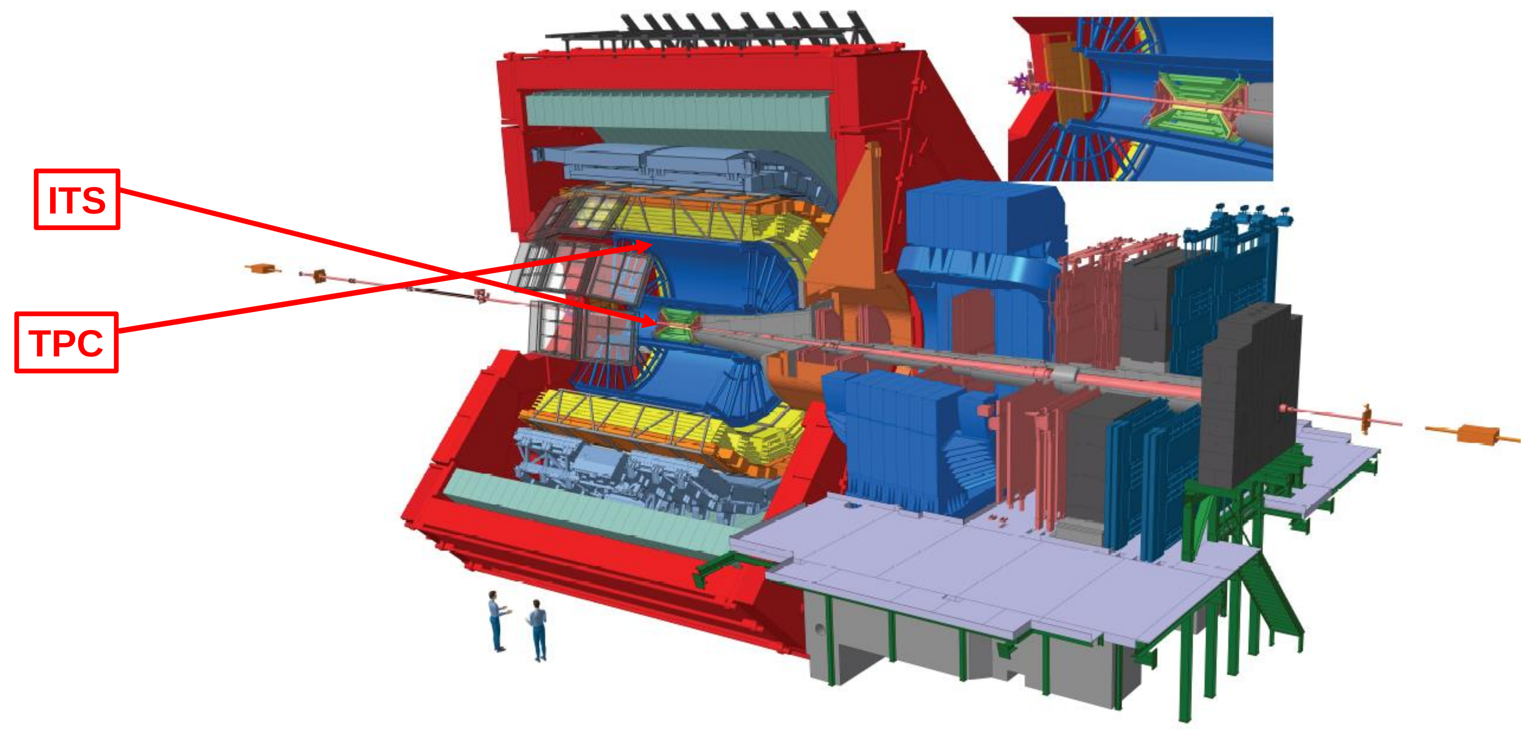
✓ Without strangeness correction factor: considered as a systematic uncertainty source.

➢ **Vertex reconstruction**: the events which have a negligible number of reconstructed tracks.

✓ For generated vertex: only |Zvtx| < 10 cm is required.

✓ Vertex reconstruction efficiency with the requirement of at least 2 contributors to reconstructed vertex is used to evaluated systematic uncertainty.

ALICE detector



Time projection chamber(TPC)

● **|η| < 0.9**

● **Charged particle tracking**

● **Particle identification**

Inner Tracking system(ITS)

● **|η| < 0.9**

● **SPD, SDD, SSD**

● **Vertex reconstruction**

● **event trigger**

Monte-Carlo: two different ALICE official Monte-Carlo samples are used for Monte-Carlo predictions, which are produced by PYTHIA8(Monash2013)and EPOS-LHC, respectively.

Event and track selection

Event selection:

1. Event trigger: MB.
2. Reject pile-up events.
3. Vertex cut: |Zvtx| < 10 cm, at least one contributor to reconstructed vertex.

Track selection:

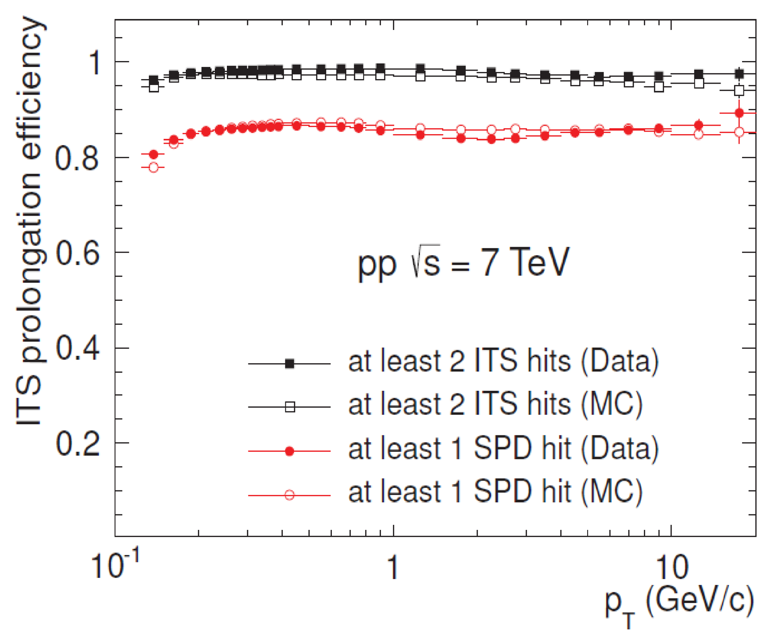
1. Tracks in the TPC are matched to the ITS (TPC-ITS) and/or the collision vertex
2. |η| < 0.8.
3. Three transverse momentum thresholds: 0.15 GeV/c , 0.5 GeV/c , 1 GeV/c .

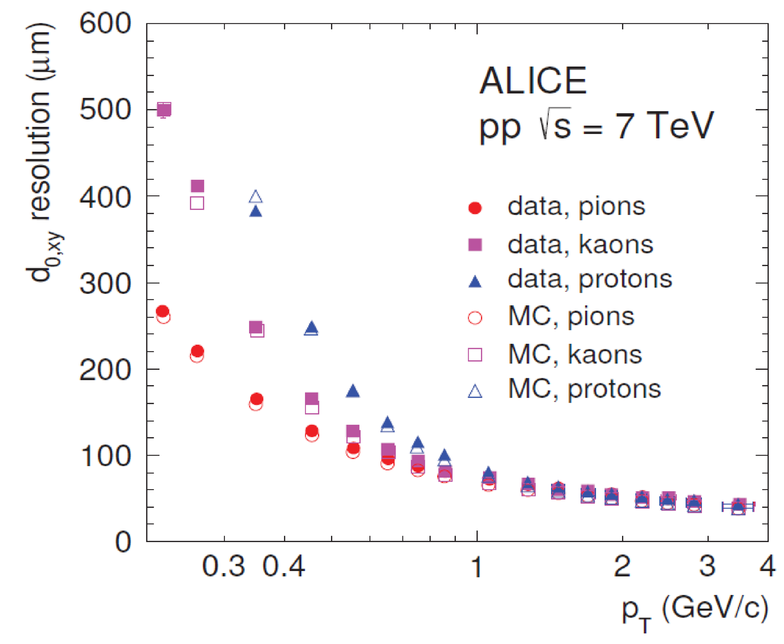
Performance

● Some performance plots on ITS-TPC tracking for 7 TeV are showed in here.

➢ Left plot: ITS–TPC matching efficiency versus p_T for data and Monte Carlo for pp collisions at 7 TeV.

➢ Right plot: Resolution of the transverse distance to the primary vertex for identified ITS–TPC tracks.

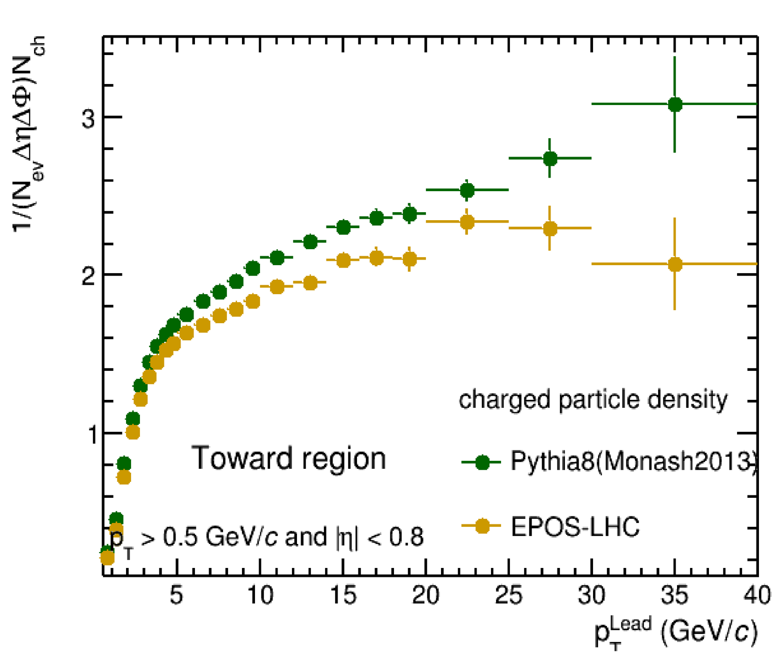


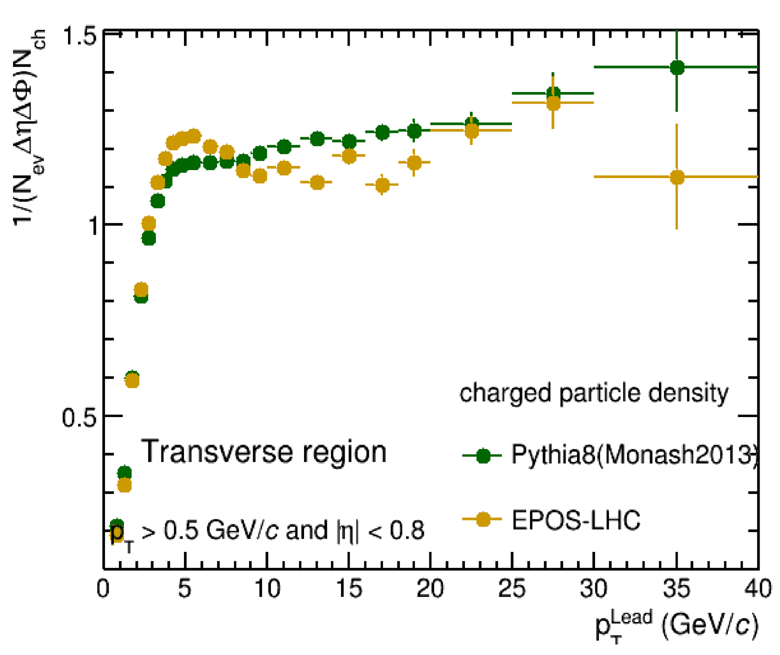


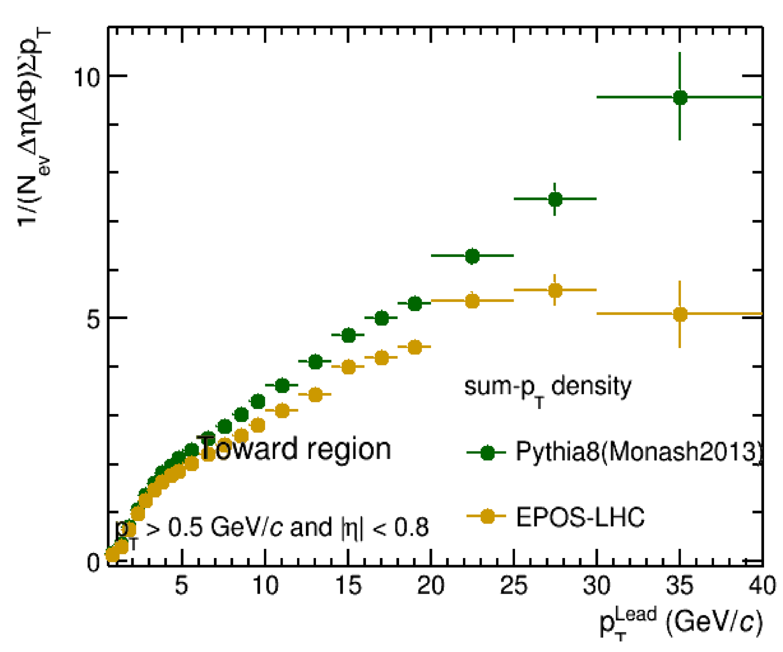
Monte-Carlo predictions

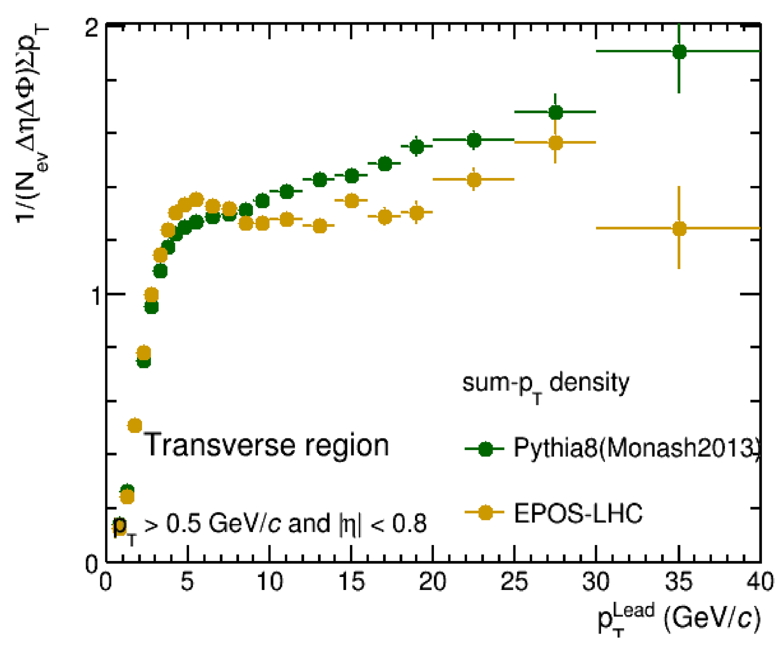
Average charged particles density vs. leading track p_T

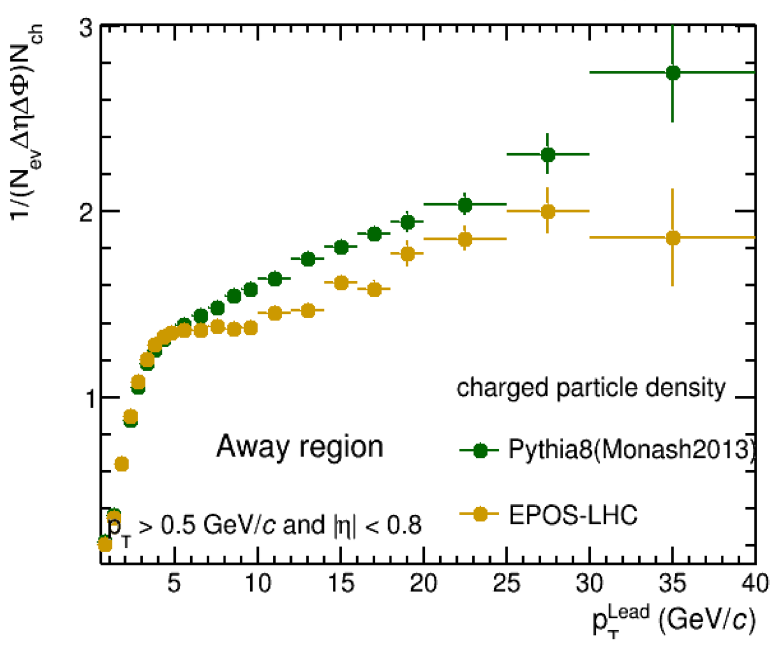
Average charged sum (p_T) density vs. leading track p_T









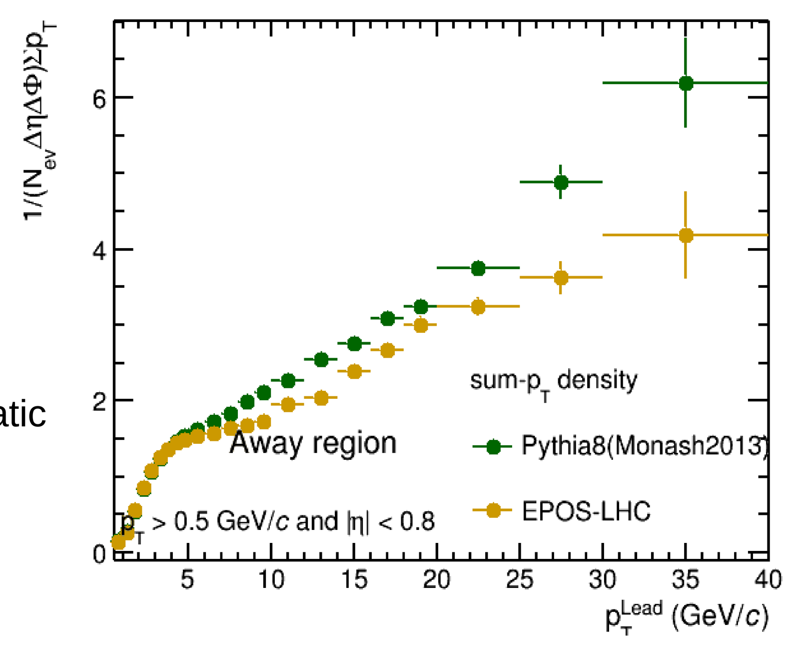


Summary

➢ The Monte-Carlo predictions of UE observables in three different topological regions are showed in here.

➢ PYTHIA8(Monash2013) and EPOS-LHC are used to do Monte-Carlo simulations.

➢ The measurement of UE observables with parts systematic uncertainties in the transverse region is in progress.



Outlook

➢ All the systematic uncertainties will be studied in the transverse region.

➢ The same analysis method will be used in the toward and away topological regions for three different p_T thresholds.