Underlying Event (UE) study as a function of R_T in pp collisions at 13 TeV

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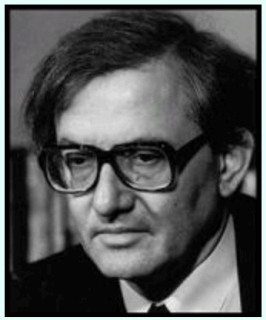
ZIMÁNYI SCHOOL'19

Győrfi András: Az úton (On the road)

19. ZIMÁNYI SCHOOL

WINTER WORKSHOP ON HEAVY ION PHYSICS

Dec. 2. - Dec. 6., Budapest, Hungary



József Zimányi (1931 - 2006)

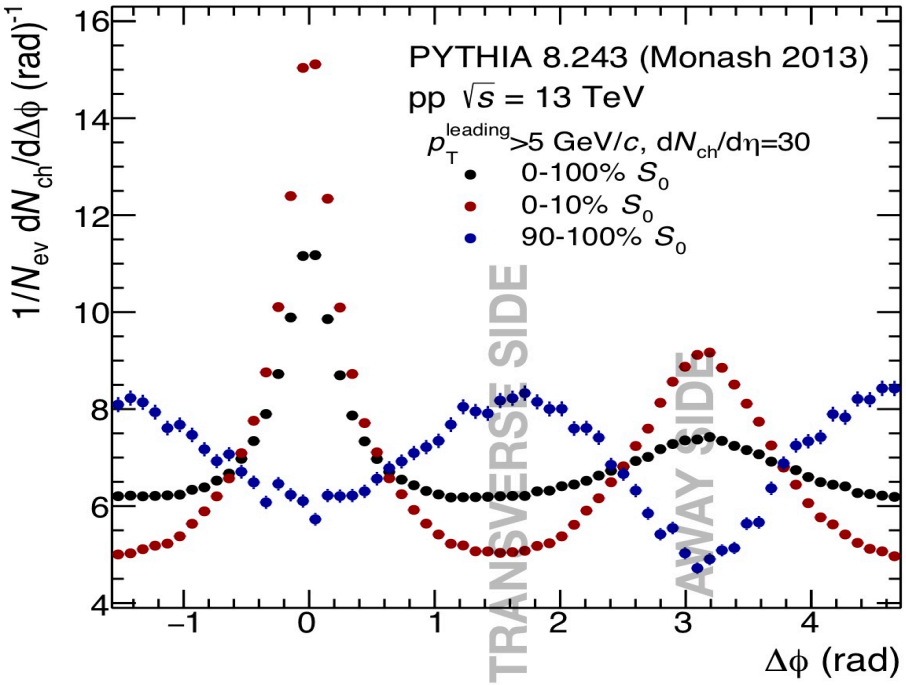
Motivation

- Understand in more details the dependence of the underlying event on multiplicity presented in the previous talk.
- Understand the development of the Transverse Side spectra.
- We use Relative Transverse activity classifier (R_T) observable to observe the leakage of high multiplicity events from Near side to Transverse Side.

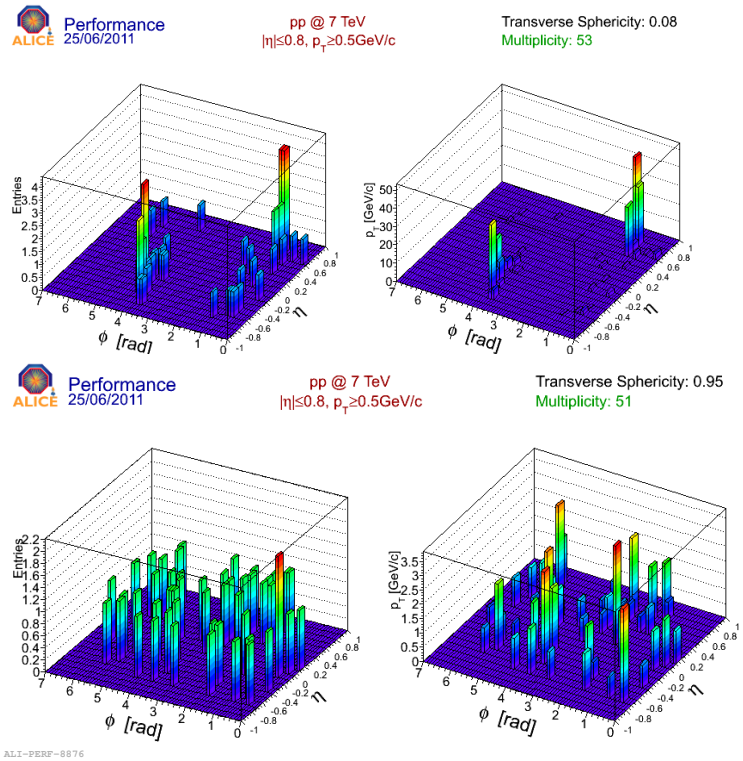
Motivation

Spherocity:

$S_0 = \begin{cases} 0 \text{ “pencil-like” limit (hard events)} \\ 1 \text{ “isotropic” limit (soft events).} \end{cases}$



A. Ortiz MPI@LHC 2019, Prague



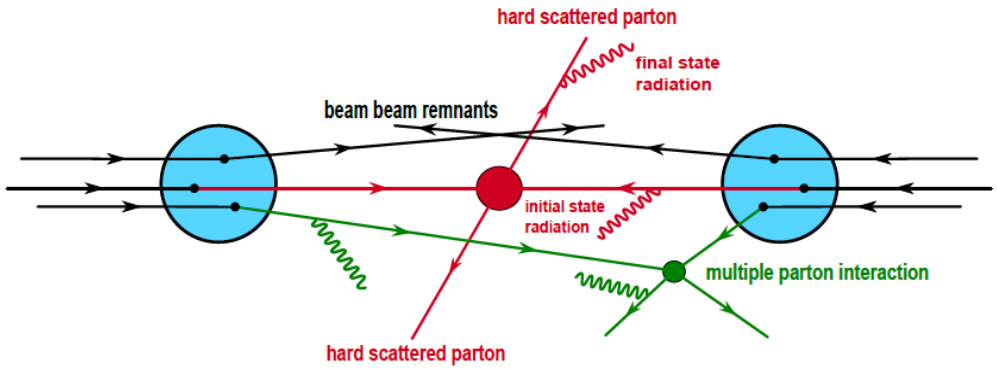
- study of the leading-hadron correlations for isotropic events also show an excess of particles in Transverse Side and peak eliminates at Near and Away side.

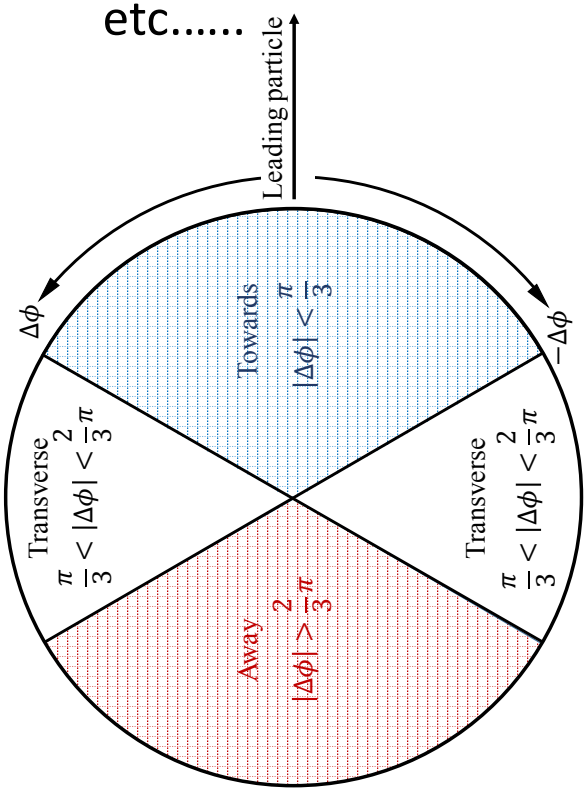
Underlying Event (UE)

In parton-parton scattering, the UE is usually defined to be everything except the two outgoing hard scattered partons:

- Beam-beam remnants.
- Additional parton-parton interacti
- Initial and final state radiations

etc……





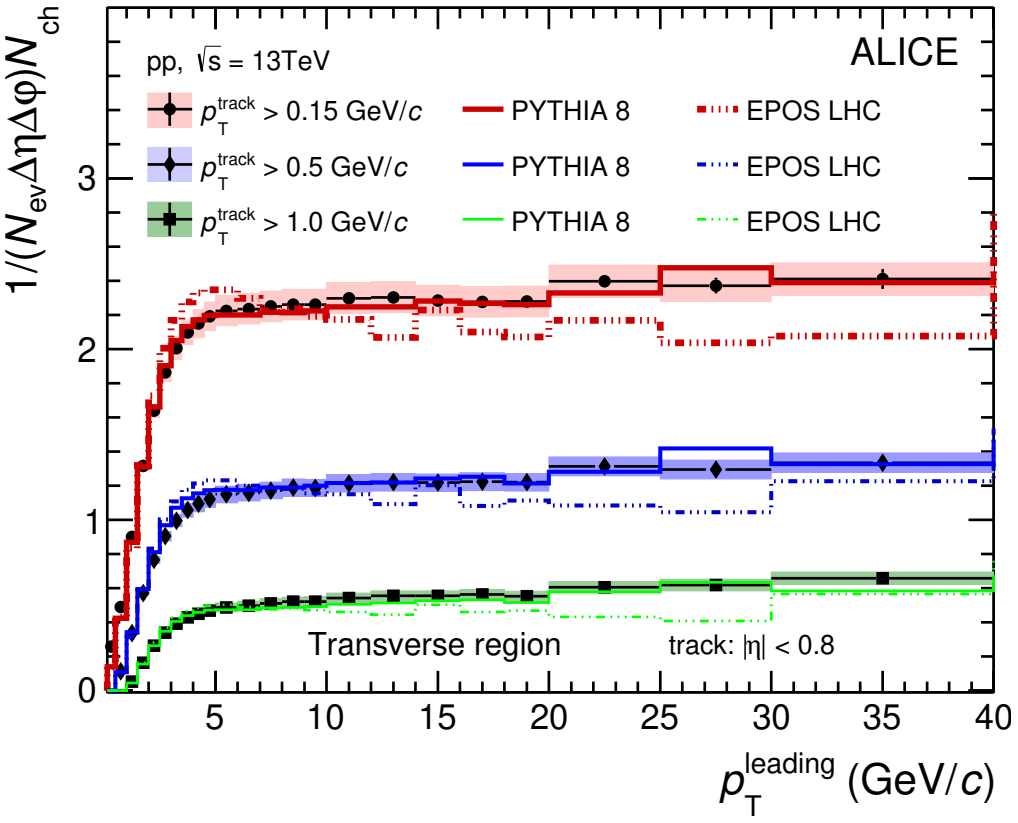
❑ **Traditional UE measurement:** according to the azimuthal direction of leading charged particle, three distinct topological regions are defined:

- Near Side (NS): $|\Delta\Phi| < \pi/3$
- Away Side (AS): $|\Delta\Phi| > 2\pi/3$

} (sensitive to Jet fragmentation)

- Transverse Side (TS): $\pi/3 < |\Delta\Phi| < 2\pi/3$ (sensitive to UE)

Underlying Event (UE): PYTHIA 8 has GOOD AGREEMENT



- Number density for charged particles for three different p_T cuts
- A Steep rise in observed at low $p_T^{leading}$ ($p_T^{leading}$ < 5 GeV/c).
- At $p_T^{leading}$ > 5 GeV/c, Number density in Transverse Side becomes almost independent of $p_T^{leading}$
- PYTHIA8 Monash 2013 explains this behaviour very well.

arXiv:1910.14400 (ALICE collaboration)

PYTHIA 8 (Monash 2013)

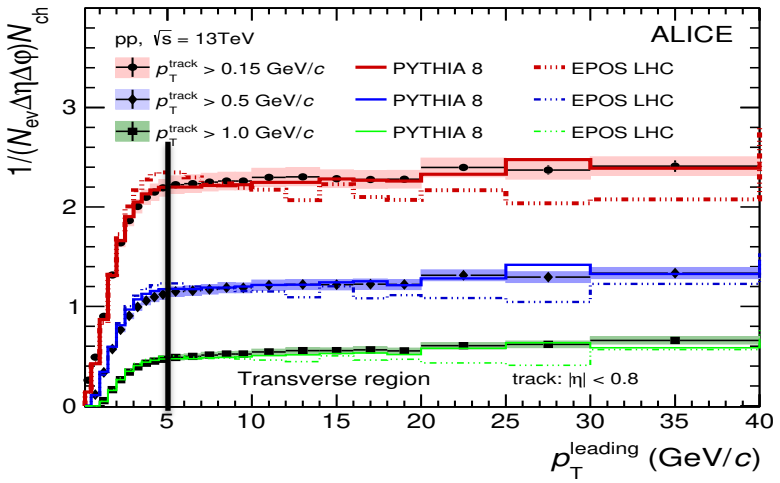
- $p_T > 0.15$ GeV
- $|\eta| < 0.8$
- $p_T^{leading} > 5.0$ GeV/c

Keep environment similar to the ALICE at LHC.

Relative Transverse activity classifier (R_T)

Above a lower threshold corresponding to the onset of the UE plateau in the transverse region (roughly, $p_T^{leading} > 5$ GeV/c), particle production can be studied as a function of event activity using the Relative Transverse activity classifier defined as follows:

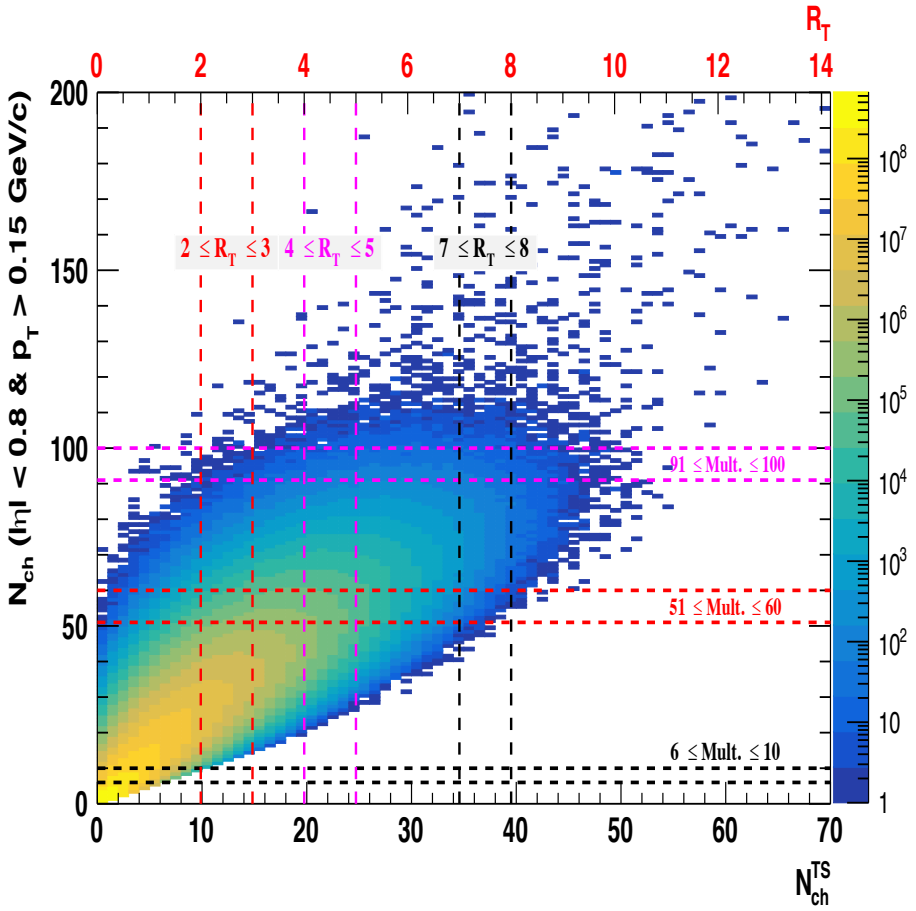
$$R_T = \frac{N_{Inc.}}{< N_{Inc.} >}$$

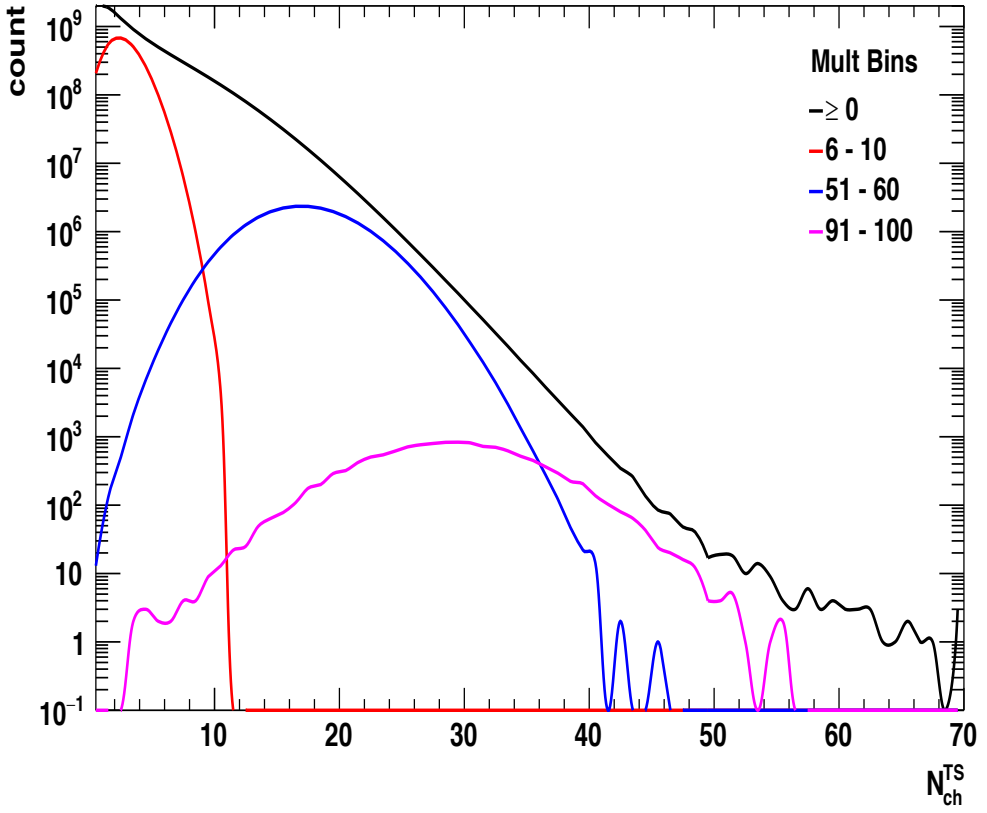


<N_{Inc}> is the event-averaged multiplicity of the inclusive set of particles.
N_{inc} is total numbers of the inclusive charged particles in the event.

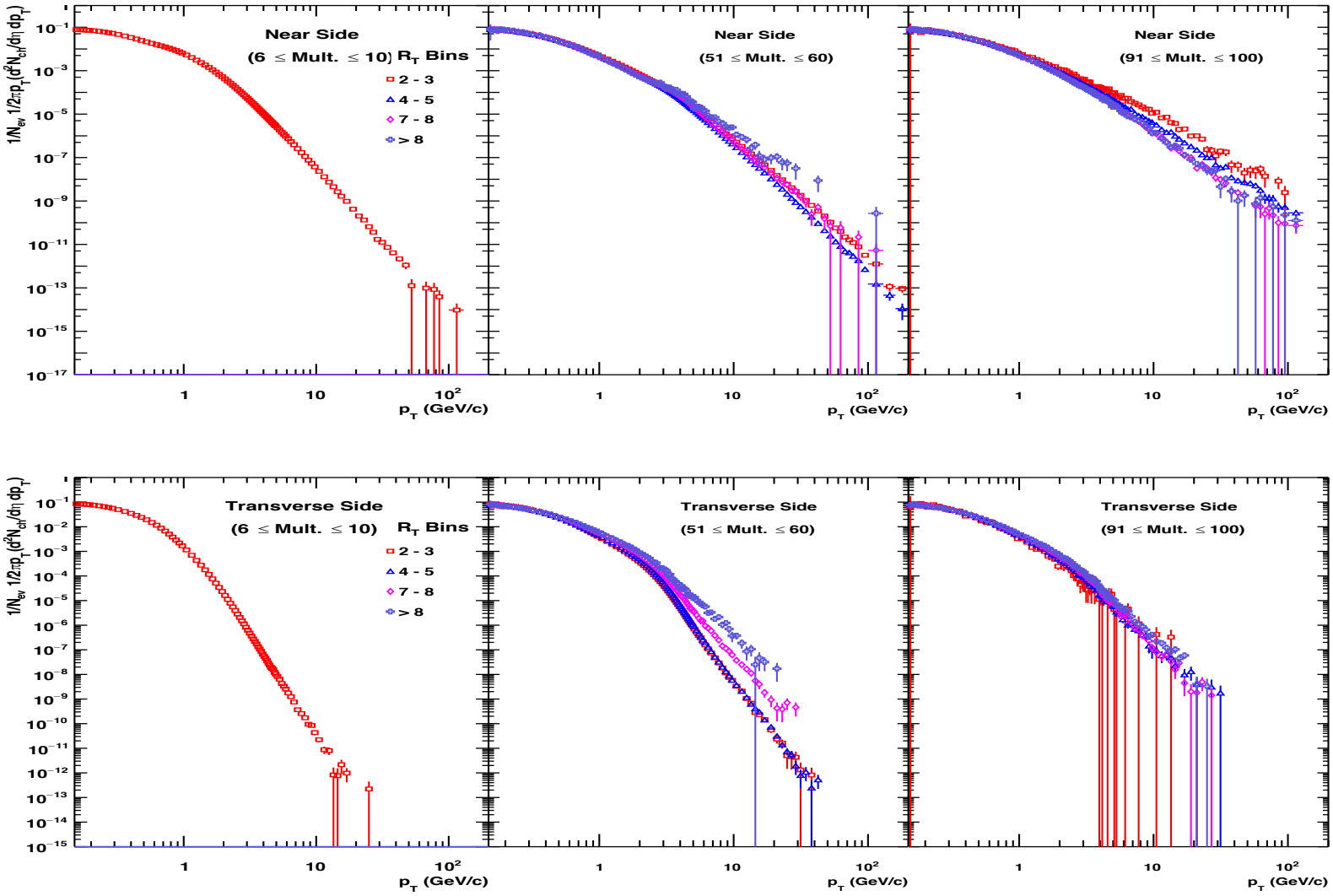
T. Martin, P. Skands, S. Farrington, **Eur. Phys. J. C (2016) 76:299**

Multiplicity bin covers a wide range of R_T





Particle leakages from Near Side to Transverse Side!



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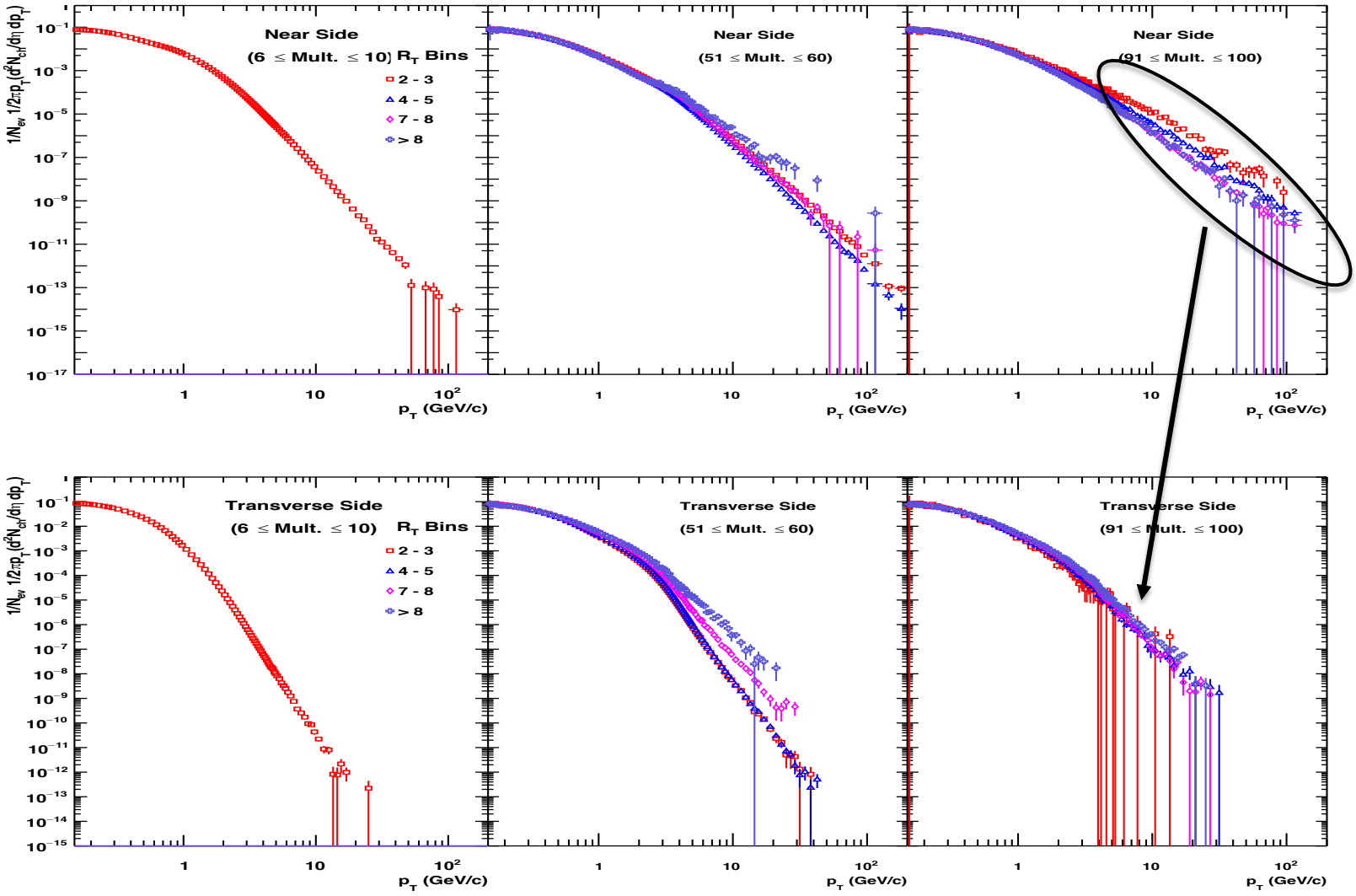


Conclusions:

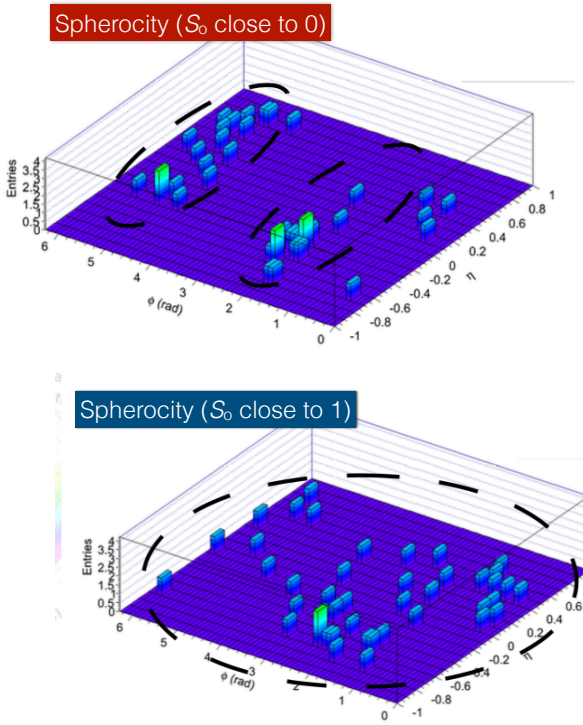
- The "leaking" of hadrons from the Near Side into the Transverse Side is not a sudden occurrence. It happens even at moderate multiplicities for a part of the events.
- We observe a gradual evolution of the transverse spectra for rising R_T values.
- We believe that the origin of the hedgehog events should be sought in high R_T events where the jetty events do not exist.

Thank you

Transverse spherocity

Transverse spherocity (S_0) is an event shape which measures the particle production which is perpendicular to the plane formed by the beam axis and that of the main partonic scattering (~spherocity axis, $\hat{\mathbf{n}}$)

$$S_0 = \min \frac{\pi^2}{4} \left(\frac{\sum_i |\vec{p}_{\mathrm{T},i} \times \hat{\mathrm{n}}|}{\sum_i p_{\mathrm{T}.i}} \right)^2$$



For the calculation of spherocity we consider at least three primary charged particles, $p_{\mathrm{T}} > 0.15$ GeV/c, $|\eta| < 0.8$

Several works have been reported:
Adv. Ser. Direct. High Energy Phys. 29 (2018) 343-357
Nucl. Phys. A941 (2015) 78-86
arXiv:1404.2372