Contribution ID: **113** Type: **not specified**

Spherocity-Dependent Study of Relative Transverse Multiplicity Activity Event Classifier in the Underlying Event

Wednesday 15 January 2025 10:26 (7 minutes)

This study investigates the intricate relationship between transverse spherocity (S_0) and the relative transverse multiplicity activity event classifier (R_T) in proton-proton collisions at the Large Hadron Collider (LHC) with a center-of-mass energy of 13 TeV. Through a detailed analysis across different spherocity regions, we examine various observables to understand underlying event dynamics in high-energy particle collisions. We have used the PYTHIA 8 Monte-Carlo (MC) with a different implementation of color reconnection and rope hadronization models to demonstrate the proton-proton collision data at $\sqrt{s}$ = 13 TeV. The sensitivity to the multi-partonic interaction is studied using a new differential approach to understand the underlying event and jetty-like domain. Furthermore, the baryon-to-meson production ratio and the average transverse momentum (p_T) are evaluated across R_T for selected spherocity classes, revealing significant dependencies on the event topology. These measurements offer insight into the complex nature of strange particle production and underlying event structure in high-energy collisions, with implications in quantum chromodynamics (QCD) studies. Experimental confirmation of these results is feasible using ALICE Run 3 data which will provide more insight
into the soft physics in the transverse region which is useful to understand the small system dynamics.

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Session Classification: Parallel D

Track Classification: 6. Collectivity in small systems