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Demystifying the effects of QCD radiation, color reconnection, and rope formation mechanism on forward-backward multiplicity correlations in proton-proton collisions at LHC energies

Forward-backward multiplicity correlation in minimum biased pp collisions has been studied within the PYTHIA8 framework at LHC energies. One of the findings of this study highlights the interplay between SRCs and LRCs in shaping the correlations among produced particles in various azimuth and pseudorapidity. Our study concludes that the azimuthal sectors with φ are predominantly affected by LRCs, whereas are primarily driven by sep > π/4 φsep < π/4 SRCs. Another notable observation is the strong dependence of the Initial State Radiation (ISR) and Final State Radiation (FSR) on the FB multiplicity correlation strength parameter b , with ISR having a more significant effect than FSR. The role of Multi-parton corr (mult.) Interaction (MPI), Color Reconnection (CR), and color rope formation on FB multiplicity correlation is also studied. We find good quantitative agreement with ALICE results [1] for MPI-based CR (CR Range 3.6 and 5.4) and QCD-based CR + Ropes across all the studied energies. On the other hand, the MPI-based CR (CR Range 1.8, default) fails to explain the
experimental data at all energies. This study serves as a baseline for exploring more interesting high-multiplicity (HM) pp collisions, which often exhibit collective behavior.

References

[1] J.Adam et al. (ALICE Collaboration), Forward-backward multiplicity correlation in pp collision at LHC energies, J. High Energy Phys., 05 097 (2015).

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