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Disentangling the gluon Bremsstrahlung effects from the underlying event in high-multiplicity pp collisions

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Recently, the so-called relative transverse activity classifier, R_T , has been proposed as a tool to disentangle the particle production originated from the soft and hard QCD processes in proton-proton (pp) collisions. R_T is a useful quantity to study particle production in events with exceptionally large or small activity in the transverse region with respect to the event-averaged mean. Contrary to the expectations, the preliminary results of the ALICE Collaboration indicate that, e.g., the proton-to-pion ratio does not exhibit the characteristic enhancement at intermediate p_T in events with large \sqrt{s} with respect to minimum-bias pp collisions. In this work, we investigate the origin of this effect using the Pythia 8 and Herwig 7 Monte Carlo event generators. The effect is a consequence of a selection bias attributed to wide-angle gluon emissions which creates jets that populate the transverse region. Therefore, we propose a modified version of R_T in order to suppress its sensitivity to hard gluon Bremsstrahlung, and enhance the sensitivity to soft Multiparton Interactions (MPI). This approach could be useful in order to study the particle production in the jet-like region as a function of MPI. The implementation of these ideas in data will provide more insight into the production mechanisms of hadrons in high-multiplicity pp collisions, and its connection with heavy-ion phenomena.

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