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Multiple Partonic Interaction and production of Charmonia in proton+proton collisions at the LHC energies

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In high multiplicity p+p collisions, the Underlying Event observable is of great interest to the scientific community. The Multiple Partonic Interaction (MPI) is one of them, where several inelastic interactions at partonic level occur in a single p+p collision. In general, MPI plays an important role to produce light quarks and gluons. But it is observed that it can also contribute to produce heavy flavor particles like charmonia, when the interaction occurs in a harder scale. This leads to a strong dependence of J/ψ production with charged particle multiplicity. ALICE experiment has observed a monotonic increase of J/ψ with charged particle multiplicity in p+p collisions at $\sqrt{s}$ = 7, 13 TeV in dimuon as well as dielectron channels. But, till now the measurements are not available for all the LHC energies. This forbids one to infer about the energy dependence role of MPI on J/ψ production.

In our current study, we have made an effort to understand the role of MPI on multiplicity and energy dependence production of J/ψ using perturbative Quantum Chromodynamics (pQCD) inspired model, PYTHIA8 at different LHC energies of $\sqrt{s}$ = 0.9, 2.76, 5.02, 7 and 13 TeV. J/ψ are reconstructed via dimuon channel at forward rapidities (2.5 < y < 4.0) and the charged particle multiplicity is measured at midrapidity (|y| < 1.0). The effect of Color Reconnection (CR) on the production of J/ψ at the LHC energies at different multiplicity bins is studied. The multiplicity ratio of higher state of charmonia, to J/ψ, i.e. $\psi(2S)/J/\psi$ will be presented as a function of multiplicity at all the LHC energies. We observe the dominance of CR and MPI effects towards high multiplicity events at the LHC energies, showing a threshold of $N_{\rm ch} > 20$. The present study will help in understanding the charmonia production in p+p collisions at the LHC energies.

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