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Chemical freeze-out study in proton-proton collisions at RHIC and LHC energies

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Particle multiplicities measured at Relativistic Heavy Ion Collider (RHIC) and Large Hadron Collider (LHC) facilities can be used to understand the chemical freeze-out dynamics. At chemical freeze-out (CFO), inelastic collisions cease and the freeze-out parameters can be determined using measured particle multiplicities within the framework of a statistical model.The statistical model has proven to be quite successful in describing the particle production from elementary $p-p$ and e^+e^- collisions up to heavy-ion collisions [1,2]. It helps to do a systematic study of the centrality and energy dependence of freeze-out parameters in heavy-ion collisions from lower SPS to higher LHC energies [3]. The new data at LHC along with the RHIC data can be used to do such a systematic study in proton-proton collisions.

Here, we will present the particle production in proton-proton collisions within a statistical model at RHIC center-of-mass energy $\sqrt{s}$ = 200 GeV and at LHC center-of-mass energy $\sqrt{s}$ = 900 GeV and 7 TeV. In this model, particle production is described by a set of thermal parameters like the temperature, the volume and the set of chemical potentials corresponding to different conserved quantities such as baryon number, strangeness and charge. Two different freeze-out schemes have been used for this study. One is single freeze-out (1CFO) [4] where all hadrons freeze-out together. Other one is double freeze-out (2CFO) [5] where strange and non-strange hadrons freeze-out separately giving two different sets of parameters. We will discuss the energy dependence of different chemical freeze-out parameters in 1CFO. The freeze-out parameters are also extracted in 2CFO and compared with 1CFO. The non-strange temperature is found to be lower than that of strange temperature in 2CFO for all energies studied here which can be interpreted as the early freeze-out of strange hadrons. The freeze-out parameters from 1CFO found to lie intermediate to the corresponding strange and non-strange values of 2CFO.

References

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