Contribution ID: **9** Type: **Talk**

Multiplicity Dependence of Thermodynamic Parameters for Strange and Multi-Strange Hadrons in Proton-Proton Collisions at $\sqrt{s}$ = 7 TeV at the LHC

Tuesday, 13 June 2017 17:05 (20 minutes)

The transverse momentum (p_{T}) spectra in proton-proton collisions at $\sqrt{s}$ = 7 TeV, measured by the ALICE experiment at the LHC are analyzed with a thermodynamically consistent Tsallis distribution. The information about the freeze-out surface in terms of freeze-out volume, temperature and the non-extensivity parameter, q, for K^0_S, $\Lambda + \bar{\Lambda}$, $\Xi^- + \bar{\Xi}^+$ and $\Omega^- + \bar{\Omega}^+$ are extracted by fitting the p_{T} spectra with Tsallis distribution function. The freeze-out parameters of these particles are studied as a function of charged particle multiplicity density ($dN_{ch}/d\eta$). In addition, we also study these parameters as a function of particle mass to see any possible mass ordering. The strange and multi-strange particles show mass ordering in volume, temperature, non-extensive parameter and also a strong dependence on multiplicity classes.

It has been observed that the Tsallis distribution provides a very good description of the transverse momentum distributions of strange and multi-strange particles produced in $p + p$ collisions at $\sqrt{s}$ = 7 TeV without incorporating the radial flow. The parameters obtained show variations with the multiplicity in the collision. Notably is the variation of the non-extensive parameter, q which decreases towards the value one as the multiplicity increases, except for the K^0_s, which shows no clear dependence. This shows the tendency of the produced system to equilibrate with higher multiplicities. This goes inline with the expected multi-partonic interactions, which increase for higher multiplicities in $p + p$ collisions and is thus responsible for bringing the system towards thermodynamic equilibrium. The variable T shows a systematic increase with multiplicity, the heaviest baryons showing the steepest increase. This is an indication of a mass hierarchy in particle freeze-out. The radius has a tendency to remain constant at high multiplicities. These changes have implications for the kinetic freeze-out conditions where the heavy multi-strange hadrons are seen to have an earlier kinetic freeze-out, meaning they come from a smaller volume at a higher temperature. These results show that the Tsallis distribution is an excellent tool to analyze high-energy $p + p$ collisions.

List of tracks

Fluctuation in initial conditions, collective flow and correlations

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Session Classification: Charge fluctuations, correlations and balance functions