A comparison of thermodynamical properties in high multiplicity pp and heavy ion collision

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High multiplicity pp collision

- Recent result on strangeness enhancement has opened up a new avenue to search for QGP in pp collision.
- Motivated by the result of the strangeness enhancement in pp collision, we started looking for the similarity or difference in the thermodynamics parameters between pp and heavy ion collision.
In order to study thermodynamical properties we analyse transverse momentum spectra.

Tsallis-Weibull distribution function has been used to fit the transverse momentum spectra over different $p_T$ range.

$P_q(x; q, \lambda, k) = \frac{k}{\lambda} \left( \frac{x}{\lambda} \right)^{k-1} e_q^{-\left( \frac{x}{\lambda} \right)^k}$

$e_q^{-\left( \frac{x}{\lambda} \right)^k} = (1 - (1 - q)(\frac{x}{\lambda})^k)(\frac{1}{1-q})$
“q” parameter

➢ “q” parameter signifies the degree of deviation from thermal equilibrium.

➢ A higher value of (q-1) indicating larger deviation from equilibrium.

➢ Plots below indicates that the system move toward thermal equilibrium with increasing multiplicity in PbPb collision.
In heavy ion collision, particle production in high $p_T$ regime is dominated by pQCD hard scattering processes and this leads to hardness in the spectra at higher $p_T$.

Hard scattering processes lead to a non-equilibrium scenario as discussed in [1].

Variation of q at higher $p_T$ indicate increase in the hard scattering with increasing multiplicity (peripheral collision has lowest q) as already reported in [1].

We observe that the q-value decreases with increase in multiplicity for all $p_T$ range and we do not observe any trend reversal as was the case in heavy ion collision.

These results indicate a difference in particle production scenario in pp and heavy ion collision and more physics insight is required to explain these results.