IS2021

The VI[th] International Conference on the
INITIAL STAGES
OF HIGH-ENERGY NUCLEAR
COLLISIONS

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

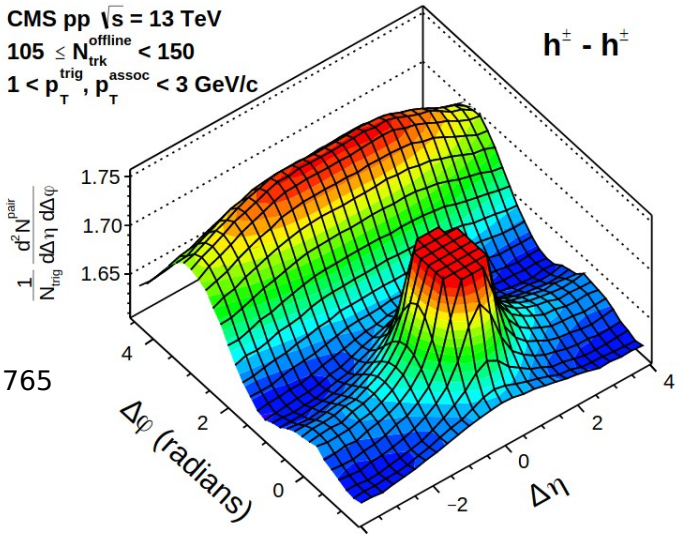
Rohit Gupta*, Satyajit Jena

Department of Physical Sciences

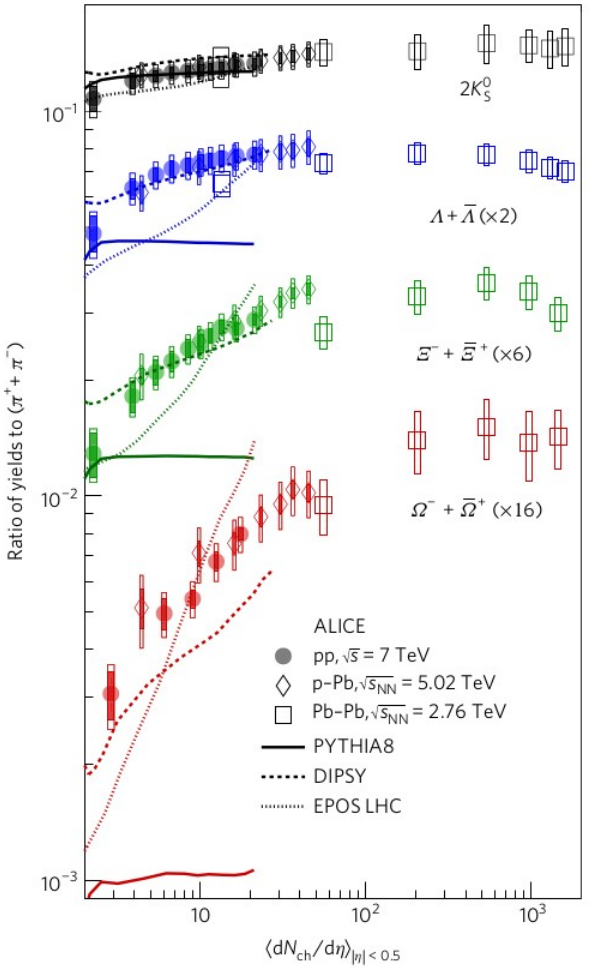
Indian Institute of Science Education and Research, Mohali, India

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 colision, we started looking for the similarity or difference in the thermodynamics parameters between pp and heavy ion collision.



CMS Collaboration, Phys.Lett.B 765 (2017) 193-220



ALICE Collaboration result in NATURE PHYSICS DOI: 10.1038/NPHYS4111

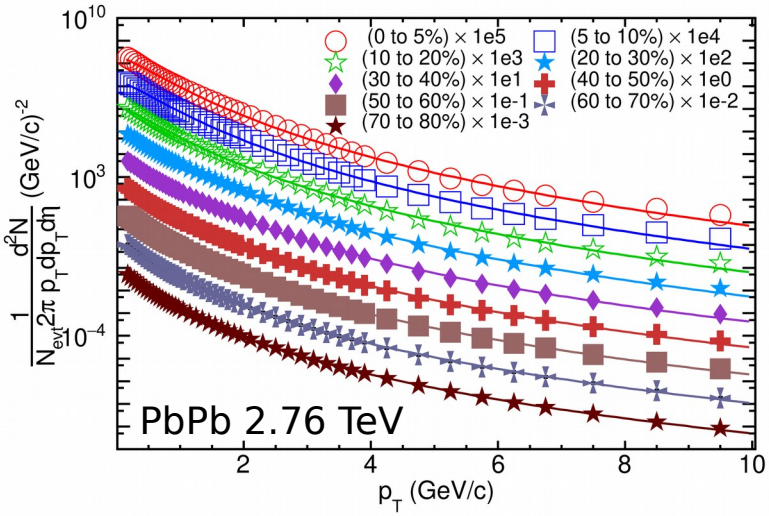
Q-Weibull distribution

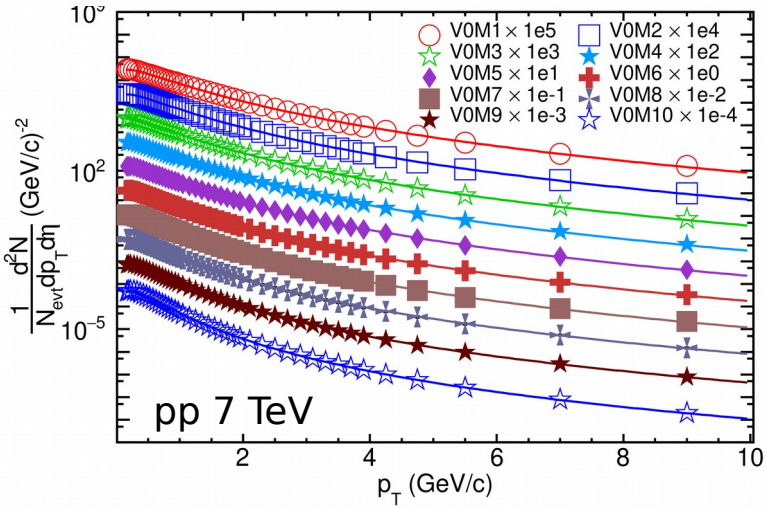
- In order to study thermodynamical properties we analyse transverse momentum spectra.
- Tsallis-Weibull distribution function has been used to fit the transverse momentum spectra over different p_T range.

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

$$e_q^{-(\frac{x}{\lambda})^k} = (1-(1-q)(\frac{x}{\lambda})^k)^{(\frac{1}{1-q})}$$

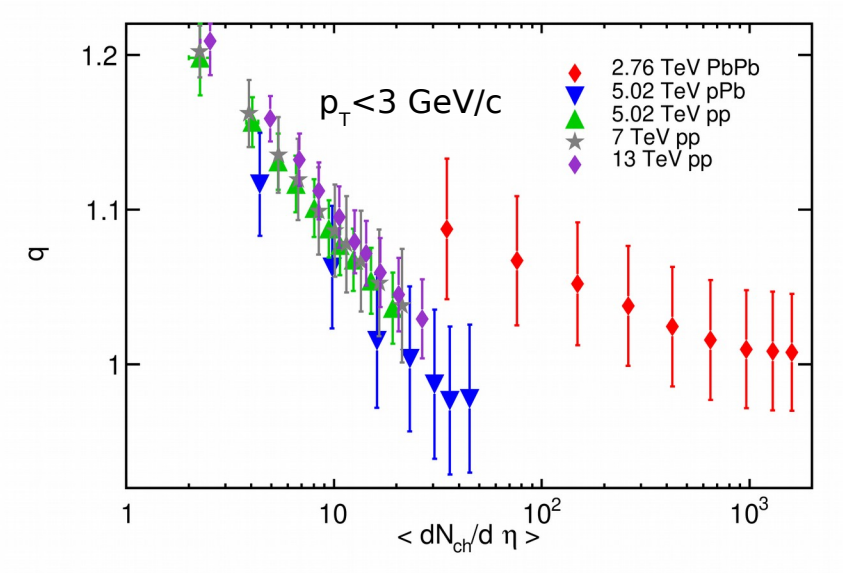
Charged Hadrons

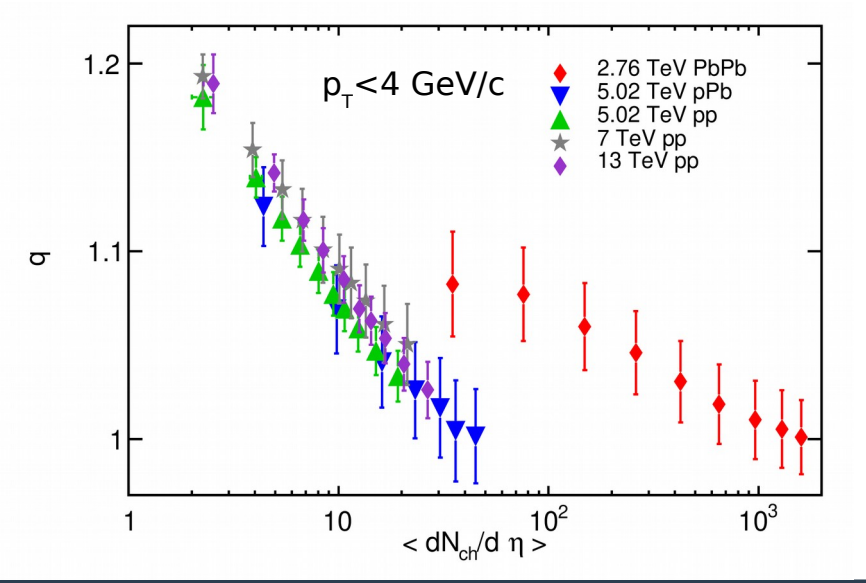




“q” parameter

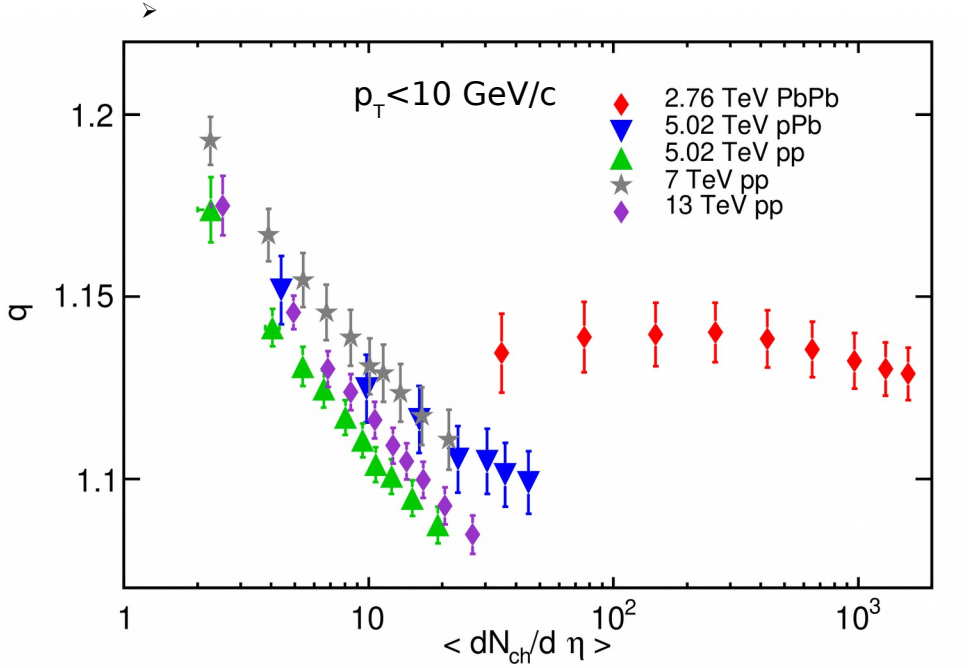
- “q” parameter signifies the degree of deviation from thermal equilibrium.
- A higher value of (q-1) indicating larger deviation from equilibrium.
- Plots below indicates that the system move toward thermal equilibrium with increasing multiplicity in PbPb collision.

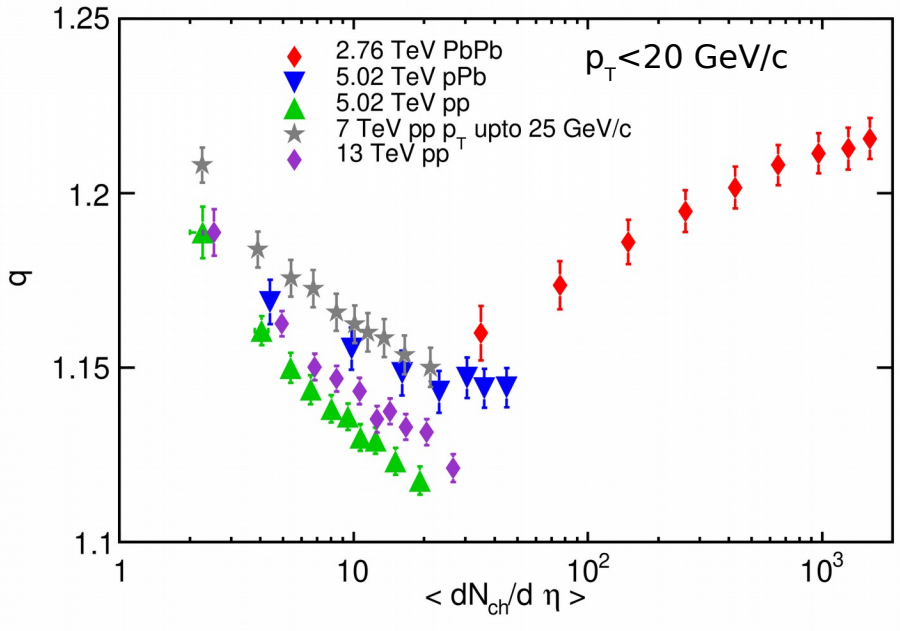




Hard scattering

- 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 process lead to a non-equilibrium scenario as discussed in [1].
-





[1] Sadhana Dash, D.P. Mahapatra Eur.Phys.J.A 54 (2018) 4, 55

Discussion

- 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 heay 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.