17th International Conference on
Strangeness in Quark Matter

Universiteit Utrecht

10-15 July 2017
Utrecht, the Netherlands

Utrecht 2017

Contribution ID: **114** Type: **oral presentation**

Estimation of the isothermal compressibility from event-by-event multiplicity fluctuation studies

Friday 14 July 2017 15:15 (20 minutes)

Fluctuations of various observables in heavy-ion collisions at ultra-relativistic energies have been extensively studied in literature as they provide important signals regarding the formation of the Quark Gluon Plasma. In addition to being sensitive to the QCD phase transitign, the multiplicity fluctuations affect other event-by-event measurements. In this work, the centrality-dependence and beam-energy dependence (from RHIC to LHC energies,i.e, from 7.7 GeV/A to 5.5TeV/A) of multiplicity fluctuations (measured by obtaining scaled variance, defined by variance scaled over mean, from the multiplicity distributions) using event generators HIJING, AMPT-Default and AMPT-String Melting will be presented and discussed. The importance of selection of proper centrality window and centrality binwidth correction will be discussed in details. The colliding system may be considered as a thermal system in Grand Canonical Ensemble (GCE) and the multiplicity fluctuations are directly proportional to the isothermal compressibility (k_{\rm T}) via the following equation :
\frac{\sigma^{\rm 2}}{\mu^{\rm 2}} = \frac{k_{\rm B}T}{V}k_{\rm T}
Therefore, it is possible to estimate the value of the isothermal compressibility ($k_{\rm T}$) at the thermal freeze-out (where the elastic processes cease to
occur and the system breaks off into smaller parts) as a
function of T and V following the above equation. The left hand side of
the equation, i.e, the multiplicity fluctuations over mean, can be measured from experiment or from event generators per centrality class at the final-state corresponding to the thermal freeze-out. For a given centrality class it can be assumed that all the events correspond to a system with the same T and V. Earlier, at chemical freeze-out, because of the expansion of the system, the temperature of
the fire ball decreases to a point where the interactions changing the number of particles are ceased. Thus, the inelastic collisions cease to occur.
Therefore, chemical composition of the system is fixed. However, the hadrons produced in the final-state in a heavy ion collision are in thermal as well as
chemical equilibrium. These quantities may be
recalculated at the higher temperature, i.e, at the
chemical freeze-out. Following this procedure, in this work, the estimation of the isothermal compressibility will be presented using the event generators AMPT, UrQMD and EPOS, for a large range of energies (from 7.7 GeV/A to 5.5TeV/A). This is a very interesting work as the isothermal compressibility has been measured first time for high energy heavy ion collision systems. Additionally, the theoretical estimation of the isothermal compressibility will be presented from Hadron Resonance Gas (HRG) model also. A comparison of the values of the isothermal compressibility with the values available for nuclear (lower) energies, water, etc, will also be presented and discussed. This study will help a lot to understand about the collision systems for a large energy range and effects of pressure on the systems. This wil also provide a baseline to study isothermal compressibility in the experiments, i.e, at RHIC and LHC energies.

List of tracks

Freeze-out, hadronisation and statistical models

Authors: MUKHERJEE, Maitreyee (Department of Atomic Energy (IN)); Dr BASU, Sumit (Wayne State University); THAKUR, Sanchari (Department of Atomic Energy (IN)); PRIYAM ADHYA, souvik; Mr CHATTERJEE, Arghya (VECC); Dr CHATTERJEE, Sandeep; Prof. NAYAK, Tapan (CERN)

Presenter: MUKHERJEE, Maitreyee (Department of Atomic Energy (IN))

Session Classification: Parallel BES

Track Classification: Freeze-out, hadronisation and statistical models