Contribution ID: **165** Type: **Poster**

Hydrodynamical analysis of centrality dependence of charged particle's multiplicity in √sNN=2.76 TeV Pb+Pb collision

Ongoing heavy ion collision at Large Hadron Collider, CERN is expected to settle the important issues like the possibility of formation of the lattice QCD predicted strongly interacting nuclear matter known as Quark Gluon Plasma (QGP) and the important issue of thermalization and the time taken by the system to achieve the same. Recently ALICE collaboration [1] measured the centrality dependence of charged particle multiplicity in √sNN=2.76 TeV Pb-Pb collision. The viscous hydro was pretty successful to describe the experimental particle multiplicity and elliptic flow data at RHIC energy, from which the initial condition of the produced medium can also be traced back. We use 2+1D viscous hydrodynamic model to explain the centrality dependence of experimental charged particle multiplicity produced in Pb-Pb √sNN=2.76 TeV collision and obtain the initial condition of the fluid produced. The space time evolution of the fluid is obtained by solving energy momentum conservation along with solving relaxation equation for shear viscous stresses obtained from Israel-Stewart' s 2nd order theory. The conservation equation were closed with an equation of state (EOS) constructed from recent lattice data [2] for QGP phase which undergoes a crossover transition to Hadronic phase (comprising all the resonances below mass 2.5 GeV) at crossover temperature Tco=174 MeV. It was assumed that initial energy density was mostly scaled with number of binary collision and the system freezes out when the temperature at any space-time points reaches Tf=130 MeV. Our study [3] shows that hydrodynamical evolution of QGP fluid, with viscosity to entropy density ratio η/s=1/4π, initialized to central energy density εi =370 GeV/fm3 at initial time τi=0.6 fm/c or initialized to energy density εi =72 GeV/fm3 at initial time τi=1.0 fm/c explains the ALICE data on centrality dependence of charged particle multiplicity. Smaller initial time τi=0.2 fm/c do not reproduce the data. Initial time τi=0.6-1.0 fm/c is also consistent with ALICE measurement of charged particles pT spectra and elliptic flow. We also show that an alternative of hadronic resonance gas, even at the unphysical high temperature of T=220 MeV do not explains the ALICE data.

[1] K Aamodt et al. [The ALICE collaboration], arXiv : 1011.3916
[2] S. Borsanyi et al. JHEP 1011, 077 (2010),[arXiv : 1007.2580[hep-lat]].
[3] A.K.Chaudhuri and Victor Roy, arXiv: 1102.4936 [nucl-th].

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Track Classification: Global and collective dynamics