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Fluid properties of hadron gas produced in relativistic collisions of pp and AA

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The applicability of hydrodynamics to study the space-time evolution of hadronic matter produced in relativistic heavy-ion collisions is one of the outstanding issues. The hadronic matter may be produced initially in the hadronic phase or may appear after a quark-gluon plasma phase produced initially revert to hadronic matter through a phase transition. The Knudsen number (Kn) can be used as an indicator of the degree of thermalization in the system. In this study, we obtain the variation of Kn to study the degree of thermalization in an excluded volume hadron resonance gas model. Kn along with other parameters like Reynolds number (Re) and Mach number (Ma) give insights into the nature of the flow in the system. The dependence of these dimensionless parameters on system size and baryonic chemical potential (μ_B) are studied. The obtained values of the parameters ($Kn << 1$, Ma 1 and $Re >> 1$) indicate the occurrence of compressible inviscid flows at high temperatures close to the QCD phase transition region (T 150—170 MeV). The degree of thermalization of hadron gas estimated is comparable over different system sizes, indicating the applicability of hydrodynamics in interpreting the results from high multiplicity pp to heavy-ion collisions.

Reference: R. Scaria, D. Sahu, C. R. Singh, R. Sahoo and J. Alam, [arXiv:2201.08096 [hep-ph]].

Authors: SCARIA, Ronald; SAHU, Dushmanta (Indian Institute of Technology Indore (IN)); SINGH, Captain Rituraj; SAHOO, Raghunath (Indian Institute of Technology Indore (IN)); Prof. ALAM, Jan-e (Variable Energy Cyclotron Centre)

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