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Energy dependence study of directed flow in Au+Au collisions using an improved coalescence in the AMPT model

Summary

Hydrodynamic models predict that the phenomenon of v_1 slope ($\mathrm{d}v_1/\mathrm{d}y$) of net-baryon changing the sign twice with energy is a signature of first order phase transition [1]. Recent experimental measurement of v_1 in Au+Au collisions at various beam energies measured in STAR gives new insights to understand the collision dynamics and particle production mechanism [2]. The quark coalescence sum rule can be tested by measuring the v_1 slope at mid-rapidity ($\mathrm{d}v_1/\mathrm{d}y|_{y=0}$) of identified hadrons as a function of energy. The scaling behaviour of coalescence sum rule can also be tested with the assumption of that s and $\bar{s}$ flow similarly and so do $\bar{u}$ and $\bar{d}$. The breakdown of this scaling behaviour at lower energies would raise questions about the validity of these assumptions. Hence, model studies are an essential tool to have a better understanding of the experimental results.

We have performed a comprehensive study of v_1 in Au+Au collisions from beam energy $\sqrt{s_{\mathrm{NN}}}$ = 7.7 to 200 GeV using an improved quark coalescence mechanism in a multi-phase transport model [3]. In light of the recent experimental observation of v_1, we have tested the coalescence sum rule to understand the particle production mechanism by measuring the v_1 slope of different hadrons such as Π, K, K^0_S, p, Φ, Λ and Ξ as a function of beam energy in a large rapidity ($|y| < 3$) range. The effect of hadronic re-scattering on the slope of hadrons is also tested using different hadronic cascade time (t_{max}) in the string-melting version of the AMPT model. The s and $\bar{s}$ quarks' slopes are different except at the highest energy. The u, d and s quarks have similar slope but deviate from the trend at lower energies indicating the transported quark dominance in this energy range. The Φ meson shows a positive slope at lower energy like the experimental data, which is similar to baryons.

References:

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