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Effect of strangeness and electric charge on violation of coalescence sum rule by directed flow of hadrons in Au+Au collisions using the AMPT model

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Rapidity-odd directed flow (v_1) of identified hadrons ($\pi^{\pm}$, $K^{\pm}$, p, $\overline{p}$, ϕ, Λ, $\overline{\Lambda}$, $\overline{\Xi}^{+}$, Ω^{-} and $\overline{\Omega}^{+}$) in Au+Au collisions at $\sqrt{s_{NN}}$ = 7.7, 14.5, 27, 54.4 and 200 GeV using the AMPT model with the new quark coalescence is analyzed. A new method to test the Coalescence Sum Rule (CSR) or the Number of Constituent Quark (NCQ) scaling is also proposed by using the v_1 of produced identified hadrons (K^{-}, $\overline{p}$, $\overline{\Lambda}$, ϕ, $\overline{\Xi}^{+}$, Ω^{-} and $\overline{\Omega}^{+}$). The CSR holds for the identical constituent quark combinations of produced hadrons. However, the sum rule is violated for non-identical quarks combination having the same mass but different strange (ΔS) and electric charge (Δq) of the constituent quark. The difference in v_1 of quark and anti-quark obtained from the combination of produced hadrons as a function of rapidity is the measure of CSR violation quantified by the Δv_1-slope, [d(Δv_1)/dy]. The Δv_1-slope as a function of strangeness difference is found to have strong energy dependence, with higher values at lower energies. The finding indicates that CSR is violated the most at low energies and has a strong strangeness dependent unlike the electric charge. The calculation performed by taking the primordial hadrons are consistent with the results of final state hadrons, which suggests that hadron scatterings and resonance decays do not much affect the sum rule. Hence, the coalescence sum rule of produced hadrons is more affected by the strong (QCD) force than the electromagnetic (QED) interaction.

Preferred track

Collectivity & Multiple Scattering

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