Charged kaon and pion femtoscopy in the RHIC Beam Energy Scan at the STAR experiment

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The RHIC Beam Energy Scan (BES) program aims to study the properties of strongly interacting matter in relativistic heavy-ion collisions at various energy densities and temperatures. Correlation femtoscopy technique is a useful tool to study systems undergoing QCD phase transitions, and can extract valuable information about the size, shape, and lifetime of the particle-emitting source in heavy-ion collisions.

This study presents the first comprehensive femtoscopic analysis of identical kaons and pions produced in Au+Au collisions at $\sqrt{s_{NN}}$ = 14.6 - 200 GeV from the RHIC Beam Energy Scan phases I and II, focusing on charge, transverse momentum, and centrality-dependent properties. The charge-dependent analysis reveals differences at the level of correlation functions for both kaons and pions for the first time at these energies. This observation is consistent with Coulomb field effect due to residual charge after the collision and hadronic final state effects, as implemented in UrQMD. The three-dimensional femtoscopic analysis reveals that the extracted radii, assuming Gaussian distribution for emission source, increase with collision energy, decrease with transverse mass, and are generally larger for kaons compared to pions under the same conditions. The study compares experimental data with different model scenarios and discusses the implications of the trend of the extracted size and lifetime of the particle source with the change of collision energy.

An analysis of one-dimensional two-pion and two-kaon correlations in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV, utilizing Lévy-stable distributions for the source shapes, is also presented. The current analysis status of the extracted Lévy source parameters, including their dependence on average transverse mass and centrality, is reported. A comparison of the pion and kaon Lévy exponent is presented, potentially shedding light on the deviation from the Gaussian approximation of the emission source. The obtained results are compared to UrQMD and EPOS model calculations.