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Bose–Einstein Correlations of Charged Pion and Kaon Pairs at RHIC Energies Using the UrQMD and SMASH+vHLLE Models

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Two-particle femtoscopy via Bose–Einstein correlations (BEC) provides direct access to the space–time structure of particle-emitting sources in relativistic heavy-ion collisions. In this study, we present a systematic analysis of BEC for identical charged pion and kaon pairs in Au+Au collisions at Relativistic Heavy Ion Collider (RHIC) energies. Model calculations were performed using the purely hadronic transport approach of the Ultrarelativistic Quantum Molecular Dynamics (UrQMD) model and the hybrid SMASH+vHLLE framework, which combines viscous hydrodynamics with a hadronic afterburner.

Correlation functions were constructed in the longitudinally co-moving system (LCMS) and fitted assuming a Gaussian source to extract femtoscopic radii (R_{out}, R_{side}, R_{long}) and correlation strengths. The beam energy, pair transverse momentum, and centrality dependencies of these radii are compared between the models and with available experimental data from the STAR Collaboration. The results demonstrate the sensitivity of $R_{\text{out}}/R_{\text{side}}$ and $R^2_{\text{out}} - R^2_{\text{side}}$ to the underlying collision dynamics, in particular to the presence or absence of a hydrodynamic phase. Differences between pions and kaons highlight the role of hadronic rescattering and resonance decays in shaping the femtoscopic observables.

Our findings contribute to ongoing efforts to constrain the space–time evolution of the medium created in heavy-ion collisions and to probe the nature of the QCD phase transition at RHIC energies.

Authors: ALPATOV, Egor (National Research Nuclear University MEPhI); KOROBITSIN, Artem (Joint Institute for Nuclear Research, National Research Nuclear University MEPhI); KRAEVA, Anna (National Research Nuclear University MEPhI); MIKHAYLOV, Konstantin (ITEP, JINR, MEPhI); POVAROV, Alexey (National Research Nuclear University MEPhI)

Presenter: KOROBITSIN, Artem (Joint Institute for Nuclear Research, National Research Nuclear University MEPhI)

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