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First indication on self-similarity of strangeness production in $Au + Au$ collisions at RHIC and critical phenomena in nuclear matter

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The general concept of the z-scaling based on fundamental principles of self-similarity, locality, and fractality of strange and non-strange particle production in $p + p$ and $Au + Au$ systems at high energies is discussed. We present new results of analysis of K^0_S- meson spectra in $Au + Au$ collisions obtained by the STAR Collaboration at RHIC using the z-scaling approach. The analyzed spectra were measured over a wide range of collision energy $\sqrt{s_{NN}} = 7.7 - 200$ GeV and transverse momentum of produced particles for different centralities in the rapidity range $|y| < 0.5$. The scaling behavior of the spectra in z-presentation as a function of the collision energy and centrality is demonstrated. The energy loss in dependence on the energy and centrality of the collisions and transverse momentum of the produced particle is estimated. New indication on self-similarity of fractal structure of nuclei and fragmentation processes with K^0_S-mesons produced in $Au + Au$ collisions at RHIC is obtained.

The notion of "scaling" (or scaling universality) has special importance in critical phenomena. The universality hypothesis reduces the great variety of physical situations to a small number of universality classes, which depend only on few parameters (critical exponents). The self-similarity and fractality of strange hadron production in $Au+Au$ collisions are expressed in terms of the z-scaling parameters which are fractal dimensions of the interacting structures and specific heat of the produced medium. Close to a critical transition point, the collective cooperative phenomena become independent of the microscopic details of the considered system and the scaling behavior should be sensitive to a change of these parameters.

The obtained results can be useful in search of signatures of a phase transition and critical point with strange probes and can serve as a benchmark for complex analysis of self-similar features of strange production in heavy ion collisions.

Preferred track

Collectivity & Multiple Scattering

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