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Anomaly of Entropy of Nuclear Medium Probed by KS0 Mesons Produced in Au+Au Collisions at RHIC

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The data [1] on spectra of K^0_S mesons measured by the STAR Collaboration in $\mathrm{Au}+\mathrm{Au}$ collisions at various centralities characterized by different multiplicity densities of negative particles were analyzed in the z-scaling approach [2,3]. The transverse momentum distributions obtained in the BES-I program at RHIC were accumulated in seven centrality classes from the most central $(0-5)\%$ to peripheral $(60-80)\%$collisions in the rapidity range $|y|<0.5$. These data and the earlier STAR data at $\sqrt{s}_{NN}=62,130$ and 200 GeV allow us a detail study of the energy and centrality dependence of K^0_S-meson production in a wide range of $\sqrt{s}_{NN}=7.7$–200 GeV. The entropy of the microscopic configurations accompanied of K^0_S-meson production in $\mathrm{Au}+\mathrm{Au}$ collisions, is constructed. It is expressed, in the z-scaling approach, via the momentum fractions of colliding particles and scattered constituents fragmented to produced particles, the structural and fragmentation fractal dimensions, the multiplicity density of negative particles and model parameter c_{AuAu} interpreted as a specific heat of produced medium. The irregularity in the behavior of the specific heat parameter c_{AuAu} was connected in [4] with existence of a phase transition in nuclear matter. The dependence of the entropy S on the collision energy $\sqrt{s}_{NN}$ over the range $7.7-200$ GeV for most central $(0-5)\%$ and peripheral $(60-80)\%$ events was studied as a function of transverse momentum of produced of K^0_S-meson. It was found that the values of the entropy in peripheral collisions at low $\sqrt{s}_{NN}$ are much smaller than in the central ones. Non-trivial dependence of S on the collision energy with decreasing p_T was found. The entropy reaches a local maximum at the energy $\sqrt{s}_{NN}=11.5-19.6$ GeV for $p_T=0.3$ GeV/c. This is followed by an abrupt fall of S at $\sqrt{s}_{NN}=27-39$ GeV with a gradual increase at higher energies. Such anomalous behavior is also visible at $p_T=0.6$ and 1.0 GeV/c in the same energy range. At higher $p_T\geq$2 GeV/c, the entropy S becomes a monotonously increasing function of the collision energy and the observed anomaly of S disappears. The monotonic growth of S is seen for all p_T in the peripheral collisions.

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