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Nuclear Experiment

Probing the QCD Critical Point with Higher Moments of Net-proton Multiplicity Distributions

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(Submitted on 15 Jun 2011)

Higher moments of event-by-event net-proton multiplicity distributions are applied to search for the QCD critical point in the heavy ion collisions. It has been demonstrated that higher moments as well as moment products are sensitive to the correlation length and directly connected to the thermodynamic susceptibilities computed in the Lattice QCD and Hadron Resonance Gas (HRG) model. In this paper, we will present measurements for kurtosis (κ), skewness (S) and variance (σ^{2}) of net-proton multiplicity distributions at the mid-rapidity ($|y|<0.5$) and $0.4<p_{T}<0.8$ GeV/c for Au+Au collisions at $\sqrt{s_{NN}}$=19.6, 39, 62.4, 130 and 200 GeV, Cu+Cu collisions at $\sqrt{s_{NN}}$=22.4, 62.4 and 200 GeV, d+Au collisions at $\sqrt{s_{NN}}$=200 GeV and p+p collisions at $\sqrt{s_{NN}}$=62.4 and 200 GeV. The moment products $\kappa \sigma^{2}$ and $S \sigma$ of net-proton distributions, which are related to volume independent baryon number susceptibility ratio, are compared to the Lattice QCD and HRG model calculations. The $\kappa \sigma^{2}$ and $S \sigma$ of net-proton distributions are consistent with Lattice QCD and HRG model calculations at high energy, which support the thermalization of the colliding system. Deviations of $\kappa \sigma^{2}$ and $S \sigma$ for the Au+Au collisions at low energies from HRG model calculations are also observed.

Comments:	10 pages, 8 figures, Proceedings of 27th Winter Workshon on Nuclear Dynamics. Feb. 6-13 (2011)
Subjects:	**Nuclear Experiment (nucl-ex)**; High Energy Physics - Experiment (hep-ex); High Energy Physics - Lattice (hep-lat); High Energy Physics - Phenomenology (hep-ph); Nuclear Theory (nucl-th)
Journal reference:	J. Phys.: Conf. Ser. 316, 012003 (2011)
DOI:	10.1088/1742-6596/316/1/012003
Cite as:	**arXiv:1106.2926 [nucl-ex]**
	(or **arXiv:1106.2926v1 [nucl-ex]** for this version)

Submission history

From: Luo Xiao-Feng [view email]
[v1] Wed, 15 Jun 2011 10:21:42 GMT (769kb)

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