V Workshop on Particle Correlations and Femtoscopy

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Multiplicity fluctuations as signature of the temperature fluctuations

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Recently experiments in high-energy nuclear collisions have observed fluctuations of multiplicity which exhibit spectacular and unexpected features as functions of the
number of participants (in particular they show that the scaled variance of the multiplicity distribution, Var(N)/<N>, increases when proceeding from the central towards peripheral collisions, i.e., when the number of participants decreases. None of the present models can account for the experimental results. In [1] we have described the observed behavior without resorting to any specific dynamical picture but, instead, by attributing it to some nonstatistical,intrinsic fluctuations existing in a hadronizing system produced in high energy heavy ion collisions. To account for such fluctuations we propose to use a special version of statistical model based on nonextensive Tsallis statistics in which fluctuations of the temperature are known to be directly connected with the nonextensivity parameter q, with |q-1| being a direct measure of fluctuations, namely
q = 1 + Var(1/T)/<1/T>ˆ2
(in the limit of vanishing fluctuationsfor, q -> 1, one recovers the usual Boltzmann-Gibbs statistical approach [2]). We evaluate the nonextensivity parameter q and its dependence on the hadronizing system size from the experimentally observed collision centrality dependence of the mean multiplicity, <N>, and its variance,
Var(N). We attribute the observed system size dependence of q to the finiteness of the hadronizing source with q = 1 corresponding to an infinite, thermalized source with a fixed temperature, and with q > 1 (which is observed) corresponding to a finite source in which both the temperature and energy fluctuate. The possible fate of such fluctuations at LHC energies is discussed.

[1] G.Wilk and Z.Wlodarczyk, Phys. Rev. C79 (2009) 054903.

[2] G.Wilk and Z.Włodarczyk, Eur. Phys. J. A40 (2009) 299.

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