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The Chiral Criticality in the Probability Distribution of Conserved Charges

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Statistical fluctuations of the net baryon number and electric charge have been regarded as an excellent diagnostic tool of the chiral phase transition in QCD and in heavy ion collisions [1]. While the second order cumulant exhibits divergence at the critical endpoint, the higher order cumulants can reveal remnants of the $O(4)$ criticality at the chiral crossover [2].

We will discuss criticality in the probability distribution of conserved charges close to the chiral transition. We calculate the probability distribution of the net baryon number $P(N_B)$ in the chiral quark-meson model within the functional renormalization group method, and compare its properties to the non-critical Skellam function [3,4].

We will show, that the ratio of $P(N_B)$ to the Skellam distribution exhibits a characteristic narrowing which is due to remnants of the $O(4)$ chiral transition [4].

We will apply the above analysis to the experimental data measured by STAR collaboration, and show that STAR data taken at the most central events exhibit a similar narrowing as found in the model calculations [4].

We will indicate a relevant reference distribution for the net electric charge fluctuations. We show that the binomial and negative binomial distribution cannot account for the characteristic behavior seen in the chiral transition, and that due to quantum statistics and multi-charged particle contribution, the Skellam distribution is also not a correct baseline for the recent STAR data on fluctuations of the electric charge [4].

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Author: Dr MORITA, Kenji (Frankfurt Institute for Advanced Studies)

Co-authors: FRIMAN, Bengt (GSI); Prof. REDLICH, Krzysztof (University of Wroclaw)

Presenter: Dr MORITA, Kenji (Frankfurt Institute for Advanced Studies)

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