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CUMULANTS C_n OF THE CHIRAL ORDER PARAMETER IN A NONEQUILIBRIUM CHIRAL BJORKEN MODEL NEAR THE QCD CRITICAL POINT

To understand experimentally obtained net-proton number cumulants in the search for the QCD critical point, we study a dynamical model based on an effective quark-meson Lagrangian with chiral symmetry. We investigate the evolution of the expanding medium created in a heavy-ion collision using a spatially homogeneous fluid and a time-dependent order parameter, the sigma field evolved by a Langevin equation. We extract cumulants of the sigma field along a parametrized freeze out curve and match the obtained freeze out points to corresponding beam energies. These cumulants are related to cumulants of the net-baryon number through the sigma-nucleon coupling to provide a qualitative comparison to experimental data from STAR's beam energy scan program. We find a skewness that is increasing monotonically with beam energy and nonmonotonic behavior of the effective kurtosis attributed to the presence of a critical region in the underlying model. We furthermore demonstrate that the presence of the spinodal or mixed phase region around the first-order chiral phase transition allows for a wide interval of cumulants at the lowest beam energies.

Author: SAIKHAM, poramin (sut)

Co-author: HEROLD, Christoph (Suranaree University of Technology)

Presenter: SAIKHAM, poramin (sut)

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