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Recent results from proton intermittency analysis in nucleus-nucleus collisions from NA61 at CERN SPS

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The search for experimental signatures of the critical point (CP) of strongly interacting matter is one of the main objectives of the NA61/SHINE experiment at CERN SPS. In the course of the experiment, an energy (beam momentum 13A –150A GeV/c) and system size (p+p, p+Pb, Be+Be, Ar+Sc, Xe+La) scan is performed.

We investigate local proton density fluctuations connected to the critical behavior of the order parameter as a possible signature of the phase transition in the neighborhood of the CP. To this end, we perform an intermittency analysis of the proton second scaled factorial moments (SSFMs) in transverse momentum space, which we expect to scale according to a universal power-law in the vicinity of the CP.

Previous analyses of this sort revealed significant power-law fluctuations in the NA49 heavy ion collision experiment for the “Si”+Si system at 158A GeV/c; no intermittency was observed in NA49 “C”+C and Pb+Pb collisions at the same energy, nor in NA61/SHINE Be+Be collisions at 150A GeV/c. The fitted power-law exponent in “Si”+Si was consistent with the theoretically expected critical value, within errors, a result suggesting a baryochemical potential for the critical point in the vicinity of ˜250 MeV. We now extend the analysis to the similar-sized NA61/SHINE Ar+Sc system at 150A GeV/c.

In the calculation of scaled factorial moments, statistical techniques are employed in order to subtract non-critical background and enhance the signal in cases of low statistics. Our analysis is supplemented by both critical and non-critical Monte Carlo simulations, through which we estimate non-critical background effects on the quality and magnitude of uncertainties of the intermittency power-law fit, as well as explore the possibility of non-critical effects producing a spurious intermittency signal.

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