Contribution ID: **253** Type: **Poster**

Intermittency analysis of proton density as a probe for the critical point of strongly interacting matter in NA61/SHINE

Tuesday, 15 May 2018 19:10 (30 minutes)

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 the CERN SPS. In the course of the experiment, an energy (beam momentum 13A – 150/158A GeV/c) and system size (p+p, p+Pb, Be+Be, Ar+Sc, Xe+La) scan is performed. Proposed observables include non-monotonic fluctuations of integrated quantities, as well as local critical fluctuations connected to the critical behavior of the order parameter in the CP neighborhood, which scale according to universal power-laws.

Proton density fluctuations are investigated as a possible order parameter of the phase transition in the neighborhood of the CP by performing an intermittency analysis of the proton second scaled factorial moments (SSFMs) in transverse momentum space. A previous analysis of this kind [1] revealed significant power-law fluctuations in the NA49 heavy-ion collision experiment for the Si+Si system at 158A GeV/c. The fitted power-law exponent was consistent with the theoretically expected critical value within uncertainties, a result suggesting a baryochemical potential for the critical point in the vicinity of ˜250 MeV.

The intermittency analysis is extended to systems of intermediate size as studied by NA61/SHINE, the primary candidates being the Be+Be and Ar+Sc systems at 150A GeV/c. Statistical techniques are developed for the calculation of scaled factorial moments which allow to subtract non-critical background and enhance the signal in case of low statistics. The analysis is supplemented by both critical and non-critical Monte Carlo simulations, by which one can 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 an intermittency signal.

References

[1] T. Anticic *et al*, Eur. Phys. J. C **75**: 587 (2015).

Content type

Experiment

Collaboration

NA61/SHINE

Centralised submission by Collaboration

Presenter name already specified

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Session Classification: Poster Session

Track Classification: Phase diagram and search for the critical point