Contribution ID: **699** Type: **Parallel talk**

Searching for the critical point of strongly interacting matter in nucleus-nucleus collisions at CERN SPS

Saturday 13 July 2019 11:30 (18 minutes)

One of the primary goals of the NA61/SHINE experiment at CERN SPS is the detection of the critical point (CP) of strongly interacting matter. In the interests of this search, an energy (beam momentum 13A –150A GeV/c) and system size (p+p, p+Pb, Be+Be, Ar+Sc, Xe+La) scan is being performed.

A number of observables are being considered as possible signatures of the CP. These include non-monotonic fluctuations of strongly intensive variables ($\Delta[p_T, N]$, $\Sigma[p_T, N]$), which so far show no prominent CP-related structures; and local fluctuations of the proton density, which are especially suited for the task, being connected to the critical behavior of the chiral phase transition order parameter in the neighborhood of the CP. In particular, proton density fluctuations are probed by means of an intermittency analysis of the proton second scaled factorial moments (SSFMs) in transverse momentum space, expected by universality theory to scale as a power-law in the vicinity of the CP.

A previous analysis of this sort probed a number of NA49 heavy ion collisions of different size [1]; significant power-law fluctuations were observed in "Si"+Si collisions at 158A GeV/c, with a power-law exponent consistent with the theoretically expected critical value, within uncertainties. Recently, NA61/SHINE Be+Be collisions at 150A GeV/c were similarly probed, yielding a negative result.

We now extend the analysis to NA61/SHINE Ar+Sc collisions at 150A GeV/c. The system size and freeze-out baryochemical potential are similar to NA49 "Si"+Si, and preliminary analysis suggests the presence of intermittency. We employ statistical techniques in order to subtract non-critical background present in factorial moments and enhance the signal in cases of low statistics. Through combined use of critical and background Monte Carlo simulations, we assess the quality and statistical significance of the observed intermittency effect.

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

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Session Classification: Heavy Ion Physics

Track Classification: Heavy Ion Physics