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Spinodal enhancement of fluctuations in nucleus-nucleus collisions (remote)

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Subensemble Acceptance Method (SAM) [1,2] is an essential link between measured event-by-event fluctuations and their grand canonical theoretical predictions such as lattice QCD. The method allows quantifying the global conservation law effects in fluctuations. In its basic formulation, SAM requires a sufficiently large system such as created in central nucleus-nucleus collisions and sufficient space-momentum correlations. Directly in the spinodal region of the First Order Phase Transition (FOPT) different approximations should be used that account for finite size effects. Thus, we present the generalization of SAM applicable in both the pure phases, metastable and unstable regions of the phase diagram [3]. Obtained analytic formulas indicate the enhancement of fluctuations due to crossing the spinodal region of FOPT and are tested using molecular dynamics simulations. A rather good agreement is observed. Using transport model calculations with interaction potential we show that the spinodal enhancement of fluctuations survives till the later stages of collision via the memory effect [4]. However, at low collision energies the space-momentum correlation is not strong enough for this signal to be transferred to second and third order cumulants measured in momentum subspace. This result agrees well with recent HADES data on proton number fluctuations at $\sqrt{s_{NN}} = 2.4$ GeV which are found to be consistent with the binomial baseline of non-interacting hadrons [5]. It indicates that the large fluctuations observed in HADES data do not signal the presence of phase transition and their origin is yet to be identified. We suggest a crosscheck of this picture based on calculating the correlation between proton multiplicities in two non-overlapping rapidity intervals.

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[2] R.P. et al., Phys. Rev. C 102 (2020) 024908.

[3] V.Kuznietsov, O.Savchuk, R.P., V.Vovchenko, M.I.Gorenstein, H.Stoecker, 2303.09193 (2023)

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[5] O.Savchuk, R.P., M.I.Gorenstein, Phys.Lett.B 835 (2022) 137540

Category

Theory

Collaboration (if applicable)

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