Contribution ID: **282** Type: **Oral**

Location of the QCD critical point predicted by holographic Bayesian analysis

Tuesday 5 September 2023 09:50 (20 minutes)

Predictions for the QCD critical point are made using Bayesian inference techniques within the holographic gauge/gravity correspondence. For that, we employ a Einstein-Maxwell-Dilaton (EMD) model capable of reproducing the latest lattice QCD results at zero and finite baryon density, known to predict a high-density critical endpoint. For the first time, we numerically find the posterior probability distribution for holographic model parameters from the lattice data at zero chemical potential, and extract their most likely values. This is possible thanks to new numerical developments which, by boosting the performance of our calculations, allow us to sample a large number of fits to the data via Monte Carlo methods. Thus, we find the maximum a posteriori estimate for the location of the critical point, as well as estimates for the corresponding statistical error bands. We determine the linear combination of model parameters which is the most relevant for these uncertainties and investigate its role for the equation of state at lower densities. Our analysis is performed for two competing model parametrizations, one of which may or may not present a critical point for samples of the prior distribution. We use the posterior distribution for this parametrization to infer the probability that a QCD critical point exists and is situated in a region of the phase diagram that can be probed by ongoing and future heavy ion collision experiments. Preliminary results favor a critical point around a baryon chemical potential of $570 - 650$ MeV and a temperature of $99 - 107$ MeV, with most of the uncertainty concentrated along a single line.

Category

Theory

Collaboration (if applicable)

MUSES

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Session Classification: Critical Point

Track Classification: Critical point searches