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Using active learning to constrain the size and location of the QCD critical point

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The BEST collaboration's equation of state (EoS) maps a 3D Ising model onto the lattice QCD EoS but contains 4 free parameters related to the size, location, and spread of the critical region across the QCD phase diagram. However, certain combinations of those 4 free parameters lead to acausal ($c_s^2 > 1$) or unstable ($\chi_2^B < 0$) realizations of the EoS that should not be considered. Here, we use an active learning framework to rule out pathological EoS efficiently. We show that checking stability and causality for a small fraction of the available parameter combinations is sufficient to produce algorithms that perform with >96% accuracy across the entire parameter space. Though we work with a specific case, this approach can be generalized to any model containing a parameter space-class correspondence.

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