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Lattice QCD with an inhomogeneous magnetic field background

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The magnetic fields generated in non-central heavy-ion collisions are among the strongest fields produced in the Universe, reaching magnitudes comparable to the scale of the strong interactions. Backed by model simulations, the resulting field is expected to be spatially modulated, deviating significantly from the commonly considered uniform profile. In this work, we present the next step to improve our understanding of the physics of quarks and gluons under extreme conditions by using lattice QCD simulations with $2+1$ staggered fermions with physical quark masses and an inhomogeneous magnetic background for a range of temperatures covering the QCD phase transition. We apply a field with strength given by a $1/\cosh^2$ function and analyze the impact on the computed observables and on the transition. We study the physics of the QCD medium by calculating local chiral condensates, Polyakov loops, electric currents and perform the continuum limit extrapolation. We find that the observables show non-trivial spatial features due to the interplay between the sea and the valence effects, especially around the critical temperature.

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