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Locating the QCD critical point via contours of constant entropy density

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We present a new method to investigate the existence and location of the conjectured high-temperature critical point of strongly interacting matter via contours of constant entropy density [1]. By approximating these lines as a power series in the baryon chemical potential μ_B, one can extrapolate them from first-principle results at zero net-baryon density, and use them to locate the QCD critical point, including the associated first-order and spinodal lines. As a proof of principle, we employ currently available continuum-extrapolated first-principles results from the Wuppertal-Budapest collaboration to find a critical point at a temperature and a baryon chemical potential of $T_c = 114.3 \pm 6.9$ MeV and $\mu_{B,c} = 602.1 \pm 62.1$ MeV, respectively, at expansion order $\mathcal{O}(\mu_B^2)$. We advocate for a more precise determination of the required expansion coefficients via lattice QCD simulations as a means of pinpointing the location of the critical endpoint in the phase diagram of strongly interacting matter.

[1] H. Shah, M. Hippert, J. Noronha, C. Ratti and V. Vovchenko,
"Locating the QCD critical point from first principles through contours of constant entropy density", arXiv:2410.16206 [hep-ph]

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