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Complex spectrum of spin models for finite-density QCD

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We consider the spectrum of transfer matrix eigenvalues associated with Polyakov loops in lattice QCD at strong coupling. The transfer matrix at finite density is non-Hermitian, and its eigenvalues become complex as a manifestation of the sign problem. We show that the symmetry under charge and complex conjugations ensures that the eigenvalues are either real or part of a complex conjugate pair, and the complex pairs lead to damped oscillatory behavior in Polyakov loop correlation functions, which also appeared in our previous phenomenological models using complex saddle points. We argue that the results reflect oscillatory behavior in color-charge densities and it should be observable in lattice simulations of QCD at finite density.

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