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Complex spectrum of QCD at finite density

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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 global symmetries of finite-density QCD ensure that the complex eigenvalues are part of a complex conjugate pair, and they lead to sinusoidally modulated decay in Polyakov loop correlation functions. We argue that the results reflect oscillatory behavior in color-charge densities reminiscent of density-density correlation functions in liquids, and it is generic in spin models for QCD at finite density, as well as phenomenological models using complex saddle points.

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