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Surprising phase structures for Wilson and twisted mass fermions

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The existence of the Aoki phase is one of the new structures of the phase space in lattice QCD when introducing Wilson fermions. It is expected that the Aoki phase may have also an impact on Wilson fermions at finite chemical potential. I am going to present new results on these phase space structures for Wilson fermions in a two-flavor theory with a finite real as well as imaginary iso-spin chemical potential. These new structures are manifested in the lowest eigenvalues of the Dirac operator. I am going to point out what the order parameters of these new phases are and to answer the question on the analytic continuation of the chemical potential. Since the Wilson Dirac operator at finite iso-spin chemical potential is unitarily equivalent to the twisted mass Dirac operator for two flavors, the spectrum and, hence, the phase diagram applies to this kind of fermions, too.

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