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Kernels and integration cycles in complex Langevin simulations

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The complex Langevin method is an approach to solve the sign problem based on a stochastic evolution of the dynamical degrees of freedom. In principle, it solves the sign problem by trading the complex path integral weight for a real probability distribution in complexified field space. However, due to the complexification, the stochastic evolution sometimes converges to an equilibrium distribution that produces incorrect results for observables. This wrong convergence can be partially explained by the appearance of boundary terms, which spoil the formal proof of correctness of the method. The introduction of a kernel into the complex Langevin equation can prevent the emergence of boundary terms, but this on its own does not guarantee correct convergence. Indeed, the results may still be affected by unwanted so-called integration cycles, which are certain integration paths in complexified field space that might be sampled in a complex Langevin simulation. In this talk, we explore the relation between a kernel and the relevant integration cycles using simple toy models.

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