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A novel density of state method for complex action system

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Recently, a new and efficient algorithm (the LLR method) has been proposed for computing density of states in statistical systems and gauge theories. In this talk, we explore whether this novel density of state method can be applied to numerical computations of observables in systems for which the action is complex. To this purpose, we introduce a generalised density of states, in terms of which integrals of oscillating observables can be determined semi-analytically, and we define a strategy to compute it with the LLR method. As a case study, we apply these ideas to the Z(3) spin model at finite density, finding a remarkable agreement of our results for the phase factor with those obtained with the worm algorithm for all explored chemical potentials, including values for which there are cancellations over sixteen orders of magnitudes. These findings open new perspectives for dealing with the sign problem on physically more relevant systems.

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