

## Reweight-annealing method: from free energy to quantum entanglement

Calculating normalizing factors or generalized partition functions in quantum Monte Carlo simulations is a fundamental problem throughout many scientific and statistical scenarios. Here, in the framework of stochastic series expansion, we present an efficient scheme based on reweighting and importance sampling to calculate generalized partition functions. We prove that our scheme requires polynomial complexity. More importantly, it can be used to evaluate not only the free energy and thermal entropy, but entanglement entropy and entanglement negativity, thus it has wide applications in quantum many-body physics.

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