Mixing Time of Sampling Gibbs States of Strongly Interacting Quantum Systems

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Algorithmically sampling the statistical Gibbs distribution of states of a physical system is a computational task of outstanding importance with applications ranging from medicine and materials science to fundamental research. Recently, some breakthrough works have generalised the well-known Metropolis-Hastings classical algorithm to give an efficiently implementable quantum algorithm for sampling Gibbs states [1-3]. Not only are these quantum Gibbs samplers of a fundamental importance, but also they provide practical use cases for future quantum computers.

In our work, we develop a tensor network code to provide an efficient numerical estimate of the mixing time of the Gibbs sampler reported in Ref. [3], that is, the time scale of convergence to the Gibbs state. We employ our code to study the performance of the Gibbs sampler algorithm applied to paradigmatic strongly correlated models, and suggest optimal choices of parameters to achieve fast convergence. These numerical calculations are supported with analytical ones in the weakly interacting limit with the mathematical framework of Refs [4,5]. Our results shed light on the possibility of studying strongly correlated systems *via* Gibbs samplers, which will likely be an important task for future quantum computers.

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