Quantum Gibbs Sampling

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Quantum computers promise to solve classically intractable quantum simulation problems. Accordingly, a plethora of quantum algorithms have been developed for simulating quantum dynamics. Until recently, we still lacked a go-to method for simulating quantum equilibrium properties. For classical systems, the analogous problem of sampling from thermal distributions was addressed by Markov Chain Monte Carlo (MCMC) methods.

Here, I will resent an efficient quantum algorithm for quantum thermal simulation exhibiting the key distinguishing features of MCMC: detailed balance, locality, and a direct connection to the open system dynamics of weak coupling to a Markovian thermal bath. This construction, in a sense culminate several decades of work on quantum Gibbs sampling methods, by finally putting it on solid conceptual and mathematical footing.

Finally, I will review some of the milestones leading up to this work and discuss what we might expect in the future.