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### **Non-equilibrium Monte Carlo: Sampling with Irreversible Markov Chains**

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Markov Chain Monte Carlo (MCMC) algorithms are ubiquitous across different fields of physics. They are an invaluable numerical tool for studies of complex many body problems, critical phenomena etc. Yet often their convergence rates for real systems are slow. MCMC algorithms are used to create realizations of the desired physical system in its steady state. Most implementations of MCMC use Markov Chains that obey detailed balance, even though this not a necessary requirement for converging to a steady state. I plan to overview several examples that utilize irreversible Markov Chains, where violating detailed balance has improved the convergence rate. Finally I will pose some open questions and discuss attempts to use non-equilibrium dynamics for efficient sampling. Potential applications of such algorithms are numerical studies of phase transitions, soft matter dynamics, protein structures, granular media etc.