



Snack &

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### **Towards (spin) coherent resolutions of the sign problem: Lefschetz thimble quantum Monte Carlo for spin systems**

**Monday, April 3, 2023 | 12:30-1:30PM | 3301 Exploratory Hall / Zoom**

#### Abstract

Monte Carlo simulations are useful tools for modeling quantum systems, but in some cases they suffer from a sign problem, where cancellations between negative and positive weights when evaluating quantities leads to an exponential slow down in their convergence. While solving the sign problem is generically NP-hard, many techniques exist for mitigating the sign problem in specific cases. In this talk, I will describe one such method: the so-called Lefschetz thimble approach, where one deforms the Monte Carlo simulation's plane of integration, seeking a complex hypersurface of stationary phase. This approach has seen significant success in the context of quantum field theory and I will describe how to port this methodology to spin systems by utilizing spin coherent state path integrals to re-express the spin system's partition function in terms of continuous variables. While we are able to demonstrate the success of these methods for mitigating the sign problem in toy spin systems, a number of issues arise related to the uncontrolled approximations made in the standard spin coherent path integral. I will comment on our current work aimed at addressing these problems and raise a number of related open questions that I think are of interdisciplinary interest and worthy of further investigation. Based on: Phys. Rev. B 106, 214416 (2022)

**Zoom link:** <https://go.gmu.edu/qcseminar>

#### About the Seminar Series

The Quantum Computing Seminar Series are a series of working seminars organized and hosted by QSEC's quantum computing subgroup on Mondays. These events are free and open to the public. More information is available on QSEC's Computing Events and Mathematical Sciences Department's Quantum Computing Seminars. For any questions, contact [qsec@gmu.edu](mailto:qsec@gmu.edu).

**Light snacks and coffee will be provided at the beginning of the seminar.**