Doctoral Dissertation Defense

Department of Chemistry, Johns Hopkins University

# Quantum Materials by and for Quantum Computing: A Defects-Oriented Approach

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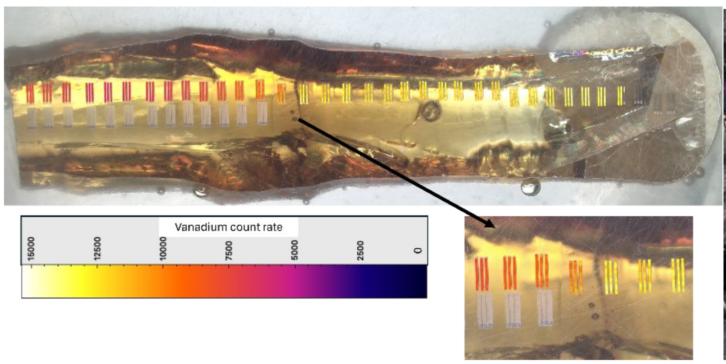
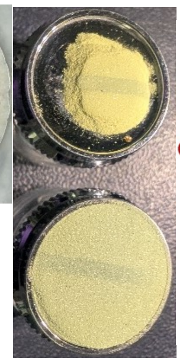
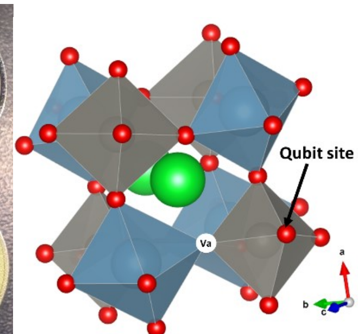
Advisor: Tyrel M. McQueen

9:00 AM EST, Thursday, August 14th, 2025

In person: Bloomberg 475. Zoom: 913 8764 4925 (passcode: defects)






Abstract: Quantum computers have the potential to revolutionize many aspects of science, including research into so-called quantum materials. These materials have properties which rely heavily on quantum mechanical phenomena within them which make them difficult to study in sufficient detail with conventional computing. However, current state-of-the-art quantum computers are limited by high noise, small size, and poor qubit connectivity. This talk will detail efforts to advance quantum computing technology through the development of new qubit-host materials as well as a project to use near-term, limited quantum computers to simulate already-existing quantum materials. In both investigations, the influence of defects and disorder on the materials under study will be discussed.

Publications:

Bernier, S., Bassen, G., Brem Matthew, Tolj, D., Simmons, Q., & McQueen, T. M. (2025). “A Crystallographic Metric for Continuous Quantification of Unit Cell Deformation”. Submitted to *Journal of Applied Crystallography*. https://doi.org/10.48550/arXiv.2508.01177

Bernier, S., Sinha, M., Pearson, T. J., Sushko, P. V., Oyala, P. H., Siegler, M. A., Adam Phelan, W., Neill, A. N., Freedman, D. E., & McQueen, T. M. (2025). “Symmetry-mediated quantum coherence of $W^{5+}$ spins in an oxygen-deficient double perovskite”. *Npj Quantum Materials*, **10**(1), 62. https://doi.org/10.1038/s41535-025-00782-3