Thomas Steckmann

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Education

University of Maryland, College Park: Physics Ph.D. Student — College Park, MD
Lanczos Fellow, Joint Center for Quantum Information and Computer Science (QuICS) — *Aug. 2022 – 2027 (Expected)*
***Research Advisors**: Alexey Gorshkov and Michael Gullans*

North Carolina State University (NCSU): *4.0 GPA - Physics B.S.* | *Mathematics B.S.* — Raleigh, NC
Park Scholarship, University Honors; Math Honors; Sigma Pi Sigma; Phi Beta Kappa — *Aug. 2018 – May 2022*

Research Interests

Theoretical physicist focused on developing and analyzing quantum algorithms for resource-limited, noisy quantum computers. Research bridges the gap between hardware architecture and algorithmic performance by creating hardware-aware strategies for error mitigation, noise characterization, and efficient Hamiltonian simulation. Core interests include optimizing analog and digital quantum protocols to leverage device-specific structure for practical advantage.

Publications and Featured Presentations

Publications:

- **Thomas Steckman**, De Luo, Yu-Xin Wang, Sean R Muleady, Alireza Seif, Christopher Monroe, Michael J Gullans, Alexey V Gorshkov, Or Katz, and Alexander Schuckert. "Error mitigation of shot-to-shot fluctuations in analog quantum simulators," (July 2025) arXiv:2506.16509
- Norman Hogan, Efekan Kökcü, **Thomas Steckmann**, Liam P Doak, Carlos Mejuto-Zaera, Daan Camps, Roel Van Beeumen, Wibe A de Jong, and AF Kemper. "A quantum computing approach to efficiently simulating correlated materials using impurity models and dynamical mean field theory," (August 2025) arXiv:2508.05738
- **Thomas Steckmann**, Trevor Keen, Efekan Kökcü, Alexander F. Kemper, Eugene F. Dumitrescu, and Yan Wang, "Mapping the metal-insulator phase diagram by algebraically fast-forwarding dynamics on a cloud quantum computer," (June 2023) Physical Review Research (Open Access)
- **Thomas Steckmann**, Indunil Angunawela, Somayeh Kashani, Youqin Zhu, Masrur M. Nahid, Harald Ade, and Abay Gadisa. "Ultrathin P(NDI2OD-T2) Films with High Electron Mobility in Both Bottom-Gate and Top-Gate Transistors." (March 2022) *Advanced Electronic Materials*.
- Efekan Kökcü, **Thomas Steckmann**, JK Freericks, Eugene F. Dumitrescu, and Alexander F. Kemper, "Fixed Depth Hamiltonian Simulation via Cartan Decomposition," (August 2022) Physical Review Letters (available on arXiv).

Software:

- **Thomas Steckmann**, Efekan Kökcü. (2021) Cartan Quantum Synthesizer

Presentations:

- "Error Mitigation for Analog Quantum Simulators" **Contributed Talk**, *QSim 2025* | Summer 2025
- "Error Mitigation for Analog Quantum Simulators" *American Physical Society, March Meeting* | Spring 2025
- "Error Mitigation for Analog Simulators" **Invited Talk**, *Institute for Robust Quantum Simulation, Annual Meeting* | Summer 2024
- "Simulating the Mott transition on a noisy digital quantum computer via Cartan-based fast-forwarding circuits" *American Physical Society, March Meeting* | Spring 2022
- "Simulating Quantum Systems on Dubious Quantum Computers" **Invited Award Talk**, *North Carolina State University McCormick Symposium* | Spring 2022

Research Positions

Lanczos Fellow (Ph.D. research) — Sept. 2022 - Present
Alexey Gorshkov, Michael Gullans — University of Maryland, College Park — *College Park, MD*

- **Research focus**: error mitigation; Hamiltonian simulation; analog quantum computing; magic in noisy quantum systems; quantum sensing; quantum optics; NISQ algorithms

- Error mitigation and Bell sampling for scalable measures of magic in noisy quantum circuits
- Developed hardware-level technique for characterizing and mitigating noisy outputs for analog quantum simulators. Collaboration with trapped-ion experimentalists at Duke
- Algorithmic and circuit optimizations for quantum applications to dynamical mean-field theory experiments on noisy quantum computers, with the aim of estimating resource and noise requirements to show advantage for studying many-body physics systems on superconducting hardware
- Quantum optics for novel gates in neutral atom architectures

DOE SULI (Hamiltonian Simulation on Noisy Quantum Computers) Summer 2020, Summer 2021

Eugene Dumitrescu, Yan Wang, Lex Kemper (NCSU) — Oak Ridge National Laboratory *Oak Ridge, TN*

- Lead author work demonstrating the application of Cartan-based fast-forwarding circuits for use in dynamical mean-field theory. Developed noise robust algorithms and error mitigation techniques to recover accurate observable for noisy Hamiltonian simulation on hardware. Published in Physical Review Research
- Extended methods in unitary matrix synthesis for quantum computers to allow for fast-forwarding long time scale dynamics in Hamiltonian simulation. Extends the Cartan decomposition of the dynamical Lie group generated by a Hamiltonian. Published in Physical Review Letters
- Developed and published a python package to simplify the implementation of the decomposition algorithm and to encourage exploration into applications beyond the expertise of the authors: Cartan Quantum Synthesizer

Undergraduate Research Assistant June 2018 – June 2022

Lex Kemper, Moody Chu, Abay Gadisa Dinku - North Carolina State University *Raleigh, NC*

- **Quantum Computing:** Investigated classical and quantum optimization schemes for Cartan decomposition and unitary synthesis via Lax dynamics and variational circuits.
- **Organic Electronics (experiment):** Demonstrated and explained an efficient fabrication method using floated polymer films as a means to preserve high quality charge transport in films down to only two molecular layers. The method opens up possibilities for fabrication of material efficient, flexible, and transparent transistors. Published in Advanced Electronic Materials. Results presented at the Material Research Society Fall 2020 meeting

Academic Service

Conference and Journal Reviews

- *Conferences*: Theory of Quantum Computing; Young Quantum Information Scientists
- *Journals*: npj Computational Materials, Physical Review Research

Seminar Organizer 2023-2025

- Logistics and scheduling for weekly departmental quantum seminar

Quantum Information Club at NC State | *Founder, President* March 2020 – 2022

- Developed approachable programming in quantum computing for undergraduate students with a range of math, science, and engineering backgrounds by working closely with community partners such as the NC State Q Hub and IBM Qiskit, and university groups at UNC Chapel-Hill, Duke, Georgetown, and Georgia Tech

Technical Expertise and Relevant Coursework

Programming: Python, Mathematica, HTML, CSS, LaTeX, Git
Libraries/Packages: Qiskit, NumPy, Scipy, Matplotlib, Numba, OpenFermion, TensorNetwork
Featured Course Work: Quantum Error Correction | Advanced Quantum Algorithms | Quantum Control | Classical Mechanics | Quantum Mechanics | Electrodynamics | Mathematical Foundations of Quantum Computation | Linear Algebra | Complex Analysis | Computational Physics | Modern Algebra | Cryptography | Software Development
Quantum Applications: Experience managing experiments across a range of quantum computer and simulator platforms | **Professional certification in Qiskit** development | Proficient in a variety of **error mitigation techniques**; developing and managing **large scale quantum circuit executions**.

Recognitions

IBM Qiskit Advocate 2023 - present
RQS Seed Grant Funding Research funding for theory/experimental collaborations - $28,000 2024
Outstanding Senior Research Award — NCSU College of Sciences 2022
Rodney I. McCormick Award for outstanding research — NCSU Department of Physics 2022
Park Scholarship — Undergraduate, four year, full cost-of-living, merit based scholarship 2018 - 2022
Phi Beta Kappa, Mathematics Honors, Sigma Pi Sigma, University Honors 2020-2022