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)*

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*

Publications and Featured Presentations

Publications:

- **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 Simulators" **Invited Talk**, *Institute for Robust Quantum Simulation, Annual Meeting* | Summer 2024
- "Error Mitigation for Analog Simulators" *American Physical Society, March Meeting* | Spring 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
- "A Highly optimized quantum circuit for simulating two-site dynamical mean-field theory on noisy quantum hardware" Joint Quantum Computation and Quantum Information Technical Talks, *Oak Ridge National Laboratory* | 2021

Research Positions

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

- Areas of focus: error mitigation; Hamiltonian simulation; analog quantum computing; resources for noisy quantum computing (magic, entanglement, hardware constraints); noisy quantum computing
- Studying error mitigation and Bell sampling for extracting measures of magic on low T-depth noisy states
- Developing hardware-level techniques for characterizing and mitigating noisy outputs for analog quantum simulators. Collaborations with trapped-ion experimentalists at Duke
- Researching algorithms 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

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
- **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

Seminar Organizer 2023-2025

- Logistics and scheduling for weekly departmental quantum seminar

Quantum Information Club at NC State | *Co-founder, President* March 2020 – 2022

- 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
- Develop and teach interactive lessons and coding tutorials on the fundamentals of quantum algorithms and quantum information

Technical Skills 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 | Quantum Control | Classical Mechanics | Quantum Mechanics | Electrodynamics | Mathematical Foundations of Quantum Computation | Linear Algebra | Complex Analysis | Computational Physics | Modern Algebra | Cryptography | Software Development

Recognitions

IBM Qiskit Advocate 2023 - present

RQS Seed Grant Funding Research funding for theory/experimental collaborations - $28,000 2023

QuICS Lanczos Graduate Fellowship 2022 - 2024

Park Scholarship — Undergraduate, four year, full cost-of-living, merit based scholarship 2018 - 2022

Outstanding Senior Research Award — NCSU College of Sciences 2022

Rodney I. McCormick Award for outstanding research — NCSU Department of Physics 2022

Phi Beta Kappa, Mathematics Honors, Sigma Pi Sigma, University Honors 2020-2022