THOMAS STECKMANN

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EDUCATION

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

RESEARCH

Hamiltonian Fast-Forwarding Algorithms (DOE SULI program)   Summer 2020 - Spring 2021
Oak Ridge National Laboratory and North Carolina State University   *Oak Ridge, TN*

- Developed an application of Lie group decomposition to produce an efficient circuit for matrix exponentials, with benefits in long-time simulation of quantum systems on quantum computers
- In review at Physical Review Letters: Fixed Depth Hamiltonian Simulation via Cartan Decomposition
- 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

Algorithms for Error-Prone Quantum Computers (DOE SULI program)   Summer 2021 - Present
Oak Ridge National Laboratory and North Carolina State University   *Oak Ridge, TN*

- Lead author in work demonstrating the application of Cartan-based fast-forwarding circuits for use in dynamical mean field theory to map the Mott-insulator phase transition of the Hubbard Model
- Developed or implemented a variety of error mitigation methods—result post-processing, randomized Cartan compiling, and measurement error mitigation—which combined with circuit simplifications, allow the fast-forwarding circuit to accurately preserve the simulation dynamics (Green's function) despite significant decoherence on IBM quantum hardware

Optimization Methods for Cartan Decomposition   Spring/Fall 2021
North Carolina State University   *Raleigh, NC*

- Developing a quantum variational cost function for optimization in Cartan Decomposition to reduce complexity
- Solved the parameter minimization problem using parameter flow in Lax dynamics, which allows for finding a solution through numerical integration of an ordinary differential equation and reduces the classical calculation complexity

Electron Transport in Organic Transistors   June 2018 – June 2020
North Carolina State University — Organic and Carbon Electronics Lab   *Raleigh, NC*

- Developed methodology to investigate the micro-structural influences on electron transport mobility in organic, field effect transistors
- 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
- Submitted to Advanced Electronic Materials. Results presented at the Material Research Society Fall 2020 meeting

PUBLICATIONS AND PRESENTATIONS

Publications:

- **Thomas Steckmann**, Trevor Keen, Alexander F Kemper, Eugene F Dumitrescu, and Yan Wang, "A highly optimized quantum algorithm for accurate simulations of dynamical impurity models on noisy quantum hardware," (December 2021) arXiv preprint arXiv:2112.05688
- **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," (Submitted: Advanced Electronic Materials, December 2021) Available Manuscript
- Efekan Kökcü, **Thomas Steckmann**, JK Freericks, Eugene F Dumitrescu, and Alexander F Kemper, "Fixed depth hamiltonian simulation via cartan decomposition," (In review: Physical Review Letters, April 2021) arXiv preprint arXiv:2104.00728

Presentations:

- "Scalable Fabrication of High Mobility Monolayer OFETs Using Floating Film Transfer" Virtual poster, *Material Research Society* | 2020
- "Constant Depth Exact Time Evolution of Spin Systems Based on Cartan Decomposition," *National Council For Undergraduate Research* | 2021
- Honorable Mention, "High Efficiency Semiconducting Polymer Self-Assembly in Organic Transistors" McCormick virtual symposium | 2020
- 3rd place: "Aggregation Mechanisms in Low Temperature Ultrathin Water-Floated Films" Research Proposal: Future of Materials IV Workshop | 2020
- 2nd place, "Efficient Quantum Simulation on a Quantum Computer," McCormick Symposium | 2021

TECHNICAL SKILLS AND RELEVANT COURSEWORK

Programming Languages: Python, Java, Mathematica, HTML, CSS, LaTeX
Libraries/Packages: Qiskit, NumPy, Scipy, Matplotlib, Numba
Featured Course Work: Graduate Level: Mathematical Foundations of Quantum Computation | Linear Algebra | Complex Analysis | Computational Physics | **Undergraduate Level:** Modern Algebra | Quantum Mechanics | Cryptography | Java Software Development

QUANTUM COMPUTING

Undergraduate School on Experimental Quantum Information Processing | *University of Waterloo*   Summer 2021
- Virtual summer program featuring lectures on the theory and implementation of quantum algorithms, qubit architectures, and quantum communication protocols

Quantum Ideas Summer School | *Duke University STAQ collaboration*   Summer 2019
- Introduction to quantum computing hardware approaches including superconducting and trapped Ion systems
- Exploration of variational algorithms and error correcting codes

Quantum Computing Hackathons with Qiskit   2020
- Qiskit Hackathon Global: With a team of five students, developed an easy to use function to evaluate the Quantum Volume of IBM hardware during a 24 hour invite only event
- NC IBM Q Summer Jam: Implemented an algorithm for quantum PageRank using Quantum Random Walk

COMMUNITY ENGAGEMENT AND LEADERSHIP DEVELOPMENT

Quantum Information Club at NC State | *Co-founder, President*   March 2020 – Present
- Developing 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
- Primary organizer for the 2020 North Carolina IBM Summer Jam Hackathon with over 60 participants, and a workshop co-organized with IBM Qiskit with over 40 participants

Park Scholarships   2018 -2022
- Four year, merit based scholarship awarded for excellence in Leadership, Service, Character, and Scholarship
- Development courses focusing on leadership, civic engagement, and diversity

CrowdSolv Developer   2019-2020
- Volunteer front end development (HTML, CSS, BootStrap, Javascript) for CrowdSolv, a non-profit building a collaborative platform for crowd-sourced problem solving

Habitat for Humanity | Works Project Officer   2019-Present
- Regular volunteer with Habitat Wake and the NCSU chapter to promote affordable housing access and work in home construction
- As a club officer, I assist with fundraising efforts, facilitate student involvement, and work with construction leaders to guide and train new volunteers