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github.com/jmmartyn
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John M. Martyn

Research Interests

The future of computation is bound to be exciting, but we will need to imagine it before we can build it! In my research, I do this imagining: I develop new quantum and classical algorithms to simulate complex quantum systems and solve hard computational problems.

Education

Sep. 2020 – May 2025 **Massachusetts Institute of Technology (MIT)**, *Cambridge, MA*.
- PhD in physics, advised by Isaac Chuang
- Thesis: *The Algorithmic Cookbook of Quantum Science: Quantum and Classical Recipes for Computation*
- NSF Graduate Research Fellow (Sep. 2022 - May 2025)
- MIT Dean of Science Fellow (Sep. 2020 - Aug. 2022)
- GPA: 5.00/5.00

Aug. 2016 – Dec. 2019 **University of Maryland, College Park (UMD)**, *College Park, MD*.
- BS in physics, advised by Brian Swingle
- GPA: 4.00/4.00

Professional Experience

Sep. 2025 – Present **Quantum Initiative Fellow**, *Harvard University*, Cambridge, MA.
- Postdoctoral fellow at the Harvard Quantum Initiative.

June 2025 – Present **Computational Scientist**, *Pacific Northwest National Laboratory*, (Remote).
- Staff scientist, developing quantum algorithms with Nathan Wiebe.

June 2025 – Aug. 2025 **Visitor**, *Yale University*, New Haven, CT.
- Visiting researcher at the Yale Quantum Institute.

Sep. 2020 – May 2025 **PhD Student**, *Massachusetts Institute of Technology*, Cambridge, MA.
- Studied quantum information under Isaac Chuang.

May 2024 – Aug. 2024 **Quantum Research Intern**, *MIT-IBM Watson AI Lab*, Cambridge, MA.
- Developed randomized quantum algorithms with Patrick Rall and Pawel Wocjan.

Jan. 2020 – May 2020 **Quantum Resident**, *(Google) X, The Moonshot Factory*, Mountain View, CA.
- Applied tensor networks to machine learning tasks with Guifre Vidal.

2018 – 2019 **Undergraduate Research Fellow**, *California Institute of Technology*, Pasadena, CA.
- Studied measurement-based quantum computation with John Preskill's group (Summer 2019).
- Designed homodyne detection for quantum optics with Rana Adhikari's group (Summer 2018).

Dec. 2017 – July 2020 **Research Assistant**, *University of Maryland*, College Park, MD.
- Worked on quantum information and condensed matter research under Brian Swingle.

Publications and Preprints

[1] **John M. Martyn**, Zane M. Rossi, Kevin Z. Cheng, Yuan Liu, and Isaac L. Chuang. "Parallel Quantum Signal Processing via Polynomial Factorization." *Quantum* **9**, 1834 (2025). arXiv:2409.19043.

[2] Yuan Liu, **John M. Martyn** (co-first author), Jasmine Sinanan-Singh, Kevin C. Smith, Steven M. Girvin, Isaac L. Chuang. "Toward Mixed Analog-Digital Quantum Signal Processing: Quantum AD/DA Conversion and the Fourier Transform." *IEEE Transactions on Signal Processing* **73**, 3641 (2025). arXiv:2408.14729.

[3] **John M. Martyn** and Patrick Rall. "Halving the Cost of Quantum Algorithms with Randomization." *npj Quantum Information* **11**, 47 (2025). arXiv:2409.03744.

[4] Eleanor Crane, Kevin C. Smith, Teague Tomesh, Alec Eickbusch, **John M. Martyn**, Stefan Kühn, Lena Funcke, Michael Austin DeMarco, Isaac L. Chuang, Nathan Wiebe, Alexander Schuckert, and Steven M. Girvin. "Hybrid Oscillator-Qubit Quantum Processors: Simulating Fermions, Bosons, and Gauge Fields." arXiv:2409.03747. Under review at *Physical Review X*.

[5] Yuan Liu, Shraddha Singh, Kevin C. Smith, Eleanor Crane, **John M. Martyn**, Alec Eickbusch, Alexander Schuckert, Richard D. Li, Jasmine Sinanan-Singh, Micheline B. Soley, Takahiro Tsunoda, Isaac L. Chuang, Nathan Wiebe, and Steven M. Girvin. "Hybrid Oscillator-Qubit Quantum Processors: Instruction Set Architectures, Abstract Machine Models, and Applications." arXiv:2407.10381. Accepted to *PRX Quantum*.

[6] **John M. Martyn**, Khadijeh Najafi, Di Luo. "Variational Neural-Network Ansatz for Continuum Quantum Field Theory." *Physical Review Letters* **131**, 081601 (2023). (Editors' Suggestion). arXiv:2212.00782.
- Associated code: github.com/jmmartyn/Neural-Network-Quantum-Field-States
- Associated Video Talk

[7] Alexander Zlokapa, Andrew K. Tan, **John M. Martyn**, Ila R. Fiete, Max Tegmark, and Isaac L. Chuang. "Fault-Tolerant Neural Networks from Biological Error Correction Codes." *Physical Review E* **110**, 054303 (2024) (Editors' Suggestion). arXiv:2202.12887.

[8] **John M. Martyn**, Yuan Liu, Zachary E. Chin, and Isaac L. Chuang. "Efficient Fully-Coherent Quantum Signal Processing Algorithms for Real-Time Dynamics Simulation." *The Journal of Chemical Physics* **158**, 024106 (2023). arXiv:2110.11327.

[9] **John M. Martyn**, Zane M. Rossi, Andrew K. Tan, and Isaac L. Chuang. "Grand Unification of Quantum Algorithms." *PRX Quantum* **2**, 040203 (2021). arXiv:2105.02859.
- Associated code: github.com/ichuang/pyqsp

[10] **John Martyn**, Guifre Vidal, Chase Roberts, and Stefan Leichenauer. Entanglement and Tensor Networks for Supervised Image Classification." arXiv:2007.06082.

[11] **John Martyn**, Kohtaro Kato, and Angelo Lucia. "Deformations of the boundary theory of the square-lattice AKLT model." *Physical Review B* **102**, 035121 (2020) (Editors' Suggestion). arXiv:1912.10327.

[12] **John Martyn** and Brian Swingle. "Product spectrum ansatz and the simplicity of thermal states." *Physical Review A* **100**, 032107 (2019). arXiv:1812.01015.

Grants Received

FY 2026 (Oct. 2025 – Sep. 2026) **Sharpening the Boundary of Quantum Advantage with Machine Learning**.

- Role: Principal Investigator
- Funding Organization: Laboratory Directed Research and Development program, Pacific Northwest National Laboratory, U.S. Department of Energy
- Amount: $100,000

Invited Talks

[1] **A Little Incoherence Goes a Long Way: Enhancing Quantum and Classical Algorithms with Randomization**, (Invited Talk).
Quantum Science and Engineering Seminar, EPFL, *Lausanne, Switzerland*, November 2025.

[2] **The Unreasonable Effectiveness of Polynomials in Quantum Algorithms**, (Invited Talk).
Brown Quantum Initiative, Brown University, *Providence, RI*, April 2025.

[3] **Halving the Cost of Quantum Algorithms with Randomization**, (Invited Talk).
Foxconn Quantum Computing Research Center, January 2025.

[4] **Halving the Cost of Quantum Algorithms with Randomization**, (Invited Talk).
Tufts Quantum Computing Seminar, Tufts University, *Medford, MA*, October 2024.

[5] **Halving the Cost of Quantum Algorithms with Randomization**, (Invited Talk).
Workshop on Adiabatic and Dynamical Algorithms for Quantum Hardware, Keble College, University of Oxford, *Oxford, United Kingdom*, August 2024.

[6] **A Grand Unification of Quantum Algorithms**, (Invited Talk).
APS New England Section Fall 2023 Meeting, University of Rhode Island, *Kingston, RI*, October 2023.

[7] **A Grand Unification of Quantum Algorithms**, (Invited Talk).
PsiQuantum, July 2021.

Contributed Talks and Presentations

[1] **The Unreasonable Effectiveness of Polynomials in Quantum Algorithms**, (Talk).
North Carolina State University, *Raleigh, NC*, February 2025.

[2] **Halving the Cost of Quantum Algorithms with Randomization**, (Talk).
2024 National Society of Black Physicists Conference, *Houston, TX*, November 2024.

[3] **Halving the Cost of Quantum Algorithms with Randomization**, (Talk).
Yale Quantum Institute, Yale University, *New Haven, CT*, September 2024.

[4] **Parallel Quantum Signal Processing via Polynomial Factorization**, (Contributed Talk).
10th International Conference on Quantum Information and Quantum Control, The Fields Institute, University of Toronto, *Toronto, Canada*, August 2024.

[5] **Halving the Cost of Quantum Algorithms with Randomization**, (Talk).
IBM Quantum, MIT-IBM Watson AI Lab, *Cambridge, MA*, August 2024.

[6] **An Animated Research Talk on: Neural-Network Quantum Field States**, (Video Talk).
Shared an animated research talk online as a means of better publicizing research, December 2023.

[7] **Neural-Network Quantum States for Continuum Quantum Field Theory**, (Talk).
2023 National Society of Black Physicists Conference, *Knoxville, TN*, November 2023.

[8] **Neural-Network Quantum States for Continuum Quantum Field Theory**, (Talk).
Institute for Artificial Intelligence and Fundamental Interactions (IAIFI), Summer Workshop 2023, *Boston, MA*, August 2023.

[9] **Neural-Network Quantum States for Continuum Quantum Field Theory**, (Poster).
Machine Learning for Quantum Many-Body Systems, Perimeter Institute for Theoretical Physics, *Waterloo, Ontario, Canada*, June 2023.

[10] **Applying the Variational Principle to Quantum Field Theory with Neural-Networks**, (Talk).
IBM Quantum, MIT-IBM Watson AI Lab, *Cambridge, MA*, April 2023.

[11] **Applying the Variational Principle to Quantum Field Theory with Neural-Networks**, (Virtual Talk).
2023 APS March Meeting (Virtual), March 2023.

[12] **Applying the Variational Principle to Quantum Field Theory with Neural-Networks**, (Talk).
2023 APS March Meeting, *Las Vegas, NV*, March 2023.

[13] **Neural-Network Quantum States for Continuum Quantum Field Theory**, (Talk).
Institute for Artificial Intelligence and Fundamental Interactions (IAIFI), Lightning Talks Series, *Cambridge, MA*, November 2022.

[14] **Efficient Fully-Coherent Hamiltonian Simulation**, (Poster).
Quantum Information Processing (QIP) 2022, *Pasadena, CA*, March 2022.

[15] **Efficient Fully-Coherent Hamiltonian Simulation**, (Virtual Talk).
2022 APS March Meeting, March 2022.

[16] **A Grand Unification of Quantum Algorithms**, (Virtual Talk).
2021 National Society of Black Physicists Conference, November 2021.

[17] **Entanglement and Tensor Networks for Supervised Image Classification**, (Virtual Talk).
2021 APS March Meeting, March 2021.

[18] **Entanglement and Tensor Networks for Supervised Image Classification**, (Virtual Talk).
2020 National Society of Black Physicists Conference, November 2020.

[19] **Deformations of the AKLT Boundary Theory**, (Virtual Presentation).
2020 APS March Meeting, March 2020.

[20] **Deformations of the Boundary AKLT Model**, (Talk).
2019 National Society of Black Physicists Conference, *Providence, RI*, November 2019.

[21] **Product Spectrum Ansatz and the Simplicity of Thermal States**, (Poster).
14th Conference on the Theory of Quantum Computation, Communication, & Cryptography (TQC), *University of Maryland, College Park, MD*, June 2019.

[22] **Product Spectrum Approximation**, (Talk).
2019 American Physical Society March Meeting, *Boston, MA*, March 2019.

Honors and Awards

2022 – 2025 National Science Foundation Graduate Research Fellowship

2020 – 2022 MIT Dean of Science Fellowship

2019 2019 Barry Goldwater Scholarship (University of Maryland Article)

2019 Ralph Myers and Friends of Physics Award for Excellence in Teaching

2016 – 2019 Angelo Bardasis Memorial Scholar Award ('16-'17, '17-'18, '18-'19, and '19-'20)

2018 2018 Carl Albert Rouse Undergraduate Research Fellowship, Awarded by The National Society of Black Physicists

2016 2016 Mary-Kathryn Abernathy Memorial Scholarship

Leadership and Outreach

June 2023 – May 2025 **Science Policy Leadership**.

- Co-chair of the Federal Affairs Subcommittee (2023 – 2024), and at-large member (2024 – 2025), of the External Affairs Board of the MIT Graduate Student Council
  - The External Affairs Board is the political advocacy branch of the MIT Graduate Student Council and works toward implementing policies that benefit graduate students, education, and research. See more information on the External Affairs Board website.
  - Organize bi-annual trips to Washington, D.C., to advocate for our priorities with Congressional offices and executive agencies.
- I led an effort to modernize the O-1A visa to better recognize junior researchers. Our suggestions were successfully implemented by U.S. Citizenship and Immigration Services (USCIS) on January 8, 2025.
  - See our letter to USCIS, of which I was the lead author.
  - Also see the ensuing statement from USCIS on policy guidance updates for the O-1A visa, and the updated guidance in the USCIS policy manual.
- Supported increased federal funding to bridge programs, which provide coursework and research experience to underserved communities. See our letter to U.S. Congress.
- Advocated for provisions to improve mentorship of graduate students and better address sexual harassment in the academic environment. See our letter to U.S. Congress.

June 2023 – May 2025 **Leader of the Harvard-MIT Chapter of the National Society of Black Physicists**.

- Vice president (2023 – 2025), and secretary (2022 – 2023), of the joint Harvard-MIT Chapter of the National Society of Black Physicists (NSBP), providing community and support for underrepresented physics students.
  - Host community events across Harvard and MIT.
  - Chair the MIT exhibition booth at the annual NSBP conference to recruit students to MIT.
  - Helped organize Quantum Noir 2024, a conference and community-building event for underrepresented groups in quantum science and engineering.

June 2024 **Student Organizer of Quantum Noir 2024**.

- Helped organize Quantum Noir 2024, a conference and community-building event for underrepresented groups in quantum science and engineering.
  - Assisted in planning talks and community events.
  - Facilitated sessions and Q&A's during the conference.

Jan. 2022 – Jan. 2024 **MIT Summer Research Program Admissions Committee Member**.

- Member of the admissions committee for the MIT Summer Research Program (MSRP) for undergraduate students of underserved communities (see MSRP website).
  - Evaluated applications and recommended admitted students.

Dec. 2023 **Science Communication**.

- In an effort to make science research more accessible, I published an animated research talk as a video where I present my research in an engaging and pedagogical format.
  - I used animations to build intuition and convey concepts more clearly than a traditional conference talk would allow, with the goal of democratizing science for wider audiences.

Feb. 2022 – May 2023 **AI Journal Club Organizer**.

- Organized a weekly journal club for the Institute for Artificial Intelligence and Fundamental Interactions (IAIFI), as an informal talk series for junior researchers (see IAIFI Journal Club website).
  - Invited visitors, arranged presentations, and facilitated Q&A and discussion.

June 2020 – Dec. 2021 **SU(5) Organizer**.

- Organizer of SU(5), a peer support and mentorship program for first year graduate students in physics and astronomy, with the goal of easing the transition into graduate school (see SU(5) news article).
  - Helped plan and launch the program.
  - Facilitated virtual support/mentorship discussions with graduate students around the globe.

Mentorship

2024 – Present **Alvan C. Arulandu**, Harvard Undergraduate Student.

- Developing a randomized algorithm for accelerated imaginary time evolution.

2023 – 2024 **Kevin Z. Cheng**, MIT Undergraduate Student.

- Wrote code to simulate parallel quantum signal processing: github.com/kevinchengg/parallelQSP.
- Contributed to our publication "Parallel Quantum Signal Processing via Polynomial Factorization," *Quantum* **9**, 1834 (2025).

2021 – 2022 **Zachary E. Chin**, MIT Undergraduate Student.

- Simulated the performance of time evolution algorithms on spin chains and the hydrogen molecule.
- Contributed to our publication "Efficient Fully-Coherent Quantum Signal Processing Algorithms for Real-Time Dynamics Simulation," *The Journal of Chemical Physics* **158**, 024106 (2023).

Teaching Experience

Aug. 2018 – Dec. 2019 **Teaching Assistant**, *University of Maryland*, College Park, MD.

- Teaching assistant for Quantum Physics II (Fall 2019), Mathematical Methods for Physics II (Spring 2019), and Mathematical Methods for Physics I (Fall 2018).
- Received the Ralph Myers and Friends of Physics Award for Excellence in Teaching (Spring 2019).

Journal and Conference Refereeing

- Program committee member for
  - ACM Symposium on Parallelism in Algorithms and Architectures (SPAA) 2025
- Journal referee for
  - npj Quantum Information
  - Quantum
- Conference referee for
  - Quantum Information Processing (QIP) 2025 and 2026
  - 2024 SIAM Symposium on Simplicity in Algorithms
  - Machine Learning and the Physical Sciences Workshop at NeurIPS 2025, NeurIPS 2023, and NeurIPS 2021
  - The Theory of Quantum Computation, Communication and Cryptography (TQC) 2022
  - AI for Science Workshop at ICML 2022 and at NeurIPS 2022