Jacob Bringewatt, Ph.D.

Curriculum Vitae

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RESEARCH INTERESTS

My work seeks to elucidate the interconnection between the limits of physics, measurement, and computation. In one direction, this means determining what information theory and computer science can tell us about physics and, more practically, showing how they can help us to design better measurement devices and better simulation algorithms. In the other direction, this means deciphering how the constraints imposed by specific physical systems (e.g., symmetries, spatial locality, and noise) impact information-theoretic and computational limits on data processing and extraction.

EDUCATION

2024 **Ph.D. in Physics**, University of Maryland, College Park
Faculty Advisor: Alexey V. Gorshkov
Thesis: *Harnessing quantum systems for sensing, simulation, and optimization.*

2018 **B.S. in Physics**, University of Maryland, College Park

APPOINTMENTS

2024- **Postdoctoral Fellow in Physics**, Harvard Quantum Initiative
Harvard University, Cambridge, MA

PUBLICATIONS

Metrics: 290+ citations, h-index 10, i10-index 11

First Author Publications

10. **J Bringewatt**, J Kunjummen, N Mueller. "Randomized measurement protocols for lattice gauge theories." *Quantum* 8, 1300 (2024)
9. **J Bringewatt***, A Ehrenberg*, T Goel*, A V Gorshkov. "Optimal function estimation with photonic quantum sensor networks." *Phys. Rev. Research* 6, 013246 (2024)
8. A Ehrenberg*, **J Bringewatt***, A V Gorshkov. "Minimum entanglement protocols for function estimation." *Phys. Rev. Research* 5, 033228 (2023)
7. **J Bringewatt**, Z Davoudi. "Parallelization techniques for quantum simulation of fermionic systems." *Quantum* 7, 975 (2023)
6. **J Bringewatt**, L T Brady. "Simultaneous stoquasticity." *Phys. Rev. A* 105, 062601 (2022)
5. **J Bringewatt**, I Boettcher, P Niroula, P Bienias, A V Gorshkov. "Protocols for estimating multiple functions with quantum sensor networks: geometry and performance." *Phys. Rev. Research* 3, 033011. (2021)
4. **J Bringewatt**, N Sato, W Melnitchouk, J Qiu, F Steffens, M Constantinou. "Confronting lattice parton distributions with global QCD analysis." *Phys. Rev. D.* 103, 016003 (2021)

3. **J Bringewatt**, M Jarret. "Effective gaps are not effective: quasipolynomial classical simulation of obstructed stoquastic Hamiltonians." *Phys. Rev. Lett.* 125, 170504 (2020)
2. **J Bringewatt**, W Dorland, SP Jordan. "Polynomial time algorithms for estimating spectra of adiabatic Hamiltonians." *Phys. Rev. A* 100 (3), 032336 (2019) Editors' Suggestion.
1. **J Bringewatt**, W Dorland, SP Jordan, A Mink. "Diffusion Monte Carlo approach versus adiabatic computation for local Hamiltonians." *Phys. Rev. A* 97 (2), 022323 (2018)

Additional Publications

7. L P García-Pintos, T O'Leary, T Biswas, **J Bringewatt**, L T Brady, Y-K Liu. "Resiliance-runtime tradeoff relations for quantum algorithms." *Rep. Prog. Phys.* (2025)
6. P Niroula, J Dolde, X Zheng, **J Bringewatt**, A Ehrenberg, K Cox, J Thompson, M Gullans, S Kolkowitz, A V Gorshkov. "Quantum sensing with erasure qubits." *Phys. Rev. Lett.* 133, 080801 (2024)
5. L P García-Pintos, K Bharti, **J Bringewatt**, H Dehghani, A Ehrenberg, N Y Halpern, A V Gorshkov. "Estimation of Hamiltonian parameters from thermal states." *Phys. Rev. Lett.* 133, 040802 (2024)
4. L P García-Pintos, L T Brady, **J Bringewatt**, Y-K Liu. "Lower bounds on quantum annealing times." *Phys. Rev. Lett.* 130, 140601 (2023)
3. T C Mooney, **J Bringewatt**, N C Warrington, L T Brady. "Lefschetz thimble quantum Monte Carlo for spin systems." *Phys. Rev. B* 106, 214416 (2022)
2. T Qian, **J Bringewatt**, I Boettcher, P Bienias, A V Gorshkov. "Optimal measurement of field properties with quantum sensor networks." *Phys. Rev. A* (Letter) 103, L030601. (2021)
1. K Pushkin, C Akerlof, D Anbajagane, J Armstrong, M Arthurs, **J Bringewatt**, T Edberg, C Hall, M Lei, R Raymond, M Reh, D Saini, A Sander, J Schaefer, D Seymour, N Swanson, Y Wang, W Lorenzon. "Study of radon reduction in gases for rare event search experiments." *Nucl. Instrum. Methods Phys. Res.*, Sect. A 903, 267-276 (2018)

Under Review

4. Y Wang, **J Bringewatt**, A Seif, A J Brady, C Oh, A V Gorshkov. "Exponential entanglement advantage in sensing correlated noise." Preprint. (2024)
3. **J Bringewatt**, Z Steffen, M Ritter, A Ehrenberg, H Wang, B S Palmer, A Kollar, A V Gorshkov, L P García-Pintos. "Generalized geometric speed limits for quantum observables." Preprint. (2024)
2. J D Watson, **J Bringewatt**, A F Shaw, A M Childs, A V Gorshkov, Z Davoudi. "Quantum algorithms for simulating nuclear effective field theories." Preprint. (2023)
1. **J Bringewatt**, M Jarret, T C Mooney. "On the stability of solutions to Schrodinger's equation short of the adiabatic limit." Preprint. (2023)

Patents and Patent Applications

3. T Qian, **J Bringewatt**, I Boettcher, P Bienias, A V Gorshkov, Systems and Methods for Measurement of Field Properties Using Quantum Sensor Networks, U.S. Patent

Application 17/978,420, filed Aug. 17, 2023.

2. A Ehrenberg, **J Bringewatt**, A V Gorshkov, Minimum Entanglement Protocols for Function Estimation, U.S. Provisional Patent Application 63/397546, filed August 12, 2022.
1. **J Bringewatt**, I Boettcher, P Niroula, P Bienias, A V Gorshkov, Measurement of Multiple Functions with Quantum Sensor Networks, U.S. Provisional Patent Application 63/363171, filed April 18, 2022.

PRESENTATIONS

Invited Talks

"Generalized quantum Fisher information and speed limits for observables." CQuIC Seminar. University of New Mexico. Feb. 2025.

"Randomized measurement protocols for $\mathbb{Z}_2$ lattice gauge theory." Los Alamos National Lab. Feb. 2025.

"Towards a geometric toolbox for quantum information and computation." United States Naval Academy. Jan. 2025.

"Uncertainty relations for metrology and computation." Perimeter Institute. Dec. 2023.

"Uncertainty relations for metrology and computation." MIT Special Quantum Seminar. Dec. 2023.

"Uncertainty relations for metrology and computation." Harvard Quantum Initiative Quantum Fest. Dec. 2023.

"Uncertainty relations for metrology and computation." JILA Science Seminar. University of Colorado, Boulder. Nov. 2023.

"Randomized measurement protocols for lattice gauge theories." Glancy/Knill Group Meeting, NIST Boulder. July 2023.

"Towards (spin) coherent resolutions of the sign problem." George Mason University Quantum Computing Seminar. Apr. 2023.

"The role of entanglement for function estimation with quantum sensor networks." Caltech/AWS Seminar. Dec. 2022.

"The role of entanglement for function estimation with quantum sensor networks." George Mason University Quantum Computing Seminar. Feb. 2022.

"Lefschetz thimble quantum Monte Carlo for spin systems." USC Condensed Matter Seminar. Nov. 2021

"Lefschetz thimble quantum Monte Carlo for spin systems." MIT Computational Research in Boston and Beyond (CRIBB) seminar. Nov. 2021.

"Lattice data in the JAM framework." Amherst Center for Fundamental Interactions (ACFI) Workshop on QCD Real-Time Dynamics and Inverse Problems. Oct. 2020.

"Confronting lattice parton densities with global QCD analysis." AI for Nuclear Physics Workshop. Mar. 2020.

Conference Talks

"Randomized measurement for lattice gauge theories." March Meeting 2025. Mar. 2025.

"Weighting God's dice: exploiting symmetry in randomized measurement protocols." DOE CSGF Annual Program Review. July 2023.

"Measuring functions with quantum sensor networks." 23rd Annual SQuInT Workshop. Oct. 2021.

"Effective gaps are not effective: quasipolynomial simulation of obstructed stoquastic Hamiltonians." DOE Computational Science Graduate Fellowship Annual Program Review. July 2021.

"Optimal measurement of field properties with quantum sensor networks." March Meeting 2021. Mar. 2021.

"Confronting lattice parton densities with global QCD analysis." DNP2019. Oct. 2019.

Other Talks

"Function estimation with quantum sensor networks." Harvard Quantum Networking Seminar. Feb. 2025.

"Function estimation with quantum sensor networks." QuSEC Grant Meeting. Nov. 2024.

"Function estimation with quantum sensor networks." Yao Group Meeting. Oct. 2024.

"A geometric toolbox for quantum information theory." Yelin Group Meeting. Sept. 2024.

"Harnessing quantum systems for sensing, simulation, and optimization." Dissertation Defense. May 2024.

"The quantum Fisher information zoo and its applications. Gorshkov Group Meeting. May 2024.

"Quantum algorithms for optimization." Davoudi Group Meeting. Feb. 2024.

"Uncertainty relations for metrology and computation." United States Naval Academy Physics Seminar. Oct. 2023.

"Randomized measurement protocols for lattice gauge theories." Davoudi Group Meeting. Apr. 2023.

"The geometry and algebra of quantum Fisher information." Gorshkov Group Meeting. Mar. 2023.

"Quantum metrology: An introduction." Davoudi Group Meeting. Mar. 2023.

"Simultaneous stoquasticity." KITP Condensed Matter/Quantum Physics Seminar. Aug. 2022.

"The sign problem and quantum advantage." KITP Locals Lunch Seminar. Aug. 2022.

"Ultimate limits for function estimation in quantum metrology." Gorshkov Group Meeting. Jan. 2022.

"Minimum entanglement protocols for function estimation." QuICS/JQI Friday Quantum Seminar. Oct. 2021.

"Fermionic mappings, qubit architectures, and graph coloring." Davoudi Group Meeting. Aug. 2021.

"Estimating multiple functions with quantum sensor networks." Gorshkov Group Meeting. Jan. 2021.

"Effective gaps are not effective." Gorshkov Group Meeting. April 2020.

"Quantum sensor networks and Fisher information." Gorshkov Group Meeting. Aug. 2019.

"Confronting lattice parton densities with global QCD analysis." Jefferson Lab Theory Seminar. July 2019.

"Diffusion Monte Carlo approach versus adiabatic computation for local Hamiltonians." Gorshkov Group Meeting. Aug. 2018.

"Diffusion Monte Carlo approach versus adiabatic computation for local Hamiltonians."

University of Maryland Undergraduate Research Showcase. May 2018

"Diffusion Monte Carlo approach versus adiabatic computation for local Hamiltonians." Undergraduate Thesis Defense. May 2018.

TEACHING AND MENTORING EXPERIENCE

Courses

Assistant Professor, United States Naval Academy

- General Physics I (2025).

Adjunct Professor, United States Naval Academy

- General Physics I (2023).

Guest Lecturer, University of Maryland

Responsibilities entailed filling in for the instructor during a week she attended a conference. Gave 3 lectures.

- Advanced Electromagnetism (2023)

Teaching Assistant, University of Maryland

Responsibilities included helping general education students to learn the linear algebra used in the course, and holding weekly office hours.

- Philosophy of Quantum Mechanics (2016)

Pedagogical Training

Courses: Physics Education Research for Teaching Quantum Mechanics (2021), Introduction to Physics Education Research (2020)

Workshops: Intuition, Reasoning, and Conceptual Understanding in Physics (2021), Science Communication (2020)

Mentoring

One undergraduate and three graduate students at Harvard University

Nine undergraduate students at the University of Maryland, Lycoming College, Notre Dame of Maryland University, MIT, George Mason University, Cornell University, and Howard University

One high school student

FELLOWSHIPS AND AWARDS

Fellowships

Harvard Quantum Initiative Prize Postdoctoral Fellow, Harvard University, 2024-26

NRC Postdoctoral Fellow (declined), NIST Boulder, 2024

Graduate Fellow, Kavli Institute for Theoretical Physics, 2022

Computational Science Graduate Fellow, United States Department of Energy, 2018-22

Lanczos Graduate Fellow, University of Maryland, 2018-20

Banneker/Key Scholar, University of Maryland, 2014-18

Prizes

Young Scientist, 73rd Lindau Nobel Laureate Meeting, 2024

Board of Visitors Outstanding Graduate Student Award, University of Maryland, 2023

Invention of the Year Finalist, University of Maryland, 2023
Charles T. Husar Fellowship in Physics, University of Maryland, 2022
Three Minute Thesis Finalist, University of Maryland, 2022
Communicate Your Science Contest Winner, Krell Institute, 2019

Grants

Institute for Robust Quantum Simulation Seed Grant, 2022
Joint Center for Quantum Information and Computer Science Seed Grant, 2022

PROFESSIONAL SERVICE

Committee Experience

UMD Physics Department Graduate Student Colloquium Committee, 2021-23

Educational Outreach

Skype a Scientist, 2020-25
Judge for Communicate Your Science Essay Contest, Krell Institute, 2023
Mentor and panelist, GRAD-MAP Winter Workshop and Summer Scholars, 2021-23
Proctor for U.S. Physics Olympiad F=ma exam, 2022
Panelist, Conference for Undergraduate Underrepresented Minorities in Physics, 2021

Departmental Service

Organizer, QuICS-JQI-CMTC Friday Seminar, 2020-21
Volunteer, University of Maryland Prospective Graduate Student Open Houses, 2019-21

Peer Review

Journal referee for *ACM Transactions on Quantum Computing, npj Quantum Information, Physical Review A, Physical Review Applied, Physical Review Letters, Quantum, Quantum Information Processing, Quantum Science and Technology*
Conference referee for QIP 2024-25, TQC 2024, QCTIP 2025
Proposal reviewer for DOE Office of High Energy Physics