

# Natalie Klco

Assistant Professor in the Department of Physics  
Nuclear Theory Group and Duke Quantum Center  
at Duke University

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## Education

### University of Washington

*Doctor of Philosophy, Physics*

Researcher with the Institute for Nuclear Theory (INT)

Dissertation (Published at ETD ResearchWorks Archive):

- [Calculating Nature Naturally: Toward Quantum Simulation of Quantum Fields](#)

**Seattle, Washington**

2015–2020

### University of Washington

*Master of Science, Physics*

**Seattle, Washington**

2015–2016

### Honors Tutorial College, Ohio University

*Bachelor of Science and Bachelor of Arts, Physics and Percussion Performance*

Theses (Published at ETD OhioLINK):

- [Bayesian Errors and Rogue Effective Field Theories](#)
- [Mental Notes: Exploring the Capacity of the Mind to Enhance Marimba Performance](#)

**Athens, Ohio**

2011–2015

## Experience

### Vocational

#### Trinity College of Arts & Sciences, Duke University

*Assistant Professor in the Department of Physics*

Nuclear Theory Group and Duke Quantum Center

**Durham, North Carolina**

Summer 2022–Present

#### Scientific Journals, Federal Funding Agencies

*Peer Reviewer*

Fall 2018–Present

Reviewed manuscripts/research proposals for the purpose of publication/funding recommendation based on scientific quality and accuracy. IOP New Journal of Physics (2), Nature Communications (1), Nature Communications Physics (1), Physical Review D (2), Physical Review A (1), Physical Review X (1), Philosophical Transactions of the Royal Society A (1), Physical Review Letters (5), and Quantum Information Processing (2), Department of Energy Office of Science Office of Nuclear Physics (1), substantial pre-Journal review upon colleague request (2), National Science Foundation Physics Division Quantum Information Science Program (1)

#### Scientific Community

*External Candidate Evaluator*

Summer 2022–Present

Summer research opportunities (1), Post-doctoral research positions (1), PhD programs (1,12)

#### Trinity College of Arts & Sciences, Duke University

*Scholar in Residence of Physics*

**Durham, North Carolina**

Spring 2022–Summer 2022

#### California Institute of Technology (Caltech)

*Sherman Fairchild Postdoctoral Scholar, Research Associate in Theoretical Physics*

*Fellow of the Walter Burke Institute for Theoretical Physics*

*Postdoctoral Scholar with the Institute for Quantum Information and Matter (IQIM)*

Explore entanglement properties of quantum fields, guiding the design and practical implementation of their dynamical quantum simulation.

**Pasadena, California**

Fall 2020–Summer 2022

#### University of Washington Department of Physics

*Research Assistant with the Institute for Nuclear Theory*

**Seattle, Washington**

Summer 2017–Summer 2020

Explore the relationship between quantum devices and many-body nuclear physics including the quantum simulation of lattice fields.

#### Microsoft Quantum (QuArC)

*Intern*

**Redmond, Washington**

Summer 2018

Developed techniques for the localization and subsequent parallelization of the non-local fermionic operators dominating the quantum simulation cost of chemical systems. Worked with Microsoft's Quantum Architectures and Computing Group (QuArC) on physical representations and molecular symmetry. Calculated the expected precision for low-energy, Trotterized propagators of small molecules.

#### University of Washington Department of Physics

*Academic Student Employee*

**Seattle, Washington**

Fall 2015–Spring 2017

Instructed undergraduate electricity and magnetism lab sections and corresponding tutorials on waves and relativity. Assisted in the teaching of the physics department's course on the physics of sound. Occasionally covered lectures in Quantum Field Theory graduate course.

## Le commissariat à l'énergie atomique et aux énergies alternatives (CEA)

*Student Researcher*

Produced documentation for the Forward Tagger tracker detector being designed and tested for the 12GeV upgrade at Jefferson Lab through the CLAS collaboration.

Saclay, France

July 2014

## Istituto Nazionale di Fisica Nucleare (INFN)

*Student Researcher*

Conducted research on the effects of temperature on the Forward Tagger calorimeter LED array being designed for the 12GeV upgrade at Jefferson Lab through the CLAS collaboration. Presented preliminary analysis of the  $\gamma P \rightarrow \phi^0 \pi^0 P \rightarrow K^+ K^- \gamma \gamma P$  reaction channel of the g11 data set at hadron spectroscopy (HASPECT) collaboration meeting.

Genova, Italy

June 2014

## Zampino's Drum Shop

*Customer Services/Sales*

Promoted private lessons, executed instrument repairs, and facilitated knowledgeable purchases of instruments for the local percussion community.

Canton, Ohio

2009–2013

## GlenOak High School

*Assistant Percussion Instructor*

Guided the GlenOak high school drum line in ensemble, musicianship, and performance development. Led rehearsals and designed an environment conducive to percussion education.

Canton, Ohio

Summer 2013

## Springfield High School

*Mallet Percussion Instructor*

Coached the Springfield high school mallet ensemble during their summer band educational experience. Responsible for the organization of members, building technique and ensemble skills, general musicianship advancements, and maintenance and repair of instruments.

Springfield, Ohio

Summer 2012, 2013

## Educational Travel

### European Center for Theoretical Studies in Nuclear Physics (ECT\*)

*Doctoral Training Program (DTP) Student*

Attended DTP focusing on techniques and applications of effective field theories in sub-atomic physics from the basic underpinnings of low-energy effective field theories describing regimes of quantum systems, through to state-of-the-art techniques applied to perform precision calculations in quantum chromodynamics and the standard model.

Trento, Italy

June/July 2019

### Bayesian Methods in Nuclear Physics

*Student*

Took part in an endeavour to facilitate cross communication, fertilization, and collaboration on Bayesian applications among the nuclear sub-fields. Strengthened existing collaborations and began new collaborations with both nuclear physicists and statisticians. Talk presented: *Estimating and checking truncation errors in effective field theory*

Seattle, Washington

June 2016

### Factors of Leadership (Ohio Fellows Program)

*Student*

Discussed aspects of leadership with successful alumni of the program. Visited museums and artistic performances.

New York, New York

December 2013

### Zeltsman Marimba Festival

*Student and Performer*

Attended marimba performance related classes taught by international performing artists. Met and discussed the applications of physics to marimba construction with internationally acclaimed marimba manufacturers at *marimba one*.

Arcata, California

Summer 2013

### Drum Corps International Audition (Blue Knights)

*Student and Performer*

Experienced, first-hand, performing in a drum-corps mallet ensemble. This knowledge has been and will be applied to later mallet ensemble instructing positions and personal performances.

Denver, Colorado

Winter 2012

### Leigh Howard Stevens Summer Seminar

*Student and Performer*

Studied with Leigh Howard Stevens. Participated in discussion and received feedback on personal performance of the four-mallet marimba technique developed by Stevens. Learned and discussed methodologies in marimba construction and development in the *Malletech* acoustics labs.

Ocean Grove, New Jersey

Summer 2012

### Percussive Arts Society International Convention

*Student*

Experienced and connected with the larger percussion community. Discussed design and techniques with manufacturers. Experienced and interacted with performers from across the world.

Indianapolis, Indiana

Fall 2011, 2013

## Teaching and Course Development

- **Jefferson National Laboratory Summer School:** In collaboration with colleagues Randy Lewis and Sarah Powell, designed and presented two-day interactive exercises spanning material from the foundations of non-Abelian lattice gauge theories to their error mitigated quantum simulation. The developed exercises and quantum simulation code has been made available to the larger community by Zenodo publication (<https://zenodo.org/record/8140834>, doi: 10.5281/zenodo.8140834) under Creative Commons Attribution 4.0 International License.
- **Phys627/ECE523 Quantum Information Science:** Designed and presented new graduate-level course to build foundation for students along trajectories of quantum information, quantum simulation/sensing, quantum engineering, etc. The developed exercises composed the core of the course and have been made available to the larger community by publication through the Center for Open Science (Open Science Framework <https://osf.io/p8zyh/>, doi: 10.17605/OSF.IO/P8ZYH) under CC-By Attribution 4.0 International License. The created combination of lectures, exercises, and facilitated collaborations resulted in an individually optimizable, and adamantly appreciated, educational experience in preparation for independent research.

## Leadership/Community Activities.....

- Organized international workshop [Entanglement, Thermalization, and Holography](#) at the [Simons Center for Geometry and Physics](#). (Stony Brook, New York. April, 2024)
- Selected member of STEM Faculty Fellows Program for Mentoring, with curriculum designed by the data-backed Center for the Improvement of Mentored Experiences in Research (CIMER) and certified by the Duke Office of Faculty Advancement. (Durham, North Carolina. 2023-2024)
- Hosted mock interview for prestigious international early career research grant.
- Certified white-belt Climate Fresk facilitator [\[Link\]](#), serving as a guide to understand the complex problem of climate change and to process the multi-dimensional impacts that will shape the next phases of personal and global life. (Durham, North Carolina. February, 2023)
- Selected participant in the 2023 Duke course on Leadership Development for Researchers (LEADER), an interactive 6-month leadership program for junior faculty. (Durham, North Carolina. January-June, 2023)
- Organized international workshop [At the Interface of Quantum Sensors and Quantum Simulation](#) (22-3b) at the InQubator for Quantum Simulation (IQUS). (Seattle, Washington. November, 2022)
- Member of local team providing organizational and technical support at the 25<sup>th</sup> Annual Conference on Quantum Information Processing (QIP) (Pasadena, California. March, 2022)
- Organized and chaired *Mini-symposium: Quantum Information Science and Nuclear Theory I-VI* at the American Physical Society Division of Nuclear Physics Fall Meeting (Boston, Massachusetts. October, 2021)
- Speaker at Caltech's [FUTURE of Physics](#) 2021 program for undergraduate women in physics. *Effective Field Theories, Music, and Quantum Information: Trajectory to the Complexity Frontier* (Pasadena, California. September, 2021)
- Organized the Quantum Simulation of Strong Interactions Workshop 2: Implementation Strategies for Gauge Theories (QuaSi-2) virtually at the InQubator for Quantum Simulation (IQUS). (Seattle, Washington. Summer 2021)
- Organized the Quantum Simulation of Strong Interactions Workshop 1: Theoretical Strategies for Gauge Theories (QuaSi-1) virtually at the InQubator for Quantum Simulation (IQUS). (Seattle, Washington. Spring 2021)
- Organized and moderated discussions sessions for the INT-20-3 program [Scientific Quantum Computing and Simulation on Near-Term Devices](#) at the Institute for Nuclear Theory. (Seattle, Washington. Fall, 2020)
- Designed and developed the Washington Directed Reading Program in Physics (DRiP), a graduate-student-run research program pairing an undergraduate student with a graduate research guide to navigate advanced literature and communicate scientific ideas. Offering essential research credits for undergraduate graduation the DRiP program has become a formal course offered by the physics department. (Winter 2018–Spring 2020)
- Led undergraduate research project on the use and consideration of entanglement in designing quantum and classical calculations. (Spring, Winter 2019)
- Member of University of Washington Physics Department Aesthetics Committee (2018)
- University of Washington physics department graduate student mentor (Fall 2017–2020)
- Prepared general-audience study-material for John Preskill's lecture on quantum computation for University of Washington's physics public lecture series, *Frontiers of Physics* (Spring 2017)
- Ohio University Outstanding Professor Selection Committee Chair (2015)
- Ohio University Outstanding Professor Selection Committee Representative (2014)
- Ohio University Outstanding Graduate Student Selection Committee Representative (2014, 2015)
- Representative for "Voices of Ohio" Program (2015)
- Resurgence Class of Ohio Fellows Program (2013–2015)
- Drum line section Leader (Fall 2010)

## Departmental and University Service.....

- Member of masters committee for Electrical and Computer Engineering student Keshav Kasliwal in the area of Sympathetic Cooling of  $\text{Ca}^+$  ions using K atoms and Internal population dynamics of  $\text{CaH}^+$  (Spring, 2024)
- Member of masters committee for Electrical and Computer Engineering student Tianshu Yu in the area of DaxPlot: A Flexible System for Real-Time Plotting and Post Experiment Analysis (Spring, 2024)
- Member of dissertation committee for student Jameson O'Reilly in the area of New Techniques for Fast and High-Fidelity Trapped Ion Photonic Interconnects (Spring, 2024)
- Member of preliminary examination committee for student Julie Campos in the area of Tailoring Quantum Error Correction to Quantum Computing Architectures (Spring 2024)
- Presentation of nuclear theory research programs in the Duke physics department at the open house event hosted for prospective graduate students (March 2024)
- Member of interview committee in search of a Research Administration Specialist (RAS) for the Duke University physics department (Spring, 2024)
- Member of preliminary examination committee for student Rui Xian Siew in the area of qubit regularizations of topological terms in  $\text{O(N)}$  spin models (Spring, 2024)

- Member of Graduate Admissions Committee (Winter 2023–Present)
- Member of preliminary examination committee for student Simon Schneider in the area of Belle II physics analyses on fragmentation studies and related QCD measurements (Fall, 2023)
- Member of preliminary examination committee for student Maria Acevedo in the area of Type Ia Supernovae cosmology and observational survey construction (Fall, 2023)
- Member of preliminary examination committee for student Mika Chmielewski in the area of Quantum Networking with a Metastable Strontium Qubit (Fall, 2023)
- Member of interview committee in search of a Research Administration Specialist (RAS) for the High Energy Physics and Nuclear Theory groups at Duke University (Summer, 2023)
- Member of dissertation committee for student Erin Conley in the area of experimental low-energy neutrino-argon inelastic interactions (Spring, 2023)
- Member of interview committee in search of departmental Grants and Contracts Manager (GCM) (April, 2023)
- Upon requests, dedicate time to aiding under-represented students navigate unique research and departmental challenges.
- Organized Society of Physics Students (SPS) zone meeting at Duke University, including tours of the TUNL research facilities and a visit by congresswoman Deborah Ross who represents the Research Triangle Park in the U.S. House of Representatives (Durham, North Carolina. February, 2023) [article]
- Member of targeted candidate search committee with the Duke Quantum Center, Duke Department of Electrical and Computer Engineering and Department of Physics (January 2023)
- Member of preliminary examination committee for student Isabella Goetting in the area of trapped ion quantum computing (Fall 2022–Present)
- Member of preliminary examination committee for student Emma van Nieuwenhuizen in the area of coherent elastic neutrino-nucleus scattering on germanium with the COHERENT experiment at ORNL (Fall 2022)
- Member of Duke University physics departmental search committee for assistant research professor position in cosmology (Fall 2022)
- Faculty advisor for Duke University Society of Physics Students (Fall 2022–Present)
- Member of Duke University physics department Graduate Curriculum Committee (Fall 2022–2023)

## Student Achievements

- Student Zoë Webb-Mack awarded the Richardson Endowment Fellowship (Summer, 2023)
- Student Aditya Verma accepted for participation U.S. Quantum Information Science Summer School, the first joint summer school facilitated by the five DOE National Quantum Information Science Research Centers: C2QA, QSA, QSC, Q-NEXT, and SQMS. (Spring, 2023)
- Student Boyu Gao awarded the Richardson Endowment Fellowship (Summer, 2022)

## Publications

[Google Scholar](#)   [InSpire](#)   [arXiv](#)

- [1] Boyu Gao and Natalie Klco. Partial-transpose-guided entanglement classes and minimum noise filtering in many-body Gaussian quantum systems, 2 2024. [arXiv:2402.13881](#).
- [2] Natalie Klco and D. H. Beck. A Natural Field-like Entanglement Resource in Trapped-Ion Chains, 11 2023. [arXiv:2311.08842](#).
- [3] Christian W. Bauer, Zohreh Davoudi, Natalie Klco, and Martin J. Savage. Quantum simulation of fundamental particles and forces. *Nature Reviews Physics*, Jun 2023. [doi:10.1038/s42254-023-00599-8](#).
- [4] Natalie Klco and D. H. Beck. Entanglement structures in quantum field theories. II. Distortions of vacuum correlations through the lens of local observers. *Phys. Rev. A*, 108(1):012429, 2023. [arXiv:2304.04143](#), [doi:10.1103/PhysRevA.108.012429](#).
- [5] Natalie Klco, D. H. Beck, and Martin J. Savage. Entanglement structures in quantum field theories: Negativity cores and bound entanglement in the vacuum. *Phys. Rev. A*, 107(1):012415, 2023. [arXiv:2110.10736](#), [doi:10.1103/PhysRevA.107.012415](#).
- [6] Anthony Ciavarella, Natalie Klco, and Martin J. Savage. Some Conceptual Aspects of Operator Design for Quantum Simulations of Non-Abelian Lattice Gauge Theories, 3 2022. Contribution to proceedings of the 2021 Quantum Simulation for Strong Interactions (QuaSi) Workshops at the InQubator for Quantum Simulation (IQUS). [arXiv:2203.11988](#).
- [7] Natalie Klco and Martin J. Savage. Hierarchical qubit maps and hierarchically implemented quantum error correction. *Phys. Rev. A*, 104(6):062425, 2021. [arXiv:2109.01953](#), [doi:10.1103/PhysRevA.104.062425](#).
- [8] Natalie Klco, Alessandro Roggero, and Martin J. Savage. Standard model physics and the digital quantum revolution: thoughts about the interface. *Rept. Prog. Phys.*, 85(6):064301, 2022. [5th top cited ROPP article in 2022]. [arXiv:2107.04769](#), [doi:10.1088/1361-6633/ac58a4](#).

- [9] Natalie Klco and Martin J. Savage. Entanglement Spheres and a UV-IR Connection in Effective Field Theories. *Phys. Rev. Lett.*, 127(21):211602, 2021. [arXiv:2103.14999](https://arxiv.org/abs/2103.14999), [doi:10.1103/PhysRevLett.127.211602](https://doi.org/10.1103/PhysRevLett.127.211602).
- [10] Anthony Ciavarella, Natalie Klco, and Martin J. Savage. Trailhead for quantum simulation of SU(3) Yang-Mills lattice gauge theory in the local multiplet basis. *Phys. Rev. D*, 103(9):094501, 2021. IQuS@UW-21-001. [PRD Editor's Suggestion]. [arXiv:2101.10227](https://arxiv.org/abs/2101.10227), [doi:10.1103/PhysRevD.103.094501](https://doi.org/10.1103/PhysRevD.103.094501).
- [11] Natalie Klco and Martin J. Savage. Geometric Quantum Information Structure in Quantum Fields and their Lattice Simulation. *Phys. Rev. D*, 103(6):065007, 2021. INT-PUB-20-031. [arXiv:2008.03647](https://arxiv.org/abs/2008.03647), [doi:10.1103/PhysRevD.103.065007](https://doi.org/10.1103/PhysRevD.103.065007).
- [12] Natalie Klco. *Calculating Nature Naturally: Toward Quantum Simulation of Quantum Fields*. PhD thesis, University of Washington, 2020. URL: <https://digital.lib.washington.edu/researchworks/handle/1773/46546>.
- [13] Natalie Klco and Martin J. Savage. Fixed-point quantum circuits for quantum field theories. *Phys. Rev. A*, 102:052422, Nov 2020. INT-PUB-20-003. [arXiv:2002.02018](https://arxiv.org/abs/2002.02018), [doi:10.1103/PhysRevA.102.052422](https://doi.org/10.1103/PhysRevA.102.052422).
- [14] Natalie Klco and Martin J. Savage. Systematically Localizable Operators for Quantum Simulations of Quantum Field Theories. *Phys. Rev. A*, 102(1):012619, 2020. INT-PUB-19-058. [arXiv:1912.03577](https://arxiv.org/abs/1912.03577), [doi:10.1103/PhysRevA.102.012619](https://doi.org/10.1103/PhysRevA.102.012619).
- [15] Natalie Klco, Jesse R. Stryker, and Martin J. Savage. SU(2) non-Abelian gauge field theory in one dimension on digital quantum computers. *Phys. Rev. D*, 101(7):074512, 2020. INT-PUB-19-033. [arXiv:1908.06935](https://arxiv.org/abs/1908.06935), [doi:10.1103/PhysRevD.101.074512](https://doi.org/10.1103/PhysRevD.101.074512).
- [16] Natalie Klco and Martin J. Savage. Minimally entangled state preparation of localized wave functions on quantum computers. *Phys. Rev. A*, 102:012612, Jul 2020. INT-PUB-19-013. [arXiv:1904.10440](https://arxiv.org/abs/1904.10440), [doi:10.1103/PhysRevA.102.012612](https://doi.org/10.1103/PhysRevA.102.012612).
- [17] Silas R. Beane, David B. Kaplan, Natalie Klco, and Martin J. Savage. Entanglement Suppression and Emergent Symmetries of Strong Interactions. *Phys. Rev. Lett.*, 122(10):102001, 2019. INT-PUB-18-056, NT@UW-18-19. [arXiv:1812.03138](https://arxiv.org/abs/1812.03138), [doi:10.1103/PhysRevLett.122.102001](https://doi.org/10.1103/PhysRevLett.122.102001).
- [18] Hsuan-Hao Lu, Natalie Klco, et al. Simulations of Subatomic Many-Body Physics on a Quantum Frequency Processor. *Phys. Rev. A*, 100(1):012320, 2019. [arXiv:1810.03959](https://arxiv.org/abs/1810.03959), [doi:10.1103/PhysRevA.100.012320](https://doi.org/10.1103/PhysRevA.100.012320).
- [19] Natalie Klco and Martin J. Savage. Digitization of scalar fields for quantum computing. *Phys. Rev. A*, 99(5):052335, 2019. INT-PUB-18-044. [arXiv:1808.10378](https://arxiv.org/abs/1808.10378), [doi:10.1103/PhysRevA.99.052335](https://doi.org/10.1103/PhysRevA.99.052335).
- [20] N. Klco, E. F. Dumitrescu, A. J. McCaskey, T. D. Morris, R. C. Pooser, M. Sanz, E. Solano, P. Lougovski, and M. J. Savage. Quantum-classical computation of Schwinger model dynamics using quantum computers. *Phys. Rev. A*, 98(3):032331, 2018. INT-PUB-18-013. [arXiv:1803.03326](https://arxiv.org/abs/1803.03326), [doi:10.1103/PhysRevA.98.032331](https://doi.org/10.1103/PhysRevA.98.032331).
- [21] David B. Kaplan, Natalie Klco, and Alessandro Roggero. Ground States via Spectral Combing on a Quantum Computer. 2017. INT-PUB-17-039. [arXiv:1709.08250](https://arxiv.org/abs/1709.08250).
- [22] Silas R. Beane and Natalie Klco. Chiral corrections to the Adler-Weisberger sum rule. *Phys. Rev. D*, 94(11):116002, 2016. NT@UW-16-04. [arXiv:1609.01350](https://arxiv.org/abs/1609.01350), [doi:10.1103/PhysRevD.94.116002](https://doi.org/10.1103/PhysRevD.94.116002).
- [23] S. Wesolowski, N. Klco, R. J. Furnstahl, D. R. Phillips, and A. Thapaliya. Bayesian parameter estimation for effective field theories. *J. Phys. G*, 43(7):074001, 2016. [arXiv:1511.03618](https://arxiv.org/abs/1511.03618), [doi:10.1088/0954-3899/43/7/074001](https://doi.org/10.1088/0954-3899/43/7/074001).
- [24] R. J. Furnstahl, N. Klco, D. R. Phillips, and S. Wesolowski. Quantifying truncation errors in effective field theory. *Phys. Rev.*, C92(2):024005, 2015. [arXiv:1506.01343](https://arxiv.org/abs/1506.01343), [doi:10.1103/PhysRevC.92.024005](https://doi.org/10.1103/PhysRevC.92.024005).
- [25] N. Klco. Bayesian Errors and Rogue Effective Field Theories. *OhioLINK Electronic Theses and Dissertations Center*, 2015. [\[LINK\]](#).
- [26] N. Klco. 'Mental Notes: Exploring the Capacity of the Mind to Enhance Marimba Performance. *OhioLINK Electronic Theses and Dissertations Center*, 2015. [\[Link\]](#).
- [27] N. Klco. You're not going to break Bach...Experiment! *Ohio University College of Arts and Sciences*, 2013. [\[Link\]](#).
- [28] N. Klco. Zeltsman marimba festival review. *Percussive Arts Society (PAS) Percussive News*, 2013.

## Grants, Funding, and Patents

- International Collaborator for Alliance International Catalyst Quantum grant from the National Sciences and Engineering Research Council of Canada (NSERC) with colleague Olivia DiMatteo "Qutrit compilation strategies toward practical quantum simulations of lattice gauge theories" (September 2023)
- co-PI for National Science Foundation (NSF) division of physics grant "Software Tailored Architecture for Quantum co-design (STAQ)-II" (September 2023)

- Funded workshop “Entanglement, Thermalization, and Holography” at the Simons Center for Geometry and Physics (January 2023, workshop date: March 2024)
- Secured funding from the Society of Physics Students (SPS) national office to support the Zone 5 meeting hosted by Duke’s SPS chapter (January 2023, meeting date: February 2023)
- Funded workshop “At the Interface of Quantum Sensors and Quantum Simulations (22-3b)” at the InQubator for Quantum Simulation (June 2021, workshop date: November 2022)
- Research utilized for Microsoft-created patent No. 20200394544: *Swap Networks for Quantum Computation* (December 2020)
- Secured research funding through Microsoft Research PhD Fellowship (2018-2020)

## Articles, Books, and Exposure

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- Research article [20] highlighted in *Analyzing the Schwinger Model Using Quantum Circuits* blog post by Sujay Kazi (February 2021)
- Research article [16] utilized in first-place project in IBM’s Qiskit Summer Jam 2020 and presented at the American Physical Society Conference for Undergraduate Women in Physics 2022 by Aurelia Brook, Dries Sels, Javad Shabani, and Andreas Tsantilas <https://meetings.aps.org/Meeting/CUWIP22/Session/A01.161>
- Research article [20] utilized as basis in *iQuHACK 2020*, annual MIT quantum computing hackathon, project by collaboration *group2*, winning the industry choice award [https://github.com/iQuHACK/2020\\_group2](https://github.com/iQuHACK/2020_group2)
- Faculty profile written by Robin A. Smith, *Computing the Quantum World*, published for the highlight *Meet the Newest Trinity College of Arts & Sciences Faculty* at Duke University.
- Writing *Entangled Fields and Post-Anthropocene Computation: Quantum Perspectives for a Healthy Planet* presented on *Quantum Frontiers* blog by the Institute for Quantum Information and Matter at Caltech (November 7, 2021. COP26 Day 8) [Swedish Translation]
- Writing *Reflections from Isolation (#12): Regression to Normal* highlighted at the Institute for New Economic Thinking Conference: Just Transition and the Transition to Justice.
- Caltech Magazine Highlight on Physics, Music, and Photography. *In all its Complexity*
- Author of zero-selling children’s book: *Charlotte the Quantum Baby*
- Interviewed on *IBM Circuit Sessions: Circuits in Action from Industry to Academia* on the role of quantum circuits in the quantum simulation of quantum field theories.
- Supported industry educational outreach program *Microsoft Quantum Impact: Teaching the next generation of quantum*
- Featured story by Whitney Sanchez *A Quantum Leap* published in Perspectives Newsletter for the University of Washington College of Arts and Sciences
- Scientific Reference for article by Shannon Brescher Shea *Quantum Computing: Learning to Speak a Whole New Technology* for the Office of Science
- Scientific Reference ([link](#)) for the press release of Fermilab’s Quantum Information Science-Enabled Discovery (QuantISED) initiative.

## Presentations

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- Lightning talk *Entanglement, Scalar Field Vacuum Initialization, and Trapped Ion Chains* at the *Simons Center for Geometry and Physics* workshop *Entanglement, Thermalization, and Holography* (April, 2024)
- Presented interconnectivity of Duke Nuclear Theory group research program for prospective students at the Duke physics Open House event (February 2024).
- Invited seminar speaker for high energy theory, cosmology and quantum information science groups at Syracuse University, *Quantum Simulating (with) Nature’s Quantum Correlations* (Syracuse, New York. December 2023)
- Invited speaker at IBM Quantum Innovation Center Workshop at NC state, *Quantum Simulating (with) Nature’s Quantum Correlations* (Raleigh, North Carolina. November 2023)
- Colloquium speaker at University of Waterloo department of physics and astronomy, *Quantum Simulating (with) Nature’s Quantum Correlations* (Waterloo, Ontario. October 2023)
- Invited Speaker at Inaugural Conference of the Center for Distributed Quantum Processing at Stony Brook University, *QIS Frontiers in High Energy Physics: Quantum Simulating (with) the Distributed Quantum Correlations of Nature’s Fundamental Fields* (Long Island, New York. October, 2023)
- Invited Speaker at Research Experience for Undergraduates (REU) site at University of Tennessee Knoxville focused on quantum algorithms and optimization (Knoxville, Tennessee. July, 2023)
- Panelist at Jefferson National Laboratory’s *Quantum Computing Boot Camp Symposium* (Newport News, Virginia. June, 2023)
- Invited speaker at *Quantum Computing, Quantum Simulation, Quantum Gravity and the Standard Model* workshop at the InQubator for Quantum Simulation (IQUS), *Lattice QCD on Quantum Computers* (Seattle, Washington. June, 2023)
- Invited speaker and panelist at Topical Workshop *Toward Quantum Advantage in High Energy Physics* of Program *Quantum Computing Methods for High Energy Physics* at the Munich Institute for Astro-, Particle, and BioPhysics (MIAPbP). *Entanglement in quantum fields: how to define, probe, and harness?* (Garching, Germany. April, 2023)


- Invited speaker for Nuclear and Particle Physics Colloquium (NPPC) at the Laboratory for Nuclear Science (LNS) at the Massachusetts Institute of Technology (MIT), *Calculating Nature Naturally: Quantum Simulating Entangled Quantum Fields* (Cambridge, Massachusetts. March, 2023)
- Invited speaker at Duke Physics Department Chair's Reception for prospective graduate students. *Computing with Quarks?* (Durham, North Carolina. March, 2023)
- Colloquium speaker at Iowa State University. *Quantum simulating (with) an entangled fabric* (Ames, Iowa. December, 2022)
- Participant-requested chalk talk at the workshop on quantum sensing and quantum simulation hosted by the InQubator for Quantum Simulation (IQuS) at the national Institute for Nuclear Theory (INT). *Detection profiles for extracting spacelike entanglement from the scalar field vacuum.* (Seattle, Washington. November, 2022)
- Presenter of the Christine Aidala Lecture in Physics for the Duke University Society of (Senior) Women in Science. *Calculating Nature Naturally: Processing Information with Quantum Correlations* (Durham, North Carolina. November, 2022)
- Invited speaker at Southwest Quantum Information and Technology (SQulnT) Annual Workshop. *Quantum simulating (with) an entangled fabric: codesigning lattice gauge theories for quantum simulation* (Berkeley, California. October, 2022)
- Invited speaker at Next-Generation Computing for Low-Energy Nuclear Physics: from Machine Learning to Quantum Computing workshop ([Link]) at the InQubator for Quantum Simulation. *Progress in quantum computing non-Abelian lattice gauge theories* (Seattle, Washington. August, 2022)
- Invited speaker at Snowmass 2022 Community Summer Study Workshop ([Link]). *Quantum Simulation for High Energy Physics* (Seattle, Washington. July, 2022)
- Invited speaker at Munich Conference for Quantum Science and Technology (MCQST) ([Link] [Speaker Photos]). *Quantum Simulating (with) an Entangled Fabric: Towards Protocols for Extracting Vacuum Entanglement* (Sonthofen, Germany. July, 2022)
- Lecturer at summer school on Advanced Cyberinfrastructure Training for Modeling Physical Systems at Rensselaer Polytechnic Institute (RPI). *Emerging Techniques Toward Dynamical SU(3) Quantum Simulation* (Troy, New York. June, 2022)
- Lecturer at Fermilab Particle Physics Division Quantum Computing Internship for Physics Undergraduates (QCIPU). *Entanglement I & II* (Batavia, Illinois. June, 2022)
- Invited Speaker at Quantum Science Center (QSC) and Superconducting Quantum Materials and Systems Center (SQMS) Quantum Algorithms Workshop. *Quantum Fields: Quantum Simulating (with) an Entangled Fabric* (Center for Quantum Information and Control (CQulC). Albuquerque, New Mexico. May, 2022)
- Rutgers Condensed Matter Seminar speaker. *Calculating Nature Naturally: Capturing Entanglement in the Quantum Vacuum* (New Brunswick, New Jersey. April, 2022)
- Presented [Poster](#) at Duke Quantum Center inaugural event. *Toward Quantum Simulation of Quantum Fields* (Durham, North Carolina. April, 2022)
- Lawrence Berkeley National Lab (LBNL) Quantum Computing for High Energy Physics Seminar. *Calculating Nature Naturally: Bound Entanglement in the Quantum Vacuum* (Berkeley, California. February, 2022)
- Overview of Caltech IQIM research at Fermilab Quantum Theory Consortium Meeting (Batavia, Illinois. December, 2021)
- Invited speaker at Brookhaven Quantum Journal Club. *Calculating Nature Naturally: Entanglement Structures for Simulation of Quantum Fields* (Upton, New York. November, 2021)
- Panelist for theory discussion at the InQubator for Quantum Simulation (IQuS) workshop [Scientific Quantum Computing and Simulation on Near-Term Devices: Quantum Simulations of Strongly Correlated Systems](#) (Seattle, Washington. November 2021)
- Colloquium speaker at PRISMA+ excellence cluster. *Calculating Nature Naturally: Quantum Simulating Quantum Fields* (Mainz, Germany. November, 2021)
- Speaker at Caltech's [FUTURE of Physics 2021](#). *Effective Field Theories, Music, and Quantum Information: Trajectory to the Complexity Frontier* (Pasadena, California. September, 2021)
- Plenary Speaker at the 38th International Symposium on Lattice Field Theory. *SU(3) Gauge Theory on Quantum Hardware: Current Implementations and Scalable Perspectives, Contextualizing Progress 2020-2021* (Cambridge, Massachusetts. July, 2021)
- Lecturer at Fermilab Particle Physics Division Quantum Computing Internship for Physics Undergraduates (QCIPU). *Entanglement I & II* (Batavia, Illinois. July, 2021)
- High Energy Theory Seminar at Caltech. *Entanglement Spheres and a UV-IR Connection in Effective Field Theories* (Pasadena, California. May, 2021.)
- High Energy Physics/Medium Energy Physics Seminar at University of Illinois at Urbana-Champaign. *A Trailhead for Quantum Simulation of SU(3) Yang Mills* (Urbana-Champaign, Illinois. May, 2021.)
- Invited speaker at the APS April meeting session on Applications of Quantum Computing. *Trailhead for Quantum Simulation of SU(3) Lattice Gauge Theory* (Aether. April, 2021)
- Plenary speaker at the APS Topical Group in Hadronic Physics. *Quantum Simulation for Lattice Gauge Theories* (Sacramento, California. April, 2021)
- [Quantum Simulation of Strong Interactions \(QuaSi\) Workshop 1: Theoretical Strategies for Gauge Theories](#). *Orientation at the Local Irrep Trailhead* (Seattle, Washington. April, 2021)

- Triangle Nuclear Theory Seminar at Duke University. *Entanglement Structures in Quantum Fields: Quantum Simulation to Effective Field Theories* (Durham, North Carolina. January 2021)
- Seminar at the Institute for Quantum Information and Matter (IQIM). *Post-Anthropocene Computation: Rewilding the Quantum Field* (Pasadena, California. December 2020)
- Seminar at the Stony Brook University Center for Nuclear Theory (CNT). *Calculating Nature Naturally: Entanglement Scales in Low Energy Nuclear Interactions* (Stony Brook, New York. November 2020)
- Hosted poster room at the National Science Foundation (NSF) site review of the Institute for Quantum Information and Matter (IQIM). *Choose your own Adventure: Toward Quantum Simulation of Lattice Gauge Theories* (Pasadena, California. November 2020)
- Seminar at European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT\*) workshop, Advances in Many-Body Theories: From First Principle Methods to Quantum Computing and Machine Learning. *Musings on the Intersimulatability of Quantum Fields* (Trento, Italy. November 2020)
- American Physical Society Division of Nuclear Physics Meeting Mini-Symposium: Quantum Information Science and Technology for Nuclear Physics. *SU(2) Non-Abelian Gauge Field Theory in One Dimension on Digital Quantum Computers: A (Flippantly Presented) Short Story Quantumly Implementing SU(2) Plaquettes* (New Orleans, Louisiana. October 2020)
- Physics Department Colloquium at Ohio University. *Calculating Nature Naturally: An Entanglement Perspective* (Athens, Ohio. October 2020)
- Nuclear Theory Seminar at the National Superconducting Cyclotron Laboratory/Facility for Rare Isotope Beams (NSCL/FRIB). *Entanglement Scales in Low Energy Nuclear Interactions* (East Lansing, Michigan. October 2020)
- Theory Seminar at University of Kentucky. *Calculating Nature Naturally* (Lexington, Kentucky. October 2020)
- Seminar at Institute for Nuclear Theory Program (INT-20-3) Scientific Quantum Computing and Simulation on Near-Term Devices. *Surveying the Lush Forest of Quantum Simulation* (Seattle, Washington. October 2020)
- Presentation to the Institute for Nuclear Theory (INT) National Advisory Committee on recent progress in the use of quantum devices for many-body calculations in nuclear physics (Fall 2020)
- University of Washington Visit Weekend Theory Symposium, *Calculating Nature Naturally* (Seattle, Washington. February 2020)
- Duke University Information Seminar, *Local Quantum Circuits for Beyond-Classical Scalar Quantum Field Theory* (Durham, North Carolina. February 2020)
- Physics Department Colloquium at Duke University, *Calculating Nature Naturally: Quantum Calculations with Quantum Systems* (Durham, North Carolina. February 2020)
- Seminar at the Perimeter Institute for Theoretical Physics, *Calculating Nature Naturally: Localized Operators for Quantum Field Theory State Preparation* (Waterloo, Ontario. December 2019)
- Seminar at the Institute for Quantum Computing at the University of Waterloo, *Calculating Nature Naturally: Quantum Field Theory on Quantum Devices* (Waterloo, Ontario. December 2019)
- Seminar for the Institute for Quantum Information and Matter (IQIM) at Caltech, *Calculating Nature Naturally: Quantum Field Theory on Quantum Devices* (Pasadena, California. November 2019)
- Invited tutorial at University of North Carolina, *Quantum Fields on qubit degrees of freedom* (Chapel Hill, North Carolina. October 2019)
- Invited Triangle Nuclear Theory seminar *Calculating Nature Naturally* (Durham, North Carolina. October 2019)
- Invited tutorial at Duke University, *S-matrix Entanglement Power* (Durham, North Carolina. October 2019)
- Presentation to the Institute for Nuclear Theory (INT) National Advisory Committee on recent progress in the application of quantum computing/information to the many-body calculations of nuclear physics (July 2019)
- Presentation at Kavli Aspen Center for Physics Workshop: Intersections quantum information science/high-energy physics, *Low-entanglement state preparation for scalar fields* (Aspen, Colorado. May 2019)
- Presented poster at 2019 Northwest Quantum Nexus Summit, *NISQ-era QFT* (Seattle, Washington. March 2019)
- Invited seminar at Skyline Community Science and Technology Group, *Computing with Entanglement* (Seattle, Washington. March 2019)
- Invited seminar at Fermilab theoretical physics department, *(little) Quantum Field Theory for (little) Quantum Devices* (Batavia, Illinois. February 2019)
- Invited department colloquium at Rensselaer University, *(little) Quantum Field Theory for (little) Quantum Devices* (Troy, New York. February 2019)
- Invited seminar for high energy/cosmology theory at Columbia University, *(little) Quantum Field Theory for (little) Quantum Devices* (New York, New York. February 2019)
- Invited talk at the Nuclear Physics Pre-Pilot Program in Quantum Computing and Quantum Information, *(little) Quantum Field Theory for (little) Quantum Devices* (Santa Fe, New Mexico. January 2019)
- Invited seminar at the Center for Experimental Nuclear physics and Astrophysics (CENPA), *Quantum computing for nuclear physics* (Seattle, Washington. December 2018)



- Invited seminar at Lawrence Berkeley National Lab Particle Theory Seminar, *Quantum computing for nuclear and particle physics* (Berkeley, California. December 2018)
- Invited poster at Microsoft Research Phd Fellowship Summit, *Quantum Fields on Quantum Computers* (Seattle, Washington. October 2018)
- Invited talk at the Fifth Joint Meeting of the Nuclear Physics Divisions of the American Physical Society (APS) and Japanese Physical Society (JPS), *Quantum computing for nuclear physics: status and expectations* and *Real-time dynamics of lattice gauge theories with a few-qubit quantum computer* (Waikoloa, Hawaii. October 2018)
- Lightning talk, *Calculating with Nature's Quantum Bits* at UW High Performance Computing Club event Lightning Strikes: Success in Research Computing (October 2018)
- Invited talk, *Calculating with Nature's Quantum Bits* at University of Washington, Bothell Campus' Physical Sciences Division 2018 Seminar Series Colloquium (October 2018)
- Invited poster, *NISQ-era QFT* at Quantum Algorithms and Testbeds PI Meeting sponsored by the U.S. Department of Energy Office of Advanced Scientific Computing Research (ASCR) and Computational Science Research Partnerships (SciDAC) Division. (Oak Ridge, Tennessee. September 2018)
- Invited talk at, *Next Steps in Quantum Computing for HEP* workshop hosted at Fermi National Lab (FNAL), *Digitization of the Scalar Field for NISQ-era Quantum Computing* (Batavia Illinois. September 2018)
- Presentations for Microsoft Quantum Architectures group QuArC in Redmond, *Non-local to Local: Quantum Chemistry for Quantum Computers* (July, August 2018)
- General Exam, *Quantum + Classical: Simulating Nature Naturally* (May 2018)
- Invited talk at the Advances in Quantum Algorithms and Computation program at the Aspen Center for Physics, *Quantum + Classical: heterogeneous calculations of Schwinger model dynamics* (Aspen, Colorado. March 2018)
- Presentation to visiting students, *Calculating Field Theories with Nature's Quantum Bits* (March 2018)
- Short talk for the special topics class on the Quantum Hall Effect on the use of Ising anyons for manipulating quantum information for scientific calculations (Winter 2018)
- Nuclear Theory brown bag talk on the role of entanglement entropy in quantum algorithm development and its definition in theories with non-local, gauge-invariant degrees of freedom (Winter 2018)
- University of Washington's Particle Theory Journal Club: *Composing Chiral Symmetry on the Lattice* (Fall 2017)
- Presentation to the Institute for Nuclear Theory (INT) National Advisory Committee on the expected role of quantum computing in the many-body calculations of nuclear physics (Fall 2017)
- University of Washington's Particle Theory Journal Club: *Physics Transcriptions: Gluon Scattering Amplitudes and BCFW Recursion*
- Weekly lecture series for the INTUW Quantum Computing Group on the basics of algorithms and current research for the quantum-mechanically-literate physicist (Winter–Spring 2017)
- University of Washington's Particle Theory Journal Club: *Quantum Embellishments: matching and running at loop order in EFTs* (Fall 2016)
- Presentation to INT National Advisory Committee on the proceedings of the program “Bayesian Methods in Nuclear Physics” (Summer 2016)
- Presentation at INT Program “Bayesian Methods in Nuclear Physics”: *Estimating and checking truncation errors in effective field theory* (Summer 2016)
- University of Washington's Particle Theory Journal Club: *Introduction to Conformal Symmetry* (Spring 2016)

## Honors, Scholarships, and Creative Activity

- While Society of Physics Students (SPS) faculty adviser, Duke Chapter received the [Outstanding Chapter Award](#) (2022-2023).
- Selected member of the Duke University Leadership Development for Researchers (LEADER) program, a 6-month interactive program designed to equip early career faculty with leadership skills to effectively establish and manage a research group or team (Winter 2022).
- Fifth most highly cited article published in Reports on Progress in Physics (ROPP) during 2022 [\[Link\]](#)
- Commissioned artist Ellyna Ruan to design graphic accompanying Ref. [\[10\]](#) honored as PRD Editor's Suggestion (Spring 2021).
-  Awarded Institute of Physics (IOP) trusted reviewer status: acknowledges demonstration of a high level of peer review competence, with the ability to critique scientific literature to an excellent standard. (Fall 2020)
- Recipient of University of Washington Departmental Henderson Prize in Physics: awarded each May to a recent recipient of PhD degree of excellence for outstanding graduate student research and Ph.D. thesis. (Spring 2020)
- Recipient of University of Washington Departmental Sebastian Karrer Prize in Physics: awarded each May to a second or third year graduate student who has done meritorious work. This monetary award is based on excellence of scholastic record and on professional promise. (Spring 2018)
- Recipient of [Outstanding Reviewer Award](#) for the IOP New Journal of Physics (2017)
- Microsoft Research Internship in the Quantum Architectures group focused on Quantum Simulation (Summer 2018)

- Recipient of Outstanding first-year TA award from University of Washington physics department (Spring 2017)
- Seattle Chapter ARCS (Achievement Rewards for College Scientists) scholar (2015–2018)
- Herbert Baer Prize Winner: Multidisciplinary essay contest *Exploring Intellectual Space with Non-Orthogonal Music and Physics Vectors* (2015)
- Honorable Mention for Ohio University Honors Tutorial College Dean's Citation for Outstanding Thesis (2015)
- Honorable Mention at Ohio University Undergraduate Physics Research Conference (2015)
- Member of Sigma Pi Sigma: National Physics Honor Society (2015–Present)
- First round interview participant for Hertz Foundation Graduate Fellowship (2015)
- Recipient of Distinguished Professor Scholarship (Fall 2014, Dr. Peter Jung)
- Member of Ohio University's Fellows Program (Fall 2013–Present)
- Dean's List at Ohio University (Fall 2011–Spring 2015)
- Speaker at Ohio University Honors Tutorial College Induction Ceremony (Fall 2013, 2014)
- Presented at Ohio University Physics Department's Open House on the physics of sound (2013)
- Presented at Ohio University Student Expo on the history, construction, and performance of the marimba (2012)
- Recipient of Ohio University Gateway Scholarship (2011–2014)
- Recipient of John Edwards Physics Scholarship (2011, 2012, 2013)
- Recipient of GlenOak high school academic achievement award in English (2011)
- Acceptance into National Honors Society (Fall 2010)

### Music Specific

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- Timpanist for Puget Sound Symphony Orchestra (Spring 2016)
- Graduated member of University of Washington's change bell ringing tower (Spring 2016)
  - Quarter Peals: 3
- Attended and performed at the Zeltsman Marimba Festival (Summer 2013)
- Performed at Ohio Day of Percussion Solo Showcase judged by Michael Burritt, Jim Culley, and Gwen Dease (Spring 2013)
- Performed with the Canton Comic Opera (2012, 2013)
- Winner of Ohio University Concerto Competition (2012–2013)
- Recipient of Ludwig Industries PASIC scholarship (2013)
- Attended and performed at the Leigh Howard Stevens Marimba Seminar (Summer 2012)
- Performed at Ohio Day of Percussion Master Class with Gordon Stout (Spring 2012)
- Member of Ohio University Percussion Club (Fall 2011–Spring 2015)
- Attended and performed at Eastman School of music summer percussion session (Summer 2011)
- Zampino's Drum Shop student of the year (2011)
- Recipient of PLIMPA music scholarship (2011)
- Recipient of Matthew W. Fox memorial music scholarship (2011)
- Recipient of John Phillip Sousa Band award (2011)
- Recipient of the MacDowell Music Club Scholarship (2011)
- Ohio University Honor Band and Choir Festival (2009, 2010, 2011)

### Skills

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#### Type Setting, Environments, and Languages:

Latex, Mathematica, C++, Python, Matlab, Microsoft Office, Root, Morse Code–Licensed Amateur Radio Technician (K17DEH), Unified English Braille, Basic Fortran and Linux.