NICHOLAS A. EZZELL

Quantum Information Scientist
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POSITIONS

HRL Laboratories *2025 — Present*
Theoretical quantum information scientist
Developed leakage detection, simulation, and removal methods in exchange only spin qubits

EDUCATION

Ph.D., University of Southern California *2019 — 2025*
Department of Energy Computational Science Graduate Fellow in Physics
Dissertation committee: Itay Hen (chair), Daniel Lidar, Todd Brun, Paolo Zanardi, Eli Levenson-Falk
Dissertation: *Theory and design of algorithms for quantum systems*
Topics: Quantum information and computation, Monte Carlo, phase transitions, dynamical decoupling

B.S., Mississippi State University *2015 — 2019*
Majors: Physics and Mathematics, *summa cum laude*, Presidential Scholar
Honors thesis: *Exploring and improving the uses of near-term quantum annealers* with Mark Novotny

Mississippi School for Mathematics and Science *2013 – 2015*
High School Diploma

RESEARCH EXPERIENCE

Los Alamos National Laboratory, Graduate Intern (DOE CSGF) 2021 — 2022
Host: Andrew Sornborger

- *Defined and solved quantum low rank approximation problem using majorization theory*
- *Designed variational approach to mixed state tomography and unitary quantum machine learning*

Oak Ridge National Laboratory, Undergraduate Intern (SULI) 2017 — 2018

- Advised by Travis Humble May – August 2018 ⋄ *Simulations of Ising systems on D-Wave*
- Advised by Miguel Fuentes-Cabrera May — August 2017 ⋄ *Computational study of 2D self-assembly*

Mississippi State University, Undergraduate Researcher 2016 — 2019

- Advised by Mark Novotny 2018 – 2019 ⋄ *Improving quantum annealing with better annealing schedules*
- Advised by Nicholas Fitzkee 2016 — 2017 ⋄ *Using Monte Carlo to study intrinsically disordered proteins*

HONORS/ AWARDS

Gold Family Graduate Fellowship, University of Southern California	2024
ITensor New User of the Month	2024
IOP Outstanding Reviewer Award (Journal of Physics A: Mathematical and Theoretical)	2023
IOP Trusted Reviewer	2022
Department of Energy Computational Science Graduate Fellowship	2019 – 2023
Shackouls Honors College Outstanding Research Award, Mississippi State University	2019
Unitary Fund Award	2018
Goldwater Scholar	2018
College of Arts and Sciences Undergraduate Student Research Award	2018

Study abroad scholarship to Christ Church of the University of Oxford 2017
Presidential Scholar, Mississippi State University 2015 – 2019

PROFESSIONAL ACTIVITIES

Journal review: npj Quantum Information, Journal of Physics A: Mathematical and Theoretical, New Journal of Physics

Conference review: QIP 2023, AQIS 2024

Conference chair volunteer: APS 2023

VOLUNTEERING AND OUTREACH

Lecture on entanglement ◇ Physics students of MSMS high-school 27 November 2023
Undergraduate Mentor ◇ Physics Mentorship Program of USC 2023
College Bound Mentor ◇ Santa Monica Boys and Girls Club 2022 — 2023
STEM Tutor ◇ Santa Monica Boys and Girls Club 2022
Course tutor ◇ Supplementary online quantum mechanics course 2021
Mentor ◇ Graduate school and scholarship applications (10+ students) 2019 – 2025

TECHNICAL COMPUTER SKILLS

Programming Languages	Python, Mathematica, Julia, C/C++
Software & Tools	GitHub, LaTeX, conda, Command Line (Bash), Jupyter, Docker
Concepts	(Quantum) Monte Carlo, Tensor networks, Supercomputing Parallel computing, Machine learning, Numerical analysis variational quantum algorithms, Clifford simulation

RESEARCH PUBLICATIONS

[*] **Nic Ezzell** and Itay Hen, "Advanced measurement techniques in quantum Monte Carlo: The permutation matrix representation approach," Computer Physics Communications , 110019 (2026).

[*] **Nic Ezzell**, Lev Barash, and Itay Hen, "A universal black-box quantum Monte Carlo approach to quantum phase transitions," npj Computational Materials (2025).

[*] Joe Gibbs, Zoë Holmes, Matthias C Caro, **Nicholas Ezzell**, Hsin-Yuan Huang, Lukasz Cincio, Andrew T Sornborger, and Patrick J Coles, "Dynamical simulation via quantum machine learning with provable generalization," Physical Review Research 6, 013241 (2024).

[*] **Nic Ezzell**, Bibek Pokharel, Lina Tewala, Gregory Quiroz, and Daniel A Lidar, "Dynamical decoupling for superconducting qubits: a performance survey," Physical Review Applied 20, 064027 (2023).

[*] Matthias C Caro, Hsin-Yuan Huang, **Nicholas Ezzell**, Joe Gibbs, Andrew T Sornborger, Lukasz Cincio, Patrick J Coles, and Zoë Holmes, "Out-of-distribution generalization for learning quantum dynamics," Nature Communications 14, 3751 (2023).

[*] **Nic Ezzell**, Elliott M Ball, Aliza U Siddiqui, Mark M Wilde, Andrew T Sornborger, Patrick J Coles, and Zoë Holmes, "Quantum mixed state compiling," Quantum Science and Technology 8, 035001 (2023).

[*] Yue Zhang, Valeria Zai-Rose, Cody J Price, **Nicholas A Ezzell**, Gene L Bidwell, John J Correia, and Nicholas C Fitzkee, "Modeling the early stages of phase separation in disordered elastin-like proteins," Biophysical Journal 114, 1563–1578 (2018).

PREPRINTS

[*] **Nicholas Ezzell**, Alan Tran, Kevin He, Stephen Carr, Daniel Volya, Riley Murray, Corey Ostrove, Kevin Young, Robin Blume-Kohout, and Thaddeus Ladd, "Leakage aware gate set tomography, quantification, and removal in an exchange only qubit," in preparation (2026).

[*] Qiulin Zeng, **Nicholas Ezzell**, Arman Babakhani, Itay Hen, and Lev Barash, "Inequalities, identities, and bounds for divided differences of the exponential function," arXiv preprint arXiv:2510.10724 (2025).

[*] Victor Kasatkin, Evgeny Mozgunov, **Nicholas Ezzell**, Utkarsh Mishra, Itay Hen, and Daniel Lidar, "Classifim: an unsupervised method to detect phase transitions," arXiv preprint arXiv:2408.03323 (2024).

[*] Victor Kasatkin, Evgeny Mozgunov, **Nicholas Ezzell**, and Daniel Lidar, "Detecting quantum and classical phase transitions via unsupervised machine learning of the fisher information metric," arXiv preprint arXiv:2408.03418 (2024).

[*] **Nic Ezzell**, Zoë Holmes, and Patrick J Coles, "The quantum low-rank approximation problem," arXiv preprint arXiv:2203.00811 (2022).

INVITED TALKS

[*] "What's going on in quantum computing these days?," Physics Colloquium, Mississippi State University, 28 November 2023.

[*] "Quantum low-rank approximation and quantum mixed state compiling," QAISG QML Seminar, Centre for Quantum Technologies, National University of Singapore, 5 April 2023.

CONTRIBUTED TALKS

[*] "A black-box quantum Monte Carlo approach to quantum phase transitions and more," 26th IUPAP Conference of Computational Physics 2025, Online.

[*] "Advanced measurement in quantum Monte Carlo," American Physical Society March Meeting 2025, Anaheim, California, USA.

[*] "Using quantum Monte Carlo to study quantum phase transitions," American Physical Society March Meeting 2024, Minneapolis, Minnesota, USA.

[*] "A variational approach to quantum tomography," Annual Program Review of Department of Energy Computational Science Graduate Fellowship 2023, Washington, DC, USA.

[*] "The quantum low-rank approximation problem and mixed state compiling," American Physical Society March Meeting 2023, Las Vegas, Nevada, USA.

[*] "Quantum mixed state compiling and the quantum low-rank approximation problem," 24th Southwest Quantum Information and Technology conference 2022, Berkeley, California, USA.

[*] "Survey of dynamical decoupling sequences on superconducting qubit devices," American Physical Society March Meeting 2022, Chicago, Illinois, USA.

[*] "A survey of dynamical decoupling sequences on a programmable superconducting quantum computer," American Physical Society March Meeting 2021, Online.

[*] "Forward-reverse error mitigation algorithm for quantum annealers," American Physical Society March Meeting 2019, Boston, Massachusetts, USA.

[*] "Sidedness and height-offset effects on the 2D self-assembly of the hexagonal tiles of bacterial microcompartments," American Physical Society March Meeting 2018, Los Angeles, California.

POSTERS

[*] "Advanced measurement in quantum Monte Carlo," USC Ming Hsieh Research Festival 2024, Los Angeles, California, USA.

[*] "Advanced measurement in quantum Monte Carlo," USC Quantum Technologies Forum 2024, Los Angeles, California, USA.

[*] "Using quantum Monte Carlo to study quantum phase transitions," 25th Southwest Quantum Information and Technology conference 2023, Albuquerque, New Mexico, USA.

[*] "Quantum low-rank approximation problem," Annual Program Review of Department of Energy Computational Science Graduate Fellowship 2022, Washington, DC, USA.

[*] "Simulations of Ising Models using a Quantum Computer," Oak Ridge National Laboratory Summer Student Poster Session 2018, Oak Ridge, TN.

[*] "Modeling Intrinsically Disordered Proteins with Chemically Realistic Monte-Carlo Simulations", Mississippi State University Spring Undergraduate Research Symposium 2017, Mississippi State, Mississippi, USA.

[*] "Improving the Performance of Simulations of the Intrinsically Disordered N-terminal Domain from p53," 61st Annual Biophysical Society Meeting 2017, New Orleans, Louisiana, USA.