

NICHOLAS A. EZZELL

Department of Energy Computational Science Graduate Fellow

Department of Physics & Astronomy, University of Southern California, Los Angeles, CA, 90089-0484

email: nezzell@usc.edu ◊ website: <https://naezzell.github.io/>

EDUCATION

University of Southern California

August 2019 - Present

PhD in Physics

Advisors: Daniel Lidar and Itay Hen

Thesis areas: Quantum computation (NISQ), quantum Monte Carlo, quantum phase transitions

Mississippi State University

August 2015 – May 2019

summa cum laude BS in Physics; *summa cum laude* BS in Mathematics

Honors Thesis topic: Exploring and improving the uses of near-term quantum annealers

Mississippi School for Mathematics and Science

August 2013 – May 2015

High School Diploma

RESEARCH EXPERIENCE

Department of Energy Computational Science Graduate Fellow

August 2019 – Present

University of Southern California

- Member of Daniel Lidar's group ◊ *Key topics: Dynamical decoupling, open quantum systems, quantum annealing, quantum error correction, quantum phase transitions, superconducting qubits*
- Member of Itay Hen's group ◊ *Key topics: Quantum Monte Carlo, quantum phase transitions*

Research Intern

May 2021 – September 2022

Los Alamos National Laboratory, 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*

Science Undergraduate Laboratory Intern (SULI)

May – August 2017, 2018

Oak Ridge National Laboratory, Advisors: Travis Humble and Miguel Fuentes-Cabrera

- 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*

Undergraduate Researcher

2016 – 2019

Mississippi State University, Advisors: Mark Novotny, Nicholas Fitzkee

- 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

IOP Trusted Reviewer

2022

Department of Energy Computational Science Graduate Fellowship

2019 – 2023

Mississippi State University Shackouls Honors College Outstanding Research Award

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

Mississippi State University Presidential Scholar

2015 – 2019

SYNERGISTIC ACTIVITIES

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

Conference review: QIP

Conference chair volunteer: APS 2023, APS 2024

VOLUNTEERING AND OUTREACH

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

TECHNICAL COMPUTER SKILLS

Programming Languages	Python, Mathematica, Julia, C/C++
Software & Tools	GitHub, L ^A T _E X, 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

- [1] **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).
- [2] 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).
- [3] **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).
- [4] 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).

RESEARCH PREPRINTS

- [1] Joe Gibbs, Zoe 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,” arXiv preprint arXiv:2204.10269. (2022).
- [2] **Nic Ezzell**, Zoë Holmes, and Patrick J Coles, “The quantum low-rank approximation problem,” arXiv preprint arXiv:2203.00811 (2022).

INVITED TALKS

- [1] “What’s going on in quantum computing these days?,” Physics Colloquium, Mississippi State University, 28 November 2023.
- [2] “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

- [1] “Using quantum Monte Carlo to study quantum phase transitions,” American Physical Society March Meeting 2024, Minneapolis, Minnesota, USA.
- [3] “A variational approach to quantum tomography,” Annual Program Review of Department of Energy Computational Science Graduate Fellowship 2023, Washington, DC, USA.
- [3] “The quantum low-rank approximation problem and mixed state compiling,” American Physical Society March Meeting 2023, Las Vegas, Nevada, USA.
- [4]) “Quantum mixed state compiling and the quantum low-rank approximation problem,” 24th Southwest Quantum Information and Technology conference 2022, Berkeley, California, USA.
- [3] “Survey of dynamical decoupling sequences on superconducting qubit devices,” American Physical Society March Meeting 2022, Chicago, Illinois, USA.
- [4] “A survey of dynamical decoupling sequences on a programmable superconducting quantum computer,” American Physical Society March Meeting 2021, Online.
- [5] “Forward-reverse error mitigation algorithm for quantum annealers,” American Physical Society March Meeting 2019, Boston, Massachusetts, USA.
- [6] “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

- [1] “Using quantum Monte Carlo to study quantum phase transitions,” 25th Southwest Quantum Information and Technology conference 2023, Albuquerque, New Mexico, USA.
- [2] “Quantum low-rank approximation problem,” Annual Program Review of Department of Energy Computational Science Graduate Fellowship 2022, Washington, DC, USA.
- [3] “Simulations of Ising Models using a Quantum Computer,” Oak Ridge National Laboratory Summer Student Poster Session 2018, Oak Ridge, TN.
- [4] “Modeling Intrinsically Disordered Proteins with Chemically Realistic Monte-Carlo Simulations”, Mississippi State University Spring Undergraduate Research Symposium 2017, Mississippi State, Mississippi, USA.
- [5] “Improving the Performance of Simulations of the Intrinsically Disordered N-terminal Domain from p53,” 61st Annual Biophysical Society Meeting 2017, New Orleans, Louisiana, USA.