



Education

Ph.D. in Mathematics

University of California Davis, CA (*expected*) Dec 2023

Advisor: Bruno Nachtergaele

Thesis: Dimerized Quantum Spin Chains and Symmetry Protected Topological (SPT) Phases of Quantum Matter

Bachelor of Science in Electrical and Computer Engineering

The University of Arizona, Tucson, AZ May 2018

Publications

Publications

Curious Dimerization in a Class of $SO(n)$ -Invariant Quantum Spin Chain Ground States, (*in preparation*) Bruno Nachtergaele and Michael Ragone

Representation Theory for Geometric Quantum Machine Learning, ([preprint 2022](#)) Michael Ragone, Paolo Braccia, Quynh T. Nguyen, Louis Schatzki, Patrick J. Coles, Frederic Sauvage, Martin Larocca, M.Cerezo.

Theory for Equivariant Quantum Neural Networks, ([preprint 2022](#)) Quynh T. Nguyen, Louis Schatzki, Paolo Braccia, Michael Ragone, Patrick J. Coles, Frederic Sauvage, Martin Larocca, M.Cerezo.

The Power of Equivariant Quantum Neural Networks (*in preparation*) Paolo Braccia, Quynh T. Nguyen, Louis Schatzki, Michael Ragone, Patrick J. Coles, Frederic Sauvage, Martin Larocca, M.Cerezo.

Research Experience

Graduate Student Researcher, Mathematical Physics

University of California, Davis

Sep 2019 - (*ongoing*)

Advisor: Bruno Nachtergaele

Projects in mathematical treatments of quantum many-body physics with connections to quantum information theory. Investigating a class of $SO(n)$ -invariant quantum spin chain ground states which exhibit dimerization. The paper (*in preparation*) will shed light upon:

- Matrix product state/tensor network structure.
- State symmetry properties via representation theory of compact Lie groups.

- Rigorous proof of predicted symmetry-protected topological phase diagram via topological indices.
- A curious counterexample to a natural conjecture for parent Hamiltonians.

Graduate Student Researcher, Geometric Quantum Machine Learning

Los Alamos National Laboratory (T-Division)

Jun 2022 - Oct 2022

Advisors: Marco Cerezo and Patrick Coles

Constructed a general framework for finite and Lie group-equivariant quantum neural networks and demonstrated some provable performance improvements. Wrote an expository article on representation theory in quantum machine learning. Worked alongside numerics team to investigate practical performance improvements based on the theoretical framework.

Graduate Student Researcher, Mixed Classical-Quantum Simulation on a Quantum Computer

Los Alamos National Laboratory (T-Division)

Jun 2022 - Oct 2022

Advisors: Andrew Sornborger

Worked on a noisy intermediate scale quantum device-friendly paradigm for resource efficient quantum simulation of mixed classical-quantum systems which feature quantum “backreaction” in the classical system. Primarily analytic work accompanied by Matlab simulations.

Engineering Senior Design, Electrical and Computer Engineering

University of Arizona, Tucson, AZ

Aug 2017 - May 2018

Corporate Sponsor: General Dynamics

Advisors: Elmer Grubbs and Gary Redford

Designed, implemented, and tested a full system for Coast Guard marine distress call denoising. Primary roles in signal processing and neural network design. Implemented in Python and Tensorflow.

Undergraduate Researcher, Undergraduate Biology Research Project (UBRP)

The University of Arizona, Tucson, AZ

May 2015 - Oct 2017

Advisors: Jean-Marc Fellous and Onur Ozan Koyluoglu

Created a biophysical model of a rat hippocampal CA1 place cell network. Investigated phenomena related to: replay, plasticity, and path encoding. Collaborated with Laboratory for Information Processing Systems to investigate information content of replay events. Model programmed in NEURON and Matlab.

Undergraduate Researcher, Masaryk University Research Abroad Program

Masaryk University, Brno, Czech Republic

Jun 2017 - Jul 2017

Advisor: Přemysl Lubal

Used machine learning tools to address problems in analytical chemistry, including estimating various physical parameters from titration and fluorescence data.

Presentations and Workshops

Talks and Conference Presentations (* indicates invited speaker)

- * 2023 NC State Quantum Workshop, *Representation Theory for Geometric Quantum Machine Learning*. (Jan 2023)
- (*multiple summer schools 2022*), *Curious Dimerization in a Class of $SO(n)$ -invariant Matrix Product States* (Aug - Sep 2023)
- * Student-Run Research Seminar, UC Davis. *Solids, Liquids, and Topological Insulators: Symmetry Protected Topological (SPT) Phases of Quantum Matter*. (Jun 2021)
- Quantum Lattice Seminar, UC Davis. *An Overview of the AKLT Model*. (Jun 2020)
- Engineering Senior Design, University of Arizona. *Advanced Voice Filtering for R21 Using Machine Learning* (May 2018)
- Society for Neuroscience 2016, *A Model of Path-encoding by Hippocampal Place Cells as a Possible Neural Basis of Approximations to the Traveling Salesperson Problem* (Nov 2016)

Workshops and Summer Schools

- UC Davis, "QMATH 2022" (Sep 2022)
- Los Alamos National Laboratory, "Quantum Computing Summer School" (Jun - Aug 2022)
- Erwin Schrödinger Institute at University of Vienna, "Tensor Network based approaches to Quantum Many-Body Systems" (Sep 5-9 2022)
- Technische Universität München, "IAMP EMS Summer School in Mathematical Physics" (Aug 29 - Sep 2 2022)
- Simons Center, "Virtual Workshop C^* -algebras, K-theories and Noncommutative Geometries of Correlated Condensed Matter Systems" (May 17-21, 2021)
- Zurich ICMP Summer School, "Current Topics in Mathematical Physics" (Jul 19-23 2021)

Teaching Experience

Graduate Professor, UC Davis (Summer 2021)

Taught vector calculus (MAT 21D) online Summer Session II 2021. Constructed lecture notes and course materials ([available online](#)), wrote exams and homework sets, and held regular office hours.

Teaching Assistant, UC Davis (Fall 2018 - ongoing)

Designed and organized discussion sections, graded exams, and held regular office hours for the following classes:

- Intro calculus (MAT 21A-21D)
- Differential equations (MAT 22B)
- Proof-based linear algebra (MAT 67)
- Real analysis (MAT 127B and 127C)

Tutor, Mt. Tamalpais Community College, San Quentin State Prison (Winter 2023 - ongoing)

Volunteer tutored college algebra, intro to statistics, vector calculus and linear algebra.

Tutor, Strategic Alternative Learning Techniques Center, University of Arizona (2017-2018)

Tutored math and science for college students with various learning disabilities, including ADHD, autism, Aspergers, dyslexia, and dyscalculia.

Tutor, Private

Private tutoring for >15 years. Spans various levels between elementary school and graduate school, including standard coursework in math, physics, computer science, electrical and mechanical engineering, and english. Administered SAT and GRE seminars, taught MCAT preparation courses.

Mentoring and Outreach

Directed Reading Program

2021 - (ongoing)

Mentored multiple advanced undergraduate students varied mathematics topics. Alumni include Saud Moalib (quantum spin systems), Jiaxin Lu (graph theory), and Ian Chi (differential geometry).

Graduate Pairing

2020 - (ongoing)

Dual paired with first year graduate mathematics student.

Quarterly Finals Tutoring Spree

2018 - 2020

Volunteer tutored every quarter for massive finals study session.

Davis Math Circle

2019

Organized lesson on algebraic coding theory for advanced middle and high school students in Davis area. [link to lesson](#)

Ms. Tran's Guest Speaker

2020

Organized lesson on algebraic coding theory for low-income middle school students in San Jose for Ms. Meagan Tran's class.

SARSEF Science Fair

2018

Volunteer judged at the Southern Arizona Research, Science, and Engineering Foundation (SARSEF) science fair.

UBRP Ambassador

2015 - 2017

Member of Undergraduate Biology Research Program (UBRP) ambassadors. Organized regular outreach, community events, and volunteering events within Tucson. Head of science cafe, wherein interdisciplinary students met biweekly to discuss modern research.

Thesis Thursday KXCI

2016

Radio interview with KXCI in Tucson discussing hippocampal place cell research with layman audience.
[link to interview](#)

Awards, Honors, and Scholarships

UC Davis Graduate Student Research Fellowships

2020 - 2022

NSF Research Funding (via advisor Dr. Nachtergaele)

2021 - (ongoing)

National Merit Scholar

2014 - 2018

University of Arizona Research Slam 1st place

2018

UA Honors College

2014 - 2018

Dean's List

2014 - 2018

Invited Guest Panelist, Fulbright US Study Abroad Conference Prague

2017

Chair of Student Forum, Universal Village 2016 Conference Nagoya

2016

References Available Upon Request
