

# Daniel Barter

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## Bio

I am a mathematical physicist and software engineer, specializing in quantum computing. I have spent a lot of time thinking about the connection between topological quantum field theory and quantum error correction. I have built simulators for 2D gapped topological phases of matter, lithium and magnesium ion batteries and linear optical quantum systems. Currently, I work on quantum error correction simulations.

## Employment

- **PsiQuantum.** November 2022 - . Computational Physicist. Worked on quantum optics simulators. Currently working on quantum error correction simulations.
- **Google.** May 2022 - September 2022. Software Engineer. Worked on Android auto, mostly networking related stuff. Contributed to [Stim](#).
- **Lawrence Berkeley National Laboratory.** November 2020 - May 2022. Postdoctoral Fellow in the Applied Energy Materials Group. Worked on short time scale simulations of metal ion batteries. Built [RNMC](#) and [HiPRGen](#).
- **Mercury Technologies.** April 2020 - August 2020. Software Engineer. Worked on backend server written in Haskell.
- **University of California, Santa Barbara.** September 2019 - March 2020. Lecturer and Postdoctoral Fellow. Course coordinator for [Calculus 4](#).
- **Australian National University.** February 2018 - August 2019. Postdoctoral fellow. Worked on constructing new exactly solvable quantum field theories using tools from algebraic topology and low dimensional category theory.
- **University of Sydney.** August 2017 - January 2018. Postdoctoral researcher in Physics. Learned quantum field theory by interacting with researchers in condensed matter physics and quantum information theory.
- **University of Michigan.** September 2012 - May 2016. Graduate student instructor for calculus 1, 2 and 3. Taught classes with 20-30 students, three times a week. Held office hours. Helped students use Mathematica. Graded homework/exams.
- **University of Sydney.** March 2011 - June 2012. Tutor for calculus 1 and 2. Supervised problem sessions and graded homework/exams.

## Education

- PhD, Mathematics, University of Michigan. September 2012 - May 2017. Specialized in representation theory. Thesis: [Some Remarks about the Interaction between Quantum Algebra and Representation Stability](#).
- B.Sc with First Class Honours and University Medal, Pure Mathematics, University of Sydney. March 2008 - December 2011.

## Software

- **C++** : Good debugging skills. Some of my favorite libraries and tools: sqlite, pybind11, gdb, perf. I have some experience using OpenMP, OpenMPI and OpenCL.
- **Python** : Comfortable with the python/C interface and core parts of the python scientific computing ecosystem: numpy, scipy, matplotlib, py-spy, memray, pydantic. I have some experience using jax and pytorch. I am really good at using pdb.
- **Linux** : Good understanding of Linux user space. Comfortable on any Linux system running bash and tmux. Check out my [NixOS configuration](#) which specifies all my personal machines.

## Papers

- [joss.07244](#). RNMC: kinetic Monte Carlo implementations for complex reaction networks. Joint work with Evan Spotte-Smith, Sam Blau and others.
- [doi:10.26434/chemrxiv-2023-tntkg-v2](#). Chemical Reaction Networks Explain Gas Evolution Mechanisms in Mg-Ion Batteries. Joint work with Evan Spotte-Smith, Sam Blau and others.
- [doi:10.26434/chemrxiv-2022-n236n](#). Towards a Mechanistic Model of Solid-Electrolyte Interphase Formation and Evolution in Lithium-ion Batteries. Joint work with Evan Spotte-Smith, Ronald Kam and others.
- [doi:10.26434/chemrxiv-2021-c2gp3](#). Predictive stochastic analysis of massive filter-based electrochemical reaction networks. Joint work with Evan Spotte-Smith, Sam Blau and others.
- [arXiv:2110.03644](#). Computing associators of endomorphism fusion categories. Joint with Jacob Bridgeman and Ramona Wolf. **Published** in SciPost.
- [arXiv:1907.06692](#). Computing data for Levin-Wen with defects. Joint with Jacob Bridgeman. **Published** in Quantum.
- [arXiv:1901.08069](#). Computing Defects Associated to Bounded Domain Wall Structures: The  $\text{Vec}(\mathbb{Z}/p\mathbb{Z})$  case. Joint with Jacob Bridgeman. **Published** in Journal of Physics A.
- [arXiv:1810.09469](#). Fusing Binary Interface Defects in Topological Phases: The  $\text{Vec}(\mathbb{Z}/p\mathbb{Z})$  case. Joint with Jacob Bridgeman and Corey Jones. **Published** in Journal of Mathematical Physics.
- [arXiv:1806.01279](#). Domain walls in topological phases and the Brauer-Picard ring for  $\text{Vec}(\mathbb{Z}/p\mathbb{Z})$ . Joint with Jacob Bridgeman and Corey Jones. **Published** in Communications in Mathematical Physics.
- [arXiv:1706.03645](#). Deligne categories and representations of the infinite symmetric group. Joint with Inna Entova-Aizenbud and Thorsten Heidersdorf. **Published** in Advances in Mathematics.
- [arXiv:1611.00071](#). Eigenvalues of rotations and braids in spherical fusion categories. Joint with Corey Jones and Henry Tucker. **Published** in Journal of Algebra.
- [arXiv:1610.05204](#). Computing the minimal model for the quantum symmetric algebra.
- [arXiv:1610.05248](#). A remark about 6j symbols and young semi-normal form.
- [arXiv:1509.04228](#). Noetherianity and rooted trees.