

# ○ ZANE M. ROSSI

*JSPS Postdoctoral Fellow at UTokyo working in the theory of quantum algorithms*

## Education

MIT — Cambridge, MA, USA

PhD, Physics · 2019–2024

Advised by Prof. Isaac Chuang.

The University of Chicago — Chicago, IL, USA

B.S. Mathematics, B.A. Physics (Honors) · 2019

Minor: creative writing.

## Contact

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Github: [white-noise](https://github.com/white-noise)

Website: [pedalferrous.github.io](https://pedalferrous.github.io)

## Research intent

My interests and experience center on the theory of quantum computing algorithms, and specifically developing mathematical tools (rooted in functional analysis and abstract algebra) to make quantum algorithms easier to design and interpret. The quantum algorithmic toolkit is still growing, and is prone to misapprehension—as hardware improves, it is essential to develop quantum algorithmic subroutines for common linear algebraic tasks that can be correctly, efficiently, and intentionally combined.

## Publications

[Summary] 13 journal articles with [DOI links»] (2 in submission), 9 first or co-leading author, 5 with undergraduate student mentees. Most leading conferences in quantum information allow simultaneous journal submission, indicated below. Representative publications are marked with [\*].

- [0] Singular value transformation for unknown quantum channels.  
R. Niwa, ZMR, P. Taranto, M. Murao.  
Under review, 2025: [arXiv:2506.24112»].
- \* [1] A Solovay–Kitaev theorem for quantum signal processing. ZMR.  
Under review, 2025, AQIS 2025 long talk (10% acceptance): [arXiv:2505.05468»].
- [2] Unification of finite symmetries in simulation of many-body systems on quantum computers.  
V. Bastidas, N. Fitzpatrick, K. Joven, ZMR, S. Islam, T. Van Voorhis, I. Chuang, Y. Liu.  
PRA, QSIM 2025 talk, TQC 2025 talk (20% acceptance): [DOI link»] [arXiv:2411.05058»].
- [3] Parallel quantum signal processing via polynomial factorization.  
J. M. Martyn, ZMR, K. Z. Cheng, Y. Liu, I. L. Chuang.  
Quantum, 2025: [DOI link»] [arXiv:2409.19043»].
- \* [4] Modular quantum signal processing in many variables. ZMR, J. Ceroni, I. Chuang.  
Quantum, 2023: [DOI link»] [arXiv:2309.16665»].  
With associated [open-source codebase»].
- [5] Quantum signal processing with the one-dimensional quantum Ising model.  
V. Bastidas, S. Zeytinoglu, ZMR, I. Chuang, W. Munro.  
PRB, 2023: [DOI link»] [arXiv:2309.04538»].
- [6] Semantic embedding for quantum algorithms. ZMR, I. Chuang.  
J. Math. Phys., 2023: [DOI link»] [arXiv:2304.14392»].
- [7] Quantum signal processing with continuous variables. ZMR, V. Bastidas, W. Munro, I. Chuang.  
Under edits, 2023: [arXiv:2304.14383»].
- [8] Multivariable quantum signal processing (M-QSP). ZMR, I. Chuang.  
Quantum, 2022: [DOI link»] [arXiv:2205.06261»].
- \* [9] A grand unification of quantum algorithms. J. Martyn, ZMR, A. Tan, I. Chuang.  
PRX Quantum, 2021: [DOI link»] [arXiv:2105.02859»].
- [10] Quantum advantage for noisy channel discrimination. ZMR, J. Yu, I. Chuang, S. Sugiura.  
PRA, 2021: [DOI link»] [arXiv:2105.08707»].
- [11] Quantum hypothesis testing with group structure. ZMR, I. Chuang.  
PRA, 2021: [DOI link»] [arXiv:2102.02194»].

- [12] Optimized compilation of aggregated instructions for realistic quantum computers. Y. Shi, N. Leung, P. Gokhale, [ZMR](#), D. I. Schuster, H. Hoffman, F. T. Chong. ASPLOS, 2019 (20% acceptance): [\[DOI link\]](#) [\[arXiv:1902.01474\]](#).

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## PhD Thesis

- [0] Functional quantum algorithms: a mélange of methods for matrix functions. [ZMR](#). MIT, May 2024: [\[MIT Libraries link\]](#).

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## Research Experience

- [UTokyo Murao Group](#) — Tokyo, JP Aug 2024–Present  
Constructed new functional analytic techniques to characterize properties of quantum circuit ansätze, relaxing restrictive assumptions of QSP/QSVT for manipulating block encodings.
- [MIT Quanta Group](#) — Cambridge, MA Aug 2019–Aug 2024  
Derived novel classes of quantum algorithms manipulating linear operators, extending quantum signal processing (QSP), with application to concrete statements of quantum advantage.  
Lead contributor on [packages](#) for numerical optimization over QSP and QSVT ansätze.
- [UChicago Chong Lab](#) — Chicago, IL Dec 2017–Jun 2019  
Designed pulse-shaping protocols for quantum control using Google’s TensorFlow, modeling scheduling schemes for approximately error correcting circuits on superconducting devices.
- [UTokyo Katsura Group](#) — Tokyo, JP Jun–Dec 2017  
Derived novel entanglement metrics and authored numerical simulation packages for for MBL quantum spin systems exhibiting time-translation symmetry breaking using DMRG principles.

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## Fellowships, Internships & Awards

- Oberwolfach Foundation Fellow for Arbeitsgemeinschaft 2441, Germany (October, 2024)
- Japan Society for the Promotion of Science (JSPS) Postdoctoral Fellow at the University of Tokyo (August, 2024 – August, 2026, 10% acceptance rate across all subfields)
- Core participant, IPAM long program, UCLA (Fall, 2023)
- Visiting researcher, NTT BRL, Japan (Fall, 2022)
- Remote NTT PhD Research Internship (Summer, 2021, in US)
- Fay and Walter Selove Prize (2018) · Stipend for summer research.
- FUTI Award (2017) · Stipend for research with Katsura group of the University of Tokyo, courtesy of Friends of UTokyo Inc. during the University of Tokyo Research Internship Program (UTRIP)
- James Franck Institute Summer Fellowship (2016) · Stipend for summer research.

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## Talks & Seminars

- [QTML 2025 \(tutorial, invited\), Singapore](#) · QSP and QSVT. Nov, 2025.
- [AQIS 2025 \(long talk\), Hong Kong](#) · A Solovay–Kitaev theorem for QSP. Aug, 2025.
- [Quantum Innovation 2025, Osaka](#) · A Solovay–Kitaev theorem for QSP. July, 2025.
- [FU Berlin Learning Seminar](#) · A Solovay–Kitaev theorem for QSP. Jun, 2025.
- [UC Berkeley Mathematics Seminar](#) · A Solovay–Kitaev theorem for QSP. Mar, 2025.
- [QIP 2025, Raleigh, NC, USA](#) · Parallel quantum signal processing. Mar, 2025.
- [ISNTT 2024, Atsugi, JP](#) · Parallel quantum signal processing. Dec, 2024.
- [QMCI 2024, Okinawa, JP](#) · Parallel quantum signal processing. Nov, 2024.
- [Oberwolfach Arbeitsgemeinschaft, Germany](#) · Multivariable quantum signal processing. Oct, 2024.
- [Tufts Quantum Seminar](#) · Modular quantum signal processing with gadgets. Jun 06, 2024.
- [RPI ‘rising stars’ invited talk](#) · Modular quantum signal processing with gadgets. Apr 05, 2024.
- [UTokyo invited seminar \(Murao group\)](#) · QSP and QSVT essentials. Jan 26, 2024.

NTT BRL invited seminar · Modular quantum signal processing with gadgets. Jan 25, 2024.  
 UOsaka invited seminar (Fujii group) · Modular quantum signal processing with gadgets. Jan 23, 2023.  
 UCLA IPAM invited talk · Modular quantum signal processing with gadgets. Oct 03, 2023.  
 RIKEN seminar · Modularity and self-embedding in quantum algorithms. Nov 25, 2022.  
 University of Tokyo · Extending the theory of QSVT. Nov 24, 2022.  
 University of Tokyo · Modularity and self-embedding in quantum algorithms. Oct 12, 2022.  
 NTT Basic Research Lab · Multivariable quantum signal processing. Sep 01, 2022.  
 C2QA Theory Meeting · Multivariable quantum signal processing. Jun 01, 2022.  
 C2QA IBM-MIT Meeting · Multivariable quantum signal processing. Mar 24, 2022.  
 Q2B Conference (invited) · A grand unification of quantum algorithms. Dec 07, 2021.  
 NTT Research · Multivariable quantum signal processing. Nov 29, 2021.  
 PsiQuantum (invited) · A grand unification of quantum algorithms. Jul 21, 2021.  
 APS March Meeting · A grand unification of quantum algorithms. Mar 15, 2021.  
 QIP 2021 (poster) · Quantum channel discrimination with group structure. Febr 04, 2021.  
 MIT QIS Group Meeting · Quantum channel discrimination with group structure. Mar 13, 2020.

## Teaching & Coursework

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### Assistance & Mentorship

Primary research mentor for five undergraduate students over summers of 2020, 2021, 2023, & 2024, each resulting in or contributing directly to publications. Secondary mentor for two additional students.

Unofficial assistant for MIT 8.371, Introduction to Quantum Information, 2020. Tested automatic grading software with official TA, and authored class-used [numerical code repository] for generating QSP/QSVT-based quantum algorithms.

President and seminar leader: UChicago Writers' Workshop (2017–2019)

Lead facilitator: Kids are Scientists Too (KAST) science outreach program (2013–2015)

### Teaching area focuses

**Mathematics** · Real, Complex, and Functional Analysis · Differential Equations · Abstract Algebra & Representation Theory · Complexity Theory · Computability Theory · Differential Geometry

**Computer Science** · Algorithms · Natural Language Processing · Fundamentals of Machine Learning · Cryptography & Interactive Proofs

**Physics** · Quantum Mechanics · General Relativity · Quantum Information and Algorithms · Quantum Field Theory · Introductory Experimental Quantum Computing

## Technical Miscellany

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**Development** · Python · Mathematica · Java · HTML/CSS/JS/Django · C · Haskell ·  $\text{\LaTeX}^{\dagger\dagger}$

**Language** · Working proficiency Japanese (7+ years of study · JLPT 日本語能力試験 N2 合格)

<sup>††</sup>This document was most recently compiled on *September 30, 2025*.