

Daniel Dunmore

Curriculum Vitae

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Education

Planned to begin in May 2024	Ph.D. Candidate in Pure Mathematics (University of New South Wales) Supervisors: Dr. Anna Romanov and Dr. Arnaud Brothier Topic: Module Categories over Soergel Bimodules
2019 – 2023	Bachelor of Advanced Science (Honours) (University of New South Wales) Majors: Pure Mathematics, Advanced Physics Cumulative WAM: 80 Honours Supervisor: Dr. Arnaud Brothier Honours Topic: From Subfactors to Richard Thompson's Groups and their Generalizations Honours WAM: 85 (First Class Honours)

Research Interests

My current research interests include

- category theory and categorical representation theory;
- group theory and representation theory, especially with respect to infinite simple groups such as Thompson-like groups and their unitary representations;
- planar algebras and subfactor theory;
- algebraic and topological quantum field theory.

Publications

Cifuentes, J. D., Tantt, T., Gilbert, W. et al., *Bounds to electron spin qubit variability for scalable CMOS architectures*, Nat. Commun. 4299.**15** (2024).

Talks

Basics of Module Categories

Planning to introduce categorical representation theory via the theory of module categories at the learning seminar “Tensor Categories and their Modules”, held jointly by the University of Sydney and the University of New South Wales. The seminar schedule and material are publicly available at <https://sites.google.com/view/tensorcategories>.

May 1st, 2024

An Introduction to Category Theory

Organized a short and informal reading course on category theory for a small group of Honours students at the University of New South Wales, roughly walking through the first few chapters of the excellent introductory book of Emily Riehl.

January 2024 – February 2024

UNSW Pure Mathematics Honours Presentation

Gave a presentation based on my Honours thesis at the UNSW Pure Maths Seminar, which explained how Vaughan Jones used planar algebras in his attempt to create conformal field theories from subfactors, as well as how this led to the discovery of a new machine for generating unitary representations of groups of fractions, inspiring the forest-skein formalism.

November 14th, 2023

AMSI Vacation Research Scholarship Presentation

Gave a brief presentation based on my AMSI Vacation Research Scholarship project at AMSIConnect, which introduced amenability within the context of discrete group C^* -algebras and concluded with an explanation of the Banach-Tarski paradox.

February 3rd, 2022

Research Experience

UNSW Pure Mathematics Honours Research

Worked under the supervision of Dr. Arnaud Brothier to study certain kinds of “discrete conformal field theories” arising from subfactor planar algebras and the technology of forest-skein categories, inspired by the surprising connections of Vaughan Jones between conformal field theory, subfactor theory and Richard Thompson’s groups.

February 2023 – November 2023

AMSI Vacation Research Scholarship

Participated in a reading project in pure mathematics over the 2021 – 2022 summer period, supervised by Dr. Arnaud Brothier and funded by the Australian Mathematical Sciences Institute. The project was concerned with investigating the elementary theory of group C^* -algebras arising from discrete groups; that is, C^* -algebras generated by discrete topological groups, in the sense that the algebra encodes all of the information regarding the (irreducible) unitary representations of the group. Further properties of discrete groups such as amenability were then studied in the context of group C^* -algebras. The report is publicly available at <https://vrs.amsi.org.au/student-profile/daniel-dunmore/>.

December 2021 – February 2022

ARC Centre of Excellence for Quantum Computation and Communication Technology Research Internship

Participated in a second research internship in theoretical physics, supervised by Dr. Andre Saraiva, as part of Scientia Professor Andrew Dzurak's group within the ARC Centre of Excellence for Quantum Computation and Communication Technology. Began with a very brief reading project on the basics of representation theory in the context of condensed matter physics. Investigated the implications of non-Hermitian dynamics in the context of quantum computing and devised a method for realizing effectively non-Hermitian behaviour using traditional Hermitian systems.

February 2021 – June 2021

ARC Centre of Excellence for Quantum Computation and Communication Technology Research Internship

Participated in a 16-week research internship in computational physics, supervised by Dr. Andre Saraiva and Dr. Chris Escott, as part of Scientia Professor Andrew Dzurak's group within the ARC Centre of Excellence for Quantum Computation and Communication Technology. Wrote software for automatically simulating metal-oxide-insulator silicon quantum dot nanodevices, as well analyzing the behaviour of the quantum dots. Investigated methods of modelling thermal strain in such devices and its theoretical effects on quantum dots.

September 2020 – December 2020

UNSW Science Talented Students Program

Participated in an investigation into alternative representations of systems of multiple qubits within a team of two other students, supervised by Professor Susan Coppersmith and Dr. Andre Saraiva. The intent of the project was to form a method for visualizing nonlocal properties of multiple qubit systems. This involved devising a new mathematical model for such systems as well as the development of software for solving and visualizing them.

July 2019 – November 2019

Extracurricular Activities

UNSW School of Physics Undergraduate Advisory Committee Member

Participated in regular discussions regarding improvements to the teaching quality of undergraduate physics at UNSW. Provided feedback and suggestions on how physics could be taught more effectively to undergraduate students, with topics ranging from general course and program structure to solutions to the various issues posed by COVID-19.

March 2020 – December 2020

Technical Skills

- Proficient in C, Assembly, MATLAB/Octave, Python, Mathematica, C++, PHP, JavaScript and HTML5.
- Experience with COMSOL Multiphysics and LiveLink for MATLAB.

Personal Projects

- Collaborating with Thomas Dunmore on writing a fully-featured game engine from scratch in C, which implements cutting-edge research in various areas such as rigid body dynamics.
- Collaborated with both Thomas Dunmore and Alvin Iskender on reverse-engineering various (discontinued) multiplayer games, whose source code had been lost, in order to make them playable again (with permission from the original developer, Jacob Grahm).
- Designed and modelled medals for a 2019 LAN tournament for a highly popular video game, which were made available in-game and are used by the tournament organizers to this day.