

Scott Morrison - Statement on research activity

Research projects I work in pure mathematics, studying **quantum symmetries** at the intersection of category theory, low dimensional topology, and operator algebras. I have made extensive contributions to our understanding of subfactors and fusion categories, particularly by discovering some of the most exotic examples of these objects. I also work in topological field theory, connecting these subjects to theoretical physics. I have active research collaborations all over the world, and I maintain strong research ties with Microsoft Station Q (where I worked for two years), connecting my work on low dimensional categories and topological field theory with their work on topological quantum computation.

Research outputs I have **published 24 papers over the last 9 years**. Of these 15 have been published or accepted since 2012, the year I arrived at ANU. They appear in a variety of excellent journals; as an indication the average of their ‘Mathematics Citation Quotient’ scores is 1.24, three times higher than the average of all mathematics journals. Some of these papers are in the best journals available – one in the *Proceedings of the National Academy of Sciences*, one in *Acta Mathematica*, and two in *Geometry & Topology*. You can find the full list in my CV. These papers are widely cited by the standards of pure mathematics. **I am publishing more and more highly cited work than typical Go8 mathematicians at higher levels: my h-index is 9.**¹

I have led a multi-author collaboration on small index subfactors, spanning many papers. I have **organized several international conferences** on this problem, including an American Institute of Mathematics workshop “Fusion Categories” in March 2012, and a Banff International Research Station workshop “Subfactors and fusion categories” in April 2014. I am organising a semester program at the Isaac Newton Institute at Cambridge in 2017. I have been **invited to give lecture series** on this work, in Australia, Japan, and the USA.

My work on blob homology with Kevin Walker, begun during my industry postdoc at Microsoft Station Q, has been published in *PNAS*. Peter Teichner (Director of the Max Planck Institute in Bonn) ran a ‘hot topics’ semester course on this work at UC Berkeley in 2011.

I have a strong independent research program, and a robust pipeline of future projects – investigating higher categorical structures in representation theory, topological order, and low dimensional topology. I have many international collaborators, including two Fields Medallists, in the USA, Canada, Japan, Germany, and the UK. In the last three years at MSI I have brought 12 international visitors.

Grants, recognition, outreach My research work has recently been recognized by the award of the **2015 Christopher Heyde Medal from the Australian Academy of Sciences**. This is one of the most prestigious early career researcher awards in mathematics in Australia; it recognises distinguished research by a researcher up to 10 years post PhD. It is awarded once every three years in pure mathematics.

I have been **very successful applying for grants**, both from the ARC and internationally.

- DECRA mid 2012-mid 2015 ‘[Fusion categories and topological quantum field theory](#)’ (\$360,000)
- Discovery 2014-2016 ‘[Symmetries of subfactors](#)’ (\$375,000)
- DARPA 2012-2014 ‘Quantum symmetries’ (USD488,058)
- Sloan Foundation 2013 grant to support development of MathOverflow (USD8,000)

I am currently applying for a 2016 Discovery Project.

Shortly after arriving in Australia, I was **invited as a plenary speaker** to the 2012 Australian Mathematical Society Meeting, where I spoke on the research program for my DECRA. I have been invited to give **colloquium talks in Australia and worldwide** (e.g. UC Berkeley, Caltech, UC San Diego, Sydney, UNSW, UQ, Wollongong, Adelaide).

I later describe my outreach activities via *MathOverflow*. I am also an active blogger at the [Secret Blogging Seminar](#). My research and service activities have appeared in the general media, e.g.

- [Sudden Progress on Prime Number Problem Has Mathematicians Buzzing](#) Erica Klarreich, **Wired Magazine**, 22 November 2013
- [Game of proofs boosts prime pair result by millions](#) Jacob Aron, **New Scientist**, 5 June 2013
- [Cracking Open the Scientific Process](#) Thomas Lin, **New York Times**, 16 Jan 2012

¹There is an explicit comparison with Go8 mathematicians in the supporting documents.

Scott Morrison - Statement on teaching activity

Courses In Semester 2 2015 I am co-teaching MATH1014, our largest first year mathematics course. I will further develop this course, achieving our paired goals of providing students with the mathematical toolset they need for coursework in other disciplines, as well as encouraging them to pursue further mathematical study. We have 260 enrolled students, and I manage a group of 7 tutors.

As an ARC Research Fellow supported by a 2012 Discovery Early Career Researcher Award, I have been in a research only position² up until last semester. Nevertheless, in 2013 and 2014 I volunteered to teach MATH3325, an honours course on functional analysis and spectral theory. This course had 10 students in 2013 and 14 in 2014. Teaching this course has been an enjoyable experience, and has helped me meet and recruit as honours students some of the strongest mathematics students in the university.

My notes for the MATH3325 course are all [available online](#). I have taught the course with an emphasis on mathematical rigour and developing techniques for high level proofs. All respondents in my 2013 mid-semester survey strongly agreed with the statement “I receive useful feedback to support my learning throughout the semester”. The student evaluations from both years are attached in the supporting documentation; both years I received an overall score of 4.3 for the course. A significant component of the assessment for the course was an extended essay on a research topic chosen by the students. I worked extensively with the students on their drafts, and was very pleased to see extremely well written and researched final essays. I hope this research component of the course was helpful preparation for writing an honours thesis. One student wrote to me afterwards “**I would also like to say that I have found this process amazingly rewarding. ... They should make us do it in all of our maths courses!**”

In Semester 2 2014 I taught a special topics course on Link Homology (joint with Anthony Licata), and ran an ASE/reading course on category theory for five students.

In Semester 1 2015 Dr. Anthony Licata and I initiated the *quantum mathematics working group*, a weekly seminar and discussion session within the department, attended by our postdocs and students and other interested members. (In some sense this is ‘just a regular lab meeting’ – nevertheless we think it is an important innovation in mathematics!)

I have been actively involved in departmental education meetings.

Supervision I have supervised three honours students since arriving at ANU. Joshua Chen (recruited to the ANU from New Zealand to do an honours thesis, following a successful Summer Research Student project) graduated with first class honours in mid-2014. His honours thesis was on [Temperley-Lieb categories and skein modules](#). He is now pursuing a masters degree in pure mathematics at Bonn. Hilary Hunt graduated with first class honours at the end of 2014, working on algorithms in low-dimensional topology, in particular computations for [Knots, isotopies, and Khovanov homology](#). Florrie Verrity is beginning her honours thesis on provable voting systems, co-supervised with Dirk Pattinson in CECS.

My first Ph.D. student, Cain Edie-Michell, has just arrived this year from New Zealand. He is working with me on problems in the classification of fusion categories.

I am co-supervising a Ph.D. student in CECS, Narjess Afzaly, who has successfully applied combinatorial enumeration algorithms developed by McKay to problems in the classification of subfactors. This has been a very pleasant and productive cross-campus collaboration with her and her supervisor, Prof. Brendan McKay.

²Note that the DECRA rules changed only after 2012 to allow a teaching component.

Scott Morrison - Statement on service activity

For my DECRA application in 2011, previous MSI Director Prof. Alan Carey wrote in my strategic statement “At age 31 Morrison is in an age group not well represented in Australian mathematics in general or in the MSI in particular. At the same time, he has a strong research track record and an international reputation. The MSI is anticipating moving Scott Morrison into a leadership role at an early stage given the large number of retirements anticipated in the next few years. The award ... would support his development and preparation for research leadership roles in MSI and nationally.” The DECRA has been very helpful in establishing my research role here; during the same time I have undertaken a variety of service activities, both within the ANU, as well as nationally and internationally.

Within ANU I have been the HDR convenor within the Mathematical Sciences Institute at ANU since mid-2014. I am hoping to significantly improve recruitment into our Ph.D. program, both internationally and domestically, e.g. by contacting students at Australia wide events such as AMSI and AustMS student workshops. I will work with our honours convenor to ensure that mentoring of our undergraduate students encourages continuations into our Ph.D. program.

I am on the IT committee within the MSI; happily our IT setup is mostly satisfactory at present. I have been working with Peter Bouwknegt to compare citations databases (particular MathSciNet, Scopus, and Web of Science) and submit corrections. We have discovered and corrected around 700 missing citations to MSI researchers’ articles so far. We are now able to scale up to automatic deployment across the colleges of science. During 2015 I have been an active participant in the MSI Building committee, particularly advocating for the needs for undergraduate and HDR students in the new building planning.

I participated in the April 2015 delegation to China, initiating contacts with mathematicians at Peking, CAS, and Tsinghua, and promoting our Ph.D. program and exchange opportunities.

National service I am on the 2013-2015 Council of the Australian Mathematical Society. I have initiated discussion at the council level on ARC funding rules, and on publishing models and journal subscription costs. (See, for example, my post about Elsevier in Australia on my blog, the [Secret Blogging Seminar](#).) I was active in the negotiation of rules for special interest groups within the AustMS, in particular ensuring these rules were compatible with the needs of the Women in Maths group.

International service My most significant service contribution to the mathematics profession has certainly been **my role as co-founder, moderator, and board member of [MathOverflow](#)**. *MathOverflow* is a website dedicated to questions and answers of interest to research mathematicians. We started in 2009, and since then it has had a major impact on mathematics research. It successfully brings together researchers distributed across the world, efficiently connecting expertise and research requirements, and initiating many new collaborations. Indeed, there are at present [over 600 preprints](#) on the arXiv which acknowledge or cite *MathOverflow*. Over 16,000 people have contributed questions to the site, and we typically have around 10,000 visits every day. We have been mentioned in the media many times, including in the *New York Times*. The creation of *MathOverflow* has been an extremely significant service to the professional mathematics community. The site has very high standards (questions below graduate level are diverted), yet at the same time it serves a unique outreach role, giving the world a window into active mathematical research.

Along with co-founders Anton Geraschenko and David Zureick-Brown we have successfully managed the dramatic growth of the *MathOverflow* community as moderators. We have published an article (with Ravi Vakil, at Stanford), in the *Notices of the American Mathematical Society* about the site. We have appointed and held elections for moderators to help with the management of the site. We have raised grant money (from the Sloan Foundation) to set up a legal entity, and for software development work on integration with the mathematical literature. We have signed a contract with the company Stack Exchange for hosting and migration into their network of question and answer sites, while preserving our independent identity.

In 2014 I joined the **mathematics advisory committee for the arXiv** (the main preprint server for mathematics and theoretical physics). After a long period in which the arXiv has been in a maintenance-only mode, there is now a significant opportunity to more tightly integrate the arXiv into mathematical publishing, and I hope to be at the forefront of driving this change. We are now in the process of appointing new subject area moderators across mathematics.