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Scott Morrison - Resume

Employment

Senior Lecturer, the Australian National University

July 2012-present. I am an ARC Research Fellow and Senior Lecturer in the Mathematical Sciences Institute at the Australian National University. Please see my research statement for a description of my current interests.

Miller Fellowship, UC Berkeley.

July 2009-June 2012. I was a Miller Fellow at UC Berkeley, in the mathematics department.

Post-doctoral research, Microsoft Station Q.

April 2007-June 2009. Station Q is a multidisciplinary research group, focusing on *topological quantum computing*. The research interests of the group cover *condensed matter physics*, especially topological phases and the fractional quantum hall effect, and *quantum topology*, a field of mathematics describing topological quantum field theories (TQFTs) and their applications. During my stay at Station Q, my research was primarily on *extensions of TQFT* which introduce ideas from homological algebra, and on *the classification of TQFTs* related to von Neumann algebras and quantum groups.

Education

University of California, Berkeley, Doctor of Philosophy (Mathematics).

2001-2007. Worked with Prof. Vaughan Jones. Received the 2007 Herbert Alexander Prize for Outstanding Dissertation in Pure Mathematics. Received the Outstanding Graduate Student Instructor Award, 2004.

University of New South Wales, Bachelor of Science (Hons.)

1998-2001, Sydney, Australia. First class honours in Mathematics, and the University Medal.

Publications

The classification of subfactors of index at most 5

Joint with Vaughan F.R. Jones and Noah Snyder. Available at arXiv:1304.6141.

An obstruction to subfactor principal graphs from the graph planar algebra embedding theorem

Available at arXiv:1302.5148.

Webs and quantum skew Howe duality

Joint with Sabin Cautis and Joel Kamnitzer. Available at arXiv:1210.6437.

Constructing spoke subfactors using the jellyfish algorithm

Joint with David Penneys. Available at arXiv:1208.3637, accepted at *Transactions of the American Mathematical Society* February 19 2013.

The little desert? Some subfactors with index in the interval $(5, 3 + \sqrt{5})$

Joint with Emily Peters. Available at arXiv:1205.2742.

Subfactors of index less than 5, part 3: quadruple points

Joint with Masaki Izumi, Vaughan F.R. Jones and Noah Snyder. *Communications in Mathematical Physics*, vol. 316, issue 2 (2012), available at DOI:10.1007/s00220-012-1472-5 or arXiv:1109.3190.

Higher categories, colimits and the blob complex
Joint with Kevin Walker. *Proceedings of the National Academy of Sciences* May 17, 2011 vol. 108 no. 20 pp. 8139-8145, available at DOI:10.1073/pnas.1018168108 or arXiv:1108.5386.

The blob complex
Joint with Kevin Walker. *Geometry & Topology* 16 (2012) 1481-1607, available at DOI:10.2140/gt.2012.16.1481 or arXiv:1009.5025.

Subfactors of index less than 5, part 2: triple points
Joint with David Penneys, Emily Peters and Noah Snyder. *International Journal of Mathematics* vol. 23, no. 3 (2012) 1250016 (33 pages), available at DOI:10.1142/S0129167X11007586 or arXiv:1007.2240.

Subfactors of index less than 5, part 1: the principal graph odometer
Joint with Noah Snyder. *Communications in Mathematical Physics*, vol. 312, issue 1 (2012), pp. 1–35, available at DOI:10.1007/s00220-012-1426-y or arXiv:1007.1730.

Cyclotomic integers, fusion categories, and subfactors
Joint with Frank Calegari and Noah Snyder, with an appendix by Victor Ostrik, *Communications in Mathematical Physics* vol. 303, issue 3 (2011), pp. 845–896, available at DOI:10.1007/s00220-010-1136-2 or arXiv:1004.0665.

Knot polynomial identities and quantum group coincidences
Joint with Emily Peters and Noah Snyder, *Quantum Topology* vol. 2 (2011) pp. 101–156. Available at DOI:10.4171/QT/16 or arXiv:1003.0022.

Non-cyclotomic fusion categories
Joint with Noah Snyder. To appear *Transactions of the American Mathematical Society*, available at arXiv:1002.0168.

Constructing the extended Haagerup planar algebra
Joint with Stephen Bigelow, Emily Peters and Noah Snyder. *Acta Mathematica*, vol. 209 (2012) pp. 29–82. Available at DOI:10.1007/s11511-012-0081-7 or arXiv:0909.4099.

Man and machine thinking about the smooth 4-dimensional Poincaré conjecture
Joint with Michael Freedman, Robert Gompf and Kevin Walker, *Quantum Topology*, vol. 1, issue 2 (2010), pp. 171–208. Available at DOI:10.4171/QT/5 or arXiv:0906.5177.

The braid group surjects onto G_2 tensor space
Pacific Journal of Mathematics, vol. 249 (2011), no. 1, pp. 189–198. Available at DOI:10.2140/pjm.2011.249.189 or arXiv:0907.0256.

Skein theory for the D_{2n} planar algebras
Joint with Emily Peters and Noah Snyder, *Journal of Pure and Applied Algebra* vol. 214, no. 2 (2010) pp. 117–139. Available at DOI:10.1016/j.jpaa.2009.04.010 or arXiv:0808.0764.

A Diagrammatic Category for the Representation Theory of $U_q(\mathfrak{sl}_n)$
Ph.D. thesis, available at arXiv:0704.1503.

Fixing the functoriality of Khovanov homology
Joint with David Clark and Kevin Walker, *Geometry and Topology* vol. 13 (2009) pp. 1499–1582, available at DOI:10.2140/gt.2009.13.1499 or arXiv:math.GT/0701339.

On Khovanov's cobordism theory for $\mathfrak{su}_3$ knot homology
Joint with Ari Nieh, *Journal of Knot Theory and its Ramifications* vol. 17, no. 9 (2008), available at DOI:10.1142/S0218216508006555 or arXiv:math.GT/0612754.

The Karoubi Envelope and Lee's Degeneration of Khovanov Homology
Joint with Dror Bar-Natan, *Algebraic & Geometric Topology* vol. 6 (2006) pp. 1459–1469, available at DOI:10.2140/agt.2006.6.1459 or arXiv:math.GT/0606542.

Classifying Spinor Structures
BSc. honours thesis at UNSW. Available at arXiv:math-ph/0106007.

Outreach

I'm a co-founder and moderator of MathOverflow, a website for mathematicians to ask and answer research-level questions. MathOverflow is just over a year old, receives approximately 10000 visits each day, and the 9000 users ask or answer about 30 new questions each day. With Anton Geraschenko and Ravi Vakil, I wrote an opinion piece about MathOverflow for the June 2010 issue of the Notices of the AMS.

Software

FusionAtlas
A Mathematica package for analysing subfactors and fusion categories, with contributions by David Penneys, Emily Peters, Noah Snyder and James Tener. Available online.

Omath
A free implementation of the core Mathematica langauge, joint with Joseph Farjoun. Available from `http://omath.org`.

QuantumGroups
A Mathematica package for the representation theory of quantum groups, including quantum knot invariants. Available online with a brief tutorial in `arXiv:1003.0022`.

KnotTheory and the Knot Atlas
A Mathematica package for knot theory, co-maintained with Dror Bar-Natan, with contributions from many people. Available from the Knot Atlas.

Conferences

AIM workshop of Fusion Categories
Co-organizer with Eric Rowell and Noah Snyder. August 2011.

Subfactors in Maui
Co-organizer of Subfactors in Maui 2011, funded by DARPA, and Subfactors in Maui 2007.

Quantum Topology in Wellington
With David Gauld, Quantum Topology at the joint NZMS/AMS meeting in New Zealand, 2007.

Refereeing

I have refereed for a number of mathematics journals, including Algebraic and Geometric Topology, the Duke Mathematical Journal, Geometry and Topology, International Mathematics Research Notices, the Journal of Functional Analysis, the Proceedings of the American Mathematical Society, and Quantum Topology.

Teaching

University of California, Berkeley
Outstanding Graduate Student Instructor Award, 2004. Teaching Assistant for 9 semesters, for MATH 1B (Introductory Calculus), 53 (Multivariable Calculus), 54 (Linear Algebra), 53H (Honors), 54H (Honors), 110 (Linear Algebra), and 121A (Mathematical Methods for the Physical Sciences).

University of New South Wales
Tutor ("Teaching Assistant") for 2 semesters, introductory calculus.

My current teaching statement is available online.

Selected talks

Classification of subfactors to index 5

- *UCLA/DARPA subfactors meeting*, "Subfactors at index 5 and beyond", October 8 2010. (slides)
- *Quantum groups, Clermont-Ferrand*, September 2 2010.
- *Operator algebras satellite conference, Chennai*, August 11 2010.
- *Non-commutative geometry and operator algebras, Vanderbilt*, May 11 2010. (slides)
- *Fusion Categories at AMS Waco meeting*, "Fusion categories and small index subfactors", October 18 2009. (slides)
- UC Berkeley Colloquium, "Fusion categories", September 3 2009. (blackboards)
- UC Riverside Colloquium, "Classifying subfactor planar algebras", June 3 2009.

Blob Homology

- ANU, July 4 2012. (slides)
- Stanford, May 21 2012. (slides)
- *Low dimensional topology and categorification, Stony Brook*, June 23 2010. (slides)
- *TQFT and link homology in Hahei*, January 18 2010.
- *Homotopy Theory and Higher Algebraic Structures at AMS Riverside meeting*, November 8 2009. (slides and video)
- Los Angeles Joint Topology Seminar, October 9 2009.
- UC Riverside, June 3 2009.
- *AMS Annual meeting, Washington DC*, January 6 2009. (slides)
- *Georgia Topology Conference*, May 15 2008.

Extended Haagerup

- *Tensor Categories in Bloomington, Indiana*, "Extended Haagerup exists!", March 22 2009. (slides, video and blog post)

Coincidences of tensor categories

- *Quantum Invariants of 3-manifolds and Modular Categories at St Paul AMS meeting*, April 10 2010.
- *Algebraic Structures in Knot Theory at AMS Riverside meeting*, November 7 2009. (slides)

The Cappell-Shaneson spheres and the s-invariant

- *Knots in Washington* January 9 2009. (slides)
- UC San Diego, topology seminar, December 4 2008. (slides)

Skein theory for the D_{2n} subfactors

- University of Tokyo operator algebras seminar, October 16 2008.
- University of New South Wales, pure mathematics seminar, October 7 2008.
- Pennsylvannia State University, noncommutative geometry seminar, September 16 2008.
- *Planar Algebras and Subfactors* at Vanderbilt, April 18-20 2008.

Khovanov Homology

Introduction

- *MSRI introductory workshop for the link homology semester*, January 25-26 2010. "Khovanov homology II, functoriality, deformations and the s-invariant" (lecture notes, streaming video, video) and "Khovanov homology I" (lecture notes, streaming video, video)

- "Local Khovanov Homology", *Workshop on Geometric Methods in the Topology of 3-Dimensional Manifolds (NZ Mathematics Research Institute)*, Taipa, New Zealand, January 2006. (slides)

Functoriality

- "Functoriality and duality in Khovanov homology", Kyoto, May 23 2007. (notes)
- Columbia, gauge theory seminar, November 17 2006. (slides)
- Invited speaker at *Categorification in Algebra and Topology*, Uppsala, September 7-10, 2006. (slides)
- *Park City Mathematics Institute*, July 3 2006. (slides)
- *Knots in Washington*, May 6 2006. (slides)

4-manifold TQFT invariants

- *TQFT and link homology in Hahei*, January 17 2010
- *Quantum Topology Special Session of the joint NZMS/AMS Wellington meeting*, December 12-15 2007. (slides)
- *Quantum Topology in Hanoi*, Vietnam, August 6-10 2007. (slides)
- *Oporto conference on Link Homology*, Portugal, July 5-8 2007. (slides)

Rational tangles

- *AMS Annual meeting, Washington DC*, January 8 2009. (slides)

$\mathbf{SU(3)}$

- "A topological categorification of $\mathfrak{su}_3$", University of Oregon colloquium, December 4 2006. (slides)
- "A cobordism theory for $\mathfrak{sl}_3$ knot homology", UCSB, topology seminar, April 11 2006. (slides)

Genus bounds

- "Genus bounds and spectral sequences made easy" Kyoto, May 15 2007. (slides)
- UC Davis Student Topology Seminar, February 22 2007.
- UC Berkeley Topology Seminar, February 21 2007.
- UT Austin *Winter School on Knot Theory and Representations*, January 11-14 2007.

Spiders for $U_q(\mathfrak{sl}_n)$

- Station Q Seminar, UC Santa Barbara, October 2 2007. (slides)
- University of Cologne, algebra seminar, November 2005.
- *Quantum Topology AMS Meeting*, Snowbird, Utah, June 2005. (slides)