

Daniel Mathews

Curriculum Vitæ

Personal Information

Address: c/- School of Mathematical Sciences
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Web: <http://www.danielmathews.info>
Date of birth: 26 November 1979
Place of birth: Melbourne, Australia
Citizenship: Australian

Appointments

- **Monash University**, Melbourne, Australia.
Lecturer, School of Mathematical Sciences, 2013–.
- **Contextual Systems**, Melbourne, Australia.
Mathematician, 2012.
- **Boston College**, Boston, Massachusetts, USA.
Visiting Assistant Professor, 2010–12.
- **Mathematical Sciences Research Institute**, Berkeley, California, USA.
Research Member, 2010.
Program in Symplectic and Contact Geometry and Topology.
- **Université de Nantes**, Nantes, France.
Postdoctoral fellow, 2009–10.

Research

Interests:

Contact and Symplectic topology and geometry

- Algebraic aspects: contact categories, string homology, representation theory.
- Combinatorial aspects: convex surfaces, dividing sets, open books.
- Physical aspects: topological quantum field theory, “it from bit”, topological recursion, quantum curves.

Hyperbolic geometry

- Holonomy and geometric structures.
- Representation and character varieties.
- Hyperbolic knots, A-polynomials.

Published research articles:

- *Counting curves on surfaces*
with N. Do and M. Koyama, *Internat. J. Math.* 28 (2017), no. 2, 1750012, 105 pages
- *Strings, fermions and the topology of curves on annuli*
accepted for publication in the *Journal of Symplectic Geometry*, 28/10/15
- *Dimensionally-reduced sutured Floer homology as a string homology*
with E. Schoenfeld, *Algebr. Geom. Topol.* 15 (2015), no. 2, 691–731
- *Twisty itsy bitsy topological field theory*
Internat. J. Math. 25 (2014), no. 10, 1450097, 68 pages
- *An explicit formula for the A-polynomial of twist knots*
J. Knot Theory Ramifications 23 (2014), no. 9, 1450044, 5 pages
- *Itsy bitsy topological field theory*
Ann. Henri Poincaré 15 (2014) 9, 1801–1865.
- *Contact topology and holomorphic invariants via elementary combinatorics*
Expo. Math. 32 (2014) 2, 121–160.
- *Sutured TQFT, torsion, and tori*
Internat. J. Math. 24 (2013) 5, 1–35.
- *The hyperbolic meaning of the Milnor–Wood inequality*
Expo. Math. 30 (2012) 1, 49–68.
- *Hyperbolic cone-manifold structures with prescribed holonomy II: higher genus surfaces*
Geom. Dedicata 160 (2012) 15–45.
- *Sutured Floer Homology, Sutured TQFT and Non-Commutative QFT*
Algebr. Geom. Topol. 11 (2011) 5, 2681–2739.
- *Hyperbolic cone-manifold structures with prescribed holonomy I: punctured tori*
Geom. Dedicata 152 (2011), 85–128.
- *Chord diagrams, contact-topological quantum field theory, and contact categories*
Algebr. Geom. Topol. 10 (2010) 4, 2091–2189.

Preprints:

- *Morse structures on partial open books with extendable monodromy*
with J. E. Licata, preprint available at <http://arxiv.org/abs/1702.07547>.
- *Polytopes, dualities, and Floer homology*
preprint available at <http://arxiv.org/abs/1702.03630>.
- *Strand algebras and contact categories*
preprint available at <http://arxiv.org/abs/1608.02710>.
- *Topological recursion and a quantum curve for monotone Hurwitz numbers*
with N. Do & A. Dyer, preprint available at <http://arxiv.org/abs/1408.3992>.

Books published:

- *Problem solving tactics*
joint with A. Di Pasquale and N. Do
published by Australian Mathematics Trust, 2014

Grants awarded:

- *Quantum invariants and hyperbolic manifolds in three-dimensional topology*
ARC Discovery Project DP160103085
joint with J. Purcell

Research student supervision:

- *PhD students:*
Tung Le (75%, primary supervisor), 2015–
Anupam Chaudhuri (25%, secondary supervisor), 2016–
- *Honours students:*
Ronald Almedia 2017
Joshua Grant 2015–16
Michelle Strumila 2015
Alastair Dyer 2014 (joint supervision with N. Do)
- *Vacation research students:*
Peizheng Ni 2016–17
Musashi Koyama, Angus Southwell 2014–15
Joshua Grant, Michelle Strumila 2013–14
- *Undergraduate research projects:*
Stephen Deng 2016
Musashi Koyama 2015
Alastair Dyer, Jake Antmann, Colin Andrews, Benjamin Jones 2013

Research talks:

- 12/16 Australian Mathematical Society Annual Meeting, ANU
Strand algebras and contact categories
- 11/16 MSI Workshop on Low-Dimensional Topology & Quantum Algebra, ANU
Strand algebras and contact categories.
- 10/16 MSI Workshop on Low-Dimensional Topology & Quantum Algebra, ANU
An introduction to contact geometry and topology.
- 04/16 University of Melbourne
Hyperbolic volume and the Mahler measure of the A-polynomial.
- 01/16 Workshop on Gromov-Witten theory, Gauge Theory, and Dualities, ANU Kioloa
Trinities, sutured Floer homology, and contact structures.
- 09/15 Australian Mathematical Society Annual Meeting, Flinders University
Counting curves on surfaces.
- 05/15 University of Melbourne, *The A-polynomial, symplectic geometry, and quantisation.*
- 02/15 Topology seminar, Tokyo Institute of Technology
Contact topology and holomorphic invariants via elementary combinatorics.
- 12/14 Australia New Zealand Mathematics Convention, University of Melbourne
Strings, fermions and the topology of curves on surfaces.
- 10/14 University of Melbourne, *Strings, fermions and the topology of curves on surfaces.*
- 05/14 Monash University, *Discrete Contact Geometry.*
- 04/14 University of Melbourne
Gopakumar-Vafa invariants of toric Calabi-Yau threefolds (joint with N. Do).

- 09/13 Australian Mathematical Society Annual Meeting, University of Sydney
A Yang-Baxter equation from sutured Floer homology.
- 05/13 University of Melbourne
Sutures, quantum groups and topological quantum field theory.
- 04/13 Australian National University
Contact topology and holomorphic invariants via elementary combinatorics.
- 12/12 Monash University
Contact topology and holomorphic invariants via elementary combinatorics.
- 12/12 Australian and New Zealand Association of Mathematical Physics Inaugural Meeting:
Some field-theoretic ideas out of contact geometry and elementary topology.
- 04/12 University of Southern California, *Itsy bitsy topological field theory.*
- 04/12 MIT, *Itsy bitsy topological field theory.*
- 03/12 Monash University, *Itsy bitsy topological field theory.*
- 11/11 University of Maryland, *Hyperbolic cone-manifolds with prescribed holonomy.*
- 05/11 Harvard University, *Sutured Floer homology and TQFT.*
- 04/11 Brown University, *Sutured topological quantum field theory.*
- 10/10 Columbia University, *Hyperbolic cone-manifolds with prescribed holonomy.*
- 10/10 Columbia University, *Sutured topological quantum field theory and contact elements in sutured Floer homology.*
- 09/10 Geometry/Topology Seminar, Boston College: *Sutured topological quantum field theory and contact elements in sutured Floer homology.*
- 07/10 Workshop on Geometry, Topology and Dynamics of Character Varieties, National University of Singapore, *Hyperbolic cone-manifolds with prescribed holonomy.*
- 05/10 Institut Mathématiques de Jussieu, Paris
Sutured Floer homology and contact-topological quantum field theory.
- 05/10 Séminaire Géométries, Institut Camille Jordan, Lyon
Sutured Floer homology and contact-topological quantum field theory.
- 04/10 Université Libre de Bruxelles,
Sutured Floer homology and contact-topological quantum field theory.
- 04/10 Michigan State University, *Sutured topological quantum field theory and contact elements in sutured Floer homology.*
- 02/10 Uppsala Universitet
Chord Diagrams, Contact-Topological Quantum Field Theory, and Contact Categories.
- 01/10 University of Melbourne
Chord Diagrams, Contact-Topological Quantum Field Theory, and Contact Categories.
- 12/09 Université de Grenoble
Chord Diagrams, Contact-Topological Quantum Field Theory, and Contact Categories
- 12/09 Université de Grenoble, *Hyperbolic cone-manifold structures with prescribed holonomy*
- 12/09 Université de Nantes
Chord Diagrams, Contact-Topological Quantum Field Theory, and Contact Categories
- 10–12/09 Series of four talks on Ph.D. work, Université de Nantes
Chord Diagrams, Contact-Topological Quantum Field Theory, and Contact Categories
- 04/09 Columbia University: *Chord diagrams, topological quantum field theory, and the sutured Floer homology of solid tori.*

- 03/09 Stanford University, *Chord diagrams, topological quantum field theory, and the sutured Floer homology of solid tori.*
- 11/08 Stanford University, November 2008, *Catalan numbers and sutured Floer homology.*
- 01/06 Manifolds at Melbourne conference, University of Melbourne
Construction of geometric cone-manifold structures with prescribed holonomy.
- 07/05 University of Melbourne, July 2005
Construction of geometric cone-manifold structures with prescribed holonomy.

Conferences attended:

- 11–12/16 *Interactions between Topological Recursion, Modularity, Quantum Invariants and Low-Dimensional Topology, MATRIX.*
- 12/16 *Australian Mathematical Society Annual Meeting, ANU.*
- 10-11/16 *MSI Workshop on Low-Dimensional Topology & Quantum Algebra, ANU*
- 07/16 *Knots in Hellas 2016, International Olympic Academy, Ancient Olympia, Greece.*
- 01/16 *Gromov–Witten Theory, Gauge Theory and Dualities, Kioloa, ANU*
- 09-10/15 *Australian Mathematical Society Annual Meeting, Flinders University, Adelaide.*
- 06/15 *CURVE 2015, Institut de Mathématiques de Jussieu, Paris.*
- 12/14 *8th Australia New Zealand Mathematics Convention, University of Melbourne.*
- 07/14 *The Geometry, Topology and Physics of Moduli Spaces of Higgs Bundles*
Institute for Mathematical Sciences, National University of Singapore.
- 09/13 *Australian Mathematical Society Annual Meeting, University of Sydney.*
- 07/13 *Low dimensional topology after Floer, Centre de Recherche Mathématiques, Montréal.*
- 12/12 *Australian and New Zealand Association of Mathematical Physics (ANZAMP) Inaugural Conference, Lorne, Victoria.*
- 05-06/11 *Trimester on Contact and Symplectic Topology, Université de Nantes, France.*
- 07/10 *Workshop on Geometry, Topology and Dynamics of Character Varieties*
Institute for Mathematical Sciences, National University of Singapore.
- 06/10 *Istanbul Contact Geometry and Topology Workshop, Bogazi ci University, Istanbul.*
- 05/10 *Seventeenth Gökova Geometry/Topology Conference, Gökova, Turkey.*
- 01/10 *Workshop on Symplectic Geometry, Contact Geometry and Interactions*
Institut Henri Poincaré, Paris.
- 07/09 *1st PRIMA Congress, University of New South Wales.*
- 08/08 *Workshop on Holomorphic Curves, Stanford University.*
- 07/08 *Workshop on Symplectic Field Theory III, Humboldt University, Berlin.*
- 07/07 *New Perspectives and Challenges in Symplectic Field Theory — a Conference in Honour of Yasha Eliashberg’s 60th Birthday, Stanford University.*
- 08/06 *Workshop on Symplectic Field Theory II, Universität Leipzig.*
- 06/06 *IAS / Park City Mathematics Institute Summer Session, Park City, Utah.*
- 03/06 *3-manifolds after Perelman, Heriot-Watt University, Edinburgh.*
- 01/06 *Manifolds at Melbourne, University of Melbourne.*
- 05/05 *3-manifolds and knot theory, University of Texas at Austin.*

Teaching

At Monash University:

- 2013– **Lecturer & unit coordinator, first year calculus:**
MTH1020 Analysis of Change. Enrolment growing to well over 500. Extensive rewriting and improvement of lecture materials. Strengthening course content. Expanding and improving problem sets and solutions. Rearrangement of curriculum, results boosted. Lectures of over 200 students. Writing assignments, solutions, exams, marking schemes. Co-ordinating up to 20 tutors, 4 lecturers, markers.
- 2013– **Lecturer & unit coordinator, differential geometry:**
An advanced undergraduate course MTH3110 on the differential geometry of curves and surfaces. Writing extensive new lecture notes / textbook. Expanding and improving problem sets and solutions. Preparing and delivering lectures. Writing assignments and solutions, co-ordinating tutors and lecturers, teaching support classes, writing and grading exams. Enrolment around 50 students.
- 2013–15 **Lecturer, honours topology:**
M4051 Topology, an advanced topology course for honours students. Responsible for all aspects of the course: content, lectures, writing and grading homework and exams, preparing solutions, office hours. Approximately 5 students.
- 2014– **Lecturer, mathematics extension for secondary students:**
MTH1040 Mathematics Extension, a course for high-achieving Year 12 students covering first-year university mathematics. Responsible for preparing and delivering 12 weeks of lectures introducing secondary students to concepts such as limits, differential and integral calculus, and differential equations. Approximately 25 students.
- 2015– **Mathematics Learning Centre videos:**
Recorded several videos for use of undergraduate students, on various topics across the undergraduate curriculum: inverse function theorem, single & multivariable calculus, topology, etc.

At Boston College:

- 2012 **Lecturer, graduate geometry/topology:**
Math 832 Geometry/Topology IV, a graduate course on symplectic and contact geometry and topology, *held for the first time, built from scratch*. Responsible for selection of content, preparing and delivering lectures, assigning and grading homework and writing solutions, conducting assessment. Two students.
- 2011–12 **Lecturer, undergraduate abstract mathematics:**
Math 216, Introduction to Abstract Mathematics. Responsible for all aspects of the course, including lectures, homework, solutions, office hours, writing tests, and grading exams. Approximately 20 students.
- 2011 **Lecturer, complex variables:**
Math 460, Complex Variables. Responsible for all aspects of the course, including lectures, homework, solutions, office hours, and examinations. Approx. 30 students.
- 2010 **Lecturer, calculus:**
Two sections of Math 105, calculus II-AP for math and science majors. Responsible for all aspects of the course: preparing and delivering lectures, assigning homework, preparing homework solutions, co-ordinating grading, holding office hours, writing and setting tests, grading exams. Approximately 80 students total.

2010–12 **Putnam Problem Sessions:**

With other faculty, lead problem sessions exploring challenging problems.

At Stanford University:

2005–9 **Course & Teaching Assistant, calculus:**

Various undergraduate subjects on calculus, linear algebra, and multivariable calculus. Responsible for leading sections, holding office hours, and grading exams.

2008 **Course Assistant, topology:**

Math 215C, first year graduate topology. Responsible for grading homework and exams, holding office hours and giving some lectures.

2007 **Course Assistant, functional analysis:**

Math 175, an advanced undergraduate course on functional analysis. Responsible for grading homework and holding office hours.

2006 **Course Assistant, complex analysis:**

Math 116, complex analysis. Responsible for grading homework, holding office hours, giving some lectures.

2004 **Course Assistant, group theory:**

Math 120, group theory. Responsible for holding office hours, grading exams and writing homework solutions.

Mathematical Olympiad:

2012– **Lecturer:**

Lectures at December School of Excellence, held at University of Melbourne.

1998–04 **Lecturer, tutor, grader:**

In residence at biannual 10-day residential camps biannually 1999–2004. At IMO training camps and IMO 2002–2004.

Talented secondary students:

2013– **Australian Mathematics Competition workshops:** Problem-solving workshops with competition winners / high-achieving students, each year.

2015 Genazzano FCJ College

2007 **Stanford University Mathematics Camp (SUMaC):**

Teaching Assistant, responsible for meeting with several students individually every day to discuss their experiences at the camp and to explain mathematics.

1998–2004 Scotch College

2001–2003 Penleigh & Essendon Grammar School

Service, engagement

At Monash University:

2016– **DATUM project:** peer feedback on teaching for support and development.

2014– **LunchMaths:** Organiser (joint with N. Do) of LunchMaths at Monash: informal talks for interested undergraduates, at lunch time, by researchers in mathematical sciences.

- 2013– **Pure maths meetups:** Organiser (joint with N. Do) or pure maths meetups: informal gatherings where fun maths topics outside the usual undergraduate syllabus are discussed.
- 2016– **Hiring committees:** Sat on several committees for hiring top calibre mathematicians.
- 2013– **Curriculum development:** Participated in overhaul of undergraduate mathematics curriculum at Monash.
- 2013– **Assessing honours and postgraduate students:** Marking honours theses, sat on many PhD and Masters milestone panels.

External reviewing

- 2015– **ARC assessments:** Reviewed many applications for grants under Australian Research Council funding schemes.
- 2011– **Mathematical reviews:** Reviewed many papers for international reviewing services *Mathematical Reviews* and *Zentralblatt Math*.
- 2007– **Peer review:** Reviewed many papers in my field for journals including *Geometry & Topology*, *Quantum Topology*, *Electronic Journal of Combinatorics*.

Conference, seminar organisation

- 2016– **Topology seminar:** Involved in organisation and administration of Monash topology seminar, with J. Purcell and N. Do.
- 2015–16 **Moduli spaces seminar:** Organiser, with P. Norbury and N. Do, of Moduli Spaces seminar at University of Melbourne.
- 2014 **ANZMC special session:** Organiser, with C. Hodgson and N. Hoffman, of Special Session on Geometry and Topology at 8th Australia–New Zealand Mathematics Convention
- 2000–04 **Melbourne University Mathematics Society:** A student society. President in 2001. Organised many events, including seminars for undergraduate students.

Secondary education

- 2012–15 **TIMES project:** Australian Mathematical Sciences Institute (AMSI), The Improving Mathematics in School (TIMES) Project. Writing modules for secondary teachers on the various topics in the Australian Curriculum, to give them required knowledge, and additional interesting background, in an engaging way.
- 10/15 **Professional development for secondary teachers:** Talk to secondary teachers, "Senior activities in the Australian Mathematical Olympiad programme", Scotch College

Mathematical Olympiad

- 2015– **Intermediate Problems Committee, Australian Mathematical Olympiad:** Set problems for Australian Intermediate Mathematical Olympiad competitions.
- 2001– **Senior Problems Committee, Australian Mathematical Olympiad:** Set problems for senior Australian mathematical Olympiad competitions, including Australian Mathematical Olympiad and AMOC Senior Contest.
- 2002–04 **Deputy Leader of Australian team at International Mathematics Olympiad:** Glasgow 2002, Tokyo 2003, Athens 2004

Mathematical art

2013 **Mathematical sculpture:** 3-D printed mathematical sculpture with H. Segerman
"Open book decomposition"

Advocacy / legal

2016 Science Meets Parliament

2015 Admitted to the legal profession in Victoria

Outreach talks

11/16 Ivanhoe Grammar, *About Mathematics*

09/16 LunchMaths, Monash University, *Bertrand Russell and his paradox*

09/16 The Laborastory, *Bertrand Russell*

08/16 Tall Poppy Experience, Quantum Victoria, *Mathematics – Topology: The Shape of Space*

08/15 LunchMaths, Monash University, *Your calculator as a weapon*

08/15 Tall Poppy Experience, Quantum Victoria, *Topology: The Shape of Space*

07/15 Presbyterian Ladies College, *Mathematics – Topology*

07/15 Genazzano FCJ College, *STEMSGEN: Being a mathematician*

07/15 Monash Inspiration Day, *Geometry and Topology: The Shape of Space*

08/14 LunchMaths, Monash University, *Topology: Shapes of Space, and Space of Shapes*

06/14 Maths in Action Day, University of Melbourne, *Mathematical games: Hackenbush*

Recreational mathematics articles:

- *A Beautiful Sequence*, Aust. M. S. Gazette, Vol. 31 No. 1 (2004)
- *Games with Galois*, Aust. M. S. Gazette, Vol. 31 No. 2 (2004). Reprinted in *Vinculum*, No. 4 (2007). the Mathematical Association of Victoria professional journal for Victorian mathematics teachers.
- *Quadratic geography, algebraic extreme sports and magical Farey trees*, Aust. M. S. Gazette, Vol. 31 No. 3 (2004)
- *Knot Man* (comic; illustrator Priscilla Brown): 4 issues available, published in *Paradox*, the magazine of the Melbourne University Mathematics and Statistics Society.

Popular articles / media

- *Talking science under the Canberra Big Tent*, NTEU Advocate 23/02, June 2016
- *Riddle. Mystery. Enigma*. ABC Radiotonic, broadcast 6/11/15.
- *Every world in a grain of sand: John Nash's astonishing geometry*, The Conversation, 27/5/15
- *Paranoid defence controls could criminalise teaching encryption*, The Conversation, 19/5/15

Education

- **Stanford University**, Stanford, California.
Ph.D. in Mathematics, 2009.
Thesis: *Chord diagrams, contact-topological quantum field theory, and contact categories*.
Advisors: Yakov Eliashberg, Steven Kerckhoff.
- **University of Melbourne**, Melbourne, Australia.
M.Sc. in Mathematics, 2004.
Thesis: *From Algebra to Geometry: A Hyperbolic Odyssey — The construction of geometric cone-manifold structures with prescribed holonomy*.
Supervisor: Craig Hodgson
- **University of Melbourne**, Melbourne, Australia.
B.Sc. (Hons) in Mathematics, L.L.B. (Hons), Dip.Mod.Lang. (Italian)
Thesis: *Mahler's Unfinished Symphony: Études in Knots, Algebra and Geometry*.
Supervisor: Craig Hodgson

Awards

- 2015 BH Neumann Award – Australian Mathematics Trust
- 2014 Tall Poppy Award – Australian Institute of Policy & Science
- 1999–03 Rowden White Prize 2002; Dean's Honours List 2000; JR Maguire Exhibition 1999 (highest ranked student in Criminal Law); Dean's Prize in Science 1998.
- 1998–02 Melbourne University National Scholarship.
- 1997–8 First Place in the State in VCE 1997. Australian Students Prize for Excellence 1997, 1998. Premier's prizes in mathematics, physics.
- 1996–7 Represented Australia at the International Mathematical Olympiad.
Mar del Plata, Argentina 1997 — silver medal.
Mumbai, India 1996 — bronze medal.

Other interests

- **Music:**
Stanford Wind Ensemble, 2005–07. Victorian Youth Symphony Orchestra 1998-2004: secretary, webmaster, French Horn.
- **Human rights:**
Amnesty International, Initiative for Equality, Peace & Justice organisations.
- **Miscellaneous:**
Physics, astronomy, programming, world politics, international law, environmental policy, alternative economics, linguistics, music composition, philosophy, economic history, beer brewing.

References

Available on request.