

Iain Moffatt

CONTACT INFORMATION

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EDUCATION

University of Warwick, UK **2001 - 2005**

Ph.D. in Mathematics,

- Thesis Title: Integration and Conjugacy in Knot Theory
- Adviser: Stavros Garoufalidis

University of St Andrews, UK **1997 - 2001**

MSci (Hons.) Pure Mathematics (first class)

APPOINTMENTS

- Assistant Professor (Tenure-Track), Dept. of Math. and Stats., University of South Alabama, USA. **From Aug. 08**
- Post-Doctoral Fellow, Combinatorics and Optimization, University of Waterloo, Canada. **Aug. 06 - Aug. 08**
- Post-Doctoral Fellow, Dept. of Applied Math. (KAM), Charles University, Czech Republic. **June 05 - Aug. 06**

VISITING APPOINTMENTS

- Honorary Research Associate, University of Liverpool, UK. **Jan. 05 - May 05**
- Visiting Scholar (during Ph.D.), Georgia Institute of Technology, USA. **Nov. 02 - May 04**

RESEARCH INTERESTS

Algebraic graph theory, topological graph theory, and knot theory.

I am particularly interested in extending results for plane and abstract graphs to graphs embedded in arbitrary surfaces. I have developed various approaches for this, finding new, and often unexpected, results that were previously unattainable. For example, amongst other results, I have been able to solve isomorphism problems for medial graphs, connect separability and the genus of a partial dual, find new connections between the chromatic polynomial and other graph polynomials, obtain a recursive definition and interpretations of the Penrose polynomial, and find new combinatorial interpretations on the Tutte polynomial.

I have worked extensively with graph polynomials. My publications in this area include new combinatorial interpretations, new identities, and new connections between graph polynomials. I have a strong interest in applications of graph polynomials to physics and knot theory. For example, I extended the classical relationship between the Tutte polynomial and the zero-field Potts model from statistical mechanics to models that involve external magnetic fields. This resulted in a deletion-contraction formulation, and a number of new expansions and results for the Potts model in an external field.

I am also interested in connections between combinatorics and knot theory: in using knot theory to develop new combinatorics, and in using combinatorics to solve hard problems in knot theory. My results in this area include the identification of the tree part

of the LMO invariant with Milnor's μ -invariants, the use of methods from enumerative combinatorics to solve problems about the LMO invariant, applications of combinatorial group theory, various connections between graph and knot polynomials, a realization of the Jones polynomial as a permanent and its applications to quantum complexity and approximation.

My work has appeared in top mathematics journals such as *Advances in Mathematics*, and *Transactions of the American Mathematical Society*.

PAPERS

- Evaluations of topological Tutte polynomials, (with J. Ellis-Monaghan) submitted.
- Partial duals of graphs embedded in the real projective plane, submitted.
- Spanning trees and expansions for the Potts model partition function in an external field, (with L. McDonald) submitted.
- A Penrose polynomial for embedded graphs, (with J. Ellis-Monaghan) submitted.
- Bipartite partial duals and circuits in medial graphs, (with S. Huggett) submitted.
- On the Seifert graphs of a link diagram and its parallels, (with S. Huggett and N. Virdee) *Mathematical Proceedings of the Cambridge Philosophical Society*, to appear.
- Partial duals of plane graphs, separability and the graphs of knots, submitted.
- The Tutte-Potts connection in the presence of an external magnetic field, (with J. Ellis-Monaghan) *Advances in Applied Mathematics* 47 (2011) 772-782.
- A permanent formula for the Jones polynomial, (with M. Loebl), *Advances in Applied Mathematics* 47 (2011) 659-667.
- Twisted duality for embedded graphs, (with J. Ellis-Monaghan), *Transactions of the American Mathematical Society*, to appear.
- A characterization of partially dual graphs, *Journal of Graph Theory* 67 (2011) 198-217.
- Partial duality and Bollobás and Riordan's ribbon graph polynomial, *Discrete Mathematics* 310 (2010) 174-183.
- Unsigned state models for the Jones polynomial, *Annals of Combinatorics* 15 (2011) 127-146.
- Expansions for the Bollobás-Riordan polynomial of separable ribbon graphs, (with S. Huggett), *Annals of Combinatorics*, to appear.
- A new proof that alternating knots are non-trivial, *Journal of Knot Theory and its Ramification* 19 (2010) 821-828.
- Knot invariants and the Bollobás-Riordan polynomial of embedded graphs, *European Journal of Combinatorics* 29 (2008) 95-107.
- The chromatic polynomial for fatgraphs and its categorification, (with M. Loebl), *Advances in Mathematics* 217 (2008) 1558-1587.
- On the group-like behaviour of the Le-Murakami-Ohtsuki invariant, (with D. M. Jackson and A. Morales), *Journal of Knot Theory and its Ramifications* 16 (2007) 699-718.
- The Århus integral and the μ -invariants, *Journal of Knot Theory and its Ramification* 15 (2006) 361-377.

CONFERENCES

Spring Southeastern Sectional Meeting of the AMS, Tampa, (2012). Speaker.
 Atlanta Lecture Series in Combinatorics and Graph Theory IV, Atlanta (2011).
 Fields Undergraduate Network: Workshop in Knot Theory, Waterloo (2011). Speaker.
 Waterloo workshop in computer algebra: W80, Waterloo (2011)
 Atlanta Lecture Series in Combinatorics and Graph Theory II, Atlanta (2011).
 SIAM conference on Discrete Mathematics, Austin (2010). Speaker.
 British Combinatorial Conference, St Andrews (2009). Speaker.
 Combo. in Vermont, Colchester (2008). Speaker.
 Spring Southeastern Sectional Meeting of the AMS, Baton Rouge (2008). Speaker.
 International Conference on Quantum Topology, Hanoi (2007). Speaker.
 C&O@40, Waterloo (2007). Poster presentation.
 CRM School on Statistical Mechanics and Combinatorics, Quebec (2007).
 Canadian Mathematical Society Winter 2006 Meeting, Toronto (2006).
 6th Czech-Slovak Symposium: Combinatorics, Graph Theory, Algorithms and Applications, Prague (2006). Speaker.
 British Mathematical Colloquium, Newcastle (2006). Speaker.
 COMBSRU workshop, Prague (2006).
 NATO School on Physics and Computer Science, Cargese (2005). Speaker and poster presentation.
 2nd Workshop on Tutte Polynomials and Applications, CRM Barcelona (2005). Speaker.
 B(A)MC, Liverpool (2005).
 Non-Positive Curvature in Group Theory, Albany (2004). Speaker.
 Discrete Groups and Hyperbolic Manifolds, Aberdeen (2004).
 Workshop on Geometric Group Theory, Newcastle (2004).
 CMI Summer School on Floer Homology, Gauge Theory and Low-Dimensional Topology, Budapest (2004).
 Knots in Poland, Będlewo (2003).
 Conference on the Topology of manifolds of Dimensions 3 and 4, Austin (2003).
 Spring Eastern Sectional Meeting of the AMS, New York (2003).
 Workshop in Quantum Topology, Warwick (2002).
 Knot Theory Algebraic Geometry and Related Topics, Liverpool (2002).
 Workshop on Geometric Topology, Warwick (2002).

INVITED

COLLOQUIUM AND SEMINAR PRESENTATIONS

Graph Theory Seminar, Georgia Institute of Technology, Atlanta (2011).
 The Tutte Seminar, University Waterloo, Waterloo (2011).
 Combinatorics Seminar, Auburn University, Auburn (2011).
 Colloquium, Troy University, Troy (2011).
 Combinatorics Seminar, University of Vermont, Burlington (2011).
 Combinatorics Seminar, University of Vermont, Burlington (2010).
 Topology Seminar, University of South Alabama, Mobile (2009).
 Combinatorics Seminar, Charles University, Prague (2009).
 Combinatorics Seminar, University of Vermont, Burlington (2009).
 Geometry and Topology Seminar, Georgia Tech., Atlanta (2008).
 Topology Seminar, University of South Alabama, Mobile (2008).
 Colloquium, University of South Alabama, Mobile (2008).
 Low-Dimensional Topology seminar, Ohio State University, Columbus (2008).
 Geometry and Topology Seminar, Georgia Tech., Atlanta (2007).
 Tutte Seminar, University of Waterloo, Waterloo (2007).
 Geometry and Topology Seminar, University of Waterloo, Waterloo (2007).
 KAM Seminar, Charles University, Prague (2005).
 Colloquium, University of Liverpool, Liverpool (2005).
 Knot Theory Seminar, University of Liverpool, Liverpool (2005).

Geometry and Topology Seminar, Georgia Tech., Atlanta (2004).

REFEREEING AND
REVIEWING

I have refereed for several journals.

I am a reviewer for Zentralblatt MATH.

I have reviewed research proposals for federal agencies.

GRANTS

Summer Professional Development Award (2011; Univ. of South Alabama)
Support and Development Award (2010, 2009, 2008; Univ. of South Alabama)

PROFESSIONAL
SERVICE

Assessment Committee (2009-2010 and 2008-2009) The role of this committee is to first formulate assessment methods and then employ these to carry out an assessment of the department's undergraduate programme, graduate programme and research, to ensure the University's continued accreditation by the Southern Association of Colleges and Schools (SACS). SACS is the body for the accreditation of degree-granting higher education institutions in the 11 Southern states of the USA. I worked with the committee in conjunction with the Chair of the School and the University Administration to prepare and submit the department's report for the accreditation.

Curriculum Committee (2010-2011 (Chair) and 2009-2010) This committee directs the department's teaching policy and the formulation and implementation of policy that will improve the quality of the teaching of mathematics at the University of South Alabama. Issues that I have addressed include capstone courses, consistent coverage, course coordinators, grading software, online homework, addressing the needs of other departments in our service courses, textbook costs, staff-student council, course re-designs, textbook choices, and course prerequisites.

Scholarship Committee (2011-2012 (Chair)) This committee is responsible selecting and recommending students for departmental scholarships and awards.

PROFESSIONAL
MEMBERSHIP

American Mathematical Society

TEACHING

I have wide and varied experience of teaching at both undergraduate and graduate level. I have taught students of widely varying ability, ranging from outstanding Mathematics, Engineering and Physics students in top institutions, to mathematically inexperienced students taking a pre-calculus math course to satisfy university requirements. In addition to traditional lecturing, I have successfully used non-traditional methods such as online homework and peer-grading to meet students' needs. I have taught classes of over 120 students to tutorial groups of 4 students.

My current teaching load is 5 courses per year (I still maintain an active research programme with this high teaching load). In South Alabama I have taught Calculus I, II and III; Foundations of Mathematics where the concepts of proof, logic, set theory, relations and functions were introduced for the first time; and Pre-Calculus Trigonometry which is a course intended to bring students with a weak mathematical background to a level where they can start university level mathematics. At the graduate level, at South Alabama I have taught courses on graph theory and on enumerative combinatorics, and supervised a Master's thesis.

At the University of Waterloo I taught Linear Algebra and Linear Algebra for Engineers over three semesters with a teaching load of up to 2 courses per semester. Over several years at the University of Warwick I tutored small groups of first year students in maths, physics and statistics programmes. I taught the diverse range of topics making up Warwick's undergraduate mathematics programme.

SUPERVISORY
EXPERIENCE

I have supervised a Master's Thesis and an undergraduate research project. Both of these projects resulted in publications. I consider supervising research students a key responsibility, and look forward to directing further research projects.

- Leslie MacDonald, Master's Thesis, *Expansions for polynomials of weighted graphs and their applications to the Potts model*. The main results of this thesis were spanning tree and forest expansions for vertex weighted graph polynomials and the Potts model. This thesis resulted in a joint publication. Leslie is currently a Ph.D. candidate at Oregon State University.
- Alejandro Morales, Undergraduate Research Assistant. I co-supervised, with D.M.R Jackson, a research project on the combinatorics of the LMO invariant. This resulted in a joint publication. Alejandro is currently a Ph.D. candidate at MIT.

REFEREES

- **Professor Jo Ellis-Monaghan**
Department of Mathematics, Saint Michael's College, 1 Winooski Park, Colchester, VT 05439, USA. jellis-monaghan@smcvt.edu
- **Professor David M. Jackson, FRSC**
Combinatorics & Optimization, University of Waterloo, Waterloo, Ontario, N2L 3G1, Canada. dmjackson@math.uwaterloo.ca
- **Professor Martin Loeb1**
Department of Applied Mathematics, Charles University, Malostranske namesti 25, 118 00 Praha 1, Czech Republic. loeb1@kam.mff.cuni.cz
- **Professor J. Scott Carter** (Teaching and service referee)
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