

Pedram Hekmati

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Research Interests

Twisted K -theory, gauge theoretic moduli spaces, character varieties, vertex operator algebras, generalised geometry, topological T -duality, knot invariants.

Employment

- 2016 – University of Auckland, New Zealand
Senior Lecturer in Pure Mathematics
- 2015 – 2017 Instituto Nacional de Matemática Pura e Aplicada, Brazil
Postdoctorate of Excellence
- 2012 – 2015 University of Adelaide, Australia
Australian Research Council DECRA Fellow
- 2010 – 2012 University of Adelaide, Australia
Research Associate

Education

- 2006 – 2010 Royal Institute of Technology, Stockholm, Sweden
Doctor of Philosophy in Mathematical Physics
Thesis: *Abelian Extensions, Fractional Loop Groups and Quantum Fields*
Supervised by Jouko Mickelsson
- 2008 – 2009 Massachusetts Institute of Technology, Cambridge, USA
Visiting Scholar. Supervised by Victor Kac
- 2000 – 2010 Royal Institute of Technology, Stockholm, Sweden
Master of Science in Engineering Physics
- 2008 – 2009 École Polytechnique, Paris, France
Stage d'Option Supervisor: Jean-Pierre Bourguignon

Short-Term Academic Visits

- 2019 Geometry and Physics of Hitchin Systems at the Simons Center, Visiting Researcher, May–June
- 2018 Focus Program at the Fields Institute, Visiting Researcher, June–July
- 2016/2017 University of São Paulo, ICMC, Visiting Researcher, June/March
- 2014 Hausdorff Research Institute for Mathematics, Mathematics Research Fellow, September–October
- 2013 Abdus Salam International Centre for Theoretical Physics, Visiting Researcher, August–September
- 2013 International School for Advanced Studies (SISSA), INdAM Research Fellow, July–August
- 2010 Università di Roma, La Sapienza, Department of Mathematics, Visiting Researcher, January

Publications

- 2020 Sign Choices for Orientifolds, (with Michael Murray, Richard Szabo and Raymond Vozzo), *Communications in Mathematical Physics*, **378** 3 (2020), pp. 1843–1873
- 2019 Real Bundle Gerbes, Orientifolds and Twisted KR -Homology, (with Michael Murray, Richard Szabo and Raymond Vozzo), *Advances in Theoretical and Mathematical Physics*, **23** 8 (2019), pp. 2093–2159
- 2017 Arithmetic of Singular Character Varieties and their E-polynomials, (with David Baraglia) *Proceedings of the London Mathematical Society*, **114** (2017) pp. 293–33
- 2016 Moduli Spaces of Contact Instantons, (with David Baraglia) *Advances in Mathematics*, **294** (2016) pp. 562–595
- Projective Families of Dirac Operators on a Banach Lie Groupoid, (with Jouko Mickelsson) *Journal of Noncommutative Geometry*, **10** (2016) pp. 1–28
- 2015 A Fourier-Mukai Approach to K -theory of Compact Lie Groups, (with David Baraglia) *Advances in Mathematics*, **269** (2015) pp. 335–345
- A Geometric Model for Odd Differential K -theory, (with Michael Murray, Vincent Schlegel and Raymond Vozzo), *Differential Geometry and its Applications*, **40** (2015) pp. 123–158
- Transitive Courant Algebroids, String Structures and T-duality, (with David Baraglia) *Advances in Theoretical and Mathematical Physics*, **19** 3 (2015) pp. 613–672
- 2013 The Faddeev-Mickelsson-Shatashvili Anomaly and Lifting Bundle Gerbes, (with Michael Murray, Danny Stevenson and Raymond Vozzo), *Communications in Mathematical Physics*, **319** 2 (2013), pp. 379–393
- 2012 T-duality of Current Algebras and their Quantization, (with Varghese Mathai) *Contemporary Mathematics*, AMS **584** (2012), pp. 17–38
- The General Caloron Correspondence, (with Michael Murray and Raymond Vozzo) *Journal of Geometry and Physics*, **62** (2012), pp. 224–241
- 2011 Calculus Structure on the Lie Conformal Algebra Complex and the Variational Complex, (with Alberto De Sole and Victor Kac), *Journal of Mathematical Physics*, **52** (2011), 35 pages
- 2010 Fractional Loop Groups and Twisted K -theory, (with Jouko Mickelsson) *Communications in Mathematical Physics*, **299** 3 (2010), pp. 741–763
- Integrability Criterion for Abelian Extensions of Lie Groups, *Proceedings of the American Mathematical Society*, **138** 11 (2010), pp. 4137–4148

Preprints

- 2021 Equivariant Seiberg-Witten Floer Cohomology, (with David Baraglia), 58 pages, [arXiv:2108.06855](https://arxiv.org/abs/2108.06855)
- Twisted Milnor Metric for Finite Group Actions (with Olivia Sorto), *in preparation*
- Crossed Modules and Categorical Actions (with David Roberts), *in preparation*
- 2018 A Foliated Hitchin–Kobayashi Correspondence (with David Baraglia), 42 pages, [arXiv:1802.09699](https://arxiv.org/abs/1802.09699)

Research Grants

- 2021 Impact Strategic Grant for the outreach project *Orbifolds in Music*
- 2018 – 2021 Marsden Faststart Grant (with D. Baraglia),
Exploiting Gauge Theory and Duality in Geometry
- 2018 – 2021 Australian Research Council Discovery Project (with M. Murray, R. Vozzo, D. Stevenson,
D. Evans), *Twisted K-theory, Operator Algebras and Higher Geometry*
- 2017 – 2018 FRDF Faculty Grant, *Symmetries and Quantum Theory: A New Synthesis*
- 2017 PBRF Faculty Research Grant
- 2014 ECMS Faculty Research Grant, *New Applications of Gauge Theory to Geometry*
- 2013 – 2015 Australian Research Council Discovery Project, (with M. Murray),
Geometric Transforms and Duality
- 2012 – 2014 Australian Research Council Discovery Early Career Researcher Award (DECRA),
Group Actions and K-theory: A New Direction
- 2010, 2011 OCLS Faculty Research Grant
- 2010 Category 1 Faculty Research Grant
- 2008, 2008 Alice and Knut Wallenberg Foundation Travel Grant
- 2007 Royal Swedish Academy of Sciences Research Grant

Conference Funding and Visiting Fellowships

- 2020 PBRF funding for an *AGT Postgraduate Workshop* at the University of Auckland
- 2019 Hood Visiting Fellowship for Professor Edward Witten
Faculty and Department Grants for the conference *Geometry of Quantum Fields and Strings*
Kalman Visiting Fellowship for Professor Fanny Kassel
- 2018 PBRF funding for *Character Varieties and TQFT* (with Vaughan Jones)
NZMS funding for graduate students
- 2017 PBRF funding for *Conformal and Symplectic Geometry* (with Rod Gover)
NZMS funding for graduate students
- 2016 CAPES and FAPERJ funding for *String Geometries and Dualities* (with Henrique Bursztyn
and Reimundo Heluani)
- 2010–2017 AMSI and AustMS funding for seven separate IGA conferences at the University of Adelaide

Appointments, Fellowships and Awards

- 2018–2020 Deputy Chair of the Australian and New Zealand Association of Mathematical Physics
2016 Member of the NSF funded research network *Geometric Structures and Representation Varieties*
2014 Research Fellowship at the Hausdorff Research Institute for Mathematics
2013 ICTP Mathematics Research Fellowship
2013 INdAM Research Fellowship from the Italian Research Council
2011, 2012 Head of School's Award for Lecturing and Tutoring Excellence
2003 Sandviken Award for Outstanding Academic Merit
2003 Anna Whitlock Award for Overseas Studies
2000 Rotary Club Award for Outstanding Academic Merit

Selected Invited Conference Talks

- 2021 Index Theory and Complex Geometry, *National University of Singapore*, September
Perspectives on Algebra, Geometry and Number Theory, *Queenstown*, April
2020 A Mathematical Medley, *University of Auckland*, November
The 8th Pacific Rim Conference, Representation Theory Session, *UC, Berkeley*, August
The Annual AZNAMP Meeting, *University of Queensland*, February
2019 The Butcher–Kalman Plenary Lecture, *New Zealand Mathematical Society Colloquium*, December
Spring Operator Algebras Program, *East China Normal University, Shanghai*, April
2018 Geometric Quantization and Applications, *CIRM, Luminy*, October
Index Theory and Applications to Positive Scalar Curvature and Related Areas, *University of Adelaide*, June
2017 Third Pacific Rim Mathematical Association Congress, *Oaxaca*, August
Mathematical Congress of the Americas, *McGill University*, July
Loop Spaces, Supersymmetry and Index Theory, *Chern Institute*, July
K-theory, Subfactors and Conformal Field Theory, *Isaac Newton Institute, Cambridge*, June
T/U-dualities and Generalized Geometry, *University of Zagreb*, June
2016 II Brazilian Meeting for Young in Pure and Applied Mathematics, *Campinas*, December
The Latin American Congress of Mathematicians, *Barranquilla*, July
Gromov-Witten theory, Gauge Theory and Dualities, *Australian National University*, January
2015 First Brazil-Spain Joint Meeting in Mathematics, *Fortaleza*, December
Interactions between Geometry and Physics, *São Paulo*, August
Infinite-Dimensional Structures in Higher Geometry and Representation Theory, *University of Hamburg*, Feb.
2014 Positive Curvature and Index Theory, *National University of Singapore*, November
Quantum Physics and Noncommutative Geometry, *Hausdorff Research Institute for Mathematics*, September
Poisson 2014, *University of Illinois at Urbana-Champaign*, August
String Geometry and Loop Spaces, *University of Greifswald*, July
2013 Representation Theory in Geometry, Topology and Combinatorics, *University of Melbourne*, November
Geometry of Strings and Fields, *The Galileo Galilei Institute for Theoretical Physics*, August
Moduli Spaces and Mathematical Physics, *CIMAT, Guanajuato*, January

A complete list is available at <http://pedram.hekmati.se>

Student Supervision

PhD Students

- 2022 – Stuart Teisseire (co-supervisor, joint with R. Gover)
- 2021 – Xavier Coulter (main supervisor, joint with N. Do)
- 2019 – Marcos Orseli (main supervisor, joint with D. Baraglia)
- 2019 – Mostafa Raziabrahimsaraei (main supervisor, joint with T. ter Elst)
- 2018 – Olivia Sorto, (main supervisor, joint with R. Gover)
- 2017 – Daniel Snell, (co-supervisor, joint with R. Gover)
- 2016 – Bartek Ewertowski, (co-supervisor, joint with R. Gover)
- 2016–2019 Keegan Flood, (co-supervisor, joint with R. Gover)
The Geometry of Solutions to the Metrisability Equation in Projective and C-Projective Geometry

Masters Students

- 2021–2022 Chris Pirie
Real Group-Valued Implosion
- 2021–2022 Oliver Li
Narasimhan-Seshadri Theorem for Twisted Holomorphic Bundles
- 2019–2020 Elizabeth Jagersma
Analytic Torsion and the Cheeger-Müller Theorem
- 2012–2013 Vincent Schlegel (co-supervised with M. Murray),
The Caloron Correspondence and Odd Differential K-theory

Honours Students

- 2022 Joshua Lehman, *Poincaré-Hopf Theorem for Orbiline Fields*
- 2021 Chris Pirie, *Donaldson's Diagonalisability Theorem for Four-Manifolds*
- 2020 Oliver Li (co-supervised with J. Schillewaert), *Sheaves in Algebraic Geometry*
Xavier Coulter, *Hurwitz Numbers and the Infinite-Wedge Algebra*
- 2019 Hunter Linton, *Localisation in Equivariant Cohomology*
David Farrell, *Stone Duality and its Generalisations*
- 2018 Louis Christie, *An Analytic Proof of the Morse Inequalities*
- 2013 Thi Quynh Trang Nguyen (co-supervised with D. Baraglia), *Einstein Metrics on Principal Circle Bundles*
- 2011 Adrián F. Tojo (co-supervised with M. Varghese), *Birkhoff Factorisation Applied to Holomorphic Bundles*

Research Students

- 2022 Joshua Lehman, *Geometry of Orbifolds*, Summer Research Student
- 2021 Matthew French, *Clifford and Geometric Algebras*, Summer Research Student
Pankaj Ghodla, *Differential Geometry of Curves and Surfaces*, Summer Research Student
- 2020 Luis Carlos Soldevilla, *Proof of the Poincare-Hopf Index Theorem*, Research Student
Juan Kim, *The Riemann Mapping Theorem*, Summer Research Student
Anish Sachdeva, *Geometry of Möbius Transformations*, Summer Research Student
Yourong Frank Wang, *Geometry of Chiral Anomalies in Quantum Field Theory*, Summer Research Student
Dannin Eccles, *Algebraic K-theory and Quadratic Reciprocity*, Summer Research Student
- 2019 Odette Jennings, *q-Polynomials of Rooted Trees*, Science Scholar Student
Chris Pirie, *Topics in Differential Topology*, Research Student
Ruta Sliazkaite, *K-theory and Adams Operations*, Northern Hemisphere Summer Research Student
- 2018 Xavier Coulter, *Classification of Root Systems*, Summer Research Student
Aria Hart, *Geometry of Minimal Surfaces*, Summer Research Student
Chris Pirie, *Milnor's Exotic 7-Spheres*, Summer Research Student
Odette Jennings, *Introduction to Knot Invariants*, Summer Research Student
Dannin Eccles, *Computations in Khovanov Homology*, Summer Research Student
- 2013 Parsa Kavkani, *Integer Partitions and Young Diagrams*, Summer Research Student
- 2012 Thi Quynh Trang Nguyen, *Geometric Aspects of Yang-Mills Theory*, Adelaide Vacation Research Scholar

Teaching

University of Auckland

- 2022 Calculus, Semester 1, Lecturer and Tutor
- 2021 General Mathematics I, Summer Semester, Lecturer
Lie Algebras and Lie Groups, Semester 2, Lecturer and Tutor
Real Analysis, Semester 2, Lecturer and Tutor
- 2020 Calculus, Semester 1, Lecturer and Tutor
Calculus, Semester 2, Lecturer and Tutor
- 2019 General Mathematics I, Summer Semester, Lecturer
Calculus, Semester 2, Lecturer and Tutor
Advancing Mathematics 2: Calculus, Semester 2, Lecturer and Tutor
- 2018 Analysis on Manifolds and Differential Geometry, Semester 2, Lecturer
Advancing Mathematics 3: Calculus, Semester 2, Lecturer and Tutor
Functional Analysis, Semester 2, Lecturer
Advancing Mathematics 2: Calculus, Semester 2, Lecturer and Tutor
- 2017 Advancing Mathematics 2: Calculus, Semester 2, Lecturer and Tutor
Advancing Mathematics 3: Calculus, Semester 2, Lecturer and Tutor

Instituto Nacional de Matemática Pura e Aplicada

2016 Index Theory, Advanced Graduate Course, Lecturer

University of Queensland

2015 K -theory and its Applications, Mini-Course at the AMSI Winter School in Brisbane, Lecturer

University of Adelaide

2015 Mathematics for Information Technology I: Probability Theory, Semester 1, Lecturer and Tutor

2014 Mathematics for Information Technology I: Discrete Mathematics, Semester 1, Lecturer and Tutor
Algebraic Topology, Semester 1, Lecturer and Tutor

2013 Mathematics IA: Calculus, Semester 1, Lecturer and Tutor

2012 Integration and Analysis III, Semester 2, Lecturer and Tutor

Mathematics IB: Calculus, Semester 1, Lecturer and Tutor

2011 Topics in Analysis IV, Semester 2, Lecturer and Tutor

Introduction to Financial Mathematics I, Semester 1, Lecturer and Tutor

Royal Institute of Technology

2009 Advanced Quantum Mechanics, Undergraduate Course, Semester 2, Tutor

2009 Vector Calculus, Undergraduate Course, Semester 2, Tutor

2009 Thermodynamics, Undergraduate Course, Semester 2, Tutor

2008 Relativity Theory, Undergraduate Course, Semester 2, Lecturer (part-time) and Tutor

2007 Relativity Theory, Undergraduate Course, Semester 2, Tutor

Academic Service

- The Departmental Graduate Student Advisor, 2019–2022
- Organiser of the Student Prizes in Mathematics, 2017–2022
- Jury member for the Departmental Student Research Conference, Auckland 2021
- Examiner for 3 PhD theses (U. Adelaide, NUS Singapore, ANU) and 6 MPhil theses (U. Auckland, ANU, USP)
- Member of the Departmental Research Committee, 2018–
- Member of the DATUM 2 Group on Development and Analysis of Teaching in Mathematics, 2019–2021
- Member of the Stage I Course Restructuring Committee, 2018–2019
- Managing Guest-Editor of the Special Issue *String Geometries, Dualities and Topological Matter*, for Elsevier’s Journal of Geometry and Physics, 2017–2018
- On the Advisory Committee for the biannual international *Poisson* conference, 2022
- Reviewer for the AMS Mathematical Reviews and Zentralblatt MATH
- Assessor for the Australian Research Council’s Discovery Project Scheme, the Dutch Research Council’s Innovational Research Incentives Scheme, FRDF Faculty Grants

- Referee for *Duke Mathematical Journal*, *Advances in Mathematics*, *Documenta Mathematica*, *International Mathematics Research Notices*, *Journal of Symplectic Geometry*, *Proceedings of the American Mathematical Society*, *Mathematische Nachrichten*, *Journal of Topology and Analysis*, *International Journal of Mathematics*, *Journal of Geometry and Physics*, *Journal of the Australian Mathematical Society*, *AMS Contemporary Mathematics*, *Vietnam Journal of Mathematics*, *New Zealand Journal of Mathematics*, *Journal of Mathematical Physics*, *New York Journal of Mathematics*.

Seminar Organisation

2022	<i>Learning Seminar on Moduli Spaces</i> at the University of Auckland
2021	<i>Geometry Learning Seminar</i> at the University of Auckland
2021	<i>Seminar on Index Theory</i> at the University of Auckland
2020	<i>Differential Topology Learning Seminar</i> at the University of Auckland
2019	<i>Geometry and Topology Learning Seminar</i> at the University of Auckland <i>General Relativity Bootcamp</i> at the University of Auckland
2018	<i>Seminar on Homological Algebra</i> at the University of Auckland
2018 –	<i>Geometry and Analysis Seminar</i> at the University of Auckland
2017 – 2019	<i>Department Colloquium</i> at the University of Auckland
2010 –2013	<i>Strings Journal Club</i> at the University of Adelaide
2009	<i>Seminar in Mathematical Physics</i> at MIT

Professional Memberships

American Mathematical Society

New Zealand and Australian Mathematical Society

International Association of Mathematical Physics

Australian and New Zealand Association of Mathematical Physics

Personal Details

Citizenships: Australia, Sweden

Languages: Swedish, Farsi, English, French, Spanish

Conference and Workshop Organisation

- 2023 Organiser of a lecture series by the Kalman Fellow *Prof Fanny Kassel* in Auckland.
Organiser of a lecture series by *Prof Eckhard Meinrenken* in Auckland.
- 2022 Co-organiser of an MSI Workshop on *Character Varieties, E-Polynomials and Zeta Functions* at ANU, Canberra.
- 2021 Organiser of a workshop on *Poisson Geometry, Groupoids and Quantisation* in Auckland.
- 2020 Co-organiser of the special session *Recent Trends in Geometric Analysis* at the 8th Pacific-RIM Conference on Mathematics at the University of California, Berkeley.
Organiser of an AGT Postgraduate Workshop in Auckland.
Organiser of a public lecture by the Hood Fellow *Prof Edward Witten* in Auckland.
Organiser of the conference *Geometry of Quantum Fields and Strings* in Auckland.
- 2019 Co-organiser of the conference *Moduli Spaces, Representation Theory and Quantization* at RIMS, Kyoto.
Co-organiser of a lecture series by *Dr Ramis Movassagh* in Auckland.
- 2018 Co-organiser of the conference *Character Varieties and Topological Quantum Field Theory* in Auckland.
Co-organiser of the conference *Conformal and Symplectic Geometry* in Auckland.
Co-organiser of the annual *ANZAMP* conference in Auckland.
- 2017 Co-organiser of a lecture series by *Prof Frances Kirwan* in Adelaide.
Co-organiser of a lecture series by *Prof J rge Ellegaard Andersen* in Adelaide.
Co-organiser of the AMSI/IGA conference *Gauge Theory and Higher Geometry* in Adelaide.
Organiser of a lecture series by *Dr David Baraglia* in Auckland.
- 2016 Co-organiser of the conference *String Geometries and Dualities* at IMPA, Rio de Janeiro.
- 2015 Co-organiser of the AMSI/IGA conference *Symmetries and Spinors: Interactions between Geometry and Physics* in Adelaide, featuring lectures by Prof Jos  Figuerola-O'Farrill and Prof Maxim Zabzine.
- 2014 Organiser of an IGA lecture series by *Dr Timothy Nguyen* in Adelaide.
- 2013 Co-organiser of the IGA conference *Aspects of Finsler Geometry* in Adelaide, featuring lectures by Prof Robert Bryant.
- 2013 Co-organiser of a *Special Session in Mathematical Physics* at the 57th Annual AustMS in Sydney.
Co-organiser of the IGA conference *Current Groups and Twisted K-theory* in Adelaide, featuring a lecture series by Prof Jouko Mickelsson.
- 2012 Co-organiser of the AMSI/IGA conference *Geometry of Supermanifolds* in Adelaide, featuring a lecture series by Prof Ugo Bruzzo.
Organiser of an IGA lecture series by Dr Ittay Weiss in Adelaide.
Co-organiser of the AMSI/IGA conference *Dualities in Field Theories and the Role of K-Theory* in Adelaide, featuring a lecture series by Prof Jonathan Rosenberg.
Co-organiser of the AMSI/IGA conference *The Mathematical Implications of Gauge-String Dualities* in Adelaide, featuring a lecture series by Prof Rajesh Gopakumar.
- 2011 Co-organiser of the AMSI/IGA conference *Group-Valued Moment Maps with Applications to Mathematics and Physics* in Adelaide, featuring a lecture series by Prof Eckhard Meinrenken.
- 2010 Co-organiser of the AMSI/IGA conference *The Dirac Operators in Geometry, Topology, Representation Theory, and Physics* in Adelaide, featuring a lecture series by Prof Dan Freed.