

# Pedram Hekmati

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## Research Interests

Gerbes and twisted  $K$ -theory, gauge theoretic moduli spaces and character varieties, vertex operator algebras, generalised geometry, geometric correspondences such as the caloron transform and topological  $T$ -duality.

## 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), to appear in *Communications in Mathematical Physics*, 28 pages, [arXiv:1905.06041](https://arxiv.org/abs/1905.06041)
- 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

## Submitted

- 2018 A Foliated Hitchin–Kobayashi Correspondence (with David Baraglia), 42 pages, [arXiv:1802.09699](https://arxiv.org/abs/1802.09699)

## Research Grants

- 2018 – 2020 Marsden Faststart Grant (with D. Baraglia),  
*Exploiting Gauge Theory and Duality in Geometry*
- 2018 – 2020 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 R. Gover)  
NZMS funding for graduate students
- 2016 CAPES and FAPERJ funding for *String Geometries and Dualities* (with H. Bursztyn  
and R. 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*, June
- 2020 Mini-Course on Generalised Geometry and Topological T-duality, *GAAG at UFF, Rio De Janeiro*, October  
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*

- 2019 – Marcos Orseli (main supervisor, joint with D. Baraglia)
- 2019 – Mostafa Raziobrahimsaraei (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*

- 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*

- 2020 Oliver Li (co-supervised with J. Schillewaert)  
*Schemes and Cohomology*
- 2020 Chris Pirie  
*Moduli Spaces of Seiberg-Witten Monopoles*
- 2020 Xavier Coulter  
*Hurwitz Numbers and the Infinite-Wedge Algebra*
- 2019 Hunter Linton  
*Localisation in Equivariant Cohomology*
- 2019 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 Fernandez Tojo (co-supervised with M. Varghese),  
*Birkhoff Factorisation Applied to Holomorphic Bundles*

### *Research Students*

- 2020 Luis Carlos Soldevilla, *Proof of the Poincare-Hopf Index Theorem*, Research Student
- 2020 Juan Kim, *The Riemann Mapping Theorem*, Summer Research Student
- 2020 Anish Sachdeva, *Geometry of Möbius Transformations*, Summer Research Student
- 2020 Yourong Frank Wang, *Geometry of Chiral Anomalies in Quantum Field Theory*, Summer Research Student
- 2020 Dannin Eccles, *Algebraic K-theory and Quadratic Reciprocity*, Summer Research Student
- 2019 Odette Jennings, *q-Polynomials of Rooted Trees*, Science Scholar Student
- 2019 Chris Pirie, *Topics in Differential Topology*, Research Student
- 2019 Ruta Sliazkaite, *K-theory and Adams Operations*, Northern Hemisphere Summer Research Student
- 2018 Xavier Coulter, *Classification of Root Systems*, Summer Research Student
- 2018 Aria Hart, *Geometry of Minimal Surfaces*, Summer Research Student
- 2018 Chris Pirie, *Milnor's Exotic 7-Spheres*, Summer Research Student
- 2018 Odette Jennings, *Introduction to Knot Invariants*, Summer Research Student
- 2018 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*

- 2020 Calculus, Semester 1, Lecturer and Tutor  
Calculus, Semester 2, Lecturer and Tutor
- 2019 General Mathematics I, Summer Course, 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 PhD Coordinator, 2019–
- Organiser of the Student Prizes in Mathematics, 2017–
- Member of the Departmental Research Committee, 2018–
- Member of the DATUM 2 Group on Development and Analysis of Teaching in Mathematics, 2019–
- 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
- Reviewer for the AMS Mathematical Reviews and Zentralblatt MATH
- Assessor for the Australian Research Council’s Discovery Project Scheme, and the Dutch Research Council’s Innovational Research Incentives Scheme
- Referee for *Duke Mathematical Journal*, *Advances in Mathematics*, *Documenta Mathematica*, *International Mathematics Research Notices*, *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*, *Contemporary Mathematics*, *Vietnam Journal of Mathematics*, *New Zealand Journal of Mathematics* and *Journal of Mathematical Physics*

### *Seminar Organisation:*

- 2020            Organiser of a *Differential Topology Learning Seminar* at the University of Auckland
- 2019            Co-organiser of a *Geometry and Topology Learning Seminar* at the University of Auckland  
                  Organiser of a *General Relativity Bootcamp* at the University of Auckland
- 2018            Organiser of a *Reading Group on Homological Algebra* at the University of Auckland
- 2018 –           Organiser of the *Geometry and Analysis Seminar* at the University of Auckland
- 2017 – 2019    Co-organiser of the *Department Colloquium* at the University of Auckland
- 2010 –2013    Organiser of the *Strings Journal Club* at the University of Adelaide
- 2009            Organiser of a *Reading Group in Mathematical Physics* at MIT

## Conference and Workshop Organisation

- 2021    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.
- 2020    Organiser of the virtual workshop on *Poisson Geometry and Groupoids*.  
          Co-organiser of the special session *Recent Trends in Geometric Analysis* at the 8<sup>th</sup> 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 Jørgen 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 José Figueroa-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.

## 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