Guo Chuan Thiang

The University of Adelaide, Adelaide, SA5000, Australia
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EDUCATION

University of Oxford, Balliol College
DPhil Mathematics, Oct 2011 - Dec 2014 (award date: March 2016)
Thesis: *Topological phases of matter, symmetries, and K-theory*. Advisor: Keith C. Hannabuss

University of Cambridge, Churchill College
MASt in Mathematics, Distinction, Oct 2010 - June 2011
Thesis: *Bell Correlations in Quantum Field Theory*. Advisor: J. Butterfield

National University of Singapore
B.Sc. in Physics and Mathematics, First Class Honours, Aug 2006 - Dec 2009
Thesis: *Optimal Lewenstein–Sanpera Decomposition of two-qubit states*. Advisor: B.-G. Englert

EMPLOYMENT

University of Adelaide, Australia
Australian Research Council DECRA Fellow, 1 April 2017–2020
Post-doctoral Research Associate, 7 Jan 2015 – 31 Mar 2017

Centre for Quantum Technologies, Singapore
Research Assistant, Jan 2010 - Sept 2010

INVITED POSITION

Simons Center for Geometry and Physics, Stony Brook University, May–June 2017
Australian National University, Visiting Fellow, May 2015.

RESEARCH GRANTS (POST-DOCTORAL)

- Australian Research Council Discovery Early Career Researcher Award (DECRA), for *T-duality and K-theory: Unity of condensed matter and string theory*. $357,000, 2017–2020
- Office of the Deputy Vice-Chancellor (Research) Establishment Grant, University of Adelaide, $25,000, 2017
- University of Adelaide Vice-Chancellor's Research Fellowship, for *Mathematics at the Intersection of string theory and topological materials*, 1-year salary and $10,000 grant, 2018 (superceded by DECRA)
- AMSI and AustMS funding for *Topological matter, strings, K-theory, and related areas*, $10,139, 2016

AWARDS (POSTGRADUATE)

- Clarendon Fund Scholarship, University of Oxford, 2011–2014
- Balliol College JT Hamilton Scholarship in Mathematics, 2011–2014
- Churchill College Prize Scholarship, University of Cambridge, 2011
- Cambridge Commonwealth Trust Scholarship, 2010–2011

AWARDS (UNDERGRADUATE)

- Singapore Academy of Sciences Award, 2010
- Institute of Physics Medal (Best Physics Honours undergraduate), 2010
- Lijen Industrial Development Medal for best academic project, 2010
- Outstanding Undergraduate Researcher Award (Individual), 2010
- Jurong Shipyard Prize (Best Physics undergraduate), 2007 & 2008
- Faculty of Science Dean's List, 2006–2009
- Sugar Industry of Singapore Faculty Book Prize (Best Science undergraduate), 2007
- National University of Singapore Undergraduate Scholarship, 2006-2010

PUBLICATION LIST

REFEREED PUBLICATIONS:

1. K.C. Hannabuss, V. Mathai and G.C. Thiang, *T-duality simplifies bulk-boundary correspondence: the noncommutative case*. Letters in Mathematical Physics (published online). [arXiv:1603.00116]

2. G.C. Thiang, K. Sato, and K. Gomi, *Fu–Kane–Mele monopoles in semimetals*. Nuclear Physics B, **923** 107–125 (2017) [arXiv:1705.06657]

3. V. Mathai and G.C. Thiang, *Differential topology of semimetals*. Communications in Mathematical Physics, **355**(2) 561–602 (2017) [arXiv:1611.08961]

4. V. Mathai and G.C. Thiang, V. Mathai and G.C. Thiang, *Global topology of Weyl semimetals and Fermi arcs*. Journal of Physics A: Mathematical and Theoretical (Letter), **50**(11) 11LT01 (2017); publicity at JPhys+ [arXiv:1607.02242]

5. K.C. Hannabuss, V. Mathai and G.C. Thiang, *T-duality simplifies bulk-boundary correspondence: the parametrised case*. Advances in Theoretical and Mathematical Physics, **20**(5) (2016). [arXiv:1510.04785]

6. V. Mathai and G.C. Thiang, *T-duality simplifies bulk-boundary correspondence: some higher dimensional cases*. Annales Henri Poincaré, **17**(12) 3399–3424 (2016). [arXiv:1506.04492]

7. V. Mathai and G.C. Thiang, *T-duality simplifies bulk-boundary correspondence*. Communications in Mathematical Physics, **345**(2) 675–701 (2016). [arXiv:1505.05250]

8. G.C. Thiang, *On the K-theoretic classification of topological phases of matter*. Annales Henri Poincaré, **17**(4) 757–794 (2016). [arXiv:1503.01206]

9. V. Mathai and G.C. Thiang, *T-duality of Topological Insulators*. Journal of Physics A: Mathematical and Theoretical (Fast Track Communication), **48** 42FT02 (2015); publicity at IOPSCIENCE. [arXiv:1406.7366]

10. G.C. Thiang, *Topological phases: isomorphism, homotopy and K-theory*. International Journal of Geometric Methods in Modern Physics, **12** 1550098 (2015). [arXiv:1412.4191]

11. G.C. Thiang, *Degree of Separability of Bipartite Quantum States*, Physical Review A, **82**(1) 012332 (2010).

12. G.C. Thiang, P. Raynal, and B.-G. Englert, *Optimal Lewenstein–Sanpera Decomposition for two-qubit states using Semidefinite Programming*, Physical Review A, **80**(5) 052313 (2009).

CONFERENCE PROCEEDINGS:

13. G.C. Thiang, *T-duality and K-theory: a view from condensed matter physics*. In: *Noncommutative Geometry and Physics IV*, proceedings for TFC thematic year 2015 on "Strings, Black Holes and Quantum Information".

14. G.C. Thiang, *On the K-theoretic classification of topological phases of matter (conspectus)*. In: Proceedings of Frontiers of Fundamental Physics 14, (2014).

PRE-PRINTS:

15. K. Gomi and G.C. Thiang, *Crystallographic bulk-edge correspondence: glide reflections and twisted mod 2 indices*, [arXiv:1804.03945]

16. V. Mathai and G.C. Thiang, *Topologial phaess on the hyperbolic plane*, [arXiv:1712.02952]

CONFERENCE TALKS AND INVITED LECTURES

- *Crystallographic T-duality and super-Baum–Connes*, Bivariant K-theory in Geometry and Physics, Erwin Schrödinger International Institute for Mathematics and Physics, 5-30 Nov 2018
- *Crystallographic bulk-edge correspondence and index theory*, Recent progress in mathematics of topological insulators, ETH Zürich, 3-7 Sept 2018.
- *Twisted mod 2 index from crystallography*, Index theory and applications to positive scalar curvature and related areas, University of Adelaide, 4-8 June 2018.
- *Crystallographic T-duality and the bulk-boundary correspondence principle*, Noncommutative Geometry and Representation Theory, Tianyuan Mathematical Center, Sichuan University, 14-18 May 2018.
- *K-theory and T-duality in topological phases*, NCTS Lecture series on Topology & Condensed Matter, National Tsinghua University, 22-23 March 2018.
- *K-theory and T-duality of topological phases*, Intensive seminars on topological insulators and K-theory, Seoul National University, 19-22 February 2018.
- *Hyperbolic topological phases and fractional bulk-boundary correspondence*, Bulk-Edge Correspondence 2018, University of Tsukuba, 6 Jan 2018.
- *Hyperbolic and crystalline topological matter via Baum–Connes isomorphisms* and *Duality methods for topological matter*, 61st Annual Meeting of AustMS, Macquarie University, 12-15 Dec 2017.
- *Time-reversal in topological semimetals*, Strongly correlated topological phases of matter, Simons Center for Geometry and Physics, Stony Brook, 9 June 2017.
- *Time-reversal and semimetals*, Mathematical aspects of disordered systems, ETH Zurich, 1 June 2017.
- *Topological Fourier transforms and K-theory in physics*, KK-theory, Gauge Theory and Topological Phases Workshop, Lorentz Center, Leiden, 8 Mar 2017.
- Lecture series, KK-theory, Gauge Theory and Topological Phases School, Lorentz Center, Leiden, 27 Feb – 10 Mar 2017.
- *The differential topology of semimetals and exotic fermions*, Fifth Annual Meeting of the ANZAMP, University of New South Wales, Kiama, 1–3 Feb 2017.
- *The differential topology of semimetals*, Second Australia–Japan Geometry, Analysis and their Applications, Kyoto University, 30 Jan – 3 Feb 2017.
- *Mathematics of topological semimetals* and *Noncommutative T-duality and boundary maps in physics*, 60th Annual Meeting of AustMS, Australian National University, 5–8 Dec 2016.
- *The solid state of K-theory*, International conference in K-theory, Western Sydney Univ., 3 Aug 2016.
- *The solid state of K-theory*, Refining C^*-algebraic invariants for dynamics using KK-theory, University of Melbourne, 27 July 2016.
- *T-duality and (real) K-theory: a view from condensed matter physics*, Higher structures in string theory and M-theory, Tohoku University, 7 Mar 2016.
- *T-duality, K-theory, and bulk-boundary correspondence for topological phases*, ESI Programme on Higher structures in string theory and quantum field theory, Erwin Schrödinger Institute, 10 Dec 2015.
- *Dualities in real K-theory and physical applications*, and *T-duality and topological phases*, 59th Annual Meeting of the AustMS, Flinders University, 28 Sept – 1 Oct 2015.
- *K-theory as obstructions between topological phases*, Workshop on topological states and non-commutative geometry, AIMR Tohoku University, Sendai, Japan, 23–26 March 2015.
- *Topological phases: homotopy, isomorphism, and K-theory (Poster)*, Symmetry and Topology in Quantum Matter, Institute for Pure and Applied Mathematics, UCLA, 26–30 Jan 2015.
- *On the K-theoretic classification of topological phases of matter*, Frontiers of Fundamental Physics 14, Aix Marseille University, 15–18 July 2014.
- *Degree of Separability of Bipartite Quantum States*, International Conference on Quantum Optics and Quantum Information, Kyiv, Ukraine, 28 May – 1 June 2010.

OTHER TALKS

- *Crystallographic bulk-boundary correspondence*, AIMR Tohoku University, July 2018.
- *Time-reversal, monopoles, and equivariant topological matter*, Pontificia Universidad Católica De Chile

Seminar, 26 Oct 2017.

- *Time-reversal, equivariant homology, and differential topology in matter*, University of Melbourne Pure Mathematics Seminar, 1 Sept 2017.
- *Time-reversal symmetric topology from physics*, University of Adelaide Differential Geometry Seminar, 25 Aug 2017.
- *Mathematics of topological phases*, Sapienza University of Rome, 15 Mar 2017.
- *Differential topology of exotic fermions in semimetals*, University of Oxford, Quantum Field Theory seminar, 14 Mar 2017.
- *Semimetals and differential topology*, Shinshu University Colloquium, Matsumoto, 25 Jan 2017.
- *Mathematics of semimetals*, AIMR Tohoku University, Sendai, 18 Jan 2017.
- *Phases of matter and the mathematics of shapes*, ECMS Researcher Talks, University of Adelaide, 2 Dec 2016.
- *Introduction to real K-theory and physics, Lecture Series, University of Adelaide, August 2016.*
- *T-duality in condensed matter I: Basic notions*, Advanced Institute for Materials Research, Tohoku University, 15 Mar 2016.
- *T-duality and bulk-boundary correspondence*, University of Adelaide Differential Geometry Seminar, 11 Sept 2015.
- *K-theory and duality of topological insulators*, University of Wollongong, 7 May 2015; Australia National University, Canberra, 5 May 2015.
- *Topological matter and its K-theory*, University of Adelaide Differential Geometry Seminar, 2 Apr 2015.
- *K-theory applied to topological phases of matter*, Series of lectures at Strings Seminar, University of Adelaide, Mar–Apr 2015.
- *Symmetry, K-theory, and the Bott Periodicity of Topological phases*, University of Oxford, Quantum Field Theory seminar, 25 Nov 2014.
- *Noncommutative topology for applications to topological insulators*, University of Oxford, Junior Geometry and Topology seminar, 13 Nov 2014.
- *Bell Correlations in Quantum Field Theory*, National University of Singapore, Prof. B.-G. Englert's group, 20 July 2011; Prof. Gong Jiangbin's group, 27 July 2011.
- *Quantum Entanglement and Convex Optimization*, Part III Seminar, Center for Mathematical Sciences, University of Cambridge, UK, 3 Dec 2010.
- *Degree of Separability of Bipartite Quantum States*, Max-Planck Institute of Quantum Optics, Garching, Germany, Prof. Ignacio Cirac's group, 10 June 2010.

RESEARCH INTERESTS

Mathematical physics: applications of K-theory, T-duality, noncommutative geometry and topology, index theory, and operator algebras to (i) topological phases of matter, especially gapped phases and semimetals, (ii) symmetries in quantum theory, (iii) T-duality in string theory and condensed matter physics, (iv) bulk-boundary correspondence. Also worked on the mathematics of quantization and quantum field theory, quantum information theory, convex optimization techniques, foundations of quantum mechanics.

TEACHING

Lecturer for *Introduction to K-theory*, Honours Year, Semester 2 2018, University of Adelaide

Teaching assistant for first-year mathematics: Calculus, Probability, Dynamics, Fourier series and PDEs, Statistics, Vector Calculus, Optimisation, Geometry. Teaching assistant for Third-year Electromagnetism and Quantum Mechanics. Tutor for Linear programming.

PROFESSIONAL SERVICE

Journal reviewer

Communications in Mathematical Physics
Journal of Geometry and Physics

Symmetry, Integrability and Geometry: Methods and Applications
Journal of Physics A: Mathematical and Theoretical
MATRIX Institute Book Series
International Journal of Quantum Information

Guest editor

Journal of Geometry and Physics

EVENT ORGANISATION

Conferences

62nd Annual Meeting of the Australian Mathematical Society, 4–7 December 2018
Australia–China conference in noncommutative geometry and related areas, 18–22 December 2017
Gauge theory and higher geometry, 28 Nov–1 Dec 2017
String Dualities and Geometries, 11–15 September 2017
Topological matter, strings, K-theory, and related areas, 26–30 September 2016
Australia–Japan Geometry, Analysis and their applications, 19–23 October 2015

Seminars

Convenor of Differential Geometry Seminar, University of Adelaide, 2018

REFERENCES

Keith Hannabuss [kch@balliol.ox.ac.uk]
Varghese Mathai [mathai.varghese@adelaide.edu.au]
Jean Bellissard [jeanbel@math.gatech.edu]
Frances Kirwan [frances.kirwan@balliol.ox.ac.uk]
Tsou Sheung Tsun [tsou@maths.ox.ac.uk]