

CURRICULUM VITAE ROBERT-JAN SLAGER

Winton PI
University of Cambridge
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INFORMATION

Citation statistics: over 1200 total citations, h-index: 16 ([Google scholar](#))

Date of birth: March 24th 1988

Nationality: Dutch

RESEARCH INTERESTS

My research interests revolve around **theoretical condensed matter** physics with a particular emphasis on **topological phases of matter**. To attack problems I rely on tailor-designed strategies that involve both analytical and numerical studies. Relevant keywords describing my work include: Topological insulators, zero-mode physics, monodromy defects, spin-charge separation, solitons, topological classification of order, Green's function formalism, lattice gauge theory, Non-Abelian discrete gauge theories, impurity problems and spinon hybridization problems, crystalline protected topological phases. Nonetheless, I think that in modern science a **broad** and sometimes even interdisciplinary area of research, in addition to a specific long-term subject of focus, is a prerequisite. In this regard I have also worked on quantum nematic phases as well as quantum criticality and try to maintain an active and open view. More recently, I have also become interested in Floquet states, magnetism and tensor network approaches. In particular, I am currently pursuing studies to identify new topological phases of matter in the context of out of equilibrium systems, such as Floquet systems and magnon spectra.

EDUCATION

- **Ph.D. at Instituut-Lorenz, Leiden University, January 2016**
 - Thesis title: The symmetry of crystals and the topology of electrons
 - With highest honors, '*Cum Laude*', awarded to top 5% of doctoral students
 - Advisor: Prof. dr. J. Zaanen
- **M.S. Theoretical Physics, Leiden University, Sept. 2009 - June 2011**
 - Thesis title: Topological aspects of Aharonov-Bohm vortices in topological band insulators
 - *With highest honors, 'Cum Laude'*
 - Advisor: Prof. dr. J. Zaanen
- **B.S. Physics, Leiden University, Sept. 2006 - June 2009**
- **B.S. Mathematics, Leiden University, Sept. 2006 - June 2009**

RESEARCH POSITIONS

- **Winton Group Leader**
 - December 2019- present
- **Postdoctoral Researcher, Harvard University**
 - Per November 2018-December 2019
 - Present position in combination with being a regular visitor of **Cambridge University**
- **Postdoctoral Researcher, Max Planck Institute for the Physics of Complex Systems**
 - September 2016 - November 2018
 - Independent postdoctoral position

AWARDS AND HONORS

- Elected SPR member Trinity college, Cambridge University, December 2019
- Winton group leader position, 5 years at the University of Cambridge starting 2019
- 2019 Marie Skłodowska-Curie grant in association with Cambridge University, converted to group money, see above
- Winner of the National Physics Shell prize for results during the master track, Koninklijke Hollandsche Maatschappij der Wetenschappen, December 2011
- Paper on the space group classification featured as *Science Magazine* editors' choice (*Science* 339, 120 (2013)).
- Paper on the topological combinatorics was featured in *Nature Reviews Physics* 1, 183184 (2019), recognising it as a pioneering work
- Wrote FOM highlight for the annual report, January 2014
- Runner-up C.J. Kok award (winner Physics section), University of Leiden, January 2017
- Postdoctoral fellowship at Perimeter Institute to start September 2018 (declined)
- Postdoctoral fellowship at École Polytechnique Fédérale de Lausanne to start per 2017 (declined)

VARIOUS

- Certified Participant "Nyenrode Business Orientation Program for Physics graduates", Nyenrode Business University, April 2015.
- Qualified teaching certificate, University of Leiden.

PUBLICATIONS

Journal Publications

Selected publications marked by ‡; Two *Nature Physics* (One editors' choice by *Science Magazine*), three *Phys. Rev. X*, four *Phys. Rev. Lett.*, two *Phys. Rev. B*

* marks equal author contributions

1. ‡ *Topological Euler class as a dynamical observable in optical lattices*, F. Nur Ünal*, Adrien Bouhon, Robert-Jan Slager*, Phys. Rev. Lett. **125**, 053601(2020);arXiv:2005.03033.
2. ‡ *Unsupervised machine learning and band topology*, Mathias S. Scheurer, Robert-Jan Slager, Phys. Rev. Lett. **124**, 226401 (2020);arXiv:2001.01711
3. *Intrinsic axion insulating behavior in antiferromagnetic $MnBi_6Te_{10}$* , Na Hyun Jo, Lin-Lin Wang, Robert-Jan Slager, Jiaqiang Yan, Yun Wu, Kyungchan Lee, Benjamin Schruck, Ashvin Vishwanath and Adam Kaminski, Phys. Rev. B **102**, 045130 (2020); arXiv:1910.14626.
4. ‡ *Non-Abelian reciprocal braiding of Weyl nodes*, Adrien Bouhon*, QuanSheng Wu*, Robert-Jan Slager*, Hongming Weng, Oleg Yazyev and Tomas Bzdusek, Nature Phys. *in press* (2020); arXiv:1907.10611.
5. *Hopf characterization of two-dimensional Floquet topological insulators*, F. Nur Ünal, Andre Eckardt and Robert-Jan Slager, Phys. Rev. Research **1**, 022003(R) (2019); arXiv:1904.03202.
6. *Wannier representation of Floquet topological states*, Masaya Nakagawa, Robert-Jan Slager, Sho Higashikawa, Takashi Oka, Phys. Rev. B **101**, 075108 (2020), arXiv:1903.12197.
7. *π -fluxes, semi-metals and flat bands in artificial materials*, Toshikaze Kariyado, Robert-Jan Slager, Phys. Rev. Research **1**, 032027(R) (2019);arXiv:1903.08638.
8. ‡ *Non-Hermitian Boundary Modes*, Dan S. Borgnia, Alex J. Kruchkov, Robert-Jan Slager, Phys. Rev. Lett. **124**, 056802 (2020); arXiv:1902.07217.
9. ‡ *Wilson loop approach to topological crystalline insulators with time reversal symmetry*, Adrien Bouhon, Annica Black-Schaffer and Robert-Jan Slager, Phys. Rev. B **100**, 195135; arXiv:1804.09719. *Editors' suggestion.*
10. *Dynamical synchronization transition in interacting electron systems*, Tanay Nag, Robert-Jan Slager, Takuya Higuchi and Takashi Oka, Phys. Rev. B, **100**, 134301 (2019); arXiv:1802.02161.
11. *Unified bulk-boundary correspondence for band insulators*, Jun-Won Rhim, Jens H. Bardarson and Robert-Jan Slager, Phys. Rev. B, **97**, 115143 (2018); arXiv:1710.01466.
12. *The translational side of topological band insulators*, Robert-Jan Slager, Journal of Physics and Chemistry of Solids, **128**, 24 (2019); arXiv:1708.08886.
13. *Dissolution of topological Fermi arcs in a dirty Weyl semimetal*, Robert-Jan Slager, Vladimir Juričić and Bitan Roy, Phys. Rev. B **96**, 201401(R) (2017); arXiv:1703.09706.
14. ‡ *Topological classification of crystalline insulators through band structure combinatorics*, Jorrit Kruthoff, Jan de Boer, Jasper van Wezel, Charles L. Kane and Robert-Jan Slager, Phys. Rev. X **7**, 041069 (2017); arXiv:1612.02007.
15. ‡ *Global phase diagram of a dirty Weyl liquid and emergent superuniversality*, Bitan Roy, Robert-Jan Slager and Vladimir Juričić, Phys. Rev. X **8**, 031076 (2018); arXiv:1610.08973.
16. *Hierarchy of orientational phases and axial anisotropies in the gauge theoretical description of generalized nematics*, Ke Liu, Jaakko Nissinen, Josko de Boer, Robert-Jan Slager and Jan Zaanen, Phys. Rev. E **95**, 022704 (2017); arXiv:1606.04507.
17. *Dual gauge field theory of quantum liquid crystals in two dimensions*, Aron J. Beekman, Jaakko Nissinen, Kai Wu, Ke Liu, Robert-Jan Slager, Zohar Nussinov, Vladimir Cvetkovic and Jan Zaanen, Physics Reports, **683**, 1-110 (2017); arXiv:1603.04254.
18. *Classification of point-group-symmetric orientational ordering tensors*, Jaakko Nissinen, Ke Liu, Robert-Jan Slager, Kai Wu and Jan Zaanen, Phys. Rev. E **94**, 022701 (2016);

arXiv:1603.04794.

19. ‡ *Generalized liquid crystals: giant fluctuations and the vestigial chiral order of I, O and T matter*, Ke Liu, Jaakko Nissinen, Robert-Jan Slager, Kai Wu and Jan Zaanen, *Phys. Rev. X* **6**, 041025 (2016); arXiv:1512.07822.
20. *Self-organized pseudo-graphene on grain boundaries in topological band insulators*, Robert-Jan Slager, Vladimir Juričić, Ville Lahtinen and Jan Zaanen, *Phys. Rev. B* **93**, 245406 (2016); arXiv:1509.07705.
21. ‡ *Impurity bound states and Green's functions zeroes as local signatures of topology*, Robert-Jan Slager, Louk Rademaker, Jan Zaanen and Leon Balents, *Phys. Rev. B* **92**, 085126 (2015); arXiv:1504.04881.
22. *Classification of nematic order in 2+1D: Dislocation Melting and $O(2)/Z_n$ lattice gauge theory*, Ke Liu, Jaakko Nissinen, Zohar Nussinov, Robert-Jan Slager, Kai Wu and Jan Zaanen, *Phys. Rev. B* **91**, 075103 (2015); arXiv:1405.2963.
23. *Interplay between electronic topology and crystal symmetry: Dislocation-line modes in topological band insulators*, Robert-Jan Slager, Andrej Mesaros, Vladimir Juričić and Jan Zaanen, *Phys. Rev. B* **90**, 241403(R) (2014); arXiv:1401.4044.
24. ‡ *The space group classification of topological band insulators*, Robert-Jan Slager, Andrej Mesaros, Vladimir Juričić and Jan Zaanen, *Nature Phys.* **9**, 98 (2013); arXiv:1209.2610. *Editors' choice Science Magazine, Jan 2013.*
25. *Zero-energy states bound to a magnetic π -flux vortex in a two-dimensional topological insulator*, Andrej Mesaros, Robert-Jan Slager, Jan Zaanen and Vladimir Juričić, *Nucl. Phys. B* **867**, 977 (2012); arXiv:1208.5708.
26. ‡ *Universal probes of two-dimensional topological insulators: Dislocation and π -flux*, Vladimir Juričić, Andrej Mesaros, Robert-Jan Slager and Jan Zaanen, *Phys. Rev. Lett.* **108**, 106403 (2012); arXiv:1108.3337.

Preprints

27. *Selective branching, quenching and converting of topological modes*, Toshikaze Kariyado and Robert-Jan Slager, arXiv::2007.01876.
28. *Geometric approach to fragile topology beyond symmetry indicators*, Adrien Bouhon, Tomas Bzdusek, Robert-Jan Slager, *under review of Phys. Rev. B*, arXiv:2005.02044.
29. *Spin Hall effect in 2D metallic delafossite $PtCoO_2$ and vicinity topology*, Sota Kitamura, Hidetomo Usui, Robert-Jan Slager, Adrien Bouhon, Veronika Sunko, Helge Rosner, Philip D. C. King, Joseph Orenstein, Roderich Moessner, Andrew P. Mackenzie, Kazuhiko Kuroki and Takashi Oka, *under review of Nature Quantum Materials*, arXiv:1811.03105.

PhD Thesis

- *The symmetry of crystals and the topology of electrons*, Leiden University (2016).

SUPERVISION

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- Master Thesis "Topology and geometry in Weyl semimetals", Olfa Jaïbi, graduated in March 2016.
 - Bachelor Thesis "Topology in band theory", Rien Vanneste [at the University of Amsterdam *by request*], graduated Juli 2016.

PARTICIPATION AND ORGANIZATION

Member of the LION Council
Leiden Institute of Physics (LION)

September 2013 - 2016
Leiden, the Netherlands

- Representing the Theoretical Physics PhD students in the LION council.
- This also included active participation in meetings to determine the physics curriculum and its evaluation with representatives of the Ministry of Education (one time evaluation).

Reviewer for the American Department of Energy

September 2015

- Reviewed a research proposal for the Department of Energy.

Reviewer for various (top) peer-reviewed journals

- Referee for various journals. These include Science Magazine, Nature Magazine, Science Advances, Nature Communications, Review of Modern Physics, Physical Review B, Proceedings of the National Academy of Sciences of the United States of America, Physics Letters A, Physical Review X and Physical Review letters.

Participant in QuantERA project

- Participant in QuantERA project entitled "Far-from-equilibrium Quantum Matter". Principal Investigator: P. Ribeiro.

Organizer "Physics at all Scales" conference

June 2016

- Co-organizer *Physics at all scales*, two week conference for prospective master students, University of Leiden, Leiden, the Netherlands.

Co-organizer seminar schedule

June 2017-November 2018

- Co-organizer of the seminars the Max Planck Institute for the Physics of Complex Systems

TEACHING

- Tutor for freshman physics and mathematics students, Leiden University, 2008 - 2010.
- Teaching assistant, *Classical mechanics* by Prof M. Orrit, Leiden University, fall 2010.
- Lecturer/Teaching assistant, *Renewable energy course*, Leiden University College the Hague, fall 2011. This involved teaching art majors about basic notions and philosophy in natural sciences.
- Teaching assistant, *Elementary particles* by Prof Ana Achúcarro, Leiden University, fall 2012.
- Teaching assistant, *Theory of special relativity* by Prof J.-W. van Holten, Leiden University, fall 2013.
- Teaching assistant, *Statistical physics* by Dr P. Denteneer, Leiden University, fall 2014.

SKILLS

- Fluent in Dutch, English (Bilingually educated, including Cambridge certificates); intermediate level in France and German.
- Extensive experience with Fortran and Mathematica, working knowledge of C++. This also includes numerical techniques such as the Kernel Polynomial Method.
- Independent researcher: able to set up a project, execute it and finalize the according paper.

CONFERENCES, VISITS AND WORKSHOPS

Oral presentations (8 invited talks, including one headline talk)

- DRSTP School on Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, "*Flux modes in topological band insulators*", March 2012.
- Casimir Spring School, Arnemuiden, the Netherlands, "*Translationally active topological band insulators*", June 2012 (invited).
- DRSTP School on Statistical Physics and Theory of Condensed Matter, Doorn, the Netherlands, "*Helical defect modes and the classification paradigm of topological phases*", March 2013.
- van Ruitenbeek group meeting, Leiden University, Leiden, the Netherlands "*The space group classification of topological band insulators*", April 2013 (invited).
- Golden group meeting, University of Amsterdam, Amsterdam, the Netherlands, "*The space group classification of topological band insulators*", April 2013 (invited).
- E-MRS meeting, Warsaw University of Technology, Warsaw, Poland, "*The space group classification of topological band insulators*", September 2014 (invited headline talk).
- TI meeting FOM, Amsterdam, the Netherlands, "*Helical defect modes in 3D topological band insulators*", May 2014 (invited).
- National Physics@FOM conference, Veldhoven, the Netherlands, "*Helical defect modes in 3D topological band insulators*", January 2015.
- NanoFront Winter Retreat, Courchevel, France, "*Isospinless graphene on grain boundaries in topological band insulators*", March 2015.
- This Week's Discoveries colloquium, Leiden, the Netherlands, "*Crystal symmetries and electronic topology: where the physics of the EPR paradox meets the mathematics of samurai swords*", December 2016 (invited).
- Talk MPI-PKS, Dresden, Germany, "*Topological insulators revisited: A space group perspective on classification procedures and new defect phenomena*", March 2016 (invited).
- Talk EPFL, Lausanne, Switzerland, "*Topological insulators revisited: A space group perspective on classification procedures and new defect phenomena*", April 2016 (invited).
- Talk at workshop "From From Quantum Field Theories to Numerical Methods", NORDITA, Stockholm, Sweden, "*Self-organized semi-metals on grain boundaries in topological band insulators*", May 2016.
- Talk at MPI-CPfS, Dresden, Germany, "*Crystalline symmetries and topological phases: physics beyond the edge*", January 2017.
- Talk at Princeton University, Princeton, NJ, USA, "*Crystalline symmetries and topological band theory: from defects to classifying combinatorics*", October 2017.
- Talk at MIT, Boston, MA, USA, "*Crystalline symmetries and topological band theory: from defects to classifying combinatorics*", November, 2017.
- Talk at Harvard University, Boston, MA, USA, "*Crystalline symmetries and topological band theory: from defects to classifying combinatorics*", November 2017.
- Talk at University of California, Berkeley, Berkeley, CA, USA, "*Crystalline symmetries and topological band theory: from defects to classifying combinatorics*", November 2017 (invited).

- Talk at University of Tokyo, Tokyo, Japan, "*Unified bulk-boundary correspondence for band insulators*", June 2018 (invited).
- Talk at workshop "Symmetry and Topology in Condensed Matter Physics", University of Tokyo, Tokyo, Japan, "*Topological crystalline phases, Wilson loops and Floquet systems*", June 2018 (invited headline).
- Theory of Condensed Matter seminar, University of Cambridge, Cambridge, UK, "*An overview of topological crystalline phases, defect physics and novel Floquet systems*", July 2018 (invited).
- Theory Seminar, Purdue University, West Lafayette, IN, USA, "*Topological phases and simple exhaustive combinatorial arguments*", January 2019 (invited).

Poster presentations

- National Physics@FOM conference, Veldhoven, the Netherlands, "*Translationally active topological band insulators*", 17-18 January 2012.
- National Physics@FOM conference, Veldhoven, the Netherlands, "*The space group classification of topological band insulators*", January 2013.
- DRSTP Trends in Theory conference, Dalfsen, the Netherlands, "*The space group classification of topological band insulators*", May 2013.
- Workshop 'Topological Phases in Condensed Matter and Cold Atom Systems: towards quantum computations', Cargèse, France, "*Defects and classification principles of topological insulating phases*", June 2013.
- Gordon conference on strongly correlated electron systems, Massachusetts, USA, "*Topological insulating phases beyond the tenfold way*", June 2014.
- NanoFront Winter Retreat, Courchevel, France, "*Nematic phases and a gauge theory description*", March 2015.

Schools

- Prospects in Theoretical Physics -Princeton Summer School on Condensed Matter Physics, Princeton University and Institute of Advanced Study, Princeton, USA, July 2015.