# LOUK RADEMAKER

## CONTACT INFORMATION


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| **Address** | Perimeter Institute for Theoretical Physics, room 326<br>31 Caroline St N<br>Waterloo, ON N2L 2Y5, Canada |
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## RESEARCH INTERESTS

My research interests involve **strongly correlated materials** and **quantum matter**. Recent work has been focussed on, but is not limited to:

- Electron glasses in disorderfree environments;
- Quantum quenches;
- Spin and charge frustration;
- Quantum many-body entanglement;
- Far-from-equilibrium dynamics;
- Unconventional superconductivity;
- Topological insulators;
- Many-body localization;
- Thermoelectric applications of correlated materials;
- Fundamentals of quantum mechanics.

## REFERENCES


**Prof. Jan Zaanen** *jan@lorentz.leidenuniv.nl*

· Lorentz Institute for Theoretical Physics, Leiden University, Leiden, The Netherlands.

**Prof. Leon Balents** *balents@physics.ucsb.edu*

· Kavli Institute for Theoretical Physics, University of California, Santa Barbara, CA, United States.

**Prof. Vladimir Dobrosavljević** *vlad@magnet.fsu.edu*

· National High Magnetic Field Laboratory, Tallahassee, FL, United States.

## EDUCATION AND RESEARCH POSITIONS

**Senior postdoctoral researcher** September 2017 - present
*Perimeter Institute for Theoretical Physics, Waterloo, Ontario, Canada*

· A five-year senior position at the Perimeter Institute, working as part of the Quantum Matter Initiative.

**Postdoctoral researcher** September 2014 - August 2017
*Kavli Institute for Theoretical Physics, University of California, Santa Barbara, USA*

· With a research grant from the Netherlands Organisation for Scientific Research (NWO), based on my proposal with the title 'What's the matter with frustration? Highly fluctuating phases in frustrated complex oxides', I work as a postdoc at the KITP.

**Postdoctoral researcher** January 2014 - July 2014
*Leiden University* *Leiden, The Netherlands*

· After obtaining my PhD degree I continued working with Prof. Jan Zaanen on quantum matter, spin ices and correlated thermoelectrics. From May onwards I worked with Prof. Tjerk Oosterkamp on the fundamentals of quantum mechanics.

**Visiting scholar** January - February 2013
*National High Magnetic Field Laboratory* *Tallahassee, FL, United States*

· Visiting the group of Vladimir Dobrosavljević to study the influence of long-range interactions on stripe formation and glasses; and to learn Dynamical Mean Field Theory.

**Visiting student** July - August 2009
*Stanford University* *Stanford, CA, United States*

· Visiting the group of Tom Devereaux and Jeroen van den Brink to learn Determinant Quantum Monte Carlo.

**Ph.D. student, Theory of Condensed Matter** January 2009 - December 2013
*Lorentz Institute for Theoretical Physics, Leiden University* *Leiden, The Netherlands*

· Thesis: "Fermions and Bosons: Excitons in strongly correlated materials".
· Supervisor: Jan Zaanen and Hans Hilgenkamp.

**M.Sc. student, Theoretical Physics** September 2006 - September 2008
*Leiden University* *Leiden, The Netherlands*

· Thesis: "Phase Transitions in Matrix Models" (high energy physics), graduated with distinction.
· Supervisor: Koenraad Schalm.

**B.Sc. student, Mathematics and Astronomy** September 2002 - September 2006
*Leiden University* *Leiden, The Netherlands*

· Thesis: "Shock waves through inhomogeneous media".
· Supervisor: Vincent Icke and Vivi Röttschafer.

## LIST OF PUBLICATIONS

### Papers and preprints

23. L. Rademaker, *Quenching the Kitaev honeycomb model*, arXiv:1710.09761 (2017).

22. L. Rademaker, J. Zaanen, *Quantum Thermalization and the Expansion of Atomic Clouds*, Sci. Rep. 7, 6118 (2017); arXiv:1703.02489.

21. Y. Wang, L. Rademaker, E. Dagotto, and S. Johnston, *Phonon linewidth due to electron-phonon interactions with strong forward scattering in FeSe thin films on oxide substrates*, Phys. Rev. B. 96, 054515 (2017); arXiv:1703.02013.

20. L. Rademaker, M. Ortuno, and A. M. Somoza, *Many-body localization and delocalization from the perspective of Integrals of Motion*, Ann. Phys. (Berlin) 529, 1600322 (2017); arXiv:1610.06238.

19. L. Rademaker, V. V. Vinokur, and A. Galda, *Universality and critical behavior of the dynamical Mott transition in a system with long-range interactions*, Sci. Rep. 7, 44044 (2017); arXiv:1608.07779.

18. L. Rademaker, Z. Nussinov, L. Balents, and V. Dobrosavljević, *Absence of Marginal Stability in Self-Generated Coulomb Glasses*, arXiv:1605.01822 (2016).

17. Y. Wang, K. Nakatsukasa, L. Rademaker, T. Berlijn, and S. Johnston, *Aspects of electron-phonon interactions with strong forward scattering in FeSe Thin Films on $SrTiO_3$ substrates*, Supercond. Sci. Technol. **29**, 054009 (2016); arXiv:1602.00656 (2016).

16. L. Rademaker and J. A. Mydosh, *Quantum Critical Matter and Phase Transitions in Rare-Earths and Actinides*, Handbook of Chemistry and Physics of Rare Earths and Actinides, Vol. 49, 293 (2016).

15. L. Rademaker, A. Ralko, S. Fratini and V. Dobrosavljević, *Avoiding Stripe Order: Emergence of the Supercooled Electron Liquid*, J. Supercond. Nov. Magn. 29, 601 (2016); arXiv:1508.03065.

14. L. Rademaker, M. Ortuño, *Explicit Local Integrals of Motion for the Many-Body Localized State*, Phys. Rev. Lett. **116**, 010404 (2016); arXiv:1507.07276.

13. L. Rademaker, *The Tower of States and the Entanglement Spectrum in a Coplanar Antiferromagnet*, Phys. Rev. B **92**, 144419 (2015); arXiv:1507.04402.

12. L. Rademaker, Y. Wang, T. Berlijn and S. Johnston, *Enhanced superconductivity due to forward scattering in FeSe thin films on $SrTiO_3$ substrates*, New J. Phys. **18**, 022001 (2016); arXiv:1507.03967.

11. R.-J. Slager, L. Rademaker, J. Zaanen and L. Balents, *Impurity Bound States and Greens Function Zeroes as Local Signatures of Topology*, Phys. Rev. B **92**, 085126 (2015); arXiv:1504.04881.

10. S. Mahmoudian, L. Rademaker, A. Ralko, S. Fratini and V. Dobrosavljević, *Glassy dynamics in geometrically frustrated Coulomb liquids without disorder*, Phys. Rev. Lett. **115**, 025701 (2015); arXiv:1412.4441.

9. L. Rademaker, T. van der Reep, N. Van den Broeck, B. van Waarde, M. de Voogd and T. Oosterkamp, *The Instability of a Quantum Superposition of Time Dilations*; arXiv:1410.2303 (2014)

8. K. Wu, L. Rademaker and J. Zaanen, *Bilayer Excitons in Two-Dimensional Nanostructures for Greatly Enhanced Thermoelectric Efficiency*, Phys. Rev. Applied **2**, 054013 (2014); arXiv:1401.7770.

7. L. Rademaker, S. Johnston, J. Zaanen and J. van den Brink, *Determinant quantum Monte Carlo study of exciton condensation in the bilayer Hubbard model*, Phys. Rev. B **88**, 235115 (2013); arXiv:1310.0623.

6. L. Rademaker, J. van den Brink, J. Zaanen and H. Hilgenkamp, *Exciton condensation in strongly correlated electron bilayers*, Phys. Rev. B **88**, 235127 (2013); arXiv:1310.0685.

5. L. Rademaker, Y. Pramudya, J. Zaanen and V. Dobrosavljević, *Influence of long-range interactions on charge ordering phenomena on a square lattice*, Phys. Rev. E **88**, 032121 (2013); arXiv:1306.4765.

4. L. Rademaker, J. van den Brink, H. Hilgenkamp and J. Zaanen, *Enhancement of spin propagation due to interlayer exciton condensation*, Phys. Rev. B **88**, 121101(R) (2013); arXiv:1304.3643.

3. L. Rademaker, K. Wu and J. Zaanen, *Dynamics of a single exciton in strongly correlated bilayers*, New J. Phys. **14**, 3040 (2012); arXiv:1202.3616.

2. L. Rademaker, K. Wu, H. Hilgenkamp and J. Zaanen, *The dynamical frustration of interlayer excitons delocalizing in bilayer quantum antiferromagnets*, Europhys. Lett. **97**, 27004 (2012); arXiv:1106.5347.

1. L. Rademaker, J. Zaanen and H. Hilgenkamp, *Prediction of quantization of magnetic flux in double-layer exciton superfluids*, Phys. Rev. B **83**, 012504 (2011); arXiv:1009.1793.

**Ph.D. Thesis**

- *Fermions and Bosons: Excitons in strongly correlated materials*, Leiden University (2013).

## AWARDS AND HONORS

- Selected *Superconductor Science and Technology Highlight 2016* for our paper 'Aspects of electron-phonon interactions with strong forward scattering in FeSe Thin Films on $SrTiO_3$ substrates'. Awarded in February 2017.
- *Early Career Award 2016* from the Handbook on the Physics and Chemistry of Rare Earths, for my contribution 'Quantum Critical Matter and Phase Transitions in Rare Earths and Actinides' published in Volume 49. Awarded in January 2017.
- *Best 2016 Scientific Paper Award* of the Computer Science and Mathematics Division at the Oak Ridge National Laboratory for 'providing new insight into enhancing superconductivity via the engineering of interfaces between materials', as proposed in our paper 'Enhanced superconductivity due to forward scattering in FeSe thin films on $SrTiO_3$ substrates.' Awarded in January 2017.
- Recipient of the *Rubicon grant* from the Netherlands Organisation for Scientific Research (NWO) which fully supports two years of research at the Kavli Institute for Theoretical Physics in Santa Barbara, April 2014.
- Runner-up at the *Best Poster Presentation award* at the DRSTP Trends in Theory conference, Dalfsen, The Netherlands, May 2013.
- Winner of the *Best Oral Presentation award* at the Casimir Spring School, Arnemuiden, The Netherlands, June 2010.
- Winner of the *Shell Stipendium 2008*, for best Master students in Theoretical Physics in The Netherlands, Rijswijk, The Netherlands, October 2008.
- Participant of *Stockholm International Youth Science Seminar*, an international seminar centered around the Nobel Prize ceremony, Stockholm, Sweden, December 2004.
- Participant of *European Union Contest for Young Scientists*, Vienna, Austria, September 2002.
- Winner of the *National Contest for Young Scientist*, for research on the binary star SS 433, Amsterdam, The Netherlands, March 2002.

## TEACHING

- Substitute lecturer for Prof. Leon Balents and Prof. Matthew Fisher at UC Santa Barbara (2014-2017).
- Teaching assistant, *Effective Field Theory* by professor Koenraad Schalm (Leiden University, Spring 2011, 2012 and 2013)
- Teaching assistant, *Quantum Field Theory* by professor Koenraad Schalm (Leiden University, Spring 2011, 2012 and 2013)
- Teaching assistant, *Quantum Field Theory* by professor Ana Achucarro (Leiden University, Spring 2010)
- Teaching assistant, *Theory of Condensed Matter* by professor Jan Zaanen (Leiden University, Spring 2009)
- Lecturer, *Introduction to LabView* (Khartoum University, Sudan, Spring 2008 and Spring 2012)

## CONFERENCES, VISITS AND WORKSHOPS

**Co-organizer of:**

- *Perimeter Institute Condensed Matter Seminar* series; an on average weekly seminar, since September 2017 onwards.
- *KITP Locals lunches and retreat* in 2014-2017. Meetings were held on an irregular basis at the Kavli Institute for Theoretical Physics and contain talks by members and postdocs - amongst the speakers were David Gross, Matthew Fisher and Boris Shraiman.
- *Trends in Theory, 16-17 May 2013*. Biannual conference of the Dutch Research School of Theoretical Physics, Dalfsen, The Netherlands. Key-note speakers were amongst others Xiao-Gang Wen and Mischa Katsnelson.
- *DRSTP PhD Day* in 2011, 2012 and 2013. Annual conference for Ph.D. students in Theoretical Physics in The Netherlands.

**Oral presentations**

- Seminar at Trent University, Peterborough, Canada, *Quantum thermalization and its breakdown*, 31 January 2018.
- Seminar at the University of Toronto, Canada, *Quenching the Kitaev model*, 18 October 2017.
- Mini-talk at the Quantum Matter Day, Perimeter Institute, Waterloo, Canada, *Quantum thermalization and its breakdown*, 3 October 2017.
- APS March Meeting, New Orleans, LA, United States, *Quantum thermalization and the expansion of atomic clouds*, 13 March 2017.
- Invited talk at 'Topological Science Workshop' at Keio University, Hiyoshi Campus, Yokohama, Japan, *Thermalization in Quantum Systems - and its breakdown*, 24 February 2017.
- Invited talk at the Workshop 'Theory of Correlated Topological Materials' at the University of Tokyo, Japan, *Thermalization in Quantum Systems - and its breakdown*, 23 February 2017.
- Seminar at the TU Dresden, Germany, *Thermalizationin Quantum Systems - and itsbreakdown*, 28 November 2016.
- Seminar at the Perimeter Institute, Waterloo, Canada, *Thermalizationin Quantum Systems - and itsbreakdown*, 23 November 2016.
- Seminar at Oxford University, United Kingdom, *MBL-to-Ergodic Transition from the perspective of Integrals of Motion*, 30 August 2016.
- Invited talk at the 16th International Conference on Transport in Interacting Disordered Systems (TIDS16) in Granada, Spain, *MBL-to-Ergodic Transition from the perspective of Integrals of Motion*, 23 August 2016.
- IRG-2 Seminar at the Material Research Laboratory at UC Santa Barbara, USA, *Electron glasses without quenched disorder in Organic Crystals*, 10 June 2016.
- Contributed talk at the International Conference on Superconductivity and Magnetism, Fethiye, Turkey, *New theoretical tools for quantum glasses, with and without quenched disorder*, 29 April 2016

- Invited talk at the APS March Meeting, *New theoretical tools for quantum glasses, with and without quenched disorder*, 15 March 2016.
- Special Condensed Matter Seminar at the Abdus Salam ICTP, Trieste, Italy, *New theoretical tools for quantum glasses, with and without quenched disorder*, 25 February 2016.
- Hard Times group meeting talk, University of California, Santa Barbara, USA, *Impurity Bound States and Greens Function Zeroes as Local Signatures of Topology*, 29 January 2016.
- Invited speaker at SPICE-Workshop on Bad Metal Behavior in Mott Systems, Mainz, Germany, *Glassy dynamics in geometrically frustrated Coulomb liquids*, 30 June 2015.
- Café KITP, public outreach talk with the title *Quasiparticles - The Dreams that Stuff is Made Of*, Santa Barbara, CA, United States, 7 May 2015.
- APS March Meeting, San Antonio, TX, United States, *Efros-Shklovskii Coulomb gap in the absence of disorder*, 5 March 2015.
- 'Hot Topic Talk' at the National High Magnetic Field Laboratory, Tallahassee, FL, United States, *Glassy dynamics in geometrically frustrated Coulomb liquids without disorder*, 13 January 2015.
- Seminar at Lorentz Institute, Leiden University, The Netherlands, *Self-generated electron glasses in frustrated organic crystals*, 4 december 2014.
- Theoretical Physics Seminar, Washington University, St. Louis, MO, United States, *Self-generated electron glasses in frustrated organic crystals*, 6 november 2014.
- APS March Meeting, Denver, CO, United States, *Dynamical frustration versus kinetic enhancement with excitons in strongly correlated bilayers*, 3-7 March 2014.
- UK-NL Condensed Matter Meeting, Bristol, United Kingdom, *Dynamical frustration versus kinetic enhancement with excitons in strongly correlated bilayers*, 30-31 August 2013.
- National High Magnetic Field Laboratory Seminar, Tallahassee, FL, United States, *Bilayer Excitons in Strongly Correlated Materials*, 1 February 2013.
- Interfaces and Correlated Electron systems UK tour, Bristol, United Kingdom, *Mott insulator bilayers*, 29 March 2012.
- Hilgenkamp group Seminar, Twente University, Enschede, The Netherlands, *Theoretical physics for experimentalists*, 1 February 2012.
- BEC-meeting in the group of Stoof, Duine and De Morais Smith, Utrecht, the Netherlands, *Frustrated interlayer excitons in antiferromagnets*, 9 september 2011.
- Presentation in the group of professor Millis, Columbia University, New York, NY, United States, *Emergent Ising confinement of excitons in strongly correlated bilayers*, 16 May 2011.
- DRSTP School on Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, *Excitons and spins in strongly correlated systems*, 9 March 2011.
- Casimir Spring School, Arnemuiden, the Netherlands, *Flux Quantization in Double Layer Exciton Superfluids*, 16 June 2010.
- DRSTP School on Statistical Physics and Theory of Condensed Matter, Driebergen, the Netherlands, *Magnetic Flux Quantization in Double Layer Exciton Superfluids*, 12 April 2010.

**Poster presentations**

- SPICE workshop 'Non-equilibrium Quantum Matter', Mainz, Germany, *Quantum Thermalization and the Expansion of Atomic Clouds*, 30 May - 2 June 2017.
- KITP conference 'Novel States in Spin-Orbit Coupled Quantum Matter', Santa Barbara, CA, United States, *Impurity Bound States and Greens Function Zeroes as Local Signatures of Topology*, 27-31 July 2015
- KITP conference 'Closing the entanglement gap: Quantum information, quantum matter, and quantum fields', Santa Barbara, CA, United States, *The Tower of States and the Entanglement Spectrum in a Coplanar Antiferromagnet*, 1-5 June 2015.
- DRSTP Trends in Theory conference, Dalfsen, The Netherlands, *Frustration & Cooperation in strongly correlated exciton condensates*, 16-17 May 2013
- Workshop 'Universal Themes of Bose-Einstein Condensation', Leiden, The Netherlands, *Frustration & Cooperation in strongly correlated exciton condensates*, 11-15 March 2013.
- Physics@FOM Veldhoven conference, The Netherlands, *Exciton condensation in strongly correlated electron bilayers*, 22-23 January 2013.
- NHMFL Theory Winter School, Tallahassee, FL, United States, *Exciton condensation in strongly correlated electron bilayers*, 7-11 January 2013.
- 'Innovations in Strongly Correlated Electron Systems' Summer School and Workshop at the ICTP, Trieste, Italy,*Exciton condensation in strongly correlated electron bilayers*, 6-17 August 2012.
- EXCON 2012 conference, Groningen, The Netherlands, *Exciton condensation in strongly correlated electron bilayers*, 2-6 July 2012.
- Physics@FOM Veldhoven conference, The Netherlands, *Exciton condensation in strongly correlated electron bilayers*, 17-18 January 2012.
- Conference on Optics of Excitons in Confined Systems, Paris, France, *Dynamical frustration of interlayer excitons in bilayer quantum antiferromagnets*, 12-16 September 2012.
- NPSM 2011 Workshop on 'Quantum phenomena in graphene, other low-dimensional materials, and optical lattices', Erice, Italy, *Dynamical frustration of interlayer excitons in bilayer quantum antiferromagnets*, 4-7 August 2011.
- 100th Anniversary of Superconductivity: Hot Topics and Future Directions, Lorentz workshop, Leiden, the Netherlands, *How a Neutral and Massless Superfluid can still exhibit Flux Quantization*, 4-8 April 2011.
- Physics@FOM Veldhoven conference, The Netherlands, *Exciton motion in strongly correlated heterostructures*, 17-19 January 2011.
- MESA+ Insitute for Nanotechnology meeting 2010, Enschede, the Netherlands, *Bose-Einstein condensation of excitons in oxide heterostructures*, 14 September 2010.
- Physics@FOM Veldhoven conference, The Netherlands, *How a Neutral and Massless Superfluid can still exhibit Flux Quantization*, 18-20 January 2010.

## SKILLS

- Fluent in Dutch, English; intermediate level (CEF level B1) in French; basic level in German and Russian.
- Highly skilled in Fortran and Mathematica, basic knowledge of C++.
- Trained in classical Monte Carlo, Determinant Quantum Monte Carlo, diagrammatic techniques and Dynamical Mean Field Theory.

## OTHER POSITIONS

**Member of the DRSTP PhD-council** April 2011 - November 2013
*Dutch Research School for Theoretical Physics (DRSTP)* *Utrecht, The Netherlands*

· Representing the Leiden PhD students in the nationwide DRSTP council.

**Member of the LION Council** September 2010 - November 2013
*Leiden Institute of Physics (LION)* *Leiden, The Netherlands*

· Representing the Theoretical Physics PhD students in the LION council.

**Elected City Council Member** March 2006 - March 2014
*City Council of Leiden* *Leiden, The Netherlands*

· The City of Leiden has about 120000 inhabitants and an annual budget of about 500 million euro. Served as member of the Socialist Party faction in the Urban Development Committee, the Regional Affairs Committee, the Committee for Social Welfare & Economics and the Budget Committee. Elected in March 2006, re-elected for a second term in March 2010.

**Strategy Consultant** January 2008 - December 2008
*Instituut voor Maatschappelijke Innovatie (IMI)* *Leiden, The Netherlands*

· Part-time position as consultant at the 'Institute for Social Innovation'. Main project was to advise the Ministry of Infrastructure on the long-term future of highway construction.

**Teacher in Economics** May 2004 - May 2005
*Stichting Studiebegeleiding Leiden (SSL)* *Leiden and Sneek, The Netherlands*

· Teaching intensive 3-day courses in economics for high school students.

**Political Assistant** May 2004 - March 2006
*Provinciale Staten van Zuid-Holland* *Den Haag, The Netherlands*

· Assisting the Socialist Party faction in the State Parliament of South-Holland.