

# **Adrian Kantian – Curriculum Vitae, Jan. 2023**

## **Personal**

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## **Current Employment**

Dec. 2020 - Associate Professor Heriot-Watt University (HWU)

Oct. 2018 - Jul. 2023 Associate Senior Lecturer (tenure track), Uppsala University (UU)

Apr. 2018 - Oct. 2018 Parental leave at 100%

Nov. 2017 – Sept. 2018 Researcher, UU

## **Previous positions, postdoctoral**

Feb. 2017 - Oct. 2017 Guest Researcher, Nordic Institute of Theoretical Physics (Nordita), Stockholm

Jan. 2015 - Jan. 2017 Independent Fellow, Nordita, Stockholm

Oct. 2013 - Jan. 2015 Senior postdoc ("Maître Assistant") with Thierry Giamarchi, University of Geneva

Feb. 2010 - Sept. 2013 Postdoctoral researcher with Thierry Giamarchi, U. Geneva

## **Education**

Feb. 2005 - Jan. 2010 PhD in Theoretical Physics, University of Innsbruck. Supervisor: Peter Zoller.

Jul. 2003 - Sept. 2004 Diploma of Physics, Leibniz Universität Hannover (LUH).  
Supervisor: Maciej Lewenstein.

Aug. 2002 - Jun. 2003 Physics at LUH

Oct. 2001 - Jun. 2002 Part III of the Mathematical Tripos, University of Cambridge

Oct. 1998 - Jun. 2001 Physics and Mathematics at LUH

## **External funding won in competition / scholarships / awards**

- Apr. 2022                      **UKRI-EPSRC Standard Grant**  
£ 484,191 for three years  
Project duration: 01.10.2022 – 30.09.2025  
Project title: “*Resolving superconductivity and pseudogap physics in oxides: beating the sign*”
- Jun. 2019                      **Olle Engkvist Foundation Research Grant**  
SEK 780,000 for two years  
Project duration: 01.04.2020 – 31.03.2022  
Project title: “*Resolving superconductivity and pseudogap physics in oxides: beating the sign problem*”
- Sept. 2017                     **Uppsala University project co-funding**  
SEK 1,875,000 for five years  
Project duration: 01.10.2018 - 31.07.2023
- Aug. 2017                     **ERC Starting Grant 2017** (Panel PE3, Condensed Matter Physics)  
€ 1,491,013 for five years  
Project duration: 01.10.2018 - 31.03.2024  
Project title: “*1D-electrons coupled to dissipation: a novel approach for understanding and engineering superconducting materials and devices*”  
Acronym: 1D-Engine
- Dec. 2014                     **Nordita Independent Fellowship stipend**, SEK 708,000 for two years.
- May 2001                      **Full stipend by the German Academic exchange service (DAAD)**  
for attending Cambridge University, academic year 2001 - 2002
- Sept. 2000                     **1<sup>st</sup> prize for best intermediate exams in Physics at LUH**
- Oct. 1998 - Sept. 2004      **Scholarship recipient of the German National Scholarship Foundation**  
("Studienstiftung des Deutschen Volkes")

## **High-performance computing resources acquired as PI**

Jul. 2022 – Jun. 2023	6 million core-hours on the “Dardel“ Cray EX cluster at KTH Stockholm and the “Tetralith“ cluster at Linköping University
May 2022 – Apr. 2023	2 million core-hours on the Peta4-Skylake cluster at CSD3 in Cambridge
Mar. 2022 – Feb. 2023	4.9 million core-hours on the “ARCHER2“ Cray EX cluster at EPCC Edinburgh
Nov. 2021 – Dec. 2022	1 million core-hours on the “Cirrus“-cluster at EPCC Edinburgh
Jul. 2021 - Jun. 2022	4.8 million core-hours on “Dardel“ and “Tetralith“
Jan. 2021 - Jun. 2021	2.4 million core-hours on the ”Beskow“ Cray XC40 cluster at KTH Stockholm and the ”Rackham“ cluster at Uppsala University
Jul. 2020 - Dec. 2020	3 million core-hours on ”Beskow“ and ”Rackham“
Jun. 2019 - Jun. 2020	3.6 million core-hours on ”Beskow“ and ”Rackham“
Feb. 2019 - Aug. 2019	0.66 million core-hours on ”Beskow“ and the ”Kebnekaise“ cluster at Umeå University

## **Group leader supervision**

- Oct. 2022 - Dr. Sam Mardazad, postdoctoral researcher,  
graduated from LMU Munich in 2022
- Apr. 2022 - Ebot Joel Etaya, PhD student,  
Masters Degrees from University of Buea (2017) and ICTP Trieste (2019)
- Sept. 2020 – Sept. 2022 Dr. Iman Mayaeh (joint supervision with Annica Black-Schaffer),  
graduated from Stockholm University in 2020
- Apr. 2020 – Apr. 2023 Dr. Mykhailo Rakov, postdoctoral researcher,  
joined from U. Braunschweig / PTB Braunschweig
- Feb. 2019 - Dr. Thomas Köhler, postdoctoral researcher,  
graduated from U. Göttingen in 2018
- Nov. 2018 - Gunnar Bollmark, PhD student,  
Masters degree from KTH in 2018

## Major scientific collaborations

- April 2015 - March 2016 - **I was lead scientist on the supercomputing production project** “Understanding the 2D Hubbard model: studying unconventional superconductivity through simulation of coupled Hubbard ladders using massively parallel DMRG” using pDMRG on the "Piz Daint" supercomputer at CSCS  
(**PI: Thierry Giamarchi**).  
- **1.169.000 node-hours awarded**  
- Collaborators: **Michele Dolfi, Alexandr Kosenkov, Matthias Troyer, Thierry Giamarchi**
- April 2014 - March 2015 - **I was lead scientist on the supercomputing production project** “Study of coupled organic chains by parallelized DMRG” using pDMRG on the "Piz Daint" supercomputer at CSCS  
(**PI: Thierry Giamarchi**).  
- **270.000 node-hours awarded**  
- Collaborators: **Michele Dolfi, Matthias Troyer, Thierry Giamarchi**
- April 2014 - March 2015 - **I was co-lead on supercomputing development project** “Development of a Highly Parallel DMRG Code for Quantum Chemistry Problems” using pDMRG on the "Piz Daint" supercomputer at CSCS  
(**PI: Matthias Troyer**).  
- **400.000 node-hours awarded**  
- Collaborators: **Michele Dolfi (lead scientist), Alexandr Kosenkov, Timothee Ewart, Matthias Troyer**
- March 2010 - June 2013 - Member of MAQUIS-collaboration between groups of **Thierry Giamarchi** (PI, U. Geneva), **Fredric Mila** (EPF Lausanne) and **Matthias Troyer** (ETH Zürich)  
- <https://alps.comp-phys.org/hp2c-trac/wiki/WikiStart>  
- Financed under **HP2C-initiative** by Swiss government with 1.2 million CHF for development of high-performance scientific codes for parallel supercomputers and supported by the **Swiss National Supercomputing Center (CSCS)**.  
- Funding was for professional programmers, **Alexandr Kosenkov** (formerly Intel) and **Timothee Ewart** (formerly IBM), who worked mainly on **parallel density renormalization group (pDMRG)** numerics, directly supervised by and collaborating with **Bela Bauer, Michele Dolfi, Matthias Troyer** and **myself**, all of whom also contributed to code development, as did **Sebastian Keller**

## Publications – Adrian Kantian

### - Preprints

1. G. Bollmark, T. Köhler, **A. Kantian**  
*Resolving Competition of Charge-Density Wave and Superconducting Phases Using the MPS+MF Algorithm*  
**arXiv/2301.08116**
2. S. Marten, G. Bollmark, T. Köhler, S. R. Manmana, **A. Kantian**  
*Transient superconductivity in three-dimensional Hubbard systems by combining matrix product states and self-consistent mean-field theory*  
**arXiv/2207.09841** (in review at **SciPost**)
3. G. Bollmark, T. Köhler, L. Pizzino, Y. Yang, H. Shi, J. S. Hofmann, S. Zhang, T. Giamarchi, **A. Kantian**  
*Solving 2D and 3D lattice models of correlated fermions--combining matrix product states with mean field theory*  
**arXiv/2207.03754** (accepted for **Phys. Rev. X**)

### - Publications in international peer-reviewed journals (as of Jan. 20<sup>th</sup> 2023)

- number of citations according to Google Scholar
- Number of citations: **4137**
- h-index: **17**

1. I. Mahyaeh, T. Köhler, A. M. Black-Schaffer, **A. Kantian**  
*Superconducting pairing from repulsive interactions of fermions in a flat-band system*  
Physical Review B 106 (12), 125155  
**Cited 1 time**
2. M. Dupont, Y. O. Kvashnin, M. Shiranzaei, J. Fransson, N. Laflorencie, **A. Kantian**  
*“Monolayer CrCl<sub>3</sub>, an ideal testbed for the universality classes of 2D magnetism”*  
**Phys. Rev. Lett.** 127 (3), 037204  
**Cited 20 times**
3. G. Bollmark, N. Laflorencie, **A. Kantian**  
*Dimensional Crossover and Phase Transitions in Coupled Chains : Density Matrix Renormalization Group Results.*  
**Phys. Rev. B** 102, 195145 (2020)  
**Cited 5 times**
4. **A. Kantian**, M. Dolfi, M. Troyer, T. Giamarchi  
*Understanding repulsively mediated superconductivity of correlated electrons via massively parallel density matrix renormalization group*  
**Phys. Rev. B**, 100(7), 075138 (2019)  
**Cited 17 times**

5. N. A. Kamar, **A. Kantian**, T. Giamarchi  
*Dynamics of a Mobile Impurity in a Two Leg Bosonic Ladder*  
**Phys. Rev. A**, 100(2), 023614 (2019)  
**Cited 16 times**
6. **A. Kantian**, S. Langer, A. J. Daley  
*Dynamical disentangling and cooling of atoms in bilayer optical lattices*  
**Phys. Rev. Lett.** 120, 060401 (2018)  
**Cited 23 times**
7. **A. Kantian**, D. S. L. Abergel  
*True Bilayer Exciton Condensate of One-Dimensional Electrons*  
**Phys. Rev. Lett.** 119, 37601 (2017)  
**Cited 3 times**
8. **A. Kantian**, U. Schollwöck, T. Giamarchi  
*Lattice assisted spectroscopy: a generalized scanning tunnelling microscope for ultra-cold atoms*  
**Phys. Rev. Lett.** 115, 165301 (2015)  
**Cited 15 times**
9. M. Dolfi, **A. Kantian**, B. Bauer, M. Troyer  
*Minimizing nonadiabaticities in optical-lattice loading*  
**Phys. Rev. A** 91, 033407 (2015)  
**Cited 22 times**
10. M. Dolfi, B. Bauer, S. Keller, A. Kosenkov, T. Ewart, **A. Kantian**, T. Giamarchi, M. Troyer  
*Matrix Product State applications for the ALPS project*  
**Comput. Phys. Commun.** 185, 3430 (2014)  
**Cited 112 times**
11. **A. Kantian**, U. Schollwöck, T. Giamarchi  
*Competing Regimes of Motion of 1D Mobile Impurities*  
**Phys. Rev. Lett.** 113, 070601 (2014)  
**Cited 38 times**
12. M. Knap, **A. Kantian**, T. Giamarchi, I. Bloch, M. D. Lukin, E. Demler  
*Probing Real-Space and Time-Resolved Correlation Functions with Many-Body Ramsey Interferometry*  
**Phys. Rev. Lett.** 111, 147205 (2013)  
**Cited 142 times**
13. F. Massel, **A. Kantian**, A. J. Daley, T. Giamarchi, P. Törmä  
*Dynamics of an impurity in a one-dimensional lattice*  
**New J. Phys.** 15, 045018 (2013)  
**Cited 40 times**

14. T. Fukuhara, **A. Kantian (lead theorist)**, M. Endres, M. Cheneau, P. Schauß, S. Hild, D. Bellem, U. Schollwöck, T. Giamarchi, C. Gross, I. Bloch, S. Kuhr  
*Quantum dynamics of a single, mobile spin impurity*  
**Nat. Phys.** 9, 235 (2013)  
**Collaboration theory/experiment**  
*Cited 549 times*
  
15. J. Catani, G. Lamporesi, D. Naik, M. Gring, M. Inguscio, F. Minardi, **A. Kantian (lead theorist)**, and T. Giamarchi,  
*Quantum dynamics of impurities in a one-dimensional Bose gas*  
**Phys. Rev. A** 85, 023623 (2012)  
**Collaboration theory/experiment**  
*Cited 352 times*
  
16. **A. Kantian**, A. J. Daley, P. Zoller  
 *$\eta$ -Condensate of fermionic atom pairs via adiabatic state preparation*  
**Phys. Rev. Lett.** 104, 240406 (2010)  
*Cited 28 times*
  
17. **A. Kantian**, M. Dalmonte, S. Diehl, W. Hofstetter, P. Zoller, A. J. Daley  
*An atomic colour superfluid via three-body loss*  
**Phys. Rev. Lett.** 103, 240401 (2009)  
*Cited 80 times*
  
18. B. Kraus, H. P. Büchler, S. Diehl, **A. Kantian**, A. Micheli, P. Zoller  
*Preparation of entangled states by quantum Markov processes*  
**Phys. Rev. A** 78, 042307 (2008)  
*Cited 659 times*
  
19. S. Diehl, A. Micheli, **A. Kantian**, B. Kraus, H. P. Büchler, P. Zoller  
*Quantum States and Phases in Driven Open Quantum Systems with Cold Atoms*  
**Nat. Phys.** 4, 878 (2008)  
*Cited 1116 times*
  
20. S. Morrison, **A. Kantian**, A. J. Daley, H. G. Katzgraber, M. Lewenstein, H. P. Büchler, P. Zoller  
*Physical replicas and the Bose glass in cold atomic gases*  
**New J. Phys.** 10, 073032 (2008)  
*Cited 25 times*
  
21. **A. Kantian**, A. J. Daley, P. Törmä, P. Zoller  
*Atomic lattice excitons: from condensates to crystals*  
**New J. Phys.** 9, 407 (2007)  
*Cited 12 times*



22. K. Winkler, G. Thalhammer, F. Lang, R. Grimm, J. Hecker Denschlag, A. J. Daley, **A. Kantian**, H. P. Büchler, P. Zoller  
*Repulsively bound atom pairs in an optical lattice*  
**Nature** 441, 853 (2006)  
**Collaboration theory/experiment**  
*Cited 625 times*
23. T. Schulte, S. Drenkelforth, J. Kruse, W. Ertmer, J. J. Arlt, **A. Kantian**, L. Sanchez-Palencia, L. Santos, A. Sanpera, K. Sacha, P. Zoller, M. Lewenstein, and J. Zakrzewski  
*Cold atomic gases in optical lattices with disorder*  
**Acta. Phys. Pol. A** 109, 89 (2006)  
*Cited 9 times*
24. L. Sanchez-Palencia, V. Ahufinger, **A. Kantian**, J. Zakrzewski, A. Sanpera, M. Lewenstein  
*Strongly correlated Fermi-Bose mixtures in disordered optical lattices*  
**J. Phys. B – Atom. Mol. and Opt. Phys.** 39, 10 Sp. Iss., 121 (2006)  
*Cited 12 times*
25. V. Ahufinger, L. Sanchez-Palencia, **A. Kantian**, A. Sanpera, M. Lewenstein  
*Disordered ultracold atomic gases in optical lattices: A case study of Fermi-Bose mixtures*  
**Phys Rev. A** 72, 063616 (2005)  
*Cited 92 times*
26. A. Sanpera, **A. Kantian**, L. Sanchez-Palencia, J. Zakrzewski, M. Lewenstein  
*Atomic Fermi-Bose mixtures in inhomogeneous and random lattices: From Fermi glass to quantum spin glass and quantum percolation*  
**Phys. Rev. Lett.** 93, 040401 (2004)  
*Cited 121 times*

#### **- Contributions to Books and Conference Proceedings**

1. A. J. Daley, **A. Kantian**, H. P. Büchler, P. Zoller, K. Winkler, G. Thalhammer, F. Lang, R. Grimm, J. Hecker Denschlag  
*Repulsively bound atom pairs: Overview, Simulation and Links,*  
**in Proceedings of the 20th International Conference of Atomic Physics** (Innsbruck, Austria, 2006)  
 (cond-mat/0608721)
2. **A. Kantian**  
*Excited states on optical lattices: Atomic lattice excitons*  
**in Proceedings of the international school of physics, Enrico Fermi, Course CLXIV, Ultra-Cold Fermi Gases** (2006)

- **Thesis**

2010 PhD-Thesis: *"Excited Many-Body States and Dissipative Dynamics of Cold Atoms in Optical Lattices"*

2004 Diploma-Thesis: *"Disordered Quantum Phases in Optical Lattices"*

## **Teaching Experience**

- Oct. 2022 - Primary supervisor for 5<sup>th</sup>-year Masters project of Mark Bengyel at Heriot-Watt University
- Apr. 2022 - Primary PhD-supervisor for Ebot Joel Etaya at Heriot-Watt University
- Mar. 2022 “Statistical Physics”, lectures and exercise groups
- Sept. 2021 – May 2022 Primary supervisor for 4<sup>th</sup> and 5<sup>th</sup>-year Masters project of Corran Paterson at Heriot-Watt University
- Feb. 2020 – Apr. 2020 Co-supervisor for Svenja Marten, visiting project student from the University of Göttingen
- Feb. 2020 - Mar. 2020 Teaching Assistant, Elektromagnetism for engineering students, Uppsala University
- Nov. 2018 - Primary PhD-supervisor for Gunnar Bollmark at Uppsala University
- Nov. 2018 - Jan. 2019 Teaching Assistant, Elektromagnetism for engineering students, Uppsala University
- Jun. 2014 – Nov. 2019 Co-supervisor for Naushad A. Kamar, PhD student of Thierry Giamarchi at the University of Geneva, on all aspects of his research concerning DMRG numerics for simulating quantum many-body physics.
- 2012 - 2014 Teaching Assistant, Département de Physique de la Matière Condensée, University of Geneva  
- Exercise classes and substitute teaching, “Electronic Properties of Solids” (winter semesters)  
- Exercise classes, “Solid State Physics”, (summer semesters)
- 2006 – 2007 Tutor, Institute for Theoretical Physics, University of Innsbruck  
- Tutorial, “Thermodynamics and Statistical Physics”  
- Tutorial “Introduction to Theoretical Physics”
- Oct 2003 – Feb 2004 Tutor, University of Hannover  
- Introductory Laboratory Courses for 2<sup>nd</sup> year students

## **Invited Talks at Conferences and Workshops**

- *Designing 2D and 3D microscopic models of high- $T_c$  and dynamically induced superconductivity using quasi-one-dimensional arrays*, International Quantum Tensor Network workshop, Dundee, Scotland, January 10<sup>th</sup>, 2023
- *Mobile impurities and Greens function measurements in strongly correlated atoms: advances through strong numerics*, Mini-Symposium On Cold Atoms And Quantum Transport, Lund University, Sweden, January 27<sup>th</sup>, 2015
- *Mobile impurities within a 1D many-body system*, Swiss Workshop on Materials with Novel Electronic Properties 2013, Les Diablerets, June 27<sup>th</sup>, 2013
- *Mobile impurities in one-dimensional cold gases*, Conference “Disorder in Condensed Matter and Ultracold Atoms”, Varenna, Italy, June 12<sup>th</sup>, 2013
- *Mobile impurities within a 1D many-body system*, CUNY workshop “Frontiers of quantum condensed matter physics: light, matter and unusual devices out of equilibrium”, New York, NY, March 26<sup>th</sup>, 2013
- *Mobile impurities within a 1D many-body system*, NORDITA workshop “Pushing the Boundaries with Cold Atoms”, Stockholm, Sweden, January 21<sup>st</sup>, 2013
- *Mobile impurities in one-dimensional cold gases: subdiffusive, diffusive and ballistic regimes*, Swiss Japan workshop 2012, Wako, Japan
- *Mobile impurities in one-dimensional cold gases: subdiffusive, diffusive and ballistic regimes*, Ringberg conference, Ringberg, Germany, April 19<sup>th</sup>, 2012
- *Excitons in optical lattices and dynamical simulation techniques*, BEC Theory Workshop, Windsor Great Park, United Kingdom, August 17<sup>th</sup>, 2005

## **Invited Talks at Seminars**

- *„Novel approaches to the quantum many-body problem: matrix product state algorithms hybridized with mean-field techniques“*, Seminar, Department of Mathematics, Uppsala University, Sweden, Nov. 10<sup>th</sup>, 2020
- *“Quasi-1D superconductors and related systems - exploring dimensional crossovers and optimised unconventional pairing”*, Theory Seminar, Strathclyde University, United Kingdom, Feb. 6<sup>th</sup>, 2020
- *“Quasi-1D superconductors and related systems - exploring dimensional crossovers and optimised unconventional pairing”*, Theory Seminar, PTB Braunschweig, Germany, Feb. 13<sup>th</sup>, 2020
- *Dynamical disentangling of bilayer systems*, seminar at Heidelberg University, Germany, Aug. 2<sup>nd</sup>, 2017
- *From exciton condensates to organic superconductors - advances through large-scale numerics*, Theory seminar, Paul Scherrer Institute, Switzerland, Mar. 9<sup>th</sup>, 2017

- *From exciton condensates to organic superconductors - advances through large-scale numerics*, Theory seminar, University of Würzburg, Germany, Jan. 12th, 2017
- *Mobile impurities and Greens function measurements in strongly correlated atoms: advances through strong numerics*, Theory seminar, EPFL, Dec. 3<sup>rd</sup>, 2014
- *Mobile impurities in one-dimensional cold gases*, Seminar University of Bonn, May 5<sup>th</sup>, 2014
- *Mobile impurities in one-dimensional cold gases*, Seminar LENS, Florence, June 18<sup>th</sup>, 2013
- *Mobile impurities in one-dimensional cold gases: subdiffusive, diffusive and ballistic regimes*, Theoretical Physics seminar, University of Frankfurt, April 12<sup>th</sup>, 2012,
- *Mobile impurities in one-dimensional cold gases: subdiffusive, diffusive and ballistic regimes*, Condensed Matter seminar, University of Pittsburgh, March 6<sup>th</sup>, 2012,
- *Mobile Impurities in Ferromagnetic Liquids*, Condensed Matter seminar, University of Pittsburgh, March 30<sup>th</sup>, 2011