

Curriculum Vitae

Personal and Contact Information

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Professional History

August 2024 – ongoing **Assistant Professor in Mathematical Physics** at the Department of Mathematics at Virginia Tech in Blacksburg, USA
July 2020 – July 2024 **Independent research fellow and lecturer** at the Institute of Mathematics of the University of Zurich (UZH) financed by an **Ambizione grant** of the Swiss National Science Foundation (SNSF)
Oct. 2019 – June 2020 **Marie Skłodowska-Curie individual fellow** at the Institute of Mathematics of the University of Zurich (UZH) in the group of Prof. Dr. Benjamin Schlein
Oct. 2016 – Sept. 2019 **Post-doc** at the Institute of Science and Technology Austria (IST Austria) in the group of Prof. Dr. Robert Seiringer
March 2012 – Sept. 2016 **Scientific employee** at the University of Tübingen
Jan. 2011 – March 2012 **Scientific editing** of lecture notes for Prof. Dr. Sandro Wimberger that later got published in book form under the title “Nonlinear Dynamics and Quantum Chaos: An Introduction” by Prof. Wimberger (see preface for reference)

Education

March 2012 – Sept. 2016 **Doctoral Studies in Mathematics** at the University of Tübingen under the supervision of Prof. Dr. Christian Hainzl within the framework of the Graduiertenkolleg 1838 (Spectral Theory and the Dynamics of Quantum Systems), Thesis title: Contributions to the mathematical study of BCS theory (Magna cum Laude), Date of award: 05.10.2016
Apr. 2002 – Dec. 2010 **Studies of Physics** at the University of Heidelberg (Grade point average 1.0, with distinction), Diploma thesis under the supervision of Prof. Dr. Lorenz S. Cederbaum, Thesis title: Dynamics of repulsively bound atom pairs in optical lattices
July 2007 – July 2010 **Absence from Studies** due to illness (fully recovered)
Jan. 2005 – June 2005 **Studies in Mathematics** at the University of Orsay, Paris 11 (Erasmus program)

Research Interests

My main research interests are mathematical quantum mechanics and quantum statistical mechanics. In my work, I develop analytic, functional-analytic, and probabilistic methods, with a focus on variational techniques, to study mathematical problems arising from solid-state physics. Currently, I am primarily interested in developing new mathematical tools to study bosonic many-particle systems at positive temperature. I have also been interested in mathematical aspects of the BCS theory of superconductivity (formulated as a non-commutative variational problem) and the physics of the angulon quasi-particle.

Grants

2022, 2023 Awarded 2019	I was admitted to the second (final) round for an ERC Starting Grant . Marie Skłodowska-Curie Individual Fellowship , Project focuses on the Mathematics of dilute Bose Gases at Positive Temperature (~ 203 000 €, 2 years).
Awarded 2019	Ambizione Fellowship of the Swiss National Science Foundation , Project focuses on the Mathematics of dilute Bose Gases at Positive Temperature (~ 551 000 CHF, 4 years).

Teaching Experience

Fall term 2024	Fourier series and partial differential equations (Lecture, 2 × 75 min/week)
Summer term 2023	Introduction to the statistical mechanics of lattice systems (Lecture, 2 hours/week + 2 hours/week exercise group)
Summer term 2022	Variational methods in analysis (Joint lecture with Dr. Alessandro Olgiati, 4 hours/week + 2 hours/week exercise group)
Summer term 2021	Mathematical statistical mechanics (Lecture, 2 hours/week + 2 hours/week discussion group)
Summer term 2020	The mathematics of dilute quantum gases (Lecture, 2 hours/week + 2 hours/week discussion group)
Summer term 2016	Repetitorium analysis 2 (Lecture, 2 hours/week)
Winter term 2015/16	Repetitorium analysis 1 (Lecture, 2 hours/week)
2012 – 2015	Teaching assistant for various lectures and one seminar including Probability theory, Calculus of variations, Mathematical quantum mechanics, Mathematics for physicists I–III.

- The lecture [Fourier series and partial differential equations](#) for fourth year Bachelor students in Mathematics, Physics, and Engineering was delivered at Virginia Tech.
- The course "[Introduction to the statistical mechanics of lattice systems](#)" (Course webpage) took place at the Institut of Mathematics at the University of Zurich. It was intended for Bachelor, Master and PhD students in Mathematics and Physics at the University of Zurich and at ETH Zurich. Three students and two PhD students passed the class.
- The lecture with the title "[Variational methods in analysis](#)" (Course webpage) was intended for Bachelor and Master students in Mathematics at the University of Zurich and at ETH Zurich. The first part of the lecture (the first eight weeks of the semester) could be booked independently as a course by

Bachelor students and was called "Advanced topics in analysis" (Course webpage). Five students passed the first part of the course and 16 additional students passed the entire class.

- The lecture "**Mathematical statistical mechanics**" was intended for Master and PhD students in Mathematics and Physics at the University of Zurich and at ETH Zurich (Course webpage). It was attended by seven students and one Post-Doc. Due to the Covid-19 pandemic it was a recorded video lecture. In addition to the lecture, there was a weakly two hour discussion group via Zoom to compensate for the lack of opportunity to ask questions during the lecture.

- The lecture "**The mathematics of dilute quantum gases**" took place at the University of Zurich, was intended for the same audience, and had the same format (Course webpage). It was attended by nine students and two Post-Docs.

- **All other lectures/exercise groups** took place at the University of Tübingen and were held in person.

Lecture Series at Winter School

I gave an invited lecture series (4×75 min) on mathematical aspects of the BCS theory of superconductivity at the Winter School of the SFB TRR 352 Mathematics of Many-Body Quantum Systems and Their Collective Phenomena (Kochl am See, 18.–22.03.2024).

Supervision Experience

01.02.2021–08.11.2023	Assisted supervision of mathematics PhD student: Marco Caporaletti, joint project: Derivation of effective evolution equations for bosonic mixed states (PhD supervisor: Prof. Dr. Benjamin Schlein), two joint publications.
01.02.2021–19.01.2022	Supervision of mathematics Master student: David Stocker, project: Upper bound for the free energy of the three-dimensional dilute Bose gas (Official supervisor: Prof. Dr. Benjamin Schlein), one joint publication.
01.02.2020–07.09.2022	Assisted supervision of mathematics PhD student: Marcel Maier (born Schaub), joint project: Microscopic derivation of Ginzburg–Landau theory and the BCS critical temperature shift in the presence of weak macroscopic external fields (PhD supervisor: Prof. Dr. Christian Hainzl), two joint publications.
01.10.2018–30.11.2019	Assisted supervision of physics PhD student: Xiang Li, joint project: Intermolecular forces and correlations mediated by a phonon bath (PhD supervisor: Prof. Dr. Mikhail Lemeshko), one joint publication.
01.12.2017–30.09.2019	Assisted supervision of mathematics PhD student: Simon Mayer, joint project: The free energy of the two-dimensional dilute Bose gas (PhD supervisor: Prof. Dr. Robert Seiringer), one joint publication.

Referee and Review Activity

Inventiones Mathematicae, Probability and Mathematical Physics, Analysis and PDE, Calculus of Variations and PDE, Journal of Spectral Theory, Transactions of the American Mathematical Society, Annales Henri Poincaré, Journal of Statistical Physics, Journal of Mathematical Physics; Mathematical Physics,

Analysis and Geometry; Reviews in Mathematical Physics, Mathematical Modelling and Analysis, Journal of Applied Physics, Applied Physics Letters, Journal of Low Temperature Physics, Springer Proceedings Series, Scientific Reports, MathSciNet (August 2020 – February 2024), zbMATH (May 2020 – February 2024).

Organization of Scientific Events

I co-organized the summer school “Current Topics in Mathematical Physics” that took place in Zurich from July 19 to July 23 in 2021 (prior to the International Congress on Mathematical Physics in Geneva).

Upcoming events

- I will participate as a Senior Fellow in the Spring Program Non-commutative Optimal Transport to be held at the Institute for Pure and Applied Mathematics (IPAM) for the period March 10th – June 13 in 2025.
- Together with Guher Camliyurt I am organizing a session on nonlinear PDEs and their microscopic derivation at the Southeastern Sectional Meeting of the AMS at Clemson University on March 8th–9th in 2025.

Talks at Conferences and Research Seminars and Poster Contributions

- The Gibbs state of the mean-field Bose gas and a new correlation inequality, Mathematical Physics Seminar, Georgia Tech, Atlanta (invited talk, 06.12.2024)
- The Gibbs state of the mean-field Bose gas, Analysis and Mathematical Physics Seminar, Virginia Tech, Blacksburg (talk, 06.11.2024)
- Microscopic Derivation of Ginzburg–Landau Theory and the BCS Critical Temperature Shift in general external fields, European Congress of Mathematics (ECM), Sevilla (invited talk, 16.07.2024)
- Condensate fluctuations and Bogoliubov theory in a weakly interacting Bose gas at positive temperature, International Congress of Mathematical Physics (ICMP), Strasbourg (contributed talk 04.07.2024)
- Upper bound for the grand canonical free energy of the Bose gas in the Gross-Pitaevskii limit for general interaction potentials, Mathematical Physics and Analysis Seminar, Institute of Science and Technology Austria (ISTA), Klosterneuburg (invited talk 13.02.2024)
- The mathematics of dilute Bose gases at positive temperature, Department of Mathematics, University of Ottawa, Ottawa (invited talk, 17.01.2024)
- The mathematics of dilute Bose gases at positive temperature, Department of Mathematics, Virginia Tech, Blacksburg (invited talk, 08.01.2024)
- Upper bound for the grand canonical free energy of the Bose gas in the Gross-Pitaevskii limit, Quantum and Dynamical Christmas, Milan (invited talk 22.12.2023)

- The mathematics of dilute Bose gases at positive temperature, Department of Mathematics, University of Houston, Houston (invited talk, 13.12.2023)
- Upper bound for the grand canonical free energy of the Bose gas in the Gross-Pitaevskii limit, Workshop on Many-Body Quantum Systems, Oberwolfach (invited talk, 12.09.2023)
- Microscopic derivation of Ginzburg–Landau theory and the BCS critical temperature shift in general external fields, Itinerant Quantum Math Meetings, Università degli Studi di Milano (invited talk, 05.06.2023)
- Upper bound for the grand canonical free energy of the Bose gas in the Gross-Pitaevskii limit, Calculus of Variations and Applications Seminar, Institute of Mathematics, LMU Munich (invited talk, 31.05.2023)
- The free energy of the two-dimensional dilute Bose gas, Exact Results in Quantum Theory and Gravity, University of Warsaw, Faculty of Physics (invited talk, 04.11.2022)
- Microscopic derivation of Ginzburg–Landau theory and the BCS critical temperature shift in a weak homogeneous magnetic field, Theory of Duality Seminar, University of Warsaw, Faculty of Physics (invited talk, 03.11.2022)
- Microscopic derivation of Ginzburg–Landau theory and the BCS critical temperature shift in a weak homogeneous magnetic field, Applied analysis and PDE section, DMV meeting, Berlin (contributed talk, 14.09.2022)
- The dynamics of weakly interacting trapped Bose gases at positive temperature, Mathematical analysis of complex quantum systems, Miniworkshop, DMV meeting, Berlin (contributed talk, 14.09.2022)
- The free energy of the two-dimensional dilute Bose gas, DPG meeting of the condensed matter section, Regensburg (contributed talk, 05.09.2022)
- The dynamics of weakly interacting trapped Bose gases at positive temperature, Mathematical results of many-body quantum systems, Herrsching (invited talk, 08.06.2022)
- Microscopic derivation of Ginzburg–Landau theory and the BCS critical temperature shift in a weak homogeneous magnetic field, Workshop on Semiclassical Analysis, Quantum Field Theory and Non-linear PDE, Politecnico di Milano (contributed talk, 26.05.2022)
- Dilute Bose gases at Positive Temperature, Mathematics Colloquium, University of Fribourg, (invited talk, 17.05.2022)
- The free energy of the two-dimensional dilute Bose gas, DPG Spring meeting, Heidelberg (contributed talk, 22.03.2022)
- The dynamics of weakly interacting trapped Bose gases at positive temperature, Workshop on Many-Body Quantum Mechanics, Quantum Statistical Mechanics and Open Quantum Systems, Politecnico di Milano (contributed talk, 08.03.2022)
- Semiclassical approximation and critical temperature shift for weakly interacting trapped bosons, Calculus of Variations and Applications Seminar, Institute of Mathematics, LMU Munich (invited talk, 08.12.2021)

- Microscopic derivation of Ginzburg–Landau theory and the BCS critical temperature shift in a weak homogeneous magnetic field, PDE and Mathematical Physics Seminar, Institute of Mathematics, University of Zurich (talk, 04.11.2021)
- Semiclassical approximation and critical temperature shift for weakly interacting trapped bosons, Analysis and Applied Mathematics Seminar, Institute of Mathematics, University of Toronto (invited talk, 12.03.21)
- The free energy of the two-dimensional dilute Bose gas, Calculus of Variations and Applications Seminar, Institute of Mathematics, LMU Munich (invited talk, 05.02.2020)
- The free energy of the two-dimensional dilute Bose gas, PDE and Mathematical Physics Seminar, Institute of Mathematics, University of Zurich (talk, 24.10.2019)
- Gross–Pitaevskii limit of a homogeneous Bose gas at positive temperature, Workshop on Many-Body Quantum Systems, Oberwolfach (invited talk, 11.09.2019)
- Gross–Pitaevskii limit of a homogeneous Bose gas at positive temperature, QMath 14, Aarhus University (contributed talk, 13.08.2019)
- Gross–Pitaevskii limit of a homogeneous Bose gas at positive temperature, Workshop on Mathematical Physics, Karlsruhe Institute of Technology (invited talk, 11.04.2019)
- Gross–Pitaevskii limit of a homogeneous Bose gas at positive temperature, Mathematical Physics Seminar, Institute of Science and Technology Austria (talk, 19.02.2019)
- Bose–Einstein condensation in a dilute, trapped gas at positive temperature, Journal Club of the Atom Chip Group, University of Vienna (invited talk, October 2018)
- Bose–Einstein condensation in a dilute, trapped gas at positive temperature, Mathematical Physics Seminar, University of Grenoble (invited talk, October 2018)
- Bose–Einstein condensation in a dilute, trapped gas at positive temperature, Equilibrium Statistical mechanics Session, ICMP 2018 in Montreal (contributed talk, 27.07.2018)
- Bose–Einstein condensation in a dilute, trapped gas at positive temperature, Mathematical Physics Seminar, University of Stuttgart (invited talk, 22.06.2018)
- Bose–Einstein condensation in a dilute, trapped gas at positive temperature, Mathematical Physics Seminar, University of Tübingen (invited talk, 14.05.2018)
- Bose–Einstein condensation in a dilute, trapped gas at positive temperature, Mathematical Physics Seminar, Institute of Science and Technology Austria (talk, 20.03.2018)
- Bose–Einstein condensation in a dilute, trapped gas at positive temperature, Mathematical Challenges in Quantum Mechanics, Rome, Italy (contributed talk, 20.02.2018)
- Lower bound for the BCS functional with boundary conditions at infinity, Master Class on Exotic Phases of Quantum Matter, Copenhagen, Denmark (contributed Poster, 17.05.2017)
- Lower bound for the BCS functional with boundary conditions at infinity, Spectral Days, Stuttgart, Germany (contributed Poster, 05.04.2017)

- A generalized relative entropy and a BCS functional without artificial boundary conditions, IST Austria, Austria (talk, 25.10.2016)
- Note on a family of monotone quantum relative entropies, Young Researcher Symposium prior to ICMP, Santiago de Chile, Chile (contributed talk, 24.07.2015)
- Some remarks on a family of monotone quantum relative entropies defined by Mathieu Lewin and Julien Sabin, Stuttgart–Tübingen Doktorandenseminar, Stuttgart, Germany (talk, 23.01.2015)
- The BCS functional and its connection to Ginzburg–Landau theory, Summer School on Mathematical Physics, Analysis and Stochastics, Heidelberg, Germany (contributed talk, 23.07.2014)
- The lower boundedness of the BCS functional in infinite space, Stuttgart–Tübingen Doktorandenseminar, Stuttgart, Germany (talk, 14.07.2014)
- The BCS functional and its connection to the Ginzburg–Landau functional, Stuttgart–Tübingen Doktorandenseminar, Tübingen, Germany (talk, 10.05.2013)

Language Skills

German (mother tongue), English (fluent), French (advanced knowledge)