

CHRISTIAN BRENNECKE

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PERSONAL INFORMATION Citizenship: German
Languages: German (mother-tongue), English (fluent), French (intermediate)

RESEARCH INTERESTS My research area is mathematical physics. I am particularly interested in the study of many-body systems from quantum mechanics and statistical mechanics using tools from analysis and probability.

EMPLOYMENT Oct. 2021 - present: Professor (*Bonn Junior Fellow*; five year non-tenure track W2 position), University of Bonn
July 2018 - June 2021: Benjamin Peirce Fellow, Harvard University

EDUCATION June 2018: Doctorate (Dr. sc. nat.) in mathematics, University of Zurich
Advisor: Prof. Dr. Benjamin Schlein
Sep. 2015: M.Sc. in mathematics with distinction, ETH Zurich
July 2013: B.Sc. in mathematics, Free University of Berlin
Sep. 2011: B.Sc. in physics, RWTH Aachen University

AWARDS & HONORS Aug. 2021: Invited speaker for the thematic session on many-body quantum systems and condensed matter physics, International Congress of Mathematical Physics 2021, Geneva
Aug. 2021: Certificate of Teaching Excellence, Harvard University
May 2021: Certificate of Teaching Excellence, Harvard University
Oct. 2018: Doctoral thesis awarded with distinction, University of Zurich
June 2016: Willi-Studer Prize, ETH Zurich

PUBLICATIONS & PREPRINTS [20] C. Brennecke, C. Xu, H.-T. Yau. Operator Norm Bounds on the Correlation Matrix of the SK Model at High Temperature. Preprint: [arXiv:2307.12535](https://arxiv.org/abs/2307.12535).
[19] C. Brennecke, A. Schertzer, C. Xu, H.-T. Yau. The Two Point Function of the SK Model without External Field at High Temperature. Preprint: [arXiv:2212.14476](https://arxiv.org/abs/2212.14476).
[18] A. Adhikari, C. Brennecke, C. Xu, H.-T. Yau. Spectral Gap Estimates for Mixed p-Spin Models at High Temperature. Preprint: [arXiv:2208.07844](https://arxiv.org/abs/2208.07844).
[17] C. Brennecke. Bogoliubov Theory for Ultra Dilute Bose Gases. *To appear in the proceedings of IQM22, Politecnico di Milano (2023)*.

- [16] C. Brennecke. The Low Energy Spectrum of Trapped Bosons in the Gross-Pitaevskii Regime. *J. Math. Phys.* **63**, 051101 (2022).
- [15] C. Brennecke, H.-T. Yau. The Replica Symmetric Formula for the SK Model Revisited. *J. Math. Phys.* **63**, 073302 (2022).
- [14] C. Brennecke, B. Schlein, S. Schraven. Bogoliubov Theory for Trapped Bosons in the Gross-Pitaevskii Regime. *Ann. Henri Poincaré* **23**, 1583-1658 (2022).
- [13] C. Brennecke, M. Caporaletti, B. Schlein. Excitation Spectrum for Bose Gases beyond the Gross-Pitaevskii Regime. *Rev. Math. Phys.* **34**, no. 09 (2022).
- [12] C. Brennecke, P. von Soosten. On the mean-field equations for ferromagnetic spin systems. *Lett. Math. Phys.* **111**, 108 (2021).
- [11] C. Brennecke, B. Schlein, S. Schraven. Bose-Einstein Condensation with Optimal Rate for Trapped Bosons in the Gross-Pitaevskii Regime. *Math. Phys. Anal. Geom.* **63**, 12 (2022).
- [10] A. Adhikari, C. Brennecke, P. von Soosten, H.-T. Yau. Dynamical Approach to the TAP Equations for the Sherrington-Kirkpatrick Model. *J. Stat. Phys.* **183**, 35 (2021).
- [9] A. Adhikari, C. Brennecke, B. Schlein. Bose-Einstein Condensation Beyond the Gross-Pitaevskii Regime. *Ann. Henri Poincaré* **22**, 1163-1233 (2021).
- [8] A. Adhikari, C. Brennecke. Free Energy of the Quantum Sherrington-Kirkpatrick Spin-Glass Model with Transverse Field. *J. Math. Phys.* **61**, 083302 (2020).
- [7] C. Boccato, C. Brennecke, S. Cenatiempo, B. Schlein. Optimal Rate for Bose-Einstein Condensation in the Gross-Pitaevskii Regime. *Comm. Math. Phys.* **376**, 1311-1395 (2020).
- [6] C. Boccato, C. Brennecke, S. Cenatiempo, B. Schlein. Bogoliubov Theory in the Gross-Pitaevskii Limit. *Acta Mathematica* **222**, no. 2, 219-335 (2019).
- [5] C. Brennecke, P. T. Nam, M. Napiórkowski, B. Schlein. Fluctuations of N-particle quantum dynamics around the nonlinear Schrödinger equation. *Ann. Inst. Henri Poincaré C - Anal. Non Linéaire* **36**, no. 5, 1201-1235 (2019).
- [4] C. Boccato, C. Brennecke, S. Cenatiempo, B. Schlein. The excitation spectrum of Bose gases interacting through singular potentials. *J. Eur. Math. Soc.* **22**, no. 7, 2331-2403 (2020).
- [3] C. Boccato, C. Brennecke, S. Cenatiempo, B. Schlein. Complete Bose-Einstein condensation in the Gross-Pitaevskii regime. *Comm. Math. Phys.* **359**, no. 3, 975-1026 (2018).

- [2] C. Brennecke, B. Schlein. Gross-Pitaevskii Dynamics for Bose-Einstein Condensates. *Analysis & PDE* **12**, no. 6, 1513-1596 (2019).
- [1] C. Brennecke, A. Linke, C. Merdon, J. Schöberl. Optimal and Pressure-independent L^2 Velocity Error Estimates for a Modified Crouzeix-Raviart Stokes Element with BDM Reconstructions. *J. Comp. Math.* **33**, no. 2, 191-208 (2015).

TALKS

- 04/2024 Frontiers in Analysis and Mathematical Physics, Seoul
- 11/2023 DACO Seminar, ETH Zürich
- 11/2023 Mathematical Physics Seminar, University of Tübingen
- 04/2023 Theory of Duality Seminar (colloquium of the Department of Mathematical Methods in Physics), University of Warsaw
- 03/2023 HCM Retreat, Bad Breisig
- 02/2023 Cambridge Probability Seminar, University of Cambridge
- 11/2022 A Geometric Fairytale full of Spectral Gaps and Random Fruit (mini-workshop), Mathematisches Forschungsinstitut Oberwolfach
- 03/2022 INdAM Quantum Meetings trimester program (three-lecture mini course *Bogoliubov Theory for Ultra-Dilute Bose Gases*), Politecnico di Milano
- 11/2021 Mathematical physics & probability theory seminar, Texas A&M
- 11/2021 Bonn Cologne Seminar on Mathematics and Physics, University of Bonn & University of Cologne
- 08/2021 ICMP 2021 (thematic session talk), Geneva
- 06/2021 Rhein-Main-Kolloquium Frankfurt, Goethe University Frankfurt
- 04/2021 Waterloo probability seminar, University of Waterloo
- 03/2021 Seminar in Probability Theory and Statistics, University of Basel
- 03/2021 Probability seminar, Northwestern University and University of Minnesota
- 02/2021 38th Western States Meeting in Mathematical Physics, Caltech
- 01/2021 Theory of Duality Seminar (colloquium of the Department of Mathematical Methods in Physics), University of Warsaw
- 12/2020 GAuS online seminar, ETH Zurich, IST Austria and TU Braunschweig
- 12/2020 Analysis und Zufall seminar, TU Munich
- 05/2020 Seminar in Probability Theory and Statistics, University of Basel

- 10/2019 Analysis Seminar, University of Rochester
- 07/2019 Tübingen-Zürich Meeting in Mathematical Physics, University of Tübingen
- 05/2019 121st Statistical Mechanics Conference, Rutgers University
- 01/2019 Spectral Methods in Mathematical Physics, Institut Mittag-Leffler, Stockholm (conference and seminar talk)
- 09/2018 Many-Body Quantum Mechanics workshop, CRM Montréal
- 04/2018 Calculus of variations and applications seminar, LMU Munich
- 02/2018 Mathematical Challenges in Quantum Mechanics workshop (contributed talk), Sapienza University of Rome
- 12/2017 Calculus of variations and applications seminar, LMU Munich
- 06/2017 GRK 1838 (Spectral Theory and Dynamics of Quantum Systems) seminar, University of Stuttgart (extra-curricular talk)

TEACHING EXPERIENCE

- lectures: *Topics in Many-Body Quantum Mechanics* (Bonn, fall 2021 & spring 2023), *Advanced Real Analysis* (Harvard, spring 2019 & 2021), *Introductory Real Analysis* (Harvard, spring 2021), *Probability Theory* (Harvard, spring 2020), *Measure, Integration and Banach Spaces* (Harvard, fall 2019 & 2020), *Vector Space Methods for Differential Equations* (Harvard, spring 2019 & 2020), *Dynamical and Spectral Properties of Large Many-Body Quantum Systems* (Harvard, fall 2018)
- seminars: *Introduction to Spin Glasses and the Parisi Formula* (Bonn, spring 2022), *Introduction to a Renormalization Group Method* (Bonn, fall 2022), *Topics in Mean Field Spin Glasses* (Bonn, fall 2023)

POSTDOCS

- Dr. Wilhelm Kroschinsky (Bonn, since August 2023)
- Dr. Adrien Schertzer (Bonn, starting in January 2024)

ORGANIZATION OF EVENTS

- local organizer *Hausdorff School: Recent Advances in Quantum and Statistical Mechanics*, June 26-30, 2023, University of Bonn (<https://www.hsm.uni-bonn.de/en/events/hsm-schools/recentadvances2023/>)

SERVICE
ACTIVITIES

- spring 2023-present: co-organizer Oberseminar Mathematische Physik, Bonn
- fall 2022-present: co-organizer Hausdorff Kolloquium, Bonn
- fall 2019-spring 2021: co-organizer RMT and Probability Seminar, Harvard
- spring 2020 & 2021: member of intensive advising committee, Harvard
- fall 2018: member of graduate admissions committee, Harvard
- referee work for *Advances in Mathematics*, *Analysis & PDE*, *Annals of Mathematics*, *Archive for Rational Mechanics and Analysis*, *Communications in Mathematical Physics*, *Duke Mathematical Journal*, *Electronic Communications in Probability*, *Forum of Math Sigma*, *Journal of Applied Probability*, *Journal of Mathematical Physics*, *Journal of Statistical Physics*, *Letters in Mathematical Physics*, *Probability and Mathematical Physics*

OUTREACH
ACTIVITIES

- 05/2022: public lecture *Bose-Einstein Kondensation des schwach wechselwirkenden Bose Gases* at *Dies Academicus*, University of Bonn
- 04/2022: public lecture *Kondensation von kleinsten Teilchen - die Vorhersagen von Bose-Einstein und was wir beweisen können* at *Fünfte Bonner Mathenacht aus Bonn* organized by the Hausdorff Center for Mathematics, University of Bonn