Christian Schilling

CONTACT INFORMATION

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PERSONAL INFORMATION

born October 13, 1984, Basel, Switzerland
Nationality: German

CURRENT RESEARCH INTERESTS

- One-particle reduced density matrix functional theory (1RDMFT)
- Foundation and complexity of functional theories
- Concept of correlation and entanglement in fermionic quantum systems
- Development and assessment of quantum algorithms for Quantum Chemistry and Materials Science
- Geometry of quantum states and the N-representability problem
- Numerical methods for strongly correlated electrons based on tools from Quantum Information Theory
- Density Matrix Renormalization Group (DMRG) approach

RESEARCH CAREER

Head of cross-consortium "Quantum Algorithms" within the **Munich Quantum Valley** — **since 10/2022**

Emmy-Noether research group leader at **LMU Munich** at the chair of **Uli Schollwöck** — **since 8/2019**

Senior Research Fellow at **Wolfson College Oxford** — **1/2019-12/2020**

EPSRC Postdoctoral Fellow at **University of Oxford** in the group of **Vlatko Vedral** — **12/2016-7/2019**

Postdoc at **University of Oxford**, United Kingdom in the group of **Vlatko Vedral** — **9/2015-11/2016**

Postdoc at **University of Oxford**, United Kingdom in the group of **Dieter Jaksch** — **3/2014-8/2015**

AWARDS / DISTINCTIONS

- ERC Consolidator Grant 2025 — **11/2025**
- Hellmann Prize[1] — **9/2024**
- Admittance to the Emmy-Noether programme — **8/2019-7/2025**
- Senior Research fellowship at Wolfson College Oxford awarded for seven years — **1/2019-12/2020**
- "Award for Excellence" from the University of Oxford (worth €2850) — **3/2017**
- EPSRC Postdoctoral fellowship (for three years), ranked as No 1 in Physical Sciences in UK — **12/2016-7/2019**
- Junior Research fellowship at Worcester College Oxford (150 applicants for two positions) — **10/2016-9/2018**

[1] highest award for scientists under 40 years in Austria, Germany and Switzerland, awarded once per year for outstanding achievements in Theoretical Chemistry

- Oxford Martin school sponsored an international workshop on the research field I have opened **4/2016**
- James-Martin fellowship from the Oxford Martin School **9/2015-11/2016**
- "Early Postdoc.Mobility"-fellowship from the Swiss National Science Foundation for a project on "Structural Aspects of Fermionic Quantum States" (funding for 3/2014 - 8/2015) **3/2014 - 8/2016**

Fellowships / External Grants

- ERC Consolidator Grant 2025 awarded in 11/2025, **€ 2.000.000**
- Funding from Munich Quantum Valley awarded in 10/2021, **€ 1.100.000**
- Emmy-Noether grant awarded in 5/2019, **€ 1.575.000**
- EPSRC Postdoctoral fellowship awarded in 9/2016, **€ 310.000**
- SNSF "Early Postdoc.Mobility"-fellowship awarded in 11/2013, **€ 71.000**
- Seed funding from the MCQST awarded in 06/2021, **€ 37.200**
- Funding for Munich-workshop awarded by MCQST in 06/2021, **€ 10.000**
- Funding for Lausanne-workshop awarded by CECAM in 12/2019, **€ 13.000**
- Funding for San Sebastian-workshop from DIPC, **€ 12.000**
- Funding for Lausanne-workshop awarded by CECAM in 11/2016, **€ 12.000**
- Funding for Lausanne-workshop awarded by Psi-k in 12/2016, **€ 5.000**
- Funding for Lausanne-workshop from the Max-Planck society (3/2017), **€ 10.000**
- Funding for Oxford-workshop from the Oxford Martin School (4/2016), **€ 12.000**

Education

PhD program[2] at **ETH Zurich**, Switzerland **1/2010 - 2/2014**
under supervision of **Matthias Christandl**
on the **Quantum marginal problem and its physical relevance**

Research stay at **ETH Zurich**, Switzerland **10/2009 - 12/2009**
with **Jürg Fröhlich**

Diploma thesis (external) at **ETH Zurich**, Switzerland **9/2008 - 9/2009**
under supervision of **Jürg Fröhlich**
(title: Some Fundamental Aspects of Standard Quantum Theory)

Studies of Physics at **University of Mainz**, Germany **4/2004 - 9/2009**
final mark: 1.0 (scale from 1.0 to 6.0)

Teaching Experience

Lecture (90 hours) on Quantum Information Theory **10/2023-2/2024**
LMU Munich & TU Munich

Seminar (26 hours) on Quantum Information Theory meets Quantum Many-Body Physics, LMU Munich **4-7/2023**

Lecture (90 hours) on Quantum Information Theory **10/2022-2/2023**
LMU Munich & TU Munich

Seminar (26 hours) on Quantum Information Theory meets Quantum Many-Body Physics, LMU Munich **4-7/2022**

Lecture (90 hours) on Mathematical Quantum Mechanics **10/2021-2/2022**
equally shared with Peter Müller, LMU Munich

Lecture (12 hours) on Quantum Information Theoretical Aspects in Quantum Many-Body Physics, LMU Munich **1-3/2020**

[2] At ETH Zürich the PhD is not graded

Lecture (22 hours) on Quantum Information Processing, including, e.g., the geometry of quantum states, the concept of correlation, quantum computing, University of Oxford — **1-6/2019**

Lecture (6 hours) on Quantum Information Processing, University of Oxford — **4&5/2018**

Invited lecture (8 hours) on Quantum Information Theory, UNESP Sao Paulo — **10/2017**

Lecture (6 hours) on Quantum Information Processing, including, e.g., the geometry of quantum states and the concept of correlation, University of Oxford — **4&5/2017**

Leading exercise classes in Theoretical Physics at ETH Zurich — **9/2010 - 12/2013**

SUPERVISION

- Supervision of PhD student Mike Wang on "Quantum algorithms for strongly correlated electrons" — **since 10/2025**
- Supervision of Master student Paul Graf on "Compressing quantum correlation" — **since 5/2025**
- Supervision of PhD student Ludvik Cigna on "Quantum computing excited states and its complexity" — **since 10/2024**
- Supervision of Master student Mike Wang on "Geometric aspects of functional theories" — **10/2024-9/2025**
- Supervision of Master student Unik Wadhwani on "Neural network ansatzes for electron systems in 2nd quantization" — **5/2024-8/2025**
- Supervision of PhD student Damiano Aliverti-Piuri on "Quantum computing fermionic ground states" — **since 8/2023**
- Supervision of Master student Laura Herzog on "Entanglement spectrum in quantum chemistry" — **4/2023- 3/2024**
- Supervision of Master student Martin Uttendorfer on "Functional theory for quantum phase transitions" — **4/2023- 3/2024**
- Supervision of PhD student Cheng-Lin Hong on "Variational quantum eigensolver for excited states" — **since 11/2022**
- Supervision of Master student Martina Jung on "Bogoliubov theory for hard-core bosons" — **10/2022-7/2023**
- Supervision of Master student Damiano Aliverti-Piuri on "Fermionic particle entanglement" — **8/2022-7/2023**
- Supervision of Master student Rolando Reiner on "Qubit functional theory: Foundation and description of quantum phase transitions" — **10/2021-9/2022**
- Supervision of Master student Lukas Kienesberger on "The curse of universality in functional theory" — **10/2021-7/2023**
- Supervision of PhD student Julia Liebert on — **since 4/2021**

"Quantum information theoretical approach to functional theories"

- Supervision of PhD student Lexin Ding on **10/2020-9/2024**
"Orbital Entanglement and Correlation in Many-Electron Systems"

- Supervision of Master student Julia Liebert on **3/2020-2/2021**
"Reduced density matrix functional theory for dilute Bose gases"

- Supervision of Master student Lexin Ding on the **10/2019-9/2020**
"Concept of fermionic entanglement"

- Supervision of Master student Suwanja Srikantha on **10/2018-4/2019**
"Entanglement analysis in an analytically solvable model"

- Supervision of Master student Mason Yousif on **10/2018-4/2019**
"Solving the "Hubbard-wheel": Interpolation between one and infinite dimensions"

- Supervision of Master student Macauley Davy on **10/2017-4/2018**
"Exclusion principle for hard-core bosons"

- Supervision of Master student Dylan Lewis on **10/2016-4/2017**
"Revealing ground state symmetries through the analysis of occupation numbers"

- Co-supervision of PhD student Felix Tennie on the **2/2015-12/2016**
"Influence of the Exchange Symmetry beyond the Exclusion Principle"

- Co-supervision of Daniel Ebler's Master thesis on the **9/2013 - 1/2014**
"N-representability problem for the Borland-Dennis setting"

- Co-supervision of Master student Daniel Ebler in a four months project on "Pinning in 4-Harmonium" **2/2013 - 5/2013**

In addition, I was serving as formal supervisor at LMU Munich and examiner for PhD student Christoph Sünderhauf, Master students Nikolaos Mitrakos, Duc Viet Hoang and Bachelor students Mika Schielein, Simon Eisenmann, Kadir Burak Karli and Kshiti Sneh Rai

TALKS

in total **147 talks** at conferences, workshops and seminars, among those **22 invited talks** at international conferences and **5** invited lecture, e.g.,

- **Quantum Computing for Quantum Chemistry**
2025 Arnold Sommerfeld School on "Quantum Computing – Status and Prospects", LMU Munich 10/2025

- **A quantum information-inspired approach to the electron correlation problem**
"The Theory Meeting for Theoreticians",
63rd Sanibel Symposium, Florida 2/2024

- **A unifying perspective on fermionic correlation and the ground state problem**
"Tensor product methods for strongly correlated molecular systems",
Max Planck Institute for the Physics of Complex Systems 3/2021

- **The Electron Correlation Problem from a Quantum Information Perspective**
"Munich Conference on Quantum Science and Technology 2020",
Munich Center for Quatum Science and Technology (MCQST) 7/2020

- **Introduction into fermionic correlation and applications in quantum chemistry**
"Entanglement Days", Budapest University of Technology and Economics 9/2018

- **Introduction to generalized Pauli constraints and their applications**
"50 Symposium on Mathematical Physics", University of Torun 6/2018

- **Lecture on Quantum Information Theory**
"School on Density Functional Theory and Quantum Information Theory", ICTP-SAIFR/IFT-UNESP Sao Paulo 11/2017

- **Fermionic Exchange Symmetry: Quantifying its Influence beyond Pauli's Exclusion Principle**
"Quantum Science Symposium (QSS) Europe", University of Cambridge 11/2016

- **One-fermion picture for Moshinsky-type atoms and significance of generalized Pauli constraints**
"Computational Mathematical Methods in Science and Engineering", Cadiz 6/2016

- **Pinning of Fermionic Occupation Numbers**
"Quantum Marginals", University of Cambridge 10/2013

- **Quantum Marginal Problem and its Physical Relevance**
International conference on "Mathematical Results in Quantum Mechanics", Berlin (QMath12) 9/2013

- **Decoherence and Indeterminism in Standard Quantum Theory**
conference on "Quantum Computation", Tokyo University 4/2010

ORGANISATION OF EVENTS

- Organisation of the 4-day international workshop **"Reduced Density Matrix Theory and the N-representability Problem"** together with David Mazziotti and Mario Piris in San Sebastian in June 2022

- Organisation of the 4-day **International Symposium on Correlated Electrons (SymCorrel21)"** together with David Mazziotti, online in October 2021

- Organisation of the 4-day international workshop **"New challenges in Reduced Density Matrix Functional Theory: Symmetries, time-evolution and entanglement"** together with Carlos Benavides-Riveros, Eberhard Gross, Miguel Marques in Lausanne in September 2017 and in Trento in October 2022

- Organisation of the workshop **"Generalized Pauli Constraints and Fermion Correlation"** together with Alex Gottlieb in Vienna in August 2016

- Organisation of a 4-day international workshop in Oxford in April 2016 on **"Reduced Density Matrices in Quantum Physics and Role of Fermionic Exchange Symmetry"** with Vlatko Vedral; 18 invited speakers, among others: D.Haldane, J.M.Leinaas, J.Myrheim, D.Mazziotti and U.Schollwöck

- Organisation of the 1-day student workshop **"Pauli2016 WarmUp"** in April 2016 as preparation for our international workshop

FURTHER ACTIVITIES/ MEMBERSHIPS

- refereeing for various journals in Physics and Chemistry
- lifetime membership in Swiss Physical Society
- member of steering committee of the International Max-Planck Research School

(IMPRS-QST) on quantum science and technology
- several training courses attended by the "Munich Center for Quantum Science and Technologies" on leadership, conflict management & modern teaching
- organisation of online series on Quantum Information Theory (since June 2020)
- 1-year education (during school time) and practical experience as a mediator
- organisation of the Jaksch/Mekhov group seminar for about two years

LANGUAGES German (mother tongue), English (advanced), French (basic knowledge)

COMPUTER SKILLS Python, Mathematica, Open Office, Latex, usage of computing clusters