



Thomas Schäfer

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Heisenbergstraße 1, DE-70569, Stuttgart, Germany

● RESEARCH INTERESTS

Strongly correlated electron systems

- Physics of the Hubbard model
- Mott-Hubbard metal-insulator transition
- low-dimensional systems

Frustrated magnetic systems

- geometric frustration
- metal-insulator transitions

Quantum criticality

- quantum and classical critical phenomena
- quantum magnetism
- electronic Kohn anomalies

High-temperature superconductivity

- pseudogap physics
- unconventional pairing mechanisms

Quantum many-body techniques

- dynamical mean field theory (DMFT)
- cluster (CDMFT, DCA) and diagrammatic (DGA, TRILEX) extensions of DMFT
- many-particle Green functions and Luttinger-Ward formalism in the non-perturbative regime
- fluctuation diagnostics and parquet decomposition

● WORK EXPERIENCE

01/09/2020 – CURRENT

RESEARCH GROUP LEADER "THEORY OF STRONGLY CORRELATED QUANTUM MATTER" (SCQM)

Max-Planck Institute for Solid State Research, Stuttgart (Germany)

appointed by the president of the Max-Planck society after decision of the MPI-FKF directors and an independent W2 commission

01/03/2019 – 31/08/2020

ERWIN-SCHRÖDINGER FELLOW – "SUMO - SUPERCONDUCTIVITY IN THE VICINITY OF MOTT INSULATORS"

FWF project J-4266, hosted by Prof. Antoine Georges (École Polytechnique and Collège de France, Paris, France with regular visits to the Center for Computational Quantum Physics, Flatiron Institute, New York, USA), principal investigator with a budget of 160,000 euros

01/09/2017 – 28/02/2019

POSTDOCTORAL RESEARCHER – ÉCOLE POLYTECHNIQUE AND COLLÈGE DE FRANCE

funded by the ERC Synergy Grant Q-MAC (Prof. Antoine Georges), supervisors Prof. Antoine Georges and Prof. Olivier Parcollet

Paris, France

01/10/2016 – 31/07/2017

POSTDOCTORAL RESEARCHER – TU WIEN

FWF project "Collective phenomena in oxide films and hetero-structures" (F4115-N28), project leader Prof. Alessandro Toschi

01/02/2013 – 30/09/2016

PROJECT ASSISTANT (PHD POSITION) – TU WIEN

FWF doctoral school "Building Solids for Function" (W1243)

FWF project "Quantum criticality in strongly correlated magnets" (I610-N16), project leader Prof. Alessandro Toschi

01/01/2013 – 30/06/2016

FREELANCER – SYSTEMIC-AGILE-PROJECT (S-A-P)

webpage creation and administration, setup of content management system

Kottingbrunn, Austria

01/10/2009 – 31/01/2013

UNIVERSITY TUTOR – TU WIEN

Fundamental Principles of Physics I-III, Analysis for Physicists I, Quantum theory I, Statistical Physics I, Electrodynamics I, Quantum theory II

01/09/2011 – 30/11/2012

STUDENT RESEARCH ASSISTANT – TU WIEN

FWF-funded master thesis

13/06/2011 – 05/08/2011

CERN SUMMER STUDENT (CMS COLLABORATION) – EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

project thesis: "Statistical tests of CMS L1T Occupancy Plots for DQM"

23 Genève, 1211, Genève, Switzerland

01/10/2006 – 30/06/2007

CIVIL SERVICE (LEGAL OFFICE) – JUSTIZANSTALT STEIN

Krems/Stein, Austria

01/07/2005 – 31/07/2005

INTERNSHIP (INFRASTRUCTURE AND RESSOURCE MANAGEMENT) – IBM AUSTRIA

Vienna, Austria

● EDUCATION AND TRAINING

01/02/2013 – 28/09/2016 – 13, Karlsplatz, Vienna, Austria

PHD STUDIES (COMPLETED WITH HIGHEST HONORS "SUB AUSPICIIS PRAESIDENTIS REI PUBLICAE") – TU Wien

Doctor rerum naturalium under the supervision of Prof. Karsten Held and Prof. Alessandro Toschi

"Promotio sub auspiciis Praesidentis rei publicae" on the 05/12/2017 (highest achievable honor for university and school studies, promotion by the federal president of Austria), every final grade in high school and university studies was the highest possible ("sehr gut")

Thesis "Classical and quantum phase transitions in strongly correlated electron systems" graded with the highest possible degree ("sehr gut") by Prof. Karsten Held (TU Wien) and Prof. Walter Metzner (Max-Planck Institute Stuttgart) funded by FWF (Austrian Science Fund) Doctoral School "Building Solids for Function", <http://solids4fun.tuwien.ac.at>

ISCED 8

01/10/2010 – 16/12/2012

MASTER STUDIES (MASTER OF SCIENCE AWARDED WITH DISTINCTION) – TU Wien, Technical Physics

Thesis: "Electronic correlations at the Two-Particle Level" awarded with the Award for an outstanding and excellent thesis of the City of Vienna (2013)

Diploma student funded by the FWF project "Quantum criticality in strongly correlated magnets (QMC)" (I 610-N16) under the supervision of Prof. Alessandro Toschi and Dr. Georg Rohringer

ISCED 7

01/10/2007 – 30/09/2010

BACHELOR STUDIES (BACHELOR OF SCIENCE AWARDED WITH DISTINCTION) – TU Wien, Technical Physics

Thesis "Numerical Simulation of μ SR for specific Kondo-systems"

ISCED 6

01/09/2001 – 30/06/2006 – 3 Waldstraße, St. Pölten, Austria

SCHOOL LEAVING EXAMINATIONS (REIFE- UND DIPLOMPRÜFUNG, AWARDED WITH DISTINCTION) – HTBLuVA St. Pölten (Higher Technical College for Informatics)

ISCED 5

01/09/1997 – 30/06/2001 – 2, Piaristengasse, Krems/Donau, Austria

GRAMMAR SCHOOL – Piaristengymnasium Krems

ISCED 2

01/09/1993 – 30/06/1997 – 12, Auböckallee, Langenlois, Austria

ELEMENTARY SCHOOL – Josef Rucker Volksschule

ISCED 1

● CITATION METRICS

Citation metrics (by 26/02/2021)

Citations (Google Scholar): 723

h-index: 13

Citations (Web of Science): 478

h-index: 12

Google Scholar: <https://scholar.google.com/citations?user=aJBvSKAAAAAJ&hl=de>

ORCID: <https://orcid.org/0000-0002-1105-5619>

● PEER-REVIEWED JOURNAL PUBLICATIONS

Anisotropy of electronic correlations: On the applicability of local theories to layered materials

B. Klebel, T. Schäfer, A. Toschi, and J. M. Tomczak
Phys. Rev. B **103**, 045121 (2021), <https://doi.org/10.1103/PhysRevB.103.045121>

Real-space cluster dynamical mean-field theory: Center focused extrapolation

M. Klett, N. Wentzell, T. Schäfer, F. Simkovic IV, O. Parcollet, S. Andergassen, and P. Hansmann
Phys. Rev. Research **2**, 033476 (2020), <https://doi.org/10.1103/PhysRevResearch.2.033476>

Quantum Criticality in the Two-Dimensional Periodic Anderson Model

T. Schäfer, A. A. Katanin, M. Kitatani, A. Toschi, K. Held
Phys. Rev. Lett. **122**, 227201 (2019), <https://doi.org/10.1103/PhysRevLett.122.227201>

Why T_c is so low in high- T_c cuprates: importance of the dynamical vertex structure

M. Kitatani, T. Schäfer, H. Aoki, K. Held
Phys. Rev. B **99**, 041115(R) (2019), <https://doi.org/10.1103/PhysRevB.99.041115>

Divergences of the irreducible vertex functions in correlated metallic systems: insight from AIM

P. Chalupa, P. Gunacker, T. Schäfer, K. Held, and A. Toschi
Phys. Rev. B **97**, 245136 (2018), <https://doi.org/10.1103/PhysRevB.97.245136>

Complementary views on electron spectra: From Fluctuation Diagnostics to real space correlations

O. Gunnarsson, J. Merino, T. Schäfer, G. Sangiovanni, G. Rohringer, and A. Toschi
Phys. Rev. B **97**, 125134 (2018), <https://doi.org/10.1103/PhysRevB.97.125134>

Breakdown of traditional many-body theories for correlated electrons

O. Gunnarsson, G. Rohringer, T. Schäfer, G. Sangiovanni, and A. Toschi
Phys. Rev. Lett. **119**, 056402 (2017), <https://doi.org/10.1103/PhysRevLett.119.056402>

Interplay of correlations and Kohn anomalies in three dimensions: quantum criticality with a twist

T. Schäfer, A. A. Katanin, K. Held, and A. Toschi
Phys. Rev. Lett. **119**, 046402 (2017), <https://doi.org/10.1103/PhysRevLett.119.046402>

Non-perturbative landscape of the Mott-Hubbard transition: Multiple divergence lines around the MIT

T. Schäfer, S. Ciuchi, M. Wallerberger, P. Thunström, O. Gunnarsson, G. Sangiovanni, G. Rohringer, and A. Toschi
Phys. Rev. B **94**, 235108 (2016), <https://doi.org/10.1103/PhysRevB.94.235108>

Parquet decomposition calculations of the electronic self-energy

O. Gunnarsson, T. Schäfer, J. P. F. LeBlanc, J. Merino, G. Sangiovanni, G. Rohringer, and A. Toschi
Phys. Rev. B **93**, 245102 (2016) featured as Editor's Suggestion <http://dx.doi.org/10.1103/PhysRevB.93.245102>

Fluctuation Diagnostics of the Electron Self-Energy: Origin of the Pseudogap Physics

O. Gunnarsson, T. Schäfer, J. LeBlanc, E. Gull, J. Merino, G. Sangiovanni, G. Rohringer, and A. Toschi
Phys. Rev. Lett. **114**, 236402 (2015), <http://dx.doi.org/10.1103/PhysRevLett.114.236402>

Separability of dynamical and nonlocal correlations in three dimensions

T. Schäfer, A. Toschi, and Jan M. Tomczak
Phys. Rev. B **91**, 121107(R) (2015), <http://dx.doi.org/10.1103/PhysRevB.91.121107>

Fate of the false Mott-Hubbard transition in two dimensions

T. Schäfer, F. Geles, D. Rost, G. Rohringer, E. Arrigoni, K. Held, N. Blümer, M. Aichhorn, and A. Toschi
Phys. Rev. B. **91**, 125109 (2015), <http://dx.doi.org/10.1103/PhysRevB.91.125109>

Dynamical vertex approximation in its parquet implementation: Application to Hubbard nanorings

A. Valli, T. Schäfer, P. Thunström, G. Rohringer, S. Andergassen, G. Sangiovanni, K. Held, and A. Toschi
Phys. Rev. B **91**, 115115 (2015), <http://dx.doi.org/10.1103/PhysRevB.91.115115>

Divergent Precursors of the Mott-Hubbard Transition at the Two-Particle Level

T. Schäfer, G. Rohringer, O. Gunnarsson, S. Ciuchi, G. Sangiovanni, and A. Toschi
Phys. Rev. Lett. **110**, 246405 (2013), <http://dx.doi.org/10.1103/PhysRevLett.110.246405>

● CONFERENCE PROCEEDINGS

Fluctuation Diagnostics of Electronic Spectra

O. Gunnarsson, T. Schäfer, J. LeBlanc, E. Gull, J. Merino, G. Sangiovanni, G. Rohringer, and A. Toschi
Proceedings of the Vienna Young Scientists Symposium, 9.-10.06.2016
ISBN 978-3-9504017-2-1

Dynamical vertex approximation for the two-dimensional Hubbard model

T. Schäfer, A. Toschi, and K. Held
J. Magn. Magn. Mater. **400**, 107-111 (2015), <http://dx.doi.org/10.1016/j.jmmm.2015.07.103>

Development of the digital storage Fuon

H. Ostad-Ahmad-Ghorabi, T. Schäfer, A. Spielauer, G. Aschinger, and D. Collado-Ruiz
Proceedings of the 19th International Conference on Engineering Design (ICED13), Design for Harmonies, Vol.2: Design Theory and Research Methodology, Seoul, Korea, 19-22.08.2013, ISBN 978-1-904670-45-2

● PREPRINTS

How to read between the lines of electronic spectra: the diagnostics of fluctuations in strongly correlated electron systems

Thomas Schäfer and Alessandro Toschi
<https://arxiv.org/abs/2012.03604> (accepted in Journal of Physics: Condensed Matter)

Fingerprints of the local moment formation and its Kondo screening

in the generalized susceptibility
P. Chalupa, T. Schäfer, M. Reitner, D. Springer, S. Andergassen, and A. Toschi
<https://arxiv.org/abs/2003.07829> (accepted in Physical Review Letters)

Tracking the Footprints of Spin Fluctuations:

A Multi-Method, Multi-Messenger Study of the Two-Dimensional Hubbard Model

Thomas Schäfer, Nils Wentzell, Fedor Šimkovic IV, Yuan-Yao He, Cornelia Hille, Marcel Klett, Christian J. Eckhardt, Behnam Arzhang, Viktor Harkov, François-Marie Le Régent, Alfred Kirsch, Yan Wang, Aaram J. Kim, Evgeny Kozik, Evgeny A. Stepanov, Anna Kauch, Sabine Andergassen, Philipp Hansmann, Daniel Rohe, Yuri M. Vilks, James P. F. LeBlanc, Shiwei Zhang, A.-M. S. Tremblay, Michel Ferrero, Olivier Parcollet, and Antoine Georges

<https://arxiv.org/abs/2006.10769> (accepted in Physical Review X)

Mott insulating states with competing orders in the triangular lattice Hubbard model

Alexander Wietek, Riccardo Rossi, Fedor Šimkovic IV, Marcel Klett, Philipp Hansmann, Michel Ferrero, E. Miles Stoudenmire, Thomas Schäfer, and Antoine Georges

<https://arxiv.org/abs/2102.12904>

● CURRENT AND FORMER COLLABORATION PARTNERS AND REFERENCE CONTACTS

Reference Contacts

- Prof. Antoine Georges (host Erwin-Schrödinger Fellowship, postdoctoral supervisor; Director CCQ, Flatiron institute, Collège de France and École Polytechnique), ageorges@flatironinstitute.org
- Prof. Karsten Held (Doktorvater; TU Wien), held@ifp.tuwien.ac.at
- Prof. Alessandro Toschi (supervisor Master thesis, co-supervisor PhD thesis; TU Wien), toschi@ifp.tuwien.ac.at
- Prof. Philipp Hansmann (research partner; Friedrich-Alexander-Universität Erlangen-Nürnberg), philipp.hansmann@fau.de
- Prof. Giorgio Sangiovanni (research partner; University of Würzburg), sangiovanni@physik.uni-wuerzburg.de

Additional current and former collaboration partners

- Prof. Sabine Andergassen (research partner; University of Tübingen), sabine.andergassen@uni-tuebingen.de
- Prof. Michel Ferrero (research partner; École Polytechnique), michel.ferrero@polytechnique.edu
- Prof. Markus Aichhorn (research partner; TU Graz), aichhorn@tugraz.at
- Prof. Olivier Parcollet (research partner; CCQ, Flatiron institute), oparcollet@flatironinstitute.org

● TEACHING

Teaching

Exercises on "Advanced Quantum Physics", Bachelor Programme, École Polytechnique (2019)
Supervisor for Projet de Recherche en Laboratoire (PRL), École Polytechnique (2018-2019)
Lecturer substitute for "Advanced Theory of Superconductivity and Magnetism", TU Wien (2016)
Organizer of the "Condensed Matter Theory Journal Club", Institute of Solids State Physics, TU Wien (2016)
Organizer and teaching assistant for the lectures "Quantum Theory I" (2013), "Quantum Theory II" (2014) and "Quantum Field Theory for Many-Body Systems" (2015) at TU Wien

● SCIENTIFIC SUPERVISION

Scientific Supervision

Marcel Klett

Postdoc, SCQM, MPI-FKF, Stuttgart 2020-ongoing

Michael Meixner: Dichotomy of electron- and hole-doped cuprates

Co-supervision together with Prof. Sabine Andergassen (EKUT Tübingen)

Master Thesis, SCQM, MPI-FKF, Stuttgart 2020-ongoing

Elie Bermot: "Fermionic Hubbard model with diagrammatic Monte Carlo"

Co-supervision together with Prof. Michel Ferrero and Dr. Fedor Simkovic

Project Thesis, CPHT, École Polytechnique, Palaiseau, 2019-2020

Han-Yu Sit: "Strongly correlated magnetism in high-temperature superconductors"

Co-supervision together with Prof. Michel Ferrero

Project Thesis, CPHT, École Polytechnique, Palaiseau, 2019-2020

Alfred Kirsch: "Properties of two- and three dimensional strongly correlated models"

Co-supervision together with Prof. Michel Ferrero and Dr. Fedor Simkovic

Master II Thesis, CPHT, École Polytechnique, Palaiseau, 2019

François-Marie Le Régent: "Random phase approximation for the two-dimensional Hubbard model"

Co-supervision together with Prof. Michel Ferrero

Project Thesis, CPHT, École Polytechnique, Palaiseau, 2018-2019

Alexander Vock: "Numerical methods in quantum criticality"

Co-supervision together with Prof. Alessandro Toschi

Master Thesis, Inst. of Solid State Physics, TU Wien, 2018-2019

Marie-Therese Philipp: "Influence of electronic correlations on the temperature behavior of scattering rates for cuprates"

Co-supervision together with Prof. Alessandro Toschi

Master Thesis, Inst. of Solid State Physics, TU Wien, 2016

Benjamin Klebel: "Space-time separability of the electronic self-energy: the crossover from three to two dimensions"

Co-supervision together with Prof. Alessandro Toschi

Project work, Inst. of Solid State Physics, TU Wien, 2016

Clemens Watzenböck: "Multidimensional density of states for many-electron calculations"

Co-supervision together with Prof. Alessandro Toschi

Bachelor Thesis, Inst. of Solid State Physics, TU Wien, March - July 2015

● INVITED TALKS

Invited Talks

"Taking locality to the next level: vertex-based extensions of DMFT and their application"

26 January 2021

Stuttgarter Physikalisches Kolloquium, Stuttgart, Germany

"Theory of Strongly Correlated Quantum Matter: our roots, our stems and our potential harvest"

27 November 2020

Directors' Board Meeting, MPI-FKF, Stuttgart, Germany

"Taking locality to the next level: vertex-based extensions of DMFT and their application"

23 April 2020

Seminar at LPS Orsay, France

"Magnetism meets strong correlations: classical and quantum criticality in two and three dimensions"

26 September 2019

Symposium "Theory of Novel Materials", MPI-FKF, Stuttgart, Germany

"Magnetism meets strong correlations: classical and quantum criticality in two and three dimensions"

24 September 2019

Seminar at Institute for Theoretical Physics, host Prof. Sabine Andergassen, Universität Tübingen, Germany

"Magnetism meets strong correlations: classical and quantum criticality in two and three dimensions"

30 July 2019

Quantum Embedding Theory Seminar at CCQ (Flatiron Institute), New York, USA

"Surely, you're joking, Mr. Feynman?! The breakdown of traditional diagrammatic perturbation theory"

29 August 2018

Lectiones Clitumnaliæ, Campello sul Clitunno, Umbria, Italy

"Surely, you're joking, Mr. Feynman?! The breakdown of traditional diagrammatic perturbation theory"

12 March 2018

Spring Meeting of the Condensed Matter Division of the German Physical Society (DPG), Berlin, Germany

"The physics underlying electronic spectra: from parquet decomposition to fluctuation diagnostics"

09 January 2017

Collège de France (Antoine Georges), Paris, France

"Irreducible Vertex Divergences: Non-Perturbative Landscape of the Mott-Hubbard transition"

14 June 2016

Workshop on multiple solutions in condensed matter theories, Paris, France

"The Mott-Hubbard transition in (in)finite dimensions - divergent precursors and a sad fate"

26 November 2015

Invited Seminar Talk in the seminar "Quantum many-body phenomena in the solid state", University of Würzburg, Germany

19 contributed talks at (international) conferences and workshops, 10 contributed posters

● THIRD-PARTY FUNDING

2021

Workshop "Correlations in Novel Quantum Materials"

organised together with Elio König, funded by ICAM

<https://www.fkf.mpg.de/cnqm2021>

budget 22,000 USD

01/03/2019 – 31/08/2020

Erwin-Schrödinger Fellowship

funded by the Austrian Science Fund

Principal Investigator of the FWF project J-4266 "SuMo - Superconductivity in the vicinity of Mott insulators"

budget 160,000 EUR

funded by the Austrian Federal Ministry of Education, Science and Research

Principal Investigator of a project on "Quantum criticality in the two-dimensional periodic Anderson model"
budget 9,000 EUR

● **HONORS AND AWARDS**

Honors and awards

Erwin-Schrödinger Fellow funded by the Austrian Science Fund FWF "SuMo - Superconductivity in the vicinity of Mott insulators" (J 4266-N37), budget 160,000 Euros
Awardee of the Scholarship of Excellence of the Federal Ministry of Education, Science and Research 2018, budget 9,000 Euros
Finalist of the Dissertation-Prize Symposium of the Condensed Matter Division of the German Physical Society (DPG)
Admission to "Promotio sub auspiciis Praesidentis rei publicae" (highest achievable honor for university and school studies, promotion by the federal president of Austria) 2016/2017
Award for an outstanding and excellent diploma thesis of the City of Vienna 2013
Awardee of the "Siegfried Ludwig Stiftung" scholarship 2010, 2011 and 2013
Awardee of the "Windhag" student scholarship 2007, 2008, 2009, 2011 and 2012 by the government of Lower Austria
Awardee of the student scholarships of the Faculty for Physics of the TU Wien, for excellent achievement (2008 and 2009)
Awardee of the Stiftungsstipendium of the TU Wien (2010 and 2012)
Social Award HTBLuVA St. Pölten 2005
"Best of the Year"-Award of HTBLuVA St. Pölten 2004, 2005, 2006
Golden Ring of Honour of HTBLuVA St. Pölten 2006

● **ORGANISATIONAL SKILLS**

Organisational skills

Organizer of the Workshop "Correlations in Novel Quantum Materials" at the MPI-FKF together with Elio König (2021)
Organizer of the joint "Seminar on Condensed Matter Physics", MPI-FKF and EKUT Tübingen (2020 and ongoing)
Organizer of the "Condensed Matter Theory Seminar", Collège de France (2019-2020)
Organizer of the "Condensed Matter Theory Journal Club", Institute of Solids State Physics (2016)
Organizer assistant of ICAME (International Conference on the Applications of the Mössbauer Effect), Vienna University of Technology 2009
Class representative 2001 – 2006
School Department representative EDVO 2004/2005
Project manager "Siemens Storage Management System" (school project)

● **OTHER INTERNATIONAL AND SCIENTIFIC ACTIVITIES**

International and Scientific Activities

Referee for Physical Review (APS), Europhysics Letters (EPL) and Physica Status Solidi (pss)
Regular stays at the Center for Computational Quantum Physics, Flatiron Institute, New York, USA: February 2020, February 2019, October 2018, February 2018
Young Scientist Attendee of the 65th Interdisciplinary Lindau Nobel Laureate Meeting (after multi-level international selection process), June/July 2015
Attendee of the official CERN summer student programme, Genève 2011
International summer academy for gifted pupils, Semmering 2004
Delegate to the European Youth Parliament, Berlin 2004

● LANGUAGE SKILLS

Mother tongue(s): GERMAN

Other language(s):

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken production	Spoken interaction	
ENGLISH	C1	C1	C1	C1	C1
FRENCH	A2	A2	A2	A2	A2

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user

● DRIVING LICENCE

Driving Licence: B

● OTHER SKILLS

Other skills

Scuba Diving License
Competitive Ballroom Dancing
Delegate to the European Youth Parliament, Berlin November 2004
International summer academy for gifted pupils, Semmering 2004
Course "Applied Mathematics - Cryptography", Seitenstetten 2006

● NETWORKS AND MEMBERSHIPS

Memberships

Member of the American Physical Society (APS)
Member of the German Physical Society (DPG)
Member of the Deutsche Hochschulverband