
CURRICULUM VITAE

Prof. Dr. Walter Metzner
Born July 21, 1961
Married, one daughter
Citizenship: German

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Research areas

Correlated electrons in solids, magnetism and superconductivity, quantum phase transitions and quantum criticality, quantum many-particle theory, quantum field theoretical methods in condensed matter physics.

Education and Professional Career

1980	Abitur (high school degree)
1980/1981	Military service
1981 – 1987	Studies of Physics and Mathematics at the Technical University München
July 1987	Graduation in Physics (Dipl.-Phys.), TU München
1987 – 1990	Research Associate at the Technical University Aachen
December 1989	Doctoral Degree (Dr. rer. nat.), <i>summa cum laude</i> (highest distinction), supervisor Professor D. Vollhardt, Technical University Aachen
1990 – 1993	Postdoc in the group of Professor C. Di Castro at the University ‘La Sapienza’ in Rome
1993/1994	Postdoc in the Condensed Matter Theory Group at Princeton University, host Professor F. D. M. Haldane
1994 – 1996	Research Associate at Technical University Aachen
July 1995	Habilitation in Theoretical Physics, Technical University Aachen
1996 – 1998	Associate Professor for Theoretical Solid State Physics at the University Munich
1998 – 2001	Full Professor for Theoretical Physics at the Technical University Aachen
since 2001	Director at the Max Planck Institute for Solid State Research in Stuttgart

Scientific Awards and Honours

1988/1989	Fellowship of the German National Scholarship Foundation
1990	Borchers Medal and Friedrich-Wilhelm-Prize (Technical University Aachen)
1991	Physics-Prize (Academy of Sciences Göttingen)
1995	Gustav-Hertz-Prize (German Physical Society) <i>for outstanding contributions to the theory of correlated electron systems</i>
2002	Honorary Professor for Physics, University of Stuttgart
2006	Europhysics Prize (European Physical Society) <i>for the development and application of the dynamical mean-field theory</i> (jointly with A. Georges, G. Kotliar, and D. Vollhardt)
2016	Outstanding Referee Award (American Physical Society)

Publications

About 115 publications in scientific journals, three long review articles (Advances in Physics, Reviews of Modern Physics, Physics Reports), about 90 papers as first or last/corresponding author. 6300 citations, 65 citations per paper, h-index 40, one article with more than 2000 citations, 14 articles with more than 100 citations (*Web of Science*, April 2024).

Invited talks and organization of conferences

About 100 invited talks at international conferences, workshops and schools. Organized and coorganized more than 10 international conferences, workshops and schools, in particular the conferences “Fermions 2009” (Obergurgl), “Fermions 2015” (Heidelberg), and the 11th Conference on the “Exact Renormalization Group” (Berlin, 2022).

Advisory service and professional activities (excerpt)

since 1990	Referee of scientific journals (PRL, PRB, RMP etc.)
since 1996	Referee of grant applications for DFG, Humboldt Foundation, Schweizer Nationalfond, European Science Foundation, etc.
2003 – 2006	Member of Schottky Prize Committee (German Physical Society)
since 2006	Member of the Advisory Board of the Conference Series on the Exact Renormalization Group
2005 – 2006	Deputy Managing Director of MPI for Solid State Research
2007 – 2008	Managing Director of MPI for Solid State Research
2008 – 2013	Member of Minerva-Weizmann Committee
2015 – 2016	Deputy Managing Director of MPI for Solid State Research
2017 – 2018	Managing Director of MPI for Solid State Research
since 2018	Member of the Scientific Committee of the Max Planck Society

Thesis and postdoctoral advises

Supervised about 20 PhD students and 10 postdocs, in particular: Sabine Andergassen (now Associate Professor at TU Vienna), Luca Dell’Anna (now Associate Professor in Padova), Pietro Bonetti (presently postdoc at Harvard University), Tilman Enss (now permanent scientist and Privatdozent in Heidelberg), Tobias Holder (now Assistant Professor at Tel Aviv University), Carsten Honerkamp (now Professor at RWTH Aachen), Pawel Jakubczyk (now Associate Professor at University Warsaw), Andrey Katanin (now Professor at Moskow Institute of Physics and Technology), Uli Schollwöck (now Professor at LMU Munich), So Takei (now Associate Professor at City University of New York), Hiroyuki Yamase (now Senior Scientist at NIMS, Tsukuba).

Scientific achievements

Variational wave functions for correlated fermions:

Analysis of an important class of variational wave functions for interacting Fermi systems, in particular first exact analytic evaluation of expectation values for the Gutzwiller wave function (proposed already in 1963) in one dimension (Metzner & Vollhardt, Phys. Rev. Lett. **59**, 121 (1987); Phys. Rev. B **37**, 7382 (1988)). The results triggered the famous work of Haldane and Shastry on Heisenberg chains with long-range interactions, where the Gutzwiller wave function turned out to yield the exact ground state.

Limit of infinite dimensionality and dynamical mean-field theory:

Discovery of the non-triviality and relevance of the limit of high dimensionality for the theory of strongly interacting lattice fermions; elucidation of the essential simplifying feature in the large d limit, namely the locality of irreducible quantities such as the self-energy (Metzner & Vollhardt, Phys. Rev. Lett. **62**, 324 (1989); Metzner, Z. Phys. B **77**, 253 (1989); Metzner, Phys. Rev. B **43**, 8549 (1991)). The large d limit and its locality have been the guideline for the formulation of the dynamical mean-field theory (and its numerous extensions), which has been a game changer in the field of strongly correlated Fermi systems, including electronic systems and cold atoms.

Luttinger liquids and Ward identities:

Clarification of the renormalization group structure and the role of conservation laws in Luttinger liquids (Di Castro & Metzner, Phys. Rev. Lett. **67**, 3852 (1991); Metzner & Di Castro, Phys. Rev. B **47**, 16107 (1993)). Discovery and application of asymptotic Ward identities for Fermi systems with singular forward scattering in dimensions $d > 1$, in particular non-perturbative derivation of crossover from Luttinger to Fermi liquids as a function of dimensionality (Castellani, Di Castro, Metzner, Phys. Rev. Lett. **72**, 316 (1994); Metzner, Castellani, Di Castro, Adv. Phys. **47**, 317 (1998)).

Functional renormalization group (fRG) for Fermi systems:

Derivation of novel approximation schemes for interacting Fermi systems from an exact renormalization group equation for the exact quantum effective action (Metzner et al., Rev. Mod. Phys. **84**, 299 (2012)). Numerous applications to one and two dimensional systems, in particular conclusive evidence for d -wave pairing driven by antiferromagnetic fluctuations in the two-dimensional Hubbard model at weak and strong coupling (Halboth & Metzner, Phys. Rev. B **61**, 7364 (2000); Vilaridi, Taranto, Metzner, Phys. Rev. B **99**, 104501 (2019)). The fermionic fRG has become a widely used method in the theory of strongly correlated electrons.

Electronic nematicity and quantum criticality:

Theory of electronic nematicity as a Fermi liquid (Pomeranchuk) instability (Halboth & Metzner, Phys. Rev. Lett. **85**, 5162 (2000); Yamase, Oganessian, Metzner, Phys. Rev. B **72**, 035114 (2005)). Discovery of Ising nematic quantum critical point in two-dimensional metals and first theory of its non-Fermi liquid properties (Metzner, Andergassen, Rohe, Phys. Rev. Lett. **91**, 066402 (2003); Dell'Anna & Metzner, Phys. Rev. B **73**, 045127 (2006); Jakubczyk, Metzner, Yamase, Phys. Rev. Lett. **103**, 220602 (2009)); discovery of unexpected anomalous dynamical scaling at four-loop level (Holder & Metzner, Phys. Rev. B **92**, 041112(R) (2015)).