

Personal information

Surname(s) / First name(s)

Email(s)

Researcher-ID: **B-3879-2010**

Nationality(-ies)

Date of birth

Gender

J.-Prof. Dr. Rizzi, Matteo

matteo.rizzi@uni-mainz.de

<http://www.rizzi-matteo.com>

Italian

June 18, 1980 - Novara, Italy

Male



Current position

Group & Institution

Further Affiliations

Junior Professor (W1) (since 01.01.2013 - positive evaluation 29.10.2015)

KOMET (Condensed Matter) - Prof. P.G.J. van Dongen (C4)

Institut für Physik - Johannes Gutenberg Universität Mainz, www.iph.uni-mainz.de

Staudingerweg 7, 55128 Mainz, Germany

MAINZ (MAterial science IN mainZ) Graduate School of Excellence

CSM Center for Computational Science Mainz

Research Interests

- *Synthetic Quantum States of Matter with Ultracold Atomic Setups*

- *Interplay of Geometry, Interactions & Gauge fields
in strongly correlated many-body systems*

- *Quantum-information inspired numerical algorithms (DMRG & Tensor-Networks)*

- *Topological Quantum Memories & Topological Insulators*

Work experience

Sep. 2007 - Dec 2012

Group & Institution

Other Responsibilities

Jan. 2007- July 2007

Group & Institution

PostDoc Researcher

Theory Group - Prof. J.I. Cirac (<http://www.mpq.mpg.de/Theorygroup/CIRAC/>)

Max-Planck-Institut für Quantenoptik (MPQ), Garching, Germany

* proposal writing, scientific and management reports of EU-IP SCALA & AQUTE

* supervision of a Ph.D. student and a Bachelor student (see Teaching ID)

Research assistant

Quantum Transport & Information Group - Prof. R. Fazio (<http://qti.sns.it>)

Scuola Normale Superiore (SNS), Pisa, Italy

Education & Training

2004-2007

Thesis

Group & Institution

Other Responsibilities

Ph.D. in Physics (Diploma di perfezionamento) 70/70 cum laude (merits)

“Quantum Phase Transitions in Hubbard lattices” with Prof. R. Fazio

Quantum Transport & Information Group - Prof. R. Fazio (<http://qti.sns.it>)

Scuola Normale Superiore (SNS), Pisa, Italy

- Representative of Ph.D. students in the Science Class Council

1999-2003

Institution

Other Responsibilities

Degree in Sciences (Diploma di Licenza) 70/70 cum laude (merits)

Scuola Normale Superiore (SNS), Pisa, Italy (<http://www.sns.it>)

- Responsible of students' Funds for Sport activities

2002-03

Thesis

Institution

Master Degree in Physics (Laurea Specialistica) 110/110 cum laude (merits)

“Phase Transitions in Josephson Junctions T_3 (dice) Arrays” with Prof. R. Fazio

Università degli Studi di Pisa - Dipartimento di Fisica (<http://www.df.unipi.it>)

1999-2002 **Bachelor Degree in Physics (Laurea)** 110/110 cum laude (merits)
Thesis "Bose Einstein Condensation" with Prof. M.P. Tosi
Institution Università degli Studi di Pisa - Dipartimento di Fisica (<http://www.df.unipi.it>)

Long Term Visits

October 2016 **Visiting Researcher (affiliated)**
Group & Institution Program "Synthetic Quantum Matter" [[link](#)]
Kavli Institute for Theoretical Physics (KITP), Santa Barbara, CA, USA

April 2015 **Visiting Researcher**
Group & Institution Program "Frontiers in Quantum Simulation with Cold Atoms" [[link](#)]
University of Washington, Seattle, WA, USA

October 2010 **Visiting Researcher (affiliated)**
Group & Institution Program "Beyond Standard Optical Lattices" [[link](#)]
Kavli Institute for Theoretical Physics (KITP), Santa Barbara, CA, USA

April 2006 & May 2007 **Research stay** (collaboration with A. Imambekov)
Group & Institution Prof. E. Demler's group, Harvard University, Cambridge MA, USA

Personal skills

Languages *Italian*: Mother-Tongue *English*: C1 Proficient *German*: C1 Proficient
Computer skills Programming in Fortran (f77-f90/5) (with basic MPI) & Mathematica & MatLab
Co-Director of a Symmetric Tensor-Network Library project (open-source soon)

Honors & Awards

2018 Abilitazione Scientifica Nazionale I Fascia - sett.02/B2
2017 Abilitazione Scientifica Nazionale II Fascia - sett.02/B2
2016 2nd Place (1st Theorist overall) in the Italian CNR Recruitment Process (87.8/100)
2016 Outstanding Referee of the American Physical Society
1999-2003 Admission to Scuola Normale Superiore - Pisa, (30 places/year 5% top nationwide):
Fellowship covering life and study expenses for the whole University period (99-03)
with additional courses & exams, strong requisites on grades, early own seminars
1999 Alfiere del Lavoro della Repubblica Italiana

Dissemination

Contributions Ca. 40 peer-reviewed papers (ISI 850 cit., h-ind. 16 // Google Scholar 1200 & 19);
25 invited & 30 contributed talks in Conferences & 30 in other Institutes, & 30 posters;
Invitation to write Rep.Progr.Phys. (IOP) "Topological order in 1D systems" (2018);

Referee Since 2007 active referee for several international journals. Since 2013 also referee
for the DFG funding agency, since 2015 for the Polish Academy of Sciences, and since
2016 for the Carl-Zeiss-Stiftung.

Editorial work Since July 2016 Editorial Board Member of Scientific Reports (Nat. Pub. Group)

Organized Events * International Workshop "Designing artificial quantum matter" (upcoming)
San Sebastian (Spain), 15th-19th July 2019 (with N. Goldman, D. Bercioux, & I. Swart)
* International Workshop "Perspectives on Quantum Many-Body Entanglement" [[link](#)]
Mainz, 25th-27th Sep. 2013 (with J.Prof. R. Orus, JGU) – 40 participants (12 invited)
* WE-Heraeus Klausurtagung "Vier Quanten" (JGU young groups' meeting),
Oberwesel, 13th-17th April 2015 (with Profs. Windpassinger, van Loock and Orus)
* MPQ Theory Workshop, around 30 people, (with A. Pflanzer)
Friedrichshafen, 12th-15th September 2012

Funding ID

2018	<i>Pending</i> FET-Open proposal: SUBLIME – “Superfluid Bosons of Light and Matter”
2018	DFG-Sachbeihilfe “Symmetrische Tensor-Netzwerke für 2D-Quantenmaterie”, 188K€ transferred from Jun.-Prof. Dr. Orus (JGU > Donostia, Spain)
2016	Stufe-I Wiss. Förderung by the JGU-Mainz (circa 30K€) about “Fractional topological phases in cold atomic ribbons”,
2015	DFG-Sachbeihilfe “OSCAR- Orbital and Spin Currents in Atomic Ring traps”, 188K€
2015	Center for Comp. Sciences Mainz - “Numerical optimization of tensor networks” circa 30K€ jointly with the JGU groups of Prof. Orus and Prof. Raasch (Math);
2014	WE Heraus Foundation - Klausurtagung - “Vier Quanten” (ref. BV 33606) circa 5K€ jointly with the JGU groups of Profs. Orus, Windpassinger, van Loock;
2013	Stufe-I Wiss. Förderung by the JGU-Mainz (circa 30K€) about “Interplay of geometry, interactions and gauge fields”,
2004-06	Member of IBM Linux on Power Innovation Grant “Powder with Power” 20k€ Support to develop open-source well-adapting DMRG code (www.dmrp.it)

Teaching ID

SS 2018	Master (6 credits) – “Selected Chapters of condensed matter physics”
WS 2017-8	Master (6 credits) – “Theory 6: Theoretical Quantum Optics & Many Body Physics”
WS 2017-8	Bachelor – “Pre-Course on Mathematics”
SS2017	Bachelor (9 credits) – “Theory 4: Thermodynamics and Statistical Mechanics”
WS 2016-7	Master (6 credits) – “Introduction to Quantum Computation”
SS 2016	Master (6 credits) – “Selected Chapters of condensed matter physics”
WS 2015-6	Master (6 credits) – “Introduction to Quantum Computation”
SS 2015	Master (6 credits) – “Selected Chapters of condensed matter physics”
WS 2014-15	Master (3 credits) – “Numerical Methods for strongly correlated electron systems”
WS 2014-5	Bachelor (3 credits) “Mathematical Methods 2”
SS 2014	Master (6 credits) – “Introduction to the theory of condensed matter”
WS 2014-5	Bachelor (3 credits) “Mathematical Methods 2”
SS 2013	Master (6 credits) – “Entanglement in many-body systems: concepts & algorithms”
2018	Supervising the Master thesis of Niklas Tausendpfund at JGU - Mainz
2018	Supervising the Master thesis of Jonas Nothhelfer at JGU - Mainz
2017 –	Supervising the PhD thesis of Andreas Haller at JGU - Mainz
2016	Supervising the Master thesis of Andreas Haller at JGU - Mainz
2015 – 17	Supervising the PhD thesis of Manon Bischoff at JGU - Mainz
2013 – 17	Supervising the PhD thesis of Johannes Jünemann at JGU - Mainz & MAINZ
2014	Supervising the Bachelor thesis of Andreas Haller at JGU - Mainz
2014 –	Second Referee of Bachelor / Master / Diploma / PhD theses at JGU - Mainz
2012	Co-supervising the Bachelor thesis of Dominik Schubert at TUM München
2008-2012	Co-supervising the Ph.D. thesis of Dr. Leonardo Mazza at TUM & MPQ-Garching

Complete List of Scientific Publications – Jun.-Prof. Dr. Matteo Rizzi

A) Publications with peer review process

- [40] **MR**, C. Miniatura, A. Minguzzi, P. Vignolo
Contact & ground-state energy of harmonically-trapped 1D interacting bosons: from two to many
Phys. Rev. A, **98**, 043607 (2018) – Editor’s suggestion
- [39] A. Haller, **MR**, and M. Burrello,
The $\nu = 1/2$ resonance in chiral fermionic ladders
New J. Phys. **20**, 053007 (2018)
- [38] M. Bischoff, J. Jünemann, M. Polini, **MR**,
Tuning the Drude Weight of Dirac-Weyl Fermions in One-Dimensional Ring Traps
Phys. Rev. B **96**, 241112(R) (2017)
- [37] M. Gerster, **MR**, P. Silvi, M. Dalmonte, and S. Montangero,
Fractional quantum Hall effect in the interacting Hofstadter model via tensor networks
Phys. Rev. B **96**, 195123 (2017)
- [36] J. Decamp, J. Jünemann, M. Albert, M. Rizzi, A. Minguzzi, and P. Vignolo
Strongly correlated one-dimensional Bose-Fermi quantum mixtures: symmetry and correlations
New J. Phys. **19**, 125001 (2017)
- [35] J.H. Pixley, W.S. Cole, I. B. Spielman, **MR**, S. Das Sarma,
Strong coupling phases of the spin-orbit-coupled spin-1 Bose-Hubbard chain: odd integer Mott lobes and helical magnetic phases
Phys. Rev. A **96**, 043622 (2017)
- [34] J. Jünemann, A. Piga, S.-J. Ran, M. Lewenstein, **MR**, A. Bermudez
Exploring Interacting Topological Insulators with Ultracold Atoms: the Synthetic Creutz-Hubbard Model
Phys. Rev. X **7**, 031057 (2017)
- [33] S.K. Ghosh, S. Greschner, U.K. Yadav, T. Mishra, **MR**, and V.B. Shenoy
Phases of Attractive Fermi Gases in Synthetic Dimensions
Phys. Rev. A **95**, 063612 (2017)
- [32] D. Draxler, J. Haegeman, F. Verstraete, and **MR**
Continuous matrix product states with periodic boundary conditions and an application to atomtronics
Phys. Rev. B **95**, 045145 (2017)
- [31] J. Decamp, J. Jünemann, M. Albert, **MR**, A. Minguzzi, and P. Vignolo,
High-momentum tails as magnetic structure probes for strongly-correlated $SU(\kappa)$ fermionic mixtures in one-dimensional traps,
Phys. Rev. A **94**, 053614 (2016)
- [30] M. Ippoliti, **MR**, V. Giovannetti, and L. Mazza,
Quantum memories with zero-energy Majorana modes and experimental constraints,
Phys. Rev. A **93**, 062325 (2016)
- [29] M. Gerster, **MR**, F. Tschirsich, P. Silvi, R. Fazio, and S. Montangero
Superfluid density and quasi-long-range order in the 1D disordered Bose-Hubbard model,
New J. Phys. **18**, 015015 (2016)
- [28] M. Burrello, **MR**, M. Roncaglia, A. Trombettoni,
Strongly correlated states of trapped ultracold fermions in deformed Landau levels,
Phys. Rev. B **91**, 115117 (2015)

- [27] D. Aghamalyan, M. Cominotti, **MR**, D. Rossini, F. Hekking, A. Minguzzi, L.C. Kwek, L. Amico
Coherent superposition of current flows in an Atomtronic Quantum Interference Device,
New J. Phys. **17**, 045023 (2015) – selected as Year Highlight
- [26] M. Ippoliti, L. Mazza, **MR**, V. Giovannetti,
Perturbative approach to continuous-time quantum error correction,
Phys. Rev. A **91**, 042322 (2015)
- [25] M. Cominotti, **MR**, D. Rossini, D. Aghamalyan, L. Amico, L.C. Kwek, F. Hekking, A. Minguzzi,
Optimal scaling of persistent currents for interacting bosons on a ring,
EPJST **224**, 519 (2015)
- [24] M. Gerster, P. Silvi, **MR**, R. Fazio, T. Calarco, S. Montangero,
Unconstrained Tree Tensor Network: An adaptive gauge picture for enhanced performance,
Phys. Rev. B **90**, 125154 (2014)
- [23] M. Cominotti, D. Rossini, **MR**, F. Hekking, and A. Minguzzi
Optimal Persistent Currents for Interacting Bosons on a Ring with a Gauge Field,
Phys. Rev. Lett. **113**, 025301 (2014)
- [22] **MR**
*Quantum simulation of gauge potentials with cold atoms in optical lattices:
a tunable platform for relativistic fermions and axions*,
PoS - SISSA **193** (QCD-TNT-III), 036 (2014)
- [21] L. Mazza, **MR**, M.A. Lukin, J.I. Cirac,
Robustness of quantum memories based on Majorana zero modes,
Phys. Rev. B **88**, 205142 (2013)
- [20] O. Romero-Isart, **MR**, C. A. Muschik, E. S. Polzik, M. Lewenstein, and A. Sanpera,
Quantum Memory Assisted Probing of Dynamical Spin Correlations,
Phys. Rev. Lett. **108**, 065302 (2012)
- [19] L. Mazza, A. Bermudez, N. Goldman, **MR**, M.A. Martin-Delgado, M. Lewenstein,
*An Optical-Lattice-Based Quantum Simulator
for Relativistic Field Theories and Topological Insulators*,
New J. Phys., **14**, 015007 (2012) – selected as Year Highlight
- [18] M. Roncaglia, **MR**, J. Dalibard,
From Rotating Atomic Rings to Quantum Hall States,
Sci. Rep. **1**, 43 (2011)
- [17] A. Bermudez, L. Mazza, **MR**, N. Goldman, M. Lewenstein, M.A. Martin-Delgado,
Wilson Fermions and Axion Electrodynamics in Optical Lattices ,
Phys. Rev. Lett. **105**, 190404 (2010) – selected as EU-IP AQUTE Y1-Highlight
- [16] L. Mazza, **MR**, M. Lewenstein, J.I. Cirac,
Emerging Bosons with 3-Body Interactions from Spin-1 Atoms in Optical Lattices,
Phys. Rev. A **82**, 043629 (2010)
- [15] **MR**, S. Montangero, P. Silvi, V. Giovannetti, R. Fazio,
Homogeneous MERA tensor networks for quantum critical systems,
New J. Phys. **12**, 075018 (2010)
- [14] M. Roncaglia, **MR**, J.I. Cirac,
Pfaffian State Generation by Strong 3-Body Dissipation,
Phys. Rev. Lett. **104**, 096803 (2010)
- [13] P. Silvi, V. Giovannetti, S. Montangero, **MR**, J. I. Cirac, R. Fazio,
Critical properties of homogeneous binary trees,
Phys. Rev. A **81**, 062335 (2010)

- [12] V. Giovannetti, S. Montangero, **MR**, R. Fazio,
Homogeneous MERA states: an information theoretical analysis,
Phys. Rev. A **79**, 052314 (2009)
- [11] S. Montangero, **MR**, V. Giovannetti, R. Fazio,
Critical exponents of 1D quantum critical models by means of MERA tensor network,
Phys. Rev. B **80**, 113103 (2009)
- [10] **MR**, S. Montangero, G. Vidal,
Simulation of time evolution with multiscale entanglement renormalization ansatz,
Phys. Rev. A **77**, 052328 (2008)
- [9] **MR**, A. Imambekov,
Pairing of 1D Bose-Fermi mixtures with unequal masses,
Phys. Rev. A **77**, 023621 (2008)
- [8] **MR**, M. Polini, M.A. Cazalilla, M.R. Bakhtiari, M.P. Tosi, R. Fazio,
Fulde-Ferrell-Larkin-Ovchinnikov superfluidity in 1D optical lattices,
Phys. Rev. B **77**, 245105 (2008)
- [7] G. Xianlong, **MR**, M. Polini, R. Fazio, M.P. Tosi, V.L. Campo Jr., K. Capelle,
Luther-Emery Phase and Atomic-Density Waves in a Trapped Fermion Gas ,
Phys Rev. Lett. **98**, 030404 (2007)
- [6] S.H. Abedinpour, M.R. Bakhtiari, G. Xianlong, M. Polini, **MR**, M.P. Tosi,
Phase Behaviors of Strongly Correlated Fermi Gases in 1D Confinements,
Las. Phys., 2007, Vol. 17, No. 2, 162-168 (2007)
- [5] G. De Chiara, **MR**, D. Rossini, S. Montangero,
Density Matrix Renormalization Group for Dummies (codesource at www.dmrg.it),
J. Comput. Theor. Nanosci. **5**, 1277_1288 (2008)
- [4] **MR**, V. Cataudella, R. Fazio,
Phase Diagram of the Bose-Hubbard Model with T_3 symmetry,
Phys Rev B **73**, 144511 (2006)
- [3] **MR**, V. Cataudella, R. Fazio,
4e-condensation in a fully frustrated Josephson junction diamond chain,
Phys. Rev. B **73**, 100502 (2006)
- [2] D. Rossini, **MR**, G. De Chiara, S. Montangero R. Fazio,
Anti-ferromagnetic spinor BECs in optical lattices,
J. Phys. B: At. Mol. Opt. Phys. **39** S163-S175 (2006)
- [1] **MR**, D. Rossini, G. De Chiara, S. Montangero, R. Fazio,
Phase diagram of spin-1 bosons on one-dimensional lattices,
Phys Rev. Lett. **95**, 240404 (2005)

The following above mentioned publications have evolved from my doctoral dissertation: 1-9.

B) Submitted publications with peer review process

- [46] S. Barbarino, D. Rossini, **MR**, R. Fazio, G. Santoro, M. Dalmonte
Topological Devil's staircase in atomic two-leg ladders
arXiv:1810.02337 – Submitted to Phys. Rev. X
- [45] A. Kshetrimayum, **MR**, J. Eisert, R. Orús
A tensor network annealing algorithm for two-dimensional thermal states
arXiv:1809.08258 – Submitted to Phys. Rev. Lett.
- [44] P. Schmoll, S. Singh, **MR**, R. Orús
A programming guide for tensor networks with global $SU(2)$ symmetry
arXiv:1809.08180 – Submitted to Ann. Phys. (NY)
- [43] A. Bermudez, E. Tirrito, **MR**, M. Lewenstein, S. Hands
Gross-Neveu-Wilson model and correlated symmetry-protected topological phases
arXiv:1807.03202 – Submitted to Ann. Phys. (NY)
- [42] Christine Cartwright, Gabriele De Chiara, **MR**
The Rhombi-Chain Bose-Hubbard Model: geometric frustration and interactions
arXiv:1807.02583 – Submitted to Phys. Rev. B
- [41] P. Silvi, F. Tschirsich, M. Gerster, J. Jünemann, D. Jaschke, **MR**, and S. Montangero
The Tensor Networks Anthology: Simulation techniques for many-body quantum lattice systems.
arXiv:1710.03733 – Submitted to SciPost