

CURRICULUM VITÆ

LUCA FAUSTO TOCCHIO

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Professional Experience

- 16/11/2019 - present: **Tenure-track assistant professor (Ricercatore a tempo determinato Legge 240/10 art.24-B) in Theoretical Condensed Matter Physics**, *Department of Applied Science and Technology (DISAT) at Politecnico di Torino (Italy)*.
- 09/01/2017 - 15/11/2019: **Assistant professor with no tenure track (Ricercatore a tempo determinato Legge 240/10 art.24-A) in Theoretical Condensed Matter Physics**, *Department of Applied Science and Technology (DISAT) at Politecnico di Torino (Italy)*.
- 01/11/2013 - 08/01/2017: **PostDoc (Assegnista di Ricerca Legge 240/10 art.22)** *in the group of Prof. Sandro Sorella and Dr. Federico Becca, International School for Advanced Studies (SISSA), Italy*. The period Nov 2013 - Oct 2015 was financed by the research project: “PRIN 2010-2011: Fenomeni quantistici collettivi: dai sistemi fortemente correlati ai simulatori quantistici”.
- 01/07/2011 - 31/10/2013: **PostDoc (Wissenschaftlicher Mitarbeiter)** *in the group of Prof. Claudius Gros and Prof. Roser Valentí, University of Frankfurt, Germany*. Financed by the research project: “SFB/TR 49: Condensed Matter Systems with Variable Many-Body Interactions”, second funding period (after positive evaluation of a referral committee).
- 01/12/2008 - 30/06/2011: **PostDoc (Wissenschaftlicher Mitarbeiter)** *in the group of Prof. Claudius Gros and Prof. Roser Valentí, University of Frankfurt, Germany*. Financed by the research project: “SFB/TR 49: Condensed Matter Systems with Variable Many-Body Interactions”, first funding period.

Education

- Nov 2004 - Oct 2008: **Ph.D. in Theoretical Condensed Matter Physics**
International School for Advanced Studies (SISSA), Trieste (Italy)
Thesis: “*A new variational wave function with backflow correlations for frustrated Hubbard models*”, discussed on the 24th October 2008
(available online at <http://www.sissa.it/cm/phdsection/alumni.php>)
Supervisors: Prof. Sandro Sorella and Dr. Federico Becca
Referee: Prof. Peter Prelovšek (University of Ljubljana)

- Nov 1999 - Jul 2004: **Laurea (Master of Science) in Physics**,
University of Genova, (Italy)
Thesis: “*Spin effects in the shot noise of a quantum dot*”, discussed on the 15th July 2004
Supervisors: Prof. Maura Sassetti and Prof. Franco Napoli
Final grade: 110/110 cum laude
- Sept 1994 - Jul 1999: **High School Degree**
Liceo Scientifico “Giordano Bruno”, Albenga (Italy)
Final grade: 100/100

Research interests

- Strongly correlated electron systems in low dimension; Hubbard (also with multiband and bilayer extensions), Heisenberg and Hubbard-Holstein models
- Variational and Green’s Function Monte Carlo; methodological improvements of variational states, i.e., backflow correlations
- Frustrated spin systems in low dimension (i.e., charge-transfer salts), spin liquids and spiral magnetic order; competing charge and magnetic orders in frustrated models with extended interactions
- High-temperature superconductivity (i.e., cuprates), the underdoped region, and the properties of the (underlying) Fermi surface; hidden parity and string orders
- Orbital-selective phases, metal-insulator transitions, magnetism and superconductivity in multiband models (i.e., physics of the iron pnictides)

Full list of Publications

Note: “*” = corresponding author

- (26) L.F. Tocchio*, A. Montorsi, and F. Becca, “*Magnetic and spin-liquid phases in the frustrated $t - t'$ Hubbard model on the triangular lattice*”, Phys. Rev. B **102**, 115150 (2020).
- (25) L.F. Tocchio*, A. Montorsi, and F. Becca, “*Metallic and insulating stripes and their relation with superconductivity in the doped Hubbard model*”, SciPost Phys. **7**, 021 (2019).
- (24) W.-J. Hu, H. Hu, R. Yu, H.-H. Lai, L.F. Tocchio, F. Becca, and Q. Si, “*Nematic and Antiferromagnetic Quantum Criticality in a Multi-Orbital Hubbard Model for Iron Pnictides*”, arXiv: 1903.12625.
- (23) L.F. Tocchio*, F. Becca, and A. Montorsi, “*Superconductivity in the Hubbard model: a hidden-order diagnostics from the Luther-Emery phase on ladders*”, SciPost Phys. **6**, 018 (2019).
- (22) C. De Franco, L.F. Tocchio*, and F. Becca, “*Metal-insulator transitions, superconductivity, and magnetism in the two-band Hubbard model*”, Phys. Rev. B **98**, 075117 (2018).
- (21) S. Karakuzu, L.F. Tocchio*, S. Sorella, and F. Becca, “*Superconductivity, charge-density waves, and antiferromagnetism in the Hubbard-Holstein model*”, Phys. Rev. B **96**, 205145 (2017).
- (20) R. Kaneko, L.F. Tocchio*, R. Valentí, and F. Becca, “*Charge orders in organic charge-transfer salts*”, New J. Phys. **19**, 103033 (2017).
- (19) L.F. Tocchio*, F. Becca, and S. Sorella, “*Hidden Mott transition and large- U superconductivity in the two-dimensional Hubbard model*”, Phys. Rev. B **94**, 195126 (2016).
- (18) R. Kaneko, L.F. Tocchio, R. Valentí, and C. Gros, “*Emergent lattices with geometrical frustration in doped extended Hubbard models*”, Phys. Rev. B **94**, 195111 (2016).

- (17) R. Kaneko, L.F. Tocchio, R. Valentí, F. Becca, and C. Gros, “*Spontaneous symmetry breaking in correlated wave functions*”, Phys. Rev. B **93**, 125127 (2016).
- (16) L.F. Tocchio*, F. Arrigoni, S. Sorella, and F. Becca, “*Assessing the orbital selective Mott transition with variational wave functions*”, J. Phys.: Condens. Matter **28**, 105602 (2016).
- (15) E. Ghorbani, L.F. Tocchio*, and F. Becca, “*Variational wave functions for the $S = 1/2$ Heisenberg model on the anisotropic triangular lattice: spin liquids and spiral orders*”, Phys. Rev. B **93**, 085111 (2016); **Editors’ Suggestion**.
- (14) J.P.F. LeBlanc *et al.* (Simons Collaboration on the Many-Electron Problem), “*Solutions of the Two Dimensional Hubbard Model: Benchmarks and Results from a Wide Range of Numerical Algorithms*”, Phys. Rev. X **5**, 041041 (2015); **Highly Cited Paper in Web of Science**.
- (13) L.F. Tocchio, C. Gros, X.-F. Zhang, and S. Eggert, “*Phase diagram of the triangular extended Hubbard model*”, Phys. Rev. Lett. **113**, 246405 (2014).
- (12) L.F. Tocchio*, C. Gros, R. Valentí, and F. Becca, “*One-dimensional spin liquid, collinear, and spiral phases from uncoupled chains to the triangular lattice*”, Phys. Rev. B **89**, 235107 (2014).
- (11) R. Rüger, L.F. Tocchio*, R. Valentí, and C. Gros, “*Phase diagram of the square lattice bilayer Hubbard model: A variational Monte Carlo study*”, New. J. Phys. **16** 033010 (2014).
- (10) A.C. Jacko, L.F. Tocchio, H.O. Jeschke, and R. Valentí, “*Importance of anisotropy in the spin-liquid candidate $Me_3EtSb[Pd(dmit)_2]_2$* ”, Phys. Rev. B **88**, 155139 (2013).
- (9) L.F. Tocchio*, H. Feldner, F. Becca, R. Valentí and C. Gros, “*Spin-liquid versus spiral-order phases in the anisotropic triangular lattice*”, Phys. Rev. B **87**, 035143 (2013).
- (8) L.F. Tocchio*, H. Lee, H.O. Jeschke, R. Valentí and C. Gros, “*Mott correlated states in the underdoped two-dimensional Hubbard model: variational Monte Carlo versus a dynamical cluster approximation*”, Phys. Rev. B **87**, 045111 (2013).
- (7) L.F. Tocchio*, F. Becca and C. Gros, “*Strong renormalization of the Fermi-surface topology close to the Mott transition*”, Phys. Rev. B **86**, 035102 (2012).
- (6) L.F. Tocchio, F. Becca and C. Gros, “*Backflow correlations in the Hubbard model: An efficient tool for the study of the metal-insulator transition and the large- U limit*”, Phys. Rev. B **83**, 195138 (2011).
- (5) A. Di Ciolo, L.F. Tocchio and C. Gros, “*Tunneling matrix elements with antiferromagnetic Gutzwiller wave functions*”, Phys. Rev. B **83**, 165116 (2011).
- (4) L.F. Tocchio, F. Becca and C. Gros, “*Interaction-induced Fermi-surface renormalization in the $t_1 - t_2$ Hubbard model close to the Mott-Hubbard transition*”, Phys. Rev. B **81**, 205109 (2010).
- (3) L.F. Tocchio, A. Parola, C. Gros and F. Becca, “*Spin-liquid and magnetic phases in the anisotropic triangular lattice: The case of $\kappa - (ET)_2X$* ”, Phys. Rev. B **80**, 064419 (2009).
- (2) F. Becca, L.F. Tocchio and S. Sorella, “*Metal-insulator transition and strong-coupling spin liquid in the $t - t'$ Hubbard model*”, J. Phys.: Conf. Ser. **145**, 012016 (2009).
- (1) L.F. Tocchio, F. Becca, A. Parola and S. Sorella, “*Role of backflow correlations for the non-magnetic phase of the $t - t'$ Hubbard model*”, Phys. Rev. B **78**, 041101(R) (2008).

Bibliometric data

Total number of citations: 676, h-index: 14, Source: Web of Science

Total number of citations: 907, h-index: 14, Source: Google Scholar

Prizes, Grants, and Qualifications

- **Europhysics Letters (EPL) Award** for the best contributed talk at the conference: “Correlations, integrability, and criticality in quantum systems”, 24-28 October, 2016 - Évora (Portugal). Talk title: “Hidden Mott transition and large- U superconductivity in the two-dimensional Hubbard model”. The prize is assigned to the best presentations by young researchers attending selected conferences, workshops, and summer schools.
- Starting Grant for Assistant Professors, provided by Politecnico di Torino for the period 2017-2019 (15 k€) and for the period 2020-2022 (15 k€); grant number: 54_RSG17TL01 - Starting grant RTDA/RTDB - Luca Fausto Tocchio
- Funding for basic research activities (FFABR), provided by the Ministry of Education, University and Research for the year 2018 (3 k€); grant number: 54_RID17TL01 - MIUR Ricerca di Base
- French qualification for the position of Maître de Conférence in the section 28 “Condensed Matter Physics”, obtained in 2013
- **Italian habilitation for the position of Associate Professor in Theoretical Condensed Matter Physics** (settore concorsuale 02/B2), obtained on 08/08/2018

Participation into research projects

- Nov 2013 - Jan 2016; Italian research project: “PRIN 2010-2011: Fenomeni quantistici collettivi: dai sistemi fortemente correlati ai simulatori quantistici”
- Dec 2008 - Oct 2013: German research project: “SFB/TR 49: Condensed Matter Systems with Variable Many-Body Interactions”
- 2008: Italian research project: “PRIN 2007: Ruolo della forte correlazione elettronica nei superconduttori non convenzionali, in sistemi bidimensionali di elettroni in dispositivi e in sistemi a molti corpi di recente interesse fisico e chimico”.

Teaching Experience and Supervision of Students

- @University of Frankfurt
 - Tutor and responsible of exercise preparation for the course “Introduction to Solid State Physics” (WS 2011/12 and WS 2010/11)
 - Tutor and responsible of exercise preparation for the course “Advanced Solid State Physics” (SS 2011 and SS 2009)
 - Tutor for the course “Quantum Mechanics I” (SS 2013)
 - Tutor for the course “Quantum Mechanics II” (SS 2010)
 - Tutor for the course “Electromagnetism” (WS 2009/2010)
 - Co-advisor (with Roser Valentí) of three bachelor theses:
 - Robert Rüger: “Monte-Carlo methods in Statistical Physics and their Application to the Simulation of Spin systems”, 2011
 - Steffi Hartmann: “Superconductivity, from the perspective of a bachelor student”, 2011

- Wiebke Ritter: “The Monte Carlo method and its application to the Ising model”, 2012
- Co-advisor (with Roser Valentí) of a master thesis:
 - Robert Rürger: “Implementation of the Variational Monte Carlo method for the Hubbard model”, 2013
- @SISSA, Trieste
 - Tutor for the week on Monte Carlo methods in the “Summer School on Atomistic Simulation Techniques for Material Science, Nanotechnology, and Biophysics”; 30 June - 4 July 2014, 6 - 10 July 2015, 11 - 15 July 2016.
 - **Supervisor of the Ph.D. thesis of Caterina De Franco.** Title: “Magnetism and Superconductivity in the Two-Band Hubbard Model: A Variational Monte Carlo Perspective”. Date of defense: 26/10/2018
- @Politecnico di Torino
 - Attendance of a training course on university teaching: “Apprendere ad Insegnare nell’Higher Education - Percorso Formativo Junior Faculty Learning”, February-June 2017
 - Lecturer for the guidance project to STEM academic disciplines: “Progetto orientamento formativo - Lezioni di Matematica e Fisica”, provided by Politecnico di Torino for high-school students (November 2018, November 2019, and November 2020)
 - Recitations (Esercitatore) and laboratory tutor in the course “Classical Physics I: Mechanics and thermodynamics” for degrees in Engineering (2nd semester a.y. 2016/2017)
 - Recitations (Esercitatore) and member of the examination committee in the course “Classical Physics II: Electromagnetism” for the degree in Mechanical Engineering (1st semester a.y.’s 2017/2018, 2018/2019, 2019/2020, and 2020/2021)
 - Lecturer and member of the examination committee in the course “Condensed Matter Theory” for the Master degree in “Physics of Complex Systems” (Quantum Monte Carlo in the 2nd semester a.y. 2018/2019; Recitations on lattices, band theory and phonons, as well as Quantum Monte Carlo in the 2nd semester a.y. 2019/2020). Lecturer for a chapter on “Quantum Monte Carlo” in the course “Complex systems modelling project” (June 2018)
 - **Lecturer for the Ph.D. course “Quantum Monte Carlo methods for strongly correlated systems” (March 2018)**

Schools and Conferences

- *ParisEdge 2019*
25-28 September, 2019 - Paris (France), oral contribution.
- *APS March Meeting*
4-8 March, 2019 - Boston (United States), oral contribution and session chair.
- *FisMat 2017*
1-6 October 2017 - Trieste (Italy), oral contribution.
- *9th World Congress on Materials Science and Engineering*
12-14 June 2017 - Rome (Italy), **invited speaker**.
- *APS March Meeting*
13-17 March, 2017 - New Orleans (United States), oral contribution.
- *Correlations, integrability, and criticality in quantum systems*
24-28 October, 2016 - Evora (Portugal), oral contribution.
- *Theoretical and Experimental Magnetism Meeting 2016*

- 16-17 June, 2016 - Rutherford Appleton Lab (UK), poster contribution.
- *FisMat 2015*
28 September - 2 October, 2015 - Palermo (Italy), oral contribution.
 - *11th International Symposium on Crystalline Organic Metals, Superconductors and Magnets*
6-11 September, 2015 - Bad Gönning (Germany), **invited speaker**.
 - *Workshop on Interacting Fermions: Precision Theory and Experiment*
6-10 July, 2015 - Trieste (Italy), poster contribution.
 - *Workshop on Gutzwiller Wave Functions and Related Methods*
16-19 June, 2014 - Valence (France), oral contribution.
 - *Condensed Matter Physics in the City: Intertwined electronic and atomic order*
9-13 June, 2014 - London (UK), **invited speaker**.
 - *Novel states in correlated condensed matter - from model systems to real materials*
8-10 April, 2014 - Königstein (Germany), poster contribution.
 - *Spring Meeting of the German Physical Society*
30 March- 4 April, 2014 - Dresden (Germany), oral contributions.
 - *Quantum spin liquids: from theory to numerical simulations*
9-20 September, 2013 - Trieste (Italy), poster contribution.
 - *The New Generation in Strongly Correlated Electron Systems 2013*
1-5 July, 2013 - Sestri Levante, Genova (Italy), poster contribution.
 - *Spring Meeting of the German Physical Society*
11-15 March, 2013 - Regensburg (Germany), oral and poster contributions.
 - *Correlations and coherence in quantum systems*
8-12 October, 2012 - Evora (Portugal), poster contribution.
 - *Annual Retreat of the SFB/TR 49*
20-21 September, 2012 - Wiesbaden (Germany), oral contribution.
 - *Summer School on Low-Dimensional Quantum Many-Body Systems*
16-21 August, 2012 - Trier (Germany), poster contribution.
 - *Quantum Magnetism in Low Spatial Dimensions*
16-18 April, 2012 - Bad Honnef (Germany), poster contribution.
 - *Spring Meeting of the German Physical Society*
26-30 March, 2012 - Berlin (Germany), oral contribution.
 - *APS March Meeting*
27 February-2 March, 2012 - Boston (United States), oral contribution.
 - *Annual Retreat of the SFB/TR 49*
15-16 September, 2011 - Alzey (Germany), oral contribution.
 - *Spring Meeting of the German Physical Society*
13-18 March, 2011 - Dresden (Germany), oral contribution.
 - *Korrelationstage 2011*
28 February-4 March, 2011 - Dresden (Germany), poster contribution.
 - *Annual Retreat of the SFB/TR 49*
7-8 October, 2010 - Kaiserslautern (Germany), oral contribution.
 - *Workshop on Emergence of New States of Matter in Magnetic Systems and Beyond*
5-9 July, 2010 - ICTP Trieste (Italy), poster contribution.
 - *Spring Meeting of the German Physical Society*
21-26 March 2010 - Regensburg (Germany), oral and poster contributions.
 - *Novel states in correlated condensed matter - from model systems to real materials*
2-4 March 2010 - Berlin (Germany), poster contributions.
 - *XIV Training Course in the Physics of Strongly Correlated Systems*
5-16 October, 2009 - Vietri sul Mare, Salerno (Italy), oral contribution.
 - *Annual Retreat of the SFB/TR 49*
24-25 September, 2009 - Oberursel (Germany), oral contribution.

- *Joint European Japanese Conference: Frustration in Condensed Matter*
12-15 May, 2009 - Lyon (France), poster contribution.
- *International Conference on Strongly Correlated Electron Systems 2008*
17-22 August, 2008 - Buzios, Rio de Janeiro (Brazil), poster contribution.
- *Advanced School on Quantum Monte Carlo Methods in Physics and Chemistry*
21 January-2 February, 2008 - ICTP, Trieste (Italy), poster contribution.
- *XII Training course in the Physics of Strongly Correlated Systems*
1-12 October, 2007 - Vietri sul Mare, Salerno (Italy), oral contribution.
- *School and Workshop on Highly Frustrated Magnets and Strongly Correlated Systems: From Non-Perturbative Approaches to Experiments*
30 July-17 August, 2007 - ICTP, Trieste (Italy)
- *Advanced School in High Performance Computing Tools for e-Science*
5-16 March, 2007 - ICTP, Trieste (Italy)
- *XI Training course in the Physics of Strongly Correlated Systems*
2-13 October, 2006 - Vietri sul Mare, Salerno (Italy)

Invited seminars at universities

- University of Frankfurt (Germany), July 2018;
- Politecnico di Torino (Italy), July 2016;
- University of Milan (Italy), May 2016;
- Royal Holloway University of London (UK), April 2016;
- IRSAMC, Toulouse (France), December 2015;
- University of Frankfurt (Germany), April 2015;
- Institut Jožef Stefan, Ljubljana (Slovenia), March 2015;
- Institut Néel, Grenoble (France), October 2014;
- University of Paris VI (France), April 2013;
- University of Marburg (Germany), November 2012;
- University of Frankfurt (Germany), October 2008;
- University of Würzburg (Germany), July 2008;
- École Normale Supérieure, Lyon (France), June 2008;
- University of Genova (Italy), June 2008.

Service for the scientific community

- Referee for “Physical Review Letters”, “Physical Review B”, “New Journal of Physics”, “Nature Communications”, “Physics Letters A”, “Annalen der Physik”, and “Condensed Matter”.

Professional memberships

- Deutsche Physikalische Gesellschaft (DPG)

Computer and Numerical skills

- **Numerical techniques:** Variational Quantum Monte Carlo, Green's Function Monte Carlo and the Fixed Node approximation, classical Monte Carlo, minimization techniques (steepest descent, stochastic reconfiguration)
- **Programming tools** (excellent knowledge): Fortran 77/90
- **Programming tools** (good knowledge): MPI libraries, batch systems, bash shell scripting
- **Programming tools** (basic knowledge): C, Java
- **Packages:** Office, L^AT_EX, gnuplot, Mathematica
- **Operating systems:** Good knowledge of Linux, standard knowledge of Windows.

Language skills

- **Italian:** mother-tongue
- **English:** excellent knowledge
- **German:** good knowledge (B1 certificate)
- **French:** intermediate knowledge

Torino, 28/01/2021

Luca Fausto Tocchio