Andrea Richaud

Postdoctoral Researcher

Current position

Apr 2020 – Now **Postdoctoral Researcher**, *SISSA*, Supervisors: prof. M. Capone, prof. M. Dalmonte, Project title: "Mixtures of multicomponent ultracold atoms: Quantum dynamics and selective phase transitions".

Previous positions

Nov 2019 – March 2020 **Research assistant (Assegnista di ricerca)**, *Politecnico di Torino*, Supervisor: prof. V. Penna, Project title: "Localization and mixing properties of topological states in bosonic binary mixtures".

Education

2016 – 2019 **PhD in Theoretical Physics**, *Politecnico di Torino*, Supervisor: prof. V. Penna, Thesis title: "Miscibility properties of bosonic binary mixtures in ring lattices". PhD title obtained on 03/02/2020 *summa con laude*.

2013 – 2015 **MSc Nanotechnologies for ICTs**, Politecnico di Torino, *110 summa cum laude / 110*.
International joint degree

Micro and Nanotechnologies for Integrated Systems, *INP Grenoble*, *Très bien*.
International joint degree

Micro and Nanotechnologies for Integrated Systems, *EPFL Lausanne*.
International joint degree

2010 – 2013 **BSc Engineering Physics**, *Politecnico di Torino*, *110/110*.

2005 – 2010 **High school degree**, *Liceo Scientifico Carlo Cattaneo (PNI course of study)*, Torino, *100 summa cum laude / 100*.

Advanced post-lauream schools

2021 **Course "Workshop Quantum Computing and High Performance Computing - 4th edition"** , *CINECA*, 2 days of intensive lectures.

2021 **FOMO 2021 - Lectures on Matter-Wave Interferometry**, *Virtual event due to Covid-19*.

2020 **Course "La comunicazione della ricerca scientifica"** , *Politecnico di Milano - Graduate School of Business*, 3 days of intensive lectures plus oral exam.

2018 **Summer school "Collective Behaviour in Quantum Matter"** , *ICTP (Trieste)*, 3 weeks of intensive lectures.

2015 **Course "Introduction to Scientific and Technical Computing in C"** , *CINECA, Segrate (MI)*, 3 days of intensive lectures.

2015 **Course "Debugging and Optimization of Scientific Applications"** , *CINECA, Bologna*, 3 days of intensive lectures.

Papers ($*$ = corresponding author)

Vittorio Penna, Alessandra Contestabile, and Andrea Richaud. Ground-state properties and phase separation of binary mixtures in mesoscopic ring lattices. *Entropy*, 23:821, 2021.

Albert Escrivá, Andrea Richaud, Bruno Julía-Diáz, and Montserrat Guilleumas. Static properties of two linearly coupled discrete circuits. *Journal of Physics B*, 54:115301, 2021.

Andrea Richaud*, Matteo Ferraretto, and Massimo Capone. Interaction-resistant metals in multicomponent fermi systems. *Physical Review B*, 103:205132, 2021.

Andrea Richaud*, Vittorio Penna, and Alexander L. Fetter. Dynamics of massive point vortices in a binary mixture of bose-einstein condensates. *Physical Review A*, 103:023311, 2021.

Andrea Richaud* and Vittorio Penna. Quantum-granularity effect in the formation of supermixed solitons in ring lattices. *Condensed Matter*, 5:2, 2020.

Andrea Richaud*, Vittorio Penna, Ricardo Mayol, and Montserrat Guilleumas. Vortices with massive cores in a binary mixture of bose-einstein condensates. *Physical Review A*, 101:013630, 2020.

Andrea Richaud* and Vittorio Penna. Pathway toward the formation of supermixed states in ultracold boson mixtures loaded in ring lattices. *Physical Review A*, 100:013609, 2019.

Andrea Richaud*, Alessandro Zenesini, and Vittorio Penna. The mixing-demixing phase diagram of ultracold heteronuclear mixtures in a ring trimer. *Scientific reports*, 9:6908, 2019.

Vittorio Penna and Andrea Richaud*. Spatial phase separation of a binary mixture in a ring trimer. *Journal of Physics: Conference Series*, 1206:012011, 2019.

Andrea Richaud* and Vittorio Penna. Phase separation can be stronger than chaos. *New Journal of Physics*, 20:105008, 2018.

Vittorio Penna and Andrea Richaud*. The phase-separation mechanism of a binary mixture in a ring trimer. *Scientific Reports*, 8:10242, 2018.

Fabio Lingua, Andrea Richaud*, and Vittorio Penna. Residual entropy and critical behavior of two interacting boson species in a double well. *Entropy*, 20:84, 2018.

Vittorio Penna and Andrea Richaud*. Two-species boson mixture on a ring: A group theoretic approach to the quantum dynamics of low-energy excitations. *Physical Review A*, 96:053631, 2017.

Andrea Richaud* and Vittorio Penna. Quantum dynamics of bosons in a two-ring ladder: Dynamical algebra, vortexlike excitations, and currents. *Physical Review A*, 96:013620, 2017.

Kerem Seyid, Andrea Richaud, Raffaele Capoccia, and Yusuf Leblebici. Fpga based hardware implementation of real-time optical flow calculation. *IEEE Transactions on Circuits and Systems for Video Technology*, 2016.

Kerem Seyid, Andrea Richaud, Raffaele Capoccia, and Yusuf Leblebici. Block matching based real-time optical flow hardware implementation. In *Circuits and Systems (ISCAS), 2016 IEEE International Symposium on Circuits and Systems*, pages 2206–2209. IEEE, 2016.

Citation Metrics (up to July 2022)

Scopus	17 Documents, 144 citations, 9 H-index;
Google Scholar	17 Documents, 191 citations, 10 H-index.

Areas of Research and Investigation

I did research in the field of ultracold quantum gases and many-body quantum systems, touching on different aspects, such as:

- Vortices in mixtures of Bose-Einstein condensates and Vortex Dynamics, both on the analytical and on the numerical side;
- Quantum phase transitions in multicomponent bosonic lattice models, both on the analytical and on the numerical side;
- Dynamics of mixtures of Bose-Einstein condensates on lattices, described in terms of discrete non-linear Schrödinger equations;
- Group-theoretic approaches for the study of static and dynamical properties of multicomponent cold-atom systems on lattices;
- Strongly correlated electron systems, with particular emphasis on the orbital-selective Mott transition and on Hund's metals;
- Quantum simulation of multiorbital Hubbard models with multicomponent ultracold gases;
- Different classes of quantum Entropies and of Entanglement measures as critical indicators for the detection of quantum phase transitions in multicomponent cold-atom systems;
- (Master Thesis: Magnetic-like algorithms in computer vision).

Teaching activities

Sep 2022 **Invited lecturer for the intensive week "Vortex Physics in Atomic and Photonic Matter"**, *Technische Universität Kaiserslautern (Germany)*, Responsible: prof. A. Pelster.

Feb 2022 **Teacher of the module "Quantization of topological fluids" of the doctoral course "Many-Body Quantum Systems"**, *PoliTO*, Responsible: prof. V. Penna.

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Scholarships and Experience

Mar 2016 **Fellowship** at Università di Bologna.

Nov 2015 **Fellowship** at ETH Zürich.

Apr 2015 **Scholarship** by Politecnico di Torino on the basis of the results of the exams, to develop the Master Thesis abroad.

Sep 2014 **Scholarship** by Politecnico di Torino on the basis of the results of the exams, to perform one semester of Erasmus in Lausanne.

Jan 2014 **Scholarship** by Politecnico di Torino on the basis of the results of the exams, to perform one semester of Erasmus in Grenoble.

Apr 2011 **Grant** by Politecnico di Torino for the results of the entrance examinations.

Sep 2010 **Grant** by Ministero dell'Istruzione for the results of high school's final test.

Languages

Italian **Native**

English **Fluent (B2)**

French **Basic (A2)**