Curriculum vitae: Alessandro Bisio

Personal Information

Name:	Alessandro
Surname:	Bisio
Date of Birth:	November 23, 1982
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Research activity

Alessandro Bisio is an associate professor at the University of Pavia, member of the research group QUIT (Quantum Information Theory).

Since his PhD and his early years of postdoc his research activities focused on the theoretical and mathematical aspects of Quantum Theory and Quantum Information. He actively contributed to the development of the "quantum comb" formalism, which generalizes the notions of channel and positive-operator valued measure to Quantum Networks. His personal contributions were: the discovery of a new realization theorem which, given the Choi representation of a Quantum Network, allows to recover a concrete implementation of it as a sequence of elementary devices; the application of the formalism to the solution of many optimization problems. Among those there were: the first optimal solution to the long-standing problem of quantum channel tomography, the introduction of the storing-retrieving protocol for a quantum gate along with its optimal realization for unitary channels and measurements, the information-disturbance tradeoff in the estimation of a unitary channel, cloning of quantum measurement. He also provided the analytical solution of the information energy-tradeoff in the discrimination of passive optical devices. The quantum protocol derived in this last work was implemented experimentally.

Together with Paolo Perinotti, he proposed an axiomatic framework for higher order quantum computation, based on the language of types of transformations. This framework has allowed a complete mathematical characterization of the whole hyerarchy of higher order quantum maps encompassing all the special cases considered in the literature.

During the last years of research, his interests also include foundational issues in quantum field theory from the perspective of Quantum Information Theory. In collaboration with the QUIT group, he started a project aimed to the information theoretic reconstruction of Quantum Field Theory based on the Quantum Cellular Automata (QCA) formalism. He contributed to the development of a 1+1 dimensional model for the evolution of free fermions and to a QCA model for free electrodynamics. He combined a model of deformed special relativity with a QCA evolution, which, for the first time in the literature, allows to formalize the notion of change of inertial frame in the QCA framework. He analytically solved the two particle sector of an interacting fermionic cellular automaton with four fermions interaction. More recently, he introduced a systematic method for computing S-matrix for quantum dynamical models evolving in discrete-time deriving the discrete time generalization of both the Lippman-Schwinger equations and the Dyson series.

2023– present	Associate professor (theoretical physics) at Università di Pavia
2020–2023	Research associate (RTDB) at Università di Pavia
2010–2019	Post-Doc at Università di Pavia
2019	Scientific habilitation to associate professor for Theoretical Physics of Fundamental Interactions (02/A2).
2019	Scientific habilitation to associate professor for Theoretical Condensed Matter Physics (02/B2).
2007–2010	PhD at Università di Pavia, supervisor Prof. Giacomo M. D'Ariano, thesis on "Quantum Networks: General Theory and Applications".
2007	Second Degree at Università di Pavia, supervisor Prof. Giacomo M. D'Ariano, thesis on "A game theoretical approach to Quantum Coin Flipping", grade: 110/110 cum laude
2004	First Degree at Università di Pavia, supervisor Dott. Oreste Nicrosini, thesis on "Stochastic Processes in Finance", grade: 110/110 cum laude
2001–2006	Fellow of the "Almo Collegio Borromeo"
2001–2006	Fellow of the "IUSS"

Grants

2023-2025 Principal Investigator of the PRIN PNRR project DISTRUCT (P2022T2JZ9)

Teaching activities

as course holder at University of Pavia:

- 2022–present, "Theoretical Physics of Information" (master in physics)
- 2020–present, "Group theory and symmetries in physics" (master in physics)
- 2023 – present "Quantum Computers" (master in Aritficial Intelligence for Science and Technology)
- 2020–2022, "General Physics" (bachelor in physical education)

as lecturer for the PhD School:

- 2018, Lecturer (9 lectures) for the course "Quantum Information Science" for the PhD school in Physics at the University of Pavia

as lecturer at summer schools:

- 2017, 9 lectures at the Quantum Networks Summer School, School of Mathematical Sciences, Zhejiang University.

as teaching assistant:

- 2019 "Mathematical Methods for Theoretical Physics" (master in physics)
- 2015–2017 "Atomic Physics and Condensed Matter" (bachelor in Physics)
- 2009–2010 "Analytical Mechanics" (bachelor in Physics)

Invited talks and seminars

Kyoto (online), October 18th, 2022 Third Workshop on Quantum Information, Computation, and Foundation "Causal and compositional structure of higher order quantum maps"

Bratislava (online), March 17th, 2022 RCQI seminar "Quantum simulation of scattering processes "

Kyoto (online), September 13th, 2021 Second Workshop on Quantum Information, Computation, and Foundation "Quantum simulation of scattering processes"

Kyoto (online), September 15th, 2020 Workshop on Quantum Information, Computation, and Foundation "Storage and retrieval of a unitary transformation"

Tokyo, September 10th 2019, University of Tokyo "Theoretical framework for Higher-Order Quantum Theory"

Banff, July 23rd 2019 Workshop: Algebraic and Statistical ways into Quantum Resource Theories, "Higher Order Quantum Computation"

Frascati, July 3rd 2018, Workshop: Is quantum theory exact?, "Higher Order Quantum Computation"

Smolenice, June 15th 2018, 15th Central European Quantum Information Processing Workshop, "Higher order quantum computation"

Frascati, November 30th 2017, Workshop: New frontiers in testing quantum mechanics from underground to the space, " From Quantum Cellular Automata to Doubly Special Relativity"

Hangzhou, July 13th 2017, School of Mathematical Sciences, Zhejiang University, "Quantum Cellular Automata for Quantum Field Theory"

Bratislava, November 4th 2016, Slovak Academy of Sciences, "Adding a control to unknown quantum channels"

Phuket, April 9th 2016, EMN Quantum Meeting, "Quantum Cellular Automata, Quantum Fields and Deformed Special Relativity"

Singapore, April 14th 2015, Centre for Quantum Technologies, "Quantum Cellular Automata, Quantum Field Theory and Deformed Special Relativity"

Grenoble, February 6th 2014, Meeting on Relativistic Quantum Walks, "A Quantum Cellular Automata approach to Quantum Field Theory"

Olomouc, July 3rd 2013, Palacky University, "Optimal covariant processing of Unitary Transformations"

Tianjin, August 20th 2012, Chern Institute of Mathematics, Nankai University, XXIX International Colloquium on Group-Theoretical Methods in Physics, "Optimal covariant processing of Quantum Gates"

Bratislava, June 8th 2010, Slovak Academy of Sciences, "Quantum Circuits Optimization"

Contributed talks and seminars

Palermo, September 12th 2022, 14th IQIS conference "Quantum simulation of scattering processes"

Tropea, June 29th 2022, Fifteenth Biennial Quantum Structure Conference "Causal and compositional structure of higher order quantum maps"

Oxford, July 11th 2019, Quantum Causal Structures, "Theoretical framework for Higher-Order Quantum Theory"

College Park, June 5th 2019, Theory of Quantum Computing, "Axiomatic theory of Higher-Order Quantum Computation"

Torino, May 30th 2019, Workshop: Quantum 2019 From Foundations of Quantum Mechanics to Quantum Information and Quantum Metrology & Sensing, "Higher Order Quantum Computation and Quantum Causal Structures"

Cagliari, October 8th 2018, Workshop: Quantum Cagliari, "Higher Order Quantum Computation"

Kazan, July 18th 2018, 14th Biennial IQSA Conference, Plenary talk: "Higher Order Quantum Computation"

Milan, June 16th 2017 Workshop INFN BELL, "Quantum Cellular Automata for Quantum Field Theory"

Kolymbari, July 13th 2016, 5th International Conference on New Frontiers in Physics, "Quantum Walks and Deformed Special Relativity"

Yokohama, November 16th 2015, Workshop on Quantum Simulation and Quantum Walks, "Quantum Walks, Quantum Fields and (deformed) Relativity"

Monopoli, September 11th 2015, IQIS 2015 - 8th Italian Quantum Information Science, "Quantum Cellular Automata, Quantum Fields and Deformed Special Relativity"

Telc, June 19th 2015, 12th Central European Quantum Information Processing Workshop, "Quantum Cellular Automata, Quantum Fields and Deformed Special Relativity"

Castiglioncello, September 17th 2014, DICE2014 – Spacetime - Matter - Quantum Mechanics, "From Quantum Cellular Automata to Deformed Special Relativity"

Olomouc, June 25th 2014, 12th Biennial IQSA Conference, "From quantum cellular automata to deformed special relativity"

Marseille, July 17th 2014, Frontiers of Fundamental Physics, "From Quantum Cellular Automata to Quantum Field Theory"

Valtice, June 8th 2010, 7th Central European Quantum Information Processing Workshop, "Quantum Circuits Optimization"

Co-supervised thesis

PhD Thesis

- 2023 A. Pizzamiglio (co-supervision with P. Perinotti)
- 2022 L. Trezzini (co-supervision with P. Perinotti)

Master Thesis

- 2023 A. Pizzamiglio, University of Milano Bicocca, thesis title: "Index Theory for multi-dimensional qubit cellular automata" (supervisor: P. Perinotti)
- 2022 L. Trezzini, University of Trieste, thesis title: "Coarse Graining Procedure for Quantum Cellular Automata" (supervisor: A. Bassi)
- 2021 E. Centofanti, University of Pavia, thsis title: "Local isotropic number preserving interaction in discrete time Dirac QCA" (supervisor: P. Perinotti)

Bachelor thesis

- 2019 A. Mondini, University of Pavia, thesis title: "Landauer principle in finite dimensional quantum systems" (supervisor: P. Perinotti)

- 2019 F. Quetti, University of Pavia, thesis title: "Leggett Garg inequalities and temporal correlations" (supervisor: P. Perinotti)

- 2018 M. Lacchini, University of Pavia, thesis title: "Spekken's toy theory as an operational probabilistic theory: a preliminary analysis" (supervisor: P. Perinotti)

Scientific organisations and coordination of academic activities

Member of the programme committee of the international conference Quantum Physics and Logic (2021 and 2023)

Member of the programme committee of the CEQIP workshop (2018 and 2019)

Organizer of the workshop "Quantum Foundations Workshop" (Pavia, June 21-22 2016)

Editorial activities

2018 Guest editor of the Special Issue on "Quantum Cellular Automata and Quantum Walks" Condensed Matter - MDPI.

Referee for international journals. Among them: Nature Communications, Physical Review Letters, Physical Review A, Annals of Physics, Journal of Physics A, Foundations of Physics.

Publications

ORCID: http://orcid.org/0000-0002-9356-3448

Google Scholar: https://scholar.google.it/citations?user=Ajo25vgAAAAJ

I, Alessandro Bisio, born in TORTONA (AL) on 23/11/1982, resident in via Vaccari n.7, PAVIA (IT), declare under penalty of perjury subject to all applicable laws, that the information provided is true and correct to the best of my knowledge,

information and belief (art. 46, 47 and 76 D.P.R. 28/12/2000 n.445).
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Pavia, 4 giugno 2024