

# Simone Murro

## Curriculum Vitae

Department of Mathematics  
University of Genova  
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### Academic Positions

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|---|-------------------|
| • Assistant Professor, University of Genova, Italy        | 02/2022 – present |
| • Research fellowship, University of Paris-Saclay, France | 10/2020 – 01/2022 |
| • Postdoc position, University of Trento, Germany         | 10/2019 – 09/2020 |
| • Postdoc position, University of Freiburg, Germany       | 08/2017 – 09/2019 |
| • Postdoc position, University of Regensburg, Germany     | 07/2017 – 04/2017 |

### Education

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|--|-------------------|
| • Ph.D. in Mathematics, University of Regensburg, Germany<br>Advisor: Felix Finster      Coadvisor: Claudio Dappiaggi<br>Thesis title: <i>Quantum states on the algebras of Dirac fields</i> | 04/2014 – 04/2017 |
| • M.S. in Mathematical Physics, University of Pavia, Italy   | 10/2011 – 10/2013 |
| • B.S. in Physics, University of Pavia, Italy  | 10/2007 – 04/2011 |

### Awards, Grants and Fellowship

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|---|-------------------|
| • <i>Abilitazione scientifica nazionale (Italian habilitation)</i>                | 06/2021 – 05/2032 |
| • <i>P.I. ICMS grant</i> , “Noncommutative Gelfand duality”                       | 02/2025           |
| • <i>P.I. FRA 2024 UniGe</i> , “Quantum Aspects of Fields and Gravity”            | 07/2024 – 06/2026 |
| • <i>Fellowship INFN</i> , sect. Genova   | 01/2023 – 12/2024 |
| • <i>P.I. INdAM grant</i> , “Feynman propagator for Dirac fields”                 | 01/2023 – 12/2023 |
| • <i>P.I. DFG Reserch grant</i> , “Hadamard states in Linearized Quantum Gravity” | 10/2020 – 01/2022 |
| • <i>Fellowship INFN</i> , sect. Trento   | 10/2019 – 09/2020 |
| • <i>DFG Fellowship</i> , GRK 1821 “Cohomological Methods in Geometry”            | 08/2017 – 09/2019 |
| • <i>Fellowship CRM</i> , Applied Mathematics Laboratory                          | 07/2018           |
| • <i>P.I. Short-visit grant</i> , COST Action MP 1405                             | 11/2015           |
| • <i>DFG Fellowship</i> , GRK 1692 “Curvature, Cycles, and Cohomology”            | 04/2014 – 03/2017 |

### Publications

23. “Notions of Fermionic Entropies of a Causal Fermion System ” to appear on *Mathematical Physics, Analysis and Geometry* (with F. Finster, R. H. Jonsson, M. Lottner and A. Much)
22. “Wick rotation of linearized gravity in Gaussian time and Calderón projectors” to appear on *Annales Henri Poincaré* (with C. Gérard and M. Wrochna)
21. “The Quantization of Maxwell Theory in the Cauchy Radiation Gauge: Hodge Decomposition and Hadamard States” *Journal of London Mathematical Society* (2024) vol 110 (with G. Schmid)
20. “On boundary conditions for linearised Einstein’s equations” *Applied Mathematics Letters* (2024) vol 158: 109210 (with M. Capoferri and G. Schmid)

19. "The five gradients inequality on differentiable manifolds" *Journal de Mathématiques Pures et Appliquées* (2024) vol 187: 294-328 (with S. Di Marino and E. Radici)
18. "On the Cauchy problem for the Fadaray tensor on globally hyperbolic manifolds with timelike boundary" *Rendiconti Lincei Matematica e Applicazioni* (2024) vol 34: 809-829 (with N. Drago and N. Ginoux)
17. "Global and microlocal aspects of Dirac operators: propagators and Hadamard states" to appear on *Advances in Differential Equations* (with M. Capoferri)
16. "The quantization of Proca fields on globally hyperbolic spacetimes: Hadamard states and Møller operators" *Annales Henri Poincaré* (2023) vol 24: 3055-3111 (with V. Moretti and D. Volpe)
15. "Paracausal deformations of Lorentzian metrics and Møller isomorphisms in algebraic quantum field theory" *Selecta Mathematica New Series* vol 29: 56 (with V. Moretti and D. Volpe)
14. "Møller operators and Hadamard states for Dirac fields with MIT boundary conditions" *Documenta Mathematica* (2022) vol 27: 1693-1737 (with N. Drago and N. Ginoux)
13. "On the Cauchy problem for Friedrichs systems on globally hyperbolic manifolds with timelike boundary" *Advances in Differential Equations* (2022) vol 27: 497-542 (with N. Ginoux)
12. "Injective tensor products in strict deformation quantization" *Mathematical Physics, Analysis and Geometry* (2022) vol 25: 2 (with C.J.F. van de Ven)
11. "Intertwining operators for symmetric hyperbolic systems on globally hyperbolic manifolds" *Annals of Global Analysis and Geometry* (2021) vol 59: 1-25 (with D. Volpe)
10. "On the uniqueness of invariant states" *Advances in Mathematics* (2021) vol 376: 107445 (with F. Bambozzi)
9. "The well-posedness of the Cauchy problem for the Dirac operator on globally hyperbolic manifolds with timelike boundary" *Documenta Mathematica* (2020) vol 25: 737-765 (with N. Große)
8. "The Fermionic Signature Operator in De Sitter Spacetime" *Journal of Mathematical Analysis and Applications* (2020) vol 485: 123808 (with C. Dappiaggi, F. Finster and E. Radici)
7. "Invariant states on noncommutative tori" *International Mathematics Research Notices* (2019) vol 2021: 3299-3313 (with F. Bambozzi and N. Pinamonti)
6. "A new class of Fermionic Projectors: Møller operators and mass oscillation properties" *Letters in Mathematical Physics* (2017) vol 117: 2433-2451 (with N. Drago)
5. "The Fermionic Signature Operator and Quantum States in Rindler Space-time" *Journal of Mathematical Analysis and Applications* (2017) vol 454: 385-411, (with F. Finster and C. Röken)
4. "Non-existence of natural states for Abelian Chern-Simons theory" *Journal of Geometry and Physics* (2017) vol 116: 119-123 (with C. Dappiaggi and A. Schenkel)
3. "Wavefront sets and polarizations on supermanifolds" *Journal of Mathematical Physics* (2017) vol 58: 023504 (with C. Dappiaggi, H. Gimperlein and A. Schenkel)
2. "The fermionic projector in a time-dependent external potential: mass oscillation property and Hadamard states" *Journal of Mathematical Physics* (2016) vol 57: 072303 (with F. Finster and C. Röken)
1. "Radiative observables for linearized gravity on asymptotically flat spacetimes and their boundary induced states" *Journal of Mathematical Physics* (2014) vol 55: 082301 (with M. Benini and C. Dappiaggi)

## Pre-print

2. "Noncommutative Gelfand Duality: the algebraic case" arXiv:2411.11816 [math.AG] (2024) (with F. Bambozzi and M. Capoferri)
1. "The fermionic entanglement entropy of causal diamonds in two-dimensional Minkowski space" arXiv:2407.05292 [math-ph] (2024) (with F. Finster, M. Lottner and A. Much)

## Invited Research Talks

- *On the construction of Hadamard states for linearized Einstein equations*  
 Seminar: "Seminar über Mathematische Physik", University of Regensburg      05/2024
- *A pathway to noncommutative Gelfand duality*  
 Seminar: "Operator Algebra", University of Roma Tor Vergata      04/2025  
 Seminar: "Seminar über Mathematische Physik", University of Regensburg      05/2024  
 Seminar: "Seminario di Fisica Matematica", University of Trento      04/2024  
 Seminar: "Algebra & Geometry Seminar ", University of Genova      03/2024
- *Hadamard states for Maxwell fields via complete gauge fixing*  
 Seminar: "Seminar über Mathematische Physik", University of Regensburg      11/2023  
 Seminar: "Heriot-Watt Analysis Seminar", Maxwell Institute, Edinburgh      10/2023  
 Conference: "Spectral Theory and Mathematical Relativity", ESI Vienna      07/2023
- *Paracausal deformations of Lorentzian metrics and their consequences in QFT*  
 Seminar: "Séminaire de Géometrie différentielle"      10/2021
- *On the Cauchy problem for Friedrichs systems on Lorentzian manifolds*  
 Seminar: "Quantum fields interacting with geometry" Institut Henri Poincaré      11/2020  
 Seminar: "Forschungsseminar Differentialgeometrie" University of Potsdam      10/2020  
 Seminar: "Seminar über Mathematische Physik", University of Regensburg      07/2020  
 Conference: "Cross-diffusion systems, gradient flows, and their perturbations"      04/2019
- *On the Cauchy problem for the Dirac operators on Lorentzian spin manifolds*  
 Conference: "Journées nancéennes de géométrie" Nancy      12/2018  
 Seminar: "Seminario di Fisica Matematica" University of Genova      02/2018  
 Seminar: "Seminar über Mathematische Physik", University of Regensburg      11/2017
- *Linearized gravity and Hadamard states*  
 Seminar: "Séminaires Math-Physique" University of Bourgogne      07/2017
- *Is there a natural states for Abelian Chern-Simons theory?*  
 Seminar: "Seminario di Fisica Matematica" University of Roma 3      09/2017  
 Seminar: "Seminario di Fisica Matematica" University of Genova      07/2017  
 Workshop: "Foundational and structural aspects of gauge theories"      03/2017
- *Invariant states on Weyl algebras for the action of the symplectic group*  
 Conference: "Young Researchers Symposium at ICMP"      07/2018  
 Workshop: "AQFT: where operator algebra meets microlocal analysis"      05/2018
- *Hadamard states for quantum Dirac fields*  
 Seminar: "Coloquio de Matemática UC" Universidad Católica de Chile      11/2016  
 Seminar: "Seminario de Teoría Espectral" Universidad Católica de Chile      10/2016  
 Seminar: "Münchner Mathematische" LMU Munich      07/2016  
 Seminar: "Seminars of Mathematical Physics" Heriot-Watt University      10/2015  
 Seminar: "Seminario di Fisica Matematica" University of Genova      04/2015  
 Seminar: "Seminario di Fisica Matematica" University of Pavia      11/2014

## **Conference and Workshop organization**

- *Algebraic and Geometric Aspects in Quantum Field Theory*  
Workshop at the University of Freiburg, 16–18 April 2019
- *Analysis of Differential Operators on Manifolds*  
Workshop at the University of Freiburg, 24–26 September 2018

## **Teaching Experiences**

- “Modelli di Sistemi Continui ed Applicazioni” at the University of Genova  
degree in Mathematics: Wi.Se. 2024
- “Elementi di Matematica” at the University of Genova  
degree in Chemistry: Wi.Se. 2024
- “Meccanica Analitica” at the University of Genova  
degree in Mathematics: Su.Se. 2022 ,Su.Se. 2023, Su.Se. 2024  
degree in Physics: Su.Se. 2024
- “Meccanica Matematica della Relatività Generale” at the University of Genova  
degree in Mathematics , Wi.Se. 2022, Wi.Se. 2023
- “Fisica Matematica ” at the University of Genova  
degree in Engineering: Su.Se. 2022 , Wi.Se. 2022, Wi.Se. 2023
- “Operator Algebras and Quantum Field Theory” at the University of Freiburg  
degree in Mathematics: Wi.Se. 2018
- “Operator Algebras and Quantum Mechanics” at the University of Freiburg  
degree in Mathematics: Su.Se. 2018
- “Mikrolocale Analysis” at the University of Freiburg  
degree in Mathematics: Wi.Se. 2017

## **Mentoring**

### **Ph.D. students**

- Stefano Rosarin, University of Genoa (11.2014 – ongoing)  
Ph.D. candidate at the University of Genoa  
co-supervised with Prof. Federico Bambozzi
- Gabriel Schmid (11.2022 – ongoing)  
Ph.D. candidate at the University of Genoa  
co-supervised with Matteo Capoferri
- Daniele Volpe, University of Trento (11.2019 – 07.2023)  
Ph.D. Thesis: Paracausal deformations, Møller operators and Hadamard states in CCR AQFT  
co-supervised with Prof. Valter Moretti

## Master students

- Matteo Vassallo – Master student in 2025 at the University of Genova

Thesis: Towards a geometric model for quantum spacetimes: the noncommutative spectrum of a ring  
co-supervised with Federico Bambozzi

## Bachelor students

- Carola Bozano Gandolfi – Bachelor student in 2025 at the University of Genova

Thesis: L'equazione di D'Alembert: applicazioni in musica

- Caterina Tavelli – Bachelor student in 2023 at the University of Genova

Thesis: Il sistema di Lorenz: un modello matematico per la convezione atmosferica

- Chiara Poggi – Bachelor student in 2023 at the University of Genova

Thesis: Stima del Wave Front Set per campi di Klein-Gordon

co-supervised with Nicola Pinamonti

## References

- Prof. Dr. C. Dappiaggi : *Dipartimento di Fisica, Università di Pavia*  
email: claudio.dappiaggi@unipv.it
- Prof. Dr. F. Finster: *Fakultät für Mathematik, Universität Regensburg*  
email: finster@ur.de
- Prof. Dr. C. Gérard: *Département de Mathématiques, Université Paris-Saclay*  
email: christian.gerard@math.u-psud.fr
- Prof. Dr. V. Moretti: *Dipartimento di Matematica, Università di Trento*  
email: valter.moretti@unitn.it

Genova  
April 4, 2025