

# Alessio Lerose

## Curriculum Vitae

### Personal Data

Born: Magenta (Italy), 18<sup>th</sup> Dec 1990      Citizenship: Italian  
Webpage <https://www.physics.ox.ac.uk/our-people/lerose>  
Profile <https://scholar.google.com/citations?user=ZC3dfLMAAAAJ&hl=it>

### Employment

2023 – **Leverhulme-Peierls Fellow**, *Rudolf Peierls Centre for Theoretical Physics*, University of Oxford (UK)  
2023 – **Junior Research Fellow**, *Wadham College*, University of Oxford (UK)  
2019 – 2023 **Post-doctoral researcher**, *Department of Theoretical Physics*, University of Geneva (CH)  
Group: Prof. D. Abanin

### Education

Oct 2019 **Ph.D.**, *Statistical Physics*, SISSA - International School for Advanced Studies, Trieste (IT), cum laude  
Thesis: *Non-equilibrium phenomena in quantum many-body systems with long-range interactions*  
Advisors: Profs. A. Gambassi, A. Silva  
Oct 2015 **Master Degree**, *Physics*, University of Milan (IT), 110/110 cum laude  
Thesis: *Thermalization and its breakdown at the many-body localization transition* (at ICTP, Trieste, Italy)  
Dec 2012 **Bachelor Degree**, *Physics*, University of Milan (IT), 110/110 cum laude  
Thesis: *Classical microscopic theory of polaritons in ionic crystals*

### Competitive Funding Awarded

Sep 2024 – **Early-Career Grant *Ambizione* of the Swiss National Science Foundation (funds: 855K CHF)**,  
Aug 2028 Project: *Universality of quantum many-body dynamics: From strong correlations to transport*,  
Collaboration: Prof. E. Demler (ETH Zurich), Prof. A. Georges (CCQ New York & CdF Paris)

### Prizes and Honors

Dec 2023 **Italian *Abilitazione Scientifica Nazionale***, as Associate Professor in *Theoretical Physics* (02/A2)  
Dec 2023 **Italian *Abilitazione Scientifica Nazionale***, as Associate Professor in *Physics of Matter* (02/B2)  
Dec 2022 **Leverhulme-Peierls Fellowship**, created “to support the most talented early-career theoretical physicists worldwide and to enrich the intellectual environment of the Rudolf Peierls Centre”  
Nov 2021 ***New Journal of Physics* (NJP) Early-Career Award (3K EUR)**, jointly awarded by the NJP Editorial Board, the German Physical Society (DPG) and the Institute of Physics (IOP), “for seminal and pioneering contributions in the field of non-equilibrium dynamics of quantum systems”  
Sep 2021 “***Giovanni Polvani*” Early-Career Prize (2K EUR)**, awarded by the Italian Physical Society (SIF)  
Apr 2021 **Best Poster Prize**, Workshop *Correlation Days 2021*, Max Planck Institute for the Physics of Complex Systems, Dresden (Germany)

## Teaching Experience

- Fall 2022 **Quantum Light and Matter**, *Master course in Physics*, University of Geneva, with Prof. D. Abanin, Prof. A. Caviglia  
Teacher (15% of lectures) and Teaching Assistant (tutorials, exams)
- Spring 2022 **Group Theory**, *Master course in Physics*, University of Geneva, with Dr. S. Foffa  
Teaching Assistant (tutorials, exams)
- Fall 2021 **Quantum Light and Matter**, *Master course in Physics*, University of Geneva, with Prof. D. Abanin  
Teacher (15% of lectures) and Teaching Assistant (tutorials, exams)
- Year 2020-21 **Laboratory of Theoretical Physics**, *Master course in Physics*, University of Geneva, with Prof. K. Kruse, Prof. A. Riotto  
Teacher
- Spring 2020 **Classical Stochastic Methods**, *Master course in Physics*, University of Geneva, with Prof. E. Sukhorukov  
Teaching Assistant (tutorials, exams)

## Organization of Events

- 2023-2024 Seminar Series *Condensed Matter Theory Forum*, Oxford *with Dr. A. Prakash*
- Mar 2023 Workshop *Quantum interactive dynamics*, Oxford *with Dr. V. Bulchandani, Prof. S. Sondhi*
- Year 2019 *SISSA Ph.D. Colloquia* *with Prof. S. Ruffo*

## Institutional Responsibilities

- Jan 2024 Examiner for Ph.D. Thesis Defense *SISSA Trieste (IT)*
- Jan 2024 Examiner for D.Phil. *Transfer of Status* *University of Oxford (UK)*
- Dec 2023 Examiner for D.Phil. *Confirmation of Status* *University of Oxford (UK)*

## Peer Review

- ★ *Nature*
- ★ *Nature Communications*
- ★ *Physical Review A, B, E, X, Letters*
- ★ *Journal of Statistical Mechanics*
- ★ *SciPost*
- ★ *Science*
- ★ *Nature Physics Journal: Quantum Info*
- ★ *New Journal of Physics*
- ★ *Journal of High-Energy Physics*
- ★ *Quantum*

## Other Experience

- 2024 *Saturday Morning of Theoretical Physics* *Outreach activity for Oxford Alumni*
- 2018 *SISSA Statistical Physics Group webpage* *Manager*
- 2018 *SISSA4Schools* *Outreach activity for Italian high schools*
- 2016-2018 *SISSA Academic Senate* *Students' representative*

## Research Interests

- **Non-equilibrium universality** in many-particle systems, collective dynamical phenomena
- **Thermalization, chaos, ergodicity breaking** in isolated quantum many-body systems
- Real-time dynamics and quantum simulation of **lattice gauge theories**
- Development of **tensor-network** computational approaches for strongly correlated matter
- Theory and applications of **long-range interactions** in atomic-molecular-optical systems

## Invited Talks at Conferences and Colloquia

- *Non-Equilibrium Workshop*, Vienna (Austria), 5<sup>th</sup> Jul 2024
- *Theoretical Physics Colloquium*, University of Innsbruck and IQOQI (Austria), 10<sup>th</sup> Apr 2024
- *Chaos and information dynamics in quantum many body systems*, Ettore Majorana Center, Erice (Italy), 26<sup>th</sup> Nov 2023
- *Exploring Non-equilibrium Long-range Quantum Matter*, KITP Santa Barbara, CA (USA), 13<sup>th</sup> Nov 2023
- *Non-equilibrium quantum dynamics – in memory of Marko Medenjak*, University of Ljubljana (Slovenia), 12<sup>th</sup> May 2023
- *Quantum interactive dynamics*, University of Oxford (UK), 27<sup>th</sup> Mar 2023
- *Mathematical Quantum Matter*, University of Milan (Italy), 10<sup>th</sup> Jan 2023
- *The many facets of Statistical Field Theory*, SISSA Trieste (Italy), 17<sup>th</sup> Oct 2022
- *Youth Forum for Quantum Physics*, Tsung-Dao Lee Institute, Shanghai (China), 14<sup>th</sup> Jan 2022
- *Spacetime Duality in Quantum Circuits*, IIT Madras & Turipati (India), 10<sup>th</sup> Nov 2021
- *Trieste Quantum Days*, ICTP Trieste (Italy), 25<sup>th</sup> Jul 2019
- *Non-equilibrium behavior of classical and quantum systems*, SISSA, Trieste (Italy), 10<sup>th</sup> Sep 2018
- *Non-ergodicity & integrability*, ESI, Vienna (Austria), 28<sup>th</sup> May 2018
- *Trieste-Ljubljana meeting*, University of Ljubljana (Slovenia), 29<sup>th</sup> Nov 2017
- *The many facets of non-equilibrium physics: from many body theory to quantum thermodynamics*, Mazara del Vallo (Italy), 18<sup>th</sup> Sep 2017

## Invited Seminars

2024:

- University of Maryland (USA) [host: Prof. Z. Davoudi], 14<sup>th</sup> May 2024
- LPTMS, University of Paris-Saclay (France) [host: Dr. V. Ros], 14<sup>th</sup> May 2024
- Politecnico di Torino (Italy) [host: Dr. L. Barbiero], 8<sup>th</sup> Apr 2024
- University of Pisa (Italy) [host: Prof. D. Rossini], 4<sup>th</sup> Apr 2024
- University of Padua (Italy) [host: Prof. S. Montangero], 27<sup>th</sup> Mar 2024
- University of Bologna (Italy) [host: Prof. E. Ercolessi], 25<sup>th</sup> Mar 2024
- Max Planck Institute for the Physics of Complex Systems (Germany) [host: Dr. M. Bukov], 9<sup>th</sup> Jan 2024

2023:

- University of Strathclyde (UK) [host: Dr. P. Poggi, Prof. A. Daley], 23<sup>th</sup> Nov 2023
- Ecole Normale Supérieure de Lyon (France) [host: Prof. T. Roscilde], 28<sup>th</sup> Sep 2023
- University of the Basque Country (Spain) [host: Prof. G. Tóth], 5<sup>th</sup> Sep 2023
- University of Augsburg (Germany) [host: Prof. M. Heyl], 19<sup>th</sup> Apr 2023

2022:

- Technische Universität Munich (Germany) [host: Prof. M. Knap], 28<sup>th</sup> Nov 2022
- Ludwig-Maximilians Universität Munich (Germany) [host: Prof. J. von Delft], 25<sup>th</sup> Nov 2022

- Freie Universität Berlin (Germany) [host: Prof. J. Eisert], 4<sup>th</sup> Jul 2022
- CEA Grenoble (France) [host: Dr. M. Filippone], 13<sup>th</sup> May 2022
- *Balades Quantiques*, Ecole Normale Supérieure de Paris (France), 7<sup>th</sup> Apr 2022
- University of Leeds (UK) [host: Dr. Z. Papic], 10<sup>th</sup> Mar 2022
- University of Cambridge (UK) [host: Prof. A. Lamacraft], 8<sup>th</sup> Mar 2022
- University of Oxford (UK) [host: Prof. S. Parameswaran], 2<sup>nd</sup> Mar 2022
- Universidade Federal do Rio Grande do Norte, Natal (Brasil) [host: Prof. T. Macri], 13<sup>th</sup> Jan 2022

2021:

- ICTP/SISSA seminar, Trieste (Italy) [host: Prof. A. Gambassi], 1<sup>st</sup> Oct 2021
- University of Mainz (Germany) [host: J. Prof. J. Marino], 14<sup>th</sup> Jul 2021
- Leeds-Leighborough-Nottingham Nonequilibrium Seminars (UK), 16<sup>th</sup> Jun 2021
- Karlsruhe Institute of Technology (Germany) [host: Dr. E. Doggen], 13<sup>th</sup> Apr 2021

2020:

- IST Vienna (Austria) [host: Prof. M. Serbyn], 16<sup>th</sup> Dec 2020

2019:

- Paul Scherrer Institute, Villigen (Switzerland) [host: Prof. M. Müller], 31<sup>st</sup> Jan 2019
- University of Saarland (Germany) [host: Prof. G. Morigi], 29<sup>th</sup> Jan 2019
- University of Heidelberg (Germany) [host: Dr. T. Enss], 23<sup>th</sup> Jan 2019

2018:

- Harvard University (USA) [host: Dr. J. Marino], 1<sup>st</sup> May 2018

## Scientific Publications and Preprints

- E. R. Bennowitz, B. Ware, A. Schuckert, **AL**, F. M. Surace, R. Belyansky, W. Morong, D. Luo, A. De, K. Collins, O. Katz, C. Monroe, Z. Davoudi, A. Gorshkov  
*Simulating Meson Scattering on Spin Quantum Simulators*  
(To appear)
- AL**, T. Parolini, R. Fazio, D. Abanin, S. Pappalardi  
*Theory of robust quantum many-body scars in long-range interacting systems*  
[arXiv:2309.12504](#) (2023)
- N. Defenu, **AL**, S. Pappalardi  
*Out-of-equilibrium dynamics of quantum many-body systems with long-range interactions*  
[arXiv:2307.04802](#) (2023) (Invited review article for *Physics Reports*)
- B. Kloss, J. Thoenniss, M. Sonner, **AL**, M. Fishman, M. Stoudenmire, O. Parcollet, A. Georges, D. Abanin  
*Equilibrium quantum impurity problems via matrix-product state encoding of the retarded action*  
*Phys. Rev. B* **108**, 205110 (2023)
- J. Thoenniss, M. Sonner, **AL**, D. Abanin  
*Efficient method for quantum impurity problems out of equilibrium*  
*Phys. Rev. B* **107**, L201115 (2023)
- J. Thoenniss, **AL**, D. Abanin  
*Non-equilibrium quantum impurity problems via matrix-product states in the temporal domain*  
*Phys. Rev. B* **107**, 195101 (2023)
- AL**, M. Sonner, D. Abanin  
*Overcoming the entanglement barrier in quantum many-body dynamics via space-time duality*  
*Phys. Rev. B* **107**, L060305 (2023)

23. F. Balducci, A. Gambassi, **AL**, A. Scardicchio, C. Vanoni  
*Interface dynamics in the two-dimensional quantum Ising model*  
[Phys. Rev. B \*\*107\*\*, 024306 \(2023\)](#)
22. M. Collura, A. De Luca, D. Rossini, **AL**  
*Discrete time-crystalline response stabilized by domain-wall confinement*  
[Phys. Rev. X \*\*12\*\*, 031037 \(2022\)](#)
21. F. Balducci, A. Gambassi, **AL**, A. Scardicchio, C. Vanoni  
*Localization and melting of interfaces in the two-dimensional quantum Ising model*  
[Phys. Rev. Lett. \*\*129\*\*, 120601 \(2022\)](#)
20. G. Giudice, G. Giudici, M. Sonner, J. Thoenniss, **AL**, D. Abanin, L. Piroli  
*Temporal entanglement, quasiparticles and the role of interactions*  
[Phys. Rev. Lett. \*\*128\*\*, 220401 \(2022\)](#)
19. K. Seetharam, **AL**, R. Fazio, J. Marino  
*Dynamical scaling of correlations generated by short- and long-range dissipation*  
[Phys. Rev. B \*\*105\*\*, 184305 \(2022\)](#)
18. M. Sonner, **AL**, D. Abanin  
*Characterizing many-body localization via exact disorder-averaged quantum noise*  
[Phys. Rev. B \*\*105\*\*, L020203 \(2022\)](#) (selected as Editors' suggestion)
17. K. Seetharam, **AL**, R. Fazio, J. Marino  
*Correlation engineering via non-local dissipation*  
[Phys. Rev. Research \*\*4\*\*, 013089 \(2022\)](#)
16. **AL**, M. Sonner, D. Abanin  
*Scaling of temporal entanglement in proximity to integrability*  
[Phys. Rev. B \*\*104\*\*, 035137 \(2021\)](#)
15. M. Sonner, **AL**, D. Abanin  
*Influence functional of many-body systems: temporal entanglement and matrix-product state representation*  
[Annals of Physics \*\*431\*\*, 168552 \(2021\)](#)
14. **AL**, M. Sonner, D. Abanin  
*Influence matrix approach to many-body Floquet dynamics*  
[Phys. Rev. X \*\*11\*\*, 021040 \(2021\)](#)
13. F. M. Surace, **AL**  
*Scattering of mesons in quantum simulators*  
[New J. Phys. \*\*23\*\* 062001 \(2021\)](#) (Fast Track Communication)
12. O. Chelpanova, **AL**, S. Zhang, I. Carusotto, Y. Tserkovnyak, J. Marino  
*Competition between lasing and superradiance under spintronic pumping*  
[arXiv:\*\*2112.04509\*\* \(2021\)](#)
11. **AL**, S. Pappalardi  
*Bridging entanglement dynamics and chaos in semiclassical systems*  
[Phys. Rev. A \*\*102\*\*, 032404 \(2020\)](#)
10. F. M. Surace, P. P. Mazza, G. Giudici, **AL**, A. Gambassi, M. Dalmonte  
*Lattice gauge theories and string dynamics in Rydberg-atom quantum simulators*  
[Phys. Rev. X \*\*10\*\*, 021041 \(2020\)](#)

9. **AL**, F. Surace, P. P. Mazza, G. Perfetto, M. Collura, A. Gambassi  
*Quasilocalized dynamics from confinement of quantum excitations*  
[Phys. Rev. B \*\*102\*\*, 041118\(R\) \(2020\)](#) (selected as Editors' suggestion)
8. **AL**, S. Pappalardi  
*Origin of the slow growth of entanglement entropy in long-range interacting spin systems*  
[Phys. Rev. Research \*\*2\*\*, 012041\(R\) \(2020\)](#)
7. **AL**, B. Žunkovič, A. Silva, A. Gambassi  
*Quasilocalized excitations induced by long-range interactions in translationally-invariant quantum spin chains*  
[Phys. Rev. B \*\*99\*\*, 121112\(R\) \(2019\)](#)
6. P. P. Mazza, G. Perfetto, **AL**, M. Collura, A. Gambassi  
*Suppression of transport in non-disordered quantum spin chains due to confined excitations*  
[Phys. Rev. B \*\*99\*\*, 180302\(R\) \(2019\)](#)
5. **AL**, J. Marino, A. Gambassi, A. Silva  
*Prethermal quantum many-body Kapitza phases of periodically driven spin systems*  
[Phys. Rev. B \*\*100\*\*, 104306 \(2019\)](#) (selected as Editors' suggestion)
4. **AL**, B. Žunkovič, J. Marino, A. Gambassi, A. Silva  
*Impact of nonequilibrium fluctuations on prethermal dynamical phase transitions in long-range interacting spin chains*  
[Phys. Rev. B \*\*99\*\*, 045128 \(2019\)](#)
3. **AL**, J. Marino, B. Žunkovič, A. Gambassi, A. Silva  
*Chaotic dynamical ferromagnetic phase induced by nonequilibrium quantum fluctuations*  
[Phys. Rev. Lett. \*\*120\*\*, 130603 \(2018\)](#)
2. V. K. Varma, **AL**, F. Pietracaprina, J. Goold, A. Scardicchio  
*Energy diffusion in the ergodic phase of a many body localizable spin chain*  
[J. Stat. Mech. \*\*053101\*\* \(2017\)](#) (based on Master thesis)
1. **AL**, A. Sanzeni, A. Carati, L. Galgani  
*Classical microscopic theory of polaritons in ionic crystals*  
[Eur. Phys. J. D \*\*68\*\*, 35 \(2014\)](#) (based on Bachelor thesis)