

# Dr. Luca Chirolli

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## Education

- PhD, Physics Sep. 2005 - Jan 2010 University of Konstanz, Germany  
Thesis: *Quantum control and quantum measurement of solid state qubits*  
Study of superconducting qubit: voltage-control, quantum non-demolition measurement, black-box quantization, quantum control, dephasing and decoherence  
Supervisor: Prof. G. Burkard
- Laurea, Physics Sept. 1999 - March 2005 University of Bologna, Italy  
Thesis: *Entanglement and phase transitions in spin 1/2 chains*  
Study of the entanglement properties of spin-1/2 chains with focus on localizable entanglement as a figure of merit  
Supervisor: Prof. G. Morandi

## Academic career

Research activity in Theory of Condensed Matter Physics:

- Marie Curie Fellow 9/2021 - present, Istituto Nanoscienze CNR, Pisa, *Incoming Phase*  
9/2019 - 2/2021, UC Berkeley, California, USA, *Outgoing Phase*  
Global Fellowship Grant awarded as PI on the project ***Simulation of topological phases in superconducting circuits***: study of the topological properties of the charge spectrum of superconducting circuits, parity-protection, and Majorana qubits
- Visiting scientist 4/2019 - 9/2019, Department of Physics, University of Bologna, Italy  
**Engineering of surface chiral superconductivity**: nematic superconductors decorated with surface magnetic impurities, phase diagram and surface solutions
- Postdoc Researcher 2/2015 - 9/2019, IMDEA Nanoscience Foundation, Madrid, Spain  
**Topological superconductivity in Dirac materials**: signatures of topologically protected surface states in bulk properties and magnetic response, with focus on Bi<sub>2</sub>Se<sub>3</sub>
- 1/2013 - 12/2014, Instituto de Ciencia de Materiales de Madrid - CSIC, Spain  
**Electronic properties of 2D and van der Waals materials**: strong spin-orbit interaction and superconductivity in transition-metal dichalcogenides
- 1/2010 - 12/2012, Scuola Normale Superiore, Pisa, Italy  
**Coherence and interferometry in electronic systems**: design of a Mach-Zehnder electronic interferometer with co-propagating spin-resolved edge states in the integer quantum Hall effect

## Teaching Experience

- Student Workshop *Graphene* 2014 - Department of Physics, Al Jadida - Morocco
- Teaching Assistance: *Introduction to theoretical physics* 2007 - Department of Physics, RWTH Aachen, DE  
*Solid state theory* 2006 - Department of Physics, University of Basel, CH

## Scientific track

|                                         |                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>Bibliometrics</u>                    | <ul style="list-style-type: none"> <li>- <b>35</b> publications in peer reviewed journals</li> <li>- <b>750+</b> citations</li> <li>- h-index <b>14</b></li> </ul>                                                                                                                                                                               |
| <u>Reviews</u>                          | <ul style="list-style-type: none"> <li>- <i>Anyons in Quantum Hall Interferometry</i>, Nature Review Physics <b>3</b>, 698 (2021)</li> <li>- <i>Theory of 2D crystals: graphene and beyond</i>, Chem. Soc. Rev. <b>46</b>, 4387 (2017)</li> <li>- <i>Decoherence in Solid State Qubits</i>, Advances in Physics <b>57</b>, 225 (2008)</li> </ul> |
| <u>Grants awarded</u>                   | TOPOCIRCUS - 841894: EU Marie Skłodowska Curie Action: Global Fellowship                                                                                                                                                                                                                                                                         |
| <u>Referee</u>                          | Referee of Nature Comm., Phys. Rev. Lett, Phys. Rev. A and B, Europhys. Lett                                                                                                                                                                                                                                                                     |
| <u>Participation in funded projects</u> | <ul style="list-style-type: none"> <li>- 2014-2018. IMDEA Nanoscience PI : F. Guinea. S2013/MIT-3007 Com. de Madrid</li> <li>- 2012-2017. PI: F. Guinea. ERC-2011-ADG 20110209</li> <li>- FIRB-IDEAS 2009-2014. PI: Prof. V. Giovannetti. MIUR</li> </ul>                                                                                        |
| <u>ASN 2020</u>                         | Abilitazione Scientifica Nazionale to Associate Professor in Italy, FIS03 02/B2, Condensed Matter Theory                                                                                                                                                                                                                                         |

## Skills

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|--------------------|----------------------------------------------------------------------------------|
| <u>Programming</u> | c++, Python, Mathematica, Linux, OSX                                             |
| <u>Languages</u>   | Italian - Mother tongue<br>English - Fluent<br>Spanish - Fluent<br>German - Good |

## Invited Talks

|                   |                                                                                                                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| - Parigi 2022     | INRIA - <i>Coherence and Majorana qubits in <math>\pi</math>-Josephson circuits</i> , Host: Z. Leghtas                                                |
| - Salerno 2022    | PD - <i>Coherence and Majorana qubits in <math>\pi</math>-Josephson circuits</i> , Host: M. Cuoco                                                     |
| - Madrid 2022     | ICMM - <i>Coherence and Majorana qubits in <math>\pi</math>-Josephson circuits</i> , Host: R. Aguado                                                  |
| - Berkeley 2019   | PD- <i>Polariton Hall effect in transition-metal dichalcogenides</i> , Host: J. Moore                                                                 |
| - Shanghai 2019   | N2D Materials - <i>Polariton Hall effect in transition-metal dichalcogenides</i> , Host: L. Martin-Moreno                                             |
| - Palermo 2018    | PD - <i>Electronic and topological properties of 2D crystals</i> , Invited by F. Ciccarello                                                           |
| - Donostia 2018   | Quantum Designer Physics: <i>Magnetic Response of Class DIII Topological Superconductors</i> , Host: F. Guinea                                        |
| - Trieste 2017    | ICTP - <i>Time-reversal symmetry breaking superconductivity in Dirac materials</i> , Host: F. Taddei                                                  |
| - Madrid 2016     | ICMM - <i>Time-reversal symmetry breaking superconductivity in Dirac materials</i>                                                                    |
| - Sevilla 2016    | PD - <i>Odd-parity time-reversal invariant superconductor in magnetic field</i>                                                                       |
| - Bilbao 2016     | ECNF - <i>Odd-parity time-reversal invariant superconductor in magnetic field</i>                                                                     |
| - Basel 2016      | PD - <i>Odd-parity time-reversal invariant superconductor in magnetic field</i>                                                                       |
| - Madrid 2016     | Spinograph Conference - <i>Odd-parity time-reversal invariant superconductor in magnetic field</i>                                                    |
| - Zurich 2015     | ETH - Group of G. Blatter: <i>Enhancement of superconductivity in atomically thin TaS<sub>2</sub></i>                                                 |
| - Pisa 2015       | SNS - CMI group: <i>Enhancement of superconductivity in atomically thin TaS<sub>2</sub></i>                                                           |
| - Konstanz 2015   | PD - Group of G. Burkard: <i>Enhancement of superconductivity in atomically thin TaS<sub>2</sub></i>                                                  |
| - Paris 2014      | LSP Paris - Group of G. Montambaux: <i>Zero-bias conductance peak and detached layers of superconducting TaS<sub>2</sub></i>                          |
| - Barcelona 2014  | ICFO - Group of Prof. M. Lewenstein: <i>Theory of integer quantum Hall polaritons in graphene</i>                                                     |
| - Madrid 2014     | Workshop NanSC2014: <i>Odd-parity superconductivity in detached flakes of TaS<sub>2</sub></i>                                                         |
| - Pisa 2013       | SNS - CMI-group: <i>Interactions in electronic Mach-Zehnder interferometers with copropagating edge channels</i>                                      |
| - Madrid 2013     | ICMM-CSIC - Group of F. Guinea: <i>Electronic Mach-Zehnder interferometry with copropagating spin-resolved edge states in the quantum Hall regime</i> |
| - Copenhagen 2012 | PD - Group of K. Flensberg: <i>Datta-Das spin transistor in the IQHE</i>                                                                              |
| - Barcelona 2012  | ICN - Group of S. Roche: <i>Proposal for a Datta Das transistor in the quantum Hall regime</i>                                                        |
| - Konstanz 2011   | PD - Group of G. Burkard: <i>Time-bin entanglement of quasiparticles in semiconductor devices</i>                                                     |

## List of publications

Open source publications available [here](#):

1. *Anomalous periodicity and parafermion hybridization in superconducting qubits*  
A. Calzona, M. Carrega, **L. Chirolli**,  
arXiv:2208.07408 (2022)
2. *SWAP gate between a Majorana qubit and a parity-protected superconducting qubit*  
**L. Chirolli**, N. Y. Yao, J. E. Moore,  
arXiv:2205.01410 (2022)
2. *Frustration driven Josephson phase dynamics*  
C. Guarcello, **L. Chirolli**, M. T. Mercaldo, F. Giazotto, M. Cuoco,  
Phys. Rev. B **105**, 134503 (2022)
3. *Colossal orbital-Edelstein effect in non-centrosymmetric superconductors*  
**L. Chirolli**, M. T. Mercaldo, C. Guarcello, F. Giazotto, M. Cuoco,  
Phys. Rev. Lett. **128**, 217703 (2022) Editors' Suggestion
4. *Anyons in quantum Hall interferometry*  
M. Carrega, **L. Chirolli**, S. Heun, L. Sorba,  
Nature Review Physics **3**, 698 (2021)
5. *Impact of electrostatic fields in layered crystalline BCS superconductors*  
**L. Chirolli**, T. Cea, F. Giazotto,  
Phys. Rev. Research **3**, 023135 (2021)
6. *Enhanced coherence in superconducting circuits via band engineering*  
**L. Chirolli**, J. E. Moore,  
Phys. Rev. Lett. **126**, 187701 (2021)
7. *Double single-channel Kondo coupling in graphene with Fe molecules*  
I. M. Vicent, **L. Chirolli**, F. Guinea,  
J. Phys. Commun. **5**, 075010 (2020)
8. *Surface chiral superconductivity in odd-parity superconductors with magnetic impurities*  
**L. Chirolli**,  
Phys. Rev. B **102**, 094202 (2020)
9. *Brightening odd-parity excitons in transition-metal dichalcogenides: Rashba spin-orbit interaction, skyrmions, and cavity photons*  
**L. Chirolli**,  
Phys. Rev. B **101**, 075426 (2020)
10. *Strain-induced bound states in transition-metal dichalcogenide bubbles*  
**L. Chirolli**, E. Prada, F. Guinea, R. Roldán, P. San-Jose  
2D Materials **6**, 025010 (2019)
11. *Signatures of surface Majorana modes in the magnetic response of topological superconductors*  
**L. Chirolli**, F. Guinea,  
Phys. Rev. B **99**, 014506 (2019)
12. *Magnetic tilting and Majorana spin connection in topological superconductors*  
**L. Chirolli**, F. Guinea,  
Phys. Rev. B **98**, 094515 (2018)
13. *Polariton anomalous Hall effect in transition-metal dichalcogenides*  
Á. Gutiérrez-Rubio, **L. Chirolli**, L. Martín-Moreno, F. J. García-Vidal, F. Guinea,  
Phys. Rev. Lett. **121**, 137402 (2018)

14. *Chiral superconductivity in thin films of doped Bi<sub>2</sub>Se<sub>3</sub>*  
**L. Chirolli**,  
 Phys. Rev. B **98**, 014505 (2018)
15. *Chiral Majorana interference as a source of quantum entanglement*  
**L. Chirolli**, J. P. Baltanás, D. Frustaglia,  
 Phys. Rev. B **97**, 155416 (2018)
16. *Impurity-assisted electric control of spin-valley qubits in monolayer MoS<sub>2</sub>*  
 G. Széchenyi, **L. Chirolli**, A. Pályi,  
 2D Materials **5**, 035004 (2018)
17. *Theory of 2D crystals: graphene and beyond*  
 R. Roldán, **L. Chirolli**, E. Prada, J. A. Silva-Guillen, P. San-Jose, F. Guinea,  
 Chem. Soc. Rev. **46**, 4387 (2017)
18. *Time-reversal and rotation symmetry breaking superconductivity in Dirac materials*  
**L. Chirolli**, F. de Juan, F. Guinea,  
 Phys. Rev. B (R) **95**, 201110 (2017)
19. *Enhanced superconductivity in atomically thin TaS<sub>2</sub>*  
 E. Navarro-Moratalla, J. O. Island, S. Mañas-Valero, E. Pinilla-Cienfuegos, A. Castellanos-Gomez, J. Quereda, G. Rubio-Bollinger, **L. Chirolli**, J. A. Silva-Guillén, N. Agraït, G. A. Steele, F. Guinea, H. S. J. van der Zant, E. Coronado,  
 Nature Comm. **7**, 11043 (2016)
20. *Nanoscale Mach-Zehnder interferometer with spin-resolved quantum Hall edge states*  
 B. Karmakar, D. Venturelli, **L. Chirolli**, V. Giovannetti, R. Fazio, S. Roddaro, L. N. Pfeiffer, K. W. West, F. Taddei, V. Pellegrini,  
 Phys. Rev. B **92**, 195303 (2015)
21. *Zero-bias conductance peak in detached flakes of superconducting 2H-TaS<sub>2</sub> probed by scanning tunneling spectroscopy*  
 J. A. Galvis, **L. Chirolli**, I. Guillamon, S. Vieira, E. Navarro-Moratalla, E. Coronado, H. Suderow, F. Guinea,  
 Phys. Rev. B **89**, 224512 (2014)
22. *Theory of integer quantum Hall polaritons in graphene*  
 F. M. D. Pellegrino, **L. Chirolli**, R. Fazio, V. Giovannetti, M. Polini,  
 Phys. Rev. B **89**, 165406 (2014)
23. *Interactions in electronic Mach-Zehnder interferometers with copropagating edge channels*  
**L. Chirolli**, F. Taddei, R. Fazio, and V. Giovannetti,  
 Phys. Rev. Lett. **111**, 036801 (2013)
24. *Coherent edge mixing and interferometry in quantum Hall bilayers*  
 S. Roddaro, **L. Chirolli**, F. Taddei, M. Polini, and V. Giovannetti,  
 Phys. Rev. B **87**, 075321 (2013)
25. *Towards an electronic interferometers based on spin-resolved quantum Hall edge states*  
 B. Karmakar, D. Venturelli, **L. Chirolli**, F. Taddei, V. Giovannetti, R. Fazio, S. Roddaro, G. Biasiol, L. Sorba, L. N. Pfeiffer, K. W. West, V. Pellegrini, F. Beltram,  
 Journal of Physics: Conference Series **456**, 012019 (2013)
26. *Drude weight, cyclotron resonance, and the Dicke model of graphene cavity QED*  
**L. Chirolli**, M. Polini, V. Giovannetti, A. H. MacDonald,  
 Phys. Rev. Lett. **109**, 267404 (2012)
27. *Proposal for a Datta-Das transistor in the quantum Hall regime*  
**L. Chirolli**, D. Venturelli, F. Taddei, R. Fazio, V. Giovannetti,  
 Phys. Rev. B **85**, 155317 (2012)
28. *Controlled coupling of spin-resolved quantum Hall edges*  
 B. Karmakar, D. Venturelli, **L. Chirolli**, F. Taddei, V. Giovannetti, R. Fazio, S. Roddaro, G. Biasiol, L. Sorba, V. Pellegrini, F. Beltram,  
 Phys. Rev. Lett. **107**, 236804 (2011)

29. *Time-bin entanglement of quasi-particles in semiconductor devices*  
**L. Chirolli**, V. Giovannetti, R. Fazio, V. Scarani,  
 Phys. Rev. B **84**, 195307 (2011)
30. *Electronic implementations of interaction-free measurements*  
**L. Chirolli**, E. Strambini, V. Giovannetti, F. Taddei, V. Piazza, R. Fazio, F. Beltram, G. Burkard,  
 Phys. Rev. B **82**, 045403 (2010)
31. *Superconducting resonators as beam splitters for linear-optics quantum computation*  
**L. Chirolli**, G. Burkard, S. Kumar, D. P. DiVincenzo,  
 Phys. Rev. Lett. **104**, 230502 (2010)
32. *Coherent detection of electronic dephasing*,  
 E. Strambini, **L. Chirolli**, V. Giovannetti, F. Taddei, R. Fazio, V. Piazza, F. Beltram,  
 Phys. Rev. Lett. **104**, 170403 (2010)
33. *Quantum non-demolition measurement of a qubit coupled to a harmonic oscillator*  
**L. Chirolli**, G. Burkard,  
 Phys. Rev. B **80**, 184509 (2009)
34. *Decoherence in Solid State Qubits*  
**L. Chirolli**, G. Burkard,  
 Advances in Physics **57**, 225 (2008)
35. *Signature of chirality in scanning-probe imaging of charge flow in graphene*  
 M. Braun, **L. Chirolli**, G. Burkard,  
 Phys. Rev. B **77**, 115433 (2008)
36. *Full control of qubit rotations in a voltage-biased superconducting flux qubit*  
**L. Chirolli**, G. Burkard,  
 Phys. Rev. B **74**, 174510 (2006)

Il sottoscritto CHIROLLI LUCA,

consapevole che, ai sensi dell'art.76 del DPR 445/2000, le dichiarazioni mendaci, la falsità negli atti e l'uso di atti falsi sono punite ai sensi del Codice penale e delle leggi speciali vigenti in materia, dichiara sotto la propria responsabilità:

che quanto dichiarato nel seguente curriculum vitae et studiorum comprensivo delle informazioni sulla produzione scientifica corrisponde a verità

, 22/08/2022  
 Luca Chirolli