

Luca Chirolli

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ResearcherID

Scopus

LinkedIn

Webpage

Education

<u>PhD, Physics</u>	Sep. 2005 - Jan 2010	University of Konstanz, Germany
	Thesis: <i>Quantum control and quantum measurement of solid-state qubits</i>	
	Study of superconducting qubit: voltage-control, quantum non-demolition measurement, black-box quantization, quantum control, dephasing and decoherence	
	Supervisor: Prof. G. Burkard	
<u>Laurea, Physics</u>	Sept. 1999 - March 2005	University of Bologna, Italy
	Thesis: <i>Entanglement and phase transitions in spin 1/2 chains</i>	
	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:

<u>Senior postdoc</u>	9/2022 - present,	Istituto Nanoscienze CNR, Pisa
	Superconducting quantum devices: quantum superconducting circuits based on novel Josephson junctions realized in semiconducting and multi-terminal systems, with focus on fundamental physics and quantum technology applications.	
<u>Marie Curie Fellow</u>	9/2021 - 9/2022,	Istituto Nanoscienze CNR, Pisa, <i>Incoming Phase</i>
	9/2019 - 2/2021,	UC Berkeley, California, USA, <i>Outgoing Phase</i>
	Global Fellowship Grant awarded as PI on the project <i>Simulation of topological phases in superconducting circuits</i> : topological properties of the charge spectrum of superconducting circuits, parity-protection, and Majorana qubits	
<u>Visiting scientist</u>	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	

<u>Postdoc Researcher</u>	2/2015 - 9/2019, IMDEA Nanoscience Foundation, Madrid, Spain Topological superconductivity in Dirac materials: signatures of topologically protected surface states in bulk properties and response, with focus on Bi ₂ Se ₃
	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

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

Scientific track

<u>Bibliometrics</u>	- 38 publications in peer reviewed journals - 850+ citations - h-index 15
<u>Reviews</u>	- <i>Anyons in Quantum Hall Interferometry</i> , Nature Review Physics 2021 - <i>Theory of 2D crystals: graphene and beyond</i> , Chem. Soc. Rev. 2017 - <i>Decoherence in Solid State Qubits</i> , Advances in Physics 2008
<u>Grants awarded</u>	TOPOCIRCUS - 841894: EU Marie Skłodowska Curie Action: Global Fellowship
<u>Grants applied</u>	first step of the ERC Consolidator 2022 on the project COHYBA
<u>Referee</u>	Referee of Nature Comm., Phys. Rev. Lett, Phys. Rev. A and B, Europhys. Lett
<u>Participation in funded projects</u>	- 2014-2018. IMDEA Nanoscience PI : F. Guinea. S2013/MIT-3007 Madrid - 2012-2017. PI: F. Guinea. ERC-2011-ADG 20110209 - FIRB-IDEAS 2009-2014. PI: Prof. V. Giovannetti. MIUR
<u>ASN 2020</u>	Abilitazione Scientifica Nazionale to Associate Professor in Italy, FIS03 02/B2, Condensed Matter Theory

Skills

Programming c++, Python, Mathematica, Linux, OSX

Languages Italian - Mother tongue
English - Fluent
Spanish - Fluent
German - Good

Invited Talks

- Ischia 2023 - Superstripe2023 - *Cooper quartets in hybrid superconducting devices*. Invited A. Bianconi
- Brixen 2023 - CMT@Brixen - *Orbital Edelstein effect in noncentrosymmetric superconductors*. Invited by G. Profeta
- Salerno 2022 Workshop online - *Orbital Edelstein effect in noncentrosymmetric superconductors*. Invited by M. Cuoco
- Donostia 2018 Quantum Designer Physics: *Magnetic Response of Class DIII Topological Superconductors*. Invited by F. Guinea
- Barcelona 2018 Workshop on interaction of light with quantum and topological materials: *Polariton Hall effect in transition-metal dichalcogenides*. Invited by F. Koppens
- Trieste 2017 ICTP - Conference on Weyl fermions in materials: *Time-reversal symmetry breaking superconductivity in Dirac materials*. Invited by F. Taddei
- Bilbao 2016 European Conference on Thin Films: *Odd-parity time-reversal invariant superconductor in magnetic field*. Invited by M. Ugueda Moreno
- Madrid 2016 Spinograph Conference: *Odd-parity time-reversal invariant superconductor in magnetic field*. Invited by J. Fernandez-Rossier
- Madrid 2014 Advances in Nanostructured Superconductors: *Zero-bias conductance peak and detached layers of superconducting TaS₂*. Invited by H. Suderow

Seminars

- Catania 2022 - PD - *Coherence and Majorana qubits in π -Josephson circuits*, Host: G. Falci
- Palermo 2022 - PD - IQIS 2022 - *Coherence and Majorana qubits in π -Josephson circuits*
- Parigi 2022 - INRIA - *Coherence and Majorana qubits in π -Josephson circuits*, Host: Z. Leghtas
- Salerno 2022 - PD - *Coherence and Majorana qubits in π -Josephson circuits*, Host: M. Cuoco
- Madrid 2022 - ICM - *Coherence and Majorana qubits in π -Josephson circuits*, Host: R. Aguado
- Berkeley 2019 - PD- *Polariton Hall effect in transition-metal dichalcogenides*, Host: J. Moore
- Shanghai 2019 - N2D Materials - *Polariton Hall effect in transition-metal dichalcogenides*, Host: L. Martin-Moreno
- Palermo 2018 - PD - *Electronic and topological properties of 2D crystals*, Invited by F. Ciccarello
- Madrid 2016 - ICM - *Time-reversal symmetry breaking superconductivity in Dirac materials*
- Sevilla 2016 - PD - *Odd-parity time-reversal invariant superconductor in magnetic field*
- Basel 2016 - PD - *Odd-parity time-reversal invariant superconductor in magnetic field*
- Zurich 2015 - ETH - Group of G. Blatter: *Enhancement of superconductivity in atomically thin TaS₂*

- Pisa 2015 - SNS - CMI group: *Enhancement of superconductivity in atomically thin TaS₂*
 - Konstanz 2015 - PD - Group of G. Burkard: *Enhancement of superconductivity in atomically thin TaS₂*
 - Paris 2014 - LSP Paris - Group of G. Montambaux: *Zero-bias conductance peak and detached layers of superconducting TaS₂*
 - Barcelona 2014 - ICFO - Group of Prof. M. Lewenstein: *Theory of integer quantum Hall polaritons in graphene*
 - Pisa 2013 - SNS - CMI-group: *Interactions in electronic Mach-Zehnder interferometers with copropagating edge channels*
 - Madrid 2013 - ICMM-CSIC - Group of F. Guinea: *Electronic Mach-Zehnder interferometry with copropagating spin-resolved edge states in the quantum Hall regime*
 - Copenhagen 2012 - PD - Group of K. Flensberg: *Datta-Das spin transistor in the IQHE*
 - Barcelona 2012 - ICN - Group of S. Roche: *Proposal for a Datta Das transistor in the quantum Hall regime*
 - Konstanz 2011 - PD - Group of G. Burkard: *Time-bin entanglement of quasiparticles in semiconductor devices*
 - Pisa 2008 - SNS, QTI-group of R. Fazio: *QND measurement of superconducting flux qubit*
- PD = Physics Department

List of publications

Open-source publications available [here](#):

- *Bipolar thermoelectric superconducting single-electron transistor*
S. Battisti, G. De Simoni, **L. Chirolli**, A. Braggio, F. Giazotto
arXiv:2305.14114 (2023)
- 2. *The quartic Blochium: an anharmonic quasicharge superconducting qubit*
L. Chirolli, M. Carrega, F. Giazotto
arXiv:2304.10401 (2023)
- 3. *Half-Integer Shapiro steps in highly transmissive InSb nanoflag Josephson junctions*
A. Iorio, A. Crippa, B. Turini, S. Salimian, M. Carrega, **L. Chirolli**, V. Zannier, L. Sorba, E. Strambini, F. Giazotto, S. Heun
Phys. Rev. Research **5**, 033015 (2023)
- 4. *Anomalous periodicity and parafermion hybridization in superconducting qubits*
A. Calzona, M. Carrega, **L. Chirolli**
Phys. Rev. B **107**, 045105 (2023)
- 5. *SWAP gate between a Majorana qubit and a parity-protected superconducting qubit*
L. Chirolli, N. Y. Yao, J. E. Moore,
Phys. Rev. Lett. **129**, 177701 (2022)
- 6. *Frustration driven Josephson phase dynamics*
C. Guarcello, **L. Chirolli**, M. T. Mercaldo, F. Giazotto, M. Cuoco,
Phys. Rev. B **105**, 134503 (2022)

7. *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
8. *Anyons in quantum Hall interferometry*
 M. Carrega, **L. Chirolli**, S. Heun, L. Sorba,
 Nature Review Physics **3**, 698 (2021)
9. *Impact of electrostatic fields in layered crystalline BCS superconductors*
L. Chirolli, T. Cea, F. Giazotto,
 Phys. Rev. Research **3**, 023135 (2021)
10. *Enhanced coherence in superconducting circuits via band engineering*
L. Chirolli, J. E. Moore,
 Phys. Rev. Lett. **126**, 187701 (2021)
11. *Double single-channel Kondo coupling in graphene with Fe molecules*
 I. M. Vicent, **L. Chirolli**, F. Guinea,
 J. Phys. Commun. **5**, 075010 (2020)
12. *Surface chiral superconductivity in odd-parity superconductors with magnetic impurities*
L. Chirolli,
 Phys. Rev. B **102**, 094202 (2020)
13. *Brightening odd-parity excitons in transition-metal dichalcogenides: Rashba spin-orbit interaction, skyrmions, and cavity photons*
L. Chirolli,
 Phys. Rev. B **101**, 075426 (2020)
14. *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)
15. *Signatures of surface Majorana modes in the magnetic response of topological superconductors*
L. Chirolli, F. Guinea,
 Phys. Rev. B **99**, 014506 (2019)
16. *Magnetic tilting and Majorana spin connection in topological superconductors*
L. Chirolli, F. Guinea,
 Phys. Rev. B **98**, 094515 (2018)
17. *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)
18. *Chiral superconductivity in thin films of doped Bi₂Se₃*
L. Chirolli,
 Phys. Rev. B **98**, 014505 (2018)

19. *Chiral Majorana interference as a source of quantum entanglement*
L. Chirolli, J. P. Baltanás, D. Frustaglia,
 Phys. Rev. B **97**, 155416 (2018)
20. *Impurity-assisted electric control of spin-valley qubits in monolayer MoS₂*
 G. Széchenyi, **L. Chirolli**, A. Pályi,
 2D Materials **5**, 035004 (2018)
21. *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)
22. *Time-reversal and rotation symmetry breaking superconductivity in Dirac materials*
L. Chirolli, F. de Juan, F. Guinea,
 Phys. Rev. B (R) **95**, 201110 (2017)
23. *Enhanced superconductivity in atomically thin TaS₂*
 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)
24. *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)
25. *Zero-bias conductance peak in detached flakes of superconducting 2H-TaS₂ probed by scanning tunneling spectroscopy*
 J. A. Galvis, **L. Chirolli**, I. Guillaumon, S. Vieira, E. Navarro-Moratalla, E. Coronado, H. Suderow, F. Guinea,
 Phys. Rev. B **89**, 224512 (2014)
26. *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)
27. *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)
28. *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)
29. *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)
30. *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)
31. *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)
32. *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)
33. *Time-bin entanglement of quasi-particles in semiconductor devices*
L. Chirolli, V. Giovannetti, R. Fazio, V. Scarani,
Phys. Rev. B **84**, 195307 (2011)
34. *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)
35. *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)
36. *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)
37. *Quantum non-demolition measurement of a qubit coupled to a harmonic oscillator*
L. Chirolli, G. Burkard,
Phys. Rev. B **80**, 184509 (2009)
38. *Decoherence in Solid State Qubits*
L. Chirolli, G. Burkard,
Advances in Physics **57**, 225 (2008)
39. *Signature of chirality in scanning-probe imaging of charge flow in graphene*
M. Braun, **L. Chirolli**, G. Burkard,
Phys. Rev. B **77**, 115433 (2008)
40. *Full control of qubit rotations in a voltage-biased superconducting flux qubit*
L. Chirolli, G. Burkard,
Phys. Rev. B **74**, 174510 (2006)

Pisa, 22/9/2023

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