

## Rubén Seoane Souto

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CONTACT INFORMATION	Trollebergsvägen 30b Lund, Sweden 22731	+34-600-546567 ruben.seoane_souto@ftf.lth.se
ACADEMIC POSITIONS	<p><b>Researcher</b> 11/2020 to present Solid state division and Nanolund, Lund university, Visiting researcher at Center for Quantum Devices University of Copenhagen</p> <p><b>Postdoctoral researcher</b> 11/2018 to 10/2020 Solid state division and Nanolund, Lund university, Visiting researcher at Center for Quantum Devices University of Copenhagen</p> <p><b>Teaching assistant</b> (during the Ph.D. studies) 10/2016-10/2018 Department of theoretical condensed matter physics, Universidad Autónoma de Madrid</p> <p><b>Doctoral student</b> 1/2013-10/2016 Department of theoretical condensed matter physics, Condensed matter Physics center (IFIMAC) Universidad Autónoma de Madrid Supervisors: Prof. Alfredo Levy Yeyati and Prof. Álvaro Martín-Rodero</p>	
RESEARCH VISITS	<b>Laboratoire Ondes et Matière d'Aquitaine, CNRS</b> 4/2016-7/2016 Université de Bordeaux Supervisor: Dr. Rémi Avriller	
EDUCATION	<p><b>Universidad Autónoma de Madrid</b>, Madrid, Spain</p> <p>Ph.D., Condensed matter physics, nanophysics and biophysics, 15/6/2018 Thesis title: <i>Quench dynamics in interacting and superconducting nanojunctions</i>. Supervisors: Prof. Alfredo Levy Yeyati and Prof. Álvaro Martín Rodero</p> <p>Master's degree, Master in condensed matter physics and nanotechnology, 7/2013 Master thesis: <i>Electronic transport through molecular transistors in the polaronic regime</i> Supervisors: Prof. Alfredo Levy Yeyati, Prof. Álvaro Martín Rodero and Prof. Rosa C. Monreal</p> <p><b>Universidad Complutense de Madrid</b>, Madrid, Spain</p> <p>Extended Bachelor in Physics (5 years degree), 7/2012</p> <ul style="list-style-type: none"><li>• Undergraduate thesis: <i>Strong coupling correlation functions and semiclassical strings</i></li><li>• Supervisor: Rafael Hernández Redondo, Ph.D.</li><li>• Topic: String theory</li></ul>	
RESEARCH INTERESTS	<ul style="list-style-type: none"><li>• Quantum transport</li><li>• Topological states of matter</li><li>• Mesoscopic superconductivity</li><li>• Full counting statistics</li><li>• Quantum computation</li></ul>	

1. S. Krøjer, **R. Seoane Souto**, and K. Flensberg, “Demonstrating Majorana nonabelian exchange using fast adiabatic charge-transfer” *Phys. Rev. B* **105**, 045425 (2022)
2. S. Vaitiekenas, **R. Seoane Souto**, Y. Liu, P. Krogstrup, K. Flensberg, M. Leijnse, C. M. Marcus, “Evidence for spin-polarized bound states in semiconductor-superconductor-ferromagnetic-insulator islands” *Phys. Rev. B* **105**, L041304 (2022)
3. **R. Seoane Souto**, A. E. Feiguin, A. Martín-Rodero, and A. Levy Yeyati, “Transient dynamics of a magnetic impurity coupled to superconducting electrodes: exact numerics versus perturbation theory” *Phys. Rev. B* **104**, 214506 (2021)
4. D. Kuzmanovski, **R. Seoane Souto**, and A. V. Balatsky “Persistent current noise in narrow Josephson junctions” *Phys. Rev. B* **104**, L100505 (2021)
5. A. Maiani, **R. Seoane Souto**, M. Leijnse, and K. Flensberg “Topological superconductivity in semiconductor-superconductor-magnetic insulator heterostructures” *Phys. Rev. B* **103**, 104508 (2021)
6. **R. Seoane Souto**, D. Kuzmanovski, and A. V. Balatsky, “Signatures of odd-frequency pairing in the Josephson junction current noise” *Phys. Rev. Research* **2**, 043193 (2020)
7. D. Kuzmanovski, **R. Seoane Souto**, and A. V. Balatsky, “Odd-frequency superconductivity near a magnetic impurity in a conventional superconductor” *Phys. Rev. B* **101**, 094505 (2020)
8. **R. Seoane Souto**, K. Flensberg, and M. Leijnse, “Timescales for charge transfer based operations on Majorana systems” *Phys. Rev. B* **101**, 081407 (Rapid communication) (2020)
9. R. Avriller, **R. Seoane Souto**, A. Martín-Rodero, and A. Levy Yeyati, “Build-up of Vibron-Mediated Electron Correlations in Molecular Junctions”. *Phys. Rev. B* **99**, 121403 (Rapid communication) (2019)
10. **R. Seoane Souto**, R. Avriller, A. Levy Yeyati, and A. Martín-Rodero, “Transient dynamics in interacting nanojunctions within self-consistent perturbation theory”. *New J. Phys.* **20**, 083039 (2018)
11. **R. Seoane Souto**, A. Martín-Rodero, and A. Levy Yeyati, “Quench dynamics in superconducting nanojunctions: Metastability and dynamical Yang-Lee zeros”. *Phys. Rev. B* **96**, 165444 (2017)
12. **R. Seoane Souto**, A. Martín-Rodero, and A. Levy Yeyati, “Analysis of universality in transient dynamics of coherent electronic transport”. *Fortschr. Phys.* **65**, 1600062 (2017)
13. **R. Seoane Souto**, A. Martín-Rodero, and A. Levy Yeyati, “Andreev Bound States Formation and Quasiparticle Trapping in Quench Dynamics Revealed by Time-Dependent Counting Statistics”. *Phys. Rev. Lett.* **117**, 267701 (2016)
14. **R. Seoane Souto**, R. Avriller, R. C. Monreal, A. Martín-Rodero, and A. Levy Yeyati, “Transient dynamics and waiting time distribution of molecular junctions in the polaronic regime”. *Phys. Rev. B* **92**, 125435 (2015)
15. **R. Seoane Souto**, A. Levy Yeyati, A. Martín-Rodero, R. C. Monreal, “Dressed tunneling approximation for electronic transport through molecular transistors”. *Phys. Rev. B* **89**, 085412 (2014)

1. Samuel D. Escribano, Andrea Maiani, Martin Leijnse, Karsten Flensberg, Yuval Oreg, Alfredo Levy Yeyati, Elsa Prada, and **Rubén Seoane Souto**, “Semiconductor-ferromagnet-superconductor planar heterostructures for 1D topological superconductivity” [arXiv:2203.06644](#)
2. **R. Seoane Souto** and M. Leijnse, “Fusion rules in a Majorana single-charge transistor” [arXiv:2112.07472](#)

Regular referee of journals of the American Physical Society, including Physical Review Letters, Physical Review B and Physical Review Research. Referee of Scientific Reports.

MONOGRAPHS	<i>Quench dynamics in interacting and superconducting nanojunctions.</i> Springer Thesis series recognizing outstanding Ph.D. research. ISBN: 978-3-030-36594-3	2020
PATENTS	Improved plano-convex lens projector, ES2570808B1 Participation on the invention and design: 50%	5/2016
PARTICIPATION IN FUNDED PROJECTS	<i>2D hybrid materials as a platform for topological quantum computing.</i> Coordinator: Prof. Klaus Ensslin. P.I. at Lund university: Dr. Martin Leijnse Quantera project. Budget: 1,047,258 € <i>Dynamics, superconductivity and topology in hybrid nanostructures.</i> Principal investigator: Prof. Alfredo Levy Yeyati. Granted by MINECO, FIS2017-84860-R. Budget: 157,300 € <i>Interactions, topology and non-stationary effects in quantum transport.</i> Principal investigator: Prof. Alfredo Levy Yeyati. Granted by MINECO, FIS2014-55486-P. Budget: 48,400 € <i>Correlated electrons in hybrid nanostructures: from transport properties to quantum information processing.</i> Principal investigator: Prof. Alfredo Levy Yeyati. Granted by MINECO, FIS2011-26516. Budget: 47,000 €	11/2018 to present 1/2017 - 10/2018 1/2014 - 1/2018 12/2013 - 12/2014
AWARDED GRANTS AND FELLOWSHIPS	Research grants as principal investigator: <ul style="list-style-type: none"> <li>Nanolund seedling project Budget 100,000 SEK</li> </ul> Student grants: <ul style="list-style-type: none"> <li>Predocdoctoral grant from the national research agency 21,500€ per year, including tuition fee Department of theoretical condensed matter physics Universidad Autónoma de Madrid Supervisors: Prof. Alfredo Levy Yeyati and Prof. Álvaro Martín-Rodero</li> <li>MsC studentship (4,000 €) Master's degree in condensed matter physics and nanotechnology Universidad Autónoma de Madrid</li> <li>Summer research fellowship from the Ignacio Cirac program chair (2700€) Quantum photonics with solids and atoms group Institute of photonic sciences (ICFO) Supervisor: Prof. Hugues de Riedmatten</li> <li>Spanish undergraduate research fellowship (2,700 €) Theoretical physics department II, Universidad Complutense de Madrid Supervisor: Dr. Rafael Hernández Redondo</li> </ul> Travel grants <ul style="list-style-type: none"> <li>Lindau Nobel Laureate meeting, Lindau (Germany). Granted by Ragnar Söderberg and Lindau Nobel Laureate Meeting foundations, 5500 €</li> <li>Workshop in bound states in superconductors and interfaces, Dresden (Germany) Granted by Lunds Tekniska Högskola, 8664 SEK</li> <li>International school and symposium on nanoscale transport and photonics. Granted by Nippon Telegraph and Telephone Corporation, 2600 €</li> </ul> Access to high-performance computational facilities granted by RES (Spanish supercomputing network). <ul style="list-style-type: none"> <li><i>Coherent control of Andreev bound states in superconducting quantum dots</i> Estimated cost: 2571.75 € Responsible of the project proposal, intermediate reports and justification.</li> <li><i>Transient transport properties of superconducting quantum dots</i> Estimated cost: 4572.00 € Responsible of the project proposal, intermediate reports and justification.</li> </ul>	1/2020 - 12/2020 1/2013 - 10/2016 1/2013 - 10/2016 7/2012 - 9/2012 1/2012 - 7/2012 11/2016 - 4/2017 11/2015 - 11/2016

	<ul style="list-style-type: none"> <li>• <i>Theoretical study of Majorana single-charge transistor using numerical renormalization group</i> 7/2015 - 11/2015 Estimated cost: 3817.62 € Responsible of the project proposal, intermediate reports and justification.</li> </ul>
AWARDS	<ul style="list-style-type: none"> <li>• Junior Scientist Ideas Award 3/2022 Awarded by Nanolund</li> <li>• Seal of Excellence Certificate delivered by the European Commission 3/2021 For the project proposal: <i>Simulating transport and dynamics of non-local and non-abelian quasiparticles</i> (STONNES) Horizon 2020s Marie Skłodowska-Curie actions call H2020-MSCA-IF-2020.</li> <li>• Best question award 12/2020 SPICE-Workshop Coherent order and transport in spin-active systems. Cash prize 50 €.</li> <li>• Junior Scientist Ideas Award 4/2020 Awarded by Nanolund</li> <li>• Seal of Excellence Certificate delivered by the European Commission 3/2020 For the project proposal: <i>Dynamical aspects of Majorana fermions out-of-equilibrium: non-local properties and quantum operations</i> (DYNAMO) Horizon 2020s Marie Skłodowska-Curie actions call H2020-MSCA-IF-2019.</li> <li>• Springer Thesis award for outstanding Ph.D. research 8/2019 Invitation to publish doctoral thesis in Springer Theses series. Cash prize 500 €.</li> </ul>
	Student awards
	<ul style="list-style-type: none"> <li>• Young researcher 1<sup>st</sup> prize in material science 12/2017 Awarded by Instituto Nicolás Cabrera. Cash prize 400 €.</li> <li>• Best student poster award 8/2016 Awarded by the International Union of pure and applied Physics. 33rd international conference on the physics of semiconductors, Beijing. Cash prize 2,500 ¥.</li> <li>• Young researcher 2<sup>nd</sup> prize in material science 12/2015 Awarded by Instituto Nicolás Cabrera. Cash prize 100 €.</li> </ul>
SUPERVISION	Master theses direction
EXPERIENCE	<ul style="list-style-type: none"> <li>• Jakob Westerberg, <i>Theory of Time-Dependent Transport and Levitons in Nanowires</i> 23/4/2021 Solid State Division, Lund University Co-directed with M. Leijnse</li> <li>• Svend K. Møller, <i>Detecting Majorana Bound States</i>. 27/8/2020 Center for Quantum Devices, Copenhagen University Co-directed with K. Flensberg</li> </ul>
	Bachelor theses direction
	<ul style="list-style-type: none"> <li>• Adrien Delpoux, <i>Tight-Binding models of Nanowires</i>. 4/6/2020 Université Toulouse III, Paul Sabatier Co-directed with A. Tsintzis and M. Leijnse</li> </ul>
TEACHING	Lund university.
EXPERIENCE	<ul style="list-style-type: none"> <li>• Theory of superconductivity, course for Ph.D. students. 6/12/2019 Guest lecture about topological superconductivity and Majorana fermions.</li> </ul>
	Universidad Autónoma de Madrid. Average evaluation 4.5/5 in internal performance assessments
	<ul style="list-style-type: none"> <li>• Experimental Techniques: Optics and Thermodynamics. Courses: 2016-2018 Third year course of the physics degree. Responsible of the weekly practices, holding office hours and grading reports.</li> <li>• Physics I. Courses: 2015-2018 Introductory Physics course for chemical engineers: Mechanics and thermodynamics Responsible of the weekly homework sessions, holding office hours and grading problem sets.</li> </ul>

- Laboratory of general physics. Courses: 2014-2017  
Introductory Physics course, chemical degree.  
Responsible of the weekly practices, holding office hours and grading reports.

## PRESENTATIONS **Oral presentations**

- *Majorana fusion rules in a single-charge topological transistor.* 15/3/2022  
APS March meeting Chicago (USA)
- *Spin-polarized bound states in semiconductor-superconductor-ferromagnetic platforms.* 18/01/2021  
Young investigators online workshop on unconventional superconductivity Online
- *Charge-transfer based operations on Majorana systems.* 15/12/2021  
722. WE-Heraeus-Seminar Online
- *Charge-transfer based operations revealing non-abelian statistics of Majorana bound states.* 15/3/2021  
APS March meeting Online.
- *Odd frequency superconductivity in quantum dot systems.* 28/9/2020  
Nanolund annual meeting Lund (Sweden)
- *Revealing non-abelian statistics of Majorana states using charge-transfer operations.* 2/9/2020  
Meeting of the European Physical society, condensed matter division, GEFES Online
- *Time scales for charge-transfer based operations on Majorana systems.* 22/11/2019  
Entangled states of matter, CRC183 Berlin (Germany).
- *Time scales for charge-transfer based operations on Majorana systems.* 9/9/2019  
Q–Rob workshop at Microsoft headquarters Redmond (USA).
- *Quench Dynamics in superconducting nanojunctions: metastability and dynamical phase transitions.* 10/4/2019  
Workshop on Bound states in superconductors and interfaces Dresden (Germany)
- *Quench Dynamics in superconducting nanojunctions.* 15/12/2017  
Nicolás Cabrera Young Research Meeting Miraflores (Spain)
- *Quench dynamics in superconducting nanojunctions.* 15/11/2017  
International school and symposium on nanoscale transport and photonics Atsugi (Japan)
- *Quench dynamics in superconducting nanojunctions: metastability and dynamical Yang-Lee zeros.* 2/8/2017  
Nanophysics, from fundamental to applications: reloaded Quy Nhn
- *Quench dynamics and counting statistics in interacting nanojunctions: quasi-particles trapping.* 20/9/2016  
10<sup>th</sup> RES (national supercomputing network) conference León (Spain)
- *Electronic Time Dependent Counting Statistics in interacting Nanojunctions.* 11/4/2016  
Nonequilibrium condensed matter and biological system Madrid (Spain)
- *Non-stationary and noise properties of molecular junctions in the polaronic regime.* 19/12/2015  
Nicolás Cabrera Young Research Meeting Miraflores (Spain)

## **Poster presentations**

- *Optimal manipulation of Majorana bound states using quantum dots.* 12/1/2021  
Advances in Scalable Hardware Platforms for Quantum Computing Online
- *Time scales for charge-transfer based operations on Majorana systems.* 6/11/2019  
Quantum life workshop Copenhagen (Denmark).
- *Time scales of charge transfer based operations of a topological qubit.* 22/7/2019  
Summer School Nanotechnology meets Quantum Information Donostia (Spain).
- *Quench dynamics in superconducting nanojunctions: Andreev bound states formation and dynamical phase transitions.* 30/6/2019 - 5/7/2019  
Poster displayed during the Lindau Nobel Laureate meeting Lindau (Germany).
- *Quench dynamics in superconducting nanojunctions.* 25/7/2018  
International Conference on Superlattices, Nanostructures and Nanodevices.
- *Self-consistent dynamics in interacting nanojunctions: the fate of bistability.* 25/7/2018  
International Conference on Superlattices, Nanostructures and Nanodevices Madrid (Spain)

- *Transient dynamics and Full Counting statistics in superconducting nanojunctions.* 2/8/2015  
33<sup>rd</sup> International Conference on the Physics of Semiconductors Beijing (China)  
**Best poster award**
- *Non-stationary transport properties of molecular junctions in the polaronic regime.* 30/7/2015  
Frontiers of Quantum and Mesoscopic Thermodynamics Prague (Czech Republic)
- *Non-stationary transport properties of molecular junctions in the polaronic regime.* 3/6/2015  
Nano Electromechanical Systems and beyond Bordeaux (France)

#### Seminars

- *Quantum transport in topological superconductors: role of non-abelian quasiparticles.* 16/6/2021  
Aachen University (Germany).
- *Dynamics of magnetic impurities coupled to superconductors.* 12/5/2021  
Niels Bohr institute, University of Copenhagen (Denmark).
- *Spin-polarized bound states in semiconductor-superconductor-ferromagnetic insulator islands.* 16/2/2021  
Autonomous University of Madrid (Spain).
- *Time scales for charge-transfer based operations on Majorana systems.* 23/6/2020  
Nordita, Stockholm (Sweden).
- *Odd-frequency superconductivity close to magnetic impurities.* 27/5/2020  
Lund university (Sweden).
- *Odd-frequency superconductivity close to magnetic impurities.* 17/4/2020  
Lund university (Sweden).
- *Time scales for charge-transfer based operations on Majorana systems.* 30/10/2019  
Niels Bohr institute, University of Copenhagen (Denmark).
- *Quench dynamics in interacting and superconducting nanojunctions.* 10/4/2019  
Nordita, Stockholm (Sweden).
- *Counting statistics revealing quasiparticle trapping in superconducting nanojunctions.* 30/1/2019  
Niels Bohr institute, University of Copenhagen (Denmark).
- *Counting statistics revealing dynamical phase transitions.* 16/11/2018  
Lund university (Sweden).
- *Quench dynamics in interacting and superconducting nanojunctions.* 25/7/2018  
Lund university (Sweden).
- *Quench dynamics in interacting and superconducting nanojunctions.* 9/7/2018  
Würzburg university (Germany).
- *Counting statistics in superconducting nanojunctions.* 13/12/2017  
Autonomous University of Madrid (Spain).
- *Electronic time dependent counting statistics in interacting nanojunctions* 27/4/2016  
Autonomous University of Madrid (Spain).
- *Inelastic effects in transport through molecular junctions* 11/3/2015  
Autonomous University of Madrid (Spain).

#### Public engagement in science

- Farad student job fair, Lund (Sweden). 28/1/2020
- Forskar Grand Prix, Helsingborg (Sweden). 26/9/2019
- Short presentation to a young audience of about 200 high school students

#### INTERNATIONAL SCHOOLS

- Nanotechnology meets Quantum Information, San Sebastián. 22-26/7/2019
- Quantum transport in topological materials, Madrid. 4-8/9/2017
- Capri spring school on transport in nanostructures, Capri. 8-12/4/2013