

# Carlos Payá – Curriculum Vitae

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<b>Latest update</b>	July 30, 2025		

## Personal Profile

I am a PhD candidate at the QUDYMA and Q4Q research groups at ICMM-CSIC, Madrid, under the supervision of Elsa Prada and Ramón Aguado. My research focuses on the theoretical study of topological superconductors with hybrid materials, with special emphasis on full-shell nanowires. I am particularly interested in the topological properties of superconducting materials and their potential applications in quantum computing.

## Education

<b>2023-Present</b>	<b>PhD in Condensed Matter Physics</b> - Universidad Autónoma de Madrid, Madrid, Spain
	<i>Tentative completion date</i> February 2027
	<i>Topic</i> Topological superconductors with hybrid materials: full-shell Majorana nanowires
	<i>Supervisors</i> Elsa Prada and Ramón Aguado
<b>2021-2022</b>	<b>Master in Condensed Matter Physics</b> - Universidad Autónoma de Madrid, Madrid, Spain
	<i>Grade</i> 9.45/10
	<i>Master's Thesis</i> Topological phase and Majorana zero modes in full-shell nanowires
	<i>Supervisor</i> Elsa Prada
<b>2017-2021</b>	<b>Bachelor in Physics</b> - Universidad Autónoma de Madrid, Madrid, Spain
	<i>Grade</i> 8.44/10
	<i>Bachelor's Thesis</i> Josephson junctions based on full-shell Majorana nanowires
	<i>Supervisor</i> Elsa Prada

## Employment History

<b>March 2023 - Present</b>	Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain
	<i>PhD Candidate, FPI grant</i>
	Quantum Dynamics of Materials (QUDYMA) and Quantum Materials for Quantum Technologies (Q4Q) groups.
<b>April - July 2025</b>	Niels Bohr Institute, University of Copenhagen, Denmark
	<i>Visiting PhD candidate</i>
	Karsten Flensberg's group.
<b>Nov 2021 - Sep 2022</b>	Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain
	<i>Research Assistant</i>
	Theory of Quantum Materials and Solid State Quantum Technologies group.

## Publications

### Preprints

- [P7] **C. Payá**, F. J. Matute-Cañadas, A. L. Yeyati, R. Aguado, P. San-Jose, and E. Prada. *Fluxoid Valve Effect in Full-Shell Nanowire Josephson Junctions*, arXiv:2504.16989 (2025).

### Journals

\* indicates first theory author.

- [P6] **C. Payá**, R. Aguado, P. San-Jose, and E. Prada. *Josephson effect and critical currents in trivial and topological full-shell hybrid nanowires*, *Physical Review B*, 111, 235420 (2025). Citations: 1.
- [P5] M. T. Deng, **C. Payá\***, P. San-Jose, E. Prada, C. M. Marcus, and S. Vaitiekėnas. *Caroli–de Gennes–Matricon Analogs in Full-Shell Hybrid Nanowires*, *Physical Review Letters*, 134, 206302 (2025). Citations: 1.
- [P4] A. Vezzosi, **C. Payá**, P. Wójcik, A. Bertoni, G. Goldoni, E. Prada, and S. D. Escribano. *InP/GaSb core-shell nanowires: A novel hole-based platform with strong spin-orbit coupling for full-shell hybrid devices*, *SciPost Physics*, 18, 069 (2025). Citations: 2.
- [P3] **C. Payá**, P. San-Jose, C. J. S. Martínez, R. Aguado, and E. Prada. *Absence of Majorana oscillations in finite-length full-shell hybrid nanowires*, *Physical Review B*, 110, 115417 (2024). Citations: 4.
- [P2] **C. Payá**, S. D. Escribano, A. Vezzosi, F. Peñaranda, R. Aguado, P. San-Jose, and E. Prada. *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*, *Physical Review B*, 109, 115428 (2024). Citations: 14.
- [P1] P. San-Jose, **C. Payá**, C. M. Marcus, S. Vaitiekėnas, and E. Prada. *Theory of Caroli–de Gennes–Matricon analogs in full-shell hybrid nanowires*, *Physical Review B*, 107, 155423 (2023). Citations: 19.

## Conferences

### Contributed Talks

- [C17] **July 2025**. “QTYR25” (PhD and Young Scientists in Quantum Technologies Network (PYSQT), Madrid, Spain). Contributed title: *Fluxoid valve effect in full-shell nanowire Josephson junctions*.
- [C16] **Mar. 2025**. “APS Global Physics Summit 2025” (American Physical Society, Anaheim, CA, US). Contributed title: *Josephson effect and critical currents in topological full-shell hybrid nanowires*.
- [C15] **July 2024**. “QTYR24” (PhD and Young Scientists in Quantum Technologies Network (PYSQT), Madrid, Spain). Contributed title: *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*.
- [C14] **May 2024**. “Condensed Matter PhD Program Annual Meeting” (Facultad de Ciencias, Universidad Autónoma de Madrid (UAM), Madrid, Spain). Contributed title: *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*.

### Poster contributions

- [C13] **July 2025**. “Quantum Designer 2025” (Donostia International Physics Center (DIPC), San Sebastián, Spain). Poster title: *Josephson effect in topological full-shell hybrid nanowires*.
- [C12] **June 2025**. “Workshop on Superconductor-Semiconductor Hybrids” (Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark). Poster title: *Josephson effect in topological full-shell hybrid nanowires*.
- [C11] **Apr. 2025**. “GRC on Hybrid Superconductor-Semiconductor Devices” (Gordon Research Conferences, Les Diablerets, Switzerland). Poster title: *Josephson effect in topological full-shell hybrid nanowires*.
- [C10] **July 2024**. “Quantum Designer 2024” (Donostia International Physics Center (DIPC), San Sebastián, Spain). Poster title: *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*.
- [C9] **May 2024**. “Quantum matter for Quantum Technologies Workshop” (SPICE, Mainz, Germany). Poster title: *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*.

- [C8] **Apr. 2024.** “European School on Superconductivity and Magnetism in Quantum Materials” (SuperQmap COST action, Gandía, Spain). Poster title: *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*.
- [C7] **Sept. 2023.** “Emergence of Quantum Phases in Novel Materials” (Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain). Poster title: *Majorana zero modes in full-shell hybrid nanowires*.
- [C6] **June 2023.** “Bound States in Superconducting Nanodevices” (TopSquad and AndQC collaborations, Budapest, Hungary). Poster title: *Theory of Caroli-de Gennes-Matricon analogs in full-shell hybrid nanowires*.
- [C5] **May 2023.** “QuantumMatter 2023” (Phantoms Foundation, Madrid, Spain). Poster title: *Theory of Caroli-de Gennes-Matricon analogs in full-shell hybrid nanowires*.
- [C4] **May 2023.** “YouMat2023” (Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain). Poster title: *Theory of Caroli-de Gennes-Matricon analogs in full-shell hybrid nanowires*.
- [C3] **July 2022.** “Frontiers in Condensed Matter Physics” (Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark). Poster title: *Theory of Caroli-de Gennes-Matricon analogs in full-shell hybrid nanowires*.

## Attended

- [C2] **Mar. 2024.** “Workshop on Superconductor-Semiconductor Hybrids” (Niels Bohr Institute, University of Copenhagen, Copenhagen, Denmark).
- [C1] **Sept. 2021.** “Emergence of Quantum Phases in Novel Materials” (Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain).

## Teaching

### Supervised students

**Sep 2024 -** César Robles - Bachelor's Thesis

**June 2025** Main supervisor: Elsa Prada

Title: *Quasi-Majoranas in inhomogeneous full-shell hybrid nanowires*

## Outreach

**March 2023** - ICMM Superconductivity Outreach Team

**Present** Lecturer and workshopper

Regular activities: monthly talks and demonstrations for high-school students.

## Events

- [O7] **Mar. 2025.** “Feria Madrid es Ciencia 2025 (Madrid Science Fair)” (Comunidad de Madrid, Madrid, Spain). Role: *workshopper*.
- [O6] **Sept. 2024.** “European Researchers' Night 2024” (CSIC, Madrid, Spain). Role: *workshopper*.
- [O5] **Mar. 2024.** “Feria Madrid es Ciencia 2024 (Madrid Science Fair)” (Comunidad de Madrid, Madrid, Spain). Role: *workshopper*.
- [O4] **Nov. 2023.** “Semana de la Ciencia (Science Week)” (CSIC, Madrid, Spain). Role: *workshopper*.
- [O3] **Sept. 2023.** “European Researchers' Night 2023” (Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain). Role: *workshopper*.
- [O2] **June 2023.** “Ciencia en la Calle” (Casa de la Ciencia, Ciudad Real, Spain). Role: *workshopper*.
- [O1] **Sept. 2022.** “European Researchers' Nigth 2022” (Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain). Role: *logistics*.

## Funding

### Student grants

[F3] *PhD Fellowship* at ICMM (CSIC) ( AEI, PRE2022-101362 for the period 2023-2027 ).

### Participation in funded projects

[F2] *Correlations, Superconductivity and Topology in Quantum Materials and Technologies* at ICMM (CSIC) ( AEI, PID2021-125343NB-I00 for the period 2022-2025 ). Principal investigators: Ramón Aguado and Elena Bascones.

[F1] *Topology and Correlations in Quantum Materials and Solid State Quantum Technologies* at ICMM (CSIC) ( AEI, PGC2018-097018-B-I00 for the period 2021-2022 ). Principal investigators: María José Calderón and Ramón Aguado.

## Awards

[A4] *Max Mazín Award*. Max Mazín Foundation and CEIM Foundation, 2021. Received during the period 2018-2021. Awarded each year of my undergraduate studies, 5th to 8th editions.

[A3] *GEFES Research Award for Students*. Condensed Matter Physics Division, Spanish Royal Society of Physics (GEFES-RSEF), 2020. For the work entitled *Josephson Junctions in Full-shell Majorana Nanowires*.

[A2] *Excellence Fellowship*. Comunidad de Madrid, 2018.

[A1] *Premio Extraordinario de Bachillerato*. Comunidad de Madrid, 2017. Top 10 academic records of the region.

## Skills

### Languages

<b>Spanish</b>	Native	
<b>English</b>	Fluent	C1 Advanced certification
<b>French</b>	Fluent	DALF C1 certification

### Programming

<b>OS</b>	MacOs, Linux (Debian and Ubuntu), Windows
<b>Programming Languages</b>	Python (advanced), Julia (advanced), C/C++ (basic), MySQL (basic)
<b>Web Development</b>	HTML5, CSS, JavaScript (basic)
<b>Scientific computing</b>	Mathematica (advanced), Quantica (Julia package, advanced), Numpy, Scipy
<b>Miscellaneous</b>	Makie (Julia package, advanced), matplotlib, Git, $\text{\LaTeX}$ , Office