Carlos Payá – Curriculum Vitae

Full Name	Carlos Payá Herrero	**Email**	carlos.paya@csic.es
Birthdate	20^{th} January 1999	**Website**	carlosp24.github.io
Birthplace	Madrid, Spain	**ORCID**	0000-0001-5709-2290
Nationality	Spanish	**Github**	Carlosp24
Latest update	March 19, 2025		

Personal Profile

I am currently a PhD candidate at the Theory of Quantum Materials and Solid State Quantum Technologies group at the Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain. My research focuses on the theoretical study of topological superconductors with hybrid materials, with special emphasis on full-shell Majorana nanowires. I am also interested in the study of the topological properties of superconducting materials and their applications in quantum computing.

I obtained my BSc in Physics from the Universidad Autónoma de Madrid in 2021, with a final grade 8.44/10. Then, I pursued in the same university my studies in the Master in Physics of Condensed Matter, which I completed in 2022 with a final grade 9.45/10. During my master's studies, I worked as a research assistant at the group that I would finaly join in 2023 for my PhD studies.

Education

2023-Present PhD in Condensed Matter Physics - Universidad Autónoma de Madrid, Madrid, Spain

Tentative completion date	February 2027
Topic	*Topological superconductors with hybrid materials: full-shell Majorana nanowires*
Supervisors	Elsa Prada and Ramón Aguado

2021-2022 Master in Physics of Condensed Matter - Universidad Autónoma de Madrid, Madrid, Spain

Grade	9.45/10
Master's Thesis	*Topological phase and Majorana zero modes in full-shell nanowires*
Supervisor	Elsa Prada

2017-2021 Bachelor in Physics - Universidad Autónoma de Madrid, Madrid, Spain

Grade	8.44/10
Bachelor's Thesis	*Josephson junctions based on full-shell Majorana nanowires*
Supervisor	Elsa Prada

Employment History

March 2023 - Present Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain
PhD Candidate, FPI grant
Quantum Dynamics of Materials (QUDYMA)
and Quantum Materials for Quantum Technologies (Q4Q) groups.

April - July 2025 Niels Bohr Institute, University of Copenhagen, Denmark
Visiting PhD candidate
Karsten Flensberg's group.

Nov 2021 - Sep 2022 Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain
Research Assistant
Theory of Quantum Materials and Solid State Quantum Technologies group.

Publications

Preprints

[P6] **C. Payá**, R. Aguado, P. San-Jose, and E. Prada. *Josephson Effect and Critical Currents in Trivial and Topological Full-Shell Hybrid Nanowires*. Mar. 2025. DOI: 10.48550/arXiv.2503.09756. arXiv: 2503.09756 [cond-mat]. (Visited on 03/14/2025).

[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*. Jan. 2025. DOI: 10.48550/arXiv.2501.05419. arXiv: 2501.05419 [cond-mat]. (Visited on 01/10/2025).

Journals

[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*. In: *SciPost Physics* 18.2 (Feb. 2025), p. 069. ISSN: 2542-4653. DOI: 10.21468/SciPostPhys.18.2.069. (Visited on 02/25/2025).

[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*. In: *Phys. Rev. B* 110.11 (Sept. 2024), p. 115417. DOI: 10.1103/PhysRevB.110.115417. (Visited on 09/10/2024).

[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*. In: *Physical Review B* 109.11 (Mar. 2024), p. 115428. DOI: 10.1103/PhysRevB.109.115428. URL: https://journals.aps.org/prb/abstract/10.1103/PhysRevB.109.115428.

[P1] P. San-Jose, **C. Payá**, C. M. Marcus, S. Vaitiekenas, and E. Prada. *Theory of Caroli–de Gennes–Matricon analogs in full-shell hybrid nanowires*. In: *Phys. Rev. B* 107 (15 Apr. 2023), p. 155423. DOI: 10.1103/PhysRevB.107.155423. URL: https://link.aps.org/doi/10.1103/PhysRevB.107.155423.

Conferences

Contributed Talks

[C13] **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*. URL: https://carlosp24.github.io/files/talk_Josephson_MM25.pdf.

[C12] **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*. URL: https://carlosp24.github.io/files/talk_phenomenology_qtyr24.pdf.

[C11] **May 2024**. "Condensed Matter PhD Program Anual Meeting" (Facultad de Ciencias, Universidad Autónoma de Madrid (UAM), Madrid, Spain). Contributed title: *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*. URL: https://carlosp24.github.io/files/talk_phenomenology_202405.pdf.

Poster contributions

[C10] **July 2024**. "Quantum Designer 2024" (Donostia International Physics Center, San Sebastián, Spain). Poster title: *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*. URL: https://carlosp24.github.io/files/Poster2024_04.pdf.

[C9] **May 2024**. "Quantum matter for Quantum Technologies Workshop" (SPICE, Mainz, Germany). Poster title: *Phenomenology of Majorana zero modes in full-shell hybrid nanowires*. URL: https://carlosp24.github.io/files/Poster2024_04.pdf.

[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*. URL: https://carlosp24.github.io/files/Poster2024_04.pdf.

[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*. URL: https://carlosp24.github.io/files/Poster2023_09.pdf.

[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*. URL: https://carlosp24.github.io/files/Poster2023_04.pdf.

[C5] **May 2023**. "QuantumMatter 2023" (Phantoms Foundation, Madrid, Spain). Poster title: *Theory of Caroli-de Gennes-Matricon analogs in full-shell hybrid nanowires*. URL: https://carlosp24.github.io/files/Poster2023_04.pdf.

[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*. URL: https://carlosp24.github.io/files/Poster2023_04.pdf.

[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*. URL: https://carlosp24.github.io/files/Poster2023_04.pdf.

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).

Outreach

March 2023 - Present ICMM Superconductivity Outreach Team
Lecturer and workshopper

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

Events

[O6] **Sept. 2024**. "European Researchers' Night 2024" (CSIC, Madrid, Spain). Role: *workshopper*. URL: https://www.csic.es/es/actualidad-del-csic/el-csic-celebra-la-noche-europea-de-los-investigadores-y-las-investigadoras-con-mas-de-200-actividades.

[O5] **Mar. 2024**. "Feria Madrid es Ciencia 2024 (Madrid Science Fair)" (Comunidad de Madrid, Madrid, Spain). Role: *workshopper*. URL: https://www.madrimasd.org/feriamadridesciencia/.

[O4] **Nov. 2023**. "Semana de la Ciencia (Science Week)" (CSIC, Madrid, Spain). Role: *workshopper*. URL: https://www.semanadelaciencia.csic.es/.

[O3] **Sept. 2023**. "European Researchers' Night 2023" (Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain). Role: *workshopper*. URL: https://lanochedelosinvestigadores.es/.

[O2] **June 2023**. "Ciencia en la Calle" (Casa de la Ciencia, Ciudad Real, Spain). Role: *workshopper*. URL: https://casadelaciencia.es/.

[O1] **Sept. 2022**. "European Researchers' Nigth 2022" (Instituto de Ciencia de Materiales de Madrid (ICMM), CSIC, Madrid, Spain). Role: *logistics*. URL: https://lanochedelosinvestigadores.es/.

Funding

Student grants

[F3] *PhD Grant* at ICMM (CSIC) (AEI, PRE2022-101362 for the period 2023-2027). Ammount: 111.758,00€ (including salary, tuition fees and a foregin research stay).

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

Spanish	Native	
English	Fluent	C1 Advanced certification
French	Fluent	DALF C1 certification

Programming

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