

# Gerardo García Moreno

## EDUCATION

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2021 - 2025	<b>Ph.D. in Physics and Mathematics</b> Universidad de Granada (Spain)	(Score: Cum Laude)
2019 - 2020	<b>Master in Theoretical Physics - Mention in Particle Physics and Cosmology</b> Universidad Autónoma de Madrid (Spain)	(Score: 8.86/10.0)
2015 - 2019	<b>Degree in Physics - Mention in Fundamental Physics</b> Universidad Complutense de Madrid (Spain)	(Score: 9.54/10.0)

## SUMMARY

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**Scientific interests:** I am a highly motivated researcher with a strong background in theoretical physics and mathematics, working at the interface between gravitational phenomena and quantum effects. I am specially interested in effective field theories for gravity beyond GR motivated by quantum effects, and their potential observational consequences in the form of alternatives to GR black holes.

**Scientific trajectory:** Before beginning my PhD studies in the Institute for Astrophysics of Andalusia (IAA-CSIC), Granada in Fall 2021, I did a few research project as an undergraduate student in a variety of topics. I have also completed two research stays at the EPFL (Lausanne, Switzerland), under the supervision of Mikhail Shaposhnikov (Fall 2023), and at the University of Tartu (Tartu, Estonia) under the supervision of Manuel Hohmann and Tomi Koivisto (Spring 2022).

## AWARDS

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**Extraordinary Degree Prize:** Awarded with the Extraordinary Degree Prize for the best overall mark among the 182 students graduated during the 2018/19 academic year.

**Best talk given by a PhD student at EREP 2023:** Prize for the best talk given by a PhD student at the conference EREP 2023 (Spanish and Portuguese Relativity Meeting 2023), awarded by the Springer Journal Gravitation and Cosmology, held in Bilbao, Spain, July 2023.

**Excellence scholarship for undergraduate students in Madrid:** Scholarship for best academic records during the academic years 2016/17 and 2017/18.

## RESEARCH FUNDING

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### Fellowships for PhD studies:

- **PhD fellowship from Universidad Complutense de Madrid:** Funding to pursue a PhD. November-December 2021.
- **FPU PhD fellowship from the Spanish Government:** Funding to pursue a PhD. December 2021 – present.

### Competitive funding for research stays and visits:

- **Dora+ Grant:** Competitive funding from the Estonian government for PhD students to conduct research abroad. Stay conducted at the Laboratory of Theoretical Physics, University of Tartu, Estonia: 15 May – 1 July 2022.
- **FPU Grant for Research Stays:** Competitive funding from the Spanish Government for PhD

students to conduct a research stay abroad. Stay conducted at the École Polytechnique Fédérale de Lausanne (EPFL), 1 October – 1 December 2023.

- **STSM from COST actions:** Obtained competitive funding three times from the COST actions “Cosmoverse” and “Quantum gravity phenomenology in the multi-messenger era” to visit other members of the action and undertake research projects.

#### Research projects:

- **PI of the project “Generation of ultrarelativistic jets in black holes beyond general relativity”:** This research initiative, awarded by the University of Granada, is designed for PhD students from various disciplines to collaborate on an interdisciplinary project. The project runned in 2024.

#### Research grants for undergraduate students:

- **JAE-intro grant:** Awarded by the Spanish Research Council (CSIC), conducted at the Institute for Theoretical Physics of Madrid (IFT). September – December 2018.
- **ICFO – Summer fellowship programme 2019:** From the Institute for Photonic Sciences (ICFO) of Barcelona, conducted during summer 2019.
- **Collaboration in departments:** From the Spanish Government, conducted at the Theoretical Physics Department of Universidad Autónoma de Madrid (UAM). Academic year 2019/20.
- **Research prize for undergraduate students:** Awarded by the Spanish Royal Society, conducted at the Institute for Fundamental Physics of Madrid (IFF-CSIC). Year 2019.

## TEACHING EXPERIENCE

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#### 180 hours/18 ECTS of lecturing at the University of Granada:

- 60 hours/6 ECTS in the Mathematics II course of the Degree in Optics and Optometry at the University of Granada during the academic years 2022/23, 2023/24 and 2024/25.

## ORGANIZATION OF EVENTS

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**Organizer of the QFTCS Workshop:** I have been one of the organizers of three editions of the Quantum Field Theory in Curved Spacetimes Workshop:

- First edition held online, 23-27 May 2022 (SOC).
- Second edition held in Granada, 24-26 May 2023 (SOC-LOC).
- Third edition held in Lisbon, 18-21 June 2024 (SOC).

## REFEREED PUBLICATIONS

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- [1] C. Barceló, G. García-Moreno, and A. Jiménez Cano. “Toroidal black holes in four dimensions”. In: *Class. Quant. Grav.* 42.15 (2025), p. 155015. DOI: [10.1088/1361-6382/adf0e1](https://doi.org/10.1088/1361-6382/adf0e1). arXiv: [2504.16790](https://arxiv.org/abs/2504.16790) [gr-qc].
- [2] J. Arrechea, C. Barceló, G. García-Moreno, and J. Polo-Gómez. “Beyond Buchdahl’s limit: Bilayered stars and thin-shell configurations”. In: *Phys. Rev. D* 111.12 (2025), p. 124017. DOI: [10.1103/dqbd-9z5f](https://doi.org/10.1103/dqbd-9z5f). arXiv: [2411.14018](https://arxiv.org/abs/2411.14018) [gr-qc].

- [3] C. Barceló, R. Carballo-Rubio, L. J. Garay, and G. García-Moreno. “No-hair and almost-no-hair results for static axisymmetric black holes and ultracompact objects in astrophysical environments”. In: *Class. Quant. Grav.* 42.7 (2025), p. 075020. DOI: [10.1088/1361-6382/adc233](https://doi.org/10.1088/1361-6382/adc233). arXiv: [2410.08128](https://arxiv.org/abs/2410.08128) [gr-qc].
- [4] A. García Martín-Caro, G. García-Moreno, J. Olmedo, and J. M. Sánchez Velázquez. “Classical and quantum field theory in a box with moving boundaries: A numerical study of the dynamical Casimir effect”. In: *Phys. Rev. D* 110.2 (2024), p. 025007. DOI: [10.1103/PhysRevD.110.025007](https://doi.org/10.1103/PhysRevD.110.025007). arXiv: [2404.06166](https://arxiv.org/abs/2404.06166) [quant-ph].
- [5] G. García-Moreno and A. Jiménez Cano. “Nonexistence of a parent theory for general relativity and unimodular gravity”. In: *Phys. Rev. D* 109.10 (2024), p. 104004. DOI: [10.1103/PhysRevD.109.104004](https://doi.org/10.1103/PhysRevD.109.104004). arXiv: [2309.06903](https://arxiv.org/abs/2309.06903) [gr-qc].
- [6] A. García Martín-Caro, G. García-Moreno, J. Olmedo, and J. M. Sánchez Velázquez. “Hawking radiation from an analogue bouncing geometry”. In: *Phys. Rev. D* 108.6 (2023), p. L061701. DOI: [10.1103/PhysRevD.108.L061701](https://doi.org/10.1103/PhysRevD.108.L061701). arXiv: [2306.05250](https://arxiv.org/abs/2306.05250) [gr-qc].
- [7] L. J. Garay and G. García-Moreno. “Embedding Unimodular Gravity in string theory”. In: *JHEP* 03 (2023), p. 027. DOI: [10.1007/JHEP03\(2023\)027](https://doi.org/10.1007/JHEP03(2023)027). arXiv: [2301.03503](https://arxiv.org/abs/2301.03503) [hep-th].
- [8] A. Delhom, G. García-Moreno, M. Hohmann, A. Jiménez-Cano, and T. S. Koivisto. “Bootstrapping gravity and its extension to metric-affine theories”. In: *JCAP* 12 (2023), p. 006. DOI: [10.1088/1475-7516/2023/12/006](https://doi.org/10.1088/1475-7516/2023/12/006). arXiv: [2211.13056](https://arxiv.org/abs/2211.13056) [gr-qc].
- [9] R. Carballo-Rubio, L. J. Garay, and G. García-Moreno. “Unimodular gravity vs general relativity: a status report”. In: *Class. Quant. Grav.* 39.24 (2022), p. 243001. DOI: [10.1088/1361-6382/aca386](https://doi.org/10.1088/1361-6382/aca386). arXiv: [2207.08499](https://arxiv.org/abs/2207.08499) [gr-qc].
- [10] C. Barceló, J. E. Sánchez, G. García-Moreno, and G. Jannes. “Chronology protection implementation in analogue gravity”. In: *Eur. Phys. J. C* 82.4 (2022), p. 299. DOI: [10.1140/epjc/s10052-022-10275-3](https://doi.org/10.1140/epjc/s10052-022-10275-3). arXiv: [2201.11072](https://arxiv.org/abs/2201.11072) [gr-qc].
- [11] C. Barceló, R. Carballo-Rubio, L. J. Garay, and G. García-Moreno. “Toward a Mechanism for the Emergence of Gravity”. In: *Appl. Sciences* 11.18 (2021), p. 8763. DOI: [10.3390/app11188763](https://doi.org/10.3390/app11188763). arXiv: [2108.06582](https://arxiv.org/abs/2108.06582) [gr-qc].
- [12] T. Armon, S. Ashkenazi, G. García-Moreno, A. González-Tudela, and E. Zohar. “Photon-Mediated Stroboscopic Quantum Simulation of a Z2 Lattice Gauge Theory”. In: *Phys. Rev. Lett.* 127.25 (2021), p. 250501. DOI: [10.1103/PhysRevLett.127.250501](https://doi.org/10.1103/PhysRevLett.127.250501). arXiv: [2107.13024](https://arxiv.org/abs/2107.13024) [quant-ph].
- [13] C. Barceló, L. J. Garay, and G. García-Moreno. “Analogue gravity simulation of superpositions of spacetimes”. In: *Eur. Phys. J. C* 82.8 (2022), p. 727. DOI: [10.1140/epjc/s10052-022-10702-5](https://doi.org/10.1140/epjc/s10052-022-10702-5). arXiv: [2104.15078](https://arxiv.org/abs/2104.15078) [gr-qc].
- [14] J. Arrechea, C. Barceló, L. J. Garay, and G. García-Moreno. “Inversion of statistics and thermalization in the Unruh effect”. In: *Phys. Rev. D* 104.6 (2021), p. 065004. DOI: [10.1103/PhysRevD.104.065004](https://doi.org/10.1103/PhysRevD.104.065004). arXiv: [2101.11933](https://arxiv.org/abs/2101.11933) [gr-qc].
- [15] C. Barceló, R. Carballo-Rubio, L. J. Garay, and G. García-Moreno. “Emergent gauge symmetries: Yang-Mills theory”. In: *Phys. Rev. D* 104.2 (2021), p. 025017. DOI: [10.1103/PhysRevD.104.025017](https://doi.org/10.1103/PhysRevD.104.025017). arXiv: [2101.12188](https://arxiv.org/abs/2101.12188) [hep-th].

- [16] G. García, L. Ares, and A. Luis. “Phase space quantum–classical hybrid model”. In: *Annals of Physics* 411 (2019), p. 167961. ISSN: 0003-4916. DOI: <https://doi.org/10.1016/j.aop.2019.167961>. URL: <https://www.sciencedirect.com/science/article/pii/S0003491619302167>.

## ORAL PRESENTATIONS

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### Invited seminars:

1. Seminar “Deforming (almost) black holes from the inside and from the outside” given at the Max Planck Institute for Gravitational Physics, Potsdam, Germany, 24 October 2024.
2. Seminar “Dissecting Buchdahl’s limit: A surgeon’s guide to compact objects” given at Department of Physics of Humboldt University of Berlin, Germany, 23 October 2024.
3. Online seminar: “Playing with causality in analogue gravity” given at the Department of Physics & Astronomy, Louisiana State University, 21 May 2024.
4. Seminar “A class of cosmological models with spatially constant sign-changing curvature” given at the Department of Physics, University of the Basque Country (UPV/EHU), Spain, 14 May 2024.
5. Seminar “Deforming (almost) black holes from the inside and from the outside” given at L’Institut de Mathématiques de Bourgogne, Dijon, France, 28 November 2023.
6. Seminar “Unimodular Gravity and General Relativity” given at the Department of High Energy Physics, Radboud University, Nijmegen, The Netherlands, 9 June 2023.
7. Seminar “Playing with time machines in laboratories” given at the Math Institute of the University of Granada, Spain, 11 May 2023.
8. Seminar “Unimodular Gravity and General Relativity” given at the Department of Theoretical and Cosmos Physics, University of Granada, Spain, 21 March 2023.
9. Seminar “Unimodular Gravity and General Relativity” given (online) at the Albert Einstein Institute (Max Planck Institute for Gravitational Physics), Potsdam, Germany, 7 February 2023.
10. Seminar “Playing with Causality in Analogue Gravity” given at the Department of Theoretical and Cosmos Physics, University of Granada, Spain, 5 May 2022.
11. Seminar “Is it possible to simulate time machines in a laboratory?” given at the Institute for Astrophysics of Andalucía, Granada, Spain, 10 April 2022.

### Contributions in conferences:

1. Talk “Deforming (almost) black holes from the inside and from the outside” given at 2nd edition of the JUGAR Workshop, held in Madrid, on December 3-5, 2024.
2. Talk “Cosmological spacetimes with time-dependent spatial curvature” given at the 18th Iberian Cosmology Meeting, held in Salamanca, Spain, 25 March 2024.
3. Talk “Bootstrapping (metric affine) gravity” given at EREP 2023 (Spanish and Portuguese Relativity Meeting 2023), University of the Basque Country, Bilbao, Spain, 17 July 2023.
4. Talk “Bootstrapping (metric affine) gravity” given at the Fourth Annual Conference of COST Action CA18108 “Quantum gravity phenomenology in the multi-messenger approach,” held in Rijeka, Croatia, 12 July 2023.
5. Talk “Unimodular Gravity in String Theory” given at the Madrid Winter Workshop, held at Universidad Complutense de Madrid, 12-15 December 2022, Madrid, Spain.
6. Talk “On the differences between General Relativity and Unimodular Gravity” given at EREP 2022 (Spanish and Portuguese Relativity Meeting 2022), USAL, Salamanca, Spain, 29 August – 2

September 2022.

7. Talk “On the differences between General Relativity and Unimodular Gravity” given at the conference Metric-Affine Frameworks for Gravity 2022, Laboratory of Theoretical Physics, Institute of Physics, University of Tartu, Tartu, Estonia, 27 June – 1 July 2022.
8. Talk “Path integral methods for quantum fields on curved spacetimes” given at the “11th Advanced Relativity Meeting - Carramplas,” Condemios de Arriba, Guadalajara, Spain, 23-26 May 2019.
9. Talk “Inconsistencies of semiclassical approaches” given at the “X Jerte Advanced Relativity Meeting,” Almería, Spain, 12-15 April 2018.

## OUTREACH ACTIVITIES

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1. **Outreach article:** “¿Qué hay dentro de un agujero negro? Los límites predictivos de la relatividad general”, for the journal “Muy Interesante”, July 2025. <https://www.muyinteresante.com/fundacion/categoria-ciencia-e-innovacion/relatividad-general-agujeros-negros-singularidad.html>
2. **Participation in the outreach project entitled “Horizontes de Luz – Reboot”:** I was interviewed as an expert in GR for the first chapter and I scientifically supervised this documentary series produced by the IAA in 2025.
3. **Participation in project PIISA:** Supervised high school students doing a research project as part of the PIISA initiative. Academic year 2024/2025.
4. **Outreach talk:** “Agujeros negros en la peluquería, solo las puntas.”, 20 May 2025, Pint of Science, Granada.
5. **Outreach article:** “Radio galáctica FM: sintonizando agujeros negros”, included in the 73rd edition of “Information and novelties in Astrophysics”, July 2023. <https://revista.iaa.es/content/radio-gal%C3%A1ctica-fm-sintonizando-agujeros-negros>
6. **Outreach article:** “Buscando un nuevo hogar: camino a Próxima Centauri”, included in the 73rd edition of “Information and novelties in Astrophysics”, July 2023. Gerardo García-Moreno, Daniel Guirado, Roberto Varas González, Eduardo Antúnez Ruiz, Pablo Castillo Mancilla, Jorge González Hernández, Pablo González Román, Mouad Kabich, Ángel Pineda Martín, María del Mar Rodríguez Rubio, Sergio Daniel Rodríguez Zevakhin. <https://revista.iaa.es/content/el-proyecto-piisa-del-instituto-de-astrof%C3%ADsica-de-andaluc%C3%ADa>
7. **Outreach talk:** “Fronteras del tiempo y el espacio: Horizontes cosmológicos”, given at Granada’s Book Fair, 23 April 2024. Speaker: Gerardo García-Moreno.
8. **Outreach article:** “¿Existen los agujeros blancos? ¿Y qué pasaría si se encontraran con un agujero negro?” Carlos Barceló, Gerardo García-Moreno. <https://theconversation.com/existen-los-agujeros-blancos-y-que-pasaria-si-se-encontraran-con-un-agujero-negro-222529>
9. **Outreach article:** “Galactic radio FM: tuning in to black holes”, published on Cosmoverse. <https://cosmoversetensions.eu/learn-cosmology/gerardo-garcia-moreno/>
10. **Workshop:** 3-session workshop with Encuentro high school, introducing students to basic concepts of General Relativity. Academic year 2023/2024.
11. **Participation in project PIISA:** Supervised high school students doing a research project as part of the PIISA initiative. Academic year 2023/2024.
12. **Member of the Espacio 3 team:** Monthly outreach activity combining scientific research and improvisational theater, running from October 2023 to July 2024.

13. **European Researcher's Night:** Gave the talk "Galactic Radio FM: Tuning in to black holes" at the European Researcher's Night, 30 September 2023.
14. **Participation in project PIISA:** Supervised high school students doing a research project as part of the PIISA initiative. Academic year 2022/2023.
15. **Volunteer at European Researcher's Night:** Participated as a volunteer during the event on 30 September 2022.
16. **Outreach talk:** "Emergent Gravity" for high school students, given at the Parque de las Ciencias, Granada, Spain, 12 July 2021.
17. **Outreach talk:** "Agujeros Negros e Información Cuántica" as part of the Noether Conference Series, Faculty of Physics, Universidad Complutense de Madrid, March 2019.