

Research Interests

- Classical, quantum, and astrophysical black holes
 - Quantum field theory in curved spacetimes and semiclassical gravity
 - On-shell scattering amplitudes
 - Quantum gravity phenomenology
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PERSONAL DATA

SURNAME: Carballo-Rubio

FIRST NAME: Raúl

PLACE AND DATE OF BIRTH: Seville, Spain (1988)

NATIONALITY: Spanish

PERMANENT ADDRESS: Calle Pintor Manuel Maldonado 9, 18007 Granada (Spain)

PHONE NUMBER: (+34)656285720, (+39)3394826040

PRESENT WORK ADDRESS: International School for Advanced Studies (SISSA),
Via Bonomea 265, 34136 Trieste (Italy)

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WEBSITE: rcarballo.es

EDUCATION

PH.D. IN PHYSICS AND MATHEMATICS

Institution: Spanish National Research Council
University of Granada

Thesis supervisors: Dr. Carlos Barceló
Prof. Luis J. Garay

Date of completion: March 3, 2016

M.SC. IN PHYSICS AND MATHEMATICS

Institution: University of Granada

Date of completion: June 30, 2012

B.SC./M.SC. IN PHYSICS (5 years degree)

Institution: Complutense University of Madrid

Graduation date: June 30, 2011

EMPLOYMENT

POSITION: Postdoctoral Research Fellow, 2017 - 2019

INSTITUTION: International School for Advanced Studies (SISSA),
Trieste (Italy)

POSITION: Postdoctoral Research Fellow, 2016 - 2017

INSTITUTION: Astrophysics, Cosmology and Gravity Centre, University of Cape Town, Cape Town (South Africa)

POSITION: Graduate Fellow, 2012-2016

INSTITUTION: Instituto de Astrofísica de Andalucía (IAA-CSIC), Spanish National Research Council, Granada (Spain)

AWARDS AND HONORS

- *Honorable Mention in the GRF 2015 Awards for Essays on Gravitation*
Institution: Gravity Research Foundation, Wellesley (USA)
Date: May 1, 2015
Description: Co-writer of the selected essay “Uncovering the effective spacetime: Lessons from the effective field theory rationale”.
 - *Honorable Mention in the GRF 2014 Awards for Essays on Gravitation*
Institution: Gravity Research Foundation, Wellesley (USA)
Date: May 1, 2014
Description: Co-writer of the selected essay “Mutiny at the white-hole district”.
 - *National Award for Excellence in Academic Performance*
Institution: Ministry of Education, Culture and Sport of Spain
Date: May 8, 2014
Description: Third prize on a competitive basis among all the graduates on Spanish universities in the B.Sc. in Physics in 2011. Monetary prize of 2200€.
 - *Extraordinary Degree Prize*
Institution: Complutense University of Madrid, Madrid (Spain)
Date: July 30, 2012
Description: First prize for the best overall mark of 3,71 over 4,00 among the graduates of the B.Sc. in Physics in 2011. The average mark of all the graduates that year was 1,84.
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PRESS COVERAGE (SELECTION)

4. **Sky & Telescope**
Physicist Proposes Alternative to Black Holes
Writer: Ben Skuse
Date: March 19, 2018
3. **Space.com**
‘Virtual Particles’ Could Create Dark, Echoing Dead Stars
Writer: Rafi Letzer
Date: March 19, 2018
2. **Scientific American**
Black Hole Pretenders Could Really Be Bizarre Quantum Stars
Writer: Charles Q. Choi
Date: March 16, 2018

1. GIZMODO

Could The Weirdness Of Quantum Physics Produce A New Kind Of Star?

Writer: Ryan F. Mandelbaum

Date: March 13, 2018

GRANTS

- *Ph.D. Scholarship for Graduate Students (JAE-Pre)*
Institution: Spanish National Research Council (CSIC)
Date: June 3, 2011
Description: Competitive national grant (10% success rate in 2011).
- *Scholarship for Introduction to Research (JAE-Intro)*
Institution: Spanish National Research Council (CSIC)
Date: May 20, 2010
Description: Competitive national grant awarded to the top undergraduate students (17% success rate in 2009).

PUBLICATIONS

Refereed Journals

22. Raúl Carballo-Rubio, Francesco Di Filippo, Stefano Liberati and Matt Visser
Phenomenological aspects of black holes beyond general relativity
Phys. Rev. **D** (2018, in press) [gr-qc/1809.08238]
21. Raúl Carballo-Rubio, Francesco Di Filippo, Stefano Liberati, Costantino Pacilio and Matt Visser
On the viability of regular black holes
JHEP **1807** (2018) 023 [gr-qc/arXiv:1805.02675]
20. Raúl Carballo-Rubio, Pawan Kumar and Wenbin Lu
Seeking observational evidence for the formation of trapping horizons in astrophysical black holes
Phys. Rev. **D97** (2018) 12, 123012 [gr-qc/arXiv:1804.00663]
19. Raúl Carballo-Rubio, Francesco Di Filippo and Stefano Liberati
Minimally modified theories of gravity: a playground for testing the uniqueness of general relativity
JCAP **1806** (2018) 06, 026 [gr-qc/arXiv:1802.02537]
18. Raúl Carballo-Rubio
Stellar equilibrium in semiclassical gravity
Phys. Rev. Lett. **120** (2018) 061102 [gr-qc/1706.05379]
17. Daniel J. Burger, Raúl Carballo-Rubio, Nathan Moynihan, Jeff Murugan and Amanda Weltman
Amplitudes for Astrophysicists
Gen. Relativ. Gravit. (2018, in press) [astro-ph/1704.05067]

16. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Weyl relativity: A novel approach to Weyl's ideas
JCAP **1706** (2017) 06, 014 [gr-qc/1703.06355]
15. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Gravitational wave echoes from macroscopic quantum gravity effects
JHEP **1705** (2017) 054 [gr-qc/1701.09156]
14. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Exponential fading to white of black holes in quantum gravity
Class. Quant. Grav. **34** (2017) 105007 [gr-qc/1607.03480]
13. Carlos Barceló, Raúl Carballo-Rubio, Francesco Di Filippo and Luis J. Garay
From physical symmetries to emergent gauge symmetries
JHEP **1610** (2016) 084 [gr-qc/1608.07473]
12. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Black holes turn white fast, otherwise stay black: no half measures
JHEP **1601** (2016) 157 [gr-qc/1511.00633]
11. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Where does the physics of extreme gravitational collapse reside?
Invited submission to the special issue "Open Questions in Black Hole Physics".
Universe **2** (2016) 7 [gr-qc/1510.04957]
10. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Uncovering the effective spacetime (Lessons from the effective field theory rationale)
Honorable Mention in the 2015 GRF Awards for Essays on Gravitation.
Int. J. Mod. Phys. **D24** (2015) 1544019 [hep-th/1505.05315]
9. Raúl Carballo-Rubio
Longitudinal diffeomorphisms obstruct the protection of vacuum energy
Phys. Rev. **D91** (2015) 124071 [gr-qc/1502.05278]
8. Carlos Barceló, Raúl Carballo-Rubio, Luis J. Garay and Gil Jannes
The lifetime problem of evaporating black holes: mutiny or resignation
Class. Quant. Grav. **32** (2015) 035012 [gr-qc/1409.1501]
7. Daniel N. Blaschke, Raúl Carballo-Rubio and Emil Mottola
Fermion pairing and the scalar boson of the 2D conformal anomaly
JHEP **1412** (2014) 153 [hep-th/1407.8523]
6. Carlos Barceló, Raúl Carballo-Rubio, Luis J. Garay and Gil Jannes
Electromagnetism as an emergent phenomenon: a step by step guide
New J. Phys. **16** (2014) 123028 [gr-qc/1407.6532]
5. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Mutiny at the white-hole district
Honorable Mention in the 2014 GRF Awards for Essays on Gravitation.
Int. J. Mod. Phys. **D23** (2014) 1442022 [gr-qc/1407.1391]

4. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Absence of cosmological constant problem in special relativistic field theory of gravity
Annals Phys. **398** (2018) 9-23 [gr-qc/1406.7713]
3. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Unimodular gravity and general relativity from graviton self-interactions
Phys. Rev. **D89** (2014) 124019 [gr-qc/1401.2941]
2. Carlos Barceló, Raúl Carballo-Rubio, Luis J. Garay and Ricardo Gómez-Escalante
Hybrid classical-quantum dynamics asks for hybrid notions
Phys. Rev. **A86** (2012) 042120 [quant-ph/1206.7036]
1. Carlos Barceló, Raúl Carballo-Rubio and Luis J. Garay
Two formalisms, one renormalized stress-energy tensor
Phys. Rev. **D85** (2012) 084001 [gr-qc/1112.0489]

Preprints

2. Stephon Alexander and Raúl Carballo-Rubio
Topological features of the quantum vacuum
[gr-qc/1810.02159]
1. Raúl Carballo-Rubio, Luis J. Garay, Eduardo Martín-Martínez and José de Ramón
The Unruh effect without thermality
[gr-qc/1804.00685]

Conference Proceedings (speaker first)

4. Luis J. Garay, Carlos Barceló, Raúl Carballo-Rubio and Gil Jannes
Do stars die too long?
The Fourteenth Marcel Grossmann Meeting (2017) pp. 1718-1723
3. Raúl Carballo-Rubio, Carlos Barceló and Luis J. Garay
Some not-so-common ideas about gravity
J. Phys.: Conf. Ser. **626** (2015) 012010
2. Carlos Barceló, Raúl Carballo-Rubio, Luis J. Garay and Gil Jannes
Do transient white holes have a place in nature?
J. Phys.: Conf. Ser. **600** (2015) 012033
1. Raúl Carballo-Rubio, Carlos Barceló and Luis J. Garay
Absence of cosmological constant problem in special relativistic field theory of gravity: one-loop renormalization group
J. Phys.: Conf. Ser. **600** (2015) 012032

CITATION METRICS

(Based on a combined search using the ADS and Inspire-HEP databases)

H-index (excluding self-citations): 10

m-index (excluding self-citations): 1.4

Total citations in the last 3 years: 115 (2018), 91 (2017), 61 (2016)

CONTRIBUTIONS TO CONFERENCES

Invited and Plenary Talks

7. *Emergent Symmetries in Particle Physics, Cosmology and Condensed Matter Systems*
Institution: Niels Bohr Institute, University of Copenhagen
Dates: June 20-22, 2018
Contribution: Invited talk “Emergence of gauge symmetries: a working example”
6. *23 Peyresq Workshop on the Micro and Macro Structure of Spacetime*
Institution: Université Libre de Bruxelles & Aix-Marseille Université
Dates: June 11-15, 2018
Contribution: Invited lecture “Regular black holes: an outsider’s view”
5. *7th Joburg Workshop on String Theory*
Institution: University of Pretoria, Pretoria (South Africa)
Dates: December 5-9, 2016
Contribution: Invited talk “Are black holes stable in quantum gravity?”
4. *Spanish Relativity Meeting ERE 2015*
Institution: University of the Balearic Islands, Palma de Mallorca (Spain)
Dates: September 7-11, 2015
Contribution: Plenary talk “Ultraviolet effects in gravitational collapse”
3. *9-Northern Hemisphere International Workshop on Relativistic Quantum Information (RQI-N 2015)*
Institution: Dartmouth College, Hanover (USA)
Dates: July 5-8, 2015
Contribution: Invited talk “Where does the physics of extreme gravitational collapse reside?”
2. *7th International Workshop DICE2014*
Institution: University of Pisa, Pisa (Italy)
Dates: September 15-19, 2014
Contribution: Invited talk “Some not-so-common ideas about gravity”
1. *1st i-Link Workshop Macro-from-Micro: Quantum Gravity and Cosmology*
Institution: Instituto de Estructura de la Materia (IEM-CSIC), Madrid (Spain)
Dates: June 24-27, 2013
Contribution: Invited talk “Emergent electrodynamics in a Helium-3-like system”

Contributed Talks

18. *X Jerte Advanced Relativity Workshop*
Institution: Instituto de Astrofísica de Andalucía (IAA-CSIC), Granada (Spain)
Dates: March 12-15, 2018
Contribution: Contributed talk “Testing the nature of black hole boundaries”

17. *Spanish-Portuguese Relativity Meeting (EREP) 2017*
Institution: University of Málaga, Málaga (Spain)
Dates: September 12-15, 2017
Contribution: Contributed talk “Exact solutions for static and spherically symmetric ultra-compact relativistic stars in semiclassical gravity”
16. *Probing the spacetime fabric: from basic concepts to phenomenology*
Institution: International School for Advanced Studies (SISSA), Trieste (Italy)
Dates: July 10-14, 2017
Contribution: Contributed talk “Exact solutions describing horizonless alternatives to black holes”
15. *Beyond The Concordance Model II*
Institution: University of Cape Town, Cape Town (South Africa)
Dates: November 28 to December 2, 2016
Contribution: Contributed talk “Faster than Hawking evaporation”
14. *Windows on Quantum Gravity: Season 2*
Institution: Instituto de Física Teórica UAM-CSIC, Madrid (Spain)
Dates: October 28-30, 2015
Contribution: Contributed talk “Keeping the cosmological constant small at all scales”
13. *14th Marcel Grossmann Meeting (MG14)*
Institution: Sapienza University of Rome, Rome (Italy)
Dates: July 12-18, 2015
Contribution: Contributed talk “On the link between the cosmological constant and spacetime”
12. *Quantum Vacuum and Gravitation (QVG2015)*
Institution: Johannes Gutenberg University, Mainz (Germany)
Dates: June 22-26, 2015
Contribution: Contributed talk “Using the cosmological constant to learn about spacetime”
11. *IberiCOS 2015 Xth Iberian Cosmology Meeting*
Institution: Complutense University of Madrid, Madrid (Spain)
Dates: March 30 to April 1, 2015
Contribution: Contributed talk “Gravitational symmetries and the quantum vacuum”
10. *VII Jerte Advanced Relativity Workshop*
Institution: Instituto de Estructura de la Materia (IEM-CSIC), Madrid (Spain)
Dates: March 24-27, 2015
Contribution: Contributed talk “Gravitational symmetries and the quantum vacuum”
9. *Dark Side of the Universe DSU 2014*
Institution: University of Cape Town, Cape Town (South Africa)
Dates: November 17-21, 2014
Contribution: Contributed talk “Matter, gravity and vacuum energy”

8. *Spanish Relativity Meeting ERE 2014*
Institution: University of Valencia, Valencia (Spain)
Dates: September 1-5, 2014
Contribution: Contributed talk “Absence of cosmological constant problem in special relativistic field theory of gravity”
7. *VI Jerte Advanced Relativity Workshop*
Institution: Instituto de Estructura de la Materia (IEM-CSIC), Madrid (Spain)
Dates: April 4-7, 2014
Contribution: Contributed talk “When gravitons gravitate”
6. *4th Iberian Gravity Waves Meeting*
Institution: University of Granada, Granada (Spain)
Dates: February 26-28, 2014
Contribution: Contributed talk “Graviton self-interactions and the cosmological constant”
5. *GR 20 International Conference*
Institution: University of Warsaw, Warsaw (Poland)
Dates: July 7-13, 2013
Contribution: Contributed talk “Sakharov’s mechanism in superfluid Helium-3”
4. *53 Cracow School of Theoretical Physics*
Institution: Jagiellonian University, Krakow (Poland)
Dates: June 28 to July 7, 2013
Contribution: Contributed talk “Emergent electrodynamics in a Helium-3-like system”
3. *V Jerte Advanced Relativity Workshop*
Institution: Instituto de Estructura de la Materia (IEM-CSIC), Madrid (Spain)
Dates: March 21-23, 2013
Contribution: Contributed talk “Emergent electrodynamics in Helium-3”
2. *IV Jerte Advanced Relativity Workshop*
Institution: Instituto de Estructura de la Materia (IEM-CSIC), Madrid (Spain)
Dates: March 27-30, 2012
Contribution: Contributed talk “Sakharov’s induced gravity”
1. *III Jerte Advanced Relativity Workshop*
Institution: Instituto de Estructura de la Materia (IEM-CSIC), Madrid (Spain)
Dates: March 3-6, 2011
Contribution: Contributed talk “Energy-momentum tensor in two-dimensional spacetimes”

RESEARCH VISITS

3. Institution: Perimeter Institute for Theoretical Physics, Waterloo (Canada)
Host: Prof. Niayesh Afshordi
Dates: July 29 to August 25, 2018

2. Institution: University of Cape Town, Cape Town (South Africa)
Department: Mathematics & Applied Mathematics
Host: Prof. Jeff Murugan
Dates: October 30, 2014 to January 13, 2015
 1. Institution: Los Alamos National Laboratory, Los Alamos (USA)
Department: Nuclear, Particle, Astrophysics and Cosmology Group (T-2)
Host: Dr. Emil Mottola
Dates: September 1 to November 30, 2012
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SEMINARS

16. Invited talk: “Flat, curved and granular spacetime: the quest for quantum gravity”
Institution: University of Central Florida, Orlando (USA)
Host: Kevin Fernando, President of the Society of Physics Students at UCF
Date: August 30, 2018
15. Invited talk: “Unexpected constraints from accretion onto ultracompact objects”
Institution: Harvard-Smithsonian Center for Astrophysics, Cambridge (USA)
Host: Prof. Ramesh Narayan
Date: August 27, 2018
14. Invited talk: “How strong is the case for the existence of horizons in astrophysical black holes?”
Institution: Institute for Quantum Computing at the University of Waterloo (Canada)
Host: Prof. Eduardo Martn-Martnez
Date: July 30, 2018
13. Invited talk: “Semiclassical relativistic stars”
Institution: Sapienza University of Rome, Rome (Italy)
Host: Dr. Paolo Pani
Date: March 21, 2018
12. Invited talk: “The structure of black holes: from theory to observations”
Institution: University of Windsor, Windsor (Canada)
Host: Dr. Shajid Haque
Date: November 13, 2017
11. Invited talk: “Black stars are solutions of semiclassical gravity”
Institution: Institute of Astrophysics and Space Sciences (IA), Lisbon (Portugal)
Host: Dr. Diego Rubiera-García
Date: June 26, 2017
10. Invited talk: “The static geometry of a black star”
Institution: CENTRA, Instituto Superior Técnico, Lisbon (Portugal)
Host: Prof. Vitor Cardoso
Date: June 23, 2017
9. Invited talk: “Gravitational lensing and modern amplitude methods”
Institution: Brown University, Providence (USA)
Host: Prof. Stephon Alexander
Date: May 24, 2017

8. Invited talk: “Exponential decay of black holes into white holes”
Institution: Louisiana State University, Baton Rouge (USA)
Host: Prof. Iván Agulló
Date: May 17, 2017
7. Invited talk: “Do astrophysical black holes have horizons?”
Institution: Florida Space Institute, Orlando (USA)
Host: Dr. Noemí Pinilla-Alonso
Date: May 3, 2017
6. Invited talk: “Black holes, white holes, and black stars”
Institution: Institute for Quantum Computing, University of Waterloo, Waterloo (Canada)
Host: Prof. Eduardo Martín-Martínez
Date: April 18, 2017
5. Invited talk: “Quantum gravity phenomenology with gravitational waves”
Institution: Florida Atlantic University, Boca Raton (USA)
Host: Prof. Jonathan Engle
Date: April 3, 2017
4. Invited talk: “A different look at black holes in quantum gravity”
Institution: University of Cape Town, Cape Town (South Africa)
Host: Prof. Álvaro de la Cruz-Dombriz
Date: October 18, 2016
3. Invited talk: “The problem of graviton bootstrapping”
Institution: Catholic University of Louvain, Louvain-la-Neuve (Belgium)
Host: Dr. Jose Beltrán Jiménez
Date: November 21, 2014
2. Invited talk: “Unimodular gravity and general relativity from graviton self-interactions”
Institution: University of Granada, Granada (Spain)
Host: Prof. Mar Bastero Gil
Date: June 26, 2014
1. Invited talk: “Graviton self-interactions and the cosmological constant”
Institution: University of Nottingham, Nottingham (United Kingdom)
Host: Prof. Kirill Krasnov
Date: May 21, 2014

LANGUAGE SKILLS

- Spanish: native speaker.
- English: highly proficient.
- Japanese: basic communication skills.

PROGRAMMING LANGUAGES

- Basic knowledge of C++11 and Python3 (I am currently attending a 48-hours advanced programming course covering these languages and their integration).

ADDITIONAL MERITS

- Referee of *Nature Astronomy*, *Physical Review Letters* (PRL), *Physical Review D* (PRD), *Journal of High Energy Physics* (JHEP), *Classical and Quantum Gravity* (CQG), *Journal of Cosmology and Astroparticle Physics* (JCAP), and *General Relativity and Gravitation* (GERG).
- Member of the Local Organizing Committee of the 4th Iberian Gravitational Waves Meeting, held in Granada in February 2014.
- Member of the Local Organizing Committee of the Spanish Relativity Meeting (ERE 2010), held in Granada in September 2010.
- Regular collaborator in outreach activities with nonprofit international organizations such as *The Mars Generation*, and Spanish social media such as *El Diario* or *Radio Nacional de España*, town councils and schools. These activities are detailed on my personal website.
- Scientific organizer of the cycle of invited seminars of the Astroparticle Physics group at SISSA for the 2018-2019 academic year.