

Raúl BOMBÍN

PhD. in Computational and Applied Physics

ADAGIO (Advanced Manufacturing Research Fellowship Programme in the Basque – New Aquitaine Region) postdoctoral researcher

*funded with a **Marie Skłodowska-Curie Action** (MSCA confund)*

Groupe THEO, ISM, CNRS/Université Bordeaux
351 cours de la libération 33405, Talence, FR
raul.bombin@u-bordeaux.fr
Born on 16th of January 1992, Spanish

Research Interests

- Material Science
- Condensed Matter
- Ultracold-gases

Research Skills

- Computational Many-Body Physics.
- Density Functional Theory
- Quantum Monte Carlo
- Perturbation Theory

Positions

- Nov 2023 – Nov 2026 **Postdoctoral researcher** Université de Bordeaux, FR
ADAGIO (Advanced Manufacturing Research Fellowship Programme in the Basque – New Aquitaine Region)
funded with a **Marie Skłodowska-Curie Action** (MSCA confund)
Collaborating with Pascal Larregaray (UBx, Institut de ciencias moleculars), Jean-Christophe Tremblay (Université de Lorraine), Oihana Galparsoro (UPV/EHU), Ricardo Díez Muiño (DIPC)
- Feb 2022 – Nov 2023 **Postdoctoral researcher** Universitat Politècnica de Catalunya, Barcelona, ES
CFM – Centro de Física de Materiales (CSIC-UPV/EHU), Donostia, ES
funded by **Margarita Salas** from UPC with European funding
Collaborating with Jordi Boronat, Ferran Mazzanti, Caludio Cazorla, Maite Alducin Ochoa and Iñaki Juaristi
- Mar 2020 – Dec 2021 **Postdoctoral researcher** CFM – Centro de Física de Materiales (CSIC-UPV/EHU), Donostia, ES
funded by **research project** from Ministry of Science and innovation
with Profs. Maite Alducin Ochoa, Iñaki Juaristi and Ricardo Díez Muiño
- Dec 2015 – Dec 2019 **Predocctoral researcher** UPC – Universitat Politècnica de Catalunya, Barcelona, ES
funded by **FPI Fellowship** from Ministry of Economy
with Profs. Jordi Boronat and Ferran Mazzanti

Education

- 2015 – 2019 **PhD in Computational and Applied Physics**, UPC – Universitat Politècnica de Catalunya, ES.
Advisors: Professors Jordi Boronat and Ferran Mazzanti.
Thesis: "Ultracold Bose and Fermi dipolar gases: a Quantum Monte Carlo study"
- 2014 – 2015 **Inter-University MSc in Nuclear Physics**, USAL – Universidad de Salamanca, ES.
Thesis: "Puesta a punto de la electrónica de coincidencia digital del sistema de espectrometría gamma para datación absoluta, Mazingher"
- 2010 – 2014 **BSc in Physics**, USAL – Universidad de Salamanca, ES.
Last year specialization: Nuclear and particle physics, computational physics, advanced quantum mechanics, statistical mechanics.

Grants

postdoctoral

- 2023 ADAGIO (Advanced Manufacturing Research Fellowship Programme in the Basque – New Aquitaine Region) – 3 yrs ~ 130k €
funded with Marie Skłodowska (MSCA) confund
Competitive call
"Investigation of quantum mechanical effects in H atom scattering from Tungsten surfaces"
UBx – Université de Bordeaux, FR
- 2022 Margarita Salas Fellowship Fellowship– 4 yrs ~ 70k €
funded by Spanish Ministry of Economy
Competitive call
"Excitons on heterostructures of transition metal dichalcogenides" project
UPC – Universitat Politècnica de Catalunya, Barcelona, ES

Predoctoral

- 2015 FPI Fellowship– 4 yrs ~ 70k €
funded by Spanish Ministry of Economy
Selection based on the CV
"Ultracold quantum matter" project
UPC – Universitat Politècnica de Catalunya, Barcelona, ES

Others

- 2019 Selected for assistance to Quantum Connections in Sweden 6: Physics Summer School on Quantum Frontiers"
Accommodation funded by Nordita, Institute of Theoretical Physics, SE
- 2014 Selected for assistance to Safe Applications of Radiation and Radionuclides - SARA 2015"
2 ECTS, Travel grant funded by Czech Technical University, Prague, CZ

Professional accreditations

- 2022 **Profesor Ayudante doctor**, National Agency for Quality Assessment and Accreditation (ANECA) (Spain)
- 2020 **Lector Profesor**, Agencia pe la qualitat del sistema universitari de Catalunya (AQU).
- 2020 **Assistant Professor**, University of the Basque Country / Euskal Herriko Unibertsitatea (UPV / EHU).

Publications

Times cited: 233 h-index: 6 i-10 index: 5 (Google Scholar)

Preprint

- [3] J. Sánchez-Baena, **R. Bombín** and J. Boronat.
"Ring solids and supersolids in spherical shell-shaped dipolar Bose-Einstein condensates"
- [2] **R. Bombín**, F. Mazzanti and J. Boronat.
"Off-diagonal long-range order in arrays of dipolar droplets"
(arXiv:2310.04597) (2023)
- [1] **R. Bombín**, F. Mazzanti and J. Boronat.
"Off-diagonal long-range order in arrays of dipolar droplets"
(arXiv:2310.10222)(2023)

Peer-Reviewed Publications

- [11] **R. Bombín**, Alberto S. Muzas, Dino Novko, J.I. Juaristi and M. Alducin.
"Vibrational dynamics of CO on Pd (111) in and out of thermal equilibrium"
(Physical Review B **108**, 045409 (2023))
- [10] **R. Bombín**, Alberto S. Muzas, Dino Novko, J.I. Juaristi and M. Alducin.
"Anomalous transient blueshift in the internal stretch mode of CO/Pd(111)"
Physical Review B **107**, L121404 (2023)
- [9] **R. Bombín**, M. Alducin, and J.I. Juaristi
"Adsorption and dissociation of diatomic molecules on monolayer 1H-MoSe₂"
Phys. Rev. B **105**, 035404 (2022)
- [8] **R. Bombín**, F. Mazzanti, and J. Boronat
"Finite-range effects in the two-dimensional repulsive Fermi polaron"
Phys. Rev. A **103**, L041302 (2021)

- [7] **R. Bombín**, F. Mazzanti, and J. Boronat
 "Reply to "Comment on "Berezinskii-Kosterlitz-Thouless transition in two-dimensional dipolar stripes""
 Phys. Rev. A **102**, 047302 (2020)
- [6] **R. Bombín**, F. Mazzanti, and J. Boronat
 "Berezinskii-Kosterlitz-Thouless transition in two-dimensional dipolar stripes"
 Phys. Rev. A **100**, 063614 (2019)
- [5] F. Böttcher, M. Enzel, J. N. Schmidt, M. Guo, T. Langen, I. Ferrier-Barbut, T. Pfau, **R. Bombín**, J. Sánchez-Baena, J. Boronat, and F. Mazzanti
 "Dilute dipolar quantum droplets beyond the extended Gross-Pitaevskii equation"
 Phys. Rev. Research **1**, 033088 (2019)
- [4] T. Comparin, **R. Bombín**, G. Bertaina, F. Mazzanti, S. Giorgini, and J. Boronat
 "Two-dimensional repulsive Fermi polarons with short- and long-range interactions"
 Phys. Rev. A **100**, 023608 (2019)
- [3] T. Comparin, **R. Bombín**, M. Holzmann, J. Boronat, F. Mazzanti, and S. Giorgini.
 "Two-dimensional mixture of dipolar fermions: Equation of state and magnetic phaseOs"
 Phys. Rev. A **99**, 043609 (2019)
- [2] **R. Bombín**, J. Boronat, and F. Mazzanti
 "Dipolar Bose supersolid stripes"
 Phys. Rev. Lett. **119**, 250402 (2017)
- [1] B. Quintana, C. Pedrosa, **R. Bombín**, S. Martín and J. C. Lozano
 "Mazinger, a γ -ray spectrometry system of high efficiency and very low background for palaeoclimate applications"
 App. Radiation and Isotopes. **116**, 116-120 (2017)

4 Invited Seminars

23 Nov 2023	Universidad de Salamanca, ES Invited seminar: "Exploring Supersolidity and droplet formation in ultracold dipolar systems" Host: Prof. Enrique Díez
3 Dec 2019	Universitat Politècnica de Catalunya, ES Invited seminar: "BKT transition and stripe phase of a 2D dipolar gas" Host: Prof. Gregory Astrakharchik
28 Nov 2019	Universitat de Barcelona, ES Invited seminar: "BKT transition and stripe phase of a 2D dipolar gas" Host: Prof. Artur Polls
6 – 8 Dec 2017	INO-CNR BEC Center, University of Trento, IT Invited seminar: "Quantum Dipolar Systems" Host: Dr. Tommaso Comparin

1 invited talk, 5 Contributed Talks & 17 Posters in International Events

Workshops

- 25 – 26 Jan 2024 "Cold Atom Workshop Barcelona"
Invited talk: "A QMC based density functional to study droplet formation and supersolid states"
Barcelona, ES
- 12 – 16 June 2023 "International Workshop on Computational Nanotechnology "
Contributed talk: "Anomalous transient blue-shift in the internal stretch mode of CO on Pd(111)"
Barcelona, ES
- 12 – 16 Sept 2022 "Fifth International Workshop on Scattering of Atoms and Molecules from Surfaces SAMS5"
Contributed talk: "Laser induced electron-phonon coupling screening for CO adsorbed on Pd(111)"
Cambridge, UK
- 11 – 15 Jul 2022 "Novel Electronic Properties of Two-Dimensional Materials (NEP2DM)"
Poster: "Adsorption and dissociation of diatomic molecules on $1H-MoSe_2$ "
Donostia, ES
- 20 – 24 Jun 2022 "II International conference on Novel 2D Materials Explored Via Scanning Probe Microscopy and Spectroscopy (2D-SPM)"
Poster: "Adsorption and dissociation of diatomic molecules on $1H-MoSe_2$ "
Donostia, ES
- 27 – 30 Sep 2021 "Challenges in reaction dynamics of gas-surface interactions and methodological advances in dissipative and nonadiabatic processes"
Poster: "Effect of electron-phonon coupling on the vibrational linewidth of CO on Pd(111)"
Toulouse, FR
- 7 – 13 Nov 2021 "Nanophotonics of 2D materials"
Poster: "Effect of electron-phonon coupling on the vibrational linewidth of CO on Pd(111)"
Centro de Ciencias de Benasque Pedro Pascual, Benasque (Huesca), ES
- 14 – 18 Jun 2021 "Virtual School on Electron-Phonon Physics and the EPW code"
Poster: "Effect of electron-phonon coupling on the vibrational linewidth of CO on Pd(111)"
Online event organized by the University of Texas, US
- 24 Oct 2019 "Quantum Machine Learning Workshop"
ICFO, Barcelona, ES
- 4 – 6 Sep 2019 "Quantum Menorca 2019 – Dynamics and interactions in quantum gases"
Institut Menorquí d'Estudis, Maó, Menorca, ES
Posters: "BKT transition in a system of dipoles"
"Droplet formation of dipolar Dy atoms"
- 15 – 17 Jul 2019 "Workshop on Quantum Mixtures and celebration of the 70th anniversary of Sandro Stringari"
Bruno Kessler Foundation and University of Trento, IT
Poster: "BKT transition in a system of dipoles"

- 25 – 28 Jun 2018 "Long-range interactions in quantum systems
Leibniz Universität Hannover, DE
Poster: "2D Fermionic dipoles at $T=0$ "
- 3 – 7 Jul 2017 "Workshop on Understanding Quantum Phenomena with Path Integrals: From Chemical Systems to Quantum fluids and Solids"
ICTP, Trieste, IT
Poster: "Superstripes in quantum dipolar systems"
- 18 – 21 Apr 2017 "Exploiting Finite Size Effects in Simulations"
University Pierre et Marie Curie, Paris, FR
Contributed talk: "Finite size effects in a quantum two dimensional system of dipoles"

Conferences

- 4 – 8 Sept 2023 "CMD 30 - FisMat 2023 conference"
Contributed talk: "Vibrational dynamics of CO on Pd(111)"
Milano, IT
- 11 – 13 Nov 2021 "International conference on electron-phonon coupling and thermoelectric efficiency"
Live Congress organized by UPV/EHU
- 10 – 14 Sep 2019 "20th conference on recent progress on many-body theories"
Université Toulouse, Toulouse, Midi-Pyrénées, FR
Poster: "BKT transition in a system of dipoles"
- 16 – 20 Jul 2019 "26th International Conference on Atomic Physics (ICAP)"
Barcelona, ES
Poster: "2D fermionic dipoles at $T=0$ "
- 3 – 6 Mar 2018 "X J2IFAM Conference"
Universitat de Barcelona, ES
Contributed talk: "Dipolar Bose Superstripes"
- 17 – 23 Sept 2017 "Quantum Optics IX"
Gdansk, PL
Poster: "Dipolar Bose Superstripes"

Schools

- 10 – 22 Jun 2019 "Quantum Connections in Sweden 6: Physics Summer School on Quantum Frontiers"
Högberga gård, Lidingö, Sweden
- 13 – 17 Jun 2016 "Path Integral Quantum Mechanics: Theory, Simulation and Application"
CECAM, Laussane, SH
Poster: "Superfluidity in a polarized system of dipolar bosons in 2D"
- 20 – 24 Mar 2015 "Rewriting Nuclear Physics textbooks: 30 years of radioactive ion beam physics"
Università di Pisa, IT
- 29 Mar – 4 Apr 2015 "Safe Applications of Radiation and Radionuclides - SARA 2015 (2 ECTS)"
Czech Technical University, Prague, CZ

8 – 19 Sept 2014 "IV Summer School on Statistical Physics of Complex and Small Systems . (2 ECTS)"
IFISC (Instituto de Física Interdisciplinar y Sistemas Complejos), ES

Meetings

8 Feb 2019 "7th Half-Day Meeting", UAB – Universitat Autònoma de Barcelona, ES
including ultracold gas and quantum optics groups of all institutions in Barcelona
Poster: "Dipolar Fermi Polaron"

29 Jan 2019 "Jornada de recerca Departament de física, UPC – Universitat Politècnica de Catalunya, Barcelona, ES
Poster: "Droplet formation of dipolar Dy atoms"

7 Dic 2018 "Experimental realization of quantum droplets in ultracold atomic mixtures"
INO-CNR BEC Center, University of Trento, IT

22 – 23 Oct 2018 "Florence-Trento meeting on Quantum gases"
Scuola Normale Superiore, Pisa, IT

18 – 20 Jul 2018 "Meeting on Ultracold Quantum Mixtures"
UPC – Universitat Politècnica de Catalunya, Barcelona, ES

20 Feb 2018 "6th Half-Day Meeting", UPC – Universitat Politècnica de Catalunya, Barcelona, ES
including ultracold gas and quantum optics groups of all institutions in Barcelona
Poster: "Dipolar Bose Superstripes"

Master Thesis supervision

2022–2023 **Title:** "Ultrafast adsorbate vibrational dynamics" – Master in Nanoscience
Author: Iñaki Fernandez
Supervisors: Maite Alducín and Raúl Bombín
UPV/EHU – Universidad del País Vasco /Euskal Herriko Unibersitate

Teaching

2022 – 2023 Physics II - Degree in Architecture Studies ~ 1h per week
UPC – Universitat Politècnica de Catalunya, Barcelona, ES

2017 – 2018 Laboratory of Physics - Degree in informatics engineering. ~ 2h per week
UPC – Universitat Politècnica de Catalunya, Barcelona, ES

2016 – 2017 Laboratory of Physics - Degree in informatics engineering. ~ 2h per week
UPC – Universitat Politècnica de Catalunya, Barcelona, ES

Research Stays

Sep – Dec 2018 **Entity:** INO-CNR BEC Center, University of Trento, IT
Start-end dates: 11th of September – 15th of December 2017
Duration: 3 months and 5 days

Prizes

2022 Special Doctoral Award - Universitat Politècnica de Catalunya

University management and representation

2023 Member of the "Claustre Universitari" (senate) of Universitat Politècnica de Catalunya (UPC)

2022 -2023 Member of "comitè d'empresa del personal docente investigador laboral" (Company Committee of Teaching and Research Staff) at UPC

2018 – 2020 Phd. students representative at Phd. student Council at UPC

Others

29 Jul 2023 Teaching day of the department of physics (4 h.)

Sep – Dec Jul 2020 Course: Machine Learning with neural networks from Master's degree in Engineering Physics (4 ECTS)

2–4 Jul 2019 Assitance to Course: How to write your doctoral thesis (6 h.)

13 Jul 2018 Teaching day of the department of physics (4 h.)

Languages

Spanish native language

English C1 level

Catalan B1 level

Euskera A2 level

Last update: December 15, 2023