

Curriculum Vitae

1. GENERAL INFORMATION

- Name: Carlos Fernando Destefani
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 - [Linkedin](#) and [Scholar](#) pages
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2. ACADEMIC EXPERIENCE (2004-2009, 2020-2024)

- 2020-2024: **Postdoctoral Researcher**, Universitat Autònoma Barcelona, Spain.
Supervisor: Prof. Xavier Oriols Pladevall.
 - 2009-2009: **Short Research Stay**, Universidade Federal São Carlos, Brazil.
Supervisor: Prof. Gilmar Eugenio Marques.
 - 2004-2008: **Postdoctoral Researcher**, University of Ottawa, Canada.
Supervisor: Prof. Thomas Brabec.
 - 2004-2004: **Short Research Stay**, Benemérita U. Autónoma Puebla, México.
Supervisor: Profa. Lilia Meza-Montes.
 - 2004-2004: **Short Research Stay**, Ohio University, USA.
Supervisor: Prof. Sergio Eduardo Ulloa.
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3. INDUSTRIAL EXPERIENCE (2010-2016)

- 2010-2016: **Audaces** (www.audaces.com/en), Florianópolis, Brazil.
 - 2010-2013: **Funding**: RHAЕ Researcher in Company, MCT/CNPq 62/2009, public initiative for fixing academic researchers into the Innovation Sector.
 - 2013-2016: **Employment**: after the public funding, hired as regular employee.
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4. EDUCATION (1993-2003)

- 1999-2003: **Ph. D. in Physics**, Universidade Federal São Carlos, Brazil.
Thesis: Effects of Electron-Electron and Spin-Orbit Interactions on the Magneto-Electronic and Magneto-Transport Properties of Confined Systems.
Supervisors: Prof. Gilmar Eugenio Marques, Prof. Sergio Eduardo Ulloa.
- 2002-2003: **Ph. D. Stay**, Ohio University, USA.
Supervisor: Prof. Sergio Eduardo Ulloa.
- 1997-1999: **M. Sc. in Physics**, Universidade Federal São Carlos, Brazil.
Dissertation: Transport Properties of Mesoscopic Systems.
Supervisor: Prof. Gilmar Eugenio Marques.
- 1993-1997: **B. Sc. in Physics**, Universidade Federal São Carlos, Brazil.

5. SUMMARY OF ACADEMIC RESEARCH

During my PhD in Brazil, I developed usual Hartree-Fock codes, like Roothaan and People-Nesbet approaches, as well as Configuration Interaction, to handle electronic spectra of quantum dots; I also worked with transport properties in quantum dots connected to leads via a master equation approach.

In my PhD Stay in USA, the focus was the study of spin-orbit coupling, namely, Rashba and Dresselhaus effects, in narrow and wide gap materials. The interplay of such effects with electron-electron interaction, magnetic and electric fields, and acoustic phonons, on properties like spin relaxation rates and effective g-factor was also the focus.

During my Postdoctoral stage in Canada, I participated in the development of the Multi-Configuration Time-Dependent Hartree-Fock (MCTDHF) code for dealing with quantum dynamics of many-body atomic and nano systems under presence of intense laser-matter interaction. In such a regime, phenomena like electron ionization followed by high harmonic generation involve a huge number of excited states, such that other usual time-dependent approaches are prohibitive. The idea of MCTDHF is to use time-dependent orbitals as basis-set, which also evolves through the dynamics, to decrease the number of configurations needed when compared to other approaches.

In my Postdoctoral stage in Spain, other than working with issues of fundamental quantum mechanics via Bohmian formalism, I had been deeply involved in the study of nanostructures-in-a-cavity, focusing on polaritonic features of the dressed states formed by the electrons in the nanostructure and the photons in the cavity quantized electromagnetic field. I had been addressing known issues related to the gauge of the electromagnetic field which appear in practical calculations, whenever the basis is cut (like in a two-level system) and only a single mode for the field is considered. Different Hamiltonians, from distinct approximations, were compared in the strong-coupling regime; from usual Jaynes-Cummings and Tavis-Cummings models to Rabi and Dicke models (no rotating wave approximation), to the full models where the “quadratic” terms are kept. Such a study started via a simplified model for TeraHertz fields in [PRB 106, 205306, 2022](#), which is also the origin of a requested patent. There, excitons were not treated since only conduction electrons were considered, and I had started to handle the Hopfield Hamiltonian, which also differs in different gauges, while the study of energy harvesters and a more “photonics” approach became a long-term interest. The study of superradiance was also on the radar, as the discussion on the presence of quadratic terms in the Hamiltonian imposing or not a no-go theorem for its occurrence is still not fully set.

During the postdoctoral stage in Spain, teaching activities were developed for a short period of time. Also, a software for a didactic material to be included in the [digiQ](#) (Digitally Enhanced Quantum Technology Master) consortium, labelled as QC_SLIM (Quantum and Classical Simulation of Light and Matter) was developed, with both software and manual being freely [downloadable](#), and where I mostly took care of its theoretical aspects. At last, the project proposal *Terahertz sources based on quantum superposition of electron-photon states in resonant tunnelling diodes embedded into an optical cavity* was produced by myself and the PI of the group to develop the patent request above mentioned, and submitted to the program “Proof of Concept 2023 (Perte Chip)”, with the requested funding being granted, as seen on this [page](#) for the respective concession resolution (project code PDC2023-145807-I00).

6. SUMMARY OF INDUSTRIAL RESEARCH

6.1 MAIN PROJECT

Title: Innovation of Automatic Nesting.

Product: [Audaces Marker](#), an Automatic Nesting Software.

Problem: The so-called Irregular Nesting Problem is an NP-hard problem in Computer Science where one needs to nest, without overlaps, several pieces of 2D geometries (non-convex, with holes) in a sheet of material to be cut, where material waste is to be minimized and were given piece restrictions like rotations, orientations, symmetries, sizes, are to be obeyed. The complexity of the optimization of such problems lies in both of their combinatorial and geometrical natures.

Solution: A set of in-house tools were developed while some others were adapted from literature: linear and mixed-integer programming, duality and sensitivity analysis, heuristics and meta-heuristics algorithms, thermal annealing, no-fit polygon, convex decomposition, hole filling, Boolean geometry operations, grid decomposition and refining, image recognition, compaction and separation methods. Due to running time restrictions what one finds in literature is useless if naively applied to real problems.

Workflow: While I was responsible for the developing of the mathematical methods and prototyping the nesting techniques in MatLab, a workmate was responsible for their implementation in C++ and the making of the software. Both technical and implementation features must be under constant improvements if the company wants to remain competitive in the market, as new optimization tools appear elsewhere.

Others: I closely followed, without taking part on them, the development of two other products: Audaces Supera, which is essentially Audaces Marker in a cloud environment with much higher computational power; Audaces 3D, which stands for the creation of 3D models dressed in a virtual mannequin allowing for a virtual trim simulation.

6.2 PARALLEL PROJECT

Title: Audaces Smart Platform.

Funding: RHAE Researcher in Company, MCT/CNPq call 54/2013.

Keyword: PaaS (Platform as a Service), IoT (Internet of Things), SM (Smart Machines).

Problem: First initiative of the company towards the era of Industry 4.0. The project combined trends from both cloud computing and internet of things territories to develop a secure platform allowing real time data acquisition and implementation of Web applications for the monitoring and controlling of smart machines.

Workflow: As coordinator of the project, I was responsible for the integration of the Production Engineers of the company with a team of professors and PhD students from the Computer Science Department of a local university, one of the students later hired by the company.

7. OTHER ACTIVITIES AND SKILLS

7.1 TEACHING EXPERIENCE

- Electronic Devices (Lab classes), 2022. Department of Electronic Engineering, Universitat Autònoma de Barcelona, Spain.
- Instrumentation and Sensors (Lab classes), 2022. Department of Electronic Engineering, Universitat Autònoma de Barcelona, Spain.

7.2 DIDACTIC SOFTWARE

- QC SLIM (Quantum and Classical Simulation of Light and Matter), digiQ (Digitally Enhanced Quantum Technology Master) consortium; Juan J. Seoane, Carlos F. Destefani, Xavier Cartoixà, and Xavier Oriols

7.3 PATENT REQUEST

- T-2020/029, 27/10/2022. Generation of intrinsic THz oscillation of electron current using quantum superposition of electron-photon states in resonant tunnelling diodes; Xavier Oriols, Matteo Villani, Michael Feiginov, and Carlos F. Destefani.

7.4 GRANTS

- Proof of Concept 2023 (Perte Chip). Terahertz sources based on quantum superposition of electron-photon states in resonant tunnelling diodes embedded into an optical cavity, Xavier Oriols (PI), Xavier Cartoixà, Gabriel Berini, Carlos Raga, Carlos F. Destefani, Matteo Villani, Michael Feiginov.
- RHAE Researcher in Company 2013, MCT/CNPq 54/2013. Audaces Smart Platform, Carlos F. Destefani, Ricardo Cunha, Claudio Grando.

7.5 CONFERENCE COMMITTEE

- IWCN-2023, International Workshop on Computational Nanotechnology, 2023, Barcelona, Spain.

7.6. LANGUAGE AND COMPUTING SKILLS

- Language: Portuguese, English, Spanish.
- Programming: Fortran, C, Matlab.
- Geometry: topology notions from no-fit polygons and winding number.
- Computer Science: linear programming, duality, stochastic and deterministic heuristics for combinatorial optimization problems.

8. ACADEMIC PRODUCTION

8.1 BOOK CHAPTERS

Bohmian Mechanics as a Practical Tool, Xabier Oianguren-Asua, Carlos F. Destefani, Matteo Villani, David K. Ferry, Xavier Oriols, Fundamental Theories of Physics Volume 215, Physics and the Nature of Reality, p. 105-123, 2024.

Plasma Physics in the Strong Coupling Regime: Intense VUV Laser-Cluster Interaction. Lora Ramunno, Christian Jungreuthmayer, Carlos F. Destefani, Thomas Brabec. Progress in Ultrafast Intense Laser Science Volume I, Springer Series in Chemical Physics Volume 84, p. 95-105, 2006.

8.2 JOURNAL ARTICLES

[due to commercial secret, there is no publication from my industrial career, 2010-2016]

Kinetic energy equipartition: A tool to characterize quantum thermalization.

Carlos F. Destefani and Xavier Oriols.

Physical Review Research **5**, 033168 (2023).

Assessing quantum thermalization in physical and configuration spaces via many-body weak values.

Carlos F. Destefani and Xavier Oriols.

Physical Review A **107**, 012213 (2023).

Resonant tunnelling diodes in semiconductor microcavities: Modeling polaritonic features in the terahertz displacement current.

C. F. Destefani, M. Villani, X. Cartoixà, M. Feiginov, and X. Oriols.

Physical Review B **106**, 205306 (2022).

Scattering in Terms of Bohmian Conditional Wave Functions for Scenarios with Non-Commuting Energy and Momentum Operators.

M. Villani, G. Albareda, C. Destefani, X. Cartoixà, X. Oriols.

Entropy **23**, 408 (2021).

Paramagnetic shift in thermally annealed $\text{Cd}_x\text{Zn}_{1-x}\text{Se}$ quantum dots.

E. Margapoti, F. M. Alves, S. Mahapatra, V. Lopez-Richard, L. Worschech, K. Brunner, F. Qu, C. Destefani, E. M.-Proupin, C. Bougerol, A. Forchel, G. E. Marques.

New Journal of Physics **14**, 043038 (2012).

Characterization of spin-state tuning in thermally annealed semiconductor quantum dots

E. Margapoti, F. M. Alves, S. Mahapatra, T. Schmidt, V. Lopez-Richard, C. Destefani, E. M.-Proupin, F. Qu, C. Bougerol, K. Brunner, A. Forchel, G. E. Marques, L. Worschech.

Physical Review B **82**, 205318 (2010).

Plasmon dynamics in strongly driven finite few-electron quantum systems: The role of the surface.

Carlos F. Destefani, Chris McDonald, Suren Sukiasyan, Thomas Brabec.
Physical Review B **81**, 045314 (2010).

Multielectron Correlation in High-Harmonic Generation: A 2D Model Analysis.

Suren Sukiasyan, Chris McDonald, Carlos Destefani, M. Yu. Ivanov, Thomas Brabec.
Physical Review Letters **102**, 223002 (2009).

Controlling transition matrix elements and relaxation in a two-electron double quantum dot

Carlos F. Destefani, Chris McDonald, Suren Sukiasyan, Thomas Brabec.
Physical Review B **79**, 155322 (2009).

Signatures of bound-state-assisted nonsequential double ionization.

Suren Sukiasyan, Chris McDonald, Cole Van Vlack, Carlos Destefani, Thomas Fennel, Misha Ivanov, Thomas Brabec.
Physical Review A **80**, 013412 (2009).

Correlated few-electron dynamics in intense laser fields.

Suren Sukiasyan, Chris McDonald, Cole Van Vlack, Carlos Destefani, Charles Varin, Misha Ivanov, Thomas Brabec, Chemical Physics **366**, 37 (2009).

Ab initio approach to the optimization of qubit manipulation.

Carlos F. Destefani, Chris McDonald, Ramin M. Abolfath, Pawel Hawrylak, Thomas Brabec, Physical Review B **78**, 165331 (2008).

Spin-orbit coupling and the singlet-triplet transition in lateral double quantum dots.

L. Meza-Montes, Carlos F. Destefani, Sergio E. Ulloa.
Physical Review B **78**, 205307 (2008).

Restricted and unrestricted Hartree-Fock approaches applied to spherical quantum dots in a magnetic field.

C. F. Destefani, J. D. M. Vianna, G. E. Marques.
International Journal of Quantum Chemistry **106**, 2090 (2006).

Spin relaxation and g-factor manipulation in quantum dots.

Carlos F. Destefani, Sergio E. Ulloa.
Brazilian Journal of Physics **36**, 443 (2006).

Multichannel field-effect spin-barrier selector: Spin-carrier dynamics under full spin-orbit coupling.

G. E. Marques, A. C. R. Bittencourt, C. F. Destefani, Sergio E. Ulloa.
Physical Review B **72**, 045313 (2005).

Oscillatory spin relaxation rates in quantum dots.

C. F. Destefani, Sergio E. Ulloa.
Physical Review B **72**, 115326 (2005).

Transport properties of nanodevices: A one-dimensional model study.

Zhongxi Zhang, C. F. Destefani, Chris McDonald, Thomas Brabec.
Physical Review B **72**, 161309(R) (2005).

Anisotropic electron g-factor in quantum dots with spin-orbit interaction.

C. F. Destefani, Sergio E. Ulloa.

Physical Review B **71**, 161303(R) (2005).

Spin carrier dynamics under full spin-orbit coupling.

G. E. Marques, A. C. R. Bittencourt, V. Lopez-Richard, C. F. Destefani, Sergio E. Ulloa

Microelectronics Journal **36**, 480 (2005).

Symmetries and anisotropies of the electronic states within full spin-orbit coupling.

G. E. Marques, A. C. R. Bittencourt, V. Lopez-Richard, C. F. Destefani, Sergio E. Ulloa

Physica Status Solidi B **242**, 1788 (2005).

Spin-orbit and electronic interactions in narrow-gap quantum dots.

C. F. Destefani, Sergio E. Ulloa, G. E. Marques.

Physical Review B **70**, 205315 (2004).

Spin-orbit coupling and intrinsic spin mixing in quantum dots.

C. F. Destefani, Sergio E. Ulloa, G. E. Marques.

Physical Review B **69**, 125302 (2004).

The violation of the Hund rule in semiconductor artificial atoms.

C. F. Destefani, J. D. M. Vianna, G. E. Marques.

Semiconductor Science and Technology **19**, L90 (2004).

Transport properties in spherical quantum dots: Orbital-blockade and spin-blockade effects.

C. F. Destefani, G. E. Marques, C. Trallero-Giner.

Physical Review B **65**, 235314 (2002).

Electronic transport in quasi-1D mesoscopic systems: the correlated electron approach.

C. F. Destefani, G. E. Marques.

Physica E **7**, 786 (2000).

8.3 CONFERENCES

IWCN-2023, International Workshop on Computational Nanotechnology, 2023, Barcelona, Spain.

Polaritonic features in the THz displacement current through RTDs in microcavities.

C. F. Destefani, M. Villani, X. Cartoixà, M. Feiginov, and X. Oriols.

IWCN-2023, International Workshop on Computational Nanotechnology, 2023, Barcelona, Spain.

Weak values: a new paradigm to characterize nanoscale systems.

Xabier Oianguren-Asua, Carlos F. Destefani, and Xavier Oriols.

IWW-2023, International Wigner Workshop, 2023, Barcelona, Spain.

Operational phase-space distribution functions through consecutive weak and strong measurements.

Xavier Oriols and Carlos F. Destefani.

QUANTUMatter22, International Quantum Matter Conference, 2022, Barcelona. Spain.
Quantum thermalization in closed systems through many-body weak values.
Carlos F. Destefani and Xavier Oriols.

QUANTUMatter22, International Quantum Matter Conference, 2022, Barcelona. Spain.
Novel high-frequency performance of nanodevices with coherent electron-photon interactions.

Xavier Oriols, Matteo Villani, Carlos Destefani, Xavier Cartoixà, and Michael Feiginov

International School on Terahertz Photonics and Electronics, 2022, Pisa, Italy.

Novel phenomena in the THz current of Resonant Tunneling Diodes with coherent electron-photon interaction.

Matteo Villani, Carlos Destefani, Xavier Cartoixà, Michael Feiginov, and Xavier Oriols

IWCN-2021, International Workshop on Computational Nanotechnology, 2021, Daejeon, Korea (online).

Assessing quantum thermalization in small isolated quantum systems through local-in-position weak values of the momentum.

Carlos F. Destefani, Xavier Oriols.

6th Technical Meeting RHAЕ Researcher in Company, 2015, Brasília, Brazil.

Audaces Smart Platform.

C. F. Destefani, M. Steffens, A. M. Irigoite, E. Comunello, M. S. Wingham.

March Meeting, 2005, Los Angeles, USA.

Multi-Configuration Time-Dependent Hartree-Fock theory applied to quantum dots.

Carlos Destefani, Alexander Pegarkov, Chris McDonald, Thomas Brabec, Pawel Hawrylak.

March Meeting, 2005, Los Angeles, USA.

Engineering the g-factor in coupled quantum dots.

L. Meza-Montes, C. Destefani, Sergio E. Ulloa.

March Meeting, 2005, Los Angeles, USA.

Oscillatory spin-flip rates and anisotropic g-factor in quantum dots.

Carlos Destefani, Sergio Ulloa.

BWSP-12, Brazilian Workshop on Semiconductor Physics, 2005, São José dos Campos, Brazil.

Spin relaxation and g-factor manipulation in quantum dots.

Carlos F. Destefani, Sergio E. Ulloa.

March Meeting, 2004, Montreal, Canada.

Spin-orbit coupling and intrinsic spin mixing in quantum dots.

C. F. Destefani, Sergio E. Ulloa, G. E. Marques.

ICPS-27, International Conference on the Physics of Semiconductors, 2004, Flagstaff, USA.

Spin-orbit coupling and magnetic spin states in cylindrical quantum dots.

C. F. Destefani, Sergio E. Ulloa, G. E. Marques.

MRS Spring Meeting, Materials Research Society, 2004, San Francisco, USA.
Spin-orbit coupling and magnetic spin states in cylindrical quantum dots.
Carlos Fernando Destefani, Sergio E. Ulloa, Gilmar Eugenio Marques.

March Meeting, 2003, Austin, USA.
Spin-orbit coupling in many-electron quantum dots.
C. F. Destefani, Sergio E. Ulloa, G. E. Marques.

March Meeting, 2003, Austin, USA.
Spectrum and current of spherical quantum dots: orbital blockade and spin blockade effects.
C. F. Destefani, G. E. Marques, C. Trallero-Giner.

MWSSC-50, Midwest Solid State Conference, 2002, Urbana-Champaign, USA.
Transport properties in spherical quantum dots: orbital blockade and spin blockade effects.
C. F. Destefani, G. E. Marques, C. Trallero-Giner.

ENFMC-25, Encontro Nacional Física Matéria Condensada, 2002, Caxambu, Brazil.
Effects of the symmetry constrain- and spin-blockade on the negative differential conductance in spherical quantum dots.
Carlos F. Destefani, Gilmar E. Marques.

BWSP-10, Brazilian Workshop on Semiconductor Physics, 2001, Guarujá, Brazil.
Electron-electron interaction in spherical quantum dots in the LS-coupling scheme.
Carlos F. Destefani, Gilmar E. Marques.

ENFMC-24, Encontro Nacional Física Matéria Condensada, 2001, São Lourenço, Brazil
Many-particle ground and excited states of spherical quantum dots in the Hartree-Fock approach: spectrum and current.
Carlos F. Destefani, Gilmar E. Marques.

ENFMC-23, Encontro Nacional Física Matéria Condensada, 2000, São Lourenço, Brazil
Magnetic field influence in a Bogoliubov canonical transformation of the Hamiltonian of an isolated electronic system coupled to free electron leads.
Carlos F. Destefani, Gilmar E. Marques.

BWSP-9, Brazilian Workshop on Semiconductor Physics, 1999, Belo Horizonte, Brazil.
Electronic transport in quasi-1D mesoscopic systems: the correlated electron approach.
Carlos F. Destefani, Gilmar E. Marques.

ENFMC-22, Encontro Nacional Física Matéria Condensada, 1999, São Lourenço, Brazil
Electron transport properties in quantum dots under a Bogoliubov canonical transformation.
Carlos F. Destefani, Gilmar E. Marques.

ENFMC-21, Encontro Nacional Física Matéria Condensada, 1998, Caxambu, Brazil.
Transport properties of a quantum dot weakly coupled to leads and to a thermal bath.
Carlos F. Destefani, Gilmar E. Marques.

9. NOTE ON PERSONAL PROJECTS (2017-2019 GAP)

There were many shifts in my professional career: 1) from ~5 years of regular jobs before university to academic life; 2) from ~15 years of academic life to research in an industrial innovation environment; 3) from ~6 years in the industry to some personal projects; 4) from ~3 years with such personal projects to the return to academic life for about 4 years. Now my focus is to continue with either Fundamental or Applied research, in either Academic or Innovation environment, bringing along useful insights acquired along my career in both academic and private sectors.

10. REFERENCES

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