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I am a Ramón y Cajal Researcher (Tenure Track) at IFIMAC, Universidad Autónoma de Madrid. I study complex many-body phenomena in light, sound, and matter using artificial platforms, with applications in energy, computing, and quantum technologies. My work lies at the intersection of quantum optics, optomechanics, and nonlinear dynamics. I develop analytical methods and open-source tools like HarmonicBalance.jl, and collaborate closely with leading experimental groups. My research has appeared in *Nature* and *Physical Review Letters*, and has been recognized with awards including a Ramón y Cajal and ETH Postdoctoral Fellowships, and a Ph.D. Extraordinary Thesis Prize.

Education and Research Experience

May 2025 – Present **Universidad Autónoma de Madrid**: Ramón y Cajal Researcher (Tenure Track)

Oct. 2023 – Mar. 2025 **University of Konstanz**: Interim Professor (W2 Professurvertretung)

May 2021 – Sept. 2023 **Institute for Theoretical Physics | ETH Zürich**: ETH Post-doctoral Fellow [[details](#)]
Host PIs: Prof. Dr. Oded Zilberberg and Prof. Dr. Christian Degen

Oct. 2018 – Apr. 2021 **AMOLF | Amsterdam**: Post-doctoral Researcher.
PI: Prof. Dr. Ewold Verhagen
Awarded Seal of Excellence from European Commission (H2020-MSCA-IF-2020) [[details](#)]

Sept. 2018 **Universidad Autónoma de Madrid**: Ph. D. degree Physics.
Awarded with distinction Cum Laude. [[Dissertation](#)]
Awarded with Extraordinary Doctoral mention - Thesis prize [[details](#)]
Advisors: Prof. Dr. F.J. García-Vidal, Dr. Johannes Feist.

Oct. – Dec 2016 **University of Cambridge**: Visiting Research Fellow.
Awarded grant from European Cooperation in Science and Technology (ECOST-STSM-MP1403-031016-080502)- Host: Dr. Alex W. Chin.

Sept. 2012- June 2013 **U. Complutense de Madrid**: M. Sc. Fundamental Physics (EQF level 7).

2007-2012 **Universidad Autónoma de Madrid**: 5-yr B. Sc. Physics (EQF level 7).

Peer-reviewed accepted publications (*equal contribution)

19. del Pino, J., Kořata, J., Zilberberg, O. (2024) Limit cycles as stationary states of an extended Harmonic Balance ansatz [[Physical Review Research 6 \(3\), 033180](#)]

18. Álvarez, P., Pittilini, D., Miserocchi, F., Raamamurthy, S., Margiani, G., Ameye, O., **del Pino, J.**, Zilberberg, O., Eichler A. (2024) A biased Ising model using two coupled Kerr parametric oscillators with external force [[Phys. Rev. Lett. 132 \(20\), 207401](#)]

17. Slim, J. J., Wanjura, C., Brunelli, M., **del Pino, J.**, Nunnenkamp A., Verhagen, E. (2024) Optomechanical realization of the bosonic Kitaev chain [[Nature 627, 767-771](#)]

16. Borovik, V., Breiding, P., **del Pino, J.**, Michałek, M., Zilberberg, O. (2023) Khovanskii bases for semimixed systems of polynomial equations—a case of approximating stationary nonlinear Newtonian dynamics [[Journal de Mathématiques Pures et Appliquées, 182, 195-222](#)]

15. Wanjura, C.*, Slim, J. J.*, **del Pino, J.**, Brunelli, M., Verhagen, E., Nunnenkamp A. (2023). Quadrature non-reciprocity in bosonic networks without breaking time-reversal symmetry (*equal contribution) [[Nature Physics 19\(10\), 1429-1436](#)]

14. **del Pino, J.**, Zilberberg, O. (2022). Dynamical gauge fields with bosonic codes [[Phys. Rev. Lett. 130\(17\), 171901](#)]
13. Margiani, G., **del Pino, J.**, Heugel, T. L., Bousse, Nicholas E., Guerrero, S., Kenny, T.W., Zilberberg, O., Sabonis, D., Eichler, A. (2023). Deterministic and stochastic sampling of two coupled Kerr parametric oscillators [[Phys. Rev. Research 5 \(1\), L012029](#)]
12. Kořata, Jan*, **del Pino, J.***, Heugel, Toni L., Zilberberg, O. (2022). HarmonicBalance.jl: a Julia suite for interacting nonlinear dynamics. (*equal contribution) [[Scipost Codebases 6](#)]
11. **del Pino, J.***, Slim, Jesse J.* and Verhagen, E. (2022). Non-Hermitian chiral phonics through optomechanically-induced squeezing. (*equal contribution) - [[Nature 606\(7912\), 82-87](#)]
10. Burgwal, R., **del Pino, J.** and Verhagen, E. (2020). Comparing nonlinear optomechanical coupling in membrane-in-the-middle and single-cavity optomechanical systems [[New Journal of Physics, Volume 22 113006, November 2020](#)]
9. Silva, R.E.F., **del Pino, J.**, García-Vidal, F. J. and Feist, J. (2020). Polaritonic Molecular Clock: All-Optical Ultrafast Imaging of Wavepacket Dynamics without Probe Pulses- [[Nature Communications 11\(1\), 1423](#)]
8. Mathew J. P.*, **del Pino, J.***, Verhagen E. (2020). Synthetic gauge fields for phonon transport in a nano-optomechanical system (*equal contribution) - [[Nature Nanotechnology 15\(3\), 198 - 202](#)]. Cover selected for *Nature Nanotech.*, [Volume 15 Issue 3, March 2020](#)
7. Duggan, R.*, **del Pino, J.***, Verhagen, E., Alù A. (2019). Optomechanically Induced Birefringence and Faraday Effect (*equal contribution) - [[Phys. Rev. Lett. 123\(2\), 023602](#)]
6. **del Pino, J.**, Schröder, F., Chin, A.W., Feist J., Garcia-Vidal, F. J. (2018). Tensor Network simulation of non-Markovian dynamics in organic polaritons - [[Phys. Rev. Lett. 121\(22\), 227401](#)]
5. **del Pino, J.**, Schröder, F., Chin, A.W., Feist J., Garcia-Vidal, F. J. (2018). Tensor Network simulation of polaron-polaritons in organic microcavities - [[Phys. Rev. B 98\(16\), 165416](#)]
4. **del Pino, J.**, Feist, J., Garcia-Vidal, F. J. (2016). Exploiting Vibrational Strong Coupling to make an Optical Parametric Oscillator out of a Raman Laser. [[Phys. Rev. Lett. 117\(27\), 277401](#)]
3. **del Pino, J.**, Feist, J., Garcia-Vidal, F. J. (2015). Signatures of Vibrational Strong Coupling in Raman Scattering. [[J. Phys. Chem. C, 2015, 119\(52\), 29132-29137](#)]
2. **del Pino, J.**, Feist, J., Garcia-Vidal, F. J. (2015). Quantum theory of collective strong coupling of molecular vibrations with a microcavity mode. [[New Journal of Physics 17\(5\), 053040](#)] (Highlighted: Ensemble strong coupling - W. L. Barnes (2015). NJP 17 081001).
1. **del Pino, J.**, Feist, J., García-Vidal, F. J., García-Ripoll, J. J. (2014). Entanglement detection in coupled particle plasmons. [[Phys. Rev. Lett. 112\(21\), 216805](#)]

Preprints under review (*equal contribution)

- PR.** Slim, Jesse J., **del Pino, J.**, and Verhagen, E. (2025). Programmable Synthetic Magnetism and Chiral Edge states in Nano-Optomechanical Quantum Hall Networks- [[arXiv:2501.18882](#)]
- PR.** Fu, M., Ameye, O., Yang, F., Kořata, J., **del Pino, J.**, Zilberberg, O., Scheer, E. (2024) Fluctuation instabilities via internal resonance in a multimode membrane as a mechanism for frequency combs [[arXiv:2409.15138](#)]
- PR.** Catalini, L., **del Pino, J.**, Kumar, S.S., Dumont, V., Margiani, G., Zilberberg, O., Eichler, A. (2024) Adiabatic and diabatic responses in a Duffing resonator driven by two detuned drives [[arXiv:2408.15794](#)]
- PR.** Villa, G. *, **del Pino, J. ***, Dumont, V., Rastelli, G., Michatek, M., Eichler, A., Zilberberg, O. (2024) Topological classification of driven-dissipative nonlinear systems [[arXiv:2406.16591](#)]
- PR.** Visani, D. A., Catalini, L., Degen, C. L., Eichler, A., **del Pino, J.** (2023) Near-resonant nuclear spin detection with high-frequency mechanical resonators [[arXiv:2311.16273](#)]

Teaching experience and student supervision

- ♦ **Lecturer at University of Konstanz** [\$= Seminar, EC = elective course, Offered to both MSc and BSc students.]: (i) *Winter Semester (2023)*: Computational Approaches to Quantum Oscillators

(EC), Computational Methods for Quantum Optics (S). (ii) *Summer Semester (2024):* Parametric & Many-body Phenomena in Quantum Optics (EC). (iii) *Winter Semester (2024):* Modeling Quantum Hardware: Open Dynamics and Control (EC).

- ◇ **Ph. D. candidate co-tutoring (official second advisor [details]):** Diego Visani (ETH Zürich), 2022-26
- ◇ **Ph. D. candidate co-tutoring (unofficial):** (1) Jesse Slim (AMOLF, TU/e), Cum-Laude award, 2018-22, (2) Jan Košata (ETH Zürich) 2021-22, (3) Greta Villa (University of Konstanz) 2022-26, (4) Soumya Kumar (University of Konstanz) 2022-26, (5) Orjan Ameye (University of Konstanz) 2022-26.
- ◇ **Bachelor Thesis:** Simon Eggert (University of Konstanz) 2023-24
- ◇ **Teaching assistant (TA). [Year | Duration]**
 - Parametric Phenomena (ETH) as a TA to PD Dr Alexander Eichler.
 - Proseminar Courses on Theoretical Physics (ETH): Nonlinear Dynamical Systems (B. Sc. In Physics), Solitons and Instantons in Condensed Matter (M. Sc. In Theoretical Physics), Riemann Surfaces in Mathematical Physics (M. Sc. In Theoretical Physics).
 - Experimental Techniques I (UAM): B. Sc. in Physics [2017-2018 | 32 h]
 - General Physics laboratory (UAM): B. Sc. in Chemistry [2013-2014 | 21 h], [2014-2015 | 48 h], [2015-2016 | 16 h] and [2016-2017 | 48 h]. Chemical Engineering [2015-2016, 24 h].
- ◇ **Training sessions:** Julia training session on HarmonicBalance.jl, aimed at researchers and students on Parametric Phenomena at ETH Zürich and University of Konstanz (Oct. 2022)
- ◇ **Private tutor:** 1st/2nd year in Physics, Mathematics, Computer Science and Chemistry B. Sc.'s (2010-2014). Python programming (2018-2021).

Additional Awards/merits

- ◇ **Ramón y Cajal Fellowship 2023:** Evaluated with 99.00/100 (granted above 97.27/100) [details].
- ◇ **Short-listed for Tenure-Track Assistant Professorship at TU Wien**, for a topical position on Complex Photonic Structures at the Institute for Theoretical Physics (2nd in the list).
- ◇ **Granted an ESPRIT fellowship:** from the Austrian Science Fund (FWF) with 316036€ to undergo the 3-year Postdoctoral project "Gauge theories in nonlinear interacting polaritons", mentored by Prof. Stefan Rotter (TU Wien), in collaboration with Prof. Jacqueline Bloch (C2N) [details].
- ◇ **Ramón y Cajal Fellowship 2022:** Evaluated with 95.64/100 (granted above 96.56/100) [details].
- ◇ **Invited to** Global Young Scientists Summit 2021 [details]
- ◇ **Predocctoral Assistant Professor position:** (Ayudante Universidad LOU (020020060)) Department of Theoretical Condensed Matter Physics UAM - Awarded in Open Competition
- ◇ **Collaboration fellowship** (2011-2012) for Introduction to Research. Title: "Spin dynamics in artificial triatomic molecules". Host: Gloria Platero (Material Science Institute (ICMM) - CSIC)

Computer skills and open-source projects

- ◇ **Core developer of HarmonicBalance.jl:** Julia package for solving nonlinear differential equations using the method of Harmonic Balance [GitHub repository]
- ◇ **Key Programming Languages (sorted by use):** Python, Julia, Mathematica, MATLAB.
- ◇ **Simulations in large-scale cluster:** Plasmonq cluster from Nanophotonics Group (UAM), SURF-sara (Science Park), Rick and Morty High-Performance Computers from QUEST group (ETH).

Outreach

- ◇ **Contributed to 42 conferences/seminars** (13 invited talks and seminars, 8 contributed talks)
- ◇ **Organization of Scientific events:**
 - **Workshop on Collective Phenomena** (U. of Konstanz, 26th-29th August 2024) [webpage]
 - **Workshop on Parametric Phenomena** (ETH Zürich, 11st -13rd January 2023) [webpage]
 - **Theory Colloquium at the University of Konstanz** (from 13rd November 2023) [webpage]
 - **Online Seminar Series on Non-Hermitian Physics** (from 17th May 2023) [webpage]
 - Konstanz University. Networking event for Theoretical Physics Groups (2021)
- ◇ **General public engagement (PR = Press release)**
 - **PR:** AMOLF [New topological metamaterial amplifies sound waves exponentially (2024)]
 - **PR:** AMOLF [Engineering dual carriageways for signals (2023)]
 - **PR:** AMOLF [Discovery of new mechanisms to control the flow of sound (2022)]

- **PR:** Department of Theoretical Condensed Matter Physics (UAM) [[Exploiting vibrational strong coupling to make an optical parametric oscillator out of a Raman laser \(2017\)](#)].
- **PR:** Department of Theoretical Condensed Matter Physics (UAM) [[Polaritonic molecular clock listening to molecules \(2020\)](#)]
- **PR:** AMOLF [[Using light to couple the strings of a nanoscopic guitar \(2020\)](#)]
- Open Day Amsterdam Science Park [[details](#)] (2 in-person events aimed at kids 2018-2019)

Commission of trust and other activities

- ◇ **Member of expert database of the AEI (Spanish State Research Agency)**, assisting in the evaluation and monitoring processes of its calls (invited) [[details](#)].
- ◇ **Evaluating panel of ETH Zurich Career Seed Awards**, which are aimed to provide early-stage postdocs with a funding opportunity for stand-alone research projects over a year [[details](#)].
- ◇ **Reviewer** for Nature Physics, Physical Review A, Physical Review B, Physical Review Letters, Physical Review Applied, Applied Physics Letters, NPJ Quantum Materials, Entropy, Journal of Applied Physics, Annalen der Physik and Quantum
- ◇ **Hosted Scientific visits at ETH:** Antonio Štrkalj (University of Cambridge), Sebastian Schmid (University of Strathclyde), Julian Lenz (Swansea University), Matteo Brunelli (University of Basel).
- ◇ **Informal Colloquia:** 6 given, at Dep. of Theoretical Condensed Matter Physics UAM & AMOLF
- ◇ **Mathematics degree** (up to 3rd year). National University of Distance Education (UNED)
- ◇ **Deep Learning specialization (MOOC)** | deeplearning.ai (2020)
Structuring Machine Learning projects [[certificate](#)], Improving Deep Neural Networks [[certificate](#)], Neural Networks and Deep Learning [[certificate](#)], Convolutional Neural Networks [[certificate](#)], Sequence Models [[certificate](#)]
- ◇ **Big Data specialization (MOOC)** | University of California, San Diego (2016-17)
Big Data Modelling and Management Systems: [[certificate](#)], Introduction to Big Data [[certificate](#)]
MOOC Statistical Mechanics: Algorithms and Computations - École normale supérieure

Language skills

- ◇ **Spanish:** Native
- ◇ **English:** Fluent - IELTS - Overall Band Score 7.0 (CEFR Level C1)
- ◇ **Portuguese:** Basic professional skills

Participation in International Projects (not as a PI)

- ◇ **2 European projects** as a PhD Student (ERC Advanced Grant "PLASMONANOQUANTA" with P.I. Francisco José García Vidal, UAM), and as a Postdoc (ERC Starting Grant "TOPP" with P.I. Ewold Verhagen, AMOLF)

Conference Contributions/Visits [Type: Contributed/Invited Talk (CT, IT), Poster (P)]

- ◇ **University of Vienna - (IT):** "One-way States and Topology in Driven Nonlinear Mechanical Resonators" [February 2025]
- ◇ **TU Wien, Institute for Theoretical Physics - (IT):** "Chirality and Nonlinear Topology in Parametrically Driven Mechanical Resonators" [February 2025]
- ◇ **Max Planck Institute for Quantum Optics (Munich) (IT):** "Chirality and Nonlinear Topology in Mechanical Networks via Parametric Driving" [October 2024]
- ◇ **Institute for Complex Quantum Systems (Ulm) (IT):** "Chirality and Topology in Optomechanical Networks via Bosonic Squeezing" [August 2024]
- ◇ **Quantum Science: Implementations '24 (Benasque)** (session organization and discussion leader)
- ◇ **QuantuMatter (CT):** "Dynamical Gauge Fields with Bosonic Codes in Nonlinear Resonators" [May 2024]

- ◇ **Gordon Research Conference on Mechanical Systems in the Quantum Regime (P):** "Harmonic Balance Method enhanced: Unveiling Limit Cycles as Fixed Point States in Nonlinear systems" [March 2024]
- ◇ **Gordon Research Seminar on Mechanical Systems in the Quantum Regime (P):** "Dynamical Gauge Fields with Bosonic Codes in Nonlinear Resonators" [March 2024]
- ◇ **CSIC, Instituto de Física Fundamental - (IT):** "Chirality and Topology in Optomechanical Networks via Bosonic Squeezing" [January 2024]
- ◇ **TU Wien, Institute for Theoretical Physics - (IT):** "Controlling Light and Sound in Complex Structures with Engineered Gauge Fields" [April 2023]
- ◇ **Laboratorio de Fotónica y Optoelectrónica del Centro Atómico de Bariloche - (IT):** "Solving nonlinear dynamics using HarmonicBalance.jl" [November 2022]
- ◇ **(TTQM2022) Trends in the Theory of Quantum Materials 2022 - (P):** "From chiral squeezing to nonlinear topology in optomechanics".
- ◇ **Laboratorio de Fotónica y Optoelectrónica del Centro Atómico de Bariloche - (IT):** "Desde el 'squeezing' quiral a la topología no lineal en optomecánica" [October 2022]
- ◇ **CMD29 – mini colloquium of Nanomechanical and Electromechanical systems (IT):** "Synthetic magnetic fields for Hermitian and non-Hermitian topologically-protected states in nano-optomechanical arrays."
- ◇ **International Conference on Complexity and Topology in Quantum Matter (CT.QMAT22) (CT):** "From chiral squeezing to nonlinear topological phases in optomechanics."
- ◇ **Quantum Science: Implementations** (session organization and discussion leader)
- ◇ **QSIT Monte Verità '22 - (P):** "From chiral squeezing to nonlinear topological phases in optomechanics."
- ◇ **TU Wien, Institute for Theoretical Physics - (IT):** "From chiral squeezing to nonlinear topological phases in optomechanics." [June 2022]
- ◇ **NanoMRI 7 - (P):** "Low-noise spin Detection enabled by coherent nanomechanical coupling".
- ◇ **QSIT General Meeting & Winter School - (IT):** "From chiral squeezing to nonlinear topological phases in optomechanics".
- ◇ **QSIT General Meeting & Winter School - (P):** "Floquet Engineering on semiclassical and quantum nonlinear systems."
- ◇ **Mathematics Department oberseminare, Universität Konstanz - (IT):** "The physics of nonlinear systems with homotopy continuation."
- ◇ **SFB 1432 Retreat, Universität Konstanz - (P):** "Charting solution landscapes in nonlinear driven-dissipative networks."
- ◇ **Condensed Matter Physics Department UAM - (IT):** "Sound with a twist: synthetic magnetic fields for phonons in nano-optomechanical networks."
- ◇ **Quantum Nanophotonics Benasque 2021 - (CT):** "Synthetic magnetic fields for topologically-protected sound in nano-optomechanical arrays."
- ◇ **ETHz, NCCR QSIT Seminar - (IT):** "Synthetic magnetic fields for Hermitian and non-Hermitian topologically protected states in nano optomechanical arrays."
- ◇ **(Accepted Contribution but Cancelled) Topological Matter Conference (2020) - (CT):** "Synthetic magnetic fields for topologically-protected sound in nano-optomechanical arrays."
- ◇ **(Accepted Contribution but Cancelled) Gordon Research Conference on Mechanical Systems in the Quantum Regime (2020) - (P):** "Hermitian and non-Hermitian topological states in optomechanically-coupled nanomechanical modes in the Doppler limit."
- ◇ **(Accepted Contribution but Cancelled) Gordon Research Seminar on Mechanical Systems in the Quantum Regime (2020) - (CT):** "Synthetic magnetic fields for Hermitian and non-Hermitian topologically-protected states in nano-optomechanical arrays."
- ◇ **OSA Advanced Photonics Congress 2019 - (IT):** "Synthetic magnetic fields for phonons and photons through optomechanical interactions."

- ◇ **DIEP Workshop on Topology and broken symmetries 2019 - (P):** "Synthetic gauge fields for phonon transport along spatial and synthetic dimensions in a nano-optomechanical system".
- ◇ **AMOLF International Nanophotonics School 2019 - (P):** "Synthetic gauge fields for phonon transport in a nano-optomechanical system."
- ◇ **CLEO US 2019 conference - (CT):** "Dynamical gauge fields for phonons in an optomechanical system."
- ◇ **Hybrid Optomechanical Technologies (HOT) annual meeting 2019 - (P):** "Synthetic gauge fields for phonon transport in a nano-optomechanical system."
- ◇ **AMOLF- (IT):** "Vibrational and electronic strong light-matter coupling with molecular excitations."
- ◇ **TU Eindhoven- (IT):** "Trap 1 photon and many molecules in a box and let the music play: Some examples of strong coupling with molecular excitations."
- ◇ **SCOM Workshop 2018 - (P):** "Tensor network simulation of non-Markovian dynamics in organic polaritons."
- ◇ **Conference on Quantum Nanophotonics 2017 - (P):** "Investigating multi-mode vibrational model for organic polaritonic chemistry: nuclear and environmental effects."
- ◇ **Quantum Nanophotonics 2017 - (P):** "Exploiting Vibrational Strong Coupling to make an Optical Parametric Oscillator out of a Raman Laser."
- ◇ **SCOM Workshop 2016 - (P):** "Exploiting Vibrational Strong Coupling to make an Optical Parametric Oscillator out of a Raman Laser."
- ◇ **COST MP1403, NQO ESR Workshop 2015 - (CT):** "Signatures of Vibrational Strong Coupling in Raman Scattering."
- ◇ **SPP7 (2015)- (P):** "Quantum theory of collective strong coupling of molecular vibrations with a microcavity mode."
- ◇ **Quantum Plasmonics 2015 - (P):** "Quantum theory of collective strong coupling of molecular vibrations with a microcavity mode."
- ◇ **INC Young Researchers Meeting XVII - (CT):** "Entanglement detection in coupled particle plasmons."
- ◇ **Photon '14 - (P):** "Entanglement detection in coupled particle plasmons."
- ◇ **Nanolight 2014 - (P):** "Entanglement detection in coupled plasmons."
- ◇ **INC Young Researchers Meeting XVI - (P):** "Entangling localised plasmons in nanoparticle arrays."