Curriculum Vitae | **Javier del Pino** | Theoretical Physicist

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I am an Interim Professor in Theoretical Quantum Physics. My research focuses on using artificial platforms to study complex, many-body phenomena in light, sound, and matter, relevant to energy, computing, and quantum technologies. My expertise is at the crossroads of quantum optics, optomechanics, and classical nonlinear dynamics. I usually develop advanced analytical tools and software, like HarmonicBalance.jl. I collaborate with high-profile experimental groups. My research is published in journals like Nature and Physical Review Letters, and I have received honors including an ETH Postdoctoral Fellow and a Ph.D. Extraordinary Thesis Prize.

Education and Research Experience

Since October 2023 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 (sorted by most recent)

17. Slim, J. J., Wanjura, C., Brunelli, M., **del Pino, J.,** Nunnenkamp A., Verhagen, E. (2023) Optomechanical realization of the bosonic Kitaev chain [arXiv:2309.05825] (Nature, *in press)*

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. Košata, 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 phononics 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

PR. Visani, Diego A., Catalini, Letizia, Degen, Christian L., Eichler, Alexander, **del Pino, J.** (2023) Near-resonant nuclear spin detection with high-frequency mechanical resonators [arXiv:2311.16273]

PR. del Pino, J., Košata, J., Zilberberg, O. (2023) Limit cycles as stationary states of an extended Harmonic Balance ansatz [arXiv:2308.06092]

PR. Álvarez, P., Pittilini, D., Miserocchi, F., Raamamurthy, S., Margiani, G., Ameye, O., **del Pino, J.**, Zilberberg, O., Eichler A. (2023) A biased Ising model using two coupled Kerr parametric oscillators with external force [arXiv:2307.13676]

Teaching experience and student supervision

- **Lecturer:** (i) *Winter Semester (2023), University of Konstanz*: Computational Approaches to Quantum Oscillators (Wahlpflichtfach), Computational Methods for Quantum Optics (Seminare). (ii) *Summer Semester (2024), University of Konstanz*: Parametric & Many-body Phenomena in Quantum Optics (Wahlpflichtfach). Offered to both MSc and BSc students.
- **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 Könstanz (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

◊ **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]

◊ **Predoctoral 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]

◊ **Programming Languages:** Python (Most used), Julia (2nd most used), MATLAB, Mathematica. Intermediate skills in: Shell Script, R, Fortran, C.

◊ **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 40 conferences/seminars** (13 invited talks and seminars, 7 contributed talks)

◊ **Organization of Scientific events:**
- **Workshop on Parametric Phenomena** (11-13 January 2023) [webpage]
- **Theory Colloquium at the University of Konstanz** (from 13th 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 [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

◊ **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, Applied Physics Letters, NPJ Quantum Materials, Entropy, Journal of Applied Physics, and Annalen der Physik

◊ **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 [Type: Contributed/Invited Talk (CT, IT), Poster (P)]

◊ **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."