

# Felipe Herrera

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## Academic Experience

<b>Universidad de Santiago de Chile</b> Assistant Professor. Department of Physics.	<b>Since 2019</b>
<b>Universidad de Santiago de Chile</b> Associate Researcher. VRIDEI – Department of Physics.	<b>2014 - 2019</b>
<b>Harvard University</b> Postdoctoral Fellow. Department of Chemistry and Chemical Biology	<b>2012 - 2014</b>

## Education

<b>University of British Columbia, Ph.D. Chemistry</b> Dissertation: <i>Quantum Control of Binary and Many-Body Interactions in Ultracold Molecular Gases</i> . Advisor: Roman Krems	<b>2007 - 2012</b>
<b>Universidad de Chile, B.Sc. Chemistry</b> Dissertation: <i>Theory of Two-Photon Spectroscopy in Coordination Complexes</i> .	<b>2007 - 2002</b>

## Honors & Awards

Award <i>Inserción en la Academia</i> PAI, Conicyt	2014
Four Year Fellowship, University of British Columbia	2009
Gladys Estella Laird Fellowship, University of British Columbia	2007
Best Student of Chemistry Award, Universidad de Chile	2007

## Teaching

**Undergraduate Physics:** *Physics for Engineering* (Mechanics), *Physics for Computer Science*, *Electricity and Magnetism for Engineers*.

**Graduate Physics:** *Introduction to Atomic, Molecular and Optical Physics*.

## Grant Funding

- FONDEF IT20I0127, **2021-2023** [US\$ 456,000, **co-Director**]
- Office of Naval Research Global CSP Award N62909-20-1-2005, **2019** [US\$ 14,500, **PI**]
- Millennium Institute for Research in Optics (MIRO) **2018-2028** [US\$ 16,130,000, **co-PI**]
- Fondecyt Regular **2018-2022** [US\$290,000, **PI**].
- CORFO Technological Contracts for Innovation [US\$ 290,000, **co-PI**].
- Conicyt PAI **2014-2016** [US\$ 69,500, **PI**].
- Fondecyt Iniciación **2014-2016** [US\$ 72,500, **PI**]

## Professional Activities

- **Conference Organization**

- "1st Workshop on Molecular Quantum Technologies", Puerto Natales, Chile, Dec. 16-20, 2019.
- APS March Meeting DCP Focus Session *"Strong light-matter coupling: Enhanced spectroscopy, modified molecular dynamics and altered chemical reactions"*, March 5-9, 2018.
- "2nd International Workshop on Quantum Coherence and Decoherence", Medellin, August 25-29, 2014.

- **Journal Review**

Nature Physics, PNAS, Physical Review Letters, Journal of Physical Chemistry Letters, Nano Letters, Chem, New Journal of Physics, Physical Review A, Journal of Physical Chemistry C, Journal of Chemical Physics, European Journal of Physics D, Molecular Physics, Scientific Reports, Physics Letters A, Optics Express, RCS Advances.

- **Grant Review**

ANID-Fondecyt (Chile), DOE (US).

## PUBLICATIONS

- [35] **F. Herrera**, M. Litinskaya, *Ensembles of single-molecule picocavities as nonlinear optical metamaterials*, [submitted], **2021**.
- [34] A.B. Grafton, A.D. Dunkelberger, B. S. Simpkins, J. F. Triana, F. Hernandez, **F. Herrera**, J.C. Owrutsky, *Excited-State vibration-polariton transitions and dynamics in nitroprusside*, Nature Communications 12, 214, **2021**.
- [33] R.A. Fritz, Y. Colón, **F. Herrera**, *Engineering entangled photon pairs using metal-organic frameworks*, Chemical Science, DOI: 0.1039/D0SC05572G, **2021**.
- [32] J. García-Garfido, J. Enríquez, I. Chi-Durán, I. Jara, L. Vivas, F.J. Hernández, **F. Herrera**, D.P. Singh, *Millimeter-sized metal-organic framework single crystals without inversion symmetry: controlled growth and self-assembly mechanism*, [Submitted to JACS, September 2020], DOI:10.26434/chemrxiv.13002950.v1, **2020**.
- [31] I. Chi-Durán, R.A. Fritz, V. Olaya, R. Urzúa-Leiva, G. Cárdenas-Jirón, D.P. Singh, **F. Herrera**, *Anisotropic absorption of millimeter-sized Zn(3-ptz)<sub>2</sub> metal-organic framework single crystals*, <https://doi.org/10.26434/chemrxiv.13370414.v1>, **2020**.
- [30] J. F. Triana, **F. Herrera**, *Self-dissociation of polar molecules in a confined infrared vacuum*, [Submitted to J. Phys. Chem. Lett, July 2020], DOI:10.26434/chemrxiv.12702419.v1, **2020**.
- [29] A. Garmulewicz, V. Hernandez, D. Ibarra, I. Jara, M. N. Faundez, D. Vasco, C. García, **F. Herrera**, L. Gordillo. *Local production for a resilient circular economy: assessing the performance of bioplastics developed with low-cost production methods*, [Submitted to J. Clean. Prod., July 2020], Mendeley Data v1 DOI:10.17632/nyz4y58jbt.1, **2020**.
- [28] J. F. Triana, F. J. Hernández, **F. Herrera**, *The shape of the electric dipole function determines the sub-picosecond dynamics of anharmonic vibrational polaritons*, J. Chem. Phys. 152, 234111, **2020**.

- [27] V. Olaya, J. Pérez-Ríos, **F. Herrera**, *C<sub>6</sub> coefficients for interacting Rydberg atoms and alkali-metal dimers*, Phys. Rev. A 101, 032705, **2020**.
- [26] **F. Herrera**, J. Owrutsky, *Perspective: Molecular polaritons for controlling chemistry with quantum optics*, J. Chem. Phys. 152, 100902, **2020**.
- [25] **F. Herrera**, *Photochemistry with Quantum Optics from a Non-Adiabatic Quantum Trajectory Perspective*, Chem 6, 5-18, **2020**.
- [24] M. Wersäll, B. Munkhbat, D. G. Baranov, **F. Herrera**, J. Cao, T. J. Antosiewicz, T. Shegai, *Correlative dark-field and photoluminescence spectroscopy of individual plasmon-molecule hybrid nanostructures in strong coupling regime*, ACS Photonics 6, 2570-2576, **2019**.
- [23] F. Hernández and **F. Herrera**, *Multi-level quantum Rabi model for anharmonic vibrational polaritons*, J. Chem. Phys. 151, 144116, **2019**.
- [22] I. Chi-Duran, Z. Setifi, F. Setifi, C. Jelsch, B. Morgenstern, A. Vega, **F. Herrera**, D. P. Singh, K. Hegetschweiler and R. Boyaala *Crystal structure and Hirshfeld surface analysis of tris-(2,2'-bi-pyridine)-nickel(II) bis-(1,1,3,3-tetra-cyano-2-eth-oxy-propenide) dihydrate*, Acta Cryst. E75, 867-871, **2019**
- [21] M. J. Carreño, J. Sepúlveda, S. Tecpan, C. Hernández, **F. Herrera**, *An Instrument-Free Demonstration of Quantum Key Distribution for High-School Students*, Physics Education 54, 065006, **2019**.
- [20] J. Enríquez, I. Chi-Durán, C. Manquían, **F. Herrera**, D. P. Singh, *Controlled growth of the non-centrosymmetric Zn(3-ptz)<sub>2</sub> and Zn(OH)(3-ptz) metal-organic frameworks*, ACS Omega 4, 7411-7419, **2019**.
- [19] I. Chi-Duran, J. Enríquez, C. Manquian, R. A. Fritz, D. Serafini, **F. Herrera**, D. P. Singh, *Azide-based high-energy metal-organic framework with enhanced thermal stability*, ACS Omega 4, 11, 14398-14403, **2019**.
- [18] M. Litinskaya and **F. Herrera**, *Vacuum-enhanced optical nonlinearities with organic molecular photoswitches*, Phys. Rev. B 99, 041107(R), **2019**.
- [17] I. Chi-Duran, J. Enríquez, A. Vega, **F. Herrera**, D. P. Singh, *Hexa-aqua-zinc(II) dinitrate bis-[5-(pyridinium-3-yl)tetra-zol-1-ide]*, Acta Cryst. E74, 1231-1234, **2018**.
- [16] I. Chi-Duran, J. Enríquez, C. Manquian, K. Wrighton-Araneda, W. Cañon-Mancisidor, D. Venegas-Yazigi, **F. Herrera**, D. P. Singh, *pH-Controlled Assembly of 3D and 2D Zinc-based Metal-Organic Frameworks with Tetrazole Ligands*, ACS Omega 3, 801-807, **2018**.
- [15] **F. Herrera**, F. C. Spano, *Theory of nanoscale organic cavities: The essential role of vibration-photon dressed states*, ACS Photonics 5, 65, **2018**.
- [14] **F. Herrera**, F. C. Spano, *Absorption and photoluminescence in organic cavity QED*, Phys. Rev. A 95, 053867, **2017**.
- [13] **F. Herrera** and F. C. Spano, *Dark vibronic polaritons and the spectroscopy of organic microcavities*, Phys. Rev. Lett. 118, 223601, **2017**.
- [12] **F. Herrera** and F. C. Spano, *Cavity-controlled chemistry in molecular ensembles*, Phys. Rev. Lett. 116,

- [11] M. Moebius, **F. Herrera**, S. Griesse-Nascimento, O. Reshef, C. Evans, G. G. Guerreschi, Alan Aspuru-Guzik, Eric Mazur, *Efficient photon triplet generation in integrated nanophotonic waveguides*, Opt. Express 24, 9932, **2016**.
- [10] B. Zhu, J. Schachenmayer, M. Xu, **F. Herrera**, J. G. Restrepo, M. J. Holland, A. M. Rey, *Synchronization of interacting quantum dipoles*, New J. Phys. 17, 083063, **2015**.
- [9] **F. Herrera**, B. Peropadre, L. A. Pachon, S. Saikin, A. Aspuru-Guzik, *Quantum nonlinear optics with polar J-aggregates in microcavities*, J. Phys. Chem. Lett. 5, 3708, **2014**.
- [8] **F. Herrera**, Y. Cao, S. Kais, K. B. Whaley, *Infrared-dressed entanglement of cold open-shell polar molecules for universal matchgate quantum computing*, New J. Phys. 16, 075001, **2014**.
- [7] A.A. Kocherzhenko, J. Dawlaty, B. P. Abolins, **F. Herrera**, D. B. Abraham, K. B. Whaley, *Collective effects in linear spectroscopy of dipole-coupled molecular arrays*, Phys. Rev. A 90, 062502, **2014**.
- [6] **F. Herrera**, S. Kais, K. B. Whaley, *Entanglement creation in cold molecular gases using strong laser pulses*, arXiv:1302.6444.
- [5] **F. Herrera**, K. W. Madison, R. V. Krems, M. Berciu, *Investigating polaron transitions with polar molecules*, Phys. Rev. Lett. 110, 223002, **2013**.
- [4] **F. Herrera** and R. V. Krems, *Tunable Holstein model with cold polar molecules*, Phys. Rev. A 84, 051401(R), **2011**.
- [3] J. Perez-Rios, **F. Herrera**, R. V. Krems, *External field control of collective spin excitations in an optical lattice of  $^2\Sigma$  molecules*, New J. Phys. 12, 103007, **2010**.
- [2] **F. Herrera**, M. Litinskaya, R. V. Krems, *Tunable disorder in a crystal of cold polar molecules*, Phys. Rev. A 82, 033428, **2010**.
- [1] **F. Herrera**, *Magnetic field-induced interference of scattering states in ultracold collisions*, Phys. Rev. A 78, 054702, **2008**.

## INVITED PRESENTATIONS

1. MRS Fall Meeting, Boston, November **2021**.
2. SPIE Conference Metamaterials, Metadevices, and Metasystems 2021, San Diego, August **2021**.
3. *Controlling the Chemistry and Dynamics of Organic Materials with Quantum Optics at the Nanoscale*, International Conference on Materials Science, Valdivia, October **2019**.
4. *Vibrational polaritons in the ultrastrong coupling regime: spectroscopy and chemistry*, Workshop on Molecular Polaritonics, Madrid, July **2019**.
5. *Controlling chemistry with quantum optics at the nanoscale*, Centro de Óptica Cuántica e Información Cuántica, Universidad Mayor, June **2019**.
6. *Controlling chemistry with quantum optics at the nanoscale*, JILA seminar, February **2019**.

7. *Cavity quantum electrodynamics with organic matter*, 2nd Workshop in Optics and Photonics, Universidad de los Andes, December **2018**.
8. *Controlling chemistry with quantum optics in nanoscale cavities*, 10th International Meeting on Photodynamics and Related Aspects, Cartagena, September **2018**.
9. *Holstein-Tavis-Cummings theory of organic polaritons: Spectroscopy and chemistry*, 9th International Conference on Spontaneous Coherence in Excitonic Systems, Montreal, July **2018**
10. *Holstein-Tavis-Cummings theory of organic polaritons: Spectroscopy and chemistry*, Workshop "Quantum Frontiers in Molecular Science", Telluride, June **2018**.
11. *The physics of organic cavities*, Universidad de Chile, Santiago, November **2017**.
12. *Controlling chemistry with quantum optics in nanoscale cavities*, Fac. de Ciencias, Universidad de Chile, Santiago, July **2017**.
13. *Controlling chemistry with quantum optics in nanoscale cavities*, Centre for Quantum Technologies, Singapore, Feb. **2017**
14. *Controlling chemistry with quantum optics in nanoscale cavities*, SMART Centre, Singapore, Feb. **2017**
15. *Cavity-controlled chemistry in molecular ensembles*, CINV, Valparaiso, July **2016**.
16. *Cavity-controlled chemistry in molecular ensembles*, CEFOP, Concepción, June **2016**.
17. *Cavity-controlled chemistry in molecular ensembles*, Photodynamics, Mendoza, May **2016**.
18. *Controlling nonlinear optical response and chemical reactions in organic cavities*, Pacificchem, Honolulu, December **2015**.
19. *Matchgate quantum computing with cold polar molecules*, APS March Meeting, San Antonio, March **2015**.
20. *Matchgate quantum computing with cold polar molecules*, JILA, Boulder, December **2014**.
21. *Solid-state nonlinear quantum optics with organic polar molecular aggregates*, IWQCD II, Medellín, August **2014**.
22. *Controlled entanglement manipulation in cold molecular gases with strong laser pulses*, University of British Columbia, Vancouver, May **2013**.
23. *Controlled entanglement manipulation in cold molecular gases with strong laser pulses*, Kavli Institute for Theoretical Physics, Santa Barbara, March **2013**.
24. *Dynamical generation of entanglement in cold molecular gases using strong laser pulses*, Institute for Theoretical AMO Physics, Boston, January **2013**.
25. *Quantum control of binary and many-body interactions with cold molecules*, Quantum Center, University of California Berkeley, May **2012**.
26. *Tunable Holstein Hamiltonian with cold polar molecules*, Institute for Theoretical AMO Physics, Boston, September **2011**.
27. *Tunable Holstein Hamiltonian with cold polar molecules*, Institut für Theoretische Physik, Universität Ulm, Ulm, June **2011**.
28. *External field control of collective coherence in optical lattices of polar molecules*, Institut für Quantenoptik und Quanteninformation, Innsbruck, May **2011**.
29. *Quantum interference induced by external fields in ultracold collisions*, AMO seminar, University of British Columbia, Vancouver, November **2009**.