Felipe Herrera

Department of Physics, Universidad de Santiago de Chile USACH. http://fherreralab.com
Av. Víctor Jara 3493, Estación Central, Santiago - Phone: (56 2) 27181203 - Email: felipe.herrera.u@usach.cl

Academic Experience

Universidad de Santiago de Chile **Since 2019**
Assistant Professor. Department of Physics. [tenured]

Universidad de Santiago de Chile **2014 – 2019**
Associate Researcher. VRIDEI – Department of Physics.

Harvard University, *Postdoctoral Fellow***.** **2012 – 2014**

Education

University of British Columbia, Ph.D. Chemistry **2007 – 2012**
Universidad de Chile, B.Sc. Chemistry **2007 – 2002**

Honors & Awards

Award *Inserción en la Academia* 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 (Mechanics) for Engineering*, *Physics for Computer Science*, *Electricity and Magnetism for Engineers*.
- **Graduate:** *Introduction to Atomic, Molecular and Optical Physics; Nanophotonics***.**

External Grant Funding

- Fondecyt Regular 2022-2026 [US$280,000, **PI**].
- FONDEF IT20I0127, **2021-2023** [US$ 456,000, **co-PI**].
- ANID-ECOS Collaborative Grant (Chile-France), 2021-2023 [US$20,000, **co-PI**].
- Office of Naval Research Global CSP Award N62909-20-1-2005, **2019** [US$ 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**].

Academic Service

- **Conference Organization**
  - "2nd *Workshop on Molecular Quantum Technologies*", Puerto Natales, Chile, Dec. 12-16, 2022.
  - "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.

- **Editorial Service**
  - The Journal of Chemical Physics, Editorial Advisory Board member, 2022 – 2024.

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

- **Grant Review**
  ANID Fondecyt (Chile), ANID Fondef IT (Chile), DOE Early Career (US).

Student and Early-Career Mentoring

- **Postdoctoral**: Rubén Fritz, Federico Hernández, Johan Triana, Thulasi Bikku.
- **Graduate**: Katy Aruachan (PhD Physics), Athul Sambasivan (PhD Physics), Felipe Recabal (PhD Phys), Mauricio Arias (PhD, Physics), Vanessa Olaya (MSc Phys), Ignacio Chi (MSc Chem), Jonathan Sepúlveda (MSc Phys), Simón Paiva (MSc Phys), Gastón González (MSc Phys).
- **Undergraduate**: *Engineering Physics*: Jonathan Sepúlveda, Iván Jara, Simón Paiva, Gastón González, Felipe Recabal; *Computer Science***:** Melissa Silva, Bastian Martínez, Fernanda Véliz, Felipe Osorio; *Engineering Mathematics***:** Diego Carvajal.

PUBLICATIONS

[38] **F. Herrera**, M. Litinskaya, *Ensembles of single-molecule picocavities as nonlinear optical metamaterials,* J. Chem. Phys 156, 114702, **2022.**

[37] J. Triana and **F. Herrera**, *Ultrafast modulation of vibrational polaritons for controlling the quantum field statistics at mid-infrared frequencies*, New J. Phys 24, 023008, **2022**.

[36] J. Triana, M. Arias, J. Nishida, E. Muller, R. Wilcken, S. C. Johnson, A. Delgado, M. B. Raschke, **F. Herrera**, *Semi-empirical quantum optics for mid-infrared molecular nanophotonics*, J. Chem. Phys. 156, 124110, **2022**.

[35] V. Olaya, J. Pérez-Ríos, **F. Herrera**, *Laser-assisted binding of ultracold polar molecules with Rydberg atoms in the van der Waals regime* [submitted to New J. Phys.], arxiv:2109.06411, **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 12, 3475-3482, **2021**.

[32] J. García-Garfido, J. Enríquez, I. Chi-Durán, I. Jara, L. Vivas, F.J. Hernández, **F. Herrera**, D.P. Singh, *Millimeter-Scale Zn(3-ptz)$_2$ Metal–Organic Framework Single Crystals: Self-Assembly Mechanism and Growth Kinetics,* ACS Omega 6, 27, 17289–17298, **2021**.

[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)$_2$ 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*, 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_6 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. Manquián, **F. Herrera**, D. P. Singh, *Controlled growth of the non-centrosymmetric Zn(3-ptz)$_2$ 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, 238301, **2016.**

[11] M. Moebius, **F. Herrera**, S. Griesse-Nascimento, O. Reshef, C. Evans, G. G. Guerreschi, Alan Aspuru-Guzik, Eric Mazur, *Effcient 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. CEAM Flagship Workshop on Polaritonic Chemistry, Bordeaux, June **2022**
2. MRS Spring Meeting 2022, Honolulu, May **2022**.
3. *Exact chemical dynamics tools for scalable simulations of noisy superconducting resonator networks*, Pacifichem 2021, Virtual Conference, December 19th **2021.**
4. MRS Fall Meeting 2021, Boston, November **2021**.
5. *Vacuum and molecules for useful quantum advantage today*, Physics Colloquium, Ohio University, October **2021.**
6. SPIE Conference Metamaterials, Metadevices, and Metasystems 2021, San Diego, August **2021**.
7. *Chemical reactivities of vibrational polaritons in the ultrastrong coupling regime*, Strong Coupling in Organic Molecules (SCOM) 2021, Chalmers (virtual), April 27, **2021**.
8. *Molecular materials and devices for scalable optical quantum technologies,* Royal Society Frontiers of Science UK-Chile, London (virtual), March 29, **2021.**
9. *Anharmonic vibrational polaritons: spectroscopy and chemistry*, Polariton Chemistry Webinars, UCSD (virtual), January **2021**.
10. *Controlling the chemistry and dynamics of organic materials with quantum optics at the nanoscale,* International Conference on Materials Science, Valdivia, October **2019.**
11. *Vibrational polaritons in the ultrastrong coupling regime: spectroscopy and chemistry,* Workshop on Molecular Polaritonics, Madrid, July **2019.**
12. *Controlling chemistry with quantum optics at the nanoscale,* Centro de Óptica Cuántica e Información Cuántica, Universidad Mayor, June **2019.**
13. *Controlling chemistry with quantum optics at the nanoscale,* JILA seminar, February **2019**.
14. *Cavity quantum electrodynamics with organic matter,* 2nd Workshop in Optics and Photonics, Universidad de los Andes, December **2018**.
15. *Controlling chemistry with quantum optics in nanoscale cavities,* 10th International Meeting on Photodynamics and Related Aspects, Cartagena, September **2018**.
16. *Holstein-Tavis-Cummings theory of organic polaritons: Spectroscopy and chemistry,* 9th International Conference on Spontaneous Coherence in Excitonic Systems, Montreal, July **2018**
17. *Holstein-Tavis-Cummings theory of organic polaritons: Spectroscopy and chemistry,* Workshop "Quantum Frontiers in Molecular Science", Telluride, June **2018.**
18. *The physics of organic cavities*, Universidad de Chile, Santiago, November **2017**.
19. *Controlling chemistry with quantum optics in nanoscale cavities*, Fac. de Ciencias, Universidad de Chile, Santiago, July **2017.**
20. *Controlling chemistry with quantum optics in nanoscale cavities*, Centre for Quantum Technologies, Singapore, Feb. **2017**
21. *Controlling chemistry with quantum optics in nanoscale cavities*, SMART Centre, Singapore, Feb. **2017**
22. *Cavity-controlled chemistry in molecular ensembles*, CINV, Valparaiso, July **2016**.
23. *Cavity-controlled chemistry in molecular ensembles*, CEFOP, Concepción, June **2016**.
24. *Cavity-controlled chemistry in molecular ensembles*, Photodynamics, Mendoza, May **2016**.
25. *Controlling nonlinear optical response and chemical reactions in organic cavities*, Pacifichem, Honolulu, December **2015**.

26. *Matchgate quantum computing with cold polar molecules*, APS March Meeting, San Antonio, March **2015**.
27. *Matchgate quantum computing with cold polar molecules*, JILA, Boulder, December **2014**.
28. *Solid-state nonlinear quantum optics with organic polar molecular aggregates*, IWQCD II, Medellín, August **2014**.
29. *Controlled entanglement manipulation in cold molecular gases with strong laser pulses*, University of British Columbia, Vancouver, May **2013**.
30. *Controlled entanglement manipulation in cold molecular gases with strong laser pulses*, Kavli Institute for Theoretical Physics, Santa Barbara, March **2013**.
31. *Dynamical generation of entanglement in cold molecular gases using strong laser pulses*, Institute for Theoretical AMO Physics, Boston, January **2013**.
32. *Quantum control of binary and many-body interactions with cold molecules*, Quantum Center, University of California Berkeley, May **2012**.
33. *Tunable Holstein Hamiltonian with cold polar molecules*, Institute for Theoretical AMO Physics, Boston, September **2011**.
34. *Tunable Holstein Hamiltonian with cold polar molecules*, Institut fur Theoretische Physik, Universitat Ulm, Ulm, June **2011**.
35. *External field control of collective coherence in optical lattices of polar molecules*, Institut fur Quantenoptik und Quanteninformation, Innsbruck, May **2011**.
36. *Quantum interference induced by external fields in ultracold collisions*, AMO seminar, University of British Columbia, Vancouver, November **2009**.