

Francisco Salces Cárcoba

Senior Postdoctoral Scholar Research Associate in Physics

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EXPERTISE	Experimental physics of coherent light and matter waves including laser interferometer gravitational-wave detector instrumentation, ultracold quantum gases for quantum simulation, and cold-atom based quantum sensors.		
DEGREES	PhD , Physics		
	University of Maryland College Park, College Park, MD, May 2020 Title of dissertation: <i>Microscopy of elongated superfluids</i>		
	BSc , Physics		
	Universidad Autónoma de San Luis Potosí, San Luis Potosí, S.L.P., Mexico, 2013		
ROLES AND PROJECTS	Senior Postdoctoral Scholar Research Associate in Physics		
	<i>LIGO Laboratory, California Institute of Technology, Pasadena, CA</i> Optical enhancement cavity prototypes for Blue Laser Fusion		2024-
	Barish-Weiss Postdoctoral Scholar Research Associate in Physics		
	<i>LIGO Laboratory, California Institute of Technology, Pasadena, CA</i> Mariner: 40-meter cryogenic gravitational-wave detector prototype		2020-
	Frequency metrology gravitational-wave detector calibration		2020-
	Balanced homodyne readout for gravitational-wave detection		2021-
	Graduate research assistant & NIST guest researcher		
	<i>Joint Quantum Institute, UMD College Park, and NIST Gaithersburg, MD</i> Digital holographic microscope of ultracold ^{87}Rb		2017-2020
	Dual chamber apparatus for quantum degenerate Bose gases		2016-2018
	Equations of state for individual one-dimensional Bose gases		2015-2017
	Digital control for bias magnetic fields		2014-2015
	Graduate teaching assistant		
	<i>Physics department, UMD College Park, MD</i> Physics 276 Experimental Physics II: Electricity and Magnetism		Fall 2013
	Physics 721 Atomic and Optical Physics I		Fall 2015
	High school teacher		
	<i>Prepa-tec ITESM campus SLP, S.L.P. Mexico</i> Instructor de física, programa de bachillerato internacional		Spring 2013
	Undergraduate teaching assistant		
	<i>Facultad de Ciencias, UASLP, S.L.P., Mexico</i> Ayudante de SNI: Física II, Termodinámica, ondas y fluidos		2012 - 2013
	Undergraduate research intern		
	<i>Oak Ridge National Lab, Oak Ridge, TN</i> Soft X-ray calorimetry from electron recapture		Summer 2012
	Characterization of scintillator dark matter detectors		Summer 2012

Undergraduate research assistant

Laboratorio de Atomos Frios, Instituto de Fisica UASLP, S.L.P, Mexico

Passive thermal stabilization of optical cavities	2011-2013
Offset laser locking for atomic gravimeter experiments	Fall 2011
Second order correlation function measurement using an oscilloscope	2009-2011

INVITED TALKS

Joint Quantum Institute - Summer School	Summer 2018
San Jose State University - Physics Colloquium	Spring 2021
Instituto de Fisica UASLP - Physics Colloquium	Fall 2021
Universidad Autonoma de Zacatecas - Division Seminar	Spring 2022
CINVESTAV Queretaro - Division Seminar	Spring 2022
University of Florida - Physics Colloquium	Winter 2023
Arizona State University - Quantum Series Seminar	Spring 2023
California Institute of Technology - LIGO Seminar	Spring 2023

AFFILIATIONS AND AWARDS

• Early career member SACNAS	2023 -
• APS Career mentoring fellow	2022 -
• Barish–Weiss prize postdoctoral fellow	2020 -
• Early career member APS	2020 -
• Early career member Optica (formerly OSA)	2020 -
• OSA innovation school, 3rd place	Summer 2019
• Student member APS	2016 - 2020
• President OSA Student Chapter UASLP	2011 - 2013
• Outreach volunteer for OSA Student Chapter UASLP	2009 - 2013
• Student member OSA	2009 - 2013

SKILLS

Human resources

- Mentoring: high school senior, undergraduate, and graduate level research and career mentor.
- Training: state-level physics and math olympiad instructor.
- Teaching: high-school physics teacher, undergraduate physics teaching assistant, undergraduate physics instructor, private physics and math tutoring.
- Outreach: local outreach K-12 schools, national science fairs, student chapters, and university fairs.

Hardware

- Optics: laser spectroscopy, adaptive optics, optomechanics, fiber optics, holography, coherent microscopy, optical cavities, laser interferometry, and laser development and control.
- Vacuum: high and ultra-high vacuum down to 10^{-12} mbar.
- Electronics: low power DC and AC circuit design, low and high power radiofrequency and microwave engineering, digital signal processing from microcontrollers to FPGAs, multilayer printed circuit boards, magnetic shielding.
- Mechanics: basic machining and assembly of metals, wood, and hard plastic components.

Software

- Programming: Python, Matlab, ImageJ, Labview, VHDL, bash, hpc, EPICS.
- CAD: Solidworks, Zeemax, Eagle.

- [1] Y. Huang, **F. Salces-Carcoba**, R. X. Adhikari, A.H. Safavi-Naeini, and L. Jiang. “Vacuum Beam Guide for Large Scale Quantum Networks”. In: *Phys. Rev. Lett.* 133 (2 **2024**), p. 020801. URL: <https://link.aps.org/doi/10.1103/PhysRevLett.133.020801>.
- [2] G. Venugopalan, **F. Salces-Cárcoba**, K. Arai, and R. X. Adhikari. “Global optimization of multilayer dielectric coatings for precision measurements”. In: *Opt. Express* 32.7 (**2024**). URL: <https://opg.optica.org/oe/abstract.cfm?URI=oe-32-7-11751>.
- [3] Y. Michimura, H. Wang, **F. Salces-Carcoba**, C. Wipf, A. Brooks, K. Arai, and R. X. Adhikari. “Effects of mirror birefringence and its fluctuations to laser interferometric gravitational wave detectors”. In: *Phys. Rev. D* 109 (2 **2024**), p. 022009. URL: <https://link.aps.org/doi/10.1103/PhysRevD.109.022009>.
- [4] A. R. Perry, S. Sugawa, **F. Salces-Carcoba**, Y. Yue, and I. B. Spielman. “Multiple-camera defocus imaging of ultracold atomic gases”. In: *Opt. Express* 29.11 (**2021**), pp. 17029–17041. URL: <http://www.opticsexpress.org/abstract.cfm?URI=oe-29-11-17029>.
- [5] S. Sugawa, **F. Salces-Carcoba**, Y. Yue, A. Putra, and I. B. Spielman. “Wilson loop and Wilczek-Zee phase from a non-Abelian gauge field”. In: *npj Quantum Information* 7.1 (Sept. **2021**), p. 144. URL: <https://doi.org/10.1038/s41534-021-00483-2>.
- [6] Andika Putra, **F. Salces-Carcoba**, Yuchen Yue, Seiji Sugawa, and I. B. Spielman. “Spatial Coherence of Spin-Orbit-Coupled Bose Gases”. In: *Phys. Rev. Lett.* 124 (**2020**), p. 053605. URL: <https://link.aps.org/doi/10.1103/PhysRevLett.124.053605>.
- [7] **F. Salces-Carcoba**, C. J. Billington, A. Putra, Y. Yue, S. Sugawa, and I. B. Spielman. “Equations of state from individual one-dimensional Bose gases”. In: *New Journal of Physics* 20 (**2018**), p. 113032. URL: <https://doi.org/10.1088%2F1367-2630%2Faaef9b>.
- [8] S. Sugawa, **F. Salces-Carcoba**, A. R. Perry, Y. Yue, and I. B. Spielman. “Second Chern number of a quantum-simulated non-Abelian Yang monopole”. In: *Science* 360.6396 (**2018**), pp. 1429–1434. URL: <https://science.sciencemag.org/content/360/6396/1429>.
- [9] K. Morgan, V. Andrianarijaona, I. N. Draganic, X. Defay, M. Fogle, A. Galindo-Uribarri, C. I. Guillen, C. C. Havener, M. Hokin, D. McCammon, D. J. Nader, S. L. Romano, **F. Salces-Carcoba**, P. Sauter, D. Seely, P. C. Stancil, C. R. Vane, A. K. Vasantachart, and D. Wulf. “Charge exchange x-ray emission: Astrophysical observations and potential diagnostics”. In: *AIP Conference Proceedings* 1525.1 (**2013**), pp. 49–54. URL: <https://aip.scitation.org/doi/abs/10.1063/1.4802288>.

- [10] The LIGO Scientific Collaboration, the Virgo Collaboration, and the KAGRA Collaboration. “All-sky search for gravitational wave emission from scalar boson clouds around spinning black holes in LIGO O3 data”. In: *Phys. Rev. D* 105 (**2022**), p. 102001. URL: <https://link.aps.org/doi/10.1103/PhysRevD.105.102001>.
- [11] The LIGO Scientific Collaboration, the Virgo Collaboration, and the KAGRA Collaboration. “Searches for Gravitational Waves from Known Pulsars at Two Harmonics in the Second and Third LIGO-Virgo Observing Runs”. In: *The Astrophysical Journal* 935.1 (**2022**), p. 1. URL: <https://dx.doi.org/10.3847/1538-4357/ac6acf>.

- [12] The LIGO Scientific Collaboration, the Virgo Collaboration, and the KAGRA Collaboration. “Model-based Cross-correlation Search for Gravitational Waves from the Low-mass X-Ray Binary Scorpius X-1 in LIGO O3 Data”. In: *The Astrophysical Journal Letters* 941.2 (2022), p. L30. URL: <https://dx.doi.org/10.3847/2041-8213/aca1b0>.
- [13] The LIGO Scientific Collaboration, the Virgo Collaboration, and the KAGRA Collaboration. “All-sky search for continuous gravitational waves from isolated neutron stars using Advanced LIGO and Advanced Virgo O3 data”. In: *Phys. Rev. D* 106 (2022), p. 102008. URL: <https://link.aps.org/doi/10.1103/PhysRevD.106.102008>.
- [14] The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration. “Search for gravitational waves from Scorpius X-1 with a hidden Markov model in O3 LIGO data”. In: *Phys. Rev. D* 106 (6 2022), p. 062002. URL: <https://link.aps.org/doi/10.1103/PhysRevD.106.062002>.
- [15] The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration. “First joint observation by the underground gravitational-wave detector KAGRA with GEO 600”. In: *Progress of Theoretical and Experimental Physics* 6 (2022). 063F01. URL: <https://doi.org/10.1093/ptep/ptac073>.
- [16] The LIGO Scientific Collaboration, The VIRGO Collaboration, and The KAGRA Collaboration. “Search for subsolar-mass black hole binaries in the second part of Advanced LIGO’s and Advanced Virgo’s third observing run”. In: *Monthly Notices of the Royal Astronomical Society* 524.4 (2023), pp. 5984–5992. URL: <https://doi.org/10.1093/mnras/stad588>.
- [17] The LIGO Scientific Collaboration. “Constraints on the Cosmic Expansion History from GWTC-3”. In: *The Astrophysical Journal* 949.2 (2023), p. 76. URL: <https://dx.doi.org/10.3847/1538-4357/ac74bb>.
- [18] The LIGO Scientific Collaboration, The VIRGO Scientific Collaboration, the KAGRA Scientific Collaboration, the GEO600 Observatory, et al. “Open Data from the Third Observing Run of LIGO, Virgo, KAGRA, and GEO”. In: *The Astrophysical Journal Supplement Series* 267.2 (2023), p. 29. URL: <https://dx.doi.org/10.3847/1538-4365/acdc9f>.
- [19] The LIGO Scientific Collaboration, The VIRGO Scientific Collaboration, the KAGRA Scientific Collaboration, the GEO600 Observatory, et al. “A Joint Fermi-GBM and Swift-BAT Analysis of Gravitational-wave Candidates from the Third Gravitational-wave Observing Run”. In: *The Astrophysical Journal* 964.2 (2024), p. 149. URL: <https://dx.doi.org/10.3847/1538-4357/ad1eed>.
- [20] The LIGO Scientific Collaboration, The VIRGO Scientific Collaboration, the KAGRA Scientific Collaboration, the GEO600 Observatory, et al. “Search for Gravitational-wave Transients Associated with Magnetar Bursts in Advanced LIGO and Advanced Virgo Data from the Third Observing Run”. In: *The Astrophysical Journal* 966.1 (2024), p. 137. URL: <https://dx.doi.org/10.3847/1538-4357/ad27d3>.
- [21] The LIGO Scientific Collaboration, The VIRGO Scientific Collaboration, the KAGRA Scientific Collaboration, the GEO600 Observatory, et al. “Observation of Gravitational Waves from the Coalescence of a 2.5–4.5 M_{\odot} Compact Object and a Neutron Star”. In: *The Astrophysical Journal Letters* 970.2 (2024), p. L34. URL: <https://dx.doi.org/10.3847/2041-8213/ad5beb>.

PREPRINTS

- [22] The LIGO Scientific Collaboration, The Virgo Collaboration, and The KAGRA Collaboration. *Tests of General Relativity with GWTC-3*. (2021). URL: <https://arxiv.org/abs/2112.06861>.

- [23] The LIGO Scientific Collaboration, the Virgo Collaboration, the KAGRA Collaboration, et al. *Search for Eccentric Black Hole Coalescences during the Third Observing Run of LIGO and Virgo*. (2023). URL: <https://arxiv.org/abs/2308.03822>.

IN
PREPARATION

- [24] A. Gupta, **F. Salces-Carcoba, et al.** *Bichromatic Gravitational Wave detector calibration*.
- [25] **F. Salces-Carcoba**, A. Gupta, et al. *Arm length stabilization for next-generation gravitational-wave detectors*.
- [26] Y. Michimura, **F. Salces-Carcoba, et al.** *Balanced homodyne gravitational-wave readout prototype*.
- [27] **F. Salces-Carcoba et al.** *Upconverted quantum efficiency for cryogenic gravitational wave detectors*.