Francisco Salces Cárcoba

Barish–Weiss 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
Universiy of Maryland College Park, College Park, MD, May 2020
Title of dissertation: *Microscopy of elongated superfluids*

BSc, Physics
Universidad Autónoma de San Luis Potosí, San Luis Potosí, S.L.P., Mexico, 2013

ROLES AND PROJECTS

Barish-Weiss Postdoctoral Scholar Research Associate in Physics
LIGO Laboratory, California Institute of Technology, Pasadena, CA
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
Joint Quantum Institute, UMD College Park, and NIST Gaithersburg, MD
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
Physics department, UMD College Park, MD
Physics 276 Experimental Physics II: Electricity and Magnetism Fall 2013
Physics 721 Atomic and Optical Physics I Fall 2015

High school teacher
Prepa-tec ITESM campus SLP, S.L.P. Mexico
Instructor de fisica, programa de bachillerato internacional Spring 2013

Undergraduate teaching assistant
Facultad de Ciencias, UASLP, S.L.P., Mexico
Ayudante de SNI: Fisica II, Termodinamica, ondas y fluidos 2012 - 2013

Undergraduate research intern
Oak Ridge National Lab, Oak Ridge, TN
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 Instute 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.

PEER-REVIEWED PUBLICATIONS

[1] 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`.

[2] 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.

[3] 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.

[4] 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.

[5] 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.

[6] **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.

[7] 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.

[8] 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. Vassantachart, 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.

LIGO SCIENTIFIC COLLABORATION

[9] 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.

[10] 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.

[11] 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.

[12] 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`.

[13] 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`.

[14] 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`.

[15] 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`.

[16] 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`.

[17] 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`.

PREPRINTS

[18] 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`.

[19] The LIGO Scientific Collaboration et al. *Search for gravitational-wave transients associated with magnetar bursts in Advanced LIGO and Advanced Virgo data from the third observing run.* (**2022**). URL: `https://arxiv.org/abs/2210.10931`.

[20] 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`.

[21] C. Fletcher, J. Wood, R. Hamburg, P. Veres, C. M. Hui, et al. *A Joint Fermi-GBM and Swift-BAT Analysis of Gravitational-Wave Candidates from the Third Gravitational-wave Observing Run.* (**2023**). URL: `https://arxiv.org/abs/2308.13666`.

IN PREPARATION

[22] A. Gupta, **F. Salces-Carcoba, et al.** *Absolute gravitational wave calibration readout using dichroic frequency metrology.*

[23] **F. Salces-Carcoba**, A. Gupta, et al. *Arm length stabilization for next-generation gravitational-wave detectors.*

[24] Y. Michimura, **F. Salces-Carcoba, et al.** *Balanced homodyne gravitational-wave detector readout in a 40 meter long prototype.*