Luis Villegas-Aguilar

Quantum physicist.

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Where am I?

Researcher at QOIL in sunny Queensland, Australia.

I specialise in

Designing and building advanced optical setups for quantum optics research.

Developing code for controlling hardware and automating experiments.

Analysing complex data and presenting research findings through clear, high-impact writing and visually engaging graphics.

My research interests are

Quantum communication and computation

New photonic technologies

Quantum foundations

Statistical methods for physics

What have I done so far?

Quantum Optics and Information Lab, Brisbane, Australia — 2021 - now

Doctoral researcher

My focus is on cutting-edge quantum communication research using single-photon technologies.

I design and build complex quantum optics experiments using ultra-fast pulsed lasers, custom-engineered nonlinear SPDC crystals, motorised optomechanical systems, and superconducting nanowire photon detectors.

I also developed a Python toolbox for instrument control and data acquisition in the lab, reducing experimental setup time and fostering code collaboration within the research group.

HSBC, Mexico City, Mexico — 2019 - 2020

Data scientist, Business Analytics team

My role helped the Compliance, Fraud, and Anti-Money Laundering teams make better decisions, turning data insights into clear actions that met regulatory needs.

I introduced new statistical methods to analyse transaction patterns and spot unusual activity and potential risks.

Cold Atoms and Quantum Optics Lab, IF, Mexico City, Mexico — 2016 - 2019

Research associate

During my undergraduate degree, I worked on four-wave-mixing experiments in laser-cooled Rubidium-87 atoms. My main focus was building a magneto-optical trap and developing some of the software tools to support the lab’s work.

National Synchrotron Light Lab, Campinas, Brazil 2017

Research intern

Had the chance to visit Prof. Liu Lin at the Accelerator Division, working on numerically optimising the southern hemisphere's first Synchrotron light source, UVX.

University of Texas at Dallas, Texas, USA 2015

Research intern

Worked with Prof. David Lary at UTD to explore hidden correlations between tiny airborne particles and health indicators, using machine learning on geospatial data.

Education

Griffith University, Brisbane, Australia Jul 2021 - Jan 2025

Ph.D in Physics

Thesis title: "Quantum networking with ultrahigh-performance entangled photon sources", under Nora Tischler, Sergei Slussarenko, and Geoff J. Pryde

UNAM, Mexico City, Mexico Sep 2013 - Jan 2019

B.Sc. (Hons) in Physics, GPA 9.98 out of 10 <!– - Thesis: "Data acquisition system for photon pairs with atomic origin"

with Daniel Sahagún-Sánchez –>

Coding

In the lab: Python (pyvisa, requests, cython, qutip, matplotlib), git

For data processing: Python (numpy, scipy, scikit-learn, pandas, dask), Matlab (cvx, Parallel Computing Toolbox), Julia, SQL

For fun: Python (networkx, Beautiful Soup, Plotly), Bash

Research output

A list is also available online.

Journal articles

Villegas-Aguilar, Luis, Polino, E., Ghafari, F., Quintino, M.T., Laverick, K.T., Berkman, I.R., Rogge, S., Shalm, L.K., Tischler, N., Cavalcanti, E.G. and Slussarenko, S., and Pryde, G. J. **Nonlocality activation in a photonic quantum network**. Nature Communications 15 (2024) p.3112. 2024

Media release: Combating disruptive 'noise' in quantum communication.

Villegas-Aguilar, Luis, Ghafari, F., Winnel, M.S., Shalm, L.K., Verma, V.B., Ralph, T.C., Pryde, G.J., and Slussarenko, S. **A heralded quantum amplifier of multi-photon states**. In preparation. (in preparation)

Villegas-Aguilar, Luis, Polino, E., Poderini, D., Walk, N., Quintino, M.T., Ghafari, F., Chaves, R., Rogge, S., Pryde, G.J., Cavalcanti, E.G., Tischler, N., and Slussarenko, S. **Experimental quantum randomness enhanced by a quantum network**. Preprint at arXiv:2412.16973. (under review)

White, S.J., Polino, E., Ghafari, F., Joch, D.J., Villegas-Aguilar, Luis, Shalm, L.K., Verma, V.B., Huber, M., and Tischler, N. **A robust approach for time-bin encoded photonic quantum information protocols**. Preprint at arXiv:2404.16106. (under review)

	Villegas-Aguilar, Luis, Wang, Y., Pepper, A., Baker, T.J., Pryde, G.J., Slussarenko, S., Tischler, N., and Wiseman, H.M. **Quantum assemblage tomography**. Preprint at arXiv:2408.15576.	(under review)
	Arias-Téllez, N., Ángeles-Aguillón, I.F., Martínez-Cara, D., Martínez-Vallejo, A., Villegas-Aguilar, Luis, Mendoza-López, L.A., Torres, Y.M., Gutiérrez-Arenas, R.A., Jáuregui, R., Sahagún-Sánchez, D., Pérez Castillo, I., and Ceré, A. **An experimental setup to generate narrowband bi-photons via four-wave mixing in cold atoms**. Revista mexicana de física, 68 (2022) p.031303.	2022
Books	Villegas-Aguilar, Luis and Cara-Camarena, S. **Informática II**. ISBN: 978-6-07-627398-2. (High-school level textbook on computer technologies. In spanish.)	2020
Talks	26th Australian Institute of Physics Congress @ Melbourne, Australia	2024
	KOALA Conference on Optics, Atoms, and Laser Applications @ Melbourne, Australia **(best speaker award!)**	2024
	28th Central European Workshop on Quantum Optics @ Olomouc, Czech Republic	2024
	OPTICA Quantum 2.0 @ Rotterdam, Netherlands	2024
	SPIE Photonics for Quantum @ Rochester, USA	2023
	24th Australian Institute of Physics Congress @ Adelaide, Australia	2022
Teaching	Undergraduate student supervision @ Griffith University	2023 - 2024
	Teaching Assistant for first-year course on Linear Algebra @ Griffith University	2021
	Teaching Assistant for fourth-year course on Atomic Physics and Condensed Matter @ UNAM	2019
	Teaching Assistant for third-year course on Optics @ UNAM	2018

Last updated: Jan 2025