Alexander Abulnaga

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EDUCATION

Princeton University, Princeton, NJ, USA — Sep. 2018 —Present
Ph.D., Department of Electrical and Computer Engineering
Advisor: Nathalie P. de Leon
Thesis: Hybrid Nanophotonics for Telecom Quantum Nodes Based on Defects in Diamond (Expected 03/2024)
Research interests: computational nanophotonics, nanofabrication and metrology, quantum spectroscopy, nonlinear optics

Princeton University, Princeton, NJ, USA — Sep. 2020
M.A. in Electrical Engineering — GPA: 3.77/4
Advisor: Nathalie P. de Leon
Thesis Proposal: Nanophotonics for Telecom Quantum Networks Based on Neutral Silicon Vacancy Centres in Diamond

The University of British Columbia, Vancouver BC, Canada — Jun. 2018
B.A.Sc. in Electrical and Computer Engineering, with Co-Operative Work Placement, Minor in Commerce — GPA: 4.33/4.33
Thesis: Tactile Shear Force Sensor for Pressure Ulcer Prevention and Applications in Robotics. (Advisor: John D. W. Madden)

RESEARCH EXPERIENCE

Princeton University
Doctoral Candidate, Supervised by Nathalie P. de Leon — *Sep. 2018 —Present*

- Developing an integrated III-V on diamond nanophotonic platform for use in quantum communication network experiments based on defects in diamond.
- Developed a robust computation protocol for designing nanophotonic devices for hybrid integration onto diamond using eigenmode (MPB) and FDTD (Meep, Lumerical) simulations, resulting in a journal publication *(Opt. Exp. 29, 9174-9189)*.
- Initiated a collaboration with researchers at the University of Washington to fabricate gallium phosphide photonic crystal cavities for integration with negatively charged silicon vacancy centres (SiV-) in diamond. We successfully demonstrated coupling of SiV- to our cavities with a 3-fold lifetime reduction on-resonance and co-operativity C=2. Our work is currently in preparation for submission.
- Currently fabricating GaAs and AlGaAs on diamond nanophotonics for purcell-enhanced coupling to neutral silicon vacancy centres (SiV) in diamond and subsequent quantum frequency conversion of the emission to the telecom band. Our fabricated nanophotonic cavities have yielded quality factors approaching 1e4, and we have achieved coupling of bulk SiV to our devices. Further work is being done to increase device quality factors and to further quantify the degree of coupling and enhancement.

University of British Columbia
Undergraduate Research Assistant, Supervised by John D. W. Madden — *Sep. 2017 —Jan. 2018*

- Designed and fabricated a tactile shear and normal force sensor using a soft-electronics approach based on conductive ionic gel mixtures and flexible electrodes.

University of Pennsylvania
Undergraduate Research Assistant, Supervised by Jorge Santiago-Avilles — *May 2017 —Aug. 2017*

- Fabricated and characterized piezoelectric nanofibers for use in a novel non-invasive ear surgery procedure in collaboration with Professor Daqing Li at the University of Pennsylvania School of Medicine and Health Systems.

TECHNICAL SKILLS

Nanofabrication: Photo and electron beam lithography, ICP-RIE etching, wafer bonding, transfer-printing, soft materials processing
Metrology: Atomic force microscopy, scanning electron beam microscopy, x-ray photoelectron spectroscopy, optical techniques
Spectroscopy: Design and assembly of free-space and fiber-based optical setups for measurement of single and bulk quantum emitters
Programming Languages: Python, Matlab, C, VHDL, Verilog

JOURNAL PUBLICATIONS

S. Chakravarthi, A. Abulnaga, N. S. Yama, D. Huang, C. Pederson, K. Hestroffer, F. Hatami, N. P. de Leon, K. C. Fu. **"Hybrid integration of GaP photonic crystal cavities with silicon-vacancy centers in diamond by stamp-transfer"** *in preparation* (2022)

D. Huang*, A. Abulnaga*, S. Welinski, M. Raha, J. D. Thompson, N. P. de Leon. **"Hybrid III-V diamond photonic platform for quantum nodes based on neutral silicon vacancy centers in diamond"** *Opt. Express 29, 9174-9189 (2021)*

CONFERENCE PRESENTATIONS

S. Chakravarthi, A. Abulnaga, N. S. Yama, D. Huang, C. Pederson, K. Hestroffer, F. Hatami, N. P. de Leon, K. C. Fu. **"Hybrid integration of GaP photonic crystal cavities with silicon-vacancy centers in diamond by stamp-transfer"** *Co-Design Center for Quantum Advantage All Hands Meeting*; 2022 Oct 5-6; New Haven, CT (Poster Presentation)

S. Mukherjee, A. Abulnaga, Z. Zhang, A. Pakpour-Tabrizi, N. P. de Leon. **"Engineering Quantum Defects in Diamond for Quantum Networks"** *Co-Design Center for Quantum Advantage All Hands Meeting*; 2022 Oct 5-6; New Haven, CT (Poster Presentation)

A. Abulnaga, S. Karg, A. Pakpour-Tabrizi, D. Huang, Z. Zhang, N. P. de Leon. **"Nanophotonics for telecom quantum networks based on defects in diamond"** *2nd International Conference on Materials for Humanity*; 2022 Sep 19-21; Singapore (Poster Presentation)

A. Abulnaga, D. Huang, Z. Zhang, S. Welinski, N. P. de Leon. **"Hybrid III-V on diamond nanophotonic platform for quantum nodes based on SiV centres in diamond"** *Co-Design Center for Quantum Advantage All Hands Meeting*; 2021 Nov 10; Virtual (Poster Presentation)

A. Abulnaga, D. Huang, Z. Zhang, S. Welinski, B. C. Rose, P. Stevenson, N. P. de Leon. **"Heterogenous III-V on diamond nanophotonic platform for telecom quantum nodes based on neutral silicon vacancy centers in diamond"** *WE-Heraeus-Seminar on Optically Addressable Spin Qubits for Quantum Networks and Quantum Computing*; 2021 Aug 03-07; Bad Honnef, Germany (Poster Presentation)

A. Abulnaga, D. Huang, Z. Zhang, S. Welinski, B. C. Rose, P. Stevenson, N. P. de Leon. **"Hybrid III-V diamond photonic platform for quantum nodes based on neutral silicon vacancy centers in diamond"** *American Physical Society March Meeting*; 2021 Mar 15-19; Virtual (Poster Presentation)

A. Abulnaga, D. Huang, Z. Zhang, S. Welinski, B. C. Rose, P. Stevenson, N. P. de Leon. **"Nanophotonics for telecom quantum networks based on neutral silicon vacancy centers in diamond."** *Tenth International School and Conference on Spintronics and Quantum Information Technology*; 2019 Jun 24-27; Chicago, IL (Poster Presentation)

INDUSTRY EXPERIENCE

Arista Networks, Santa Clara, CA, USA
Hardware Engineering Intern *Jan. 2017 —May 2017*

- Designed the I/O connectivity of a commercial ethernet switch board for use in a large-scale datacenter.
- Produced schematics detailing the connections between the I/O ports and the ASIC, SCD, and main CPLD.
- Implemented shift register functionality onto three CPLDs using Verilog to minimize the number of SCD ports used in communicating with the I/O ports.
- Designed three compensation circuits to resolve power rail instability issues observed on a board during testing. The circuits were adopted as the standard for all future boards.

John Deere – Hitachi Specialty Products, Aldergrove, BC, Canada
Manufacturing Engineering Co-op *May 2016 —Dec. 2016*

- Designed a diesel flushing system to clean fuel lines in machines, resolving ongoing failure during initial machine startup.
- Designed the control circuits to power two pumps, programmed the pump motor drivers, and used NX to design a custom cart to fit the system into a compact and mobile tool.

TEACHING AND MENTORING EXPERIENCE

Assistant in Instruction: Selected Topics in Solid-State Electronics Sep. 2021 —Feb. 2022

- Graduate level course investigating advanced spectroscopy techniques in solid state systems such as coherent and time-resolved optical techniques, mesoscopic spin dynamics and sensing, photo-electron spectroscopy, and transport measurements
- Responsibilities included writing problems and solutions, hosting office hours, and grading

Assistant in Instruction: Electronic and Photonic Devices Sep. 2019 —Feb. 2020

- Led an undergraduate lab section where students fabricated semiconductor devices including MOSFETs and solar cells in an instructional nanofabrication facility
- Responsibilities included guiding students through various silicon fabrication processes including wafer doping, oxide growth, lithography, and wet etching
- Other responsibilities included writing problems and solutions, hosting office hours, and grading

Undergraduate Mentor 2019

- Mentored an undergraduate student working on inverse-designed nanophotonic structures

AWARDS AND FELLOWSHIPS

Natural Sciences and Engineering Research Council of Canada Postgraduate Scholarship – Doctoral	2020 —Present
Gordon Y.S. Wu Fellowship in Engineering	2018 —Present
UBC Applied Science Rising Stars Award	2018
Association of Professional Engineers and Geoscientists (APEG) Achievement Award in Engineering	2018
Quan Memorial Scholarship	2018
Fluor Canada Ltd. Award in Electrical Engineering	2017
Donald J. Evans Scholarship in Engineering	2017
Trek Excellence Scholarship	2014, 2015, 2017
Charles and Jane Banks Scholarship	2015