Edwin Ng

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Education

Stanford University Sept 2013–Present
PhD Candidate in Applied Physics Stanford, CA
Master of Science in Electrical Engineering

Thesis: *Time- and Frequency-Multiplexed Quantum Optical Networks* (tentative)
Thesis Advisor: Prof. Hideo Mabuchi
Expected Graduation Date: June 2020

Massachusetts Institute of Technology Sept 2009–June 2013
Bachelor of Science in Physics and in Mathematics Cambridge, MA

Thesis: *Experimental Designs for Efficient Free-Space Multi-Spatial-Mode Optical Communication*
Thesis Advisor: Dr. Franco N.C. Wong

Research

Edward L. Ginzton Laboratory Apr 2014–Present
Graduate Research Assistant, Mabuchi Lab

Working under the supervision of Prof. Hideo Mabuchi on using quantum nonlinear optics to explore coherent control as an approach to quantum systems engineering. Experimental projects include:

- construction of a continuous-wave nondegenerate optical parametric amplifier which was coupled to an atom-cavity QED experiment using optical feedback;
- characterization of SOI chip-scale devices using electric-field-induced chi(2) nonlinearity;
- implementation of a time-multiplexed free-space coherent Ising machine with minimal losses to measure time-domain entanglement between pulses; and
- analysis of experimental feasibility for quantum-scale nonlinearities in chip-scale chi(2) devices based on periodically-poled thin-film lithium niobate waveguides.

Also collaborated extensively with lab members (Tatsuhiro Onodera, Ryotatsu Yanagimoto, and Peter McMahon) on theoretical projects, which include:

- development and simulation of a quantum network model for the coherent Ising machine with mutual injections using input-output theory;
- development of semiclassical reduced models for measurement-based coherent Ising machines with entanglement and nonlinearity using manifold projection techniques;
- development and analysis of a proposal for a programmable all-to-all-coupled quantum annealer using Floquet engineering; and
- development of an input-output theory for ultrashort-pulse optical parametric oscillators.

Research Laboratory of Electronics at MIT June 2012–June 2013
UROP, Optical & Quantum Communications Group

Worked under the supervision of Dr. Franco N.C. Wong on the PIECOMM (Photon Information Efficient Communications) project in collaboration with BBN Technologies, as part of the DARPA InPho (Information in a Photon) program. The project aimed to demonstrate scalable designs, protocols, and techniques for efficient optical communication via free-space spatial pulse-position-modulation at the single photon level. Responsibilities included the characterization of leakage and crosstalk in the optical components and involvement in the design and implementation of the transmitter-receiver system.

Teaching

Stanford Department of Physics Jan 2018–Mar 2018
Graduate Teaching Assistant Jan 2016–Mar 2016

Graduate TA for PHYSICS 107: Intermediate Physics Laboratory II. Responsibilities include one-on-one instruction in laboratory technique, atomic and optical physics in the context of experiment, data analysis, and written/oral presentation of results. Provided extensive feedback on scientific writing and presentation of results. Student evaluations available on request.

MIT Physics Junior Laboratory Feb 2013–Sept 2013
8.13x Course Content Development

Contributed to the design and implementation of new course content for 8.13x, an online supplement to 8.13 utilizing the open-source edX/MITx platform for MOOCs. Extensively rewrote several labguides to improve content, clarity, and suitability for online presentation. Course launched Fall 2013 for MIT 8.13 students.

MIT Physics Junior Laboratory Sept 2012–June 2013
Undergraduate Lab and Teaching Assistant

Undergraduate TA for 8.13: Experimental Physics I. Responsibilities include one-on-one instruction in laboratory technique, troubleshooting paradigms, fundamental physics in the context of experiment, data analysis, and written/oral presentation of results.

Publications

* denotes equal contribution

1. Ryotatsu Yanagimoto, Edwin Ng, Tatsuhiro Onodera, and Hideo Mabuchi, "Adiabatic Fock state generation scheme using Kerr nonlinearity", *Physical Review A* **100**, 033822 (2019).
2. Ryan Hamerly, Takahiro Inagaki, Peter L. McMahon, Davide Venturelli, Alireza Marandi, Tatsuhiro Onodera, Edwin Ng, and 16 others, "Experimental investigation of performance differences between coherent Ising machines and a quantum annealer", *Science Advances* **5**, eaau0823 (2019).
3. Scott R. Johnston, Edwin Ng, Scott W. Fong, Walter Y. Mok, Jeongwon Park, Peter Zalden, Anne Sakdinawat, and 3 others, "Scanning microwave imaging of optically patterned $Ge_2Sb_2Te_5$", *Applied Physics Letters* **114**, 093106 (2019).
4. Ryotatsu Yanagimoto, Peter L. McMahon, Edwin Ng, Tatsuhiro Onodera, and Hideo Mabuchi, "Embedding entanglement generation within a measurement-feedback coherent Ising machine", Preprint at arXiv:1906.04902 [quant-ph].

5. Tatsuhiro Onodera*, Edwin Ng*, and Peter L. McMahon, "A quantum annealer with fully programmable all-to-all coupling via Floquet engineering", Preprint at arXiv:1907.05483 [quant-ph].
6. Tatsuhiro Onodera*, Edwin Ng*, Niels Lörch, Atsushi Yamamura, Ryan Hamerly, Peter L. McMahon, Alireza Marandi, and Hideo Mabuchi, "Nonlinear quantum behavior of ultrashort-pulse optical parametric oscillators", Preprint at arXiv:1811.10583 [quant-ph].

Conferences and Presentations

1. Edwin Ng, Tatsuhiro Onodera, Ryotatsu Yanagimoto, and Hideo Mabuchi, "Coherent frequency transfer of optical nonlinearities by feedback control of a non-degenerate optical parametric oscillator", in APS March Meeting 2019, Boston, USA, March 2019.
2. Edwin Ng, Tatsuhiro Onodera, Peter McMahon, Alireza Marandi, and Hideo Mabuchi, "Coherent quantum effects in networks of degenerate optical parametric oscillators", in APS March Meeting 2018, Los Angeles, USA, March 2018.
3. Edwin Ng, Tatsuhiro Onodera, and Hideo Mabuchi, "Nonlinear coherent feedback control of a non-degenerate optical parametric oscillator", in Quantum Information and Measurement 2017 (paper QF5C.2), Paris, France, April 2017.

Patents

1. Peter L. McMahon, Edwin Ng, and Tatsuhiro Onodera, "Fully programmable all-to-all coupling in quantum annealers and quantum simulators using Floquet engineering", U.S. Provisional Patent 62/814750 (filed 2019).

Other Activities and Experience

- Completed training course at Stanford Varian Machine Shop (2015)
- Programming proficiencies: Julia, Python, MATLAB, Mathematica, Java, Scheme, NI LabVIEW