

Christian M. Lange

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 Research group website

 Google Scholar

 PhD Defense

Profile-Summary

- Experimental physicist specializing in quantum optics and nanophotonics, with a strong track record of rapidly building end-to-end systems. Led a research subgroup from an empty optical table to a *Nature Physics* publication in 2.5 years. Deep expertise in nanofabrication, tabletop optics, programming and automation, quantum theory, and materials synthesis.

Education

- 2026 – Present ➤ **Postdoctoral Researcher**, Purdue University, Quantum Photonic Integrated Design Center (QuPIDc),
Advisor: Dr. Libai Huang
- 2021 – 2025 ➤ **Ph.D. in Physics**, Purdue University
Thesis: *Quantum Light–Matter Interactions with Organic Molecules*
Advisor: Dr. Jonathan D. Hood
- 2017 – 2021 ➤ **B.S. in Physics**, Utah State University
Minors: Mathematics, Computer Science
Summa Cum Laude GPA: 3.99 / 4.00
Thesis: *The reflection of light from periodic conducting interfaces* (2021)
Advisor: Dr. Tsung-Cheng Shen

Publications

- Lange, C. M., E. Daggett, V. Walther, L. Huang, and J. D. Hood, “Superradiant and subradiant states in lifetime-limited organic molecules through laser-induced tuning”, *Nature Physics*, vol. 20, pp. 836–842, 2024.  DOI: 10.1038/s41567-024-02404-4.
- E. Daggett, Lange, C. M., et al., “Many-body entanglement in solid-state emitters”, *Nature Reviews Materials*, 2026.  DOI: 10.1038/s41578-026-00893-8.
- Lange, C. M. et al., “Cavity qed with molecular defects coupled to a photonic crystal cavity”, Under review; submitted to *ACS Nano*.  DOI: doi.org/10.48550/arXiv.2506.01917.
- Lange, C. M. and T.-C. Shen, “Fabrication of height-modulated carbon nanotube forests: Morphologies and prospects for broadband absorption”, *Carbon Trends*, vol. 4, p. 100 070, 2021.  DOI: 10.1016/j.cartre.2021.100070.
- A. D. Keni, Lange, C. M., et al., “Vapor phase assembly of molecular emitter crystals for photonic integrated circuits”, Under review; submitted to *ACS Photonics*.
- E. Daggett, Lange, C. M., et al., “Coherence in individual perovskite quantum dots”, Manuscript in preparation.

Patents

- Lange, C. M. and J. D. Hood, *Photon emission with organic molecules and nanophotonics*, U.S. Provisional Patent Application, Purdue Research Foundation (PRF Ref: 2025-HOOD-71146-01), 2025.

Selected Projects

Nanofabrication

- **Si₃N₄ nanobeam cavities and grating couplers** — Designed/fabricated various cavity geometries with optical $Q \sim 10,000$ and mode volume $\sim (2.5 \lambda/n)^3$ and grating couplers with 20% coupling efficiency.

Optics

- **Confocal microscopes** — Built several scanning confocal microscopes in different configurations (galvos vs. motorized stages and free-space vs. optical fiber spatial filtering).
- **Time-domain quantum emitter measurements** — Photon correlation Fourier spectroscopy, Hanbury Brown-Twiss measurement, and fluorescence lifetime of individual quantum emitters.
- **Lasers & cavities** — Aligned several MSquared Ti:sapphire lasers and high-finesse cavities.
- **Extreme cross-polarization extinction** — Developed precision optics for cross-polarization extinction with visibility > 70 dB.

Micromechanics

- **Crystal micromanipulator** — Positioned 30 μm crystals onto nanophotonic devices using a tapered fiber on a 3D micropositioner.
- **Motorized XY stage** — Built precision stage for heavy loads (> 25 lbs) with $< 2 \mu\text{m}$ repeatability.

Programming, electronics, and automation

- **Experiment automation** — Python based GUI and custom drivers for remote/automated experiments: FAST Comtec and Swabian time taggers (Python), M Squared laser (TCP/IP), various optomechanical instruments (NI-DAQ, Python), and custom instruments (ARDUINO, RPi, ESP32).
- **Low-cost photon counter** — ESP32-based solution for low-time resolution photon counting.
- **Remote lab monitoring** — RPi/Arduino sensors + Grafana temperature monitoring.

Theory

- **Collective quantum systems** — QuTiP-based simulator for collective interactions.
- **Electromagnetic scattering** — Analytical and numerical modeling of reflection from periodic metal grids (undergraduate thesis topic).
- **Probability and linear algebra course development** — Assisted in developing courses for probability and statistics and linear algebra based on Jupyter notebooks.

Materials synthesis

- **DBT:anthracene crystal growth** — Built a custom two-stage tube furnace for vapor-phase growth of ultra-high aspect-ratio crystals and implemented a protocol for solution-based growth of DBT-doped anthracene nanocrystals.

Posters and Talks

Oral Presentations

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|-----------|---|
| Jan 2026 | ➤ <i>Cavity QED with individual cryogenic molecules</i> , SPIE Photonics West |
| Apr 2024 | ➤ <i>Superradiant and subradiant states in lifetime-limited organic molecules</i> , Second Annual Birck Symposium.
➤ <i>Workshop: A visual introduction to quantum optics</i> , Quantum Science at Purdue. |
| Sept 2023 | ➤ <i>Seminar: Superradiant and subradiant states in lifetime-limited organic molecules through laser-induced tuning</i> , Purdue AMO-QIS. |
| Oct 2022 | ➤ <i>Organic dye molecules as a platform for coherent light-matter interactions</i> , Quantum Advances Seminar. |

Posters and Talks (continued)

- Apr 2021 ➤ *Electromagnetic scattering from periodic conducting arrays*, USU Student Research Symposium.
- Dec 2020 ➤ *Modeling reflectance spectra of nanorod arrays by arrays of light sources*, USU Student Research Symposium.
- Oct 2020 ➤ *Modeling reflectance spectra of nanorod arrays by arrays of light sources*, APS Four Corners Section.
- Feb 2020 ➤ *How to create very dark surfaces for applications*, Utah Conference on Undergraduate Research.
- Oct 2019 ➤ *Synthesis of carbon nanotube forests on deep-etched patterns for light absorption*, APS Four Corners Section.

Poster Presentations

- Aug 2024 ➤ *Scalable collective systems through laser-induced frequency tuning of organic molecules*, Cooperative Phenomena in Hybrid Quantum Systems Workshop.
- June 2023 ➤ *Coupling organic molecules to nanophotonic cavities to study collective effects*, DAMOP.
- Apr 2023 ➤ *Tailoring the entanglement of quantum emitters through light-induced frequency tuning*, Purdue Quantum Summer School.
- Oct 2021 ➤ *Scattering of light from periodic conducting structures*, APS Four Corners Section (co-author).
- Apr 2019 ➤ *Fabrication of carbon-nanotube based bolometers*, USU Student Research Symposium.

Awards and Achievements

- 2024 ➤ 1st Place Oral Presentation, Second Annual Birck Symposium.
- 2021–2025 ➤ Purdue University Ross Fellowship.
- 2021 ➤ Joyce Kinkead Outstanding Honors Capstone Award.
- 2020 ➤ PEAK Summer Research Fellowship.
 - USU College of Science Scholarship.
 - Lillywhite Scholarship.
 - USU “A” Pin Award.
- 2019 ➤ Outstanding Student Presentation, APS Four Corners Section.
 - URCO Grant (Utah State University).
 - USU College of Science Mini-Grant.
 - Sigma Pi Sigma (Physics Honor Society), Member.
 - O. Harry Otteson Scholarship.
- 2018 ➤ Honorable Mention, USU Concerto Competition.
- 2017–2021 ➤ USU Presidential Scholarship.
- 2017–2019 ➤ USU Department of Music Scholarship.

Teaching, Mentoring, and Service

Teaching Assistant

- Purdue University — MA 41690 Data Science Lab (Probability).
- Purdue University — Linear Algebra Lab (TA + course development), Spring/Fall 2024.
- Utah State University — PHYS 4650 Optics I, Fall 2020.
- Utah State University — PHYS 2110 Introductory Physics.

Teaching, Mentoring, and Service (continued)

Mentoring

- Summer 2025 ➤ Undergraduate Research Experience.
Worked with a student to build: cosublimation chamber; inexpensive photon counter.
- Summer 2024 ➤ Sloan PReMMiSS Program — Research mentor.
- Fall 2019 ➤ Native American STEM Mentorship Program — Mentor (solid-state physics & micro-fabrication).
- 2014 ➤ ESL Tutor (Spring/Fall 2014).

Other Service

- Jan 2026 ➤ Session Chair, “Sources II,” SPIE Photonics West.