SEOU CHOI

Phone: +1 (617) 201-1420 Email: seouc130@mit.edu

CURRENT POSITION

Ph.D. candidate — MIT, Department of Electrical Engineering and Computer Science

EDUCATION

- **MIT, Department of Electrical Engineering and Computer Science** 2022 - Present
  - Ph.D. (Expected 2028) | M.S. (2024)
  - M.S. Thesis: Photonic Probabilistic Machine Learning Using Quantum Vacuum Noise (Advisor: Prof. Marin Soljačić)
  - Total GPA: 5.0/5.0 | Minor: Artificial Intelligence (Courses: Deep Learning, Tissues vs. Silicon in ML)
- **SNU (Seoul National University), Department of Electrical and Computer Engineering** 2022
  - B.S. (2022), Graduated Summa Cum Laude (1^{st} of 147)
  - B.S. Thesis: Chirality-Selective All-Dielectric Metasurface Structural Color Display

RESEARCH INTEREST

Optical computing, Quantum optics, Nanophotonics

PUBLICATION SUMMARY

- **12+ journal articles** (11 peer-reviewed, 1 preprint) in high-impact journals including *Science*, *Nature Springer journals* (e.g., Communications, LSA), *APS*, *OPTICA*, and *ACS* journals.
- **24+ peer-reviewed conference talks and proceedings, 3+ invited talks**, and **2+ patents** (1 provisional).

FELLOWSHIPS, AWARDS AND HONORS

- 73^{rd} Lindau Nobel Laureate Meeting, Young Scientists Nominee 2024
- Ph.D. Study-Abroad Scholarship, Korea Foundation for Advanced Studies (Full tuition + stipend) 2022 - today
- Outstanding Graduate Award, Department of Electrical and Computer Engineering, SNU 2022
- Presidential Science Scholarship, Korea Student Aid Foundation (Full tuition + stipend) 2016 – 2021
- 46^{th} International Physics Olympiad (IPhO), Mumbai, India (Silver medal) 2015
- 21^{st} Humantech Paper Award, Samsung Electronics (Bronze award) 2015
- Hansung Son Jae han Scholarship 2014 – 2015

RESEARCH HIGHLIGHTS

- **Optics Computing**
  Demonstrated fundamental building blocks of optical copmuters, including all-optical memory and probabilistic bits, and developed optical computing hardware capable of implementing probabilistic machine learning algorithms.
- **Quantum Optics**
  Investigated quantum-to-classical transitions in an optical parametric oscillator (OPO) and demonstrated its applicability to intracavity quantum tomography and femtosecond pulse characterization.
- **Nanophotonics**
  Introduced nanophotonic scintillators as next-generation X-ray detector modules, achieving improved image resolution and reduced X-ray radiation dose by engineering their angular emission spectra.

PUBLICATION

Recent updates can be found in my Google Scholar. {†, *} denote {corresponding, equally contributing} authors.

11. J. Chen†, S. Vaidya, S. Pajovic, **S. Choi**, W. Michaels, L. Martin-Monier, J. Hu, C. Cogswell, C. Roques-Carmes, and M. Soljačić, *Wavefront Engineering for Scintillation-Based Imaging, ACS Photonics (2026)*, (Link to article)

10. S. Pajovic†, C. Roques-Carmes, **S. Choi**, S. E. Kooi, R. Gupta, M. E. Zalis, I. Čelanović, and M. Soljačić, *Nanophotonic thermal management in X-ray tubes*, **ACS Nano** 19, 35 (2025), (Link to article)

9. **S. Choi***,†, Y. Salamin*,†, C. Roques-Carmes, J. Sloan, M. Horodynski, and M. Soljačić, *Observing the dynamics of quantum states generated inside nonlinear optical cavities*, **Nature Communications** 16, 7576 (2025), (Link to article)

8. L. Martin-Monier*,†, S. Pajovic*,†, M. G. Abebe*,†, J. Chen, S. Vaidya, S. Min, **S. Choi**, S. E. Kooi, B. Maes, J. Hu, M. Soljačić, and C. Roques-Carmes†, *Large-scale self-assembled nanophotonic scintillators for X-ray imaging*, **Nature Communications**, 16, 5750 (2025), (Link to article)

7. A. Gu†, J. Sloan, C. Roques-Carmes, **S. Choi**, E. I. Rosenthal, M. Horodynski, Y. Salamin, J. Vučković, and M. Soljačić, *Quantum sensitivity of parametric oscillators*, **Phys. Rev. Research**, 7, L022056 (2025), (Link to article)

6. S. Min, **S. Choi**, S. Pajovic, S. Vaidya, N. Rivera, S. Fan, M. Soljačić, and C. Roques-Carmes†, *End-to-end design of multicolor scintillators for enhanced energy resolution in X-ray imaging*, **Light: Science & Applications** 14, 158 (2025), (Link to article)

5. M. Horodynski†, C. Roques-Carmes, Y. Salamin, **S. Choi**, J. Sloan, D. Luo, and M. Soljačić, *Stochastic logic in biased coupled photonic probabilistic bits*, **Communication Physics** 8, 1 (2025), (Link to article)

4. **S. Choi**†, Y. Salamin, C. Roques-Carmes†, R. Dangovski, D. Luo, Z. Chen, M. Horodynski, J. Sloan, S. Z. Uddin, and M. Soljačić, *Photonic probabilistic machine learning using quantum vacuum noise*, **Nature Communications** 15, 7760 (2024), (Link to article)

3. C. Roques-Carmes*,†, Y. Salamin*,†, J. Sloan, **S. Choi**, G. Velez, E. Koskas, N. Rivera, S. E. Kooi, J. D. Joannopoulos, and M. Soljačić, *Biasing the quantum vacuum to control macroscopic probability distributions*, **Science** 381, 6654 (2023), (Link to article)

2. **S. Choi***, J. Kim*, J. Kwak, N. Park, and S. Yu†, *Topologically-protected all-optical memory*, **Advanced Electronic Materials** 2200579 (2022) [**Cover Paper**], (Link to article)

1. **S. Choi**, H. Son, and B. Lee†, *Chirality-selective all-dielectric metasurface structural color display*, **Optics Express** 29, 25 (2021) [**Editors' Pick**], (Link to article)

PREPRINT

Recent updates can be found in my Google Scholar. {†, *} denote {corresponding, equally contributing} authors.

1. S. Z. Uddin*,†, S. Pontula*,†, J. Liu, S. Xu, **S. Choi**, M. Y Sander, and M. Soljačić, *Probing intensity noise in ultrafast pulses using the dispersive Fourier transform augmented by quantum sensitivity analysis*, arXiv:2503.12646 (2025), (Linke to preprint)

CONFERENCE

Recent updates can be found in my Google Scholar. {†, *} denote {corresponding, equally contributing} authors.

24. R. Simovitch†, **S. Choi**, and Y. Salamin†, *All-Optical Spiking Neurons Realized via Biased Optical Parametric Oscillator*, **CLEO 2026**, May 2026

23. R. Simovitch†, **S. Choi**, and Y. Salamin†, *Biased Vacuum-Driven Probabilistic State Switching In a Near-Threshold Degenerate OPO*, **CLEO 2026**, May 2026

22. R. Simovitch†, J. O. Herrera, **S. Choi**, M. Rizk, L. Therrien, and Y. Salamin†, *Non-Destructive Intracavity Quantum-State Tomography With a Correlated-Mode non-Degenerate OPO*, **CLEO 2026**, May 2026

21. J. Chen†, S. Pajovic, S. Vaidya, W. Michaels, **S. Choi**, L. Martin-Monier, C. Spagele, C. Cogswell, C. Roques-Carmes, J. Hu, and M. Soljačić, *Micron-Scale X-Ray Resolution in Metalens-Integrated Thick Scintillators*, **CLEO 2026**, May 2026

20. **S. Choi†**, S. Vaidya, C. Roques-Carmes, and M. Soljačić, *Supercollimating Photonic Crystal Scintillators*, **CLEO 2026**, May 2026

19. **S. Choi†**, S. Vaidya, J. Chen, S. Pajovic, C. Roques-Carmes, and M. Soljacic, *Simultaneous Enhancement of X-ray Absorption and Light Emission in Nanophotonic Scintillators*, **CLEO 2026**, May 2026

18. S. Vaidya[†], **S. Choi**, C. Roques-Carmes, and M. Soljačić, *Supercollimating photonic crystal scintillators*, **SPIE**, January 19th 2026, — **invited talk**, (Link to article)

17. L. Martin-Monier[*,†], S. Pajovic[*], M. G. Abebe[*], J. Chen, S. Vaidya, S. Min, **S. Choi**, S. E. Kooi, B. Maes, J. Hu, M. Soljačić, and C. Roques-Carmes., *Large-area nanophotonic scintillators for X-ray imaging*, **2025 Nineteenth International Congress on Artificial Materials for Novel Wave Phenomena**, September 1st 2025, (Link to article)

16. S. Pontula[†], C. Roques-Carmes, J. Sloan, **S. Choi**, M. Soljačić, and Y. Salamin., *Modeling arbitrary continuous probability distributions in lasers through probabilistic biasing*, **CLEO 2025**, May 8th 2025, (Link to article)

15. Y. Huang[*,†], **S. Choi**[*,†], Y. Salamin, J. Sloan, C. Roques-Carmes, M. Horodynski, and M. Soljačić., *Vacuum-induced switching between macroscopic states*, **CLEO 2025**, May 7th 2025, (Link to article)

14. J. Chen[†], S. Pajovic, S. Vaidya, W. Michaels, S. Pontula, **S. Choi**, L. Martin-Monier, J. Hu, C. Cogswell, C. Roques-Carmes, and M. Soljačić., *Phase mask metasurfaces for high-resolution X-ray imaging*, **CLEO 2025**, May 5th 2025, (Link to article)

13. S. Z. Uddin[*,†], S. Pontula[*,†], J. Liu, S. Xu, **S. Choi**, M. Y. Sander, and M. Soljačić., *Probing power-dependent intensity noise in ultrafast pulses by dispersive Fourier transform*, **CLEO 2025**, May 8th 2025, (Link to article)

12. S. Pajovic[†], C. Roques-Carmes, **S. Choi**, S. E. Kooi, R. Gupta, M. E. Zalis, I. Celanovic, and M. Soljačić., *Nanophotonic Thermal Management for High-Brightness X-Ray Sources*, **CLEO 2025**, May 6th 2025, (Link to article)

11. **S. Choi**[*,†], Y. Salamin[*,†], C. Roques-Carmes, J. Sloan, M. Horodynski, and M. Soljačić., *Measuring the dynamics of quantum states generated inside optical nonlinear cavities*, **CLEO 2025**, May 9th 2025, (Link to article)

10. C. Roques-Carmes[†], Y. Salamin, **S. Choi**, M. Horodynski, J. Sloan, D. Luo, and M. Soljačić., *Stochastic computing with biased optical parametric oscillators*, AI and Optical Data Sciences VI. Vol. 13375. **SPIE**, 2025, (Link to article)

9. Y. Salamin[†], C. Roques-Carmes, **S. Choi**, J. Sloan, M. Horodynski, D. Luo, and M. Soljačić., *Quantum tomography and intracavity dynamics with a biased optical parametric oscillator*, AI and Optical Data Sciences VI. Vol. 13375. **SPIE**, 2025, (Link to article)

8. **S. Choi**[†], Y. Salamin, C. Roques-Carmes, R. Dangovski, D. Luo, Z. Chen, M. Horodynski, J. Sloan, S. Z. Uddin, and M. Soljačić., *Photonic probabilistic computing leveraging quantum vacuum noise*, **CLEO 2024**, May 12th 2024, **upgraded to highlighted talk [top 1-2% of abstracts]**, (Link to article)

7. S. Min[†], C. Roques-Carmes, **S. Choi**, S. Pajovic, S. Vaidya, and M. Soljačić., *Multilayer Scintillators for Enhanced Energy Resolution in X-Ray Imaging*, **CLEO 2024**, May 12th 2024, (Link to article)

6. A. Gu[†], J. Sloan, C. Roques-Carmes, **S. Choi**, M. Horodynski, Y. Salamin, and M. Soljačić., *Controlling steady-state statistics of a bistable driven-dissipative system with quantum bias*, **CLEO 2024**, May 12th 2024, (Link to article)

5. M. Horodynski[†], C. Roques-Carmes, Y. Salamin, **S. Choi**, J. Sloan, D. Luo, and M. Soljačić., *Stochastic logic in biased coupled photonic probabilistic bits*, **CLEO 2024**, May 10th 2024, **upgraded to highlighted talk [top 1-2% of abstracts]**, (Link to article)

4. Y. Salamin[*,†], **S. Choi**[*,†], C. Roques-Carmes, J. Sloan, M. Horodynski, and M. Soljačić., *Intracavity quantum dynamics and tomography in a biased optical parametric oscillator*, **CLEO 2024**, May 8th 2024, (Link to article)

3. C. Roques-Carmes[*,†], Y. Salamin[*,†], J. Sloan, G. Velez, E. Koskas, **S. Choi**, N. Rivera, S. E. Kooi, J. D. Joannopoulos, and M. Soljačić., *Tunable probabilities from the quantum vacuum*, **CLEO 2023**, May 7th 2023, (Link to article)

2. C. Roques-Carmes[*,†], Y. Salamin[*,†], J. Sloan, G. Velez, E. Koskas, **S. Choi**, N. Rivera, S. E. Kooi, J. D. Joannopoulos, and M. Soljačić., *Tuning the probability distribution of a quantum bistable optical system*, **APS March Meeting 2023**, March 9th 2023, (Link to article)

1. **S. Choi**[†], N. Park, and S. Yu., *Coexistence of oscillation quenching states in nonlinear parity-time-symmetric systems*, **OSA Nonlinear Optics Topical Meeting 2021**, Virtual, August 12th 2021, (Link to article)

INVITED TALKS AND SEMINARS

3. Probabilistic computing and intracavity quantum tomography using quantum vacuum noise, MIT, hosted by Dr. Shi-Yuan Ma, **March 2025, Invited Seminar**

2. Probabilistic computing and intracavity quantum tomography using quantum vacuum noise, Stanford, hosted by Dr. Charles Roques-Carmes, **December 2024, Invited Seminar**

1. Photonic computing and quantum tomography using quantum vacuum noise, SNU, hosted by Dr. Sunkyu Yu, **July 2024, Invited Seminar**

PATENT

2. **S. Choi**, S. Vaidya, C. Roques-Carmes, and M. Soljačić, *Supercollimating Photonic Crystal Scintillators*, Massachusetts Institute of Technology, January 2026 — U.S. Provisional Application 63/960,449

1. S. Yu, N. Park, **S. Choi**, J. Kwak, J. Kim, *Topologically-Protected All-Optical Memory*, KR 10-2624621 (January 2024)

REFEREE ACTIVITY

7+ referee activities: Optics Express, Optics Letters, Photonics Research

SKILLS

- Programming Languages: MATLAB, Python, Julia, C++, Verilog, VHDL
- Machine Learning Frameworks: MATLAB, TensorFlow, PyTorch
- Photonic Simulation Software: Lumerical, Geant4, Meep, MPB

MENTORSHIP AND TEACHING

- MIT Undergraduate Research Opportunities Program 2023-today
- SNU Active Mentoring, Tutoring program for high school students 2020
- Two Times of Undergraduate Teaching Assistant, Application of Quantum Mechanics 2020-2021

MILITARY SERVICE

- KATUSA (Korean Augmentation to the U.S. Army) Sergeant IT Specialist (U.S. MOS 25B), 2017-2019