

Yun Zhao

Postdoctoral Scholar,
E. L. Ginzton Laboratory,
Stanford University,
www.linkedin.com/in/yun-zhao-phd

348 Via Pueblo
Stanford, CA 94305, USA
Phone: 9375462735
yun.zhao@columbia.edu, yunzhao@stanford.edu

Education

- 2016 - 2022 Ph. D. in Electrical Engineering, Columbia University, New York, NY
Advisor: Prof. Alexander Gaeta
Dissertation: Nonlinear photonics for room temperature quantum metrology and information processing
- 2014 - 2016 Master of Science in Electro-Optics, University of Dayton, Dayton, OH
Advisor: Prof. Imad Agha
Thesis: Low noise all optical switch and GeSn laser for silicon photonics
- 2009 - 2013 Bachelor of Engineering in Electronic Science and Technology,
& Bachelor of Science in Mathematics and Applied Mathematics,
Tianjin University, Tianjin, China

Research interests

Quantum simulation, computing, and metrology with squeezed states; Quantum and classical frequency conversion; Kerr frequency comb; Photonics for high-performance computing

Post-Graduate Research Experiences

- 2025 - present **Postdoctoral scholar advised by Amir Safavi-Naeini, E. L. Ginzton Laboratory, Stanford University**
- Developing lithium niobate integrated circuits to interact with atoms.
- 2022 - 2025 **Postdoctoral scholar advised by Alexander Gaeta, Department of Applied Physics and Applied Mathematics, Columbia University**
- Developed chip-based high-gain quantum-noise-limited regenerative parametric amplifier with few-milliwatt pump power.
 - Developed ultra-low-noise high-frequency microwave source using compact optical frequency division
 - Developed near-unit-efficiency chip-based quantum frequency conversion
 - Developed novel theory for laser linewidth squeezing

Graduate Research Experiences

- 2016 - 2022 **Ph.D. student advised by Alexander Gaeta, Department of Electrical Engineering, Columbia University**
- Developed on-chip visible light sources capable of interacting with atoms and ions, including Kerr frequency comb and heralded photon.
 - Improved Rb-filled photonic-bandgap-fiber for nonlinear light-atom interaction at low-power level.
 - Developed integrated devices towards Gaussian Boson sampling and continuous-variable quantum computing. Demonstrated quadrature-squeezed-state

generation. Proposed and analyzed a room-temperature photon-number-resolving detection scheme based on quantum nondemolition measurement.

- Developed general theory of efficient frequency conversion for all cavity-based nonlinear processes
- Developed ultra-low-noise microwave oscillator based on shot-noise-limited optical parametric oscillator and broadband Kerr frequency comb. Proposed the scheme, performed theoretical analysis and initial characterizations.

2014 - 2016 **Master's student advised by Imad Agha, the Electro-Optics Program, University of Dayton**

- Developed devices for photonic interconnection and all-optical signal processing based on four-wave-mixing in silicon.
- Characterized the optical emission properties of GeSn alloy as a candidate for monolithically integrated on-silicon laser source.

Leadership and Services

2022 - 2024 Postdoc community chair at Codesign Center for Quantum Advantage (C2QA), Department of Energy, USA

2014 - 2015 Vice president of OSA (now Optica) student chapter at University of Dayton

Professional Activities and Outreach

2022 - 2024 Organize monthly postdoc and graduate student online workshop at Codesign Center for Quantum Advantage (recordings available online)

2022 Organized poster session and mixer at the all-hands meeting of Codesign Center for Quantum Advantage, New Haven, CT

2019 - present Reviewed papers > 30

2014 - 2015 Co-organized exhibitions at local science fairs, Dayton, OH

Awards

2025 Columbia University nomination for Blavatnik Regional Postdoc Award

2019 Incubic Milton Chang Travel Grant, Optica

2018 Best presentation award, IONS Midwest, Optica

2014 Summer research fellowship, University of Dayton

Patents

“Low frequency wave generation via optical frequency division,” Y. Zhao, J. K. Jang, Y. Okawachi, B. Y. Kim, M. Lipson, and A. L. Gaeta.

Computer Languages

Python, Matlab, Mathematica (Wolfram), C++, Verilog

Scientific Software

COMSOL Multiphysics, Lumerical, Zemax, LTspice, Cadence Virtuoso, Keysight ADS,
AMD Vitis, Vivado, Blender

Languages

Fluent English and Chinese

Publications

- 2024 **Y. Zhao**, J. K. Jang, Garrett J. Beals, K. J. McNulty, X. Ji, Y. Okawachi, M. Lipson, and A. L. Gaeta, All-optical frequency division on-chip using a single laser, *Nature* **627**, 546 (2024).
- **Y. Zhao** and A. L. Gaeta, “Frequency stability of optical parametric oscillators: Classical noise, Schawlow-Townes linewidth, and beyond,” under preparation (2024).
 - S. Sanyal, Y. Okawachi, **Y. Zhao**, B. Y. Kim, K. J. McNulty, M. Lipson, A. L. Gaeta, Nonlinear dynamics of coupled-resonator Kerr-combs, arXiv:2409.17343.
- 2023 **Y. Zhao**, J. K. Jang, X. Ji, Y. Okawachi, M. Lipson, and A. L. Gaeta, Large regenerative parametric amplification on chip at ultra-low pump powers, *Optica* **10**, 819 (2023).
- 2022 Z. Li, **Y. Zhao**, J. D. Gallagher, D. Lonbardo, A. Sarangan, I. Agha, J. Kouvetakis, J. Menéndez, and J. Mathews, Room temperature emission spectroscopy of GeSn waveguides under optical pumping, *AIP Adv.* **12**, 075016 (2022).
- Y. Okawachi, B. Y. Kim, **Y. Zhao**, J. K. Jang, X. Ji, M. Lipson, and A. L. Gaeta, Active tuning of dispersive waves in Kerr soliton combs, *Opt. Lett.* **47**, 2234 (2022).
- 2021 **Y. Zhao**, J. K. Jang, Y. Okawachi, and A. L. Gaeta, Theory of $\chi^{(2)}$ -microresonator-based frequency conversion, *Opt. Lett.* **46**, 5392 (2021).
- Y. Okawachi, B. Y. Kim, **Yun Zhao**, X. Ji, M. Lipson, and A. L. Gaeta, Dynamic control of photon lifetime for quantum random number generation, *Optica* **8**, 1458 (2021).
 - J. K. Jang, Y. Okawachi, **Y. Zhao**, X. Ji, C. Joshi, M. Lipson, and A. L. Gaeta, Conversion efficiency of soliton Kerr combs, *Opt. Lett.* **46**, 3657 (2021).
 - R. R. Domenegueti, **Y. Zhao**, X. Ji, M. Martinelli, M. Lipson, and A. L. Gaeta, Parametric sideband generation in CMOS-compatible oscillators from visible to telecom wavelengths, *Optica* **8**, 316 (2021).
- 2020 **Y. Zhao**, Y. Okawachi, J. K. Jang, X. Ji, M. Lipson, and A. L. Gaeta, Near-degenerate quadrature-squeezed vacuum generation on a silicon-nitride chip, *Phys. Rev. Lett.* **124**, 193601 (2020).
- **Y. Zhao**, X. Ji, B. Y. Kim, P. S. Donvankar, J. K. Jang, C. Joshi, M. Yu, C. Joshi, R. R. Domenegueti, F. A. S. Barbosa, P. Nussenzveig, Y. Okawachi, M. Lipson, and A. L. Gaeta, Visible nonlinear photonics via high-order-mode dispersion engineering, *Optica* **7**, 198 (2020).
 - C. Joshi, A. Farsi, A. Dutt, B. Y. Kim, X. Ji, **Y. Zhao**, A. M. Bishop, M. Lipson, and A. L. Gaeta, Frequency-domain quantum interference with correlated photons from an integrated microresonator, *Phys. Rev. Lett.* **124**, 143601 (2020).

-
- Y. Okawachi, M. Yu, J. K. Jang, X. Ji, **Y. Zhao**, B. Y. Kim, M. Lipson, and A. L. Gaeta, Demonstration of chip-based coupled degenerate optical parametric oscillators for realizing a nanophotonic spin-glass, *Nat. Commun.* **11**, 1 (2020).
- 2019 B. Y. Kim, Y. Okawachi, J. K. Jang, M. Yu, X. Ji, **Y. Zhao**, C. Joshi, M. Lipson, and A. L. Gaeta, Turn-key, high-efficiency Kerr comb source, *Opt. Lett.* **44**, 4475 (2019).
- 2017 **Y. Zhao**, D. Lombardo, J. Mathews, and I. Agha, All-optical switching via four-wave mixing Bragg scattering in a silicon platform, *APL Photonics* **2**, 026102 (2017).
- H. Li, X. Huang, Q. Cao, **Y. Zhao**, P. Li, C. Wan, and A. Chong, Generation of three-dimensional versatile vortex linear light bullets (Invited Paper), *Chin. Opt. Lett.* **15**, 030009 (2017).
- 2016 **Y. Zhao**, D. Lombardo, J. Mathews, and I. Agha, Low control-power wavelength conversion on a silicon chip, *Opt. Lett.* **41**, 3651 (2016).
- 2015 J. Wang, **Y. Zhao**, I. Agha, and A. M. Sarangan, SU-8 nanoimprint fabrication of wire-grid polarizers using deep-UV interference lithography, *Opt. Lett.* **40**, 4396 (2015).

Invited Talks

- 2025 Active Photonic Platforms, SPIE, “All optical frequency division on chip” (Upcoming).
- 2024 The 9th International Forum of Advanced Photonics for Young Scientists, Zhejiang University, China, “Near-unit-efficiency on-chip frequency conversion.”
- Applied physics undergraduate-student seminar, Columbia University, “Photons in quantum information science.”
 - Shanghai Jiao Tong University, China, “Nonlinear photonics in high-Q microresonators.”
 - Shanghai Tech University, China, “Nonlinear photonics in high-Q microresonators.”
 - University of Shanghai for Science and Technology, China, “Nonlinear photonics in high-Q microresonators.”
 - Southeast University, China, “Nonlinear photonics in high-Q microresonators.”
- 2023 Zhejiang University, China, “On-chip all-optical frequency division.”
- Nonlinear Optics Topical Meeting (NLO), Optica (formerly The Optical Society), “High-gain regenerative parametric amplification on-chip.”

Conference Presentations

- 2024 Conference on Lasers and Electro-Optics (CLEO), “Photonic-Chip-Based Ultralow-Noise Microwave Generation.”
- Conference on Lasers and Electro-Optics (CLEO), “Near-Unity-Efficiency Frequency Conversion on a Silicon-Nitride Chip.”
- 2023 Optica Nonlinear Optics Topical Meeting (NLO), “Chip-Based All-Optical Frequency Division.”
- Conference on Lasers and Electro-Optics (CLEO), “Active Tuning of the Microresonator Coupling Condition with Coupled Rings.”

-
- Conference on Lasers and Electro-Optics (CLEO), “High-Gain Parametric Amplification On-Chip at Low Pump Powers.”
 - Conference on Lasers and Electro-Optics (CLEO), “Noise Properties of Microresonator-Based Optical-Parametric Oscillators.”
- 2022 Conference on Lasers and Electro-Optics (CLEO), “Ultra-Large Cross-Phase Modulation for Room-Temperature Photon-Number-Resolving Detection.”
- Conference on Lasers and Electro-Optics (CLEO), “High-Efficiency On-Chip Frequency Conversion in the Telecom Band.”
- 2021 Conference on Lasers and Electro-Optics (CLEO), “Maximizing the Efficiency of $\chi^{(2)}$ Processes in Microresonators.”
- 2020 Optica Quantum 2.0 “Microresonator Based Discrete- and Continuous-Variable Quantum Sources on Silicon-Nitride.”
- Conference on Lasers and Electro-Optics (CLEO), “On-Chip Squeezed-State Generation via Dual-Pumped Four-Wave Mixing.”
- 2019 Frontiers in Optics (FiO) “On-Chip Photon-Pair Generation in the Near-Visible.”
- Conference on Lasers and Electro-Optics (CLEO), “Near-Visible Microresonator-Based Soliton Combs.”
- 2018 Conference on Lasers and Electro-Optics (CLEO), “Effective $\chi^{(2)}$ in a Rb-Filled Hollow-Core Photonic Bandgap Fiber for Coherent Photon Conversion.”
- 2017 Conference on Lasers and Electro-Optics (CLEO), “Rb-Compatible Silicon-Based Correlated Photon Source.”
- Conference on Lasers and Electro-Optics (CLEO), “Telecom-to-Near-Visible Frequency Translation via Bragg Scattering Four-Wave Mixing in a Rb Vapor Cell.”
 - Conference on Lasers and Electro-Optics (CLEO), “Low-power optical logic gate in a silicon waveguide.”
- 2015 Frontiers in Optics (FiO) “Frequency conversion via asymmetrically pumped four-wave-mixing Bragg scattering in silicon waveguides.”
- Frontiers in Optics (FiO) “Moiré Patterns and their Suppression during Digital Recording and Reconstruction of Fresnel Holograms.”
 - 228th Electrochemical Society Meeting “Measurement of Optical Emission from GeSn Waveguides.”