ZIHE GAO

Assistant Professor
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RESEARCH INTERESTS

Quantum illumination projectors, reconfigurable photonic devices, ultrafast dynamics in coupled nonlinear resonators, and their applications in communications, sensing, and computing in both classical and quantum regimes.

EDUCATION

Ph.D. in Electrical and Computer Engineering
University of Illinois Urbana-Champaign, Urbana, IL, USA Jan. 2013 – May 2018

M.S. in Physics
University of Illinois Urbana-Champaign, Urbana, IL, USA Aug. 2011 – Dec. 2012

B.S. in Physics
Nanjing University, Nanjing, China Sep. 2007 – Jun. 2011

POSITIONS

Auburn University, Auburn, AL, USA Aug. 2023 – present
Assistant Professor, Department of Electrical and Computer Engineering

University of Pennsylvania, Philadelphia, PA, USA Feb. 2020 – Jul. 2023
Postdoctoral Researcher
Advisor: Liang Feng

- A topological semimetal realized in photonic lattices with anomalous chiral quantum transport [Nat. Commun. 2023]
- Microlaser arrays with reconfigurable asymmetric injection locking, showing persistent phase locking and programmable intensity profiles [IPC 2022 Post-Deadline], [PRL 2023]
- High-dimensional supersymmetric microlaser arrays with record-breaking array size and two-orders-of-magnitude power density enhancement [Science 2021]

Meta Reality Labs, Redmond, WA, USA Jun. 2018 – Feb. 2020
Postdoctoral Research Scientist

- Research on reconfigurable integrated photonic devices for next-generation 3D sensing {3 patents filed}
- Research on 3D sensing systems {6 patents filed}

University of Illinois Urbana-Champaign, Champaign, IL, USA May 2012 – May 2018
Research Assistant
Advisor: Kent D. Choquette
Dissertation: Non-Hermitian aspects of coherently coupled vertical cavity laser arrays

- Demonstration of parity-time (PT) symmetry breaking and exceptional points (for the first time in coupled diode lasers) [Optica 2017]
- Nonlinear mode control mechanism in weakly coupled diode lasers [JAP 2018], [APL 2019]
- Bottom-emitting two-dimensional coherent VCSEL array, with the largest array size at the time [PTL 2016]

TEACHING EXPERIENCE

University of Illinois Urbana-Champaign, Urbana, IL, USA

ECE 466: Optical Communication Lab *(Teaching Assistant, lab)*	Fall 2015
ECE 495: Photonic Device Laboratory *(Teaching Assistant, lab)*	Spring 2015
ECE 451: Advanced Microwave Measurements (*Teaching Assistant, lab*)	Fall 2014
Physics 214: University Physics – Quantum Physics (*Teaching Assistant, discussion*)	Fall 2013
Physics 212: University Physics – Elec & Mag (*Teaching Assistant, lab*)	Fall 2012, Spring 2014

HONORS AND AWARDS

IEEE Journal of Quantum Electronics Outstanding Reviewer	2019
John Bardeen Memorial Graduate Research Award, UIUC	2017
Best Poster Award, the International Year of Light Workshop, UIUC	2015
List of teachers Ranked as Excellent, Outstanding (top 10%), UIUC	Spring 2015, Fall 2015
List of teachers Ranked as Excellent, UIUC	Fall 2012, Fall 2013, Spring 2014, Fall 2014

SERVICE

Chapter Chair, IEEE Photonics Society Student Chapter at UIUC	2016 – 2017
Treasurer, OSA Student Chapter at UIUC	2016 – 2017
Committee Member, Engineering Graduate Student Advisory Committee, UIUC	2014 – 2015

PUBLICATIONS

Journal Publications

[PRL 2023] **Z. Gao***, X. Qiao*, M. Pan*, S. Wu, J. Yim, K. Chen, B. Midya, L. Ge, L. Feng, "Two-Dimensional Reconfigurable Non-Hermitian Gauged Laser Array," *Phys. Rev. Lett.* 130, 263801 (2023).

[Nat. Commun. 2023] **Z. Gao**, H. Zhao, T. Wu, X. Feng, Z. Zhang, X. Qiao, C.-K. Chiu, L. Feng, "Topological quadratic-node semimetal in a photonic microring lattice," *Nat. Commun.* 14, 1–8 (2023).

[Nat. Photonics 2023] T. Wu, M. Menarini, **Z. Gao**, L. Feng, "Lithography-free reconfigurable integrated photonic processor," *Nat. Photonics*, 1–7 (2023).

[Nano Lett 2023] T. Wu, Y. Li, X. Feng, S. Wu, **Z. Gao**, L. Feng, "Topological Photonic Lattice for Uniform Beam Splitting, Robust Routing, and Sensitive Far-Field Steering," *Nano Lett.* 23, 3866–3871 (2023).

[Nature 2022] Z. Zhang, H. Zhao, S. Wu, T. Wu, X. Qiao, **Z. Gao**, R. Agarwal, S. Longhi, N. M. Litchinitser, L. Ge, L. Feng, "Spin-orbit microlaser emitting in a four-dimensional Hilbert space," *Nature*, (2022).

[eLight 2022] J. Yim, N. Chandra, X. Feng, **Z. Gao**, S. Wu, T. Wu, H. Zhao, N. M. Litchinitser, L. Feng, "Broadband continuous supersymmetric transformation: a new paradigm for transformation optics," *eLight*. 2 (2022).

[Optica 2022] Y. Ma, H. Zhao, N. Liu, **Z. Gao**, S. S. Mohajerani, L. Xiao, J. Hone, L. Feng, S. Strauf, "On-chip spin-orbit locking of quantum emitters in 2D materials for chiral emission," *Optica*. 9, 953 (2022).

[OL 2022] S. Wu, **Z. Gao**, T. Wu, Z. Zhang, L. Feng, "Ultrafast heterodyne mode imaging and refractive index mapping of a femtosecond laser written multimode waveguide," *Opt. Lett.* 47, 214 (2022).

[Science 2021] X. Qiao,* B. Midya,* **Z. Gao**,* Z. Zhang, H. Zhao, T. Wu, J. Yim, R. Agarwal, N. M. Litchinitser, L. Feng, "Higher-dimensional supersymmetric microlaser arrays," *Science*. 372, 403–408 (2021).

[Light Sci. Appl. 2020] Z. Zhang, H. Zhao, D. G. Pires, X. Qiao, **Z. Gao**, J. M. Jornet, S. Longhi, N. M. Litchinitser, L. Feng, "Ultrafast control of fractional orbital angular momentum of microlaser emissions," *Light Sci. Appl*. 9, 179 (2020).

[APL 2020] H. Dave, **Z. Gao**, K. Choquette, "Complex coupling coefficient in laterally coupled microcavity laser diode arrays," *Appl. Phys. Lett.* 117, 041106 (2020).

[JSTQE 2019-1] H. Dave, **Z. Gao**, S. T. M. Fryslie, B. J. Thompson, K. D. Choquette, "Static and Dynamic properties of coherently-coupled photonic-crystal vertical-cavity surface-emitting laser arrays," *IEEE J. Sel. Top. Quantum Electron.* 25, 1–8 (2019).

[JSTQE 2019-2] B. J. Thompson, **Z. Gao**, S. T. M. Fryslie, K. D. Choquette, "Mode engineering in linear coherently coupled vertical-cavity surface-emitting laser arrays," *IEEE J. Sel. Top. Quantum Electron.* 25, 1–5 (2019).

[APL 2019] **Z. Gao**, B. J. Thompson, H. Dave, S. T. M. Fryslie, K. D. Choquette, "Non-Hermiticity and exceptional points in coherently coupled vertical cavity laser diode arrays," *Appl. Phys. Lett.* 114, 061103 (2019).

[PTL 2019] H. Dave, P. Liao, S. T. M. Fryslie, **Z. Gao**, B. J. Thompson, A. E. Willner, K. D. Choquette, "Digital modulation of coherently-coupled 2×1 vertical-cavity surface-emitting laser arrays," *IEEE Photonics Technol. Lett.* 31, 173–176 (2019).

[JAP 2018] **Z. Gao**, M. T. Johnson, K. D. Choquette, "Rate equation analysis and non-Hermiticity in coupled semiconductor laser arrays," *J. Appl. Phys.* 123, 173102 (2018). (Editor's Pick).

[JOSA B 2018] **Z. Gao**, D. Siriani, K. D. Choquette, "Coupling coefficient in antiguided coupling: magnitude and sign control," *J. Opt. Soc. Am. B*, 35, 417–422 (2018).

[JSTQE 2017] S. T. M. Fryslie, **Z. Gao**, H. Dave, B. J. Thompson, K. Lakomy, S. Lin, P. J. Decker, D. K. McElfresh, J. E. Schutt-Ainé, K. D. Choquette, "Modulation of coherently coupled phased photonic crystal vertical cavity laser arrays," *IEEE J. Sel. Top. Quantum Electron.* 23, 1–9 (2017).

[PJ 2017] B. J. Thompson, **Z. Gao**, S. T. M. Fryslie, M. T. Johnson, D. F. Siriani, K. D. Choquette, "Coherence in multielement-phased vertical-cavity surface-emitting laser arrays using resonance tuning," *IEEE Photonics J*. 9, 1–8 (2017).

[Optica 2017] **Z. Gao**, S. T. M. Fryslie, B. J. Thompson, P. Scott Carney, K. D. Choquette, "Parity-time symmetry in coherently coupled vertical cavity laser arrays," *Optica*, 4, 323–329 (2017).

[PTL 2016] **Z. Gao**, B. J. Thompson, G. Ragunathan, M. T. Johnson, B. Rout, K. D. Choquette, "Bottom-emitting coherently coupled vertical cavity laser arrays," *IEEE Photonics Technol. Lett.* 28, 513–515 (2016).

Selected Conference Presentations

[IPC 2022 Post-Deadline] **Z. Gao**,* X. Qiao,* M. Pan,* S. Wu, B. Midya, L. Ge, L. Feng, "On-chip reconfigurable phase locking by asymmetric coupling in two-dimensional laser arrays," IEEE Photonic Conference, Vancouver, Canada (Nov. 2022).

PATENTS

[P1] M. Hall, X. Liu, Z. Zhu, R. L. Chhabria, H. Tang, S. Su, and **Z. Gao**, "Dynamic structured light for depth sensing systems," USPTO patent 20190355138:A1 (2019).

[P2] **Z. Gao**, M. Hall, Q. Chao, Z. Zhu, and T. Komljenovic, "Switchable fringe pattern illuminator," USPTO patent 11070789 (2021).

[P3] F. Li, **Z. Gao,** M. Hall, Z. Zhu, S. Su, H. Tang, X. Liu, and N. D. Trail, "Dynamic illumination control for depth determination," USPTO patent 11195291 (2021).

[P4] M. Hall, X. Liu, Z. Zhu, R. L. Chhabria, H. Tang, S. Su, and **Z. Gao**, "Selective propagation of depth measurements using stereoimaging," USPTO patent 10929997 (2021).

[P5] F. Li and **Z. Gao**, "High frame rate reconstruction with N-tap camera sensor," US Patent (2021).

[P6] **Z. Gao**, Z. Zhu, M. Hall, and G. Wei, "Photonic integrated circuits with integrated optical conditioning elements," USPTO patent 11435528 (2022).

[P7] N. Grossinger, M. Hall, R. Hasbun, J. Ginzburg, and **Z. Gao**, "VCSEL arrays for generation of linear structured light features," USPTO patent 20220013991:A1 (2022).

[P8] M. Hall, X. Liu, Z. Zhu, R. L. Chhabria, H. Tang, S. Su, and **Z. Gao**, "Dynamic structured light for depth sensing systems based on contrast in a local area," USPTO patent 20220036571:A1 (2022).

[P9] F. Li, **Z. Gao**, and M. Hall, "Three-dimensional imaging with spatial and temporal coding for depth camera assembly," USPTO patent 11348262 (2022).