Alexander Cerjan, PhD

Theoretical Physics, Photonics

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EDUCATION

PhD, Physics, Yale University, New Haven, CT 2015
BS, Physics, Philosophy, Brown University, Providence, RI 2009

RESEARCH FUNDING (total research funding: $1.3M)

PI, "Novel transport states in phonon-polariton systems," Laboratory Directed Research and Development (LDRD), Sandia National Laboratories (SNL), $284k 2022

PI, "Enhancing photonic systems using topology and non-Hermiticity," LDRD, SNL, $1,050k 2021-2023

PROFESSIONAL EXPERIENCE

Senior Member of the Technical Staff 2021-Present
Sandia National Laboratories, Albuquerque, NM
Affiliated with the Center for Integrated Nanotechnologies (CINT)

Research Assistant Professor (via Letter of Academic Title) 2021-Present
Department of Mathematics and Statistics
University of New Mexico, Albuquerque, NM

Postdoctoral Scholar 2017-2021
Pennsylvania State University, University Park, PA
Advisor: Mikael C. Rechtsman

Postdoctoral Scholar 2015-2017
Stanford University, Stanford, CA
Advisor: Shanhui Fan

HONORS & AWARDS

Best Talk Award, U.S./Middle East Conference on Photonics, New York City 2019
Prize Teaching Fellowship Award, Yale University 2014
Prize Teaching Fellowship Award, Yale University 2012
Karen T. Romer Undergraduate Teaching and Research Award, Brown Univ. 2008
Eagle Scout Award 2004

EDITORIAL WORK

Journals Reviewed

APS Journals: *Physical Review Letters*, *Physical Review A*, *Physical Review B*, *Physical Review Research*, *Physical Review Applied*, *Physical Review Materials*
Nature Journals: *Nature*, *Nature Physics*, *Nature Photonics*, *Nature Communications*, *Light: Science & Applications*, *Scientific Reports*
AAAS Journals: *Science*

OSA Journals: *Optica*, *Optics Letters*, *Optics Express*, *Applied Optics*
AIP Journals: *Applied Physics Letters*

TEACHING & MENTORING

Undergraduates Mentored

- Kanchita Klangboonkrong, Pennsylvania State University, 2019
- Lauren Bittner, Pennsylvania State University, 2018
- Jingjing Pan, Pennsylvania State University, 2017-2018
- Jason Frost, Stanford University, 2016
- Kevin Lai, Yale University, 2012-2013

Teaching Fellow

"Ordinary and Partial Differential Equations with Applications" (100-level, Applied Physics), Yale University	2015
"Thermodynamics and Statistical Mechanics" (400-level, Physics), Yale University	2011-2014
"Electromagnetic Fields and Optics" (400-level, Physics), Yale University	2014
"Solid State Physics II" (500-level, Physics), Yale University	2013
"General Physics Laboratory" (100-level, Physics), Yale University	2009,2010,2012
"Electromagnetic Theory I" (500-level, Physics), Yale University	2011
"Classical Mechanics (Intensive)" (400-level, Physics), Yale University	2010

PROFESSIONAL ACTIVITIES & AFFILIATIONS

Society Affiliations

Member, American Physical Society	2011-Present
Member, Optical Society of America	2015-Present

CO-AUTHORS & COLLABORATORS

- Mikael C. Rechtsman, Penn State Univ.
- Wladimir A. Benalcazar, Princeton Univ.
- Chia Wei Hsu, Univ. Southern California
- Georg von Freymann, TU Kaiserslautern
- Terry A. Loring, Univ. New Mexico
- Igal Brener, Sandia National Labs
- Thomas Beechem, Purdue Univ.

TECHNICAL EXPERTISE

MEEP Contributor

Validated the saturable multi-level atomic susceptibility and gyrotropic media features in the open-source photonics simulation software package MEEP. (see arXiv: 2007.09329)

Computer Languages

- Python
- Matlab
- C++
- Perl
- Scheme
- Mathematica
- Bash

PUBLICATIONS (total publications: 31, h-index: 16, total citations ~1400, Google Scholar Link, ORCID 0000-0002-4362-7300)

- 11 articles in high-impact journals (6 as first author)
- 20 as first/last author

Peer-Reviewed Journal Articles

[31] S. Vaidya, W. A. Benalcazar, A. Cerjan, and M. C. Rechtsman, "Point-defect-localized bound states in the continuum in photonic crystals and structured fibers," *Physical Review Letters* **127**, 023605 (2021).

[30] S. Vaidya, J. Noh, A. Cerjan, C. Jörg, G. von Freymann, and M. C. Rechtsman, "Observation of a charge-2 photonic Weyl point in the infrared," *Physical Review Letters* **125**, 253902 (2020).
- ❖ APS Editors' Suggestion

[29] A. Cerjan, M. Jürgensen, W. A. Benalcazar, S. Mukherjee, and M. C. Rechtsman, "Observation of a higher-order topological bound state in the continuum," *Physical Review Letters* **125**, 213901 (2020).
- ❖ APS Editors' Suggestion

[28] A. Cerjan, M. Wang, S. Huang, K. P. Chen, and M. C. Rechtsman, "Thouless pumping in disordered photonic systems," *Light: Science & Applications* **9**, 178 (2020).

[27] M. Benzaouia, A. Cerjan, and S. G. Johnson, "Is single-mode lasing possible in an infinite periodic system?" *Applied Physics Letters* **117**, 051102 (2020).
- ❖ Editor's Pick

[26] W. A. Benalcazar and A. Cerjan, "Bound states in the continuum of higher-order topological insulators," *Physical Review B* **101**, 161116(R) (2020).

[25] A. Cerjan, S. Bittner, M. Constantin, M. Guy, Y. Zeng, Q. J. Wang, H. Cao, and A. D. Stone, "Multimode lasing in wave-chaotic semiconductor microlasers," *Physical Review A* **100**, 063814 (2019).

[24] A. Cerjan, C. W. Hsu, and M. C. Rechtsman, "Bound states in the continuum through environmental design," *Physical Review Letters* **123**, 023902 (2019).

[23] A. Cerjan, S. Huang, M. Wang, K. P. Chen, Y. D. Chong, and M. C. Rechtsman, "Experimental realization of a Weyl exceptional ring," *Nature Photonics* **13**, 623 (2019).
- ❖ >130 citations (Google Scholar)
- ❖ "Highly Cited Paper," in the top 1% of all papers in physics in 2021 (Web of Science)

[22] A. Pick, A. Cerjan, and S. G. Johnson, "Ab initio theory of quantum fluctuations and relaxation oscillations in multimode lasers," *Journal of the Optical Society of America B* **36**, C22 (2019).

[21] A. Cerjan, M. Xiao, L. Yuan, and S. Fan, "Effects of non-Hermitian perturbations on Weyl Hamiltonians with arbitrary topological charges," *Physical Review B* **97**, 075128 (2018).

[20] A. Cerjan and S. Fan, "Complete photonic bandgaps in supercell photonic crystals," *Physical Review A* **96**, 051802(R) (2017).

[19] A. Cerjan and S. Fan, "Achieving arbitrary control over pairs of polarization states using complex birefringent metamaterials," *Physical Review Letters* **118**, 253902 (2017).

[18] Y. Shi, A. Cerjan, S. Fan, "Acousto-optic finite-difference frequency-domain algorithm for first-principles simulations of on-chip acousto-optic devices," *APL Photonics* **2**, 020801 (2017).
[17] A. Cerjan and S. Fan, "Effects of non-uniform distributions of gain and loss in photonic crystals," *New Journal of Physics* **18**, 125007 (2016).
[16] A. Cerjan, B. Redding, L. Ge, S. F. Liew, H. Cao, A. D. Stone, "Controlling mode competition by tailoring the spatial pump distribution in a laser: a resonance-based approach," *Optics Express* **24**, 26006 (2016).
[15] A. Cerjan and S. Fan, "Eigenvalue dynamics in the presence of non-uniform gain and loss," *Physical Review A* **94**, 033857 (2016).
[14] Y. Shen, G. Fang, A. Cerjan, Z. Chi, S. Fan, and C. Jin, "Slanted gold mushroom array: a switchable bi/tridirectional surface plasmon polariton splitter," *Nanoscale* **8**, 15505 (2016).
[13] A. Cerjan, A. Raman, and S. Fan, "Exceptional contours and band structure design in parity-time symmetric photonic crystals," *Physical Review Letters* **116**, 203902 (2016).
[12] L. Ge, D. Liu, A. Cerjan, S. Rotter, H. Cao, S. G. Johnson, H. E. Türeci, and A. D. Stone, "Interaction-induced mode switching in steady-state microlasers," *Optics Express* **24**, 41 (2016).
[11] A. Cerjan and A. D. Stone, "Why the laser linewidth is so narrow: A modern perspective," *Physica Scripta* **91**, 013003 (2016).
[10] A. Cerjan, A. Pick, Y. D. Chong, S. G. Johnson, and A. D. Stone, "Quantitative test of general theories of the intrinsic laser linewidth," *Optics Express* **23**, 28316 (2015).
[9] A. Pick, A. Cerjan, D. Liu, A. W. Rodriguez, A. D. Stone, Y. D. Chong, and S. G. Johnson, "Ab-initio multimode linewidth theory for arbitrary inhomogeneous laser cavities," *Physical Review A* **91**, 063806 (2015).
❖ APS Editors' Suggestion
[8] A. Cerjan, Y. D. Chong, and A. D. Stone, "Steady-state *ab initio* laser theory for complex gain media," *Optics Express* **23**, 6455 (2015).
[7] B. Redding, A. Cerjan, X. Huang, M. L. Lee, A. D. Stone, M. A. Choma, and H. Cao, "Low-spatial coherence electrically-pumped semiconductor laser for speckle-free full-field imaging," *Proceedings of the National Academy of Sciences USA* **112**, 1304 (2015).
❖ Featured in Optics and Photonics News
❖ Selected for a Microscopy Today Innovation Award
[6] S. Esterhazy, D. Liu, M. Liertzer, A. Cerjan, L. Ge, K. G. Makris, A. D. Stone, J. M. Melenk, S. G. Johnson, and S. Rotter, "Scalable numerical approach for the steady state *ab initio* laser theory," *Physical Review A* **90**, 023816 (2014).
[5] A. Cerjan, and A. D. Stone, "Steady-state *ab initio* theory of lasers with injected signals," *Physical Review A* **90**, 013840 (2014).
[4] M. Liertzer, L. Ge, A. Cerjan, A. D. Stone, H. E. Türeci, and S. Rotter, "Pump-induced exceptional points in lasers," *Physical Review Letters* **108**, 173901 (2012).
[3] A. Cerjan, Y. D. Chong, L. Ge, and A. D. Stone, "Steady-state ab-initio laser theory for N-level lasers," *Optics Express* **20**, 474 (2012).
[2] A. Cerjan and C. Cerjan, "Orbital angular momentum of Laguerre-Gaussian beams beyond the paraxial approximation," *Journal of the Optical Society of America A* **28**, 2253 (2011).
[1] A. Cerjan and C. Cerjan, "Analytic solution of flat-top Gaussian and Laguerre-Gaussian laser field components," *Optics Letters* **35**, 3465 (2010).

Perspectives

[1] A. Cerjan, "A whole surface of exceptional points," *Physics* **12**, 138 (2019).

Technical Notes

[1] A. Cerjan, A. Oskooi, S.-L. Chua, S. G. Johnson "Modeling lasers and saturable absorbers via multilevel atomic media in the Meep FDTD software: Theory and implementation," arXiv: 2007.09329.

Conference Proceedings

[1] B. H. Hokr, A. Cerjan, J. V. Thompson, L. Yuan, S. F. Liew, J. N. Bixler, G. D. Noojin, R. J. Thomas, H. Cao, A. D. Stone, B. A. Rockwell, M. O. Scully, and V. V. Yakovlev, "Evidence of Anderson localization effects in random Raman lasing," *Proceedings of SPIE* **9731**, 973110 (2016).

Work-in-Progress (manuscripts available upon request)

[4] W. A. Benalcazar and A. Cerjan, "Chiral-symmetric higher-order topological phases protected by multipole winding number invariants," arXiv:2109.06892. (in preparation)

[3] J. Murray, A. Cerjan, and B. Redding, "Distributed Brillouin fiber laser sensor," (in submission)

[2] C. Jörg,* S. Vaidya,* J. Noh, A. Cerjan, S. Augustine, G. von Freymann, and M. C. Rechtsman, "Observation of quadratic (charge-2) Weyl point splitting in near-infrared photonic crystals," arXiv:2106.12119. (in submission)

[1] A. Cerjan,* C. Jörg,* S. Vaidya, S. Augustine, W. A. Benalcazar, C. W. Hsu, G. von Freymann, and M. C. Rechtsman, "Observation of bound states in the continuum embedded in symmetry bandgaps," arXiv:2104.09603. (in revision)

PROFESSIONAL PRESENTATIONS (25 total presentations)

Invited

[9] A. Cerjan, "Using symmetry and topology to confine and control light," University of New Mexico, Albuquerque, NM. September 2nd, 2021.

[8] A. Cerjan, "Topological photonic systems: from structure to function," Sandia National Laboratories, Albuquerque, NM. September 1st, 2020.

[7] A. Cerjan, "Topological photonic systems: from structure to function," Rice University, Houston, TX. February 18th, 2020.

[6] A. Cerjan, "Advances in non-Hermitian and topological photonics," Institute for Basic Science: Center for Theoretical Physics of Complex Systems, Daejeon, South Korea, October 22nd, 2019.

[5] A. Cerjan, "Weyl points and Weyl exceptional rings in helical waveguide arrays," International Institute of Physics: Weyl Fermions in Condensed Matter, Natal, Brazil. August 7th, 2019.

[4] A. Cerjan, "Exceptional contours formed in non-Hermitian topological photonic systems," Banff International Research Station Workshop on Photonic Topological Insulators, Banff, Canada. September 14th, 2017.

[3] A. Cerjan, “Photonic systems with patterned gain and loss,” Northrop Grumman Next Workshop on the Physics of Light Matter Interactions and Excited State Dynamics, Redondo Beach, CA. October 27th, 2016.
[2] A. Cerjan, “Exceptional contours and eigenvalue dynamics in systems with non-uniform gain and loss,” Yale University: Applied Physics Seminar, New Haven, CT. August 24th, 2016.
[1] A. Cerjan, “Quantitative test of general theories of the intrinsic laser linewidth,” Texas A&M Physics of Quantum Electronics Follow-on Workshop, College Station, TX. January 12th, 2015.

Invited Guest Lectures

[2] A. Cerjan, “Introduction to the steady-state ab initio laser theory,” Yale University, New Haven, CT. April 21st, 2015.
[1] A. Cerjan, “Exploring the nature of genius in science and mathematics,” Yale University, New Haven, CT. February 3rd, 2015.

Contributed

[15] A. Cerjan, C. Jörg, S. Vaidya, S. Augustine, W. A. Benalcazar, C. W. Hsu, G. von Freymann, and M. C. Rechtsman, “Using symmetry bandgaps to create bound states in the continuum in photonic crystals,” CLEO, Virtual. May 13th, 2021.
[14] A. Cerjan, M. Jürgensen, W. A. Benalcazar, S. Mukherjee, and M. C. Rechtsman, “Observation of a higher-order topological bound states in the continuum,” APS March Meeting, Virtual. March 17th, 2021.
[13] A. Cerjan, M. Jürgensen, W. A. Benalcazar, S. Mukherjee, and M. C. Rechtsman, “Bound states in the continuum of higher-order topological photonic systems,” CLEO, Virtual. May 11th, 2020.
[12] A. Cerjan, M. Wang, S. Huang, K. P. Chen, and M. C. Rechtsman, “Thouless pumping in disordered photonic systems,” CLEO, Virtual. May 11th, 2020.
[11] A. Cerjan, S. Huang, M. Wang, K. P. Chen, Y. D. Chong, and M. C. Rechtsman, “Experimental realization of a Weyl exceptional ring,” U.S./Middle East Conference on Photonics, New York City, NY. Nov 4th, 2019.
[10] A. Cerjan, C. W. Hsu, and M. C. Rechtsman, “Bound states in the continuum through environment engineering,” CLEO, San Jose, CA. May 7th, 2019.
[9] A. Cerjan and S. Fan, “Complete photonic bandgaps in supercell photonic crystals,” CLEO, San Jose, CA. May 17th, 2018.
[8] A. Cerjan, S. Huang, K. P. Chen, Y. D. Chong, and M. C. Rechtsman, “Weyl exceptional ring in a helical waveguide array,” CLEO, San Jose, CA. May 14th, 2018.
[7] A. Cerjan, M. Xiao, L. Yuan, and S. Fan, “Effects of non-Hermitian perturbations on Weyl Hamiltonians with arbitrary topological charges,” CLEO, San Jose, CA. May 14th, 2018.
[6] A. Cerjan and S. Fan, “Eigenvalue dynamics in the presence of non-uniform gain and loss,” CLEO, San Jose, CA. May 15th, 2017.
[5] A. Cerjan, A. Raman, and S. Fan, “Exceptional contours and band structure design in parity-time symmetric photonic crystals,” Frontiers in Optics, Washington, DC. October 21st, 2016.
[4] A. Cerjan, A. Pick, Y. D. Chong, S. G. Johnson, and A. D. Stone, “Quantitative test of general theories of the intrinsic laser linewidth,” CLEO, San Jose, CA. May 13th, 2015.

[3] A. Cerjan, B. Redding, H. Cao, and A. D. Stone, "Device design using the steady-state *ab initio* laser theory," CLEO, San Jose, CA. May 13th, 2015.
[2] A. Cerjan, and A. D. Stone, "Ab initio theory of injection locking of lasers," CLEO, San Jose, CA. June 10th, 2013.
[1] A. Cerjan, Y. D. Chong, L. Ge, and A. D. Stone, "Steady-state ab initio laser theory: generalizations," APS March Meeting, Boston, MA. March 2nd, 2012.