Wladimir Alejandro Benalcázar

CONTACT INFORMATION

Department of Physics
Emory University
N220, Math & Science Center
Atlanta, GA 30307 USA

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E-mail: benalcazar@emory.edu
Website: Emory Univ. profile

EDUCATION

University of Illinois at Urbana-Champaign, IL USA

- Ph.D. Physics — 2018
  Thesis: " Electric multipole moments and higher-order topological phases in crystalline insulators and superconductors"
  Advisor: Prof. Taylor L. Hughes
- M.S. Physics — 2014
- M.S. Electrical Engineering — 2010

Universidad San Francisco de Quito, Ecuador

- B.S. Physics — 2007
  Summa cum Laude
- B.S. Electrical Engineering — 2007
  Summa cum Laude

ACADEMIC POSITIONS

Assistant Professor — 2022-present
Department of Physics, Emory University, GA USA

Moore Postdoctoral Fellow — 2021-2022
Department of Physics, Princeton University, NJ USA

Eberly Postdoctoral Fellow — 2018-2021
Department of Physics, Pennsylvania State University, PA USA

PUBLICATIONS

Citations $>$ 8000, h-index = 26 (Google Scholar)
Publications in physics per journal: Science (2), Nature (1), Nature Materials (1), Nature Photonics (1), Science Advances (1), Nature Communications (2), PRL (8), PRX (1), PRR (2), PRB (12).

40. "Higher-order topological knots and the classification of non-Hermitian lattices under C_n symmetry"
    Wang Y, **Benalcazar W**
    Phys. Rev. B 111, 205123, 2025

39. "Nonlinear breathers with crystalline symmetries"
    Schindler F, Bulchandani V, **Benalcazar W**
    Phys. Rev. B 111 (6), 064312, 2025

38. "Higher-order skin effect and its observation in an acoustic Kagome lattice"
    Zhong J, Fittipaldi P, Lu T, Kim J, Oudich M, Ji J, Shi L, Chen K, Lu J, Jing Y, **Benalcazar W**
    Phys. Rev. B 111 (1), 014314, 2025

37. "Monoatomic orbital-based one-dimensional topological crystalline insulator"
    Liu G, Workman V, Noh J, Ma Y, Hughes T, **Benalcazar W**, Bahl G
    Phys. Rev. B 110 (5), 056602, 2024

36. "Prevalence of two-dimensional photonic topology"
Ghorashi A, Vaidya S, Rechtsman M, **Benalcazar W**, Soljačić M, Christensen T
Phys. Rev. Lett. 133 (5), 056602, 2024

35. "Polarization and weak topology in Chern insulators"
Vaidya S, Rechtsman M, **Benalcazar W**
Phys. Rev. Lett. 132 (11), 116602, 2024

34. "Realization of a $\mathbb{Z}$-classified chiral-symmetric higher-order topological insulator in a coupling-inverted acoustic crystal"
Wang D, Deng Y, Oudich M, **Benalcazar W**, Ma G, Jing Y
Phys. Rev. Lett. 131 (15), 157201, 2023
Selected as Editors' Suggestion

33. "Topological phases of photonic crystals under crystalline symmetries"
Vaidya S, Ghorashi A, Christensen T, Rechtsman M, **Benalcazar W**
Phys. Rev. B 108, 085116, 2023

32. "Photonic quadrupole topological insulator using orbital-induced synthetic flux"
Schulz J, Noh J, **Benalcazar W**, Bahl G, von Freymann G
Nat. Comm. 13, 6597, 2022

31. "Higher-order topological pumping and its observation in photonic lattices"
Benalcazar W, Noh J, Wang M, Huang S, Chen K, Rechtsman M
Phys. Rev. B 105, 195129, 2022

30. "Observation of degenerate zero-energy topological states at disclinations in an acoustic lattice"
Deng Y, **Benalcazar W**, Chen Z, Oudich M, Ma G, Jing Y
Phys. Rev. Lett. 128 (17), 174301, 2022
Selected as Editors' Suggestion and Featured in Physics

29. "Chiral-Symmetric Higher-Order Topological Phases of Matter"
Benalcazar W, Cerjan A
Phys. Rev. Lett. 128 (12), 127601, 2022

28. "Observation of bound states in the continuum embedded in symmetry bandgaps"
Cerjan A, Jörg C, Vaidya S, Augustine S, **Benalcazar W**, Wei Hsu C, Von Freymann G, Rechtsman M
Science Advances 7 (52), 2021

27. "Topological phases of the dimerized Hofstadter butterfly"
Zuo Z, **Benalcazar W**, Liu CX
Journal of Physics D: Applied Physics 54 (41), 414004, 2021

26. "Point-Defect-Localized Bound States in the Continuum in Photonic Crystals and Structured Fibers"
Vaidya S, **Benalcazar W**, Cerjan A, Rechtsman M
Phys. Rev. Lett. 127 (2), 023605, 2021

25. "Photonic analog of bilayer graphene"
Oudich M, Su G, Deng Y, **Benalcazar W**, Huang R, Gerard N, Lu M, Zhan P, Jing Y
Phys. Rev. B 103,214311, 2021

24. "Boundary-obstructed topological phases"
Khalaf E, **Benalcazar W**, Hughes T, Queiroz R
Phys. Rev. Research, 3, 013239, 2021

23. "Boundary-obstructed topological high-T_c superconductivity in iron pnictides"
Wu X, **Benalcazar W**, Li Y, Thomale R, Liu CX, Hu J
Phys. Rev. X 10, 041014, 2020

22. "Observation of a higher-order topological bound state in the continuum"
Cerjan A, Jurgensen M, **Benalcazar W**, Mukherjee S, Rechtsman M
Phys. Rev. Lett. 125, 213901, 2020
Selected as Editors' Suggestion

21. "A fractional corner anomaly reveals higher-order topology"
Peterson C, Li T, **Benalcazar W**, Hughes T, Bahl G
Science 368 (6495), 1114-1118, 2020

20. "Bound states in the continuum of higher-order topological insulators"
Benalcazar W, Cerjan A
Phys. Rev. B 101, 161116, 2020

19. "Fractional disclination charge in two-dimensional symmetric topological crystalline insulators"
Li T, Zhu, P, **Benalcazar W**, Hughes T
Phys. Rev. B 101 (11), 115115, 2020

18. "Robust temporal pumping in a magneto-mechanical topological insulator"
Grinberg I, Lin M, Harris C, **Benalcazar W**, Peterson C, Hughes T, Bahl G
Nature Communications 11(1), 1-9, 2019

17. "Trapped state at a dislocation in a weak magnetomechanical topological insulator"
Grinberg I, Lin M, **Benalcazar W** , Hughes T, Bahl G
Phys. Rev. Applied 14, 064042, 2020
Selected as Editors' Suggestion

16. "Robust zero-energy modes in an electronic higher-order topological insulator"
Kempkes S, Slot M, van Den Broeke J, Capiod P, **Benalcazar W**, Vanmaekelbergh D, Bercioux D, Swart I, Morais Smith C
Nature Materials 18, 1292-1297, 2019

15. "Fractional corner charges in spin-orbit coupled crystals"
Schindler F, Brzezińska M, **Benalcazar W**, Iraola M, Bouhon A, Tsirkin S, Vergniory M, Neupert T
Phys. Rev. Research 1 (3), 033074, 2019

14. "Strong nonreciprocity in modulated resonator chains through synthetic electric and magnetic fields"
Peterson C, **Benalcazar W**, Lin M, Hughes T, Bahl G
Phys. Rev. Lett. 123, 063901, 2019

13. "Quantization of fractional corner charge in C_n-symmetric topological crystalline insulators"
Benalcazar W, Li T, Hughes T
Phys. Rev. B 99 (24), 245151, 2019
Selected as Editors' Suggestion

12. "Topological protection of photonic mid-gap cavity modes"
Jiho N*, **Benalcazar W***, Sheng H*, Collins M, Chen K, Hughes T, Rechtsman M
Nature Photonics 12, 408-415, 2018. *equally contributing authors

11. "A quantized microwave quadrupole insulator with topologically protected corner states"
Peterson C, **Benalcazar W**, Hughes T, Bahl G
Nature 555, 346-350, 2018

10. "Electric multipole moments, topological multipole moment pumping, and chiral hinge states in crystalline insulators"
Benalcazar W, Bernevig B, Hughes T
Phys. Rev. B 96, 245115, 2017.
Selected as Editors' Suggestion and featured in Physics
Also selected as a Phys. Rev. B 50th Anniversary Milestone Paper

9. "Quantized electric multipole insulators"
Benalcazar W, Bernevig B, Hughes T
Science 357 (6346), 61-66, 2017

8. "Classification of two-dimensional topological crystalline superconductors and Majorana bound states at disclinations"
Benalcazar W, Teo J, Hughes T
Phys. Rev. B 89 (22), 224503, 2014

7. "Multimodal Nonlinear Microscopy by Shaping a Fiber Supercontinuum From 900 to 1160 nm"
Liu Y, Tu H, **Benalcazar W**, Chaney E, Boppart S
J. Select. Topics Quant. Elect 18 (3), 1209-1214, 2012

6. "Aberration characterization for the optimal design of high-resolution endoscopic optical coherence tomography catheters"
Benalcazar W, Jung W, Boppart S
Opt. Lett. 37 (6), 1100-1102, 2012

5. "Nonlinear interferometric vibrational imaging for fast label-free visualization of molecular domains in skin"
Benalcazar W, Boppart S
Anal. Bioanal. Chem. 400 (9), 2817-2825, 2011

4. "Molecular histopathology by spectrally reconstructed nonlinear interferometric vibrational imaging"
Chowdary P, Jiang Z, Chaney E, **Benalcazar W**, Marks D, Gruebele M, Boppart S
Cancer Research 70 (23), 9562-9569, 2010

3. "High-speed nonlinear interferometric vibrational imaging of biological tissue with comparison to Raman microscopy"
Benalcazar W, Chowdary P, Jiang Z, Marks D, Chaney E, Gruebele M, Boppart S
J. Select. Topics Quant. Elect. 16 (4), 824-832, 2010

2. "High speed nonlinear interferometric vibrational analysis of lipids by spectral decomposition"
Chowdary P, **Benalcazar W**, Jiang Z, Marks D, Boppart S, Gruebele M
Anal. Chem. 82 (9), 3812-3818, 2010

1. "Numerical analysis of GRIN lens-based OCT imaging probes"
Jung W, **Benalcazar W**, Sharma U, Ahmad A, Tu H, Boppart S
J. Biomed. Optics, 15 (6), 066027, 2010

WORK IN PREPARATION

2. Invited review article from Physics Reports on "Higher-order topological phases"

1. "Solitons with Self-induced Topological Nonreciprocity"
   Fittipaldi P, **Benalcazar W**
   under review at PRL
   arXiv preprint, arXiv:2405.14919, 2024

BOOK CHAPTERS

2. Nonlinear interferometric vibrational imaging and spectroscopy
   Tu H, Jiang Z, Chowdary P, **Benalcazar W**, Chaney E, Marks D, Gruebele M, Boppart S
   Handbook of Biophotonics, 2nd Edition, Vo Dinh T, Ed., CRC Press, 2012

1. Optical coherence imaging for real-time surgical pathology
   Benalcazar W, Boppart S
   Handbook of Biophotonics: Pathology, Surgical Pathology (Optical Biopsy Analysis), Popp J, Ed., Wiley-VCH, 2010

FELLOWSHIPS

Moore Postdoctoral Fellowship 2021
Princeton University

Eberly Postdoctoral Fellowship 2018
Pennsylvania State University

Beckman Institute Graduate Fellowship 2010
University of Illinois at Urbana-Champaign

HONORS & AWARDS

50th Anniversary Milestone Paper 2020
Physical Review B, American Physical Society
My paper on multipole moments and higher-order TIs got selected
as a milestone paper for having made "lasting contributions to condensed matter physics"

USFQ Alumni Award 2018
Universidad San Francisco de Quito
For an outstanding scientific achievement, senior category

John Bardeen Award 2018
University of Illinois at Urbana-Champaign
For outstanding work by a graduate student in condensed matter physics

INVITED PRESENTATIONS

27. Special Condensed Matter Physics Seminar — 2025
Massachusetts Institute of Technology
Boston, Massachusetts, USA

26. Physics Theory Colloquium — 2024
RPTU Kaiserslautern-Landau
Kaiserslautern, Germany

25. Workshop: Mathematical aspects of topological insulators — 2024
Univ. of Miami and Institute of the Mathematical Sciences of the Americas
Miami, Florida, USA

24. Workshop: Topological and Holographic Quantum Matter — 2024
Pontificia Universidad Católica de Chile
Santiago, Chile

23. Conference: META — 2023
Paris, France

22. Seminar: Technical University of Denmak — 2023
Lyngby, Denmark

21. Workshop: A Universe in a Crystal: — 2023
Symmetry and topology across the correlation spectrum
Kavli Institute for Theoretical Physics
Santa Barbara, California, USA

20. Condensed Matter Physics Seminar — 2022
Georgia Institute of Technology
Atlanta, Georgia, USA

19. Seminar, Department of Physics — 2022
Universidad San Francisco de Quito
Quito, Ecuador

18. Special CPM Seminar, Department of Physics — 2022
McGill University
Montreal, Quebec, Canada

17. Applied Math Seminar — 2021
University of New Mexico
Albuquerque, New Mexico, USA

16. Seminar, Department of Physics — 2021
Emory University
Altanta, Georgia, USA

15. Condensed Matter Seminar, Department of Physics — 2021
Texas A&M,
College Station, Texas, USA

14. Colloquium, Department of Physics — 2021
Texas A&M,
College Station, Texas, USA

13. Princeton Quantum Initiative Seminar — 2021
Princeton University
Princeton, New Jersey, USA

12. Condensed Matter Seminar — 2020
    École Normale Superiéure
    Paris, France

11. Condensed Matter Seminar, Department of Physics — 2020
    Stony Brook University
    New York, USA

10. Coloquium, Department of Physics — 2020
    Escuela Politecnica Nacional
    Quito, Ecuador

9. Colloquium, Department of Physics — 2020
    Pennsylvania State University
    University Park, Pennsylvania, USA

8. Workshop: Recent developments on Multipole Moments in Quantum Systems — 2020
    University of Tokyo
    Online Workshop

7. Workshop: Frontiers in Higher-Order Topological Matter — 2020
    Nordic Institute for Theoretical Physics
    Stockholm, Sweden (postponed due to Covid)

6. Workshop: Condensed matter analogies in mechanics, optics, and cold atoms — 2019
    Tel Aviv University
    Tel Aviv, Israel

5. Condensed matter, atomic, and molecular physics Seminar — 2018
    Pennsylvania State University
    University Park, Pennsylvania, USA

4. Workshop: Topological Matter Beyond the Ten-Fold Way — 2018
    Nordic Institute for Theoretical Physics
    Stockholm, Sweden

3. Seminar, Institute for Condensed Matter Theory — 2018
    University of Illinois at Urbana-Champaign
    Urbana, Illinois, USA

2. Workshop on Topological Dynamics: Quantum and Classical — 2017
    New Jersey Institute of Technology
    Jersey City, New Jersey, USA

1. Workshop on Photonic Topological Insulators — 2017
    Banff International Research Station
    Banff, Alberta, Canada

CONTRIBUTED PRESENTATIONS

12. March meeting 2022 - American Physical Society — 2022
    Chicago, USA

11. March meeting 2021 - American Physical Society — 2021
    Online meeting, USA

10. March meeting 2019 - American Physical Society — 2019
    Boston, Massachusetts, USA

9. March meeting 2018 - American Physical Society — 2018
   Los Angeles, California, USA
8. March meeting 2017 - American Physical Society — 2017
   New Orleans, Louisiana, USA
7. Summer school at the Institute for Condensed Matter Theory — 2016
   Urbana, Illinois, USA
6. March meeting 2016 - American Physical Society — 2016
   Baltimore, Maryland, USA
5. March meeting 2014 - American Physical Society — 2014
   Denver, Colorado, USA
4. Beckman Institute Graduate Seminar — 2011
   Urbana, Illinois, USA
3. SPIE Photonics West — 2011
   San Francisco, California, USA
2. Beckman Institute Graduate Seminar — 2009
   Urbana, Illinois, USA
1. SPIE Photonics West — 2009
   San Jose, California, USA

Media Highlights, Editorials and Commentary on my Research

9. Ezawa, M. *Protected corners* — 2019
   Nature Materials (link)
8. Özdemir, Ş. K. and El-Ganainy, R. *Topological lattices lit at the corners* — 2019
   Nature Photonics (link)
7. Editorial, *Topology reaches higher spheres* — 2018
   Nature Physics (link)
6. Fruchart, M. and Vitelli, V. *Waves cornered* — 2018
   Nature News & Views (link)
5. Sholtis, S. *Capturing light in a waveguide array* — 2018
   Penn State University News (See release at Phys.org)
4. Parameswaran, S. A. and Wan, Y. *Topological Insulators Turn a Corner* — 2017
   Physics Magazine. (link)
3. Yoksoulian, *Researchers demonstrate existence of new form of electronic matter* — 2018
   University of Illionis at Urbana-Champaign News (See release at Phys.org)
2. *New class of insulating crystals hosts quantized electric multipole moments* — 2017
   University of Illinois at Urbana-Champaign News (See release at Phys.org)
1. New imaging technique accurately finds cancer cells, fast — 2010
   College of Engineering, Univ. of Illinois at Urbana-Champaign

SUMMER SCHOOLS &WORKSHOPS

7. Mathematical aspects of topological insulators 2024
   Univ. of Miami and Institute of the Mathematical Sciences of the Americas
   Miami, Florida, USA

6. Topological and Holographic Quantum Matter 2024
   Pontificia Universidad Católica de Chile
   Santiago de Chile, Chile

5. A Quantum Universe in a Crystal: 2023
   Symmetry and Topology across the Correlation Spectrum
   Kavli Institute for Theoretical Physics
   University of California, Santa Barbara

4. Ultra-Quantum Matter 2020
   Perimeter Institute, Canada

3. Quantum Science 2018
   Cornell University, New York

2. Introduction to topological phases of matter 2016
   University of Illinois at Urbana-Champaign, Illinois

1. Quantum Matter 2014
   Centro de Ciencias de Benasque, Spain

GRANTS

Funded

- Developing a real-space approach to topology in many-body quantum systems 2023
  Sponsor: Sandia National Labs
  Role: subcontractor
  Total funding: $255k ($85k/year for 3 years)
  Direct Amount: $55k/year
  Indirect Amount: $30k/year

Not funded

- Sloan Fellowship 2024
- Beckman Young Investigator Fellow 2024
- MURI: Synthetic colloidal assemblies for meta-photonics 2023
  Title: Flow+ Colloidal Assemblies for Non-Linear Optical and Photonic Bandgap Metastructures
  Participants: Prakash Shanurya (Ohio State), Minami Yoda (Georgia Tech), Wladimir Benalcazar (Emory), Hayk Harutyunyan (Emory), Ghasemi Hadi (Houston), Randall Lee (Houston)
- MURI: Dislocations as One-Dimensional Quantum Matters 2022
  Title: Creation and Manipulation of One-Dimensional Topological States in Dislocations
  Participants: Cui-Zu Chang (Penn State), Frances Ross (MIT), Arun Bansil (Northeastern), Wladimir Benalcazar (Emory), Chao-Xing Liu (Penn State), Weida Wu (Rutgers)

MENTORING

Postdocs

- Zheng-Wei Zuo, visiting scholar — 2018-2019
  Department of Physics, Penn State University

Graduate students

- Haylen Gerhard — 2023-present
  Dept. of Physics, Emory University
- Pedro Fittipaldi de Castro — 2022-present
  Dept. of Physics, Emory University
- Jiho Noh — 2018-2020
  Dept. of Physics, Penn State University
- Sachin Vaidya — 2019-2020
  Dept. of Physics, Penn State University
- Christopher Peterson — 2017-2018
  ECE Department, Univ. of Illinois at Urbana-Champaign
- Tianhe Li — 2017-2018
  Dept. of Physics, Univ. of Illinois at Urbana-Champaign

Undergraduate students

- Ivan Wang — 2023 - present
  Dept. of Physics, Emory University Emory University

TEACHING

Instructor of record

Deparment of Physics, Emory University

- Phys751: Topics in Solid State Physics: Topological Phases of Matter
- Phys501: Quantum Mechanics
- Phys421: Thermodynamics and Statistical Physics
- Phys152: Physics for Science and Engineering II

Graduate Teaching Assistant

Dept. of Physics, University of Illinois at Urbana-Champaign
Discussion sessions in the following undergraduate courses:

- University Physics: Mechanics (PHYS211) — Spring 2015
- Electromagnetic Fields I (PHYS435) — Fall 2014
- Electromagnetic Fields I (PHYS435) — Spring 2014
- Special Relativity and Math Applications (PHYS225) — Fall 2013
- College Physics: Mech & Heat (PHYS101) — Summer 2013
- Quantum Mechanics I (PHYS486) — Spring 2013
- Electromagnetic Fields I (PHYS435) — Fall 2012
- College Physics: Mech & Heat (PHYS101) — Spring 2012
- College Physics: Mech & Heat (PHYS101) — Fall 2011

SERVICE AT EMORY

Member of committees: Honors thesis ($\times$4), Masters thesis ($\times$1), Qualifying exam ($\times$7), PhD thesis ($\times$2)	2022-present
Chair of the Colloquium committee	Spring 2025 - present
Member of the graduate curriculum committee	Fall 2024 - present
Member of the faculty search committee	Fall 2023-Spring 2024
Member of the graduate student selection committee	Fall 2022-Spring 2023
Member of the graduate student selection committee	Fall 2021-Spring 2022

PROFESSIONAL SERVICE

Reviewer for grant proposals at the National Research and Development Agency of Chile	2024
Member of the jury for the “Alumni Award in Science” Universidad San Francisco de Quito Quito, Ecuador	2023
Chaired the session “Topological Insulators: Theory II" March Meeting 2021 - American Physical Society Online meeting, USA	2021
Chaired the session “Topological and Non-Hermitian Photonics" March Meeting 2019 - American Physical Society Boston, Massachusetts, USA	2019
Referee for: Science, Science Advances, Nature, Nature Physics, Nature Materials, Nature Communications, Physics Review X, Physics Review Letters, Physics Review A, Physics Review B, Physics Review R, Europhysics Letters, New Journal of Physics, Optics Communications	2010-present

MEMBERSHIPS

American Physical Society	2011 - present

OUTREACH

Public lecture on the Nobel Physics prize of 2023 Departement of Physics, Emory University	2023