

Junyeong Ahn, PhD

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RESEARCH INTERESTS

My theoretical research aims at uncovering and investigating the functional properties of quantum materials — an objective of critical importance not only to fundamental sciences but also to the development of next-generation technologies that will help us to overcome grand challenges in sustainable energy and information. My recent research focuses on elucidating the optical response properties of quantum materials with the geometry and topology of quantum states.

EMPLOYMENT

The University of Texas at Austin Assistant Professor	2025-
Harvard University Postdoctoral Fellow Faculty Advisor: Ashvin Vishwanath	2020-2024
RIKEN & The University of Tokyo Postdoctoral Fellow Faculty Advisor: Naoto Nagaosa	2020

EDUCATION

Seoul National University Ph.D. in Physics Thesis: “Band topology of space-time-inversion-symmetric systems” Faculty Advisor: Bohm-Jung Yang	2020
Pohang University of Science and Technology (POSTECH) B.Sc. in Physics	2013

TEACHING EXPERIENCE

Teaching Assistant at Seoul National University ○ (Graduate) Phase Transition and Critical Phenomena ○ (Undergraduate) General Physics, General Physics Lab, Classical Mechanics	2013-2016
Teaching Assistant of High-Potential Youth Development Program at POSTECH ○ General Physics	2011-2012
Student Mentoring Program at POSTECH ○ General Physics ○ Electromagnetism courses	2011-2012

PROFESSIONAL SERVICE

Referee

Nature, Nature Communications, Science Advances, npj Quantum Materials, Communications Physics
Physical Review X, Physical Review Letters, Physical Review B, and Physical Review Research
Quantum

PUBLICATIONS

15+1 first-author and 11 co-author papers (1939 Citations as of 10/07/2024 based on [Google Scholar](#))

Nature (1), Nature Physics (1), Nature Materials (1), Nature Communications (2), Physical Review X (2), Physical Review Letters (4), Physical Review B (7), Phys. Rev. Research (1), npj Quantum Materials (1), Communications Physics (1), Chinese Physics B (1), under review (4), in preparation (1).

First Author

1. **Junyeong Ahn** and A. Vishwanath, "Circular-polarization-selective perfect reflection of chiral superconductors", in preparation.
2. **Junyeong Ahn** and B. Ghosh, "Topological circular dichroism in chiral multifold fermions", Physical Review Letters 116603 (2023).
3. **Junyeong Ahn**, "Topological enhancement of nonlinear transports in unconventional point-node semimetals", Physical Review B 107, L201112 (2023)
4. **Junyeong Ahn**, S.-Y. Xu, and A. Vishwanath, "Theory of optical axion electrodynamics and application to the Kerr effect in topological antiferromagnets", Nature Communications 13, 7615 (2022).
5. **Junyeong Ahn**, G.-Y. Guo, N. Nagaosa, and A. Vishwanath, "Riemannian geometry of resonant optical responses", Nature Physics 18, 290 (2022).
6. **Junyeong Ahn** and N. Nagaosa, "Superconductivity-induced spectral weight transfer due to quantum geometry", Physical Review B 104, L100501 (2021)
7. **Junyeong Ahn** and B.-J. Yang, "Unconventional Majorana fermions on the surface of topological superconductors protected by rotational symmetry", Physical Review B 103, 184502 (2021).
8. **Junyeong Ahn** and N. Nagaosa, "Many-body selection rule for quasiparticle pair creations in centrosymmetric superconductors", arxiv:2108.04846.
9. **Junyeong Ahn** and N. Nagaosa, "Theory of optical responses in clean multiband superconductors", Nature Communications 12, 1617 (2021).
10. **Junyeong Ahn**, G.-Y. Guo, and N. Nagaosa, "Low-frequency divergence and quantum geometry of the bulk photovoltaic effect in topological semimetals", Physical Review X 10, 041041 (2020).
11. **Junyeong Ahn** and B.-J. Yang, "Higher-order topological superconductivity of spin-polarized fermions", Physical Review Research 2, 012060(R) (2020).
12. **Junyeong Ahn**, S. Park, D. Kim, Y. Kim, and B.-J. Yang, "Stiefel-Whitney classes and topological phases in band theory", Chinese Physics B 28, 117101 (2019).
13. **Junyeong Ahn** and B.-J. Yang, "Symmetry representation approach to topological invariants in C_{2z}T-symmetric systems", Physical Review B 99, 235125 (2019).
14. **Junyeong Ahn**, S. Park, and B.-J. Yang, "Failure of Nielsen-Ninomiya theorem and fragile topology in two-dimensional systems with space-time inversion symmetry: application to twisted bilayer graphene at magic angle", Physical Review X 9, 021013 (2019).
15. **Junyeong Ahn**, D. Kim, Y. Kim, and B.-J. Yang, "Band topology and linking structure of nodal line semimetals with Z₂ monopole charges", Physical Review Letters 121, 106403 (2018).
16. **Junyeong Ahn** and B.-J. Yang, "Unconventional topological phase transition in two-dimensional systems with space-time inversion symmetry", Physical Review Letters 118, 156401 (2017).

Coauthor

1. Jian-Xiang Qiu, Barun Ghosh, Jan Schutte-Engel, Tiema Qian, Michael Smith, Yueh-Ting Yao, **Junyeong Ahn**, Anyuan Gao, Christian Tzschaschel, Hou-Chen Li, Yu-Fei Liu, Ioannis Petrides, Damien Berube, Thao Dinh, Tianye Huang, Olivia Liebman, Joanna Blawat, Kenji Watanabe, Takashi Taniguchi, Kin Chung Fong, Hsin Lin, P Orth, Prineha Narang, Claudia Felser, Tay-Rong Chang, Arun Bansil, Qiong Ma, Ross McDonald, Robert McQueeney, Ivar Martin, Ni Ni, David Marsh, Ashvin Vishwanath, and Su-Yang Xu, submitted.
2. Christopher Broyles, Sougata Mardanya, Mengke Liu, **Junyeong Ahn**, Thao Dinh, Gadeer Alqasseri, Jalen Garner, Zackary Rehfuß, Ken Guo, Jiahui Zhu, David Martinez, Du Li, Yiqing Hao, Huibo Cao, Matt Boswell, Weiwei Xie, Jeremy Philbrick, Tai Kong, Li Yang, Ashvin Vishwanath, Philip Kim, Su-Yang Xu, Jenny Hoffman, Jonathan Denlinger, Sugata Chowdhury, and Sheng Ran, submitted.
3. Brinda Kuthanazhi, Benjamin Schruck, Evan O'Leary, Andrew Eaton, Robert-Jan Slager, **Junyeong Ahn**, Lin-Lin Wang, Paul Canfield, and Adam Kaminski, under review.
4. H.-C. Hsu, J.-S. You, **Junyeong Ahn**, G.-Y. Guo, "Nonlinear photoconductivities and quantum geometry of chiral multifold fermions", Physical Review B 107, 155434 (2023).
5. J.-X. Qi, C. Tzschaschel, **Junyeong Ahn**, A. Gao, H. Li, X.-Y. Zhang, C. Hu, Y.-X. Wang, B. Ghosh, D. Bérubé, Z. Gong, K. Watanabe, T. Taniguchi, D. C. Bell, H.-Z. Lu, A. Bansil, H. Lin, T.-R. Chang, Q. Ma, A. Vishwanath, N. Ni, and S.-Y. Xu, "Axion optical induction of antiferromagnetic order", Nature Materials 22, 583 (2023).

6. L.-L. Wang, **Junyeong Ahn**, R.-J. Slager, Y. Kushnirenko, B. G. Ueland, A. Sapkota, B. Schrunck, B. Kuthanazhi, R. J. McQueeney, P. C. Canfield, A. Kaminski, “Unconventional surface state pairs in a high-symmetry lattice with anti-ferromagnetic band-folding”, *Communications Physics* 6, 78 (2023).
7. Y. Kushnirenko, B. Schrunck, B. Kuthanazhi, L.-L. Wang, **Junyeong Ahn**, E. O’Leary, A. Eaton, S. L. Bud’ko, R.-J. Slager, P. C. Canfield, and A. Kaminski, “Rare-earth monopnictides: Family of antiferromagnets hosting magnetic Fermi arcs”, *Physical Review B* 106, 115112 (2022).
8. B. Schrunck, Y. Kushnirenko, B. Kuthanazhi, **Junyeong Ahn**, L.-L. Wang, E. O’Leary, K. Lee, A. Eaton, A. Fedorov, R. Lou, v. Voroshnin, O. J. Clark, J. Sanchez-Barriga, S. L. Bud’ko, R.-J. Slager, P. Canfield, and A. Kaminski, “Emergence of Fermi arcs and novel magnetic splitting in an antiferromagnet”, *Nature* 603, 610 (2022).
9. E. Lee, R. Kim, **Junyeong Ahn**, and B.-J. Yang, “Two-dimensional higher-order topology in monolayer graphdiyne”, *npj Quantum Materials* 5:1 (2020).
10. J. Y. Lee, **Junyeong Ahn**, H. Zhou, and A. Vishwanath, “Topological correspondence between Hermitian and non-Hermitian systems: Anomalous dynamics”, *Physical Review Letters* 123, 206404 (2019).
11. Y. Hwang, **Junyeong Ahn**, and B.-J. Yang, “Fragile topology protected by inversion symmetry: Diagnosis, bulk-boundary correspondence, and Wilson loop”, *Physical Review B* 100, 195128 (2019).

PRESENTATIONS

Invited Conference Talks

1. “Unique Electromagnetic Responses of Unconventional Topological Semimetals”, 2024 MRS Spring Meeting & Exhibit (Seattle, USA, April 2024).
2. “Quantum geometric optical responses beyond Berry curvature and quantum metric”, Workshop on Quantum Geometry in Condensed Matter (Beverly, USA, October 2023).
3. “Quantum Geometry for the Optical Properties of Crystals”, 36th US-Korea Conference 2023 on Science, Technology, and Entrepreneurship (Dallas, USA, August 2023).
4. “Quantum geometric theory of optical responses in quantum materials”, 2023 AKPA-KPS Symposium (Online, Korea-USA, May 2023).
5. “Kerr Effect in Antiferromagnets by Optical Axion Electrodynamics”, Joint IQ Initiative & PITT PACC Workshop: Axions, Fundamental and Synthetic (University of Pittsburgh, April 2023).
6. “Optical axion magneto-electric effect”, Holography 2022: Quantum Matter and Spacetime (Online, Korea, August 2022).
7. “Optical transitions in clean superconductors”, The International Workshop on Recent Progress in Superconductivity (IWRS) 2022 (Online, Korea, August 2022).
8. “Quantum geometry of light-matter interactions”, Korean Physical Society Fall Meeting 2021 (Online, Korea, October 2021).
9. “Riemannian geometry of optical responses”, CATS Workshop on Nonlinear Responses in Topological Materials (Online, USA, January 2021).
10. “Unconventional Majorana Surface States in Rotation-Protected Topological Superconductors”, Online International Workshop Recent Developments on Multipole Moments in Quantum Systems (Online, Korea-Japan, May 2020).

Invited Seminars & Colloquium

1. “Shedding Light on Topology: Exploring Topological Materials with Light-Matter Interactions”, Columbia APAM Seminar (Columbia University, USA, May 2024).
2. “Shedding Light on Topology: Exploring Topological Materials with Light-Matter Interactions”, ISU Physics Colloquium (Iowa State University, USA, March 2024).
3. “Shedding Light on Topology: Exploring Topological Materials with Light-Matter Interactions”, CQS Seminar (University of Texas at Austin, USA, February 2024).
4. “Shedding Light on Topology: Exploring Topological Materials with Light-Matter Interactions”, Mizzou Physics Colloquium (University of Missouri, USA, February 2024).
5. “Shedding Light on Topology: Exploring Topological Materials with Light-Matter Interactions”, UMich Physics Department Colloquium (University of Michigan at Ann Arbor, USA, February 2024).
6. “Shedding Light on Topology: Exploring Topological Materials with Light-Matter Interactions”, UNC Physics Colloquium (University of North Carolina at Chapel Hill, USA, February 2024).
7. “Exploring optical material properties through quantum geometry”, CM/BIO/ECE Seminars (Online, University of Missouri, USA, October 2023).
8. “Quantum geometry: Quantum route to optical properties of materials”, Condensed Matter Seminar (UC Los Angeles, USA, Mar 2023).
9. “Quantum geometry: Quantum route to optical properties of materials”, Condensed Matter Seminar (UC Santa Cruz, USA, Jan 2023).

10. "Quantum geometry: Quantum route to optical properties of materials", Quantum Materials Seminar (UC Berkeley, USA, Jan 2023).
11. "Optical axion electrodynamics", Topological Quantum Matter Seminar (Online, Harvard CMSA, USA, October 2022).
12. "Optical axion electrodynamics", Harvard Kid's Seminar (Harvard University, USA, October 2022).
13. "Geometric Principle behind Optical Properties of Quantum Materials", UNIST Physics Seminar (Online, UNIST, Korea, September 2022).
14. "Quantum Geometry for Optical Properties of Materials", Yale Electric Engineering Seminar (Online, Yale, USA, August 2022).
15. "Shift Current and Quantum Materials", Philip Kim Group Seminar (Harvard, USA, April 2022)
16. "Quantum Geometry of Light-Matter Interactions", IBS-CCES Seminar (Online, Seoul National University, Korea, January 2022).
17. "Quantum Geometry of Light-Matter Interactions: New Approach to Multi-Band Physics", POSTECH Special Seminar (Pohang, POSTECH, Korea, October 2021).
18. "Geometric Paradigm of Light-Matter Interactions", Yonsei SRC Special Seminar (Online, Yonsei University, Korea, June 2021).
19. "Quantum Geometry of Light-Matter Interactions", Correlated Electrons Virtual International Seminars (CEVIS) (Online, KIAS-University of Tokyo-IBS CALDES, Korea-Japan, May 2021).
20. "Riemannian geometry of optical responses", Budapest Exotic Quantum Phases Seminar (Online, Budapest University of Technology and Economics, Hungary, April 2021).
21. "Riemannian geometry of optical responses", MPSD Theory Seminar (Online, Max Planck Institute, Germany, April 2021).
22. "Bulk Photovoltaic Effects in Topological Semimetals: Quantum Geometric Perspective", Harvard CMP Seminar (Online, Harvard University, USA, Sep 2020).
23. "Failure of Nielsen-Ninomiya Theorem and Fragile Topology in Twisted Bilayer Graphene", IBS-CCES Seminar (Seoul National University, Korea, Feb 2019).
24. "Band Topology of Nodal Line Semimetal with Z2 Monopole Charges", SKKU Seminar (Sungkyunkwan University, Korea, August 2018).
25. "Unconventional topological phase transition in two-dimensional systems with space-time inversion symmetry", IBS-CCES Seminar (Seoul National University, Korea, August 2017).

Contributed

1. "Polar Kerr effect in antiferromagnets by optical axion electrodynamics", APS March Meeting 2023 (Las Vegas, USA, March 2023).
2. "Quantum Geometry of Light-Matter Interactions", APS March Meeting 2022 (Chicago, USA, March 2022).
3. "Quantum Geometric Characterization of Topological Semimetals", CATS Annual Meeting (Online, USA, Dec 2021).
4. "Theory of optical responses in clean multi-band superconductors", APS March Meeting 2021 (Online, USA, March 2021).
5. "Quantum Geometry of Photogalvanic Effects in Topological Semimetals", CATS Annual Meeting (Online, USA, Sep 2020).
6. "Higher-Order Topological Superconductivity of Spin-Polarized Fermions", Korean Physical Society Fall Meeting 2019 (Kimdaejung Convention Center, Korea, October 2019).
7. "Band Topology of Real Bloch Wavefunctions", APS March Meeting 2019 (Boston Convention and Exhibition Center, USA, March 2019).
8. "Hidden Link, Creation, and Annihilation of Nodal Lines with Z2 Monopole Charges in PT-Symmetric Systems", APS March Meeting 2018 (Los Angeles Convention Center, USA, March 2018).
9. "Linking characterizes Z2 monopole charge in nodal line semimetal", Korean Physical Society Fall Meeting 2017 (Hwabaek International Convention. Center, Korea, October 2017).

Posters

1. "Theory of optical axion electrodynamics", EFRC Summit / TIQM Summer Workshop 2023 (Seattle, USA, Aug 2023).
2. "Theory of optical axion electrodynamics", CATS Kickoff Meeting 2023 (Argonne National Laboratory, USA, Jan 2023).
3. "Theory of optical axion electrodynamics", Gordon Research Conference on Correlated Electron Systems (Mount Holyoke College, USA, June 2022).
4. "Optical axion electrodynamics", 2022 EPIQS Postdoctoral Symposium (Wylie Inn & Conference Center, USA, May 2022).
5. "Riemannian geometry of optical responses", APS March Meeting 2021 (Online, USA, March 2021).
6. "Theory of optical responses in clean multi-band superconductors", 2021 Theory Winter School (Online, National MagLab, USA, Jan 2021).

7. "Failure of Nielsen-Ninomiya Theorem and Fragile Topology in Twisted Bilayer Graphene", Oxide Superspin Workshop (Seoul National University, Korea, June 2019).
8. "Failure of Nielsen-Ninomiya Theorem and Fragile Topology in Twisted Bilayer Graphene", Gordon Research Conference on Topology and Correlated Matter (Hong Kong University of Science and Technology, China, June 2019).
9. "Failure of Nielsen-Ninomiya Theorem and Fragile Topology in Twisted Bilayer Graphene", KIAS Workshop on Topology and Correlation in Quantum Materials (Shilla Stay Hotel, Korea, May 2019).
10. "Band Topology of Real Wavefunctions", IBS-ISSP joint workshop (Seoul National University, Korea, April 2019).
11. "Higher-Order Topology in $C_{2z}T$ -symmetric 3D systems", Kavli ITS-APW-Tsinghua-RIKEN workshop: Highlights in Condensed Matter Physics (University of Chinese Academy of Science, China, November 2018).
12. "Band Topology of Nodal Line Semimetal with Z2 Monopole Charges", International Workshop on Symmetry and Topology in Condensed-Matter Physics (Tokyo University, Japan, June 2018).
13. "Linking characterizes Z2 monopole charge in nodal line semimetal", CEMS Symposium on Trends in Condensed Matter Physics (RIKEN, Japan, November 2017).
14. "Linking characterizes Z2 monopole charge in nodal line semimetal", IBS-CCES workshop (Seoul National University, Korea, June 2017).
15. "Unconventional topological phase transition in two-dimensional systems with space-time inversion symmetry", IBS-CCES workshop (Mangsang Convention Center, Korea, August 2017).
16. "Unconventional topological phase transition in two-dimensional systems with space-time inversion symmetry", Korean Physical Society Spring Meeting 2017 (Daejeon Convention Center, Korea, April 2017).
17. "Unconventional topological phase transition in two-dimensional systems with space-time inversion symmetry", APCTP Quantum Materials Symposium 2017 (Yongpyeong Resort, Korea, February 2017).
18. "Finite Transformations in Doubled Space", CERN-CKC TH Institute on duality symmetries in string and M-Theories (CERN, Switzerland, August 2015).

HONORS AND AWARDS

Fellowship and Scholarships

Post-Doctoral Overseas Training Program, National Research Foundation of Korea	2020-2021
BK Scholarship for Distinguished Doctoral Students, Seoul National University	2018
National Science and Technology Scholarship, Korea Student Aid Foundation	2009-2013
Special Admission Scholarship, POSTECH	2009

Research Awards

Outstanding Young Researcher Award, Association of Korean Physicists in America	2023
Best Publication Award, CATS Kickoff Meeting 2023	2023
Dissertation of the Year Awards, S-Oil Science Prodigy and Culture Foundation	2021
Best Ph. D. Thesis Prize, Seoul National University	2020
Young Physicist Award, Korean Physical Society (KPS)	2019

Conference Awards

Best Rapid-Fire Science Reports Award, CATS Annual Meeting	2021
Best Oral Presentation Award, KPS Fall Meeting	2019
Best Poster Presentation Award, Korea Institute for Advanced Study (KIAS) Workshop	2019
Best Poster Presentation Award, KPS Spring Meeting	2017

Teaching Award

Outstanding Teaching Assistant Award, Seoul National University	2015
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REFERENCES

Prof. Ashvin Vishwanath (Postdoc Advisor)
Department of Physics, Harvard University
17 Oxford St, Cambridge
Massachusetts 02138, United States of America
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Prof. Su-Yang Xu
Department of Chemistry and Chemical Biology,
Harvard University
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Prof. Naoto Nagaosa (Postdoc Advisor)
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Prof. Robert J McQueeney
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