

Edwin Huang

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Education and experience

Assistant Professor

Department of Physics and Astronomy

University of Notre Dame

Aug. 2023 - present

Gordon and Betty Moore Postdoctoral Research Associate

Department of Physics and Institute for Condensed Matter Theory

University of Illinois at Urbana-Champaign

Aug. 2019 - Aug. 2023

Ph.D., Physics, Stanford University

Thesis: "Intertwined orders and their dynamical properties in strongly correlated systems"

Advisor: Thomas Devereaux

Sept. 2013 - Aug. 2019

B.A., Physics (Highest Honors) and B.A., Statistics, UC Berkeley

Thesis: "Graphene/hBN heterostructures and photodoping experiments"

Advisor: Feng Wang

Sept. 2009 - May 2013

Awards and Honors

- Gordon and Betty Moore Postdoctoral Fellowship in Theory of Quantum Materials, 2019.
- UC Berkeley High Distinction in General Scholarship, 2013.
- Berkeley Physics Undergraduate Research Scholar, 2012.
- UC Berkeley Dean's Honor List, 2012 and 2013.

Research Interests

- Theory of strongly correlated electron systems, intertwined order in unconventional superconductors, strange metals and non-Fermi liquids, fluctuating order and pseudogaps.

- Numerical algorithms: Determinantal Quantum Monte Carlo, Cluster Perturbation Theory, Maximum Entropy Method analytic continuation, High-temperature expansions, Exact Diagonalization.
- Experimental collaborations: resonant X-ray scattering, angle-resolved photoemission, electron energy loss spectroscopy, neutron scattering, ultracold atom quantum simulators.

Select Publications

1. A. A. Husain, [E. W. Huang](#), M. Mitranó, M. S. Rak, S. I. Rubeck, H. Yang, C. Sow, Y. Maeno, B. Uchoa, T. C. Chiang, P. W. Phillips, P. Abbamonte, “Pines’ demon observed as a 3D acoustic plasmon in Sr_2RuO_4 ”, *Nature* (2023). [🔗](#)
2. [E. W. Huang](#)^{*}, G. La Nave^{*}, P. W. Phillips^{*}, “Discrete symmetry breaking defines the Mott quartic fixed point”, *Nature Physics* **18**, 511-516 (2022). [🔗](#)
3. S. Lee^{*}, [E. W. Huang](#)^{*}, T. Johnson^{*}, X. Guo, A. A. Husain, M. Mitranó, K. Lu, A. V. Zakrzewski, G. A. de la Peña, Y. Y. Peng, H. Huang, S.-J. Lee, H. Jang, J.-S. Lee, Y. I. Joe, W. B. Doriese, P. Szypryt, D. S. Swetz, S. Chi, A. A. Aczel, G. J. MacDougall, S. A. Kivelson, E. Fradkin, P. Abbamonte, “Generic character of charge and spin density waves in superconducting cuprates”, *Proc. Natl. Acad. Sci.* **119**, e2119429119 (2022). [🔗](#)
4. P. W. Phillips, L. Yeo, [E. W. Huang](#), “Exact superconducting instability in a doped Mott insulator”, *Nature Physics* **16**, 1175-1180 (2020). [🔗](#)
5. [E. W. Huang](#), R. Sheppard, B. Moritz, T. P. Devereaux, “Strange metallicity in the doped Hubbard model”, *Science* **366**, 987-990 (2019). [🔗](#)
6. [E. W. Huang](#), C. B. Mendl, S. Liu, S. Johnston, H.-C. Jiang, B. Moritz, T. P. Devereaux, “Numerical evidence of fluctuating stripes in the normal state of high- T_c cuprate superconductors”, *Science* **358**, 1161-1164 (2017). [🔗](#)

Invited Talks

1. “Determinantal Quantum Monte Carlo solver for Cluster Perturbation Theory”,
2023 Frontera User Meeting, Aug 2023, Austin, TX.
2. “Theory of Pines' demon in multiband metals”,
KUJI (Korea, UK, Japan, Italy) QMAT seminar, June 2023, (virtual).
3. “Fluctuating stripes in the Hubbard model”,
The Inaugural Workshop on Trends in Quantum Matter, University of Notre Dame, May 2023,
Notre Dame, IN.
4. “Theory of Pines' demon in multiband metals”,
Binghamton University, Physics Colloquium, March 2023, Binghamton, NY.
5. “Theory of Pines' demon in multiband metals”,
University of North Texas, Department of Physics Seminar, February 2023, Denton, TX.
6. “Theory of Pines' demon in multiband metals”,
University of Notre Dame, Department of Physics & Astronomy Colloquium, February 2023,
Notre Dame, IN.
7. “Theory of Pines' demon in multiband metals”,
University of Houston, Department of Physics Colloquium, February 2023, Houston, TX.
8. “A Quantum Monte Carlo perspective on orders and fluctuations in the Hubbard model”,
EFRC - Quantum Sensing and Quantum Materials All-hands meeting, August 2022, Chicago, IL.
9. “Fluctuating intertwined stripes in the strange metal regime of the Hubbard model”,
33rd IUPAP Conference on Computational Physics, August 2022, (virtual).
10. “Stripes in the strange metal normal state of the Hubbard model”,
NORDITA Program: Recent Developments in Strongly-Correlated Quantum Matter, June 2022,
Stockholm, Sweden.
11. “Fluctuating intertwined stripes in the strange metal regime of the Hubbard model”,
Gordon and Betty Moore Foundation - EPiQS Postdoctoral Symposium, May 2022, Beverly, MA.
12. “Orders and fluctuating orders in the Hubbard model: the numerical evidence”,
Recent Progress in the Experimental and Theoretical search for Pair-Density-Wave Order, May
2022, Santa Barbara, CA.
13. “Exact theory for superconductivity in a doped Mott insulator”,
APS March Meeting, March 2022, Chicago, IL.

14. “Fluctuating intertwined stripes in the strange metal regime of the Hubbard model”, LLNL Physics Seminar, March 2022, (virtual).
15. “Incipient order in the strange metal of the Hubbard model”, UIUC Institute for Condensed Matter Theory Seminar, October 2021, Urbana, IL.
16. “Incipient intertwined order in the Hubbard model”, University of Michigan, Interdisciplinary QC/CM Seminar, September 2021, Ann Arbor, MI.
17. “Exact numerical and theoretical results beyond Fermi liquid theory”, Louisiana State University, Physics Colloquium, May 2021, (virtual).
18. “Exact numerical and theoretical results beyond Fermi liquid theory”, University of Alabama at Birmingham, Physics Colloquium, March 2021, (virtual).
19. “Superconducting instability in a doped Mott insulator: Exact results”, University of British Columbia, Department of Physics & Astronomy Seminar, January 2021, (virtual).
20. “Non-Fermi liquids from doping a Mott insulator: exact results from solvable models”, UC San Diego Condensed Matter Seminar, September 2020, (virtual).
21. “Quantum Monte Carlo studies of transport in the Hubbard model”, Aspen Winter Conference: Quantum Matter – Computation Meets Experiments, March 2020, Aspen, CO.
22. “Quantum Monte Carlo studies of normal state properties of the Hubbard model”, UIUC Institute for Condensed Matter Theory Seminar, September 2019, Urbana, IL.
23. “Strange metallicity in the doped Hubbard model”, CAP Congress, June 2019, Burnaby, Canada.
24. “Quantum Monte Carlo studies of normal state properties of the Hubbard model”, MIT Informal Condensed Matter Theory Seminar, February 2019, Cambridge, MA.
25. “Strange metallicity in the doped Hubbard model: insights from determinantal quantum Monte Carlo”, Center for Computational Quantum Physics, January 2019, New York, NY.
26. “Strange metallicity in the doped Hubbard model”, UC Berkeley Quantum Materials Seminar, October 2018, Berkeley, CA.

27. “Strange metallicity in the doped Hubbard model”,
Correlated Electron Systems (Gordon Research Seminar), June 2018, South Hadley, MA.
28. “Numerical evidence of fluctuating stripes in high- T_c cuprate superconductors”,
Aspen Winter Conference: High Temperature Superconductivity – Unifying Themes in Diverse Materials, January 2018, Aspen, CO.

Contributed Talks

1. “Theory of Pines' demon in multiband metals”,
APS March Meeting, March 2022, Las Vegas, NV.
2. “Generic character of charge and spin density waves in superconducting cuprates”,
APS March Meeting, March 2022, Chicago, IL.
3. “Strong-coupling mechanism of the pseudogap in small Hubbard clusters”,
APS March Meeting, March 2021, (virtual).
4. “Strong-coupling mechanism of the pseudogap in small Hubbard clusters”,
Spectroscopy of Strongly Correlated Electron Systems, October 2020, (virtual).
5. “Strange metallicity in the doped Hubbard model”,
APS March Meeting, March 2019, Boston, MA.
6. “Fluctuating spin stripes in the Emery and Hubbard models: evidence from determinant quantum Monte Carlo”,
M²S-2018, August 2018, Beijing, China.
7. “Understanding spin excitations in cuprates by combining RIXS and numerical simulation”,
APS March Meeting, March 2018, Los Angeles, CA.
8. “Evidence for fluctuating stripes in cuprates from finite temperature quantum Monte Carlo”,
Many Electron Collaboration Summer School, June 2017, Stony Brook, NY.
9. “Fluctuating spin stripes in the normal state of high- T_c cuprate superconductors”,
APS March Meeting, March 2017, New Orleans, LA.
10. “Searching for stripe order in the Hubbard model”,
APS March Meeting, March 2016, Baltimore, MD.
11. “Stability of the AFM phase in the three-band Hubbard-Holstein model”,
APS March Meeting, March 2015, San Antonio, TX.

Poster Presentations

1. “Theory of Pines’ demon in multiband metals”, Gordon Research Conference on Superconductivity, May 2023, Les Diablerets, Switzerland.
2. “Incipient order in the strange metal of the Hubbard model”, M²S-2022, July 2022, Vancouver, Canada.
3. “Fluctuating intertwined stripes in the strange metal”, New Directions in Strong Correlation Physics: From Strange Metals to Topological Superconductivity (Aspen Winter Conference), Jan 2022, Aspen, CO.
4. “Superconducting instability in a toy model of a doped Mott insulator”, Quantum Matter: Computation Meets Experiments (Aspen Winter Conference), March 2020, Aspen, CO.
5. “Strange metallicity in the Hubbard model”, Correlated Electron Systems (Gordon Research Conference), June 2018, South Hadley, MA.
6. “Numerical evidence of fluctuating stripes in high- T_c cuprate superconductors”, Order, Fluctuations, and Strong Correlations: New Platforms and Developments, August 2017, Santa Barbara, CA.
7. “Numerical evidence of fluctuating stripes in high- T_c cuprate superconductors”, Gordon Research Conference: Novel Trends in Superconductivity of Correlated Electrons, June 2017, Waterville Valley, NH.
8. “Stripe ordering and dynamics in the Hubbard model”, New Quantum Phases with Frustration and Entanglement, June 2016, Krakow, Poland.

Teaching and Mentorship

- Department of Physics and Astronomy, Notre Dame.
 - Physics 10310 – Engineering Physics I: Mechanics, Fall 2023
- Teaching assistant, Department of Physics, Stanford.
 - Physics 41 – Mechanics, Winter 2014
 - Physics 46 – Light and Heat Laboratory, Autumn 2017
 - Physics 113 – Computational Physics, Spring 2018
- Graduate student mentoring in Devereaux group (Stanford): Tianyi Liu, Xuxin Huang, Wen Wang, Katherine Ding, Fangze Liu, Ryan Sheppard (undergraduate).

- Graduate student mentoring in Phillips group (UIUC): Jinchao Zhao, Yuhao Ma.

Professional Service

- Journal referee for: Proceedings of the National Academy of Sciences, Nature Communications, npj Quantum Materials, SciPost Physics, Communications Physics, Physical Review Letters, Physical Review B, Communications in Computational Physics.
- Grant referee for: European Research Council.

Publications

1. A. A. Husain, E. W. Huang, M. Mitranò, M. S. Rak, S. I. Rubeck, H. Yang, C. Sow, Y. Maeno, B. Uchoa, T. C. Chiang, P. W. Phillips, P. Abbamonte, “Pines’ demon observed as a 3D acoustic plasmon in Sr_2RuO_4 ”, *Nature* (2023). [🔗](#)
2. P. Mai, E. W. Huang, J. Yu, B. E. Feldman, P. W. Phillips, “Interaction-driven spontaneous ferromagnetic insulating states with odd Chern numbers”, *npj Quantum Materials* **8**, 14 (2023). [🔗](#)
3. E. W. Huang^{*}, T. Liu^{*}, W. O. Wang, H.-C. Jiang, P. Mai, T. A. Maier, S. Johnston, B. Moritz, T. P. Devereaux, “Fluctuating intertwined stripes in the strange metal regime of the Hubbard model”, *Phys. Rev. B* **107**, 085126 (2023). [🔗](#)
4. E. W. Huang, S. Ding, J. Liu, Y. Wang, “Determinantal Quantum Monte Carlo solver for Cluster Perturbation Theory”, *Phys. Rev. Research* **4**, L042015 (2022). [🔗](#)
5. J. Zhao, L. Yeo, E. W. Huang, P. W. Phillips, “Thermodynamics of an exactly solvable model for superconductivity in a doped Mott insulator”, *Phys. Rev. B* **105**, 184509 (2022). [🔗](#)
6. J. K. Ding, W. O. Wang, B. Moritz, Y. Schattner, E. W. Huang, T. P. Devereaux, “Thermodynamics of correlated electrons in a magnetic field”, *Communications Physics* **5**, 204 (2022). [🔗](#)
7. W. O. Wang, J. K. Ding, B. Moritz, E. W. Huang, T. P. Devereaux, “Magnon heat transport in a 2D Mott insulator”, *Phys. Rev. B* **105**, L161103 (2022). [🔗](#)

8. [E. W. Huang*](#), G. La Nave*, P. W. Phillips*,
“Discrete symmetry breaking defines the Mott quartic fixed point”,
Nature Physics **18**, 511 (2022). [DOI](#)
9. S. Lee*, [E. W. Huang*](#), T. Johnson*, X. Guo, A. A. Husain, M. Mitrano, K. Lu, A. V. Zakrzewski, G. A. de la Peña, Y. Y. Peng, H. Huang, S.-J. Lee, H. Jang, J.-S. Lee, Y. I. Joe, W. B. Doriese, P. Szypryt, D. S. Swetz, S. Chi, A. A. Aczel, G. J. MacDougall, S. A. Kivelson, E. Fradkin, P. Abbamonte,
“Generic character of charge and spin density waves in superconducting cuprates”,
Proc. Natl. Acad. Sci. **119**, e2119429119 (2022). [DOI](#)
10. [E. W. Huang](#), W. O. Wang, J. K. Ding, T. Liu, F. Liu, X.-X. Huang, B. Moritz, T. P. Devereaux,
“Intertwined states at finite temperatures in the Hubbard model”,
J. Phys. Soc. Jpn. **90**, 111010 (2021). [DOI](#)
11. T. Liu, D. Jost, B. Moritz, [E. W. Huang](#), R. Hackl, T. P. Devereaux,
“Tendencies of enhanced electronic nematicity in the Hubbard model and a comparison with Raman scattering on high-temperature superconductors”,
Phys. Rev. B **103**, 134502 (2021). [DOI](#)
12. B. Nosarzewski, [E. W. Huang](#), P. M. Dee, I. Esterlis, B. Moritz, S. A. Kivelson, S. Johnston, T. P. Devereaux,
“Superconductivity, charge-density-waves, and bipolarons in the Holstein model”,
Phys. Rev. B **103**, 235156 (2021). [DOI](#)
13. W. O. Wang, J. K. Ding, B. Moritz, Y. Schattner, [E. W. Huang](#), T. P. Devereaux,
“Numerical approaches for calculating the low-field dc Hall coefficient of the doped Hubbard model”,
Phys. Rev. Research **3**, 033033 (2021). [DOI](#)
14. [E. W. Huang](#), K. Limtragool, C. Setty, A. A. Husain, M. Mitrano, P. Abbamonte, P. W. Phillips,
“Extracting correlation effects from Momentum-Resolved Electron Energy Loss Spectroscopy (M-EELS): Synergistic origin of the dispersion kink in $\text{Bi}_{2.1}\text{Sr}_{1.9}\text{CaCu}_2\text{O}_{8+x}$ ”,
Phys. Rev. B **103**, 035121 (2021). [DOI](#)
15. Y. Wang, Y. He, K. Wohlfeld, M. Hashimoto, [E. W. Huang](#), D. Lu, S.-K. Mo, S. Komiyama, C. Jia, B. Moritz, Z.-X. Shen, T. P. Devereaux,
“Emergence of quasiparticle in doped Mott insulators”,
Communications Physics **3**, 210 (2020). [DOI](#)
16. W. O. Wang, J. K. Ding, B. Moritz, [E. W. Huang](#), T. P. Devereaux,

- “DC Hall measurements in the strongly correlated Hubbard model”,
npj Quantum Materials **5**, 51 (2020). [🔗](#)
17. P. W. Phillips, L. Yeo, E. W. Huang,
“Exact superconducting instability in a doped Mott insulator”,
Nature Physics **16**, 1175-1180 (2020). [🔗](#)
 18. S. Sayyad, E. W. Huang, M. Kitatani, M.-S. Vaezi, Z. Nussinov, H. Aoki, A. Vaezi,
“Pairing and non-Fermi liquid behavior in partially flat-band systems: beyond nesting physics”,
Phys. Rev. B **101**, 014501 (2020). [🔗](#)
 19. P. T. Brown, E. Guardado-Sanchez, B. M. Spar, E. W. Huang, T. P. Devereaux, W. S. Bakr,
“Angle-resolved photoemission spectroscopy of a Fermi-Hubbard system”,
Nature Physics **16**, 26-31 (2020). [🔗](#)
 20. X. X. Huang, M. Claassen, E. W. Huang, B. Moritz, T. P. Devereaux,
“Biexciton condensation in electron-hole doped Hubbard bilayers: a sign-problem-free quantum Monte Carlo study”,
Phys. Rev. Lett. **124**, 077601 (2020). [🔗](#)
 21. E. W. Huang, M.-S. Vaezi, Z. Nussinov, A. Vaezi,
“Enhanced correlations and superconductivity in weakly interacting partially flat band systems: A determinantal quantum Monte Carlo study”,
Phys. Rev. B **99**, 235128 (2019). [🔗](#)
 22. E. W. Huang, R. Sheppard, B. Moritz, T. P. Devereaux,
“Strange metallicity in the doped Hubbard model”,
Science **366**, 987-990 (2019). [🔗](#)
 23. J.-F. He, C. R. Rotundu, M. S. Scheurer, Y. He, M. Hashimoto, K. Xu, Y. Wang, E. W. Huang, T. Jia, S.-D. Chen, B. Moritz, D.-H. Lu, Y. S. Lee, T. P. Devereaux, Z.-X. Shen, “Fermi surface reconstruction in electron-doped cuprates without antiferromagnetic long-range order”,
Proc. Natl. Acad. Sci **116**, 3449 (2019). [🔗](#)
 24. M. Hepting, L. Chaix, E. W. Huang, R. Fumagalli, Y. Y. Peng, B. Moritz, K. Kummer, N. B. Brookes, W.-C. Lee, M. Hashimoto, T. Sarkar, J. He, C. R. Rotundu, Y. S. Lee, R. L. Greene, L. Braicovich, G. Ghiringhelli, Z. X. Shen, T. P. Devereaux, W. S. Lee,
“Three dimensional collective charge excitations in electron-doped cuprate superconductors”,
Nature **563**, 374-378 (2018). [🔗](#)

25. Y. Y. Peng, [E. W. Huang](#), R. Fumagalli, M. Minola, Y. Wang, X. Sun, Y. Ding, K. Kummer, X. J. Zhou, N. B. Brookes, B. Moritz, L. Braicovich, T. P. Devereaux, G. Ghiringhelli, “Dispersion, damping, and intensity of spin excitations in the single-layer $(\text{Bi,Pb})_2(\text{Sr,L a})_2\text{CuO}_{6+\delta}$ cuprate superconductor family”, *Phys. Rev. B* **98**, 144507 (2018). [🔗](#)
26. L. Chaix, [E. W. Huang](#), S. Gerber, X. Lu, C. Jia, Y. Huang, D.E. McNally, Y. Wang, F. H. Vernay, A. Keren, M. Shi, B. Moritz, Z.-X. Shen, T. Schmitt, T. P. Devereaux, W.-S. Lee, “RIXS studies of magnons and bimagnons in the lightly doped cuprate $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ ”, *Phys. Rev. B* **97**, 155144 (2018). [🔗](#)
27. Y. Wang, [E. W. Huang](#), B. Moritz, T. P. Devereaux, “Magnon splitting induced by charge transfer in the three-orbital Hubbard model”, *Phys. Rev. Lett.* **120**, 246401 (2018). [🔗](#)
28. I. Esterlis, B. Nosarzewski, [E. W. Huang](#), B. Moritz, T. P. Devereaux, D. J. Scalapino, S. A. Kivelson, “Breakdown of Migdal-Eliashberg theory; a determinant quantum Monte Carlo study”, *Phys. Rev. B* **97**, 140501(R) (2018). [🔗](#)
29. [E. W. Huang](#), C. B. Mendl, H.-C. Jiang, B. Moritz, T. P. Devereaux, “Stripe order from the perspective of the Hubbard model”, *npj Quantum Materials* **3**, 22 (2018). [🔗](#)
30. C. B. Mendl, E. A. Nowadnick, S. Johnston, [E. W. Huang](#), B. Moritz, T. P. Devereaux, “Doping dependence of ordered phases and emergent quasiparticles in the doped Hubbard-Holstein model”, *Phys. Rev. B* **96**, 205141 (2017). [🔗](#)
31. [E. W. Huang](#), D. J. Scalapino, T. A. Maier, B. Moritz, T. P. Devereaux, “Decrease of d -wave pairing strength in spite of the persistence of magnetic excitations in the overdoped Hubbard model”, *Phys. Rev. B* **96**, 020503(R) (2017). [🔗](#)
32. W. Hu, R. T. Scalettar, [E. W. Huang](#), B. Moritz, “Effects of an additional conduction band on the singlet-antiferromagnet competition in the periodic Anderson model”, *Phys. Rev. B* **95**, 235122 (2017). [🔗](#)
33. [E. W. Huang](#), C. B. Mendl, S. Liu, S. Johnston, H.-C. Jiang, B. Moritz, T. P. Devereaux,

“Numerical evidence of fluctuating stripes in the normal state of high- T_c cuprate superconductors”,
Science **358**, 1161-1164 (2017). [🔗](#)

34. Y. F. Kung, C.-C. Chen, Y. Wang, E. W. Huang, E. A. Nowadnick, B. Moritz, R. T. Scalettar, S. Johnston, T. P. Devereaux,
“Characterizing the three-orbital Hubbard model with determinant quantum Monte Carlo”,
Phys. Rev. B **93**, 155166 (2016). [🔗](#)

35. L. Ju, J. Velasco Jr, E. Huang, S. Kahn, C. Nosisgia, H.-Z. Tsai, W. Yang, T. Taniguchi, K. Watanabe, Y. Zhang, G. Zhang, M. Crommie, A. Zettl, F. Wang,
“Photoinduced doping in heterostructures of graphene and boron nitride”,
Nature Nanotechnology **9**, 348 (2014). [🔗](#)

Preprints and manuscripts in preparation

36. W. O. Wang, J. K. Ding, E. W. Huang, B. Moritz, T. P. Devereaux,
“Quantitative assessment of the universal thermopower in the Hubbard model”,
under review at *Nature Communications*.

37. W. O. Wang, J. K. Ding, Y. Schattner, E. W. Huang, B. Moritz, T. P. Devereaux,
“The Wiedemann-Franz law in doped Mott insulators without quasiparticles”,
under review at *Science*.

38. C. Setty, J. Zhao, L. Fanfarillo, E. W. Huang, P. J. Hirschfeld, P. W. Phillips, K. Yang,
“Exact solution for finite center-of-mass momentum Cooper pairing”,
submitted to *Proc. Natl. Acad. Sci.* [🔗](#)

39. E. W. Huang,
“Strong-coupling mechanism of the pseudogap in small Hubbard clusters”,
submitted to *npj Quantum Materials*. [🔗](#)

40. Attendees of the “The Future of the Correlated Electron Problem Workshop”,
“The Future of the Correlated Electron Problem”,
submitted to *SciPost Physics*. [🔗](#)