

XIAOMENG LIU

Email: xiaomeng@princeton.edu; Website: xiaomengliu.com

RESEARCH INTERESTS

I am a condensed matter experimentalist who seeks to discover, understand, and manipulate quantum states of matter through advanced techniques such as quantum transport and scanning probe microscopy. My area of specialization lies in van der Waals materials, which consist of 2D layers assembled using mechanical methods to achieve complete control over the chemical composition and lattice orientation of each atomic layer. Through precise manipulation and interplay between different atomic layers, we can engineer material properties and promote the creation of novel quantum phases. My current interests include exciton condensation, unconventional superconductivity, quantum magnetism, topological orders, and strongly correlated electron states.

EMPLOYMENT

2019 - Present **Princeton University**, Princeton, NJ
Princeton Materials Science Postdoctoral Fellow
Advisor: Prof. Ali Yazdani

EDUCATION

2019 **Ph.D. in Physics, Harvard University.**
Thesis: "Correlated Electron States in Coupled Graphene Double-layer Heterostructures"
Advisor: Prof. Philip Kim

2013 **M.S. in Applied Physics, Columbia University.**

2012 **B.A. in Physics, Peking University.**

PUBLICATIONS

Summary: 15 peer-reviewed publications (7 as the first-author), including 3 in Nature, 3 in Science, 3 in Nature Physics, with over 2000 total citations. Google Scholar: [\[Link\]](#).

(†Corresponding author; *equal contribution).

Selected Publications

1. **X. Liu***, G. Farahi*, C. Chiu*, Zlatko Papic, K. Watanabe, T. Taniguchi, M. Zaletel, A. Yazdani†. "Visualizing Broken Symmetry and Topological Defects in a Quantum Hall Ferromagnet." *Science* 375, 321-326 (2022), [\[Link\]](#).
2. **X. Liu***, J.I.A Li*, K. Watanabe, T. Taniguchi, J. Hone, B. I. Halperin, C. R. Dean & P. Kim†. "Crossover between strongly-coupled and weakly-coupled exciton superfluids." *Science* 375, 205-209 (2022), [\[Link\]](#).
3. **X. Liu†**, Z. Hao*, E. Khalaf, J. Y. Lee, Y. Ronen, H. Yoo, D. H. Najafabadi, K. Watanabe, T. Taniguchi, A. Vishwanath, P. Kim†. "Tunable spin-polarized correlated states in twisted double bilayer graphene." *Nature* 583, 221-225 (2020), [\[Link\]](#).

4. **X. Liu**, Z. Hao, K. Watanabe, T. Taniguchi, B. Halperin, P. Kim†. "Interlayer fractional quantum Hall effect in a coupled graphene double-layer." *Nature Physics* 15, 893–897 (2019), [\[Link\]](#).
5. **X. Liu**, K. Watanabe, T. Taniguchi, B. I. Halperin & P. Kim†. "Quantum Hall drag of exciton superfluid in graphene." *Nature Physics* 13, 746-750 (2017), [\[Link\]](#).

Additional Publications

6. G. Farahi*, C. Chiu*, **X. Liu***, Zlatko Papic, K. Watanabe, T. Taniguchi, M. Zaletel, A. Yazdani†. "Broken symmetries and excitation spectra of interacting electrons in partially filled Landau levels." *arXiv: 2303.16993* (2023)
7. **X. Liu***, J.I.A Li*, K. Watanabe, T. Taniguchi, J. Hone, C. R. Dean & P. Kim†. "Transport signature of magnetoexciton insulating state in electron-hole graphene double-layers." *In preparation*.
8. Y. Jia, P. Wang, C. Chiu, Z. Song, G. Yu, B. Jäck, S. Lei, S. Klemen, F. A. Cevallos, M. Onyszczak, N. Fishchenko, **X. Liu**, G. Farahi, F. Xie, Y. Xu, K. Watanabe, T. Taniguchi, B. A. Bernevig, R. J. Cava, L. M. Schoop, A. Yazdani, S. Wu†. "Evidence for a monolayer excitonic insulator." *Nature Physics* 18, 87–93 (2022), [\[Link\]](#).
9. M. Oh, K. P. Nuckolls, D. Wong, R. L. Lee, **X. Liu**, K. Watanabe, T. Taniguchi, A. Yazdani†. "Evidence for unconventional superconductivity in twisted bilayer graphene." *Nature* 600, 240–245 (2021), [\[Link\]](#).
10. **X. Liu***, C. Chiu*, J. Y. Lee, G. Farahi, K. Watanabe, T. Taniguchi, A. Vishwanath, A. Yazdani†. "Spectroscopy of a Tunable Moiré System with a Correlated and Topological Flat Band." *Nature Communications* 12, 2732 (2021), [\[Link\]](#).
11. M. C. Diamantini, A. Yu. Mironov, S. V. Postolova, **X. Liu**, Z. Hao, D. M. Silevitch, Ya. Kopelevich, P. Kim, C. A. Trugenberger, V. M. Vinokur. "Bosonic topological insulator intermediate state in the superconductor-insulator transition." *Physical Review A*, 384, 126570 (2020), [\[Link\]](#).
12. Y. Xie, B. Lian, B. Jack, **X. Liu**, C. Chiu, K. Watanabe, T. Taniguchi, B.A. Bernevig, A. Yazdani†. "Spectroscopic signatures of many-body correlations in magic-angle twisted bilayer graphene." *Nature* 572, 101–105 (2019), [\[Link\]](#).
13. J. Y. Lee, E. Khalaf, S. Liu, **X. Liu**, Z. Hao, P. Kim, A. Vishwanath†. "Theory of correlated insulating behaviour and spin-triplet superconductivity in twisted double bilayer graphene." *Nature Communications* 10, 5333 (2019), [\[Link\]](#).
14. B. Jiang, G. Ni, Z. Addison, J. Shi, **X. Liu**, S. Zhao, P. Kim, E. Mele, D. Basov & M. Fogler†. "Plasmon reflections by topological electronic boundaries in bilayer graphene." *Nano letters* 17 (11), 7080-7085 (2017), [\[Link\]](#).
15. **X. Liu**, L. Wang, K. C. Fong, Y. Gao, P. Maher, K. Watanabe, T. Taniguchi, J. Hone, C. R. Dean & P. Kim†. "Frictional magneto-Coulomb drag in graphene double-layer heterostructures." *Physical Review Letters*, 119, 056802 (2017), [\[Link\]](#).
16. J. Crossno, J. K. Shi, K. Wang, **X. Liu**, A. Harzheim, A. Lucas, S. Sachdev, P. Kim, T. Taniguchi, K. Watanabe, T. A. Ohki & K. C. Fong†. "Observation of the Dirac fluid and the breakdown of the Wiedemann-Franz law in graphene." *Science* 351, 1058–1061 (2016), [\[Link\]](#).

17. J. Crossno, **X. Liu**, T. A. Ohki, P. Kim & K. C. Fong†. "Development of high frequency and wide bandwidth Johnson noise thermometry." *Appl. Phys. Lett.* 106, 23121 (2015), [\[Link\]](#).

FELLOWSHIPS AND AWARDS

- The Lee Osheroff Richardson (LOR) Science Prize, Oxford Instruments, 2023
- Outstanding Chinese Self-Financed Students Abroad, China Scholarship Council, 2020
- Princeton Materials Science Postdoctoral Fellowship, Princeton Center for Complex Materials, 2019

PRESENTATIONS

Invited Presentations

Physics Seminar, The Hong Kong University of Science and Technology, online, April 2023

"VdW Heterostructures: A New Route to Quantum Matter. "

Physics Faculty Seminar, Cornell University, April 2023

"Visualizing electron orders in two-dimensional quantum materials. "

Colloquium, University of California, Davis, April 2023

"Visualizing emergent electron orders in 2D materials. "

Condensed Matter Seminar, University of California, Davis, April 2023

"VdW heterostructures: a new route to quantum matter. "

MSE Seminar, University of Pennsylvania, Mar 2023

"VdW heterostructures: a new route to designing quantum material. "

QMC Condensed Matter Colloquium, University of Maryland, Mar 2023

"VdW heterostructures: a new route to quantum matter. "

Condensed Matter Seminar, University of Massachusetts Amherst, Mar 2023

"VdW heterostructures: a new route to designing quantum matters. "

Physics Seminar, Purdue University, Feb 2023

"Visualizing emergent electron orders in two-dimensional quantum materials. "

R. G. Herb Condensed Matter Seminar, University of Wisconsin–Madison, Feb 2023

"VdW heterostructures: a new route to designing quantum matters. "

LASSP&AEP Seminar, Cornell University, Feb 2023

"Visualizing emergent electron orders in two-dimensional quantum materials. "

Condensed Matter Seminar, University of Illinois Urbana-Champaign, Feb 2023

"More layers are different: designing quantum matter with assembled heterostructures. "

CQS Seminar, University of Texas at Austin, Feb 2023

"VdW heterostructures: a new route to designing quantum matters. "

Condensed Matter Seminar, University of Florida, Jan 2023

"VdW heterostructures: a new route to designing quantum matters. "

MSE Seminar, National University of Singapore, online, Dec 2022

"Visualize emergent electron orders in two-dimensional quantum materials. "

AVS 68th International Symposium & Exhibition, Pittsburgh, PA, Nov 2022

"Visualize emergent electron orders in two-dimensional quantum materials. "

Gordon and Betty Moore Foundation EPiQS Postdoctoral Symposium, Beverly, MA, May 2022.

"Visualize emergent electron orders in two-dimensional quantum materials. "

Seminar, University of California Riverside, Riverside, CA, May 2022.

"Visualize emergent electron orders in two-dimensional quantum materials."

Seminar, University of Washington, Seattle, WA, April 2022.

"Visualize emergent electron orders in two-dimensional quantum materials."

Physics Colloquium, University of Chicago, online, Jan. 2022.

"Visualizing emergent electron orders in 2D materials."

Condensed Matter Seminar, University of California Berkeley, online, Nov. 2021.

"Visualizing broken symmetry, topological excitations and Landau orbits in the graphene quantum Hall system."

MRSEC Meeting, University of Texas at Austin, online, Nov. 2021.

"Visualizing broken symmetry and topological excitations in a graphene quantum Hall ferromagnet."

APS March Meeting, Mar. 2020 (cancelled due to COVID).

"Spin-polarized correlated insulator and superconductor in twisted double bilayer graphene."

Emergent Phenomena in Quantum Hall Systems (EPQHS-7), Beijing, China, June 2019.

"Emergent phenomena in graphene double-layers: from exciton condensation to interlayer fractional quantum Hall effect."

Boston Area Carbon Nanoscience Meetings, Cambridge, MA, Oct. 2017.

"Novel Exciton Phases in Graphene Double-Layer Heterostructures."

Boston Area Carbon Nanoscience Meetings, Cambridge, MA, Sep. 2016.

"Exciton superfluidity in graphene double-layers."

Condensed Matter Theory Seminar, Harvard University, Cambridge, MA, Mar. 2016.

"Coulomb Drag and exciton condensation in graphene double layers."

Contributed Presentations

APS March Meeting, Las Vegas, NV, Mar. 2023.

"Scanning tunneling spectroscopy of exciton condensate in graphene double-layers."

GRC on Two Dimensional Electronics Beyond Graphene, Manchester, NH, June 2022.

"Visualize emergent electron orders in two-dimensional quantum materials."

APS March Meeting, Chicago, IL, Mar. 2022.

"Scanning tunneling spectroscopy of quantum Hall ferromagnetic states in graphene."

APS March Meeting, Boston, MA, Mar. 2019.

"Spin-polarized correlated insulator and superconductor in twisted double bilayer graphene."

KITP Workshop: Correlations in Moire Flat Bands, Santa Barbara, CA, Jan. 2019.

"Spin-polarized correlated insulator and superconductor in twisted double bilayer graphene."

23rd International Conference on High Magnetic Fields in Semiconductor Physics, Toulouse, France, June 2018.

"Observation of interlayer anyon pairing through fractional quantum Hall drag."

GRC on Two Dimensional Electronics Beyond Graphene, Easton, MA, June 2018.

"BEC-BCS crossover of exciton condensation in graphene double-layer."

APS March Meeting, Los Angeles, CA, Mar. 2018.

"BEC-BCS crossover of exciton condensation in graphene double-layer."

APS March Meeting, New Orleans, LA, Mar. 2017.

"Quantum Hall drag of exciton condensation in bilayer graphene double layer."

33rd International Conference on the Physics of Semiconductors, Beijing, China, Aug. 2016.

"Coulomb drag and exciton condensation in graphene quantum hall double layers."

APS March Meeting, Baltimore, MD, Mar. 2016.

"Anomalous Coulomb drag in bilayer graphene double layers."

Big Ideas in Quantum Material, San Diego, CA, Dec. 2015.

"Anomalous Coulomb drag in bilayer graphene double layers."

APS March Meeting, San Antonio, TX, Mar. 2015.

"Coulomb drag in graphene quantum Hall bilayer systems."

APS March Meeting, Denver, CO, Mar. 2014.

"Magnetoelectric and Hall drag in graphene double-layer."

PROFESSIONAL SERVICE

Journal Reviewer

Nature, Physical Review Letter, Nature Communications, Nano Letters, Physical Review B, Applied Physics Letters, Synthetic Metals and Transactions on Electron Devices.

Leadership

Session Moderator, AVS 68, Nov. 2022

Discussion Leader, Gordon Research Seminar, June 2022

Session Chair, APS March Meeting, Mar. 2022

Organizer, Princeton Summer School on Condensed Matter Physics, June 2020

Organizer, Kim-Yacoby condensed matter journal club