Wencan Jin

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Research Interest

Exotic orders emerging from the interplay between the lattice, charge, spin and orbital degrees of freedom at interfaces of van der Waals and molecular-beam-epitaxy heterostructures, by both developing laboratory-based linear/nonlinear optical spectroscopy techniques and exploiting synchrotron-based photoemission spectroscopy/microscopy.

Education

Columbia University — New York, NY, USA
Ph.D. in Applied Physics — Dec. 2016
Thesis: Electronic Structure and Surface Physics of Two-dimensional Material MoS_2
Supervisor: Richard M. Osgood Jr.

Renmin University of China — Beijing, China
B.S. in Physics — Jun. 2011
Supervisor: Shancai Wang, Hong Ding

Research Experience

Postdoctoral Researcher, University of Michigan — 2017 -- Present
Supervisor: Liuyan Zhao
Scientific interest: Electronic and magnetic orders in spin-orbit-coupled correlated systems, two-dimensional materials and ferroic materials.

- Revealed disorder-interrupted unidirectional charge order in La-doped spin-orbit coupled weak Mott insulator $Sr_3Ir_2O_7$
- Observed two branches of spin waves in a two-dimensional honeycomb Ising ferromagnet CrI_3
- Identified the ferro-rotational domains and corresponding conjugate field in a type-II multiferroic compound $RbFe(MoO_4)_2$
- Resolved the symmetry of the unconventional magnetic excitations in a spin-orbit-coupled bilayer magnet $Sr_3Ir_2O_7$ (on going)
- Revealed a net polarization present in the tetragonal phase of the perovskite solar cell $CH_3NH_3PbI_3$ (on going)

Experimental techniques: Linear and nonlinear optical spectroscopy with symmetry, spatial and temporal resolutions.

- Polarized Raman spectroscopy
- Rotation-anisotropic second harmonic generation
- Time-resolved optical reflectivity spectroscopy

Graduate Research Assistant, Columbia University — 2011 -- 2016
Supervisor: Richard M. Osgood Jr.
Scientific interest: How the dimensionality and the local geometry affect electronic structures of two-dimensional materials.

- Revealed the thickness dependent electronic structure of MoS_2 and WSe_2
- Investigated the substrate-induced electronic structure changes in monolayer MoS_2
- Revealed the electronic structure of graphene/MoS_2 heterostructure tuned via interlayer twist

- Demonstrated electronic structure of epitaxial SnSe topological crystalline insulator can be tuned by surface termination and unraveled the mechanism that stabilizes the polar surface

Experimental Techniques: Synchrotron-based photoemission spectroscopy and microscopy with capability of real-time imaging and *in situ* structural, chemical and electronic analysis.

- Angle-resolved photoemission spectroscopy (ARPES)
- Low energy electron microscopy (LEEM)
- Photoemission electron microscopy (PEEM)

Publications

$*$ denotes equal contribution.

Manuscripts in preparation

20. Symmetry-resolved magnetic excitations in a strong spin-orbit-coupled bilayer magnet
    S. Li, W. Jin*, Z. Porter, R. Merlin, S. D. Wilson, K. Sun, and L. Zhao
19. Multipole conjugate field coupling to a ferro-rotational order revealed by second harmonic generation
    W. Jin, E. Drueke, K. Mattioli, S. Li, A. Admasu, J. W. Kim, Y. Wang, S.-W. Cheong, and L. Zhao

Manuscripts under review

18. Polarized Raman spectroscopy study of metallic $(Sr_{1-x}La_x)_3Ir_2O_7$: a consistent picture of disorder-interrupted unidirectional charge order
    W. Jin, S. Li, J. Liu, Q. Han, Z. Porter, C. Peterson, J. Schmehr, I. Boulares, K. Sun, R. Merlin, S. D. Wilson, and L. Zhao
    arXiv: 1810.09087 (2018)

Peer-reviewed journals

17. Two terahertz spin waves in a two-dimensional honeycomb Ising ferromagnet
    W. Jin, H. H. Kim, Z. Ye, S. Li, P. Rezaie, F. Diaz, S. Siddiq, E. Wauer, B. Yang, C. Li, S. Tian, K. Sun, H. Lei, A. W. Tsen, L. Zhao, and R. He
    arXiv: 1808.00168 (2018). (**Accepted by Nature Communications**)
16. Excitation and characterization of image potential state electrons on quasi-free-standing graphene
    Y. Lin, Y. Li, J. T. Sadowski, W. Jin, J. I. Dadap, M. S. Hybertsen, R. M. Osgood
    Physical Review B 97, 165413 (2018).
15. Surface buckling of black phosphorus: Determination, origin, and influence on electronic structure
    Z. Dai, W. Jin, J.-X. Yu, M. Grady, J. T. Sadowski, Y. D. Kim, J. Hone, J. I. Dadap, J. Zang, R. M. Osgood, and K. Pohl
    Physical Review Materials 1, 074003 (2017).
14. Electronic structure of the metastable epitaxial rock-salt SnSe $\{111\}$ topological crystalline insulator
    W. Jin, S. Vishwanath, J. Liu, L. Kong, R. Lou, Z. Dai, J. Sadowski, X. Liu, H.-H. Lien, A. Chaney, Y. Han, M. Cao, J. Ma, T. Qian, S. Wang, M. Dobrowolska, J. Furdyna, D. A. Muller, K. Pohl, H. Ding, J. I. Dadap, H. G. Xing, and R. M. Osgood, Jr
    Physical Review X 7, 041020 (2017).
13. Engineering the structural and electronic phases of $MoTe_2$ through W substitution
    D. Rhodes, D. A. Chenet, B. E. Janicek, C. Nyby, Y. Lin, W. Jin, D. Edelberg, E. Mannebach, N. Finney, A. Antony, T. Schiros, T. Klarr, A. Mazzoni, M. Chin, Y.-C. Chiu, W. Zheng, Q. R. Zhang, F. Ernst, J. I. Dadap, X. Tong, J. Ma, R. Lou, S. Wang, T. Qian, H. Ding, R. M. Osgood, Jr., D. W. Paley, A. M. Lindenberg, P. Y. Huang, A. N. Pasupathy, M. Dubey, J. Hone, and L. Balicas
    Nano Letters 17, 1616 (2017).

12. Two-color filed enhancement at an STM junction for spatiotemporally resolved photoemission
X. Meng, W. Jin, H. Yang, J. I. Dadap, R. M. Osgood, A. Dolocan, P. Sutter, and N. Camilone
Optics Letter 42, 2651 (2017).

11. Surface Structure of bulk 2H-MoS_2 (0001) and exfoliated suspended monolayer MoS_2: A selected area low energy electron diffraction study
Z. Dai, W. Jin, M. Grady, J. T. Sadowski, J. I. Dadap, R. M. Osgood, K. Pohl
Surface Science 660, 16 (2017).

10. Rigorous theoretical analysis of a surface-plasmon nanolaser with monolayer MoS_2 gain medium
X. Meng, R. R. Grote, W. Jin, J. I. Dadap, N. C. Panoiu, and Richard M. Osgood, Jr.
Optics Letters 41, 2636 (2016).

9. Direct measurement of the tunable electronic structure of bilayer MoS_2 by interlayer twist
P.-C. Yeh, W. Jin, N. Zaki, J. Kunstmann, D. Chenet, G. Arefe, J. T. Sadowski, J. I. Dadap, P. Sutter, J. Hone, and R. M. Osgood, Jr.
Nano Letters 16, 953 (2016).

8. Tuning the electronic structure of monolayer graphene/MoS_2 van der Waals heterostructure via interlayer twist
W. Jin, P.-C. Yeh, N. Zaki, D. Chenet, G. Arefe, Y. Hao, A. Sala, T. O. Mentes, J. I. Dadap, A. Locatelli, James Hone, and Richard M. Osgood, Jr.
Physical Review B 92, 201409(R) (2015). **(Editors' Suggestion)**

7. Sudden gap closure across the topological phase transition in $Bi_{2-x}In_xSe_3$
R. Lou, Z. Liu, W. Jin, H. Wang, Z. Han, K. Liu, X. Wang, T. Qian, Y. Kushnirenko, S.-W. Cheong, R. M. Osgood Jr., H. Ding, and Shancai Wang
Physical Review B 92, 115150 (2015).

6. Layer-dependent electronic structure of an atomically heavy two-dimensional dichalcogenide
P.-C. Yeh, W. Jin, N. Zaki, D. Zhang, J. T. Liou, J. T. Sadowski, A. Al-Mahboob, J. I. Dadap, I. P. Herman, P. Sutter, and Richard M. Osgood, Jr.
Physical Review B 91, 041407(R) (2015). **(Editors' Suggestion)**

5. Substrate interaction with suspended and supported monolayer MoS_2: angle-resolved photoemission spectroscopy
W. Jin, P.-C. Yeh, N. Zaki, D. Zhang, J. T. Liou, J. T. Sadowski, A. Barinov, M. Yablonskikh, J. I. Dadap, P. Sutter, I. P. Herman, and Richard M. Osgood, Jr.
Physical Review B 91, 121409(R) (2015).

4. Quasiparticle interference, quasiparticle interactions, and the origin of the charge density wave in 2H-$NbSe_2$
C. Arguello, E. Rosenthal, E. Andrade, W. Jin, P. Yeh, N. Zaki, S. Jia, R. Cava, R. Fernandes, A. Millis, T Valla, R. M. Osgood, Jr., and A. N. Pasupathy
Physical Review Letters 114, 037001 (2015). **(Editors' Suggestion & On the Cover)**

3. Probing substrate-dependent long-range surface structure of single-layer and multilayer MoS_2 by low-energy electron microscopy and microprobe diffraction
P.-C. Yeh, W. Jin, N. Zaki, D. Zhang, J. T. Sadowski, A. Al-Mahboob, A. M. van der Zande, D. A. Chenet, J. I. Dadap, I. P. Herman, Peter Sutter, James Hone, and Richard M. Osgood, Jr.
Physical Review B 89, 155408 (2014).

2. Direct measurement of the thickness-dependent electronic band structure of MoS_2 using angle-resolved photoemission spectroscopy
W. Jin, P.-C. Yeh, N. Zaki, D. Zhang, J. T. Sadowski, A. Al-Mahboob, A. M. van der Zande, D. A. Chenet, J. I. Dadap, I. P. Herman, Peter Sutter, James Hone, and Richard M. Osgood, Jr.
Physical Review Letters 111, 106801 (2013).

1. Absence of a holelike Fermi surface for the iron-based $K_{0.8}Fe_{1.7}Se_2$ superconductor revealed by angle-resolved photoemission spectroscopy
   T. Qian, X.-P. Wang, W.-C. Jin, P. Zhang, P. Richard, G. Xu, X. Dai, Z. Fang, J.-G. Guo, X.-L. Chen, and H. Ding
   Physical Review Letters 106, 187001 (2011).

Presentations

Invited talks

5. Raman Spectroscopy Studies of Charge Order in Metallic La-doped $Sr_3Ir_2O_7$
   Department of Physics, University of Michigan, MI, Oct. 31, 2017
4. Electronic Structure and Surface Physics of Two-dimensional Materials
   Department of Physics, University of New Hampshire, NH, Dec. 7, 2016
3. Electronic Structure and Surface Physics of Transition Metal Dichalcogenides
   Department of Physics, University of Michigan, MI, Dec. 2, 2016
2. Applications of LEEM/PEEM in Electronic Structure and Surface Physics of Atomically Thin Materials
   Center for Functional Nanomaterials, Brookhaven National Laboratory, NY, Nov. 17, 2016
1. Electronic- and Surface Structure of Transition Metal Dichalcogenides and van der Waals Interfaces
   Center for Nanophase Materials Sciences, Oak Ridge National Laboratory, TN, Jun. 13, 2016

Contributed talks

7. Raman Spectroscopy Study of Charge Order Excitations in Metallic $(Sr_{1-x}La_x)_3Ir_2O_7$
   APS March Meeting, Los Angeles, CA; March 5-9, 2018
6. Observation of Oscillatory Relaxation in the Sn-terminated Surface of Epitaxial Rock-salt SnSe $\{111\}$ Topological Crystalline Insulator
   APS March Meeting, New Orleans, LA; March 13-17, 2017
5. SPELEEM Studies on the Surface and Electronic Structure of Halide Perovskites
   AVS 62nd International Symposium & Exhibition, San Jose, CA; October 18-23, 2015.
4. Direct Measurements of the Electronic Structure of Twisted Graphene/MoS_2 van der Waals Heterostructures
   International Conference on Electron Spectroscopy and Structure, Stony Brook, NY; September 28 - October 2, 2015.
3. SPE-LEEM Studies on the Electronic Structure of MoS_2/Graphene Heterostructure
   APS March Meeting, San Antonio, TX; March 2-6, 2015.
2. SPE-LEEM Studies on the Surface and Electronic Structure of 2D Transition Metal Dichalcogenides (Part II)
   APS March Meeting, Denver, CO; March 3-7, 2014.
1. Direct Measurement of the Thickness-Dependent Electronic Band Structure of MoS_2 using Angle-Resolved Photoemission Spectroscopy
   Young Researcher Symposium, Brookhaven National Laboratory, NY; November 15, 2013.

Honors & Awards

- Graduate student professional development scholarship, Columbia University 2015
- Outstanding Undergraduate Thesis, Renmin University of China 2011

Synergistic Activities

- Referees of *Physical Review X, Physical Review Letters, Physical Review B*, and *Nano Letters*
- Organizer of Girls Science Day at Columbia University
- Organizer of OSA Columbia student chapter Maker Faire event at New York Hall of Science

Teaching & Mentoring

- Teaching assistant of Partial Differential Equation and Quantum Mechanics in Solids at Columbia University, 2011-2012
- Mentored University of Michigan undergraduate student Yanyu Jia and Austin Kaczmarek on experimental technique and data analysis of autocorrelation
- Mentored University of Michigan graduate student Siwen Li on Raman spectroscopy and pump probe optical reflectivity

References

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