

Zhenzhong Shi

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PROFESSIONAL PREPARATION

- University at Buffalo – SUNY Physics Ph.D. 2013
- University at Buffalo – SUNY Electrical Engineering M.S. 2013
- University of Science and Technology of China (USTC) Physics B.S. 2006

PROFESSIONAL APPOINTMENTS

2017-present Postdoctoral Associate, Duke University, Durham, NC
2013-2017 Postdoctoral Associate, National High Magnetic Field Laboratory, Tallahassee, FL
2007-2013 Graduate Student Research Assistant, University at Buffalo – SUNY, Buffalo, NY

RESEARCH EXPERIENCE

Postdoctoral Associate, Duke University

2017 - present

1. Lead the studies of magnetization of chemically doped Shastry-Sutherland system $\text{SrCu}_{2-x}\text{Mg}_x(\text{BO}_3)_2$ in high magnetic fields (H up to 60 T) at ambient and high pressure (P up to 2.2 GPa).
2. Lead the study of the charge density wave and its interplay with superconductivity in one-dimensional superconductor $\text{Ta}_4\text{Pd}_3\text{Te}_{16}$ at high pressure, using synchrotron x-ray diffraction.
3. Lead the study of the phonon dispersion near a pressure-induced bi-critical point of $\text{Ca}_{0.73}\text{La}_{0.27}\text{FeAs}_2$ ($\text{CaLa}112$) with inelastic synchrotron X-ray scattering.
4. Lead the magnetization studies and collaborated in the neutron scattering studies of (1) the quantum spin liquid candidates $\text{Yb}(\text{Mg,Zn})\text{GaO}_4$; and (2) the breathing pyrochlore $\text{Ba}_3\text{Yb}_2\text{Zn}_5\text{O}_{11}$.
5. Participated in single crystal growth and characterization of new quantum magnet systems, with a focus on low-dimensional geometrically frustrated system.

Postdoctoral Associate, National High Magnetic Field Laboratory

2013 - 2017

6. Studied the magneto-transport properties of a series of underdoped cuprate superconductors near their magnetic-field-driven superconducting transitions at low temperatures (T down to 0.016 K) and high magnetic fields (H up to 45 T).
7. Studied the nature of thermal transition to superconducting state on highly underdoped $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$.

Research Assistant, Department of Physics, University at Buffalo – SUNY

2007 - 2013

8. Developed the technique for measuring ultra-small low frequency $1/f$ conductance fluctuations (electrical noise) and used it to study strongly correlated electron systems, including (1) one-dimensional charge density wave conductors NbSe_3 , NbS_3 , TaS_3 , (2) VO_2 near its metal-insulator transition, and (3) 2D and 1D amorphous InO_x near their superconductor-insulator phase transitions.

PUBLICATIONS

1. Xiaoyan Shi, **Zhenzhong Shi**, and Dragana Popovi , “[Low-temperature resistance noise spectroscopy as a probe of the superconducting transition in underdoped \$\text{La}_{2-x}\text{Sr}_x\text{CuO}_4\$](#) ”, Proc. SPIE **10105**, 1010503 (2017).
2. **Zhenzhong Shi**, Xiaoyan Shi, and Dragana Popovi , “[Evidence for correlated dynamics near the Berezinskii-Kosterlitz-Thouless-like transition in a highly underdoped \$\text{La}_{2-x}\text{Sr}_x\text{CuO}_4\$](#) ”, Phys. Rev. B **94**, 134503 (2016).
3. P. G. Baity, Xiaoyan Shi, **Zhenzhong Shi**, L. Benfatto, and Dragana Popovi , “[Effective 2D thickness for the Berezinskii-Kosterlitz-Thouless-like transition in a highly underdoped \$\text{La}_{2-x}\text{Sr}_x\text{CuO}_4\$](#) ”, Phys. Rev. B **93**, 024519 (2016).
4. **Zhenzhong Shi**, Paul Baity, and Dragana Popovi , “[Current-voltage characteristics and vortex dynamics in highly underdoped \$\text{La}_{2-x}\text{Sr}_x\text{CuO}_4\$](#) ”, J. Supercond. Nov. Magn. **29**, 651 (2016).
5. Katie E. Farley*, **Zhenzhong Shi***, G. Sambandamurthy, and Sarbajit Banerjee, “[Charge density waves in individual nanoribbons of orthorhombic- \$\text{TaS}_3\$](#) ”, Phys. Chem. Chem. Phys. **17**, 18374 (2015).
[*Co-first Author]
6. Sujay Singh, Gregory Horrocks, Peter M. Marley, **Zhenzhong Shi**, Sarbajit Banerjee, and G. Sambandamurthy, “[Proliferation of metallic domains caused by inhomogeneous heating near the electrically driven transition in \$\text{VO}_2\$ nanobeams](#)”, Phys. Rev. B **92**, 155121 (2015).

Under Review:

1. **Zhenzhong Shi**, P. G. Baity, T. Sasagawa, and Dragana Popovi , “[Hidden order of Cooper pairs in striped cuprates at high magnetic fields](#)”, under review at Nature.
2. **Zhenzhong Shi**, P. G. Baity, T. Sasagawa, and Dragana Popovi , “[Vortex phase diagram of underdoped cuprates: A unified perspective](#)”, under review at Nat. Comm.
3. **Zhenzhong Shi**, W. Steinhardt, D. Graf, P. Corboz, D. F. Weickert, N. Harrison, M. Jaime, C. Marjerrison, H. Dabkowska, F. Mila, S. Haravifard, “[Emergent impurity pairs in chemically doped Shastry-Sutherland system](#)”, submitted to Nat. Comm.

Preprint:

1. W. Steinhardt, **Zhenzhong Shi**, A. Samarakoon, S. Dissanayake, H. Lu, B. Popovic, D. Graf, Y. Liu, C. Marjerrison, C. Batista, S. Haravifard, “Investigating the Quantum vs Classical Nature of the Spin Liquid State in $\text{Yb}(\text{Mg,Zn})\text{GaO}_4$ ”, preprint (to be submitted to Science).
2. S. Kuhn, **Zhenzhong Shi**, F. Flicker, T. Helm, J. Lee, B. Popovic, D. Graf, J.P.C. Ruff, S. Haravifard, “Direct Observation of Charge Density Wave in the One-dimensional Superconductor $\text{Ta}_4\text{Pd}_3\text{Te}_{16}$ ”, preprint (to be submitted to Phys. Rev. Lett.).
3. **Zhenzhong Shi**, Sachith Dissanayake, Dipanshu Bansal, Wenli Bi, Ahmet Alatas, Steve Kuhn, Brodie Popovic, Eve Emmanouilidou, Ni Ni, Olivier Delaire, Ayman Said, Sara Haravifard, “Observation of low-energy phonon anomalies in $\text{Ca}_{0.73}\text{La}_{0.27}\text{FeAs}_2$ ”, preprint.
4. **Zhenzhong Shi**, Peter M. Marley, Katie E. Farley, Sarbajit Banerjee, and G. Sambandamurthy, “Non-monotonic resistance noise in the charge density wave pinned state in single nanoribbons of CDW conductor NbSe_3 ”, preprint.

PRESENTATIONS

Invited talks:

1. “Field-induced emergent bound states in doped Shastry-Sutherland model systems”, The 12th Intl. Conference on Research in High Magnetic Fields (RHMF 2018), Santa Fe, NM, June 2018
2. “Hidden order of Cooper pairs in a striped cuprate at high magnetic fields”, seminar at Duke University, Durham, NC, April 2017
3. “Magnetotransport studies of underdoped stripe-ordered cuprate superconductors”, seminar at the Pulsed Field Facility, Los Alamos National Laboratory, Los Alamos, NM, October 2016

Contributed presentations (as presenting author):

1. “High Magnetic Field, High Pressure Studies of Emergent Bound States in Chemically Doped Shastry-Sutherland System”, (Zhenzhong Shi, W. Steinhardt, D. Graf, P. Corboz, M. Jaime, Y. Liu, D. Silevitch, C. Marjerrison, H. Dabkowska, T. Rosenbaum, F. Mila, S. Haravifard), March meeting of American Physical Society, Los Angeles, CA, March 2018
2. “Hidden order of Cooper pairs in a striped cuprate at high magnetic fields”, (Zhenzhong Shi, P. G. Baity, T. Sasagawa, Dragana Popovi), March meeting of American Physical Society, New Orleans, LA, March 2017
3. “Anomalous high-field-induced phase in underdoped $\text{La}_{1.7}\text{Eu}_{0.2}\text{Sr}_{0.1}\text{CuO}_4$ ”, (Zhenzhong Shi, P. G. Baity, T. Sasagawa, Dragana Popovi), March meeting of American Physical Society, Baltimore, MD, March 2016
4. “Signatures of the Berezinskii-Kosterlitz-Thouless transition in highly underdoped $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ ”, (Zhenzhong Shi, X. Shi, Dragana Popovi), March meeting of American Physical Society, San Antonio, TX, March 2015
5. “Low frequency noise behavior in mesoscopic charge density wave conductors of o-TaS₃ and NbSe₃”, (Zhenzhong Shi, P. M Marley, K. Farley, S. Banerjee, G. Sambandamurthy), March meeting of American Physical Society, Denver, CO, March 2014
6. “1/f noise anomalies in nanoribbons of charge density wave materials”, (Zhenzhong Shi, P. M Marley, K. Farley, S. Banerjee, G. Sambandamurthy), March meeting of American Physical Society, Baltimore, MD, March 2013
7. “Finite Size Effects in Nanoribbons of Quasi-one Dimensional Charge Density Wave Materials”, (Zhenzhong Shi, P. M Marley, S. Banerjee, G. Sambandamurthy), Fall Meeting & Exhibit of Materials Research Society, Boston, MA, November 2012
8. “Low frequency resistance fluctuations in nanoribbons of charge density wave (CDW) conductor NbSe₃”, (Zhenzhong Shi, P. M Marley, S. Banerjee, G. Sambandamurthy), March meeting of American Physical Society, Boston, MA, February 2012

Posters (presenting author underlined):

1. “Correlated Dynamics near the Berezinskii-Kosterlitz-Thouless-like transition in a highly underdoped $\text{La}_{2-x}\text{Sr}_x\text{CuO}_4$ ”, (Zhenzhong Shi, P. G. Baity, T. Sasagawa, Dragana Popovi), conference on Quantum Dynamics: From Models to Materials, Aspen Center for Physics, Aspen, CO, January 2017

2. “Magnetoresistance studies of highly underdoped superconducting $\text{Bi}_2\text{Sr}_2\text{CaCu}_2\text{O}_{8+x}$ films”, (Zhenzhong Shi, H. Raffy, Z. Z. Li, P. Senzier, V. Jovanovic, Dragana Popovi), Conference of Physical Phenomena at High Magnetic Fields - 8, Tallahassee, FL, January 2016
3. “Angle-dependent transport across the superconductor-insulator transition in amorphous indium oxide films”, (M. Kim, Zhenzhong Shi, G. Sambandamurthy), NYSS-APS 105th Topical Symposium, SUNY College at Oneonta, Oneonta, NY, October 2011

SKILLS

Experiment Techniques

1. Transport techniques

- Electrical transport measurements.
- Noise spectroscopy and higher-order statistics.

2. Magnetization measurement techniques

- SQUID magnetization measurements.
- Tunnel diode oscillator (TDO) measurements
- Two-coil mutual inductance/ac susceptibility measurements.
- Magnetic torque measurements.
- Magnetostriction measurements.

3. Scattering techniques

- Neutron scattering (single crystal diffuse scattering/inelastic scattering/diffraction).
- Synchrotron X-ray scattering (single crystal non-resonant inelastic scattering/diffraction).

4. Programming

- Labview, Python, Mathematica, Matlab, C and C++.

Sample Environments

5. Low temperature cryogenic systems

- Dilution refrigerator, ^3He cryomagnet system, Physical Property Measurement System (PPMS), Magnetic Property Measurement System (MPMS), and Liquid Helium Variable Temperature Insert (VTI).

6. High magnetic field

- The dc-field user facility (superconducting magnets up to 18 T and resistive magnets up to 45 T) at NHMFL, Tallahassee, and the pulsed field user facility (pulsed fields up to 60 T) at NHMFL-LANL, Los Alamos.

7. High pressure

- Piston cylinder pressure cell (magneto-transport, neutron scattering)
- Diamond anvil cell (inelastic X-ray scattering, X-ray diffraction)

Sample growth/preparation

8. Solid-state reaction for polycrystal/powder systems

9. Single crystal growth

- Optical floating zone technique
- Flux method

10. Device fabrication

- UV, E-beam and Focused Ion Beam (FIB) lithography.
- Thin film deposition (E-beam and thermal).
- RIE and wet etching.
- Material characterization using AFM, SEM, STM, and TEM and Raman spectroscopy.

HONORS AND AWARDS

1. Postdoctoral Scholars Career Development Travel Awards, NHMFL/FSU 2016
2. Silvestro Graduate Fellowship, University at Buffalo – SUNY 2012
3. Travel award for NYSS-APS Symposium, University at Buffalo – SUNY 2011
4. Outstanding Student Scholarship, USTC 2003 - 2005

TEACHING EXPERIENCE

1. Instructor for College Physics Lab PHY 151, 152, 158 and 257. Fall 2008 – Spring 2012
2. Assistant to the Director of undergraduate physics lab. Spring 2012

OUTREACH/SERVICE ACTIVITIES

1. The Magnet Lab Annual Open House: volunteer 2014-2017
2. Condensed matter physics journal club at Duke University: chair 2017-present