Yi Lu

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Contact Information

National Laboratory of Solid State Microstructures and
Department of Physics,
Nanjing University,
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Education

Max Plack Institut für Festköperforschung, Stuttgart, Germany
University of Stuttgart, Stuttgart, Germany

Ph.D. in Physics, Sep. 2017

- Thesis Topic: *X-ray spectroscopy study of transition metal oxides*
- Advisor: Prof. Bernhard Keimer
- *summa cum laude*

M.Sc. in Physics, Nov. 2012

- Topic: *Structural and Electronic Properties of Perovskite Rare-Earth Nickelate Superlattices*
- Advisor: Prof. Bernhard Keimer

Peking University, Beijing, China

B.Sc. in Physics (Yuanpei College), Jul 2010

Research Experience

Postdoctoral research, Oct 2017 to Apr 2021
Institut für Theoretische Physik
Host: Prof. Maurits W. Haverkort
Correlated-electron systems; X-ray spectroscopy

Doctoral Research, Nov 2012 to Sep 2017
Max Plack Institut für Festköperforschung
Advisor: Prof. Bernhard Keimer
Experimental and theoretical study of electronic structure of metal-oxide super-conductors

Visiting Student, Jul 2013 to Jul 2016
Max-Planck-Instituts für Chemische Physik fester Stoffe
Host: Prof. Maurits W. Haverkort
Dynamical mean field theory and spectroscopy in multi-orbital systems.

Visiting Student, Jul 2012 to Sep 2012
Max-Planck-UBC Centre for Quantum Materials,
University of British Columbia
Host: Prof. Maurits W. Haverkort
Density functional theory study of nickelates structure and Fermiology.

Master Research, Oct 2010 to Oct 2012
Max Plack Institut für Festköperforschung
Advisor: Prof. Bernhard Keimer
Structural and electronic properties of perovskite rare-earth nickelate superlattices studied by X-ray scattering and density functional theory.

Undergraduate Research, May 2008 to Jul 2010
Nanostructure and Low Dimensional Physics Laboratory
Department of Physics, Peking University
Advisors: Prof. Zhi-Min Liao, Prof. Da-Peng Yu
Transport properties of ZnO nanowires.

Publications

(†: equal contribution; *: correspondence)

1. Y. E. Suyolcu, K. Fürsich, M. Hepting, Z. Zhong, **Y. Lu**, Y. Wang, G. Christiani, G. Logvenov, P. Hansmann, M. Minola, B. Keimer, P. A. van Aken, and E. Benckiser, "Control of the Metal-Insulator Transition in $NdNiO_3$ Thin Films through the Interplay between Structural and Electronic Properties", *Phys. Rev. Materials* **5**, 045001 (2021).

2. N. B. Brookes, D. Betto, K. Cao, **Y. Lu**, K. Kummer, and F. Giustino, "Spin Waves in Metallic Iron and Nickel Measured by Soft x-Ray Resonant Inelastic Scattering", *Phys. Rev. B* **102**, 064412 (2020).

3. R. He, P. Jiang, **Y. Lu**, Y. Song, M. Chen, M. Jin, L. Shui, and Z. Zhong, "Polarity-Induced Electronic and Atomic Reconstruction at $NdNiO_2/SrTiO_3$ Interfaces", *Phys. Rev. B* **102**, 035118 (2020).

4. L. Si, W. Xiao, J. Kaufmann, J. M. Tomczak, **Y. Lu**, Z. Zhong, and K. Held, "Topotactic Hydrogen in Nickelate Superconductors and Akin Infinite-Layer Oxides ABO_2", *Phys. Rev. Lett.* **124**, 166402 (2020).

5. **Y. Lu**, X. Cao, P. Hansmann, and M. W. Haverkort, "Natural-Orbital Impurity Solver and Projection Approach for Green's Functions", *Phys. Rev. B* **100**, 115134 (2019).

6. A. Frano, M. Bluschke, Z. Xu, B. Frandsen, **Y. Lu**, M. Yi, R. Marks, A. Mehta, V. Borzenets, D. Meyers, M. P. M. Dean, F. Baiutti, J. Maier, G. Kim, G. Christiani, G. Logvenov, E. Benckiser, B. Keimer, and R. J. Birgeneau, "Control of dopant crystallinity in electrochemically treated cuprate thin films", *Phys. Rev. Materials* **3**, 063803 (2019).

7. C. Song, W. Xiao, L. Li, **Y. Lu**, P. Jiang, C. Li, A. Chen, and Z. Zhong, "Tunable Band Gap and Enhanced Ferromagnetism by Surface Adsorption in Monolayer $Cr_2Ge_2Te_6$", *Phys. Rev. B* **99**, 214435 (2019).

8. K. Fürsich, **Y. Lu**, D. Betto, M. Bluschke, J. Porras, E. Schierle, R. Ortiz, H. Suzuki, G. Cristiani, G. Logvenov, N. B. Brookes, M. W. Haverkort, M. Le Tacon, E. Benckiser, M. Minola, and B. Keimer, "Resonant Inelastic x-Ray Scattering Study of Bond Order and Spin Excitations in Nickelate Thin-Film Structures", *Phys. Rev. B* **99**, 165124 (2019).

9. H. Suzuki, M. Minola, **Y. Lu**, Y. Peng, R. Fumagalli, E. Lefrançois, T. Loew, J. Porras, K. Kummer, D. Betto, S. Ishida, H. Eisaki, C. Hu, X. Zhou, M. W. Haverkort, N. B. Brookes, L. Braicovich, G. Ghiringhelli, M. Le Tacon, and B. Keimer, "Probing the Energy Gap of High-Temperature Cuprate Superconductors by Resonant Inelastic x-Ray Scattering", *Npj Quantum Materials* **3**, 65 (2018).

10. **Y. Lu**†, D. Betto†, K. Fürsich, H. Suzuki, H.-H. Kim, G. Cristiani, G. Logvenov, N. B. Brookes, E. Benckiser, M. W. Haverkort, G. Khaliullin, M. Le Tacon, M. Minola, and B. Keimer, "Site-selective Probe of Magnetic Excitations in Rare-earth Nickelates using Resonant Inelastic X-ray Scattering", *Phys. Rev. X*, **8**, 031014 (2018).

11. **Y. Lu** and M. W. Haverkort, "Non-perturbative series expansion of Green's functions: The Anatomy of Resonant Inelastic X-Ray Scattering in Doped Hubbard Model", *Phys. Rev. Lett.* **119**, 256401 (2017).

12. M. Minola†, **Y. Lu**†, Y. Y. Peng, G. Dellea, H. Gretarsson, M. W. Haverkort, Y. Ding, X. Sun, X. J. Zhou, D. C. Peets, L. Chauviere, P. Dosanjh, D. A. Bonn, R. Liang, A. Damascelli, M. Dantz, X. Lu, T. Schmitt, L. Braicovich, G. Ghiringhelli, B. Keimer, and M. Le Tacon, "Sharp Crossover from Collective to Incoherent Spin Excitations in Superconducting Cuprates Probed by Detuned Resonant Inelastic X-ray Scattering", *Phys. Rev. Lett.* **119**, 097001 (2017).

13. **Y. Lu** and M. W. Haverkort, "Exact diagonalization as an impurity solver in dynamical mean field theory", *EPJ ST*, **226**, 2549 (2017).

14. **Y. Lu**, Z. Zhong, M. W. Haverkort, and P. Hansmann, "Origins of bond and spin order in rare-earth nickelate bulk and heterostructures", *Phys. Rev. B* **95**, 195117 (2017).

15. Y. X. Zhao* and **Y. Lu***, "PT-Symmetric Real Dirac Fermions and Semimetals", *Phys. Rev. Lett.* **118**, 056401 (2017).

16. A. Frano, S. Blanco-Canosa, E. Schierle, **Y. Lu**, M. Wu, M. Bluschke, M. Minola, G. Christiani, H. U. Habermeier, G. Logvenov, Y. Wang, P. A. van Aken, E. Benckiser, E. Weschke, M. Le Tacon, and B. Keimer, "Long-range charge-density-wave proximity effect at cuprate/manganate interfaces", *Nat. Mater.* **15**, 831 (2016).

17. **Y. Lu**, A. Frano, M. Bluschke, M. Hepting, S. Macke, J. Strempfer, P. Wochner, G. Cristiani, G. Logvenov, H. U. Habermeier, M. W. Haver-kort, B. Keimer, and E. Benckiser, "Quantitative determination of bond order and lattice distortions in nickel oxide heterostructures by resonant x-ray scattering", *Phys. Rev. B* **93**, 165121 (2016).

18. M. Minola, G. Dellea, H. Gretarsson, Y. Y. Peng, **Y. Lu**, J. Porras, T. Loew, F. Yakhou, N. B. Brookes, Y. B. Huang, J. Pelliciari, T. Schmitt, G. Ghiringhelli, B. Keimer, L. Braicovich, and M. Le Tacon, "Collective nature of spin excitations in superconducting cuprates probed by resonant inelastic x-ray scattering", *Phys. Rev. Lett.* **114**, 217003 (2016).

19. M. W. Haverkort, G. Sangiovanni, P. Hansmann, A. Toschi, **Y. Lu**, S. Macke, "Bands, resonances, edge singularities and excitons in core level spectroscopy investigated within the dynamical mean field theory", *EPL* **108**, 57004 (2014).

20. N. Gauquelin, E. Benckiser, M. K. Kinyanjui, M. Wu, **Y. Lu**, G. Christiani, G. Logvenov, H. U. Habermeier, U. Kaiser, B. Keimer, and G. A. Botton, "Atomically resolved EELS mapping of the interfacial structure of epitaxially strained $LaNiO_3$/ $LaAlO_3$ superlattices", *Phys. Rev. B* **90**, 195140 (2014).

21. **Y. Lu**, M. Höppner, O. Gunnarsson, M. W. Haverkort, "Efficient real frequency solver for dynamical mean field theory", *Phys. Rev. B* **90**, 085102 (2014).

22. M. K. Kinyanjui, **Y. Lu**, N. Gauquelin, M. Wu, A. Frano, P. Wochner, M. Reehuis, G. Christiani, G. Logvenov, H. U. Habermeier, G. A. Botton, U. Kaiser, B. Keimer, and E. Benckiser, "Lattice distortions and octahedral rotations in epitaxially strained $LaNiO_3/LaAlO_3$ superlattices", *Appl. Phys. Lett.* **104**, 221909 (2014).

23. A. Frano, E. Benckiser, **Y. Lu**, M. Wu, M. Castro-Colin, M. Reehuis, A. V. Boris, E. Detemple, W. Sigle, P. van Aken, G. Cristiani, G. Logvenov, H. U. Habermeier, P. Wochner, B. Keimer, and V. Hinkov, "Layer selective control of the lattice structure in oxide superlattices", *Adv. Mater.* **26**, 258 (2014).

24. M. Wu, E. Benckiser, M. W. Haverkort, A. Frano, **Y. Lu**, U. Nwankwo, S. Bruck, P. Audehm, E. Goering, S. Macke, V. Hinkov, P. Wochner, G. Christiani, S. Heinze, G. Logvenov, H. U. Habermeier, and B. Keimer, "Strain and composition dependence of orbital polarization in nickel oxide superlattices", *Phys. Rev. B* **88**, 125124 (2013).

25. A. Frano, E. Schierle, M. W. Haverkort, **Y. Lu**, M. Wu, S. Blanco-Canosa, U. Nwankwo, A. V. Boris, P. Wochner, G. Cristiani, H. U. Habermeier, G. Logvenov, V. Hinkov, E. Benckiser, E. Weschke, B. Keimer, "Orbital control of noncollinear magnetic order in nickel oxide heterostructures", *Phys. Rev. Lett.* **111**, 106804 (2013).

26. J. A. Rosen, R. Comin, G. Levy, D. Fournier, Z.-H. Zhu, B. Ludbrook, C. N. Veenstra, A. Nicolaou, D. Wong, P. Dosanjh, Y. Yoshida, H. Eisaki, G. R. Blake, F. White, T. T. M. Palstra, R. Sutarto, F. He, A. Frano, **Y. Lu**, B. Keimer, G. A. Sawatzky, L. Petaccia, A. Damascelli, "Surface-enhanced charge-density-wave instability in underdoped Bi2201", *Nat. Commun.* **4**, 1977 (2013).

27. S. Blanco-Canosa, A. Frano, T. Loew, **Y. Lu**, J. Porras, G. Ghiringhelli, M. Minola, C. Mazzoli, L. Braicovich, E. Schierle, E. Weschke, M. Le Tacon, B.

Keimer, "Momentum-Dependent Charge Correlations in $YBa_2Cu_3O_{6+\delta}$ Superconductors Probed by Resonant X-ray Scattering: Evidence for Three Competing Phases", *Phys. Rev. Lett.* **110**, 187001 (2013).

28. M. Rössle, K. W. Kim, A. Dubroka, P. Marsik, C. N. Wang, R. Jany, C. Richter, J. Mannhart, C. W. Schneider, A. Frano, P. Wochner, **Y. Lu**, B. Keimer, D. K. Shukla, J. Strempfer, C. Bernhard, "Electric-Field-Induced Polar Order and Localization of the Confined Electrons in $LaAlO_3/SrTiO_3$ Heterostructures", *Phys. Rev. Lett.* **110**, 136805 (2013).

29. Z. Liao, **Y. Lu**, H. Wu, Y. Bie, Y. Zhou, and D. Yu, "Improved performance of ZnO nanowire field-effect transistors via focused ion beam treatment", *Nanotechnology* **22**, 375201 (2011).

30. Z. Liao, **Y. Lu**, H. Zhang, D. Yu, "Hysteresis Magnetoresistance and Micromagnetic Modeling of Ni Microbelts", *JMMM* **322**, 2231 (2010).

31. Z. Liao, **Y. Lu**, J. Xu, J. Zhang, D. Yu, "Temperature dependence of photoconductivity and persistent photoconductivity of single ZnO nanowires", *Appl. Phys. A* **95**, 363 (2009).

Talks

- "Dynamical mean field theory of nickelate superlattices", Nov 2013
  Workshop on strongly correlated systems, Schloss Ringberg, Kreuth
- "Efficient real frequency solver for dynamical mean field theory", Apr 2014
  DPG spring meeting, Dresden
- "Efficient real frequency impurity solver and application in spectroscopy", Jan 2015
  University of Geneva, Geneva, Switzerland
- "X-ray spectroscopy of transition metal oxides", Feb 2015
  FOR1346 meeting, Würzburg, Germany
- "Resonant inelastic x-ray scattering of high-T_c cuprates", Mar 2015
  DPG spring meeting, Berlin, Germany
- "Efficient real frequency solver for dynamical mean field theory", Jun 2015
  Many Electron Summer School, SUNY Stony Brook, New York, NY, USA
- "Charge order in nickelate superlattices", Oct 2015
  Symposium on High Temperature Supercondictivity, Schloss Ringberg, Kreuth, Germany
- "Anatomy of resonant inelastic x-ray scattering in Hubbard model", Jul 2016
  RIXS-REXS workshop, Dresden, Germany
- "Resonant inelastic x-ray scattering in cuprate superconductors", Nov 2016
  IMPRS-PKU workshop, ICQM Peking University, Beijing, China
- "Resonant inelastic x-ray scattering in cuprate superconductors", Dec 2017
  Invited seminar, SUSTech, Shenzhen, China
- "Resonant inelastic x-ray scattering in cuprate superconductors", Dec 2017
  Invited seminar, Nanjing University, Nanjing, China
- "Magnetic Excitations in $NdNiO_3$ probed by RIXS", Sep 2018
  NGSCES 2018, Donostia-San Sebastian, Spain
- "Using QUANTY to calculate X-ray Spectroscopies", Feb 2019
  Gave a week-long workshop on X-ray spectrscopy theory and tutorials on practical calculation at UC San Diego, USA

Teaching

Teaching assistant

- Advanced Experimental Physics I, University of Stuttgart — Winter 2014
- Advanced Experimental Physics II, University of Stuttgart — Summer 2015
- Theoretical Statistical Physics, University of Heidelberg — Winter 2017
- Advanced Quantum Theory, University of Heidelberg — Summer 2018
- Theoretical Statistical Physics, University of Heidelberg — Winter 2018
- Condensed Matter Theory II, University of Heidelberg — Summer 2019

Honors and Awards

- Karl Freudenberg Prize, Heidelberger Akademie der Wissenschaft — 2019
- Otto Hahn Medal, Max Planck Society — 2018
- Fellowship from Max Planck Exzellenzstiftung — 2010 - 2012
- Excellent Achievements of Undergraduate Research, Department of Physics, Peking University — Dec 2009
- President Fund for Undergraduates' Academic and Scientific Research, Peking University — 2008 - 2009
- Mingde Scholarship (*top tier*), Peking University — 2006 - 2010

Programming Skills

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