

CONGJUN WU

Curriculum Vitae

[as of October 12, 2009]

CONTACT INFORMATION

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RESEARCH AREA

I am interested in novel phases and properties in cold atom and condensed matter systems, including strongly correlated bosonic and fermionic systems with cold atoms, orbital physics, unconventional generalization of magnetism, superconductivity, spin-orbit coupling and spintronics, excitons, transition metal oxides, quantum phase transitions and criticality, and numerical algorithms for two dimensional quantum systems.

EDUCATION

- Ph. D. in Physics, Stanford University, Jun. 2002 - Sept. 2005.
Advisor: Prof. Shou-Cheng Zhang.
Dissertation: “*Applications of the symmetry principle in cold atom and condensed matter physics*”.
- University of Illinois at Urbana-Champaign, May 2000 - May 2002.
Advisor: Prof. Eduardo H. Fradkin.
- M.S. in Physics, Peking University, Beijing, China, Sept. 1997 - Jun. 2000.
Advisor: Prof. Zhao-Bin Su.
- B.S. in Physics, Tsinghua University, Beijing, China, Sept. 1992 - Jul. 1997.

EMPLOYMENT

- Jul. 2007-* Assistant Professor, Department of Physics, University of California, San Diego.
- Aug. 2005- Jun. 31 2007* Postdoctoral Research Associate, Kavli Institute for Theoretical Physics, University of California, Santa Barbara.
Supervisors: Profs. Matthew P. A. Fisher and Leon Balents

HIRSCH CITATION INDEX: 14

HONORS, AWARDS & FELLOWSHIPS

- Alfred P. Sloan Research Fellowship, 2008.
- “Outstanding Young Researcher Award” of Overseas Chinese Physics Association, 2008.
- “Postdoctoral Prize Fellowship in Theoretical Physics or Astrophysics” at California Institute of Technology, in Dec. 2004 (declined).
- Stanford Graduate Fellowship, Stanford University, Jun. 2002 - Jun. 2005.
- Guanghai Scholarship, Peking University, Beijing, Sept. 1998 and Sept. 1999.

SCIENTIFIC DUTIES

- Proposal Reviewer for U. S. National Science Foundation, Division of Materials Research.
- Proposal Reviewer for U. S. Army Research Office.

- Referee for *Physical Review* journals, including *Physical Review Letters*, *Physical Review A*, and *Physical Review B*.
- Referee for *Nuclear Physics B*.
- Referee for *Physics Letters A*.
- Referee for *Europhysics Letters*.

TEACHING

- Instructor for physics courses (Solid State Physics, Quantum Mechanics, and Many-body theory), UC San Diego.

INVITED REVIEW ARTICLE

- Invited review article on spin-3/2 cold atomic systems, *Mod. Phys. Lett. B*, **20**, 1707 (2006).
- Invited review article on unconventional Bose-Einstein Condensation, *Mod. Phys. Lett. B*, **23**, 1 (2009).

INVITED COLLOQUIA

1. Department of Physics, **Washington University in St. Louis**, Physics Colloquia, “*Unconventional magnetism and dynamic generation of spin-orbit coupling*”, Jan. 17, 2007.
2. Department of Physics, **Washington State University**, Physics Colloquia, Nov. 17, 2009 (scheduled).

INVITED CONFERENCE TALKS

3. **Workshop of Exotic Insulating Phases of Matter**, The Johns Hopkins University, Jan. 2010 (scheduled).
4. **Canadian Institute for Advanced Research, Cold Atoms Meeting**, Halifax, Canada “*Novel orbital physics with fermions in optical lattices*”, August 12-16, 2009.
5. **American Physical Society March Meeting 2009**, Pittsburgh, PA, “*Novel orbital physics with fermions in optical lattices*”, Mar. 20, 2009.
6. **New Directions in Low-Dimensional Electron Systems (Conference)**, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, Feb 23, 2009.
7. **The 39th Winter Colloquium on the PHYSICS OF QUANTUM ELECTRONICS**, “*Novel orbital physics with fermions in optical lattices*”. Jan. 8, 2009.
8. **Academic conference for the 80-year anniversary of Institute of Physics, Chinese Academy of Sciences**, Beijing, “*Novel Orbital Physics with Cold Atoms in Optical Lattices*”, Jun. 20, 2008.
9. Department of Physics, University of Maryland, **Condensed Matter Theory Center Symposium**, “*Pomeranchuk instability and dynamic generation of spin-orbit coupling*”, Nov. 8, 2006.

INVITED SEMINAR TALKS

10. Kavli Institute for Theoretical Physics, **University of California, Santa Barbara**, “*Novel orbital physics with cold atoms – Unconventional BEC, Cooper pairing, and frustration*”, Jul. 29, 2009.
11. Department of Physics, **University of California, San Diego**, condensed matter seminar, “*Novel Orbital Physics with Cold atoms in Optical lattices*”, May 27, 2009.
12. Department of Physics, **California Institute of Technology**, condensed matter seminar, “*Novel Orbital Physics with Cold atoms in Optical lattices*”, Nov 21, 2008.
13. Department of Physics, **University of California, Riverside**, condensed matter seminar, “*Novel Orbital Physics with Cold atoms in optical lattices*”, Oct. 29, 2008.
14. Department of Physics, **University of California, Los Angeles**, condensed matter seminar, “*Novel Orbital Physics with Cold atoms in optical lattices*”, Oct. 29, 2008.

- Novel Orbital Physics with Cold atoms in Optical lattices” , Oct 22, 2008.
15. Department of Physics, **Stanford University**, condensed matter seminar, ”Novel orbital Physics with Cold atoms in Optical Lattices”, Oct. 16, 2008.
 16. Department of Physics, **University of Michigan**, condensed matter seminar, ”*Orbital Physics with Cold atom optical lattices*”, Sept. 16, 2008.
 17. Academic conference for the 80-year anniversary of **Institute of Physics, Chinese Academy of Sciences**, Beijing, ”Novel Orbital Physics with Cold Atoms in Optical Lattices”, Jun. 20, 2008.
 18. Department of Physics, **University of California, Davis**, condensed matter seminar, “Novel Orbital Physics with Cold Atoms in Optical Lattices”, April 17, 2008.
 19. Department of Physics, **University of Toronto**, condensed matter seminar, “Novel features of orbital physics of cold bosons and fermions in optical lattices”, Nov. 19, 2007.
 20. Department of Physics, **University of California, Irvine**, condensed matter seminar, “Novel features of orbital physics of cold bosons and fermions in optical lattices”, Nov. 14, 2007.
 21. Microsoft station-Q, **University of California, Santa Barbara**, “Novel features of orbital physics of cold bosons and fermions in optical lattices”, Oct. 23, 2007.
 22. Kavli Institute for Theoretical Physics, **University of California, Santa Barbara**, “Unconventional magnetism: electron liquid crystal states and dynamic generation of spin-orbit coupling”, May 16, 2007.
 23. Institute of Physics, **Chinese Academy of Sciences**, Beijing, Condensed Matter Seminar, “Unconventional magnetism: electron liquid crystal states and dynamic generation of spin-orbit coupling”, Mar. 11, 2007.
 24. Center of Advanced Studies, **Tsinghua University**, Beijing, Condensed Matter Seminar, “Unconventional magnetism: electron liquid crystal states and dynamic generation of spin-orbit coupling”, Mar. 7, 2007.
 25. Department of Physics, **University of Hong Kong**, Condensed Matter Seminar, “Unconventional magnetism and dynamic generation of spin-orbit coupling”, Feb. 28, 2007.
 26. Department of Physics, **University of Michigan**, Condensed Matter Seminar, “Unconventional magnetism and dynamic generation of spin-orbit coupling”, Feb. 20, 2007.
 27. Department of Physics, **University of Illinois at Urbana-Champaign**, Condensed Matter Seminar, “Unconventional magnetism: electron liquid crystal states and dynamic generation of spin-orbit coupling”, Feb. 15, 2007.
 28. Department of Physics, **University of Maryland**, Joint Quantum Institute seminar, “Exploring new states of matter in the p-orbital bands of optical lattices”, Feb. 05, 2007.
 29. Kavli Institute for Theoretical Physics, **University of California, Santa Barbara**, “Exploring new states of matter in the p-orbital bands of optical lattices”, Feb. 01, 2007.
 30. Department of Physics, **Pennsylvania State University, Condensed Matter Seminar**, “Unconventional magnetism and dynamic generation of spin-orbit coupling”, Jan. 24, 2007.
 31. Department of Physics, **University of California, San Diego**, Condensed Matter Seminar, “*Pomeranchuk instability and dynamic generation of spin-orbit coupling*”, Nov. 15, 2006.
 32. Department of Physics, **Ohio State University**, Cold Atom Physics Seminar, “*Quantum phases of spin-3/2 fermions*”, May 09, 2006.
 33. Department of Physics, **University of Michigan**, FOCUS (Frontiers in Optical Coherent and Ultrafast Science) Seminar, “*Hidden symmetry and novel phases in spin-3/2 cold atomic systems*”, Apr. 06, 2006.
 34. Department of Physics, **Princeton University**, Condensed Matter Seminar, “*Hidden symmetry and novel phases in spin-3/2 cold atomic systems*”, Jan. 23, 2006.
 35. Department of Physics, **University of Illinois at Urbana-Champaign**, Condensed Matter Seminar, “*Hidden symmetry and novel phases in spin-3/2 cold atomic systems*”, Dec. 08, 2005.

CONTRIBUTED CONFERENCE TALKS

1. Department of Physics, Ohio State University, invited talk at the group meeting of Profs. M. Randeria and N. Trivedi, “*Vortex configuration near the superfluid-Mott insulator transition*”, May 12, 2006.
2. APS March Meeting 2006, Baltimore, Maryland. Contributed talks: “*Helical Luttinger liquid and quantum spin Hall edge states*”, and “*Quartetting and pairing instabilities in one dimensional spin-3/2 fermionic systems*”.
3. Department of Physics, University of California, Santa Barbara, condensed matter group meeting, “*Two dimensional staggered orbital current phase*”, Jan. 2006.
4. Department of Physics, University of California, Santa Barbara, condensed matter group meeting, “*Exact $SO(5)$ symmetry in spin-3/2 fermionic systems*”, Sept. 2005.
5. Department of Physics, University of California, Santa Barbara, condensed matter group meeting, “*Dynamic generation of spin-orbit coupling*”, Sept. 2005.
6. APS March meeting in Los Angeles, CA, Mar. 21 - 25, 2005. Contributed talks: “*Sufficient condition for the absence of the sign problem in quantum Monte-Carlo simulations*”, and “*Staggered current ground state in a bi-layer model*”.
7. Boulder Summer School: “*Coherence and Interactions in Atomic and Condensed Matter Physics*”, Jul. 4 - Jul. 31, 2004. Contributed talk: “*Vortex configuration near the superfluid-Mott insulator transition*”.
8. Santa Barbara KITP Conference on “*Exotic order and Criticality in Quantum Matter*”, Jun. 7 - Jun. 12, 2004.
9. APS March Meeting 2004, Montreal, Canada. Contributed talk: “*Dynamic generation of spin-orbit coupling*”.
10. APS DAMOP Meeting 2003, Boulder, Colorado. Contributed talk: “ *$SO(5)$ symmetry in spin 3/2 fermionic systems*”.
11. APS March Meeting 2003, Austin, Texas. Contributed talk: “*Superfluid vortex with Mott-insulating core*”.
12. APS March Meeting 2002, Indianapolis, Indiana. Contributed talk: “*Phase diagram of two-coupled Luttinger liquids*”.

Participation of International Academic Workshops

1. **Kavli Institute for Theoretical Physics**, University of California, Santa Barbara, **invited to participate**, “*Low Dimensional Electron Systems Workshop*”, Feb, 2009.
2. **Kavli Institute for Theoretical Physics**, University of California, Santa Barbara, **invited to participate**, “*Quantum Spin Hall Effect and Topological Insulators Workshop*”, DEC, 2008.
3. **Aspen Center for Physics**, “*Frontiers in Strongly Correlated Systems*”, Aug - Sept, 2008.
4. **Kavli Institute for Theoretical Physics**, University of California, Santa Barbara, “*Moments and Multiplets in Mott Materials Workshop*”, Oct, 2007.
5. **Aspen Center for Physics**: Ultra-cold Trapped Atomic Gases, participation from May 29 - Jun. 18, 2005.
6. **Ohio Center for Theoretical Science at Ohio State University**, “*Strongly Interacting Quantum Gases Workshop*”, Columbus, OH, Apr. 18 - 21, 2005.

CONGJUN WU'S PUBLICATIONS AND PREPRINTS

Invited Review Articles

1. **Congjun Wu**, “*Unconventional Bose-Einstein Condensations Beyond the ‘No-node’ Theorem*”, Mod. Phys. Lett. **23**, 1 (2009).
2. **Congjun Wu**, “*Hidden symmetry and quantum phases in spin 3/2 cold atomic systems*”, Mod. Phys. Lett. B **20**, 1707 (2006).

Book Chapters

3. Wenjun Zheng, Jiangping Hu, and **Congjun Wu**, “*Dynamic stripes, RVB spin liquid and high Tc superconductivity - a game of two players*”. Chapter 10 in “*Models and methods of high-Tc superconductivity: Some frontal aspects V2, 2003*”, Nova Science Publishers, Inc.

Research Articles

A. Cold atom physics

1. Orbital physics in optical lattices

4. Hsiang-hsuan Hung, Wei-Cheng Lee, **Congjun Wu**, “Frustrated Cooper pairing and the f -wave supersolidity”, arxiv:0910.0507.
5. Wei-cheng Lee, **Congjun Wu**, and S. Das Sarma “*F-wave pairing of cold atoms in optical lattices*”, arXiv:0905.1146.
6. Doron L. Bergman, **Congjun Wu**, Leon Balents, “*Band touching from real space topology in frustrated hopping models*”, Phys. Rev. B **78**, 125104 (2008).
7. **Congjun Wu**, “*Orbital analogue of quantum anomalous Hall effect in p -band systems*”, Phys. Rev. Lett. **101**, 186807 (2008).
8. Shizhong Zhang, **Congjun Wu**, “*Proposed realization of itinerant ferromagnetism in optical lattices*”, arXiv:0805.3031 .
9. Vladimir M. Stojanovic, **Congjun Wu**, W. Vincent Liu, S. Das Sarma, “*Incommensurate superfluidity of bosons in a double-well optical lattice*”, Phys. Rev. Lett. **101**, 125301 (2008).
10. **Congjun Wu**, “*Orbital ordering and frustration of p -band Mott-insulators*”, Phys. Rev. Lett. **100**, 200406 (2008).
11. **Congjun Wu**, and S. Das Sarma, “*The $p_{x,y}$ -orbital counterpart of graphene: cold atoms in the honeycomb optical lattice*”, Phys. Rev. B **77**, 235107 (2008).
12. **Congjun Wu**, Doron Bergman, Leon Balents, and S. Das Sarma, “*Flat bands and Wigner crystallization in the honeycomb optical lattice*”, Phys. Rev. Lett. **99**, 70401 (2007).
13. **Congjun Wu**, W. Vincent Liu, Joel Moore, and Sankar Das Sarma, “*Predicted quantum stripe ordering in optical lattices*”, Phys. Rev. Lett. **97**, 190406 (2006).
14. W. Vincent Liu and **Congjun Wu**, “*Atomic matter of non-zero momentum Bose-Einstein condensation and orbital current order*”, Phys. Rev. A **74**, 13607 (2006).

2. Dipolar Molecules

15. Ching-Kit Chan, **Congjun Wu**, Wei-cheng Lee, S. Das Sarma “*Anisotropic Fermi liquid theory of fermionic polar molecules*”, arXiv:0906.4403.

3. Large spin systems in optical lattices and traps

16. **Congjun Wu**, Daniel Arovas, and Hsiang-Hsuan Hung “*A Γ -matrix generalization of the Kitaev model*”, Phys. Rev. B **79**, 134427 (2009).

17. Cenke Xu, and **Congjun Wu**, “*Resonating plaquette phases in large spin cold atom systems*”, Phys. Rev. B **77**, 134449 (2008).
18. **Congjun Wu**, Jiangping Hu and Shou-Cheng Zhang, “*Quintet pairing and non-Abelian vortex string in spin-3/2 cold atomic systems*”, submitted to Phys. Rev. Lett., cond-mat/0512602.
19. Shu Chen, **Congjun Wu**, Shou-Cheng Zhang, and Yupeng Wang, “*Exact spontaneous plaquette ground states for spin-3/2 ladder models*”, Phys. Rev. B **72**, 214428 (2005).
20. **Congjun Wu**, “*Competing orders in the one dimensional spin 3/2 fermionic system*”, Phys. Rev. Lett. **95**, 266404 (2005).
21. C. H. Chern, H. D. Chen, **Congjun Wu**, Jiangping Hu, and Shou-Cheng Zhang, “*Non-Abelian Berry’s phase and Chern numbers in higher spin pairing condensates*”, Phys. Rev. B **69**, 214512 (2004).
22. **Congjun Wu**, Jiangping Hu, and Shou-Cheng Zhang, “*Exact SO(5) symmetry in spin 3/2 fermionic systems*”, Phys. Rev. Lett. **91**, 186402 (2003).

4. Vortex and superfluid-Mott insulator transition in optical lattices

23. Fei Zhou and **Congjun Wu**, “*Quantum dynamics, particle delocalization and instability of the Mott state: the effect of fermion-boson conversion on Mott states*”, New Journal of Physics **8**, 166 (2006).
24. **Congjun Wu**, Han-Dong Chen, Jiangping Hu, and Shou-Cheng Zhang, “*Vortex configurations of bosons in an optical lattice*”, Phys. Rev. A **69**, 43609 (2004).

B. Condensed Matter Physics

1. Unconventional magnetism and Pomeranchuk instabilities

25. Wei-cheng Lee, **Congjun Wu**, “*Spectroscopic Imaging Scanning Tunneling Microscopy as a Probe to Orbital Ordering*”, arXiv:0906.1973, accepted by Phys. Rev. Lett.
26. Wei-cheng Lee, and **Congjun Wu**, “*Electron nematic states enhanced by orbital band hybridization*”, Phys. Rev. B **80**, 104438 (2009).
27. **Congjun Wu**, Kai Sun, Eduardo Fradkin, and Shou-Cheng Zhang “*Fermi liquid instabilities in the spin channel*”, Phys. Rev. B **75**, 115103 (2007).
28. **Congjun Wu** and Shou-Cheng Zhang, “*Dynamic generation of spin-orbit coupling*”, Phys. Rev. Lett. **93**, 36403 (2004).

2. Spin Hall effects and topological insulators

29. Wei-Cheng Lee, **Congjun Wu**, Daniel P. Arovas, Shou-Cheng Zhang “*Quasiparticle Interference on the Surface of the Topological Insulator Bi₂Te₃*”, arxiv:0910.1668.
30. J. Maciejko, C. Liu, Y. Oreg, X.-L. Qi, **Congjun Wu**, and Shou-cheng Zhang “*Kondo effect in the helical edge liquid of the quantum spin Hall state*”, Phys. Rev. Lett. **102**, 256803 (2009).
31. Shi-liang Zhu, Hao Fu, **Congjun Wu**, Shou-Cheng Zhang, and Lu-Ming Duan, “*Spin Hall effects for cold atoms in a light induced gauge potential*”, Phys. Rev. Lett. **97**, 240401 (2006).
32. **Congjun Wu**, B. Andrei Bernevig, and Shou-Cheng Zhang, “*The helical liquid and the edge of quantum spin Hall systems*”, Phys. Rev. Lett. **96**, 106401(2006).
33. Jiangping Hu, B. Andrei Bernevig, and **Congjun Wu**, “*Spin current in spin-orbit coupling systems*”, Int. J. Mod. Phys. B **17**, 5991 (2003).

3. Unconventional Superconductivity

34. Wei-cheng Lee, Shou-cheng Zhang, and **Congjun Wu**, “*Time-reversal symmetry breaking pairing state in FeAs based superconductors*”, Phys. Rev. Lett. **102**, 217002 (2009).
35. Jiangping Hu, **Congjun Wu**, Xi Dai, “*Proposed Design of a Josephson Diode*”, Phys. Rev.

Lett. **99**, 067004 (2007) .

36. **Congjun Wu**, Jan Zaanen, and Shou-Cheng Zhang, “*Spin-orbit coupling-induced magnetic phase in the d-density-wave phase of $La_{2-x}Ba_xCuO_4$* ”, Phys. Rev. Lett. **95**, 247007 (2005).
37. Han-Dong Chen, **Congjun Wu**, and Shou-Cheng Zhang, “*Quantitative test of $SO(5)$ symmetry in the vortex state of $Nd_{1.85}Ce_{0.15}CuO_4$* ”, Phys. Rev. Lett. **92**, 107002 (2004).
38. **Congjun Wu** and W. Vincent Liu, “*Thermodynamic properties of the d-density wave order in cuprates*”, Phys. Rev. B **66**, 20511 (2002).
39. **Congjun Wu**, Tao Xiang, and Zhao-Bin Su, “*Absence of the zero bias peak in vortex tunneling spectra of high temperature superconductors*”, Phys. Rev. B **62**, 14427 (2000).

4. Spin chains and Luttinger liquids

40. Shu Chen, Yupeng Wang, W. Q. Ning, **Congjun Wu**, H. Q. Lin, “*One-dimensional spin pyrochlore lattice: exact ground state and elementary excitations*”, Phys. Rev. B **74**, 174424 (2006).
41. **Congjun Wu** , W. Vincent Liu, and Eduardo Fradkin, “*Competing orders in coupled Luttinger liquids*”, Phys. Rev. B **68**, 115104 (2003).
42. **Congjun Wu**, Bin Chen, Xi Dai, Yue Yu, and Zhao-Bin Su, “*Schwinger boson mean field theory of the Heisenberg ferrimagnetic spin chain*”, Phys. Rev. B **60**, 1057 (1999).

5. Excitons and Polaritons

43. **Congjun Wu** , and Ian Mondragon Shem, “*Exciton condensation with spontaneous time-reversal symmetry breaking*” , arXiv:0809.3532 .

6. Carbon Systems

44. B. Andrei Bernevig, Taylor L. Hughes, Han-Dong Chen, **Congjun Wu**, Shou-Cheng Zhang, “*Band Collapse and the Quantum Hall Effect in Graphene*”, Int. J. Mod. Phys. B Vol. 20, 3257-3278 (2006) ,
45. Xiaoqing Yu, **Congjun Wu**, Chui-Lin Wang, and Zhao-Bin Su, “*Electronic and structural properties of C_{36} molecule*”, Int. J. Mod. Phys. B **13**, 1513 (1999).

C. Numerical methods

1. Quantum Monte-Carlo algorithm and applications

46. **Congjun Wu** and Shou-Cheng Zhang, “*A sufficient condition for the absence of the sign problem in the fermionic quantum Monte-Carlo algorithm*”, Phys. Rev. B **71**, 155115 (2005).
47. Sylvain Capponi, **Congjun Wu**, and Shou-Cheng Zhang, “*Current carrying ground state in a bi-layer model*”, Phys. Rev. B **70**, 220505(R), (2004).