W. Vincent Liu

Curriculum Vitae [as of Sep 2011]

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Visa Status*: U.S. permanent resident*

EDUCATION

- Ph.D. in Physics, University of Texas at Austin, May 1999
  Advisor: STEVEN WEINBERG *(Nobel laureate)*
  Thesis: "Applications of effective field theory to condensed matter"
  Awarded: "Best Dissertation in Physics" in the class of 1998–99.
- M.S. in Physics, Beijing Normal University, China, 1994
- B.S. in Physics, Jilin University, China, 1991
  Awarded: "Outstanding University Graduate" (top 5%)

EMPLOYMENT

Sep 2009–	Associate Professor with tenure, University of Pittsburgh
Sep 2004-Aug 2009	Assistant Professor of Physics, University of Pittsburgh
Aug 2001- Aug 2004	Postdoctoral Fellow, Department of Physics, MIT. [with both the Center for Theoretical Physics and the Condensed Matter Theory Group.] Supervisor: Frank Wilczek *(Nobel laureate)* Affiliated with: Xiao-Gang Wen and Patrick A. Lee
Aug 1999-Aug 2001	Postdoctoral Research Associate, Condensed Matter Theory Group, Department of Physics, University of Illinois at Urbana-Champaign. Supervisors: Eduardo Fradkin and Mike Stone

HONORS & AWARDS

- Lead coordinator, KITP Conference, "Frontiers of Ultracold Atoms and Molecules," Kavli Institute for Theoretical Physics, UCSB, Santa Barbara, Oct 11–15, 2010, http://www.kitp.ucsb.edu/activities/dbdetails?acro=BOPTILATT_C10
- Lead coordinator (primary contact), KITP Program, "Beyond Standard Optical Lattices," Kavli Institute for Theoretical Physics, UCSB, Santa Barbara, September 13–December 10, 2010 (on schedule).
  http://www.kitp.ucsb.edu/activities/dbdetails?acro=BOPTILATT10
- Co-Organizer (with P. Zoller, C. P. Sun, F. Zhou, et al), KITPC Program, "Condensed Matter Physics of Cold Atoms," Kavli Institute for Theoretical Physics China (KITPC), Chinese Academy of Sciences, Beijing, China, Sep 21–Nov 6, 2009. http://www.kitpc.ac.cn/program.jsp?id=PC20090921
- 2007 "Outstanding Young Researcher Award", Overseas Chinese Physics Association http://www.ocpaweb.org/new/oyraaward/oyraaward.html
- "Best Dissertation in Physics" Award in the class of 1998-99, Department of Physics, University of Texas at Austin

- "Outstanding University Graduate" [with bachelor], presented by the President of Jilin University, China (July 1991)
- 2nd place University Academic Award for 1990-91, Jilin University, China.
- 1st (top 3%) place University Academic Award for 1989-90, Jilin University, China.
- 1st (top 3%) place University Academic Award for 1987–88, Jilin University, China.

VISITING FELLOWSHIPS

8/23–9/05/2010 & 12/18/2010–6/10/2011	General Member (on sabbatical leave with pay from KITP), Kavli Institute for Theoretical Physics (KITP), University of California, Santa Barbara (with full financial support for 9+ months including the Program's period shown next).
9/06–12/17/10	Program Primary Contact Coordinator, Kavli Institute for Theoretical Physics (KITP), University of California, Santa Barbara (with travel and local support).
9/20–11/7/09	Program Organizer, Kavli Institute for Theoretical Physics China (KITPC), Chinese Academy of Sciences, Beijing, China. (with financial support for travel and local expenses.)
7/05–9/20/09	Visiting Overseas Professorship of Chinese Academy of Sciences. Funds provided by China's State Administration of Foreign Experts Affairs. Work based in Wuhan Institute of Physics and Mathematics and Shanghai Institute of Optics and Fine Mechanics as part of a 4-year cold atom physics International Partnership Project.
6/24–7/20/07	Visiting Scientist, Centre Emile Borel, Institut Henri Poincar, Paris, France (with daily financial support).
4/30–5/25/07	Program Invited Participant, Kavli Institute for Theoretical Physics (KITP), University of California, Santa Barbara (with daily & traveling financial support).
6/24–7/1/06	Visiting Professor, APCTP (Asia Pacific Center for Theoretical Physics, Pohang, Korea). (with financial support for all local expenses & international travel)
2/08–2/16/06	Program Invited Participant, Kavli Institute for Theoretical Physics (KITP), University of California, Santa Barbara (with daily and traveling financial support).
8/01–8/13/05	Visiting Fellow, Institute of Nuclear Theory, Unversity of Washington, Seattle, WA. (with financial support)
5/10–6/12/04	Program Invited Participant, Kavli Institute for Theoretical Physics (KITP), University of California, Santa Barbara (with daily and traveling financial support).
6/30–7/20/02	Visiting Fellow in BEC Summer Program, European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*), Trento, Italy. (with daily financial support)

SCIENTIFIC DUTIES

1. Referee for *Physical Reviews* and *Physical Review Letters*, and *Annals of Physics*.
2. Proposal Reviewer for (U.S.) NSF, ARO (Army Research Office), and PECASE (Presidential Early Career Awards for Scientists and Engineers).

PRESS PUBLICITY

Press News: **Phys. Rev. Focus** reported in January 2005 a possible new state of matter—"breached pair superfluidity"—proposed by me [and my collaborators at MIT]. See the Focus story at http://focus.aps.org/story/v15/st1.

INVITED TALKS

18-22 July 2011	Advanced Workshop on "Non-standard superfluids and insulators", ICTP, Trieste, Italy, invited talk: "p-band superfluid and insulator phases in optical lattices"
13 July 2011	Universitaet Hamburg, Institute of Laser Physics, Colloquium of the Center for Optical Quantum Technologies: "Ultracold atoms in the unprecedented regimes of condensed matter"
17 Feb 2011	Brown University, Department of Physics, Condensed Matter Seminar: "Ultracold spin-imbalanced Fermi gases in low dimensions"
3-8 Jan 2011	International Conference "Frontiers of Condensed Matter Physics", Stockholm, Sweden, January 3-8, 2011, invited talk: "Ultracold spin-imbalanced Fermi gases in low dimensions"
14 Dec 2010	Boston College, Department of Physics, Condensed Matter Seminar: "Beyond the s-orbital band of optical lattices: from finite-momentum px+ipy Bose-Einstein condensation to topological semi-Fermi liquids"
27 July 2010	Department of Physics, Ludwig-Maximilians-Universität (LMU), Munich, Germany. Quantum Optics Group Seminar: "p-orbital ultracold particles and Bose-Einstein crystal"
22 July 2010	NORDITA Workshop "Quantum solids, liquids, and gases," Stockholm, Sweden, 19 July —27 Aug, 2010. Invited talk: "p-orbital ultracold particles and Bose-Einstein crystal."
6 July 2010	CAS 4th International Symposium on Cold Atom Physics, July 5-8, 2010, Zhoushan Islands, Zhejiang, China. Sponsored by Center for Cold Atom Physics (Shanghai), Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences. More than 260 participants. Invited talk: "Novel p-orbital quantum phases in cold atom optical lattices"
25 Feb 2010	Department of Physics, Univ of Maryland, College Park. CNAM Condensed Matter Colloquium: "Exotic superfluidity of spin imbalanced fermions: from three to one dimension"
17 Nov 2009	Institute for Quantum Optics and Quantum Information (IQOQI), Austrian Academy of Sciences, Innsbruck, Austria. Quantum Optics Seminar: "Orbital phases in optical lattices."
11-13 Nov 2009	Workshop on "Ab-initio Modeling of Cold Gases," CECAM/ETH, Zurich, Switzerland, November 11-13, 2009. Invited talk: "Cold atoms and molecules in elongated Wannier orbitals."
8 Sep 2009	Conference: Bose-Einstein Condensation 2009, Frontiers in Quantum Gases, Sant Feliu de Guixols (Costa Brava), Spain, 05-11 September 2009. Invited short talk: "Analytic thermodynamics and thermometry of 1D imbalanced Fermi gases at strong interaction."
20 Mar 2009	APS March Meeting, Pittsburgh, PA, March 16-20, 2009. Invited talk in the invited session on "Novel orbital quantum phases in cold atom optical lattices": "Non-zero momentum Bose-Einstein condensation of orbital atoms."

8 Jan 2009	PQE 2009: 39th Winter Colloquium on the Physics of Quantum Electronics, Snowbird, Utah, January 4-8, 2009. Invited talk in the "Optical Lattice" Session: "Crystalline superfluidity of cold atoms in lattice p-bands."
7 Nov 2008	Department of Physics, Purdue University. Condensed Matter and Biological Physics Seminar: "Crystalline superfluidity of ultracold Bose and Fermi gases."
19 Aug 2008	Aspen Center for Physics. Summer Workshop, "Frontiers in Strongly Correlated Systems," Seminar: "Orbital physics of optical lattices."
22 Aug 2007	National Institute of Standards and Technology (NIST), Gaithersburg. Quantim Information/BEC (QIBEC) Seminar: "Orbital order in optical lattices."
10 July 2007	Henri Poincare Institute, Paris, France, Quantum Gases Program Seminar: "Some unconventional phases of cold atomic matter with or without an optical lattice".
7 June 2007	APS DAMOP/DAMP (38th Annual Meeting of APS Division of AMO), 5-9 June 2007, Calgary, Canada. Invited speaker in the "Optical Lattices" session: "Orbital phases of cold atoms in the lattice p-orbital band"
8 May 2007	KITP, U. California Santa Barbara. "Strongly Correlated Phases in Condensed Matter and Degenerate Atomic Systems" Program Seminar: "Exploring New Phases of Cold Atomic Matter with or without an Optical Lattice".
14 Dec 2006	UMass Amherst. Department of Physics Condensed Matter Seminar: "Exotic condensed matter phases of ultracold atoms".
28 & 29 Jun 2006	APCTP (Asia Pacific Center for Theoretical Physics, Pohang, Korea), Focus Program on Search for Exotic State of Dense Matter. Two lectures on "Exotic superfluids for ultracold atomic gases". (with all international travel expenses paid by the program)
6 Mar 2006	University of Toronto. Department of Physics Condensed Matter Physics Seminar: "Novel phases and anomaly of ultracold atoms in Feshbach resonance".
16 Nov 2005	Johns Hopkins University. Department of Physics & Astronomy Condensed Matter Seminar: "Novel pairing and quantum anomaly in ultracold atomic gases".
7 Nov 2005	University of British Columbia. Department of Physics & Astronomy Theory Seminars: "Breached pair superfluidity for cold fermionic atoms".
19-23 Sep 2005	Univ of Washington Institute for Nuclear Theory in Seattle, Workshop on Pairing in Fermionic Systems—Beyond BCS, Session Talk: "Breached pair superfluidity"
16 June 2005	Aspen Center for Physics, Program on Ultracold Atomic Gases (May 29–June 18, 2005), Blackboard Discussion Session Talk: "Anomalous quantum flow of atoms near p-wave resonance".
18-21 Apr 2005	OCTS at Ohio State University, Strongly Interacting Quantum Gases Conference: "Anomalous quantum mass flow of atoms near p-wave resonance"
21-25 Mar 2005	APS March meeting, Los Angeles, invited talk: "Quantum phases and an anomaly of interacting fermionic atoms"

24 Feb 2004	University of Texas at Austin. Department of Physics Special Colloquium: "Exotic superfluidity of cold atomic gases".
19 Feb 2004	University of Pittsburgh. Department of Physics & Astronomy Condensed Matter Seminar: "Exotic superfluidity of cold atomic gases".
16 Feb 2004	Purdue University. Department of Physics Special Nanoscience Seminar: "Exotic superfluidity of cold atomic gases".
7 Oct 2003	Cornell University. Laboratory of Atomic and Solid-State Physics Seminar: "Breached Pairing Superfluidity: A Possible New State of Matter in Cold Fermi Atoms".
23 Jan 2003	Yale University. Condensed Matter Seminar: "Quantum phase transition and interior gap superfluidity of cold Fermi atoms in optical lattices".
26 Dec 2002	Tsinghua University, Beijing. Lecture in Center for Advanced Study: "Interior gap superfluidity and quantum phase transition".
10 Oct 2002	Harvard University. Condensed Matter Theory Seminar: "New states of matter in cold atoms: I. topological spin-disordered superfluids; II. interior gap superfluidity".
10 July 2002	BEC 2002 Summer Program at Trento, Italy. Program invited talk: "New states of matter in cold atoms".
12 Jan 2001	Bell Labs, Lucent Technologies. Condensed Matter Seminar on Friday: "Stripes in doped Mott insulators: in-phase or anti-phase?"
17 Feb. 1999	Institute for Theoretical Physics, University of California at Santa Barbara. Special Seminar: "Bose–Eintein condensation and broken U(1) symmetry".
4 Feb. 1999	Harvard University. Condensed Matter Theory Seminar: "Effective field theory approach to Bose-Einstein condensation".
23 Sep. 1998	Ohio State Univ. HEP/Astro Seminar: "Effective field theory approach to Bose-Einstein condensation".

RESEARCH GRANTS

- Army Research Office (ARO), "Exotic Phases of Ultracold Gases", 4/1/2011–3/31/2015 (4-year plan), total budget $640,616. Proposal selected to be awarded, final award number to be issued by April (Technical Contact: Program Manager Dr. Paul Baker, (919) 549-4202).
- DARPA 'Optical Lattice Emulator' Program Award through ARO, #W911NF-07-1-0464. Co-PI in a multi-university consortium led by Randy Hulet/Rice University, 07/01/2007–06/30/2009 (phase 1)–06/30/2012 (phase 2). Total 10 PIs from institutions: Rice (lead), Cornell, Ohio State, Princeton, UIUC, and U of Pittsburgh. Pittsburgh subcontract's total 5-year budget: $600,677.
- Army Research Office (ARO), Award # W911NF-07-1-0293, 05/2007-05/2010, single PI. Total 3-year budget: $290,035. Extension (05/2010-05/2011) with Add-on fund: $35,367.
- Ralph E. Powe Junior Faculty Enhancement Award, ORAU (Oak Ridge Associated Universities), 2006-07

PUBLICATIONS

A. Selected Significant Publications

1. W. V. Liu, "Theoretical study of the damping of collective excitations in a Bose-Einstein condensate," *Phys. Rev. Lett.* **79**, 4056 (1997). cond-mat/9708080. (Web of Science citations as of Feb 2010: **62**)

2. W. V. Liu and F. Wilczek, "Interior gap superfluidity," *Phys. Rev. Lett.* **90**, 047002 (2003). arXiv: cond-mat/0208052. (Web of Science citations as of Feb 2010: **178**)

3. E. Gubankova, W. V. Liu, F. Wilczek, "Breached pairing superfluidity: Possible realization in QCD," *Phys. Rev. Lett.* **91**, 032001 (2003). arXiv: hep-ph/0304016. (Web of Science citations as of Feb 2010: **76**)

4. M. M. Forbes, E. Gubankova, W. V. Liu, and F. Wilczek, "Stability criteria for breached pair superfluidity," *Phys. Rev. Lett.* **94**, 017001 (2005). arXiv: hep-ph/0405059. (Web of Science citations as of Feb 2010: **66**). [Reported in **Phys. Rev. Focus** (January 5, 2005)]

5. M. Lewenstein and W. V. Liu, "Orbital Dance," a "News & Views" article, *Nature Physics* **7**, 101 (FEB 2011).

B. Other Publications

6. K. Sun, W. V. Liu, A. Hemmerich, S. Das Sarma, "Topological semimetal in a fermionic optical lattice," arXiv:1011.4301, accepted by Nature Physics.

7. Z. Zhang, X. Li, W. V. Liu, "Orbital Liquid Crystal Phases of Cold Fermions in Optical Lattices," arXiv:1105.3387

8. Xiaopeng Li, Erhai Zhao, W. V. Liu, "Effective action approach to the p-band Mott insulator and superfluid transition," *Phys. Rev. A***83**, 063626 (2011).

9. P. Hauke, E. Zhao, K. Goyal, I. H. Deutsch, W. V. Liu, M. Lewenstein, "Time-reversal symmetry breaking of fermions in the p-band of an optical lattice," arXiv:1103.5964.

10. C. Lin, X. Li, W. V. Liu, "$U(1)\times U(1)/Z_2$ Kosterlitz-Thouless transition of the Larkin-Ovchinnikov phase in an anisotropic two-dimensional system," *Phys. Rev. B***83**, 092501 (2011).

11. Z. Zhang, W. V. Liu, "Finite temperature damping of collective modes of a BCS-BEC crossover superfluid," *Phys. Rev. A***83**, 023617 (2011).

12. X. Li, W. V. Liu, and C. Lin, "Bose-Einstein supersolid phase for a novel type of momentum dependent interaction," *Phys. Rev. A***83**, 021602(R) (2011).

13. Z. Zhang, H.-H. Hung, C. M. Ho, E. Zhao, W. V. Liu, "Modulated pair condensate of p-orbital ultracold fermions," *Phys. Rev. A***82**, 033610 (2010)

14. K. Sun, E. Zhao, W. V. Liu, "Topological phases of dipolar particles in elongated Wannier orbitals," *Phys. Rev. Lett.* **104**, 165303 (2010).

15. C. Lin, E. Zhao, W. V. Liu, "Liquid crystal phases of ultracold dipolar fermions on a lattice," *Phys. Rev. B***81**, 045115 (2010). (**Editor's selection** for the January 2010 issue of Virtual Journal of Atomic Quantum Fluids)

16. E. Zhao and W. V. Liu, "An effective field theory for one-dimensional polarized Fermi gases," J. Low Temp. Phys. **158**, 36 (2010).

17. E. Zhao, X.-W. Guan, W. V. Liu, M. T. Batchelor, M. Oshikawa, "Analytic thermodynamics and thermometry of Gaudin-Yang Fermi gases," *Phys. Rev. Lett.* **103**, 140404 (2009). (**Editor's selection** for the October 2009 issue of Virtual Journal of Atomic Quantum Fluids)

18. E. Zhao, W. V. Liu, "Theory of quasi-one dimensional imbalanced Fermi gases," *Phys. Rev. A***78**, 063605 (2008).

19. V. M. Stojanovic, C. Wu, W. V. Liu, S. Das Sarma, "Incommensurate superfluidity of bosons in a double-well optical lattice," *Phys. Rev. Lett.* **101**, 125301 (2008). arXiv:0804.3977

20. E. Zhao, W. V. Liu, "Orbital order in Mott insulators of spinless p-band fermions", *Phys. Rev. Lett.* **100**, 160403 (2008). arXiv:0801.0589

21. C. Wu, W. V. Liu, J. Moore, S. Das Sarma, "Prediction of quantum stripe ordering in optical lattices", *Phys. Rev. Lett.* **97**, 190406 (2006). cond-mat/0606743

22. V. M. Stojanovic, W. V. Liu, Y. B. Kim, "Unconventional interaction between vortices in a polarized Fermi gas", *Annals of Physics* **323**, 989 (2008). On the arxiv: Short version: cond-mat/0611295; long version: arXiv:0710.2522.

23. W. V. Liu, C. Wu, "Atomic matter of non-zero momentum Bose-Einstein condensation and orbital current order," *Phys. Rev. A***74**, 013607 (2006). cond-mat/0601432.

24. W. V. Liu, "Effective theory of excitations in a Feshbach resonant superfluid", *Phys. Rev. Lett.* **96**, 080401 (2006). arXiv: cond-mat/0508139

25. W. V. Liu, "Anomalous quantum mass flow of atoms in p-wave resonance", *Phys. Rev. A*72, 053613 (2005). arXiv: cond-mat/0503622

26. W. V. Liu, F. Wilczek, and P. Zoller, "Spin-Dependent Hubbard Model and a Quantum Phase Transition in Cold Atoms", *Phys. Rev. A* **70**, 033603 (2004). arXiv: cond-mat/0404478. (Web of Science citations as of Feb 2010: **27**)

27. C. Wu, W. V. Liu, and E. Fradkin, "Competing orders in coupled Luttinger liquids", *Phys. Rev. B* **68**, 115104 (2003). [arXiv: cond-mat/0206248.] (Web of Science citations as of Feb 2010: **28**)

28. W. V. Liu, F. Wilczek, "Comment on 'Superfluidity in the interior-gap states' by Wu–Yip". arXiv: cond-mat/0304632.

29. W. V. Liu, F. Wilczek, "Spin-orbit ordering, momentum space coexistence, and cuprate superconductivity", arXiv: cond-mat/0312685.

30. C. Wu and W. V. Liu, "Thermodynamic properties of the d-density wave order in cuprates", *Phys. Rev. B* **66**, 020511(R) (2002). arXiv: cond-mat/0201120.

31. W. V. Liu and X.-G. Wen, "Spin-disordered superfluid state for spin-1 bosons with fractional spin and statistics". arXiv: cond-mat/0201187.

32. W. V. Liu and E. Fradkin, "Antiferromagnetic spin ladders effectively coupled by one-dimensional electron liquids", *Phys. Rev. Lett.* **86**, 1865 (2001). cond-mat/0008394 .

33. W. V. Liu, "New skyrmions in the attractive Hubbard model with broken SO(4) symmetry", *Phys. Lett. A* **260**, 94 (1999). arXiv: cond-mat/9903355 .

34. W. V. Liu, "Parity breaking and phase transition induced by a magnetic field in superconductors", *Nucl. Phys. B* **556**, 563 (1999). arXiv: cond-mat/9808134. (Web of Science citations as of Feb 2010: **24**)

35. W. V. Liu, "Effective field theory approach to Bose-Einstein condensation", *Int. J. Mod. Phys. B* **12**, 2103 (1998) (**invited review** article). cond-mat/9711250

36. W. V. Liu and W. C. Schieve, "Comment on 'Collective Excitations of a Bose-Einstein Condensate in a Magnetic Trap' ", arXiv: cond-mat/9702122.

37. W. V. Liu and W. C. Schieve, "Quantum chaotic attractor in a dissipative system", *Phys. Rev. Lett.* **78**, 3278 (1997). arXiv: chao-dyn/9703012 .

38. W. Liu, Y. N. Lu, and E. J. Ding, "Dynamical phase transitions and self-organized criticality in a theoretical spring-block model", *Phys. Rev. E*, **51**, 1916 (1995).

39. Y. N. Lu, W. Liu, and E. J. Ding, "Hysteresis in a theoretical spring-block model", *Phys. Rev. Lett.* **72**, 4005 (1994).

STUDENTS AND POSTDOCS

Current Students

- Xiaopeng Li
- Zixu Zhang

Former Students

- Chiu Man Ho, officialy a high energy physics/cosmology student of Prof. Dan Boyanovsky. Worked with me in condensed matter/cold atom physics from 2004-2007. Postdoc in UC Berkeley (2007-2009), and then in Vanderbilt University (2009–).
- Vladimir Stojanovic, graduate student from Dept of Physics, Carnegie-Mellon University (CMU), co-advisor: Prof. Michael Widom, awarded PhD by CMU in 2008. Now postdoc at University of Basel in the group of Profs. Daniel Loss and Christoph Bruder.
- Hsiang-Hsuan Hung, 2007-2008. Recommended him for transfer to UCSD, now graduate student with Prof. Congjun Wu (long time collaborator).

Current and Former Postdocs

- Erhai Zhao (PhD, Northwestern University, 2005, advisor: Prof. J.A. Sauls), Sep 2007–Aug 2009 in Pittsburgh. Now Assistant Professor, Department of Physics and Astronomy, George Mason University, Fairfax, VA.
- Chungwei Lin (PhD, Columbia University, 2008, Advisor: Prof. A. Millis), Nov 2009–Nov 2011

List of Recommenders

for W. Vincent Liu

1. **Prof. Sankar Das Sarma**
   Department of Physics
   University of Maryland
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2. **Prof. Eduardo Fradkin**
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   University of Illinois at Urbana-Champaign
   1110 W. Green St.
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3. **Prof. Randall G. Hulet**
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5. **Prof. Frank Wilczek**
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6. **Prof. Peter Zoller**
   Institute of Theoretical Physics
   University of Innsbruck
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