

W. Vincent Liu

Curriculum Vitae

[as of Nov 2009]

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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

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| <i>Sep 2009–</i> | Associate Professor with tenure, University of Pittsburgh |
| <i>Sep 2004-Aug 2009</i> | Assistant Professor of Physics, University of Pittsburgh |
| <i>Aug 2001- Aug 2004</i> | Postdoctoral Fellow, Department of Physics, MIT. [with both the Center for Theoretical Physics and the Condensed Matter Theory Group.]
Supervisor: Frank Wilczek (<i>Nobel laureate</i>)
Affiliated with: Xiao-Gang Wen and Patrick A. Lee |
| <i>Aug 1999-Aug 2001</i> | 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 25–29, 2010 [to be announced on the KITP website.]
- 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/auto/?id=1000>]
- Co-Organizer, 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

9/13–12/10/10	Program Organizer, Kavli Institute for Theoretical Physics (KITP), University of California, Santa Barbara (with travel and local support).(<i>on schedule</i>)
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	Visiting Member, 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	Visiting Member, 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, University of Washington, Seattle, WA. (with financial support)
5/10–6/12/04	Visiting Member, 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)

RESEARCH GRANTS

- 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, 05/2007-04/2010, single PI. Total 3-year budget: \$290,035
- Ralph E. Powe Junior Faculty Enhancement Award, ORAU (Oak Ridge Associated Universities), 2006-07

SCIENTIFIC DUTIES

1. Referee for *Physical Reviews* and *Physical Review Letters*.

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

- July/August 2010* Invited International Participant, Nordita Program “Quantum solids, liquids, and gases” from 19 July to 27 August 2010, Stockholm, Sweden. (on schedule)
- 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. 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. Quantum 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–Einstein 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”.

CONFERENCE ACTIVITIES

1. Workshop on “Ab-initio Modeling of Cold Gases,” ETH, Zurich, Switzerland, November 11-13, 2009.
2. BEC 2009 Conference: “Frontiers in Quantum Gases” in Sant Feliu de Guixols (Costa Brava), Spain, 05–11 September 2009.
3. KITPC (Kavli Institute for Theoretical Physics China) “Condensed Matter Physics of Cold Atoms” Program, Beijing, China, participated as organizer on Sep 20–Nov 6, 2009.
4. APS March Meeting, Pittsburgh, March 16-20, 2009
5. PQE 2009: 39th Winter Colloquium on the Physics of Quantum Electronics, Snowbird, Utah, participated January 4-8, 2009.
6. Aspen Center for Physics. Summer Workshop, “Frontiers in Strongly Correlated Systems,” participated Aug 10–23, 2008.
7. Paris Program on “Quantum Gases”, Centre Emile Borel, Institut Henri Poincar, April 23- July 20, 2007, Paris, France, to participate June 24 —July 20. (invited)
8. KITP (Santa Barbara) Program on “Strongly Correlated Phases in Condensed Matter and Degenerate Atomic Systems”, participated Apr 30–May 25, 2007. (invited)
9. APS March Meeting, Denver, Colorado, March 5–9, 2007,
10. Gordon Research Conference on Correlated Electron Systems, Mt Holyoke College, Mass., Jun 18-23, 2006
11. Aspen Center for Physics: Supersolid State of matter, participated from 29 May-11 June, 2006.
12. KITP (Santa Barbara) Miniprogram: Supersolid State of Matter. Participant from Feb 8–16, 2006. (invited)
13. Seattle INT: “Pairing in Fermionic Systems: Beyond the BCS Theory”, Seattle, Washington, September 19 - 23, 2005 (invited to attend).
14. Seattle INT (jointly Harvard ITAMP): Few- and Many-body Physics in Quantum Liquids and Gases, Univ of Washington, Seattle, WA. Visiting Fellow from Aug 1–13, 2005.
15. Aspen Center for Physics: Ultracold Trapped Atomic Gases, participated from May 29–June 18, 2005.
16. Ohio Center for Theoretical Science (OCTS) at Ohio State University: Strongly Interacting Quantum Gases Workshop, Columbus, OH, April 18-21, 2005
17. APS March meeting in Los Angeles, CA, March 21-25, 2005
18. NSF Workshop on Opportunities in Materials Theory, in Washington DC, October 25-27, 2004.
19. KITP Program (Santa Barbara): Quantum Gases 2004. Participant from May 10–June 12, 2004. (invited)
20. KITP (Santa Barbara) Conference: Exotic Order and Criticality in Quantum Matter (Jun 7-11, 2004)
21. KITP (Santa Barbara) Conference: Quantum Gases (May 10 - 14, 2004)
22. Aspen Summer program 2003: Competing Orders and Quantum Criticality in Correlated Elec-

- trons. Participated from July 7 – 13, 2003.
23. Aspen Summer program 2003: Exploring the Interface Between Cold Atom and Condensed Matter Physics. Participated from June 29 – July 6, 2003.
 24. BEC Summer Program 2002, held at European Centre for Theoretical Studies in Nuclear Physics and Related Areas (ECT*) at Trento, Italy (July 1 – August 9, 2002).
 25. Workshop on “Recent developments in the physics of cold atomic gases”, held at the Physics Department in Povo, Trento in the period 15-18 July, 2002.
 26. APS March Meeting 2002 (March 18-22, 2002), Indianapolis, Indiana. 10-minute talk in session B27 (Quantum Spin Liquids and Bose-Einstein Condensation): “Spin liquid Bose-Einstein condensate of a two-dimensional spin-1 Bose gas”
 27. APS March Meeting 2001 (March 12-16, 2001), Seattle, Washington. 10-minute talk in session J16 (Non-Fermi Liquids: Theory): “Antiferromagnetic spin ladders effectively coupled by one-dimensional electron liquids”
 28. Santa Babara ITP Conference on High Temperature Superconductivity (August 14-18, 2000).
 29. Aspen Summer Program 1999: Exploring Bose–Einstein Condensates (June 14 - Jul 4, 1999). Invited to participate for two weeks.

PUBLICATIONS

- [1] Z. Zhang, H.-H. Hung, C. M. Ho, E. Zhao, W. V. Liu, “Center-of-mass p -wave fermionic superfluidity,” arXiv:0910.2431
- [2] C. Lin, E. Zhao, W. V. Liu, “Liquid crystal phases of ultracold dipolar fermions on a lattice,” arXiv:0909.5267.
- [3] K. Sun, E. Zhao, W. V. Liu, “Topological phases of dipolar particles in elongated Wannier orbitals,” arXiv:0908.0190
- [4] 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).
- [5] E. Zhao, W. V. Liu, “Theory of quasi-one dimensional imbalanced Fermi gases,” *Phys. Rev.* **A78**, 063605 (2008).
- [6] 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
- [7] E. Zhao, W. V. Liu, “Orbital order in Mott insulators of spinless p -band fermions”, *Phys. Rev. Lett.* **100**, 160403 (2008). arXiv:0801.0589
- [8] 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
- [9] W. V. Liu, C. Wu, “Atomic matter of non-zero momentum Bose-Einstein condensation and orbital current order”, *Phys. Rev.* **A74**, 013607 (2006). cond-mat/0601432.
- [10] 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.

- [11] W. V. Liu, “Effective theory of excitations in a Feshbach resonant superfluid”, *Phys. Rev. Lett.* **96**, 080401 (2006). arXiv: cond-mat/0508139
- [12] W. V. Liu, “Anomalous quantum mass flow of atoms in p-wave resonance”, *Phys. Rev. A* **72**, 053613 (2005). arXiv: cond-mat/0503622
- [13] 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. (ISI citations as of Nov 2009: **65**). [Reported in **Phys. Rev. Focus** (January 5, 2005)]
- [14] 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
- [15] E. Gubankova, W. V. Liu, F. Wilczek, “Breached pairing superfluidity: Possible realization in QCD”, *Phys. Rev. Lett.* **91**, 032001 (2003). arXiv: hep-ph/0304016. (ISI citations as of Nov 2009: **76**)
- [16] W. V. Liu, F. Wilczek, “Comment on ‘Superfluidity in the interior-gap states’ by Wu–Yip”. arXiv: cond-mat/0304632.
- [17] W. V. Liu and F. Wilczek, “Interior gap superfluidity”, *Phys. Rev. Lett.* **90**, 047002 (2003). arXiv: cond-mat/0208052. (ISI citations as of Nov 2009: **174**)
- [18] W. V. Liu, F. Wilczek, “Spin-orbit ordering, momentum space coexistence, and cuprate superconductivity”, arXiv: cond-mat/0312685.
- [19] 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.
- [20] C. Wu, W. V. Liu, and E. Fradkin, “Competing orders in coupled Luttinger liquids”, *Phys. Rev. B* **68**, 115104 (2003). [arXiv: cond-mat/0206248.]
- [21] W. V. Liu and X.-G. Wen, “Spin-disordered superfluid state for spin-1 bosons with fractional spin and statistics”. arXiv: cond-mat/0201187.
- [22] 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 .
- [23] 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 .
- [24] 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.
- [25] 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
- [26] 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. (ISI citations as of Nov 2009: **60**)
- [27] W. V. Liu and W. C. Schieve, “Comment on ‘Collective Excitations of a Bose-Einstein Condensate in a Magnetic Trap’ ”, arXiv: cond-mat/9702122.

- [28] W. V. Liu and W. C. Schieve, “Quantum chaotic attractor in a dissipative system”, *Phys. Rev. Lett.* **78**, 3278 (1997). arXiv: [chao-dyn/9703012](https://arxiv.org/abs/chao-dyn/9703012) .
- [29] 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).
- [30] Y. N. Lu, W. Liu, and E. J. Ding, “Hysteresis in a theoretical spring-block model”, *Phys. Rev. Lett.* **72**, 4005 (1994).