

## Charles L. Kane

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### Research Interests:

Quantum Condensed Matter Theory: electronic properties of mesoscopic structures; topological electronic phases; strongly correlated electronic systems; disordered electronic systems; field theory and quantum many body physics.

### Professional Preparation:

1985	B.S.	Physics	University of Chicago
1989	Ph.D.	Physics	Massachusetts Institute of Technology

### Professional Appointments:

2012-	Class of 1965 Endowed Term Professor, University of Pennsylvania
2006-	Professor, Department of Physics and Astronomy, University of Pennsylvania
2002-2005	Associate Chair for Undergraduate Affairs, Department of Physics and Astronomy, University of Pennsylvania
1997-2006	Associate Professor, Department of Physics and Astronomy, University of Pennsylvania
1991-1997	Assistant Professor, Department of Physics and Astronomy, University of Pennsylvania
1989-1991	Postdoctoral Fellow, IBM T.J. Watson Research Center
1984-1985	Research Assistant, University of Chicago

### Honors and Awards:

2014	Elected to National Academy of Sciences
2014	Lindback Award for Distinguished Teaching, University of Pennsylvania
2013	Physics Frontiers Prize, Fundamental Physics Prize Foundation
2012	Dirac Medal and Prize, International Center for Theoretical Physics
2012	Simons Investigator, Simons Foundation
2012	Oliver Buckley Prize, American Physical Society
2010	Europhysics Prize of European Physical Society
2006	Fellow, American Physical Society
1988-1989	IBM Predoctoral Fellow
1985-1989	NSF Graduate Fellow

### Recent Grant History:

2012-2017	<i>Topological Phenomena in Condensed Matter</i> , Simons Foundation, \$500,000
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2011-2015 *Development of a low voltage, low power transistor based on topological surface states*, DARPA, \$100,000/year  
2009-2013 *Theory of Topological Insulators*, NSF, \$380,000  
2005-2008 *Electronic Properties of Graphene*, ACS Petroleum Research Fund, \$80,000  
2005-2009 *Theory of Graphene and the Spin Hall Effect*, NSF, \$240,000

#### **Ph.D. Students:**

Current Benjamin Wieder, Yichen Hu  
2011 Jeffrey Teo *Topological Insulators and Superconductors*, Post Doc, University of Illinois  
2009 Liang Fu, *Theory of Topological Insulators*, Assistant Professor, MIT  
2002 Ahmed Marouf, *Electronic Properties of Carbon Nanotube Structures*, Senior Research Scientist, Egypt Nanotechnology Research Center  
1996 Hangmo Yi, *Electronic Transport in Mesoscopic Structures: the Quantum Brownian Motion Picture*, Professor, Soongsil University, Seoul Korea

#### **Post Docs:**

Current Fan Zhang

#### **Service:**

2007 Organized KITP miniprogram on topological insulators.  
2010-2013 Executive Committee, American Physical Society Division of Condensed Matter Physics.  
2011 Organized Workshop and School on Topological Phenomena in Condensed Matter at the ICTP, Trieste, Italy.  
2011 Organized workshop on topological insulators and superconductors at KITP in Santa Barbara, CA.  
2012-2013 Chair, APS Fellowship committee  
2013-2017 Advisory Board, Kavli Institute for Theoretical Physics

#### **Courses Taught (last 3 years):**

Fall 2011 Sabbatical Leave  
Spring 2012 Physics 171 Honors Intro Physics II.  
Fall 2012 Physics 662 Advanced Condensed Matter.  
Spring 2013 Physics 171 Honors Intro Physics II.  
Fall 2013 Physics 611 Graduate Statistical Mechanics.  
Spring 2014 Physics 171 Honors Intro Physics II.

## Publications

### Refereed Articles

1. "Time Reversal Invariant  $Z_4$  Fractional Josephson Effect," Fan Zhang and C. L. Kane, arXiv: 1404.1072; Phys. Rev. Lett. in press (2014).
2. "Anomalous Topological Pumps and Fractional Josephson Effects," Fan Zhang and C. L. Kane, arXiv: 1310.5281; Phys. Rev. B (R) in press (2014). Selected for *Editor's suggestion*.
3. "Bulk Dirac points in distorted spinels," J. A. Steinberg, S. M. Young, S. Zaheer, C. L. Kane, E. J. Mele, A. M. Rappe, Phys. Rev. Lett. **112**, 036403/1-5 (2014).
4. "Topological Boundary Modes in Isostatic Lattices," C. L. Kane, T. C. Lubensky, Nature Physics **10**, 39-45 (2014). *Cover Article*.
5. "Bosonic topological insulator in three dimensions and the statistical Witten effect," M. A. Metlitski, C. L. Kane, M. P. A. Fisher, Phys. Rev. B **88**, 035131/1-13 (2013). Selected for *Editor's suggestion*.
6. "Signatures of Majorana Fermions in Topological Insulator Josephson Junction Devices," B. J. Wieder, F. Zhang, C. L. Kane, Phys. Rev. B. **89**, 075106 (2014).
7. "Topological Mirror Superconductivity," F. Zhang, C. L. Kane, E. J. Mele, Phys. Rev. Lett. **111**, 056403/1-5 (2013).
8. "Time Reversal Invariant Topological Superconductivity and Majorana Kramers Pairs," F. Zhang, C. L. Kane, E. J. Mele, Phys. Rev. Lett. **111**, 056402/1-5 (2013).
9. "Absence of Luttinger's Theorem due to Zeros in the Single-Particle Green Function," K. B. Dave, P. W. Phillips, C. L. Kane, Phys. Rev. Lett. **110**, 090403/1-5 (2013).
10. "Surface State Magnetization and Chiral Edge States on Topological Insulators," F. Zhang, C. L. Kane, E. J. Mele, Phys. Rev. Lett. **110**, 046404/1-5 (2013).
11. "Spin texture on the Fermi surface of tensile strained HgTe," S. Zaheer, S. M. Young, D. Cellucci, J. C. Y. Teo, C. L. Kane, E. J. Mele, A. M. Rappe, Phys. Rev. B, **87**, 045202/1-7 (2013).
12. "Topology, Delocalization via Average Symmetry and the Symplectic Anderson Transition," Liang Fu, C. L. Kane, Phys. Rev. Lett. **109**, 246605/1-4 (2012).
13. "Surface States of Topological Insulators," F. Zhang, C. L. Kane, E. J. Mele, Phys. Rev. B **86**, 081303(R)/1-4 (2012). Selected for *Editor's suggestion*.
14. "Dirac semimetal in three dimensions," S. M. Young, S. Zaheer, J. C. Y. Teo, C. L. Kane, E. J. Mele, A. M. Rappe, Phys. Rev. Lett. **108**, 140405/1-4 (2012).

15. "From Luttinger liquid to non-Abelian quantum Hall states," Jeffrey C. Y. Teo, C. L. Kane, Phys. Rev. B **89**, 085101/1-22 (2014). Selected for *Editor's suggestion*.
16. "Theoretical investigation of the evolution of the topological phase of  $\text{Bi}_2\text{Se}_3$  under mechanical strain," S. M. Young, S. Chowdhury, E. J. Walter, E. J. Mele, C. L. Kane, A. M. Rappe, Phys. Rev. B **84**, 085106/1-4 (2011). Selected for *Editor's suggestion*.
17. "Interface between Topological and Superconducting Qubits," L. Jiang, C. L. Kane, and J. Preskill Phys. Rev. Lett. **106**, 130504/1-4 (2011). Featured in *Physics*.
18. "Topological Defects and Gapless Modes in Insulators and Superconductors," J. C. Y. Teo and C. L. Kane, Phys. Rev. B **82**, 115120/1-26 (2010). Selected for *Editor's suggestion*.
19. "Observation of neutral modes in the fractional quantum Hall regime," A. Bid, N. Ofek, H. Inoue, M. Heiblum, C. L. Kane, V. Umansky and D. Mahalu, Nature **466**, 585-590 (2010).
20. "Majorana Fermions and Non-Abelian Statistics in Three Dimensions," J. C. Y. Teo and C. L. Kane, Phys. Rev. Lett. **104**, 046401/1-4 (2010). Featured in *Physics*.
21. "Critical Behavior of a Point Contact in a Quantum Spin Hall Insulator," J. C. Y. Teo and C. L. Kane, Phys. Rev. B **79**, 235321/1-22 (2009). Selected for *Editor's suggestion*.
22. "Probing Neutral Majorana Fermion Edge Modes with Charge Transport," Liang Fu and C. L. Kane, Phys. Rev. Lett. **102**, 216403/1-4 (2009).
23. "Observation of Unconventional Quantum Spin Textures in Topological Insulators," D. Hsieh, Y. Xia, L. Wray, D. Qian, A. Pal, J. H. Dil, J. Osterwalder, F. Meier, G. Bihlmayer, C. L. Kane, Y. S. Hor, R. J. Cava, M. Z. Hasan, Science **323**, 919-922 (2009).
24. "Josephson Current and Noise at a Superconductor-Quantum Spin Hall Insulator-Superconductor Junction," Liang Fu and C. L. Kane, Phys. Rev. B **79**, R161408/1-4 (2009). Selected for *Editor's suggestion*.
25. "Surface states and topological invariants in three-dimensional topological insulators: Application to  $\text{Bi}_1 - x\text{Sb}_x$ ," Jeffrey C. Y. Teo, Liang Fu and C. L. Kane, Phys. Rev. B **78**, 045426/1-15 (2008). Selected for *Editor's suggestion*. Featured in *Physics*.
26. "Superconducting proximity effect and Majorana fermions at the surface of a topological insulator," Liang Fu and C. L. Kane, Phys. Rev. Lett. **100**, 096407/1-4 (2008).
27. "Topological Insulators with Inversion Symmetry," Liang Fu and C. L. Kane, Phys. Rev. B **76**, 045302/1-17 (2007).
28. "Topological Insulators in Three Dimensions," Liang Fu, C. L. Kane and E. J. Mele, Phys. Rev. Lett. **98**, 106803/1-4 (2007).
29. "Time Reversal Polarization and a  $Z_2$  spin pump," Liang Fu and C. L. Kane, Phys. Rev. B, **74** 195312/1-13 (2006).

30. "Many body effects in carbon nanotube fluorescence spectroscopy," C. L. Kane and E. J. Mele, Solid State Communications **135**, 527-531 (2005).
31. "One-Dimensional Diffusion Limited Relaxation of Photoexcitations in Suspensions of Single-Walled Carbon Nanotubes," R. M. Russo, E. J. Mele, C. L. Kane, I. V. Rubtsov, M. J. Therien and D. E. Luzzi, Phys. Rev. B **74**, 041405/1-4 (2006).
32. " $Z_2$  Topological Order and the Quantum Spin Hall Effect," C. L. Kane and E. J. Mele, Phys. Rev. Lett. **95**, 246802/1-4 (2005).
33. "Quantum Spin Hall Effect in Graphene," C. L. Kane and E. J. Mele, Phys. Rev. Lett. **95**, 226801/1-4 (2005).
34. "Kane Replies", C. L. Kane, Phys. Rev. Lett. **93**, 169706/1-2 (2004).
35. "Electron Interactions and Scaling Relations for Optical Excitations in Carbon Nanotubes," C. L. Kane and E. J. Mele, Phys., Rev. Lett. **93**, 197402/1-4 (2004).
36. "Direct Measurement of the Polarized Optical Absorption Cross-Section of Single-Wall Carbon Nanotubes," M. F. Islam, D. E. Milkie, C. L. Kane A. G. Yodh, J. M. Kikkawa, Phys. Rev. Lett. **94** 037404/1-4 (2004).
37. "Telegraph Noise and Fractional Statistics in the Quantum Hall Effect," C. L. Kane, Phys. Rev. Lett. **90**, 226802/1-4 (2003).
38. "The Ratio Problem in Single Carbon Nanotube Fluorescence Spectroscopy," C. L. Kane and E. J. Mele, Phys. Rev. Lett. **90**, 207401/1-4 (2003).
39. "Shot noise and the transmission of dilute Laughlin quasiparticles," C. L. Kane and M. P. A. Fisher, Phys. Rev. B **67**, 045307/1-17 (2003).
40. "Theory of scanning tunneling spectroscopy of fullerene peapods," C. L. Kane, E. J. Mele, A. T. Johnson, D. E. Luzzi, B. W. Smith, D. J. Hornbaker, and A. Yazdani, Phys. Rev. B **66**, 235423/1-15 (2002).
41. "The Fractional Quantum Hall Effect in Arrays of Quantum Wires," C. L. Kane, R. Mukhopadhyay, and T. C. Lubensky, Phys. Rev. Lett. **88** 36401-36404 (2002).
42. "Sliding Luttinger liquid phases," R. Mukhopadhyay, C. L. Kane and T. C. Lubensky, Phys. Rev. B **63**, 045120/1-18, (2001).
43. "Crossed sliding Luttinger liquid phase," R. Mukhopadhyay, C. L. Kane and T. C. Lubensky, Phys. Rev. B Rapid Communication **63**, 1103-1106, (2001).
44. "Dielectric Control of Electrostatic Barriers for Molecular Electronics," C. L. Kane and E. J. Mele, Applied Physics Letters, **78**, 114-116, (2001).
45. "High-Field Electrical Transport in Single-Wall Carbon Nanotubes," Z. Yao, C. L. Kane, and C. Dekker, Phys. Rev. Lett. **84**, 2941-2944 (2000).

46. "Electronic Structure of Carbon Nanotube Ropes," A. Maarouf, C. L. Kane and E. J. Mele, Phys. Rev. B **61**, 11156-11165 (2000).
47. "Electron Backscattering on Single Wall Carbon Nanotubes Observed by Scanning Tunneling Microscopy," W. Clauss, D.J. Bergeron, M. Freitag, C. L. Kane, E. J. Mele and A. T. Johnson, Europhys. Lett. **47**, 601-607 (1999).
48. "Broken Symmetries in Scanning Tunneling Images of Carbon Nanotubes," C. L. Kane and E. J. Mele, Phys. Rev. B Rapid Communications, **59**, 12759-12762 (1999).
49. "Temperature Dependent Resistivity of Single Wall Carbon Nanotubes," C. L. Kane, E. J. Mele, R. Lee, J. E. Fischer, P. Petit, H. Dai, A. Thess, and R. E. Smalley, Europhys. Lett. **41** 683-688 (1998).
50. "Coulomb Interactions and Mesoscopic Effects in Carbon Nanotubes", C. L. Kane, L. Balents and M. P. A. Fisher, Phys. Rev. Lett. **79**, 5086-5089 (1998).
51. "Quantum Brownian Motion in a Periodic Potential and the Multi-Channel Kondo Problem," Hangmo Yi and C. L. Kane, Phys. Rev. B Rapid Communications, **57**, 5579-5582 (1998).
52. "Size, Shape and Low Energy Electronic Structure of Carbon Nanotubes," C. L. Kane and E. J. Mele, Phys. Rev. Lett. **78**, 1932-1935 (1997).
53. "Line Junctions in the Quantum Hall Effect," C. L. Kane and M. P. A. Fisher, Phys. Rev. B **56**, 15231-15237 (1997).
54. "Quantized Thermal Transport in the Fractional Quantum Hall Effect," C. L. Kane and M. P. A. Fisher, Phys. Rev. B **55**, 15832-15837 (1997).
55. "Thermal Transport in a Luttinger Liquid," C. L. Kane and M. P. A. Fisher, Phys. Rev. Lett. **76**, 3192-3195 (1996).
56. "Coulomb Blockade in a Quantum Dot Strongly Coupled to a Lead," H. Yi and C. L. Kane, Phys. Rev. B **53**, 12956-12966 (1996).
57. "Contacts and Edge State Equilibration in the Fractional Quantum Hall Effect," C. L. Kane and M. P. A. Fisher, Phys. Rev. B, **52**, 17393-17405 (1995).
58. "Impurity Scattering and Transport of Fractional Quantum Hall Edge States," C. L. Kane and M. P. A. Fisher, Phys. Rev. B, **51**, 13449-13466 (1995).
59. "Randomness at the Edge: Theory of Quantum Hall Transport at Filling  $\nu = 2/3$ ," C. L. Kane, M. P. A. Fisher and J. Polchinski, Phys. Rev. Lett. **72**, 4129-4132 (1994).
60. "Fermi Edge Singularities and Backscattering in a Weakly Interacting One Dimensional Electron Gas," C. L. Kane, K. Matveev, L. I. Glazman, Phys. Rev. B Rapid Communications **49**, 2253-2256 (1994).
61. "Non Equilibrium Noise and Fractional Charge in the Quantum Hall Effect," C. L. Kane and M. P. A. Fisher, Phys. Rev. Lett. **72**, 724-727 (1994).

62. "Resonant Tunneling Between Edge States in the Fractional Quantum Hall Effect," K. Moon, H. Yi, C. L. Kane, S. M. Girvin, M. P. A. Fisher, *Phys. Rev. Lett.* **71**, 4831-4834 (1993).
63. "Transport through Barriers and Resonant Tunneling in an Interacting One Dimensional Electron Gas," C. L. Kane and M. P. A. Fisher, *Phys. Rev. B* **46**, 15233-15262 (1992).
64. "Resonant Tunneling in an Interacting One Dimensional Electron Gas," C. L. Kane and M. P. A. Fisher, *Phys. Rev. B Rapid Communications* **46**, 7268-7271 (1992).
65. "Cuprate Superconductivity: The Van Hove Scenario," D.M. Newns, C. C. Tsuei, P. C. Pattnaik and C. L. Kane, *Comments on Condensed Matter Physics*, **15**, 273-302 (1992).
66. "Saddle Point Pairing: an Electronic Mechanism for Superconductivity," D. M. Newns, H. R. Krishnamurthy, P. C. Pattnaik, C. C. Tsuei, C. L. Kane, *Phys. Rev. Lett.* **69**, 1264-1267 (1992).
67. "Transport in a one-channel Luttinger liquid," C. L. Kane and M. P. A. Fisher, *Phys. Rev. Lett.* **68**, 1220-1223 (1992).
68. "Evidence for the Van Hove Scenario in High Temperature Superconductivity from Quasi-particle Lifetime Broadening," P. C. Pattnaik, C. L. Kane, D. M. Newns and C. C. Tsuei, *Phys. Rev. B* **45**, 5714-5717 (1992).
69. "The General Validity of Jastrow-Laughlin Wavefunctions," C. L. Kane, S. Kivelson, D. H. Lee, S. C. Zhang, *Phys. Rev. B* **43**, 3255-3258 (1991).
70. "Spiral Phases and Time Reversal Violating Resonating Valence Bond States of Doped Antiferromagnets," B. Chakraborty, N. Read, C. L. Kane and P. A. Lee, *Phys. Rev. B* **42**, 4819-4822 (1990).
71. "Boson-Vortex-Skyrmion Duality, Spin Singlet Fractional Quantum Hall Effect and Spin 1/2 Anyon Superconductivity," D. H. Lee, C. L. Kane, *Phys. Rev. Lett.* **64**, 1313-1316 (1990). Also reprinted in "Fractional Statistics and Anyon Superconductivity," edited by Frank Wilczek, World Scientific (1990).
72. "Mean Field Theory of the Spiral Phases of a Doped Antiferromagnet," C. L. Kane, P. A. Lee, T. K. Ng, B. Chakraborty, N. Read, *Phys. Rev. B Rapid Communications* **41**, 2653-2656 (1990).
73. "The Motion of a Single Hole in a Quantum Antiferromagnet," C. L. Kane, N. Read, P. A. Lee, *Phys. Rev. B* **39**, 6880-6897 (1989).
74. "Correlations and Fluctuations of Coherent Wave Transmission through Disordered Media," S. Feng, C. L. Kane, P. A. Lee, and A. D. Stone, *Phys. Rev. Lett.* **61**, 834-837 (1988).
75. "Voltage Fluctuations in Mesoscopic Metal Rings and Wires," D. P. DiVincenzo, C. L. Kane, *Phys. Rev. B* **38**, 3006-3015 (1988).
76. "Voltage Fluctuations in Multi Lead Devices," C. L. Kane, P. A. Lee, D. P. DiVincenzo, *Phys. Rev. B* **38**, 2995-3005 (1988).

77. "Long Rang Correlations in Disordered Metals," C. L. Kane, R. A. Serota, P. A. Lee, Phys. Rev. B **37**, 6701-6710 (1988).
78. "Enhancement of Conductance Fluctuations in Disordered Metals: Thin Lead and Isolated Samples," R. A. Serota, S. Feng, C. L. Kane, P. A. Lee, Phys. Rev. B **36**, 5033-5036 (1987).

### **Invited Review Articles**

1. "Topological Band Theory and the  $Z_2$  Invariant," C. L. Kane. First chapter of the book, "Topological insulators" edited by M. Franz and L. Molenkamp, Elsevier, 2013 (16 pages).
2. "Topological Insulators," C. L. Kane and J. E. Moore, Physics World **24**, 32-36 (2011).
3. "Colloquium: Topological Insulators," M. Z. Hasan and C. L. Kane, Rev. Mod. Phys. **82**, 3045-3067 (2010).
4. "An Insulator with a Twist," C. L. Kane, Nature Physics **4**, 348-349 (2008).
5. "A New Spin on the Insulating State," C. L. Kane and E. J. Mele, Science **314**, 1692-1693 (2006).
6. "Erasing Electron Mass," C. L. Kane, Nature **438**, 168-170 (2005).
7. "A Shot in the Arm for Fractional Charge," C. L. Kane and M. P. A. Fisher, Nature **389**, 119-120 (1997).
8. "Edge State Transport," C. L. Kane and M. P. A. Fisher. Review article published the book "Novel Quantum Liquids in Low-Dimensional Semiconductor Structures", edited by S. Das Sarma and A. Pinczuk, Wiley and Sons, 1996 (52 pages).

### **Conference Articles**

1. "Graphene and the Quantum Spin Hall Effect," C. L. Kane, Int. J. Mod. Phys. B **21**, 1155-1164 (2007).
2. "Electron Interactions and Excitons in Carbon Nanotube Fluorescence Spectroscopy," C. L. Kane and E. J. Mele in Electronic Properties of Synthetic Nanostructures, H. Kuzmany Ed. 2004.
3. "Excitons and Carbon Nanotube Fluorescence Spectroscopy," E. J. Mele and C. L. Kane in Molecular Nanostructures, H. Kuzmany Ed., 2003.
4. "Low Energy Theory for STM Imaging of Single Wall Carbon Nanotubes," C. L. Kane and E. J. Mele , in Science and Applications of Nanotubes Fundamental Materials Research Series (Plenum, New York, 2000) p 321f.
5. "Electronic Structure and Transport in Nanotube Ropes," C. L. Kane and E. J. Mele in Electronic Properties of Novel Materials - Progress in Molecular Nanostructures, H. Kuzmany ed., 1998.

6. "Thermal Transport in a Luttinger Liquid," C. L. Kane, published in conference proceedings for conference "Rencontres de Moriond" held in Les Arcs, France, Jan. 22-26, 1996.
7. "Transmission through Barriers and Resonant Tunneling in a One Dimensional Electron Gas," C. L. Kane, *Physica B* **189**, 250-257 (1993).
8. "Transmission through Barriers and Resonant Tunneling in a Luttinger Liquid," C. L. Kane, in *Optical Phenomena in Semiconductor Structures of Reduced Dimension*, D.J. Lockwood and A. Pinczuk eds., Kluwer Academic Publishers, 365-372 (1993).
9. "The Van Hove Scenario for High Temperature Superconductivity," D. M. Newns, H. R. Krishnamurthy, P. C. Pattnaik, C. C. Tsuei, C. C. Chi, C. L. Kane, *Physica B* 188, 801-807 (1993).
10. "The Van Hove Scenario for High Temperature Superconductivity," C. L. Kane, D. M. Newns, P. C. Pattnaik, C. C. Tsuei, C. C. Chi, in "Electronic Structure and Mechanisms for High Temperature Superconductivity," Eds. J. Ashkenazi and G. Vezzoli, Plenum press, 493-501 (1992).

## **Presentations:**

1. Physics Colloquium, “Topological Boundary Modes from Hard to Soft Matter,” University of Stockholm, Stockholm, Sweden (June 2014).
2. Invited Talk, “Topological Superconductivity and the Fractional Josephson Effect,” Nobel Symposium on New Forms of Matter: Topological Insulators and Superconductors, Stockholm, Sweden (June 2014).
3. Condensed Matter Seminar, “Topological Superconductivity and the Fractional Josephson Effect,” University of Illinois, Urbana, IL (May 2014).
4. Physics Colloquium, “Topological Boundary Modes from Hard to Soft Matter,” University of Maryland, College Park, MD (April 2014).
5. JQI seminar, “Topological Superconductivity and the Fractional Josephson Effect,” Joint Quantum Institute, University of Maryland, College Park, MD (April 2014).
6. Physics Colloquium, “Topological Boundary Modes from Hard to Soft Matter,” New York University, New York, NY (February 2014).
7. Applied Physics Colloquium, “From Topological Insulators to Majorana Fermions,” Harvard University, Cambridge, MA (November 2013).
8. Condensed Matter Seminar, “Topological Order at the Surface of a Topological Insulator,” Massachusetts Institute of Technology, Cambridge, MA (October 2013).
9. Invited Talk, “Topological Order at the Surface of a Topological Insulator,” Workshop on Topology and Non-Equilibrium in Low-Dimensional Electronic Systems, Max Planck Institute, Dresden Germany (September 2013).
10. Invited Talk, “Topological Order at the Surface of a Topological Insulator,” Workshop on Geometric Aspects of Quantum States in Condensed Matter, International Center for Theoretical Physics, Trieste Italy (July 2013).
11. Dirac Prize Talk, “Topological Insulators,” International Center for Theoretical Physics, Trieste Italy (July 2013).
12. Invited Talk, “Topological Delocalization, Average Symmetry and Symplectic Anderson Transition,” Workshop on Topological Phases of Matter, Simons Center for Theoretical Physics, Stony Brook, NY (June 2013).
13. Physics Colloquium, “From Topological Insulators to Majorana Fermions,” Florida State University, Tallahassee, FL (April 2013).
14. Invited Talk, “Electronic Materials and the Materials Genome Initiative,” MGI Workshop, National Science Foundation, Arlington, VA (December 2012).
15. Physics Colloquium, “From Topological Insulators to Majorana Fermions,” Haverford College, Haverford, PA (November 2012).

16. Condensed Matter Seminar, "Experimental Signatures of Majorana Fermions," University College London, London, UK (October 2012).
17. Bragg Lecture, "From Topological Insulators to Majorana Fermions," University College London, London, UK (October 2012).
18. Condensed Matter Seminar, "Topological Insulators and Majorana Fermions," Cambridge University, Cambridge, UK (October 2012).
19. Invited Talk, "Topology and Electronic Phases of Matter, Applied Topology Workshop, Rutgers University, Piscataway, NJ (October 2012).
20. Physics Colloquium, "From Topological Insulators to Majorana Fermions," Texas A&M University, College Station, TX (September 2012).
21. Invited Talk, "Majorana Fermions and Topological Insulators," Workshop on Majorana Fermions in Condensed Matter, Leiden, the Netherlands (July 2012).
22. Invited Talk, "Topological Insulators," Workshop to honor the 50th Birthday of the Laboratory for Research on the Structure of Matter, University of Pennsylvania (May 2012).
23. Physics Colloquium, "From Topological Insulators to Majorana Fermions," Rutgers University, Piscataway, NJ (March 2012).
24. Physics Colloquium, "From Topological Insulators to Majorana Fermions," Los Alamos National Lab, Los Alamos, NM (March 2012).
25. Oliver Buckley Prize Invited Talk, "Topological Insulators," March Meeting of the APS, Boston, MA (March 2012).
26. Condensed Matter Seminar, "From Topological Insulators to Majorana Fermions," Institute for Quantum Information, Technical University of Aachen, Aachen, Germany (January 2012).
27. Plenary Lecture, "From Topological Insulators to Majorana Fermions," Physics@FOM, Annual meeting of the Dutch Physical Society, Eindhoven, Netherlands (January, 2012).
28. Master Class, "Topological Band Theory of Insulators and Superconductors," Physics@FOM, Annual meeting of the Dutch Physical Society, Eindhoven, Netherlands (January, 2012).
29. Physics Colloquium, "From Topological Insulators to Majorana Fermions," University of California, Santa Barbara, CA (November 2011).
30. Physics Colloquium, "From Topological Insulators to Majorana Fermions," University of British Columbia, Vancouver, BC (November 2011).
31. Condensed Matter Seminar, "From Luttinger Liquid to Non-Abelian quantum Hall states," Cornell University, Ithaca, NY (October 2011).

32. Physics Colloquium, "From Topological Insulators to Majorana Fermions," Cornell University, Ithaca, NY (October 2011).
33. Physics Colloquium, "From Topological Insulators to Majorana Fermions," Duke University, Durham, NC (September 2011).
34. Seminar, "Introduction to Topological Insulators," Workshop on topological insulators and superconductors, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, CA (September 2011).
35. Invited Talk, "From Luttinger Liquid to Non-Abelian quantum Hall states," Conference in honor of Duncan Haldane's 60th birthday, Princeton University, Princeton, NJ (September 2011).
36. Invited Talk, "Topological Insulators and Topological Band Theory," ES11 conference, University of Pennsylvania, Philadelphia, PA (June 2011).
37. Physics Colloquium, "Topological Insulators and Topological Band Theory," Dartmouth College, Hanover, NH (May 2011).
38. Condensed Matter Seminar, "Topological Insulators and Topological Band Theory," NRC Institute for Microstructural Sciences, Ottawa, Canada (May 2011).
39. Invited Talk, "Topological Insulators and Majorana Fermions," Symposium to Honor Michael Freedman", Microsoft Station Q, Santa Barbara, CA (April, 2011).
40. Physics Colloquium, "Topological Insulators and Topological Band Theory," Massachusetts Institute of Technology, Cambridge, MA (April 2011).
41. Physics Colloquium, "Topological Insulators and Topological Band Theory," University of Chicago, Chicago, IL (January 2011).
42. Invited Talk, "Topological Defects in Insulators and Superconductors," Miniconference on topological phases, Weizman Institute, Rehovot, Israel (January 2011).
43. Physics Colloquium, "Topological Insulators and Topological Band Theory," Weizmann Institute, Rehovot, Israel (January 2011).
44. Invited Pedagogical lectures on topological insulators (3 lectures), Jerusalem winter school on topological states in condensed matter physics, Jerusalem, Israel (December 2010-January 2011).
45. Condensed Matter Seminar, "Topological Insulators and Topological Band Theory," Columbia University, New York, NY (November 2010).
46. Invited Talk, "Topological Band Theory of Insulators and Superconductors," Workshop on Topological Insulators and Superconductors, Princeton University, Princeton, NJ. (November 2010).

47. Condensed Matter Seminar, "Topological Defects in Insulators and Superconductors," University of Colorado, Boulder, CO (October 2010).
48. Colloquium, "Topological Insulators and Topological Band Theory," University of Colorado, Boulder, CO (October 2010).
49. Physics Department Colloquium, "Topological Insulators and Topological Band Theory," Carnegie Melon University, Pittsburgh, PA (September 2010).
50. Invited Pedagogical lectures on topological insulators (4 lectures), Windsor Summer School on Condensed Matter Physics and Nanoscience, Windsor Great Park, UK (August 2010).
51. Invited Pedagogical lectures on topological insulators (4 lectures), Princeton Summer School on condensed matter physics, (August 2010).
52. Invited Talk, "Topological Defects in Topological Insulators," Workshop on Interactions, Disorder, and Topology in Quantum Hall Systems, Max Planck Institute, Dresden, Germany (June 2010).
53. Invited Talk, "From Graphene to Topological Insulators," Nobel Symposium on Graphene, Stockholm, Sweden (May 2010).
54. Condensed Matter Seminar, "Majorana Fermions and Topological Insulators," Niels Bohr Institute, Copenhagen Denmark (May 2010).
55. Niels Bohr Colloquium, "Topological Insulators and Topological Band Theory," Niels Bohr Institute, Copenhagen Denmark (May 2010).
56. Physics Department Colloquium, "Topological Insulators and Topological Band Theory," University of Texas, Austin, Texas (April 2010).
57. Physics Department Colloquium, "Topological Insulators and Topological Band Theory," Indiana University, Bloomington, Indiana (April 2010).
58. Invited Talk, "From Quantum Spin Hall Effect to Topological Quantum Computation," at workshop to celebrate the distinguished career of Steven Girvin entitled "From From Quantum Hall Effect to Quantum Computation", National Magnet Lab, Talahassee Florida (March 2010).
59. Invited Talk, "Majorana Fermions and Topological Insulators," APS March Meeting, Portland, Oregon (March 2010).
60. Invited Pedagogical Lecture, "Topological Band Theory," given at Tutorial on Topological Insulators at the 2010 APS March Meeting, Portland, Oregon (March 2010).
61. Physics Department Colloquium, "Topological Insulators and Topological Band Theory," State University of New York, Stony Brook (February 2010).
62. Condensed Matter Seminar, "Topological Insulators and Topological Band Theory," City University of New York (January 2010).

63. Invited Talk, "Majorana Fermions and Topological Insulators," Workshop on Exotic Insulating Phases, Johns Hopkins University (January 2010).
64. Invited Talk, "Majorana Fermions and Topological Insulators," Microsoft Station Q Meeting, Santa Barbara, CA (December 2009).
65. Physics Department Colloquium, "Topological Insulators and Topological Band Theory," Temple University (December 2009).
66. Physics Department Colloquium, "Topological Insulators and Topological Band Theory," Penn State University (November 2009).
67. Condensed Matter Seminar, "Topological Insulators and Topological Band Theory," IBM T.J. Watson Research Center (November 2009).
68. High Energy Physics Seminar, "Majorana Fermions and Topological Insulators", Rutgers University (November 2009).
69. Physics Department Colloquium, "Topological Insulators and Topological Band Theory," University of Toronto (October 2009).
70. Invited Talk, "Majorana Fermions and Topological Insulators," Workshop on Topological Order: From Quantum Hall Systems to Magnetic Materials, Max Planck Institute, Dresden, Germany (July 2009).
71. Invited Talk, "Topological Band Theory and the Quantum Spin Hall Effect," SpinTech-V, Krakow, Poland (July 2009).
72. Condensed Matter Seminar, "Topological Band Theory and the Quantum Spin Hall Effect," Hong Kong Institute of Science and Technology, Hong Kong, China June 2009.
73. Invited Talk, "Topological Insulators and Majorana Fermions," Workshop on Novel Topological States, Hong Kong University, Hong Kong, China June 2009.
74. Condensed Matter Seminar, "Majorana Fermions on Topological Insulators," Princeton University, May 2009.
75. Physics Department Colloquium, "Topological Band Theory and the Quantum Spin Hall Effect," Johns Hopkins University, April 2009.
76. Condensed Matter Seminar, "Topological Band Theory and the Quantum Spin Hall Effect," Michigan State University, April 2009.
77. Physics Department Colloquium, "Topological Band Theory and the Quantum Spin Hall Effect," University of Virginia, February 2009.
78. Plenary talk, "Topological Band Theory and the Quantum Spin Hall Effect," KITP workshop on Topological Insulators and the Quantum Spin Hall Effect. Kavli Institute for Theoretical Physics, University of California, Santa Barbara, December 2008.

79. Invited Talk, "Majorana Fermions in Topological Insulators," Workshop on topological phases in condensed matter," University of Illinois at Urbana Champaign, October 2008.
80. Physics Department Colloquium, "Topological Band Theory and the Quantum Spin Hall Effect," Princeton University, September 2008.
81. Invited Talk, "Topological Insulators and the Quantum Spin Hall Effect," 9th International Symposium on the Foundations of Quantum Mechanics in Light of New Technology, Tokyo, Japan, August 2008.
82. Invited Talk, "The Quantum Spin Hall Effect and Topological Band Theory," Trends in Solid State Physics conference, Weizmann Institute, Rehovet, Israel, May 2008.
83. Condensed Matter Seminar, "The Quantum Spin Hall Effect and Topological Band Theory," Massachusetts Institute of Technology, March 2008.
84. Invited Talk, "Superconducting Proximity Effect and Majorana Fermions at the surface of a topological insulator," Conference on the Route to Non Abelian Physics, Princeton University, February 2008.
85. Condensed Matter Seminar, "The Quantum Spin Hall Effect and Topological Band Theory," University of Pennsylvania, January 2008.
86. Invited Talk, "Superconducting Proximity Effect and Majorana Fermions at the surface of a Topological Insulator," Q-Meeting, Microsoft Station Q, Santa Barbara, CA, December 2007.
87. Condensed Matter Seminar, "The Quantum Spin Hall Effect and Topological Band Theory," Californian Institute of Technology, December 2007.
88. Invited Talk, "The Quantum Spin Hall Effect," Emergent Phenomena in Quantum Hall Systems Conference, State College, PA, June 2007.
89. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," Stanford University May 2007.
90. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," University of California, Berkeley, May 2007.
91. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," Florida State University, March 2007.
92. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," Princeton University March 2007.
93. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," Yale University, March 2007.
94. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," Ohio State University, February 2007.

95. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," Rutgers University January 2007.
96. Physics Colloquium, "From Pencil Lead to Relativistic Quantum Physics: Adventures in Topological Band Theory," Georgetown University November 2006.
97. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," Duke University October 2006.
98. Physics Colloquium, "From Pencil Lead to Relativistic Quantum Physics: Adventures in Topological Band Theory," University of North Carolina October 2006.
99. Condensed Matter Seminar, "Graphene and the Quantum Spin Hall Effect," University of Illinois October 2006.
100. Invited Talk, "The quantum spin Hall effect," International High Magnetic Field Conference, Wurzburg, Germany, July 2006.
101. Invited Talk, "The quantum spin Hall effect," Gordon Conference on Strongly Correlated Systems, Mt. Holyoke, MA, June 2006.
102. Condensed Matter Seminar, "The quantum spin Hall effect", University of Minnesota, Minneapolis, MN, April 2006.
103. Invited Talk, "The quantum spin Hall effect," APS March Meeting, Baltimore, MD, March 2006.
104. Condensed Matter Seminar, "The quantum spin Hall effect," University of Pennsylvania, January 2006.
105. Condensed Matter Seminar, "The quantum spin Hall effect," University of Delaware, November 2005.
106. Condensed Matter Seminar, "The Quantum Spin Hall Effect," Boulder Summer School on Condensed Matter Physics, Boulder, CO, July 2005.
107. Invited Talk, "The Quantum Spin Hall Effect," CECAM Workshop on the Anomalous Hall effect, Lyon, France, July 2005.
108. Condensed Matter Seminar, "Quantum Spin Hall Effect in Graphene," Columbia University, April 2005.
109. Condensed Matter Seminar, "Excitons and Electron Interactions in Carbon Nanotube Fluorescence Spectroscopy," IBM T.J. Watson Research Laboratory. November 2004.
110. Condensed Matter Seminar, "Excitons and Electron Interactions in Carbon Nanotube Fluorescence Spectroscopy," University of Michigan, September 2004.
111. Physics Colloquium, "Electronics to Optics: The Long and Short of Carbon Nanotubes," Temple University, April 2004.

112. Invited Talk, "Excitons and Electron Interactions in Carbon Nanotube Fluorescence Spectroscopy," XVIIIth International Winterschool Euroconference on Electronic Properties of Novel Materials, Kirchberg, Austria, March 2004.
113. Condensed Matter Seminar, "Charge and Statistics of Dilute Laughlin Quasiparticles," Cornell University, November 2003.
114. Condensed Matter Seminar, "Excitons and Electron Interactions in Carbon Nanotube Fluorescence Spectroscopy," Boston University, September 2003.
115. Invited Talk, "Excitons and Carbon Nanotube Fluorescence Spectroscopy," Condensed Matter Gordon Conference, Connecticut College, June 2003.
116. Condensed Matter Seminar, "Charge and Statistics of Dilute Laughlin Quasiparticles," Yale University, April 2003.
117. Invited Talk, March Meeting, "Sliding Luttinger Liquids," Indianapolis, IN, March 2002.
118. Invited Talk, ITP Conference on Nanoscience, Institute for Theoretical Physics, Santa Barbara, CA, August 2001.
119. Condensed Matter Seminar, Duke University November 2000.
120. Physics Department Colloquium, University of Illinois at Chicago, October 2000.
121. Invited Talk, Workshop on Interactions and Chaos in Mesoscopic Systems, University of Minnesota, Minneapolis, MN, May 2000.
122. Invited Talk, International workshop on latest developments in low density and low dimensional electronic systems, University of Florida, Gainesville, FL, March 2000.
123. Seminar, Purdue University, West Lafayette, IN, October 1999.
124. Physics Department Colloquium, Simon Fraser University, October 1998.
125. Physics Department Colloquium, University of British Columbia, October 1998.
126. Invited Talk, "Edge Transport in the Quantum Hall Effect," Conference on Disorder and Interactions in Quantum Hall and Mesoscopic Systems, Institute for Theoretical Physics, Santa Barbara, CA, August 1998.
127. Seminar, Chalmers University, Goteborg, Sweden, May 1998.
128. Seminar, Delft University, Delft, The Netherlands, May 1998.
129. Invited Talk, "Electronic Structure and Conductivity in Carbon Nanotube Ropes," IWEPNM98 Workshop on Molecular Nanostructures, Kirchberg, Austria, March 1998.
130. Seminar, Johns Hopkins University, Baltimore, MD, December 1997.
131. Seminar, University of Pennsylvania, Philadelphia, PA, October 1997.

132. Invited Talk, "Electronic Structure and Transport in Carbon Nanotubes," ONR Workshop on Carbon Nanotubes, Houston, TX, June 1997
133. Invited Talk, "Electronic Structure and Transport in Carbon Nanotubes," Workshop on Physical Properties of Carbon Nanotubes, Lexington, KY, July 1997.
134. Invited Talk, "Low Energy Electronic Structure of Carbon Nanotubes", Conference on Quantum Field Theory in Low Dimensions, Santa Barbara, CA, June 1997.
135. Seminar, University of Delaware, Newark, DE, April 1997.
136. Invited Talk, "Size, Shape and Low Energy Electronic Structure of Carbon Nanotubes," APS March meeting, Kansas City, MO, March 1997.
137. Seminar, University of Florida, Gainesville, FL, March 1997.
138. Seminar, "Escape from Flatland: Physics in  $d=1$ ", Penn State University, University Park, PA, February 1997.
139. Invited Talk, "Electronic Structure and Transport in Carbon Nanotubes," Aspen Winter Conference on Condensed Matter: Strongly Interacting Electrons in Reduced Dimensions, January 1997.
140. Seminar, Lucent Technologies Bell Laboratories, Murray Hill, NJ, December 1996.
141. Seminar, University of Maryland, College Park, MD, October 1996.
142. Physics Department Colloquium, "Edge States and Luttinger Liquids", University of Pennsylvania, Philadelphia, PA, October 1996.
143. Invited Talk, "Thermal Transport in a Luttinger Liquid," "Rencontres de Moriond," workshop on mesoscopic physics and strong correlation, Les Arcs, France, January 1996.
144. Seminar, AT&T Bell Laboratories, Murray Hill, NJ, June 1995.
145. Seminar, Rutgers University, New Brunswick, NJ, February 1995.
146. Seminar, NEC Research Center, Princeton, NJ, January 1995.
147. Seminar, Duke University, Durham, NC, September 1994.
148. Physics Department Colloquium, "New Physics in Low Dimensions: Strong Correlation Phenomena in Condensed Matter," Duke University, September 1994.
149. Invited Talk, "Edge Transport in the Quantum Hall Effect," Workshop on Compressible Phases of the Quantum Hall Effect, University of Minnesota, May 1994.
150. Physics Department Colloquium, "The Quantum Hall Effect at the Edge," Temple University, Philadelphia, PA, April 1994.
151. Seminar, Institute for Advanced Study, Princeton, NJ, March 1994.

152. Seminar, City College of New York, New York, NY, March 1994.
153. Invited Talk, "Edge Transport and Tunneling in the Quantum Hall Effect," APS March Meeting, Pittsburgh, PA, March 1994.
154. Seminar, University of Pennsylvania, Philadelphia, PA, December 1993.
155. Invited Talk, "Edge Transport in the Quantum Hall Effect," Workshop on Electronic Properties of Disordered Systems, Argonne National Lab, Argonne, IL, August 1993.
156. Seminar, University of Minnesota, Minneapolis, MN, May 1993.
157. Seminar, Ohio State University, Columbus, OH, April 1993.
158. Seminar, Indiana University, Bloomington, IN, October 1992.
159. Seminar, Johns Hopkins University, Baltimore, MD, October 1992.
160. Seminar, University of Virginia, Charlottesville, VA, October 1992.
161. Invited Talk, NATO ARW, "Transport in a Luttinger Liquid," "Physics of Few-Electron Nanostructures," Noordwijk aan Zee, The Netherlands, September 1992.
162. Invited Talk, "Transport in a Luttinger Liquid," NATO ARW, "Frontiers of Optical Phenomena in Semiconductor Structures of Reduced Dimension," Yountsville, CA, July 1992.
163. Invited Talk, "Transport through Barriers and Resonant Tunneling in a Luttinger Liquid," Conference of Quantum Phase Transitions, ITP, Santa Barbara, CA, July 1992.
164. Seminar, Institute for Theoretical Physics, Santa Barbara, CA, June 1992.
165. Seminar, Princeton University, Princeton, NJ, April 1992.
166. Seminar, University of Maryland, College Park, MD, March 1992.
167. Seminar, Yale University, New Haven, CT, February 1992.
168. Seminar, Massachusetts Institute of Technology, Cambridge, MA, February 1992.
169. Winter School on Fractional Statistics and 2D Magnetism, International Center for Condensed Matter Physics, Brasilia, Brazil, 6 lectures, June 1991.
170. Seminar, University of California, San Diego, CA, March 1991.
171. Seminar, Brown University, Providence, RI, January 1991.
172. Seminar, Stanford University, Stanford, CA, December 1990.
173. Seminar, University of Pennsylvania, Philadelphia, PA, November 1990.
174. Seminar, Brandeis University, Waltham, MA, April 1990.

175. Invited Talk, "The Motion of Holes in a Quantum Antiferromagnet," APS March Meeting, Anaheim, CA, March 1990.
176. Seminar, University of Pennsylvania, Philadelphia PA, March 1990.
177. Seminar, University of California, Berkeley, CA, February 1990.
178. Seminar, IBM Almaden Research Lab, Almaden, CA, February 1990.
179. Seminar, Yale University, New Haven, CT, October 1989.
180. Seminar, Indiana University, Bloomington, IN, May 1989.
181. Seminar, AT&T Bell Laboratories, Murray Hill, NJ, February 1989.
182. Seminar, IBM T.J. Watson Research Center, Yorktown Heights, NY, February 1989.
183. Seminar, Institute for Theoretical Physics, Santa Barbara, CA, February 1989.
184. Seminar, Cornell University, Ithaca , NY, January 1989.
185. Invited Talk, "Voltage Fluctuations in Multi-Lead Devices," Workshop on Quantum Electrical Engineering, University of Minnesota, October 1988.