

Michael A. Hermele

Curriculum Vitae. August 2014.

Department of Physics, 390 UCB
University of Colorado
Boulder, CO 80309-0390

Phone: (303) 492-7466
Email: Michael.Hermele@colorado.edu
www: <http://spot.colorado.edu/~hermele>

Field of research: Theoretical Condensed Matter Physics

Positions Held

2014 – present	Associate Professor (with tenure), University of Colorado Boulder
2007 – 2014	Assistant Professor, University of Colorado Boulder
2005 – 2007	Postdoctoral Associate, Massachusetts Institute of Technology (with Profs. P. A. Lee, T. Senthil and X.-G. Wen)
2001 – 05	Graduate work with Prof. M. P. A. Fisher (UC Santa Barbara)
2000 – 01	Undergraduate research assistant (condensed matter theory) with Prof. B. I. Halperin and Luca Marinelli (Harvard)
1999	Undergraduate research assistant (experimental atomic physics) with Prof. J. M. Doyle (Harvard)

Education

2005	Ph.D. in Physics, University of California Santa Barbara. Advisor: Matthew P. A. Fisher Dissertation Title: <i>Spin Liquid Quantum Critical Phases in Two and Three Dimensions</i>
2003	M. A. in Physics, University of California Santa Barbara.
2001	A. B., Harvard University, <i>magna cum laude</i> with highest honors in Physics.

Honors and Awards

2014	Simons Fellowship in Theoretical Physics
2010	Packard Fellowship in Science and Engineering
2010	Department of Energy Early Career Award
2009	Air Force Office of Scientific Research Young Investigator Research Program Award ¹
2008	Junior Faculty Development Award, University of Colorado
2005	Robert H. Dicke Fellowship, Princeton University (declined)
2001 – 04	National Defense Science and Engineering Graduate Fellow
2000 – 01	Barry M. Goldwater Scholar

¹ Hermele declined funding in order to accept the DOE Early Career Award for the same project.

Current Extramural Financial Support

- Current: Department of Energy Early Career Program. “New states of matter and quantum simulation with ultracold alkaline earth fermions.” Principal investigator, \$750,000, 2010 - 2015.
- Current: Packard Fellowship for Science and Engineering. \$875,000, 2010-2015.
- Current: Simons Foundation (Simons Fellowship in Theoretical Physics). “Symmetry enriched topological phases of matter.” Principal investigator, \$94,808, 2014-2015.

Teaching

Classroom Teaching

- Fall 2007: Physics 1120 Recitations (General Physics 2)
- Spring 2008: Physics 7440 (Theory of the Solid State)
- Fall 2008: Physics 4230 (Thermodynamics and Statistical Mechanics)
- Fall 2009: Physics 7440 (Theory of the Solid State)
- Spring 2010: Physics 7450 (Theory of Solid State 2)
- Fall 2010: Physics 1120 Support Instructor & Recitations (General Physics 2)
- Fall 2011: Physics 1120 Primary Lecturer (General Physics 2)
- Spring 2012: Physics 7450 (Theory of Solid State 2)
- Fall 2012: Physics 7440 (Theory of the Solid State)
- Spring 2013: Physics 4340 (Solid State Physics)
- Fall 2013: Physics 5030 (Intermediate Mathematical Physics I)
- Spring 2014: Physics 4340 (Solid State Physics)

Supervision of Ph.D. Students and Postdoctoral Researchers

- Advisor for three current Ph.D. students
- Co-supervisor of two former postdoctoral researchers, and two current postdocs (one to start September 2014)

Departmental Service

- Colloquium committee (2007-08, 2008-09, Fall 2010. Chairperson Spring 2008, Spring 2009 and Fall 2010)
- Winter staff recognition event committee (2007-08, 2008-09)
- Website committee (2009-10)
- Graduate admissions committee (2009-10, 2011-12)
- High energy physics theory faculty search committee (2012-13)
- Arts and Sciences advising committee (2013-14)
- Organizer of Condensed Matter Seminar in Department of Physics, (Fall 2009 - Fall 2010).

University Service

- Campus selection committee for Packard Fellowship nomination internal competition (2013-14).

Professional Service

- Peer review of manuscripts for *Physical Review Letters*, *Physical Review B*, *Physical Review X*, *Science*, *Nature Communications*, *EPL*, and *Modern Physics Letters B*.
- Proposal review for National Science Foundation, Department of Energy, and Army Research Office.
- Co-organizer of conference “Strongly Correlated Systems and Gauge/Gravity Duality,” Aspen Center for Physics, January/February 2011.
- Co-organizer of conference “Symmetry and Topology in Quantum Matter,” to be held at the NSF Institute for Pure and Applied Mathematics in January 2015.

Selected Other Activities (including outreach)

- Public lecture: CU Boulder Saturday Physics Series for adults and high school students, “Cool Physics: the Surprising Story of Ice.” February 14, 2009.
- Public lecture: CU Boulder Saturday Physics Series for adults and high school students, “Quantum Matter.” April 26, 2014.
- Panelist in discussion on careers in academia, presented as part of the *Beyond Boulder* series for undergraduates in physics and astronomy. January 2010 and February 2013.
- Participant in Kavli Institute for Theoretical Physics programs, “Strongly Correlated Phases in Condensed Matter and Degenerate Atomic Systems” (2007), “Quantum Criticality and the AdS/CFT Correspondence” (2009), “Frustrated Magnetism and Quantum Spin Liquids: From Theory and Models to Experiments” (2012).
- Participant in Aspen Center for Physics summer workshops (2004, 2005, 2008, 2012, 2014).
- Lecturer at advanced schools for Ph.D. students and postdoctoral researchers: *Topological Aspects in Correlated Systems*, held at International Center for Quantum Materials at Peking University, Beijing, China (June 2012). *Spin liquids, matrix product states and entanglement*, Princeton Summer School on Condensed Matter Physics, Princeton University (August 2013). *Quantum Spin Liquids: from Theory to Numerical Simulations*, SISSA, Trieste, Italy (September 2013).

Publications and works submitted

Publications in peer-reviewed journals

1. “d-wave Quasiparticles in the Tilted Vortex Lattice,” M. A. Hermele and L. Marinelli, *Phys. Rev. B* **66**, 132512 (2002) [4 pages].
2. “Pyrochlore Photons: The U(1) Spin Liquid in a S = 1/2 Three-Dimensional Frustrated Magnet,” M. Hermele, M. P. A. Fisher and L. Balents, *Phys. Rev. B* **69**, 064404 (2004) [21 pages].
3. “Stability of U(1) Spin Liquids in Two Dimensions,” M. Hermele, T. Senthil, M. P. A. Fisher, P. A. Lee, N. Nagaosa and X.-G. Wen, *Phys. Rev. B* **70**, 214437 (2004) [9 pages].
4. “Atomic quantum simulator for lattice gauge theories and ring exchange models,” H. P. Büchler, M. Hermele, S. D. Huber, M. P. A. Fisher and P. Zoller, *Phys. Rev. Lett.* **95**, 040402 (2005) [4 pages].
5. “Criticality in quantum triangular antiferromagnets via fermionized vortices,” J. Alicea, O. I. Motrunich, M. Hermele and M. P. A. Fisher, *Phys. Rev. B* **72**, 064407 (2005) [23 pages].
6. “Algebraic spin liquid as the mother of many competing orders,” M. Hermele, T. Senthil and M. P. A. Fisher, *Phys. Rev. B* **72**, 104404 (2005) [16 pages].
7. “Fate of the Josephson Effect in thin-film superconductors,” M. Hermele, G. Refael, M. P. A. Fisher and P. M. Goldbart, *Nature Physics* **1**, 117-121 (2005). [See also News and Views article by Steven M. Girvin, Nature Physics 1, 83 (2005).]
8. “Universal point contact resistance between thin-film superconductors,” M. Hermele, G. Refael, M. P. A. Fisher and P. M. Goldbart, *Phys. Rev. B* **73**, 134504 (2006) [21 pages].
9. “Projected-wave-function study of Spin-1/2 Heisenberg model on the Kagomé lattice,” Y. Ran, M. Hermele, P. A. Lee and X.-G. Wen, *Phys. Rev. Lett.* **98**, 117205 (2007) [4 pages].
10. “SU(2) gauge theory of the Hubbard model and application to the honeycomb lattice,” M. Hermele, *Phys. Rev. B* **76**, 035125 (2007) [28 pages].
11. “Properties of an algebraic spin liquid on the kagome lattice,” M. Hermele, Y. Ran, P. A. Lee and X.-G. Wen, *Phys. Rev. B* **77**, 224413 (2008) [23 pages]. [Physical Review B Editors’ Suggestion.]
12. “Monopoles in CP^{N-1} model via the state-operator correspondence,” M. A. Metlitski, M. Hermele, T. Senthil and M. P. A. Fisher. *Phys. Rev. B* **78**, 214418 (2008) [10 pages]. [Physical Review B Editors’ Suggestion.]
13. “Non-abelian descendant of abelian duality in a two-dimensional frustrated quantum magnet,” M. Hermele. *Phys. Rev. B* **79**, 184429 (2009) [14 pages]. [Physical Review B Editors’ Suggestion; highlighted in Physics: <http://physics.aps.org/synopsis-for/10.1103/PhysRevB.79.184429>]

14. “Mott Insulators of Ultracold Fermionic Alkaline Earth Atoms: Underconstrained Magnetism and Chiral Spin Liquid,” M. Hermele, V. Gurarie and A. M. Rey. *Phys. Rev. Lett.* **103**, 135301 (2009) [4 pages].
15. “Two-orbital SU(N) magnetism with alkaline-earth atoms,” A. V. Gorshkov, M. Hermele, V. Gurarie, C. Xu, P. S. Julienne, J. Ye, P. Zoller, E. Demler, M. D. Lukin, and A. M. Rey. *Nature Physics* **6**, 289-295 (2010).
16. “Probing the Kondo lattice model with alkaline-earth-metal atoms,” M. Foss-Feig, M. Hermele and A. M. Rey. *Phys. Rev. A* **81**, 051603(R) (2010) [4 pages].
17. “Heavy fermions in an optical lattice,” M. Foss-Feig, M. Hermele, V. Gurarie and A. M. Rey. *Phys. Rev. A* **82**, 053624 (2010) [11 pages].
18. “Topological liquids and valence cluster states in two-dimensional SU(N) magnets,” M. Hermele and V. Gurarie. *Phys. Rev. B* **84**, 174441 (2011) [24 pages].
19. “Majorana spin liquids and projective realization of SU(2) spin symmetry,” G. Chen, A. Essin and M. Hermele. *Phys. Rev. B* **85**, 094418 (2012) [17 pages].
20. “High-temperature properties of fermionic alkaline-earth-metal atoms in optical lattices,” K. R. A. Hazzard, V. Gurarie, M. Hermele and A. M. Rey. *Phys. Rev. A* **85**, 041604(R) (2012) [5 pages].
21. “Frustrated quantum critical theory of putative spin-liquid phenomenology in $6H$ - $Ba_3NiSb_2O_9$,” G. Chen, M. Hermele and L. Radzihovsky. *Phys. Rev. Lett.* **109**, 016402 (2012) [5 pages].
22. “Magnetic orders and topological phases from f - d exchange in pyrochlore iridates,” G. Chen and M. Hermele. *Phys. Rev. B* **86**, 235129 (2012) [7 pages].
23. “Classifying fractionalization: symmetry classification of gapped Z_2 spin liquids in two dimensions,” A. M. Essin and M. Hermele. *Phys. Rev. B* **87**, 104406 (2013) [26 pages].
24. “Mott insulators of ultracold fermionic alkaline earth atoms in three dimensions,” Hao Song and M. Hermele. *Phys. Rev. B* **87**, 144423 (2013) [9 pages]. [Physical Review B Editors’ Suggestion.]
25. “Quantum spin ices and topological phases from dipolar-octupolar doublets on the pyrochlore lattice,” Yi-Ping Huang, G. Chen and M. Hermele. *Phys. Rev. Lett.* **112**, 167203 (2014).

Selected other publications (not peer-reviewed)

26. “Erratum: Algebraic spin liquid as the mother of many competing orders [Phys. Rev. B 72, 104404 (2005)],” M. Hermele, T. Senthil and M. P. A. Fisher, *Phys. Rev. B* **76**, 149906(E) (2007) [2 pages].

Works submitted

27. “Spectroscopic signatures of crystal momentum fractionalization,” A. M. Essin and M. Hermele. arXiv:1401.1846. Submitted to *Physical Review Letters*.
28. “String flux mechanism for fractionalization in topologically ordered phases,” M. Hermele. arXiv:1406.0218. Submitted to *Physical Review B*.
29. “Hallmarks of the Mott-Metal Crossover in the Hole Doped $J=1/2$ Mott insulator Sr_2IrO_4 .” Yue Cao, Qiang Wang, Justin A. Waugh, Theodore J. Reber, Haoxiang Li, Xiaoqing Zhou, Stephen Parham, Nicholas C. Plumb, Eli Rotenberg, Aaron Bostwick, Jonathan D. Denlinger, Tongfei Qi, Michael A. Hermele, Gang Cao and Daniel S. Dessau. arXiv:1406.4978. Submitted to *Nature Materials*.

Invited Presentations

* Denotes invited talk at a professional conference/workshop

** Denotes departmental colloquium

***Denotes lectures at an advanced school for Ph.D. students and postdoctoral researchers

2014

1. “Fractionalization of crystal momentum and other quantum numbers.” Theory seminar, Washington University St. Louis Department of Physics. February 13, 2014.

2013

1. “Classifying fractionalization: symmetry classification of gapped Z_2 spin liquids in two dimensions.” Condensed matter seminar, Perimeter Institute for Theoretical Physics. March 26, 2013.
2. “Classifying fractionalization: symmetry classification of gapped Z_2 spin liquids in two dimensions.” Condensed matter theory seminar, University of Maryland. April 15, 2013.
3. Three lectures presented at Princeton Summer School on Condensed Matter Physics, *Spin liquids, matrix product states and entanglement*, held at Princeton University, August 5-6, 2013. Lecture title: “Effective theories of quantum spin liquids.”***
4. Four lectures presented at advanced school *Quantum spin liquids: from theory to numerical simulations*, held at SISSA, Trieste, Italy, September 9-13, 2013. Lecture title: “Symmetry in quantum spin liquids.”***
5. “Quantum spin ice from dipolar-octupolar doublets on the pyrochlore lattice.” Presented at conference *Mott Physics Beyond the Heisenberg Model*, Ascona, Switzerland, October 27-31, 2013.*

2012

1. “Exotic Phases of Matter.” JILA Colloquium. January 24, 2012.**
2. Three lectures presented at summer school *Topological Aspects in Correlated Systems*, held at International Center for Quantum Materials at Peking University, Beijing, China. June 18-22, 2012. Lecture titles: 1. “Exotic phases of matter and quantum spin liquids.” 2. “Parton approach to spin liquids and projective symmetry group classification.” 3. “Symmetry classes for Z_2 topological spin liquids.”***
3. “Symmetry classification of gapped Z_2 spin liquids.” Seminar presented at Kavli Institute for Theoretical Physics program *Frustrated Magnetism and Quantum Spin Liquids: From Theory and Models to Experiments*, Santa Barbara, CA. August 22, 2012.*

4. “Symmetry Classification of Gapped Z_2 Spin Liquids.” Presented at conference *Exotic Phases of Frustrated Magnets*, Kavli Institute for Theoretical Physics, Santa Barbara, CA. October 12, 2012.*
5. “Mott insulators of ultracold alkaline earth fermions: A new class of quantum magnets.” Condensed matter seminar, University of Kentucky, Lexington, KY. October 23, 2012.
6. “Classifying fractionalization: symmetry classification of gapped Z_2 spin liquids in two dimensions.” Condensed matter theory seminar, University of Kentucky, Lexington, KY. October 24, 2012.

2011

1. “Exotic magnetism and new states of matter with alkaline earth atoms.” *American Physical Society March Meeting* (Dallas, TX), March 24, 2011.*
2. “Majorana spin liquids and projective spin rotation symmetry.” *Symposium on Theoretical and Mathematical Physics*, Euler International Mathematical Institute, St. Petersburg, Russia. July 10, 2011.*
3. “Exotic Phases of Matter.” *23rd annual Packard Fellows Meeting*. Monterey, CA. September 8, 2011.*

2010

1. “Algebraic Spin Liquid on the Kagome Lattice.” Presented at conference *Novel Physics on the Kagome Network*, Orsay, France, Jan. 18, 2010.*
2. “Mott insulators of ultracold alkaline earth fermions: A new class of quantum magnets,” seminar, LPTMC, Université Pierre et Marie Curie, Paris, France, Jan. 21, 2010.
3. “Mott insulators of ultracold alkaline earth fermions: A new class of quantum magnets,” Complex Quantum Systems Seminar, University of Texas Austin, Feb. 18, 2010.
4. “Quantum Spin Liquids in Frustrated Magnets and Near the Mott Transition.” *CIFAR Quantum Materials Program Meeting*, Montreal, May 8, 2010.*
5. “Mott insulators of ultracold alkaline earth fermions: A new class of quantum magnets.” Condensed Matter Physics Seminar, California Institute of Technology, Nov. 29, 2010.

2009

1. “Collective behavior from top to bottom: stable phases without quasiparticles in quantum magnets,” University of Michigan Physics Department Seminar, January 20, 2009.
2. “Quantum critical phases in two dimensions,” Physics Department Colloquium, Boston College, March 3, 2009.**
3. “The Elusive Quantum Spin Liquid,” Physics Department Colloquium, Colorado State University, April 13, 2009.**
4. “Quantum Criticality II and IV,” tutorial lectures on quantum criticality presented at Kavli Institute for Theoretical Physics Miniprogram *Quantum Criticality and the AdS/CFT Correspondence*, July 1 & 3, 2009.*
5. “Monopoles and the Fermionic Dual of the O(4) Vector Model,” seminar presented at Kavli Institute for Theoretical Physics Miniprogram *Quantum Criticality and the AdS/CFT Correspondence*, July 23, 2009.*
6. “Beyond Valence Bonds with Ultracold Atoms: Chiral Spin Liquids and Other Surprises in SU(N) Quantum Magnetism,” Q Seminar, Microsoft Station Q, September 15, 2009.
7. “Beyond Valence Bonds with Ultracold Atoms: Chiral Spin Liquids and Other Surprises in SU(N) Quantum Magnetism,” ICMT Seminar, University of Illinois at Urbana-Champaign, October 5, 2009.
8. “Quantum magnetism of ultracold alkaline earth fermions.” Presented at conference *Control of quantum correlations in tailored matter: Common perspectives of mesoscopic systems and quantum gases*, Günzburg, Germany, November 17, 2009.*
9. “Exotic phases in condensed matter physics,” condensed matter seminar, University of Stuttgart, Germany, November 19, 2009.
10. “Tutorial: Exotic phases and phase transitions in quantum magnetism.” Presented at conference *Frontiers of Condensed Matter Physics*, Seoul, South Korea, Dec. 17, 2009.*
11. “Mott insulators of ultracold alkaline earth fermions: A new class of quantum magnets.” Presented at conference *Frontiers of Condensed Matter Physics*, Seoul, South Korea, Dec. 19, 2009.*
12. “Beyond valence bonds with ultracold atoms: Chiral spin liquid and other surprises,” seminar, Asia Pacific Center for Theoretical Physics, Pohang, South Korea, Dec. 22, 2009.

2008

1. “Critical spin liquids in two dimensions: New insights from new dualities,” *Quantum Magnetism Conference*, University of Minnesota Fine Theoretical Physics Institute, May 2-4, 2008.

2007

1. “Exotic Quantum Liquids with Gapless Excitations,” Kavli Institute for Theoretical Physics Program on *Strongly Correlated Phases in Condensed Matter and Degenerate Atomic Systems*, April 5, 2007.*
2. “Exotic quantum matter on the kagome lattice of $\text{ZnCu}_3(\text{OH})_6\text{Cl}_2$,” Physics Department Seminar, University of Massachusetts at Boston, May 16, 2007.

2006

1. “Emergent photons (and beyond) in quantum magnets and optical lattices,” Condensed Matter Physics Seminar, Yale University, January 12, 2006.
2. “New light on strongly correlated systems: Emergent photons in exotic liquids,” Physics Department Colloquium, University of Colorado at Boulder, January 25, 2006.**
3. “Fate of the Josephson effect in thin-film superconductors,” Condensed Matter Seminar, University of Colorado at Boulder, January 26, 2006.
4. “Fate of the Josephson effect in thin-film superconductors,” Condensed Matter Seminar, Berkeley, February 2, 2006.
5. “Fate of the Josephson effect in thin-film superconductors,” Condensed Matter Seminar, Princeton, February 6, 2006.
6. “Quantum critical phases: Algebraic spin liquids in two dimensions,” *American Physical Society March Meeting* (Baltimore, MD), March 2006.*
7. “Spin liquids near the Mott transition,” Condensed Matter Seminar, Brown University, November 2, 2006.

2005

1. “The Algebraic Spin Liquid as the Mother of Many Competing Orders.” Berkeley Condensed Matter Theory Seminar, February 3, 2005.
2. “Basics of exotic quantum states of matter,” informal seminar, Institute for Quantum Optics and Quantum Information, Innsbruck, November 11, 2005.
3. “Fate of the Josephson effect in thin-film superconductors,” Theory Seminar, University of Illinois at Urbana-Champaign, December 5, 2005.

2004

1. “Monopoles and their Quantum Numbers in π -flux (and other) U(1) Spin Liquids.” Kavli Institute for Theoretical Physics Program on *Exotic Order and Criticality in Quantum Matter*, June 1, 2004.*
2. “The Algebraic Spin Liquid as the Mother of Many Competing Orders.” Princeton Condensed Matter Theory Seminar, October 29, 2004.
3. “The Algebraic Spin Liquid as the Mother of Many Competing Orders.” University of Toronto Condensed Matter Seminar, December 6, 2004.
4. “The Algebraic Spin Liquid as the Mother of Many Competing Orders.” Harvard University Special Condensed Matter Theory Seminar, December 9, 2004.