David Sumner Hall

Paula R. and David J. Avenius 1941 Professor of Physics

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Research Interests

Experiments in Bose–Einstein condensation; topological excitations in superfluids.

Professional Experience

2014 – present	Paula R. and David J. Avenius 1941 Professor of Physics, Amherst College
2012 – 2013	Chair, Department of Physics, Amherst College
2011 – 2014	Professor of Physics, Amherst College
2006 – 2011	Associate Professor of Physics, Amherst College
1999 – 2006	Assistant Professor of Physics, Amherst College
1998	Teaching Assistant, Physics, University of Colorado
1997 – 1999	Postdoctoral Research Associate, JILA and University of Colorado
1992 – 1997	Graduate Research Assistant, Harvard University
1991 – 1992	Teaching Fellow, Physics, Harvard University
1989	Laboratory Assistant, Physics, Amherst College
1989 – 1991	Teaching Assistant, Physics, Amherst College
1988 – 1989	Editorial Assistant, American Journal of Physics

Education

Ph.D., Physics, Harvard University, November 1997. Thesis: *Positrons, Antiprotons, and Interactions for Cold Antihydrogen* (Gerald Gabrielse, advisor).

A.M., Physics, Harvard University, May 1994.

A.B. *summa cum laude*, Physics, Amherst College, May 1991. Honors thesis: *Three-Photon Decay of Orthopositronium and a Possible Application to Bell's Theorem* (Kannan Jagannathan, advisor).

Awards and Honors

Cottrell Scholar, Research Corporation for Scientific Advancement, 2015.

Fellow, American Physical Society, 2013.

American Physical Society Prize for a Faculty Member for Research in an Undergraduate Institution, 2012.

Max and Etta Lazerowitz Lectureship (Amherst College), 2004.

Trustee Faculty Fellowship (Amherst College), 2002–2003.

Amherst College Fellowship, 1991–1992.

Sigma Xi (national scientific honor society), May 1991.

William Warren Stifler Physics Prize (Amherst College), May 1991.

Phi Beta Kappa (national honor society), May 1990.

Bassett Physics Prize (Amherst College), May 1989.

Grants Received

(* denotes co-PI)

National Science Foundation Grant PHY–1519174, 2015–2018, *RUI: Experiments with Topological Excitations in Bose–Einstein Condensates.* $475,000.

National Science Foundation Grant PHY–1205822, 2012–2015, *Experiments with Bose–Einstein Condensates II.* $475,000.

National Science Foundation Grant PHY–0958900,* 2010–2013, *Acquisition of an Electron-Beam Evaporator for Undergraduate Research.* $350,000.

National Science Foundation Grant PHY–0855475, 2009–2012, *Experiments with Bose–Einstein Condensates.* $469,086.

National Science Foundation Grant DMS–0806762,* 2008–2010, *Modeling, Analysis, Computation and Experiments of Two-Component Bose–Einstein Condensates.* $300,000.

National Science Foundation Grant PHY–0457402, 2005–2008, *Bose–Einstein Condensates with Vortices and Tunable Interactions.* $317,500.

National Science Foundation Grant PHY–0140207, 2002–2005, *Binary Bose–Einstein Condensates near a Feshbach Resonance.* $376,088.

Cottrell College Science Award, Research Corporation for Scientific Advancement, 2002–2004, *Tunable Interactions in a Rb-87 Bose–Einstein Condensate.* $39,785.

Faculty Research Award (Amherst College), 2001, *Binary Bose–Einstein Condensates near a Feshbach Resonance.* $20,000.

Professional Society Membership

American Physical Society, 1995–present. Fellow, 2013–present.

Sigma Xi, 1991–present.

Certification and Other Education

School of Physics "Enrico Fermi," Course CXL: "Bose–Einstein Condensation," Varenna, Italy, July 1998.

Radiation Protection for the Use of Radionuclides in Research, Harvard University, February 1995.

Courses Taught

Spring 2018	Introductory Physics II: Electromagnetism and Optics (Physics 117)
Spring 2017	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 124)
Fall 2016	Modern Physics (Physics 225)
	Electromagnetic Theory I (Physics 347)
Spring 2016	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 124)
Spring 2016	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 124)
Fall 2015	Modern Physics (Physics 225)
	Electromagnetic Theory I (Physics 347)
Spring 2015	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 124)
Fall 2014	Introductory Physics I: Mechanics and Wave Motion (Physics 116)
Fall 2013	Introductory Physics I: Mechanics and Wave Motion (Physics 116)
Spring 2013	Intermediate Laboratory (Physics 226)
Fall 2012	The Newtonian Synthesis: Dynamics of Particles and Systems, Waves (Physics 123)
Spring 2012	Intermediate Laboratory (Physics 226)
Fall 2011	Introductory Physics I: Mechanics and Wave Motion (Physics 116)
Spring 2011	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 24)

Spring 2010	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 24)
Fall 2009	Introductory Physics II: Electromagnetism and Optics (Physics 17)
	Electromagnetic Theory I (Physics 47)
Spring 2009	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 24)
Fall 2008	Methods of Theoretical Physics (Physics 27)
	Electromagnetic Theory I (Physics 47)
Spring 2007	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 24)
Fall 2007	Computational Physics (Physics 15)
	Electromagnetic Theory I (Physics 47)
Spring 2006	Intermediate Optics (Physics 28)
	Statistical Mechanics and Thermodynamics (Physics 30)
Fall 2005	Introductory Physics II: Electromagnetism and Optics (Physics 17)
Spring 2005	The Maxwellian Synthesis: Dynamics of Particles and Fields (Physics 24)
	Statistical Mechanics and Thermodynamics (Physics 30)
Fall 2004	Introductory Physics II: Electromagnetism and Optics (Physics 17)
Spring 2004	Statistical Mechanics and Thermodynamics (Physics 30)
	Quantum Mechanics (Physics 48)
Fall 2003	Introductory Physics II: Electromagnetism and Optics (Physics 17)
Spring 2002	Electronics (Physics 10)
	Quantum Mechanics (Physics 48)
Fall 2001	Electromagnetism and Electronics (Physics 33)
Spring 2001	Electronics (Physics 10)
	Quantum Mechanics (Physics 48)
Fall 2000	Electromagnetism and Electronics (Physics 33)
Spring 2000	Introductory Physics II: Electromagnetism and Optics (Physics 17)
	Quantum Mechanics (Physics 48)
Fall 1999	Electromagnetism and Electronics (Physics 33)

Undergraduate Theses Supervised

24. L. S. Weiss, *Polar-Core Vortices in Bose–Einstein Condensates* (2018).
23. W. Lee, *Exotic Synthetic Electromagnetic Fields in Shankar Skyrmions* (2016).
22. A.-H. Gheorghe, *Knots and Skyrmions in Spinor Bose–Einstein Condensates* (2015).
21. S. J. Vickery, *Meron Pairs: A Topological Defect in Pseudospinor Bose–Einstein Condensates* (2015).
20. A. L. Antunes de Sá, *Constructing an Optical Phase-Locked Loop for Partial-Transfer Imaging of Bose–Einstein Condensates* (2014).
19. N. B. Bern, *AC Magnetic Noise Cancelation for the Purpose of Creating Dirac Monopoles in a Spinor Condensate* (2013).
18. N. H. Thomas, *Applications of Stimulated Raman Scattering in Bose–Einstein Condensates* (2013).
17. S. Kandel, *Seeking a Dirac Monopole in a Spinor Condensate* (2012).
16. E. Altuntaş, *Real-Time Dynamics of Co-Rotating Vortex Pairs in Bose–Einstein Condensates* (2011).

15. T. K. Langin, *Generation of Counter-Circulating Vortex Lines in a Bose–Einstein Condensate* (2011).
14. D. V. Freilich, *Real-Time Experimental Visualization of Bose–Einstein Condensates with One and Two Vortices* (2010).
13. D. M. Bianchi, *Characterizing a Crossed-Beam Optical Dipole Trap for Ultra-cold ^{87}Rb Atoms* (2009).
12. A. M. Kaufman, *Radiofrequency Dressing of Atomic Feshbach Resonances* (2009).
11. M. L. Goldman, *Landau-Zener Transitions and a Feshbach Resonance in Spinor Bose–Einstein Condensates* (2008).
10. E. S. Petrik, *Vortices in an Optically Trapped ^{87}Rb Bose–Einstein Condensate* (2008).
9. D. H. Guest, *A Cross-Beam Far Off-Resonance Optical Trap for ^{87}Rb Bose–Einstein Condensates* (2007).
8. J. W. Merrill, *Characterization of Inelastic Losses from Bose–Einstein Condensates in the $|2,1\rangle$ State of ^{87}Rb* (2006).
7. T. Menon, *Quantized Vortex Nucleation in a ^{87}Rb Bose–Einstein Condensate* (2005).
6. M. H. Wheeler, *A New Observation of Matter-Wave Interference in Binary Bose–Einstein Condensates* (2004).
5. T. J. Reber, *Creating and Optically Trapping a Bose–Einstein Condensate of Rubidium 87* (2003).
4. J. Bedell, *Soundspace: An Automated Electroacoustic Environment* (Hampshire College Division III, 2002).
3. S. F. Owen, *Magnetic Trapping for Bose–Einstein Condensation of ^{87}Rb* (2002).
2. B. J. Samelson-Jones, *Vacuum System Construction and Magneto-Optic Trapping For Bose–Einstein Condensation* (2001).
1. N. J. Stokes, *Diode Laser Systems for Bose–Einstein Condensation* (2000).

Other Students Supervised

Winter 2018: Arthur Xiao '19. *Summer 2017:* Arthur Xiao '19. *Summer 2016:* Shreeansh Agrawal '19, Angelika Hirsch '19. *Summer 2015:* Wonjae Lee '16. *Summer 2014:* Nigel Mevana '16, Jayson Paul '16. *Summer 2013:* André Lucas Antunes de Sá '14, Nigel Mevana '16. *Summer 2012:* André Lucas Antunes de Sá '14, Hamid Aziz '14, Andrei-Horia Gheorghe '15, Nathan Thomas '13, Sarah Vickery '15. *Winter 2012:* Shenglan Qiao '13, Nathan Thomas '13. *Summer 2011:* Saugat Kandel '12, Phyo Aung Kyaw '14. *Winter 2011:* Nathan Thomas '13. *Summer 2010:* Emine Altuntaş '11, Aftaab Dewan '12, Thomas Langin '11, Shenglan Qiao '13. *Winter 2010:* Andrew Eddins '11, Thomas Langin '11. *Summer 2009:* Aftaab Dewan '12, Daniel Freilich '10 *Winter 2009:* Thomas Langin '11. *Summer 2008:* Dylan Bianchi '09, Daniel Freilich '10, Adam Kaufman '09, John Ware '11. *Summer 2007:* Michael Goldman '08, Adam Kaufman '09, Melissa Moulton '09, Elizabeth Petrik '08. *Summer 2006:* Daniel Guest '07E. *Summer 2005:* Michael Goldman '08, Daniel Guest '07E, Jason Merrill '06, Elizabeth Petrik '08. *Summer 2004:* Margaret McKeon '05, Tarun Menon '05, Jason Merrill '06, Adam Kaplan '07. *Winter 2004:*

Jessie Erwin '06. *Summer 2003:* Max Calabro '06, Jessie Erwin '06, Drew Foss '03, D.-K. Kim '06, Mark Wheeler '04. *Summer 2002:* Theodore Reber '03, Michael Reed '04, Mark Wheeler '04. *Winter 2002:* Katayun Adhami '04, Jessica Anna Cabot '03. *Summer 2001:* Micaela Mendlow '03, Scott Owen '02. *Summer 2000:* Aaron Butler '01, Matt Eckelman '02E, Benjamin Samelson-Jones '01. *Summer 1999:* Scott Owen '02, Nathan Stokes '00.

Professional Service

Fellowships Committee, DAMOP, 2017–present.
Thesis Prize Committee, DAMOP, 2011–2013. Chair, 2012–2013.
Prize Committee, Prize for a Faculty Member for Research in an Undergraduate Institution, 2012–2013.
Textbook Reviewer (Secondary Science), Holt, Rinehart, and Winston, 2003–2005.
Grant Reviewer, National Science Foundation, 2002–present.
Referee, American Journal of Physics, 1999–present.
Referee, Physical Review, 1998–present.

College Service (selected)

Search Committee for Dean of Admission and Financial Aid, 2018; Co-Chair.
Committee on Educational Policy, 2014–2017; Chair, 2015–2017.
Science Faculty Steering Committee, 2011–present; Chair, 2012–2013.
Committee of Six, 2008–2010.
Committee on Student Fellowships, Fall 2007.
Faculty Committee on Admission and Financial Aid, 2003–2006; Chair, 2005–2006.
Committee on Academic Support, 2001–2002.
Health Professions Committee, 2001–2002.
Committee on College Housing, 2000–2001.

Refereed Publications

(* denotes undergraduate co-author)

25. K. Tiurev, T. Ollikainen, P. Kuopanportti, M. Nakahara, D. S. Hall, and M. Möttönen, "Three-dimensional skyrmions in spin-2 Bose–Einstein condensates," New Journal of Physics **20**, 055011 (2018).

24. W. Lee,* A. H. Gheorghe,*, K. Tiurev, T. Ollikainen, M. Möttönen, and D. S. Hall, "Synthetic Electromagnetic Knot in a Three-Dimensional Skyrmion," Science Advances **4**, eaao3820 (2018).

23. T. Ollikainen, K. Tiurev, A. Blinova, W. Lee,* D. S. Hall, and M. Möttönen, "Experimental Realization of a Dirac Monopole through the Decay of an Isolated Monopole," Physical Review X **7**, 021023 (2017).

22. D. S. Hall, M. W. Ray, K. Tiurev, E. Ruokokoski, A. H. Gheorghe,* and M. Möttönen, "Tying Quantum Knots," Nature Physics **12**, 478 (2016).

21. K. Tiurev, E. Ruokokoski, H. Mäkelä, D. S. Hall, and M. Möttönen, "Decay of an isolated monopole into a Dirac monopole configuration," Physical Review A **93**, 033638 (2016).

20. M. W. Ray, E. Ruokokoski, K. Tiurev, M. Möttönen, and D. S. Hall, "Observation of Isolated Monopoles in a Quantum Field," Science **348**, 544 (2015).

19. M. W. Ray, E. Ruokokoski, S. Kandel,* M. Möttönen, and D. S. Hall, "Observation of Dirac Monopoles in a Synthetic Magnetic Field," Nature **505**, 657 (2014).

18. R. Navarro, R. Carretero-González, P. J. Torres, P. G. Kevrekidis, D. J. Frantzeskakis, M. W. Ray, E. Altuntaş,* and D. S. Hall, "Dynamics of a Few Corotating Vortices in Bose–Einstein Condensates," Physical Review Letters **110**, 225301 (2013).

17. P. J. Torres, P. G. Kevrekidis, D. J. Frantzeskakis, R. Carretero-González, P. Schmelcher, and D. S. Hall, "Dynamics of Vortex Dipoles in Confined Bose–Einstein Condensates," Physics Letters A **375**, 3044 (2011).

16. S. Middelkamp, P. J. Torres, P. G. Kevrekidis, D. J. Frantzeskakis, R. Carretero-González, P. Schmelcher, D. V. Freilich,* and D. S. Hall, "Guiding-center dynamics of vortex dipoles in Bose–Einstein condensates," Physical Review A **84**, 011605(R) (2011).

15. D. V. Freilich,* D. M. Bianchi,* A. M. Kaufman,* T. K. Langin,* and D. S. Hall, "Real-Time Dynamics of Single Vortex Lines and Vortex Dipoles in a Bose–Einstein Condensate," Science **329**, 1182 (2010).

14. A. M. Kaufman,* R. P. Anderson, T. M. Hanna, E. Tiesinga, P. S. Julienne, and D. S. Hall, "Radio-frequency dressing of multiple Feshbach resonances," Physical Review A **80**, 050701(R) (2009).

13. K. M. Mertes, J. W. Merrill,* R. Carretero-González, D. J. Frantzeskakis, P. G. Kevrekidis, and D. S. Hall, "Nonequilibrium Dynamics and Superfluid Ring Excitations in Binary Bose–Einstein Condensates," Physical Review Letters **99**, 190402 (2007).

12. M. H. Wheeler,* K. M. Mertes, J. D. Erwin,* and D. S. Hall, "Spontaneous Macroscopic Spin Polarization in Independent Spinor Bose–Einstein Condensates," Physical Review Letters **93**, 170402 (2004).

11. D. S. Hall, "Triggerable GPIB Controller," Review of Scientific Instruments **75**, 562 (2004).

10. S. F. Owen* and D. S. Hall, "Fast Line-Based Timing System for LabVIEW," Review of Scientific Instruments **75**, 259 (2004).

9. D. S. Hall, "Resource Letter BEC-1: Bose–Einstein Condensates in Trapped Dilute Gases," American Journal of Physics **71**, 649 (2003).

8. M. R. Matthews, B. P. Anderson, P. C. Haljan, D. S. Hall, M. J. Holland, J. E. Williams, C. E. Wieman, and E. A. Cornell, "Watching a Superfluid Untwist Itself: Recurrence of Rabi Oscillations in a Bose–Einstein Condensate," Physical Review Letters **83**, 3358 (1999).

7. M. R. Matthews, B. P. Anderson, P. C. Haljan, D. S. Hall, C. E. Wieman, and E. A. Cornell, "Vortices in a Bose–Einstein Condensate," Physical Review Letters **83**, 2498 (1999).

6. G. Gabrielse, D. S. Hall, T. Roach, P. Yesley, A. Khabbaz, J. Estrada, C. Heimann, and H. Kalinowsky, "The Ingredients of Cold Antihydrogen: Simultaneous Confinement of Antiprotons and Positrons at 4 K," Physics Letters B **455**, 311 (1999).

5. G. Gabrielse, A. Khabbaz, D. S. Hall, C. Heimann, H. Kalinowsky, and W. Jhe, "Precision Mass Spectroscopy of the Antiproton and Proton Using Simultaneously Trapped Particles," Physical Review Letters **82**, 3198 (1999).

4. D. S. Hall, M. R. Matthews, C. E. Wieman, and E. A. Cornell, "Measurements of Relative Phase in Two-Component Bose–Einstein Condensates," Physical Review Letters **81**, 1543 (1998).

3. D. S. Hall, M. R. Matthews, J. R. Ensher, C. E. Wieman, and E. A. Cornell, "Dynamics of Component Separation in a Binary Mixture of Bose–Einstein Condensates," Physical Review Letters **81**, 1539 (1998).

2. M. R. Matthews, D. S. Hall, D. S. Jin, J. R. Ensher, E. A. Cornell, C. E. Wieman, F. Dalfovo, C. Minniti, and S. Stringari, "Dynamical Response of a Bose–Einstein Condensate to a Discontinuous Change in Internal State," Physical Review Letters **81**, 243 (1998).

1. D. S. Hall and G. Gabrielse, "Electron Cooling of Protons in a Nested Penning Trap," Physical Review Letters **77**, 1962 (1996).

Other Publications

9. D. S. Hall, "Multi-Component Condensates: Experiment," in *Emergent Nonlinear Phenomena in Bose–Einstein Condensates*, edited by P. G. Kevrekidis, D. J. Frantzeskakis, and R. Carretero-González, (New York: Springer), 307 (2008).

8. D. S. Hall, "Measurements of the Relative Phase Between Two Bose–Einstein Condensates" and "Intertwined Bose–Einstein Condensates," in *Bose–Einstein Condensates and Atom Lasers — Proceedings of the 27th Course of the International School of Quantum Electronics on Bose–Einstein Condensates and Atom Lasers*, edited by S. Martellucci, A. N. Chester, A. Aspect, and M. Inguscio, (New York: Kluwer Academic/Plenum Publishers), 31 (2000).

7. D. S. Hall, M. R. Matthews, C. E. Wieman, and E. A. Cornell, "Measurements of Relative Phase and Quantum Beat Note between Bose–Einstein Condensates," in *Quantum Coherence and Decoherence - ISQM - Tokyo '98*, edited by Y. A. Ono and K. Fujikawa, (New York: Elsevier Science B.V.), 123 (1999).

6. G. Gabrielse, A. Khabbaz, D. S. Hall, C. Heimann, H. Kalinowsky, and W. Jhe, "Testing CPT with Precision Mass Spectroscopy of the Antiproton and Proton," in *Proceedings of the Meeting on CPT and Lorentz Symmetry*, edited by V. A. Kostelecky, (Singapore: World Scientific), 94 (1999).

5. E. A. Cornell, D. S. Hall, M. R. Matthews, and C. E. Wieman, "Having it Both Ways: Distinguishable Yet Phase-Coherent Mixtures of Bose–Einstein Condensates," Journal of Low Temperature Physics **113**, 151 (1998).

4. D. S. Hall, J. R. Ensher, D. S. Jin, M. R. Matthews, C. E. Wieman, and E. A. Cornell,"Recent Experiments with Bose–Condensed Gases at JILA," Proceedings of the SPIE **3270**, 98 (1998).

3. G. Gabrielse, D. S. Hall, A. Khabbaz, T. Roach, P. Yesley, C. Heimann, H. Kalinowsky, W. Jhe, and B. Brown, "Comparing the Antiproton and Proton and Progress toward Cold Antihydrogen," in *Atomic Physics 15 – Fifteenth International Conference on Atomic Physics, Zeeman-Effect Centenary*, edited by H. B. van Linden van den Heuvell, J. T. M. Walraven, and M. W. Reynolds (Singapore: World Scientific), 446 (1997).

2. B. Brown, G. Gabrielse, D. S. Hall, C. Heimann, W. Jhe, H. Kalinowsky, A. Khabbaz, T. Roach, and P. Yesley, "Comparing the Antiproton and Proton and Progress toward Cold Antihydrogen," Nuclear Physics B (Proc. Suppl.) **56A**, 326 (1997).

1. W. Quint, R. Kaiser, D. Hall, and G. Gabrielse, "(Anti)hydrogen Recombination Studies in a Nested Penning Trap," Hyperfine Interactions **76**, 181 (1993).

Invited Presentations

57. "Tying Knots in a Quantum Fluid," OSA/JSAP Joint Meeting, Fukuoka, Japan, September 2017.

56. "Tying Quantum Knots," International Workshop on Topological Structures in Quantum Matter, Espoo, Finland, June 2017.

55. "Tying Knots in a Quantum Fluid," Physics Club, Yale University, February 2017.

54. "Tying Knots in a Quantum Fluid," iQuISE Seminar, Massachusetts Institute of Technology, October 2016.

53. "Tying Knots in a Quantum Fluid," Physics Colloquium, Reed College, October 2016.

52. "Tying Knots in a Quantum Fluid," Physics Seminar, Washington State University, October 2016.

51. "Tying Knots in a Quantum Fluid," Physics Colloquium, Dartmouth College, April 2016.

50. "Monopoles in Spinor Bose–Einstein Condensates," Physics Colloquium, University of Illinois at Urbana-Champaign, March 2015.

49. "Dirac Monopoles in Spinor Bose–Einstein Condensates," Physics Seminar, Smith College, March 2015.

48. "Monopoles in Spinor Bose–Einstein Condensates," JQI Seminar, University of Maryland, November 2014.

47. "Monopoles in Spinor Bose–Einstein Condensates," FiO/LS 2014, Tucson, Arizona, October 2014.

46. "Monopoles in Spinor Bose–Einstein Condensates," Quantum Gases 2014, Beijing, China, August 2014.

45. "Dirac Monopoles in a Synthetic Magnetic Field," ICAP 2014, Washington, D.C., August 2014.

44. "Dirac Monopoles in a Spinor Bose–Einstein Condensate," DAMOP 2014, Madison, Wisconsin, June 2014.

43. "Dirac Monopoles in a Bose–Einstein Condensate," Atomic Physics Seminar, University of Connecticut, April 2014.

42. "I Have Not Yet Finished This Talk on Monopoles," Physics Colloquium, Amherst College, April 2014.

41. "Synthetic Magnetic Monopoles," Physics Seminar, Bates College, October 2013.

40. "Vortex Roulettes in Dilute-Gas Bose–Einstein Condensates," Condensed Matter Seminar, University of Massachusetts, Amherst, November 2012.

39. "Quantum Twisters in the Coldest Stuff in the Universe," Physics Seminar, Colby College, October 2012.

38. "One Decade of Research (Teaching) with Bose–Einstein Condensates," Physics Department Colloquium, Amherst College, September 2012.

37. "Research (Teaching) with Bose–Einstein Condensates," DAMOP 2012, Anaheim, California, June 2012.

36. "Real-Time Observation of Vortex Dynamics in a Bose–Einstein Condensate," Physics Seminar, Hamilton College, April 2012.

35. "Vortex Dipole Dynamics in a Bose–Einstein Condensate," Seminar, Harvard–MIT Center for Ultracold Atoms, March 2012.

34. "Putting the Spin in Experiments with Vortex Clusters," Interdisciplinary Workshop on Quantum Mechanics and Dynamical Systems, Universidad de Granada, October 2011.

33. "Vortex Dipole Dynamics in a Bose–Einstein Condensate," Atomic Physics Seminar, University of Connecticut, March 2011.

32. "Real-Time Observation of Vortex Dynamics in a Bose–Einstein Condensate," Physics Seminar, Reed College, October 2010.

31. "Real-Time Observation of Vortex Dynamics in a Bose–Einstein Condensate," QI/AMO Seminar, University of Illinois at Urbana-Champaign, October 2010.

30. "Tunable Interatomic Interactions 1-2-3," Physics Department Colloquium, Williams College, October 2009.

29. "Pseudospinor Bose–Einstein Condensates," Physics Seminar, Clark University, October 2007.

28. "Binary Bose–Einstein Condensates," Physics Seminar, Smith College, April 2006.

27. "Spontaneous Macroscopic Spin Polarization in Independent Spinor Bose–Einstein Condensates," Physics Seminar, University of Massachusetts, April 2005.

26. "Spontaneous Macroscopic Spin Polarization in Independent Spinor Bose–Einstein Condensates," Atomic Physics Seminar, NIST (Gaithersburg), April 2005.

25. "Spontaneous Macroscopic Spin Polarization in Independent Spinor Bose–Einstein Condensates," Atomic Physics Seminar, University of Maryland, April 2005.

24. "Spontaneous Macroscopic Spin Polarization in Independent Spinor Bose–Einstein Condensates," Seminar, Harvard–MIT Center for Ultracold Atoms, October 2004.

23. "Bose, Einstein, and the Coldest Stuff in the Universe," Lazerowitz Lecture, Amherst College, April 2004.

22. "Interference between Independent Bose–Einstein Condensates," Physics Department Colloquium, Swarthmore College, March 2004.

21. "Interference between Independent Bose–Einstein Condensates," Mathematics Department Seminar, University of Massachusetts, March 2004.

20. "Bose-Einstein Condensate," New England Section Meeting, American Physical Society, Bridgewater State College, October 2002.

19. "Birth and Death of a Bose–Einstein Condensate," Physics Department Colloquium, College of the Holy Cross, January 2002.

18. "Death of a Bose–Einstein Condensate," Atomic Physics Seminar, University of Connecticut, April 2001.

17. "Birth and Death of a Bose–Einstein Condensate," Condensed Matter Seminar, University of Delaware, February 2001.

16. "Superatomic Physics with Bose–Einstein Condensates," Physics Department Colloquium, Mount Holyoke College, November 2000.

15. "Putting the Spin *in* a Bose–Einstein Condensate," Physics Department Colloquium, Williams College, April 2000.

14. "Vortices in a Bose–Einstein Condensate," Condensed Matter Seminar, University of Massachusetts, February 2000.

13. "Intertwined Bose–Einstein Condensates," Physics Department Colloquium, University of Michigan, January 2000.

12. "Intertwined Bose–Einstein Condensates," Modern Optics and Spectroscopy Seminar, Massachusetts Institute of Technology, November 1999.

11. "Vortices in a Bose–Einstein Condensate," Atomic Physics Colloquium, Yale University, November 1999.

10. "Measurement of the Relative Phase between Two Bose–Einstein Condensates" and "Intertwined Bose-Einstein Condensates," International School of Quantum Electronics, 27th Course: Bose-Einstein Condensation, Erice, Italy, October 1999.

9. "Topological Collective Excitations of a Binary Bose–Einstein Condensate," Macroscopic Quantum Coherence Phenomena, ICTP/SISSA, Trieste, Italy, July 1999.

8. "Dressed and Undressed Bose–Einstein Condensates," Keynote Speaker, Northwest Section Meeting, American Physical Society, Vancouver, British Columbia, May 1999.

7. "Bose–Einstein Condensation," AAAS Annual Meeting, Anaheim, California, January 1999.

6. "Superatomic Physics with Bose–Einstein Condensates," Physics Department Colloquium, Amherst College, December 1998.

5. "Quantum Beat Note between Bose–Einstein Condensates," Physics Seminar, University of Chicago, November 1998.

4. "Experiments with Interacting Bose–Einstein Condensates," Physics Division Colloquium, Oak Ridge National Laboratory, November 1998.

3. "Measurements of Relative Phase and Quantum Beat Note between Bose–Einstein Condensates," International Symposium on the Foundations of Quantum Mechanics (ISQM), Tokyo, Japan, August 1998.

2. "Recent Experiments with Bose-Condensed Gases at JILA," Photonics West '98, San Jose, California, January 1998.

1. "Recent Progress Toward Cold Antihydrogen," Atomic Physics Colloquium, State University of New York at Stony Brook, October 1996.

Contributed Presentations (selected)

(* denotes undergraduate co-author)

19. M. Ray, E. Ruokokoski, K. Tiurev, M. Möttönen, and D. Hall, "Isolated Monopoles in a Spinor Bose–Einstein Condensate," Bulletin of the American Physical Society **59**, 43 (2014).

18. M. Ray, E. Altuntaş,* T. Langin,* and D. Hall, "Nucleation of Quantized Vortices in an Ultracold Atomic Gas," Bulletin of the American Physical Society **58**, 25 (2013).

17. M. Ray, E. Altuntaş,* and D. Hall, "Experiments with Non-Equilibrium Co- and Counter-circulating Vortices," Bulletin of the American Physical Society **57**, 53 (2012).

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