

A. Alan Middleton
Curriculum Vitae, June, 2016

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Education

Princeton University Ph.D., Physics, October 1990
Cambridge University Certificate of Advanced Study (Mathematical Tripos Part III), June 1985
Harvey Mudd College B.S., Physics and Mathematics, with Distinction,
 Honors in Physics and Mathematics, June 1984

Professional Employment

2008 - Professor in the Department of Physics, Syracuse University
 Chair, 2013 - present
 Associate Chair, 2009 - 2013
2001 - 2008 Associate Professor in the Department of Physics, Syracuse University
1995 - 2001 Assistant Professor in the Department of Physics, Syracuse University
1992 - 1994 Visiting scientist at the NEC Research Institute, Princeton, NJ
1990 - 1992 Research associate, Department of Physics, Syracuse University
1989 - 1990 Graduate Research Assistant, Department of Physics, Princeton University
Summer 1989 Theoretical Physics Department, AT&T Bell Labs, Murray Hill, NJ
1987-1989 Teaching Assistant, Department of Physics, Princeton University
Summer 1984 Research Assistant at IBM's San Jose Research Laboratory

Honors and Awards

Fellow of the American Physical Society (2010)
Alfred P. Sloan Foundation Fellowship (1995)
Graduate Computational Physics award from Princeton University (1990)
National Science Foundation Graduate Fellowship (1984)
Churchill Scholar (1984)

Research Interests

Materials with disorder: ground states, barriers and metastable states in
 random materials such as spin glasses and other random magnets
Connections between algorithm dynamics, computer science analyses,
 including computational complexity, and physics
Transport in disordered materials, such as vortices in type-II superconductors,
 interface motion, and colloidal assemblies.
Algorithms for efficient simulation of complex dynamics, including heuristic
 coarse graining for glassy materials
Deriving visualizations and qualitative results from large scale simulations

Grants

- Principal Investigator (PI) “Algorithms, States, and Dynamics in Models of Disordered Matter”, National Science Foundation, Division of Materials Research, \$330,000, 2014-2017
- PI “Complex Dynamics and Algorithms for Disordered Matter”, National Science Foundation, Division of Materials Research, \$300,000, 2010-2014
- Co-PI “IGERT: Soft Interfaces - Bridging the Divide in Graduate Education”, with Profs. Marchetti (PI), Mather, Ren, Ruhlandt, National Science Foundation, IGERT, \$1,166,039, 2011-2016
- PI “Statics and Dynamics of Materials with Quenched Disorder”, National Science Foundation, Division of Materials Research, \$279,000, 2006-2010
- PI “Phases and Dynamics of Disordered Condensed Matter Systems”, National Science Foundation, Division of Materials Research, \$225,000, 2001-2005
- Co-PI “Statistical Physics and Computational Complexity”, NSF DMR, under Information and Technology Research, with Profs. Bowick and Marchetti, \$474,000, 2002-2007
- PI “Dynamics and Phase Space Structure of Condensed Matter Systems with Mesoscopic Degrees of Freedom”, NSF DMR, \$211,000, 1997-2001
- Co-PI “Information Science in the Service of Science Education”, with Profs. Vidali, Catterall, Lipson, NSF Division of Undergraduate Education, \$200,000, 1996-2000

I have also received, with Eric Schiff, an internal grant for \$2,450 from the Syracuse University Faculty Instructional Grant Program (12/95) and have been awarded computer time from the National Partnership for Advanced Computational Infrastructure, from the Cornell Theory Center, and Brookhaven National Laboratory.

Administration and Service

Chair of the Department of Physics (2013-present): As current Chair, I work with 30 faculty, 75 graduate students, 23 postdoctoral researchers, 15 staff members. The department has about \$7.7M in research spending and 17 undergraduate majors per year. I have worked with others on restructuring our staff to handle an increased volume of research, setting up new faculty and facilitating training in teaching, laboratory and common space renovations, the addition of Holden Observatory as teaching space, and increased publicity for our accomplishments.

Associate Chair of the Department of Physics (2009-2013): I served primarily as administrator for educational matters, planning courses and space and handling reports, student interactions, and curriculum matters.

Director of Undergraduate Studies (2000-2007): During the time I held the position, the total number of majors rose from about 7 to 52. This involved planning for our program, recruiting and giving tours to prospective students, extensive advising, initiation of an undergraduate lounge, and helping with teaching assignments and course schedules. I continue to be involved in undergraduate education and planning. I maintain contacts with the New Faculty Workshop network and gave an invited talk on teaching at the 2009 APS March Meeting.

Other: I am the Faculty Sponsor for the Syracuse University Travel Team (2015-) which has reviewed and made substantial revisions to the University's Travel Policy, in order to achieve savings and efficiency and in response to community input on travel matters. I have served on the College of Arts and Sciences Faculty Council (2014-) and as its Chair (2015-2016). I have served on a number of search committees, curriculum committees, smaller scholarship committees, the qualifying examination committee, and faculty review committees, including promotion and tenure committees. I have served several times on the Coronat Selection Committee, which reviews and recruits students for the College of Arts and Science's largest merit award. I have served on the College Promotion and Tenure Committee and on the Core Faculty of Renee Crown University Honors Program.

Teaching and Outreach

I have developed and taught courses ranging from large introductory science courses to graduate quantum mechanics. I have invested large amounts of time in each course developing new approaches to the content and updating the material. My methods involve interactions with students, deemphasizing long presentations and including conversations, white board work in pairs, and frequent student feedback. I have created an Honors Course, "Seeing Light", that involves dedicated students (primarily not science majors) in a historical, experimental, and philosophical discussion of vision and light, through color, images, quantum physics, and relativity. The computational course has less emphasis than traditional on numerical methods and instead focuses on developing problem solutions through using existing tools and object-oriented programming. I received the "Lunch on the Department" award for upper division undergraduate teaching in 2012 for teaching undergraduate statistical physics.

Undergraduate courses

- "Science for the 21st Century", a lecture and lab course, focused on light and matter including applications to nuclear weapons and liquid crystal displays
- "Science and Computers", an upper division computer-lab oriented course emphasizing visualization and simulations
- "Statistical Mechanics and Thermodynamics", a course for juniors and seniors
- "Journal Workshop in Physics", a course for new majors that introduces them to landmark papers and research and careers in physics
- "Problem Solving in Contemporary Physics", a course for seniors including problem solving skills and career & graduate school opportunities
- "Seeing Light", an honors course for a variety of majors that reviews the history of theories of light and vision and modern applications
- "First-year forum", a short seminar course for incoming students
- "Major Concepts of Physics II", a core course for non-majors, co-taught.

Graduate Courses

“Science and Computers”, using C++ and Unix tools to solve scientific problems
“Quantum Mechanics II”, including my addition of MRI and quantum communication
“Condensed Matter Physics”, based on Chaikin & Lubensky
“Solid State Physics”, traditional crystals, band structure, superconductivity

Community Outreach and Service

Public science lectures on campus
Visits to local schools, for physics demonstrations (> twice/year)
Guest on local PBS show to discuss chaos
Interview on local morning radio program to explain double rainbows
Talk on “The Spectacular Science of Six-Sided Snow” at the Museum of Science and Technology
Arrange for visits by local high school students to shadow faculty and staff researchers
Co-organizer for the 2001 Boulder School in Condensed Matter Physics
Article on and AAPT prize for demonstration on color mixing

Graduate students: David McNamara, Shantenu Jha, Berta-Elizabeth Rodriguez-Milla, Creighton Thomas, Sean Sweeney, Jie Yang.

Post-doctoral associates: Chen Zeng, Thomas Prellberg, Karl Saunders, Jennifer Schwarz, Jan Meinke.

I have also worked on research projects with undergraduate students and taught undergraduate and graduate independent study courses.

Service to the research community

- Co-organizer of the 2001 Boulder School, the 2008 Aspen Center for Physics Workshop “Complexity, Disorder, and Algorithms”, the 2012 Aspen Workshop “Disorder, Algorithms, and Complexity”, and the 2018 Kavli Institute for Theoretical Physics Workshop “Memory Formation in Matter”. Chair of an abstract sorters group for the 2010 APS March Meeting.
- Regular reviewer for Physical Review Letters, Physical Review X, Physical Review E, Physical Review B, JSTAT, Europhysics Letters, and other journals.
- Grant reviewer and panel participant for the National Science Foundation and Department of Energy. Served on the High Performance Computing review panel for the NSF Mathematical and Physical Sciences Division (2005).

Invited Talks

2006: Joint LPTENS/Jussieu seminar in Paris, France, Invited participant and talk at the International Centre for Theoretical Physics, Trieste, Italy, Invited participant and talk at Max Planck Institute for Complex Systems, Dresden, Germany, Invited participant and talk at Kavli Institute for Theoretical Physics (Oct-Dec.), George Washington University. 2007: Institute for Pure and Applied Mathematics at UCLA, Los Alamos National Laboratory, Central New York Workshop on Complex Matter [Also invited participant at Aspen Center for Physics, July 2005 & July 2007, invited participant at American Institute of Mathematics Workshop, August, 2006], Syracuse University. 2008: Louisiana State University Center for Computation and Technology, Kavli Institute of Theoretical Physics in China, Los Alamos National Laboratory, University of Massachusetts Amherst. 2009: 101st Statistical Mechanics Meeting at Rutgers (May), Physics of Algorithms Workshop in Santa Fe, NM (Sept.). 2010: American Physical Society March Meeting (Portland, OR); 104th Statistical Mechanics Meeting at Rutgers (December). 2011: Washington University in St. Louis, Kavli Institute for Theoretical Physics China (Beijing), University of Science and Technology of China (Hefei). 2012: "Quantum Information Meets Statistical Physics" conference, Innsbruck, Austria. August, 2013: Invited speaker at Santa Fe Institute (“Deep Computation in Statistical Physics”) and at a symposium in honor of Dan Stein at New York University. 2014: Kavli Institute of Theoretical Physics, invited speaker at workshop on “Complexity and Mechanics”; Invited workshop speaker, "Classical and Quantum Optimization", Zurich; Invited session speaker, March American Physical Society Meeting. 2016: “Workshop on Physics Informed Machine Learning”, Santa Fe, NM; 116th Statistical Mechanics Conference, Rutgers University.

PUBLICATIONS

[Also see aamiddle.expressions.syr.edu for latest list, source code, and gallery]

1. “Minimal spanning trees at the percolation threshold: A numerical calculation”,
Physical Review E **88**, 032129 (2013)
Sean M. Sweeney, A. Alan Middleton.
2. “Extracting thermodynamic behavior of spin glasses from the overlap function”,
Physical Review B **87**, 220201 (2013)
A. Alan Middleton.
3. “Numerically exact correlations and sampling in the two-dimensional Ising spin glass”,
Physical Review E **87**, 043303 (2013), Creighton K. Thomas, A. Alan Middleton.
4. “Zero and low temperature behavior of the two-dimensional $\pm J$ Ising spin glass”,
Physical Review Letters **107**, 047203 (2011),
Creighton K. Thomas, David A. Huse, A. Alan Middleton.
5. “Chaos and universality in two-dimensional Ising spin glasses”,
preprint archived as `cond-mat/1012.3444`,
Creighton K. Thomas, David A. Huse, A. Alan Middleton.
6. “Exact Algorithm for Sampling the 2D Ising Spin Glass”,
Physical Review E **80**, 046708 (2009),
Creighton K. Thomas, A. Alan Middleton.
7. “Statistics of static avalanches in a random pinning landscape”,
Physical Review B **79**, 050101 (2009),
Pierre Le Doussal, A. Alan Middleton, Kay Joerg Wiese.
8. “Persistence and Memory in Patchwork Dynamics for Glassy Models”,
Physical Review B **77**, 092415 (2008),
Creighton K. Thomas, Olivia L. White, A. Alan Middleton.
9. “Matching Kasteleyn Cities for Spin Glass Ground States”,
Physical Review B **76**, 220406(R) (2007),
Creighton K. Thomas, A. Alan Middleton.
10. “Are Domain Walls in Spin Glasses Described by Stochastic Loewner Evolution?”,
Physical Review B **76**, 020403(R) (2007),
D. Bernard, P. Le Doussal, A. Alan Middleton.
11. “Irrational mode locking in quasiperiodic systems”,
Physical Review Letters **98**, 148001 (2007),
Creighton K. Thomas, A. Alan Middleton.
12. “Measuring functional renormalization group fixed-point functions for pinned manifolds”,
Physical Review Letters **98**, 155701 (2007),
A. Alan Middleton, P. Le Doussal, and K. J. Wiese,
13. “Effects of Disorder on Electron Transport in Arrays of Quantum Dots”,
preprint with S. Jha, <http://arxiv.org/abs/cond-mat/0511094>.
14. “Linking Physics and Algorithms in the random-field Ising model”,
preprint with Meinke, <http://arxiv.org/abs/cond-mat/0502471>.

15. "Exploring optimization for the random-field Ising model",
preprint archived as cond-mat/0501269,
D. Clay Hambrick, Jan H. Meinke, A. Alan Middleton.
16. "Counting States and Counting Operations",
Chapter 5 (pp. 71-100) in *New Optimization Algorithms in Physics*,
Eds. Hartmann and Rieger, Wiley-VCH (2004),
A. Alan Middleton.
17. "Improved extremal optimization for the Ising spin glass",
Physical Review E **69**, 055701 (2004),
A. Alan Middleton.
18. "Mean Field Theory of Collective Transport with Phase Slips",
Physical Review B **70**, 024205 (29 pp., 2004),
Karl Saunders, J. M. Schwarz, M. Cristina Marchetti, A. Alan Middleton.
19. "Percolation of unsatisfiability in finite dimensions",
Physical Review E **70**, 035103(R) (4pp., 2004),
J. M. Schwarz and A. Alan Middleton.
20. "Driven depinning of strongly disordered media and anisotropic mean-field limits",
Physical Review Letters **91**, 107002 (4 pp., 2003),
M. Cristina Marchetti, A. Alan Middleton, Karl Saunders, J. M. Schwarz.
21. "The three-dimensional random field Ising magnet: interfaces, scaling, and the nature of states",
Physical Review B **65**, 134411 (31 pp., 2002),
A. Alan Middleton and Daniel S. Fisher.
22. "Critical slowing down in polynomial time algorithms",
Physical Review Letters **88**, 017202 (4 pp., 2002),
A. Alan Middleton.
23. "Scaling, domains, and states in the four-dimensional random field Ising magnet",
preprint archived as cond-mat/0208182,
A. Alan Middleton.
24. "Energetics and geometry of excitations in random systems",
Phys. Rev. B **63**, 060202(R) (4 pp., 2001),
A. Alan Middleton.
25. "Viscoelastic Depinning of Driven Systems: Mean-Field Plastic Scallop",
Physical Review Letters **85**, 1104-1107 (2000),
M. Cristina Marchetti, A. Alan Middleton, Thomas Prellberg.
26. "Disorder-Induced Topological Defects in a d=2 Elastic Medium at Zero Temperature",
Physical Review B **61**, 14787-14790 (2000),
A. Alan Middleton.
27. "Numerical investigation of the thermodynamic limit for ground states in models with quenched disorder",
Physical Review Letters **83**, 1672-1675 (1999),
A. Alan Middleton.
28. "Simulation of the Zero Temperature Behavior of a 3-Dimensional Elastic Medium",
Phys. Rev. B **60**, 10062-10069 (1999),
David McNamara, A. Alan Middleton, Chen Zeng.

29. “Computational Complexity of Determining the Barriers to Interface Motion in Random Systems”,
Physical Review E **59**, 2571-2577 (1999),
A. Alan Middleton.
30. “Statistical Topography of Glassy Interfaces”,
Physical Review Letters **80**, 109-112 (1998),
Chen Zeng, Jané Kondev, David McNamara, and A. Alan Middleton.
31. “Ground-State Roughness of the Disordered Substrate and Flux Lines in $d=2$ ”,
Physical Review Letters **77**, 3204-3207 (1996),
Chen Zeng, A. Alan Middleton, Y. Shapir.
32. “Vortex Dynamics and Defects in Simulated Flux Flow”,
Physical Review B **54**, 12427-12436 (1996),
Michael C. Faleski, M. Cristina Marchetti, and A. Alan Middleton.
33. “Numerical Results for the Ground-State Interface in a Random Medium”,
Physical Review **E52**, R3337 (1995).
A. Alan Middleton.
34. “Self-Organized criticality in non-conserved systems”,
Physical Review Letters **74**, 742 (1995).
A. Alan Middleton and Chao Tang.
35. “Avalanches and the renormalization group for pinned charge-density waves”,
Physical Review B **49**, 244 (1994).
Onuttom Narayan and A. Alan Middleton.
36. “Collective Transport in Arrays of Small Metallic Dots”,
Physical Review Letters **71**, 3198 (1993).
A. Alan Middleton and Ned S. Wingreen.
37. “Scaling Near Mode Locking in a Charge Density Wave Conductor”,
Physical Review Letters **70**, 3784 (1993).
Mark J. Higgins, A. Alan Middleton, and S. Bhattacharya.
38. “Critical Behavior of Charge Density Waves Below Threshold: Numerical and Scaling Analysis”,
Physical Review B **47**, 3530 (1993).
A. Alan Middleton and D. S. Fisher.
39. “Self-Organization and a Dynamical Transition in Traffic-flow Models,”
Physical Review A **46**, R6124 (1993).
Ofar Biham, A. Alan Middleton, and Dov Levine.
40. “Elastic String in a Random Potential,”
Physical Review Letters **70**, 662 (1993).
M. Dong, A. Alan Middleton, M. Cristina Marchetti, and Valerii Vinokur.
41. “Dynamics of Directed Polymers with Cutting Interactions,”
Physical Review A **45**, 7288 (1992).
Sergei E. Esipov and A. Alan Middleton.
42. “Thermal Rounding of the Charge Density Wave Depinning Transition,”
Physical Review B **45**, 9465 (1992).
A. Alan Middleton.

43. "Complete Mode-locking in Models of Charge-density Waves,"
Physical Review Letters **68**, 1586 (1992).
A. Alan Middleton, Ofer Biham, Peter B. Littlewood, and Paolo Sibani.
44. "Asymptotic Uniqueness of the Sliding State for Charge Density Waves,"
Physical Review Letters **68**, 670 (1992).
A. Alan Middleton.
45. Reply to comment on "Critical Behavior of Pinned Charge-Density Waves below the Threshold for Sliding,"
Physical Review Letters **67**, 3873(1991).
A. Alan Middleton, Daniel S. Fisher, and Peter B. Littlewood.
46. "Critical Behavior of Pinned Charge-Density Waves below the Threshold for Sliding,"
Physical Review Letters **66**, 92 (1991).
A. Alan Middleton and Daniel S. Fisher.
47. "Discrete Scatterers and Autocorrelations of Multiply Scattered Light,"
Physical Review B **43**, 5934 (1991).
A. Alan Middleton and Daniel S. Fisher.
48. " $^{11}B(\alpha, p)^{14}C^*$ ($E_x = 23.288$ MeV) reaction and (p, π^+) production mechanisms,"
Physical Review C **38**, 1958 (1988).
L. K. Herold, K. E. Luther, A. A. Middleton, M. L. Pitt, and J. D. Brown.
49. "The Deconfining Transition for Finite-temperature $U(1)$ Lattice Gauge Theory in $(2+1)$ Dimensions,"
Physics Letters **B175**, 64 (1986).
P. Coddington, A. Hey, A. A. Middleton, and J. Townsend.