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## Curriculum Vitæ

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Current Positions	2017– 2014– 2006– 2003–	Lead Editor, Reviews of Modern Physics Secondary Appointment, Department of Mathematics Vicki and William Abrams Professor in the Natural Sciences Professor of Physics and Astronomy
Education	1992 1988 1988	Ph.D., Physics, Harvard University M.S., Physics, California Institute of Technology B.S., California Institute of Technology
Prior Positions	2006 2001–2005 2000–2003 1997–2000 1995–1997 1992–1995	Edmund J. and Louise W. Kahn Endowed Term Professor William Smith Term Professor in the School of Arts & Sciences Associate Professor of Physics and Astronomy Assistant Professor of Physics and Astronomy Postdoctoral Research Associate, Department of Physics and Astronomy, University of Pennsylvania, Philadelphia, PA Member, School of Natural Sciences, Institute for Advanced Study, Princeton, NJ
Awards & Honors	2021 2016 2013 2010 2003 2001 1999–2001 1998–2002	Provost's Award for Distinguished PhD Teaching and Mentoring G.W. Gray Medal, British Liquid Crystal Society Simons Investigator Samsung Mid-Career Award, International Liquid Crystal Society Fellow, American Association for the Advancement of Science Fellow, American Physical Society (DCMP) Fellow, Alfred P. Sloan Foundation CAREER Award, National Science Foundation
Visiting Positions	Spring 2019 July 2017  2009–2010 May 1998 Fall 1995	Edwards Fellow, Edwards Centre for Soft Matter, Cambridge, UK Simons Visiting Professor, Mathematisches Forschungsinstitut Oberwolfach, Germany  Member, School of Mathematics, Institute for Advanced Study Professeur Invité, Université Paris XI, Orsay, France Visiting Scientist, Center for Studies in Physics and Biology, The Rockefeller University, New York, NY

### Peer-Reviewed Publications

1. R.D. Kamien, H.D. Politzer and M.B. Wise, “Universality of Random-Matrix Predictions for the Statistics of Energy Levels”, *Phys. Rev. Lett.* **60** (1988) 1995–1998.
2. L. Balents, R.D. Kamien, P. Le Doussal and E. Zaslav, “On the Isotropic-Nematic Transition for Polymers in Liquid Crystals”, *J. Phys. I France* **2** (1992) 263–272.
3. R.D. Kamien, P. Le Doussal and D.R. Nelson, “Theory of Directed Polymers”, *Phys. Rev. A* **45** (1992) 8727–8750. [[cond-mat/9204007](#)]
4. R.D. Kamien and D.R. Nelson, “Directed Polymer Melts and Quantum Critical Phenomena”, *J. Stat. Phys.* **71** (1993) 23–50. [[cond-mat/9206006](#)]
5. R.D. Kamien, “Flory Exponents from a Self-Consistent Renormalization Group”, *J. Phys. I France* **3** (1993) 1663–1670. [[cond-mat/9304004](#)]
6. R.D. Kamien, P. Le Doussal and D.R. Nelson, “Rotational Invariance and the Theory of Directed Polymer Nematics”, *Phys. Rev. E* **48** (1993) 4116–4117. [[cond-mat/9306021](#)]
7. R.D. Kamien and T.C. Lubensky, “Twisted Line Liquids”, *J. Phys. I France* **3** (1993) 2131–2138. [[cond-mat/9306043](#)]
8. R.D. Kamien and D.R. Nelson, “Iterated Moiré Maps and Braiding of Chiral Polymer Crystals”, *Phys. Rev. Lett.* **74** (1995) 2499–2502. [[cond-mat/9411039](#)]
9. R.D. Kamien and J. Toner, “Anomalous Elasticity of Polymer Cholesterics”, *Phys. Rev. Lett.* **74** (1995) 3181–3184. [[cond-mat/9408041](#)]
10. R.D. Kamien and D.R. Nelson, “Defects in Chiral Columnar Phases: Tilt Grain Boundaries and Iterated Moiré Maps”, *Phys. Rev. E* **53** (1996) 650–666. [[cond-mat/9507080](#)]
11. R.D. Kamien, “Liquids with Chiral Bond Order”, *J. Phys. II France* **6** (1996) 461–475. [[cond-mat/9507023](#)]
12. R.D. Kamien and G.S. Grest, “Structure Function of Polymer Nematic Liquid Crystals: A Monte Carlo Simulation”, *Phys. Rev. E* **55** (1997) 1197–1200. [[cond-mat/9512157](#)]
13. R.D. Kamien and T.C. Lubensky, “Chiral Lyotropic Liquid Crystals: TGB Phases and Helicoidal Structures”, *J. Phys. II France* **7** (1997) 157–163. [[cond-mat/9605129](#)]
14. A.B. Harris, R.D. Kamien and T.C. Lubensky, “On the Microscopic Origin of Cholesteric Pitch”, *Phys. Rev. Lett.* **78** (1997) 1476–1479; 2867 *erratum*. [[cond-mat/9607084](#)]
15. R.D. Kamien, T.C. Lubensky, P. Nelson and C.S. O’Hern, “Direct Determination of DNA Twist-Stretch Coupling”, *Europhys. Lett.* **38** (1997) 237–242. [[cond-mat/9611224](#)]
16. R.D. Kamien, “Smectic Order in Double-Twist Cylinders”, *J. Phys. II France* **7** (1997) 743–750. [[cond-mat/9611021](#)]
17. R.D. Kamien and T.R. Powers, “Determining the Anchoring Strength of a Capillary Using Topological Defects”, *Liq. Cryst.* **23** (1997) 213–216. [[cond-mat/9612169](#)]
18. J.D. Moroz and R.D. Kamien, “Self-Avoiding Walks with Writhe”, *Nucl. Phys. B* **506** (1997) 695–710. [[cond-mat/9705066](#)]
19. R.D. Kamien, “Local Writhing Dynamics”, *Eur. Phys. J. B* **1** (1998) 1–4. [[cond-mat/9703137](#)]
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21. J.E. Martin, J. Odinek, T.C. Halsey and R.D. Kamien, “Structure and Dynamics of Electrorheological Fluids”, *Phys. Rev. E* **57** (1998) 756–775.

22. R.D. Kamien, “Force-Free Configurations of Vortices in High-Temperature Superconductors near the Melting Transition”, *Phys. Rev. B* **58** (1998) 8218–8221. [[cond-mat/9804287](#)]
23. R.D. Kamien and T.C. Lubensky, “Minimal Surfaces, Screw Dislocations, and Twist Grain Boundaries”, *Phys. Rev. Lett.* **82** (1999) 2892–2895. [[cond-mat/9808306](#)]
24. M. Triantafillou and R.D. Kamien, “Polymer Shape Anisotropy and The Depletion Interaction”, *Phys. Rev. E* **59** (1999) 5621–5624. [[cond-mat/9810234](#)]
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102. Y. Xia, E. Lee, H. Hu, M.A. Gharbi, D.A. Beller, E.-K. Fleischmann, R.D. Kamien, R. Zentel, and S. Yang, “Better Actuation Through Chemistry: Using Surface Coatings to Create Uniform Director Fields in Nematic Liquid Crystal Elastomers”, *ACS Appl. Mater. Interfaces* **8** (2016) 12466–12472. [DOI:10.1021/acsami.6b02789]
103. L. Tran, M.O. Lavrentovich, D.A. Beller, N. Li, K.J. Stebe, and R.D. Kamien, “Lassoing Saddle-Splay and the Geometrical Control of Topological Defects”, *Proc. Natl. Acad. Sci.* **113** (2016) 7106–7111. [DOI:10.1073/pnas.1602703113] [arxiv:1602.06992] *Cover Article*
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111. E.A. Matsumoto, R.D. Kamien, and G.P. Alexander, “Straight Round the Twist: Frustration and Chirality in Smectics-A”, *Interface Focus* **7** (2017) 20160118: 7 pages. [[arxiv:1611.03830](https://arxiv.org/abs/1611.03830)]
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129. R.D. Kamien and T. Machon, “Geodesic Fibrations for Packing Diabolic Domains”, *Proc. Natl. Acad. Sci.* **117** (2020) 24102–24109. [arxiv:2007.05850] [DOI:10.1073/pnas.2014402117]
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131. B.J. Hocking, H.S. Ansell, R.D. Kamien, and T. Machon, “The Topological Origin of the Peierls-Nabarro Barrier”, *submitted* (2021). [arxiv:2103.02055]
132. H.S. Ansell and R.D. Kamien, “Twisted loxodromes in spindle-shaped polymer nematics”, *to appear in Soft Matter* (2021). [arxiv:2105.11526]d
133. P. Wadekar, C.E. Amanatides, L. Kapllani, G. Dion, R.D. Kamien, and D. Breen, “Geometric modeling of complex knitting stitches using a bicontinuous surface and its offsets”, *Comput. Aided Geom. Des.* **89** (2021) 102024. [DOI:10.1016/j.cagd.2021.102024]
134. M. Tanaka, X. Wang, C.K. Mishra, J. Cai, J. Feng, R.D. Kamien, and A.G. Yodh, “Ratchetlike motion of helical bilayers induced by boundary constraints”, *submitted* (2021).
135. C. Blanc, G. Durey, R.D. Kamien, T. Lopez-Leon, M.O. Lavrentovich, and L. Tran, “Helfrich-Hurault elastic instabilities driven by geometrical frustration”, *submitted* (2021). [arxiv:2109.14668]

### Conference Proceedings, Commentaries, Reviews, and Book Chapters

1. D.R. Nelson and R.D. Kamien, “Polymer Braids and Iterated Moiré Maps”, in *The Legacy of Norbert Wiener; A Special Symposium in Honor of the 100<sup>th</sup> Anniversary of Norbert Wiener’s Birth*, edited by D. Jerison, I.M. Singer and D.W. Stroock (American Mathematical Society, Providence, RI, 1997). [cond-mat/9412119]
2. T.C. Lubensky, R.D. Kamien and H. Stark, “Chiral Fluctuations and Structures”, in *Proceedings of “Liquid Crystals and Supramolecular Order”*, Bangalore, India, (Mol. Cryst. Liq. Cryst. **288** (1996) 15–23). [cond-mat/9512163]
3. R.D. Kamien, “Weak Chirality in Ordered DNA Phases”, in *Proceedings of “The 16<sup>th</sup> International Liquid Crystal Conference”*, Kent, OH, USA, (Mol. Cryst. Liq. Cryst. **299** (1997) 265–275). [cond-mat/9606028]
4. C.S. O’Hern, R.D. Kamien, T.C. Lubensky and P. Nelson, “Twist-Stretch Elasticity of DNA”, in *Statistical Mechanics in Physics and Biology, MRS Proceedings Vol.*

- 463, edited by D. Wirtz, T.C. Halsey and J. Van Zanten (Materials Research Society, Pittsburgh, 1997). [[cond-mat/9612085](#)]
5. T.C. Lubensky, A.B. Harris, R.D. Kamien and G. Yan, “Chirality in Liquid Crystals: From Microscopic Origins to Macroscopic Structure”, in *Proceedings of “The 6<sup>th</sup> International Conference on Ferroelectric Liquid Crystals”*, Brest, France, (*Ferroelectrics* **212** (1998) 1–20). [[cond-mat/9710349](#)]
  6. R.D. Kamien, “Chiral Mesophases of DNA”, in *Proceedings of “The 35<sup>th</sup> Annual Technical Meeting of the Society of Engineering Science”*, Pullman, WA, (*International Journal of Engineering Science* **38** (2000) 1025–1032). [[cond-mat/9812128](#)]
  7. S. Fraden and R.D. Kamien, “Self-Assembly in Vivo”, *Biophys. J.* **78** (2000) 2189–2190.
  8. R.D. Kamien, “Chiral Interactions and Structures”, *Proceedings of “The VIII<sup>th</sup> International Topical Meeting on Optics of Liquid Crystals”*, Humacao, PR, (*Mol. Cryst. Liq. Cryst.* **358** (2001) 97–101). [[cond-mat/9908277](#)]
  9. R.D. Kamien, “Review of *Physical Properties of Liquid Crystals: Nematics*, by Dummer and Luckhurst”, *Liq. Cryst. Today* **11**:1 (2002).
  10. R.D. Kamien, “Soap Froths and Crystal Structures”, *Proceedings of “TH-2002: International Conference on Theoretical Physics”*, Paris, France, (*Ann. Henri Poincaré*, **4**, Suppl. 2 (2003) S679–S681).
  11. R.D. Kamien, “Topology from the Bottom Up”, *Science* **299** (2003) 1671–1673. [[cond-mat/0303353](#)]
  12. D.E. Discher and R.D. Kamien, “Towards Precision Micelles”, *Nature* **430** (2004) 519–520.
  13. R.D. Kamien and M. Kaul, “Nice planet, shame about the human race”, *Nature* **434** (2005) 1067.
  14. R.D. Kamien, “Review of *Bicontinuous Liquid Crystals*, by Lynch and Spicer”, *Liq. Cryst. Today* **15** (2006).
  15. R.D. Kamien, “Better Geometry through Chemistry”, *Science* **315** (2007) 1083–1084.
  16. R.D. Kamien, “Entropic Attraction and Ordering”, in *Soft Matter: Volume 3, Colloidal Order: Entropic and Surface Forces*, ed. by G. Gompper and M. Schick, (Wiley-VCH, Weinheim, 2007), pp. 1–40.
  17. R.D. Kamien, “Knot Your Simple Defect Lines?”, *Science* **333** (2011) 46–47.
  18. M.A. Gharbi, D.A. Beller, A. Honglawan, K.J. Stebe, S. Yang, and R.D. Kamien, “Controlling Liquid Crystal Defects”, *SPIE Newsroom* (2014) 10.1117/2.1201402.005369.
  19. R.D. Kamien, “Colloidal Inclusions in Liquid Crystals”, in *Proceedings of the International School of Physics “Enrico Fermi,” Course 193: Soft Matter Assembly* (IOS Press, Amsterdam, 2016). [[arxiv:1506.06815](#)]
  20. R.D. Kamien, “Soft Matter”, in *The Princeton Companion to Applied Mathematics*, ed. by N.J. Higham, (Princeton University Press, Princeton, 2015) 516–522.
  21. S. Yang, I-S. Choi, R.D. Kamien, “Design of super-conformable, foldable materials via fractal cuts and lattice kirigami”, *MRS Bulletin* **41** (2016) 130–137.
  22. R.D. Kamien, “Reviews of Modern Physics at 90”, *Physics Today* **72** (2019) 32.
  23. P.M. Goldbart and R.D. Kamien, “Tying it all together”, *Physics Today* **72** (2019) 46–47.

### Patents

1. “Patterning Structures Using Deformable Substrates”, S. Yang, Y. Zhang, R.D. Kamien,

- J.M. Kikkawa, E. Mastumoto, and D. Chandra. US Patent Number 8,577,341 B2 (15 October 2013).
2. “Mapping of Local Director Field of Nematic Liquid Crystals at the Nanoscale”, S. Yang, Y. Xia, F. Serra, R.D. Kamien, and K.S. Stebe. US Patent Application #62/127,365 (3 March 2015).
  3. “The Kirigami Modification Of Biomedical Tissue Reinforcing Meshes And Matrices For Expansile Two-To-Three Dimensional Conversion”, S. Yang, S.K. Kanchwala, R.D. Kamien, E. Jablonka, J.C. Jolly, H. Cho, and M. Tanis. US Patent Application #62/643,973 (16 March 2018).
  4. “Topology Optimization for Modeling and Prediction of Complex Fabric Structures and Properties”, G. Dion, R.D. Kamien, M. Tanis, A. Stoltzfus, C. Knittel, T. Castle. US Patent Application #62/644,397 (17 March 2018).

### Invited Presentations

1. “Grain Boundaries and Braiding of Chiral Polymer Crystals”, Liquid Crystal Gordon Research Conference, June 1995.
2. “Twisting and Braiding of Chiral Polymer Crystals”, Materials Research Society Meeting, Complex Fluids Symposium, Fall 1995.
3. “The Origin of Cholesteric Pitch”, Symposium on Liquid Crystals, Colloids and Emulsions, Laboratory for Research on the Structure of Matter, University of Pennsylvania, May 1996.
4. “Weak Chirality in Ordered DNA Phases”, 16<sup>th</sup> International Liquid Crystal Conference, June 1996.
5. “Chiral Mesophases of DNA”, 1997 March Meeting of the American Physical Society, Session on Physical Properties of DNA, March 1997.
6. “Chiral Mesophases of DNA”, National Institutes of Health Workshop on Interaction between DNA Double Helices: Chirality and Structure of DNA Liquid-Crystals, June 1997.
7. “Chiral Interactions and Structures”, Materials Research Society Meeting, Complex Fluids and Biomaterials Symposium, Fall 1997.
8. “The Mystery of the Missing Chirality”, Aspen Center for Physics Winter Workshop on Defects in Soft Condensed Matter, January 1998.
9. “Chiral and Polymer Liquid Crystals”, International Centre for Theoretical Physics Spring College on The Statistical Mechanics and Dynamics of Soft Condensed Matter, May 1998 (*4 Lectures*).
10. “Chiral Mesophases of DNA”, 35<sup>th</sup> Annual Technical Meeting of the Society of Engineering Science, Eringen Medal Symposium, September 1998.
11. “Scherk’s First Surface, Twist Grain Boundaries and All That”, 1999 March Meeting of the American Physical Society, Session on Defects in Polymers and Soft Materials, March 1999.
12. “Minimal Surfaces, Twist Grain Boundaries and All That”, Liquid Crystal Gordon Research Conference, June 1999.
13. “The Microscopic Origin of Macroscopic Chirality”, Complex Materials Conference in Honor of Philip A. Pincus, August 1999.
14. “Chiral Interactions and Structures”, VIII<sup>th</sup> International Topical Meeting on Optics of Liquid Crystals, September 1999.
15. “Scherk’s First Surface, Twist Grain Boundaries and All That”, 3<sup>rd</sup> Society for Industrial and Applied Mathematics (SIAM) Conference on Mathematical Aspects of Materials Science, May 2000.

16. “The Microscopic Origin of Macroscopic Chirality”, 3<sup>rd</sup> Society for Industrial and Applied Mathematics (SIAM) Conference on Mathematical Aspects of Materials Science, May 2000.
17. “Minimal Surfaces and Topological Defects”, Nonlinear Analysis: 2000 →, Courant Institute, New York University, May 2000.
18. “Macroscopic Chirality and Biaxial Correlations”, Fall 2000 National Meeting of the American Chemical Society, Liquid Dynamics: Into the New Millennium, August 2000.
19. “Soap Froths and Crystal Structures”, 21<sup>st</sup> CNLS Annual Conference, Principles of Soft Matter, May 2001.
20. “Bees Do It”, 6<sup>th</sup> Society for Industrial and Applied Mathematics (SIAM) Conference on Applications of Dynamical Systems, May 2001.
21. “Bees Do It”, 7<sup>th</sup> New England Quarterly Workshop on Complex Fluids, June 2001.
22. “Turn of the Screws”, 8<sup>th</sup> International Conference on Ferroelectric Liquid Crystals, August 2001.
23. “The Geometry of Soft Materials”, 2002 Boulder School for Condensed Matter and Materials Physics: Physics of Soft Condensed Matter, July 2002 (*4 lectures*).
24. “Minimal Surfaces and Crystal Structure”, Society for Industrial and Applied Mathematics (SIAM) 50<sup>th</sup> Anniversary and 2002 Annual Meeting, July 2002.
25. “Soap Froths and Crystal Structures”, TH-2002: International Conference on Theoretical Physics, July 2002.
26. “Packing Fuzzy Spheres”, Soft Matters, Laboratory for Research on the Structure of Matter, University of Pennsylvania, September 2002.
27. “The Geometry of Defect Phases”, Materials Research Society Meeting, Defect-Mediated Phenomena in Ordered Polymers Symposium, December 2002.
28. “Hard Spheres, Soap Froths and Self-Assembly”, 26<sup>th</sup> Asilomar Conference on Polymeric Materials, February 2003.
29. “Hard Spheres, Soap Froths and Self-Assembly”, Advanced Computation Inspired by Biological Processes Conference (NSF), April 2003.
30. “Geometric Approach to Self-Assembly”, Fall 2003 National Meeting of the American Chemical Society, September 2003.
31. “Geometric Frustration in Soft Materials”, Modeling of Soft Matter Workshop, Institute for Mathematics and Its Applications (IMA), September 2004.
32. “What’s Kelvin’s Problem?”, National Science Foundation Workshop on Opportunities in Materials Theory 2004, October 2004.
33. “Smectics with Three Dimensional Periodicity”, 2005 March Meeting of the American Physical Society, Session on Novel Ordering In Smectics and other Layered Systems, March 2005.
34. “What’s Kelvin’s Problem?”, Frontiers in Soft Condensed Matter Workshop, May 2005.
35. “The Geometry and Topology of Smectics”, 21<sup>st</sup> International Liquid Crystal Conference, July 2006 (*Plenary Lecture*).
36. “Geometry and Topology in Smectics”, Princeton Center for Complex Materials (PCCM) 2006 Summer School, August 2006 (*2 lectures*).
37. “Materials Geometry”, International Seminar on Applied Geometry in Andalusia, September 2006 (*4 lectures*).
38. “Spherical Phases of Diblocks”, 96<sup>th</sup> Statistical Mechanics Conference, Rutgers Uni-

- versity, December 2006.
39. “Self-Assembly of Soft Spheres”, 81<sup>st</sup> ACS Colloid and Surface Science Symposium, June 2007 (*Keynote Lecture*).
  40. “Defect Effects in Smectics”, Society for Industrial and Applied Mathematics (SIAM) Conference on Mathematical Aspects of Materials Science, May 2008.
  41. “The Geometry of Topological Defects”, Geometrical Singularities and Singular Geometries Workshop, Institute for Mathematics and Its Applications (IMA), July 2008.
  42. “Geometry of Topological Defects in Soft Matter”, Workshop on Topology and Physics, Drexel University, September 2008.
  43. “What’s Kelvin’s Problem”, Colloquium Ehrenfestii, Leiden University, April 2009.
  44. “Geometry and Topology of Smectics”, Hougen Symposium on Frontiers of Liquid Crystals, University of Wisconsin, April 2009.
  45. “Smectic Topology, Topography, and Tomography”, Joint IAS-Rutgers workshop on Topology: Identifying Order in Complex Systems, Rutgers University, May 2009.
  46. “Geometry of Soft Materials”, Soft Solids and Complex Fluids Summer School, University of Massachusetts, Amherst, June 2009.
  47. “Smectics!”, Liquid Crystal Gordon Conference, June 2009.
  48. “Films and Layers: Nematics and Smectics”, Variational Problems for Curves and Surfaces and Related Topics, Nara Women’s University, Japan, June 2009.
  49. “Smectic Topology, Topography, and Tomography”, Variational Problems for Curves and Surfaces and Related Topics, Nara Women’s University, Japan, June 2009.
  50. “New Chiral Geometries”, Chirality, July 2009.
  51. “Focal Conics”, Complex energy landscapes and long time dynamics, Princeton Center for Theoretical Sciences, Princeton, November 2009.
  52. “Smectics!”, Annual Meeting of the International Institute for Complex Adaptive Matter, University of California, Davis, January 2010.
  53. “Smectic Topology”, 23<sup>rd</sup> International Liquid Crystal Conference, July 2010.
  54. “Hidden Symmetry in Focal Conics”, Confined Liquid Crystals: Landmarks and Perspectives, Ljubljana, Slovenia, July 2010.
  55. “Topological Defects in Liquid Crystals”, 2<sup>nd</sup> School of the Italian Liquid Crystal Society, Erice, Italy, July 2011.
  56. “Topology and Geometry of Materials”, Topological Methods in Complex Systems, Institute for Mathematics and its Applications (IMA) Participating Institutions Graduate Students Summer Program, Philadelphia, July-August 2011.
  57. “Smectics!”, 8<sup>th</sup> Liquid Matter Conference, Vienna, Austria, September 2011.
  58. “Layered Liquid Crystals”, Geometry of Interfaces, Primosten, Croatia, October 2011.
  59. “Constructing Smectics”, Frontiers in Soft Matter, University of Colorado, Boulder, May 2012.
  60. “I Got Stripes”, Polymer Gordon Conference, July 2012.
  61. “What do Burgers and Lorentz Have to Say About Smectics?”, Modern Perspectives on Thin Sheets: Geometry, Elasticity, and Statistical Physics, Lorentz Center, Leiden, The Netherlands, September 2012.
  62. “Packing Sheets in Curved Space”, 2012 MRS Meeting: Colloidal Crystals, Quasicrystals, Assemblies, Jammings, and Packings, Boston, November 2012.
  63. “Conformal Smectics”, 2012 MRS Meeting: Geometry and Topology of Biomolecular

- and Functional Nanomaterials, Boston, November 2012.
64. “Topological Defects and the Ground State Manifold”, Symmetry, Bifurcation, and Order Parameters, Isaac Newton Institute, January 2013.
  65. “Topological Defects and the Ground State Manifold”, SIAM Conference on Mathematical Aspects of Materials Science, June 2013.
  66. “Pure and Applied Focal Conics”, Liquid Crystal Defects and Blue Phase Structure; Elastomers and Related Systems, Isaac Newton Institute, June 2013.
  67. “Homotopy Theory and Topological Defects”, I-CAMP Summer School on Liquid Crystals, Cambridge, UK, June 2013.
  68. “Ring Around the Colloid”, Evolution of Colloidal Matter, NYU, June 2013.
  69. “Lectures on Topological Defects”, (4 lectures), Mathematical Approaches to Complex Fluids - a Two Week Summer School, Isaac Newton Institute, July 2013.
  70. “O Topology”, Waterloo Soft Matter Theory Conference, Perimeter Institute, December 2013.
  71. “Pure and Applied and Pure Smectics”, British Liquid Crystal Society Meeting, Durham, UK, April 2014.
  72. “Pure and Applied and Pure Smectics”, Mid-Atlantic Soft Matter Meeting, Johns Hopkins, August 2014.
  73. “Making the Cut: *Kirigami* Topology”, This Week’s Discoveries Colloquium, Leiden University, October 2014.
  74. “Topology of Broken Translation Invariance”, ICERM Workshop on Small Clusters, Polymer Vesicles and Unusual Minima, Providence, RI, March 2015.
  75. “Liquid Crystals”, Public Lecture: Is the Abstract Mathematics of Topology Applicable to the Real World? Institute for Advanced Study, Princeton, NJ, May 2015.
  76. “Cholesteric Twist”, Chirality at the Nanoscale, Kent, OH, June 2015.
  77. “What Becomes a Cholesteric”, Liquid Crystal Gordon Conference, Biddeford, ME, June 2015.
  78. “Liquid-Crystal/Colloid Dispersions”, (4 hours), Summer School on Soft Matter Self-Assembly, International School of Physics “Enrico Fermi”, Varenna, IT, June 2015.
  79. “Are Smectics Cholesterics or What?”, Soft Matter Gordon Conference, New London, NH, August 2015.
  80. “Cholesteric Geometry and Topology”, International Conference on Geometry and Physics of Spatial Random Systems, Bad Herrenalb, Germany, September 2015.
  81. “Cholesteric Geometry and Topology”, 2015 MRS Meeting: Topology in Materials Science: Biological and Functional Nanomaterials, Metrology and Modeling, Boston, November 2015.
  82. “Kirigami Topology”, 2015 MRS Meeting: Shape Programmable Materials, Boston, November 2015.
  83. “Cholesteric Geometry and Topology”, NYU-Oxford Workshop on Mathematical Models of Defects and Patterns, New York, NY, January 2016.
  84. “Cutting, Folding, and Cutting and Folding”, 2016 March Meeting of the American Physical Society, Session on Extreme Mechanics, March 2016.
  85. “Linking in Liquid Crystals”, Gray Medal Lecture, Joint Meeting of the British Liquid Crystal Society and the German Liquid Crystal Society (BLCS/DFKG 2016), Edinburgh, March 2016.
  86. “The Mathematics of Paper”, 2016 CLEC Lecture, Georgia Southern University, March 2016.

87. “Liquid Crystals and their (Algebraic) Topology”, Applied Algebra Days 3, Madison, WI, April 2016.
88. “The Topology of Defects in Smectics”, SIAM Conference on Mathematical Aspects of Materials Science, Philadelphia, May 2016.
89. “Elasticity, Topology, and Geometry: FC Frank’s Legacy on the Field of Liquid Crystals”, Sir Charles Frank Lecture, Bristol, UK, May 2016.
90. “Linking in Smectics”, 26<sup>th</sup> International Liquid Crystal Conference, Kent, OH, July 2016.
91. “Putting Patterns on Spheres”, 252<sup>nd</sup> American Chemical Society National Meeting, Session on A Materials Genome Approach to Materials Structure and Function, August 2016.
92. “Linking in Smectics”, Knots and Links in Biological and Soft Matter Systems, ICTP Trieste, September 2016.
93. “Cholesteric Geometry”, 116<sup>th</sup> Statistical Mechanics Conference, Rutgers University, December 2016.
94. “The Mathematics of Paper”, 2017 Maggie & Nick DeWolf Physics Lecture, Aspen, CO, January 2017.
95. “Scissors Beats Paper”, Gordon Research Conference on Complex Active & Adaptive Materials Systems, January 2017.
96. “Progress in Focal Conic Domains”, Geometry and Interactions in Self-Assembled Biological Systems, Orsay, France, March 2017.
97. “Liquid Crystals: Not Just Another Pretty Phase”, Advancing and Accelerating Materials Innovation through the Synergistic Interaction among Computation, Experiment, and Theory: Opening New Frontiers, National Science Foundation, May 2017.
98. “The Mathematics of Paper”, Personalized Intelligent Living: Human, Robot and Nature, PENN Wharton China Center, June 2017.
99. “The Topological Character of Smectic Liquid Crystals”, Mathematisches Forschungsinstitut Oberwolfach, July 2017.
100. “Progress in Focal Conic Domains”, Geometrically Frustrated Self-assembly, Princeton Center for Theoretical Science, November 2017.
101. “Singularities in Three-Dimensional Smectics”, Geometric and Topological Methods in Liquid Crystals, De Morgan House, London, April 2018.
102. “Packing Liquid Crystal Domains”, ICERM Workshop on Computation and Optimization of Energy, Packing, and Covering, Providence, RI, April 2018.
103. “The Topological Character of Smectics”, Soft Matter Forefronts, Georgia Tech, April 2018.
104. “Knitogami”, Geometry of Soft Matter, International Institute of Physics, Natal, Brazil, May 2018.
105. “The Topological Character of Smectics”, 33<sup>rd</sup> Summer Conference on Topology and its Applications, Bowling Green, KY, July 2018.
106. “The Mathematics of Paper”, 2018 Northeast Ohio REU Symposium, Kent, OH, August 2018.
107. “Knitogami”, Optimal Design of Complex Materials, Isaac Newton Institute, January 2019.
108. “Packing Liquid Crystal Domains”, Optimal Design of Soft Matter, Isaac Newton Institute, May 2019.
109. “The Softest Crystals”, HKUST Jockey Club Institute for Advanced Study Distinguished Lecture, September 2019.

110. “A New Classification of Topological Defects”, 122<sup>nd</sup> Statistical Mechanics Conference, Rutgers University, December 2019.
111. “Keeping it Together”, EMI/PMC 2021, Columbia University, NY, (Virtual) May 2021.
112. “Disclinations and Dislocations in Smectics and Crystals”, SIAM Conference on Mathematical Aspects of Materials Science, Bilbao, Spain (Virtual), May 2021.
113. “Scaffolds for Knitting”, The Geometry & Topology Behind Fabrics at Multiple Scales, Tohoku University, Japan (Virtual), May 2021.
114. “The Softest Crystals”, International Webinar on Physics, Pabna University of Science and Technology, Bangladesh (Virtual), June 2021.
115. “A New Classification of Topological Defects”, Israeli Society of Nonlinear, Statistical, Complex, Biological and Soft-Matter Physics (Virtual), January 2022.
116. “The Topological Origin of the Peierls-Nabarro Barrier”, Physics@Veldhoven, The Netherlands, January 2022.
117. “A New Classification of Topological Defects”, Simons Center’s Workshop on Geometry, Topology, and Symmetry in Soft and Living Matter, Stony Brook, NY, May 2022.
118. “Why Topology Needs Liquid Crystals”, 28<sup>th</sup> International Liquid Crystal Conference, Lisbon, Portugal, July 2022.

#### **Recent Colloquia**

*University of California, San Diego (October 2020), Utrecht University (February 2020), Duke University (January 2020), University of Oxford (May 2019), University of Waterloo (April 2019), Weizmann Institute (March 2018), Hebrew University (March 2018), University of Michigan (October 2017), Universität Heidelberg (July 2017), University of Chicago (October 2016), University of Ljubljana (March 2016), New York University (February 2016).*

#### **Recent Seminars**

*Kent State University (September 2021), GEOTOP Seminar (March 2022), Harvard University (August 2020), University of Chicago (July 2020), Seoul National University (September 2019), New York University (April 2019), ShanghaiTech (March 2019), Fudan University (March 2019), Southeast University Nanjing (March 2019), Cambridge University (February 2019), École Supérieure de Physique et de Chimie Industrielle (February 2019), Laboratoire de Physique des Solides Orsay (February 2019), University of Bristol (January 2019), Tel Aviv University (March 2018), Northwestern University (November 2017), École Supérieure de Physique et de Chimie Industrielle (March 2017), Laboratoire de Physique des Solides Orsay (March 2017), Brown University (September 2016), University of Oxford (May 2016), University of Vienna (March 2016).*

#### **Current Support**

1. Advanced Functional Fabrics of America (AFFOA. PI: Geneviève Dion, Drexel University), *Technical Textiles for Wearable Sensors*, 2020–2021. *W15QKN-16-3-0001*
2. University of Pennsylvania MRSEC Grant, National Science Foundation, 2017–2023 (Co-Leader of IRG3). *DMR-1720530*
3. Simons Investigator Grant, 2013–2023.

#### **Past Support**



- National Science Foundation Grant, *EFRI-ODISSEI: Cutting and Pasting - Kirigami in Architecture, Technology, and Science*, 2013–2020. *EFRI-1331583*
- National Science Foundation Grant, *Topological and Geometrical Problems in Soft Matter*, 2013–2020. *DMR-1262047*
- University of Pennsylvania MRSEC Grant, National Science Foundation, 2011–2017 (Co-Leader of IRG1). *DMR-1120901*
- National Academies Keck Futures Initiative, *Diagnostic Design: Knitted passive probes* (Co-PI; PI Genevieve Dion, Drexel), 2016–2017.
- Charles E. Kaufman Foundation, *Living Photonic Devices: Self-assembly from Proteins as Patchy Colloids* (Co-PI; PI Alison Sweeney), 2014–2017. *KA2014-73924*
- University of Pennsylvania Research Foundation, *Topological Physics: From Elementary Particles to Electrons to Elasticity* (with C.L. Kane and M. Trodden), 2013–2014.
- National Science Foundation Grant (Co-PI; PI Shu Yang), *From a Single Micropatterned Elastic Membrane to a Library of Complex Patterns of Nanostructures: an Efficient Nanomanufacturing Route via Harnessing of Elastic Instability*, 2009–2013. *CMMI-0900468*
- National Science Foundation Grant, *Bending, Twisting and Packing: Geometry and Soft Materials*, 2006–2013. *DMR-0547230*
- University of Pennsylvania MRSEC Grant, National Science Foundation, 2005–2011.
- Petroleum Research Fund Type AC Grant, American Chemical Society, *Bending the Rules* 2005–2007.
- University of Pennsylvania Research Foundation, *Materials Geometry: The Use of Modern Geometry in Real Materials*, 2006.
- National Science Foundation Grant, *Cells and Boundaries All Around Us*, 2002–2005. *DMR-0129804*
- Nanoscience Interdisciplinary Research Team (NIRT) Grant, National Science Foundation, *Single Molecule Functional Nanostructures*, 2001–2005.
- University of Pennsylvania Research Foundation, *Novel Spherical Phases of Diblock Copolymers*, 2003.
- Petroleum Research Fund Type AC Grant, American Chemical Society, *Soap Froths and the Rational Design of Molecular Crystals*, 2001–2003.
- National Science Foundation International Grant (with CNRS), *Structure of Smectic Blue Phases*, 2000–2003. *INT-9910017*
- Drug Delivery Team, Southeastern Pennsylvania Nanotechnology Institute, 2001–2006.
- University of Pennsylvania Research Foundation, *Soap Froths and the Rational Design of Molecular Crystals*, 2001.
- Fellowship, Alfred P. Sloan Foundation, 1999–2001.
- University of Pennsylvania MRSEC Grant, National Science Foundation, 1998–2001.
- Faculty Early Career Development (CAREER) Award, National Science Foundation, *Chiral Molecules, Structures and Materials*, 1998–2002. *DMR-9732963*
- Research Innovation Award, Research Corporation, *Entanglement Hydrodynamics of Polymer Nematics*, 1998–2000.
- Petroleum Research Fund Type G Grant, American Chemical Society, *Dynamics of Polymer Nematics*, 1998–2000.

### Editorships and Editorial Boards

- Lead Editor, *Reviews of Modern Physics*, 2017–
- Editorial Board, *New Journal of Physics*, 2016–2017.

- Associate Editor, *Science Advances*, 2014–2017.
- Editorial Board, *Liquid Crystal Reviews*, 2013–2017.
- Editorial Board, *Physics Reports*, 2012–2017.
- Associate Editor, *Reviews of Modern Physics*, 2006–2010.
- Associate Editor, *Physical Review E*, 2000–2003.

### Selected Professional Activities

- Honors & Awards Committee, International Liquid Crystal Society, 2016–
- Organizing Committee, 2016 International Liquid Crystal Conference, Kent, OH.
- Chair, APS Group on Soft Matter (GSOFT), 2014–2016 (Past Chair 2016–2017).
- Corresponding Member, Journal Club for Condensed Matter Physics, 2005–
- Member, Board of Directors, Boulder School for Condensed Matter and Materials Physics, 2004–2020.
- Soft Matter Organizing Committee, APS, 2014–2015.
- Session Leader on Multi/Inter-Disciplinary Courses, 2013 APS Graduate Education in Physics Conference.
- Fellowship Committee, Division of Polymer Physics, APS, 2010–2011.
- Member, KITP Advisory Board, 2009–2012.
- Scientific Committee, 23<sup>rd</sup> International Liquid Crystal Conference, Kraków, Poland 2010.
- Co-organizer, Journal Club for Condensed Matter Physics, 2009–2011.
- Discussant, *Students Lunch with the Experts*, 2009 and 2005 March Meeting of the American Physical Society.
- Summer Program Committee, Aspen Center for Physics 2006–2009 (Chair 2007 and 2008).
- Chair of Nominating Committee, Division of Condensed Matter Physics (DCMP), American Physical Society, 2006 – 2009.
- General Member, Aspen Center for Physics, 2004–2009.
- Fellowship Committee, Group on Statistical and Nonlinear Physics, 2003.
- Program Committee, Group on Statistical and Nonlinear Physics, March 2002.
- Member-at-Large, Executive Committee of the American Physical Society Topical Group on Statistical and Nonlinear Physics (GSNP), March 2001–2004
- Lecturer, University of Pennsylvania Summer Science Academy, 1998, 2000, 2003, 2004, 2006, 2011.

### Conferences and Schools Organized

- Co-organizer, *Principal of Condensed Matter Physics: A Symposium in Honor of Tom Lubensky*, Philadelphia, PA 4-5 November 2017.
- Co-organizer, *Different is Different: A Celebration of Sue Coppersmith's 60th Birthday*, Aspen, CO 3-4 March 2017.
- Co-organizer, *Topology in Motion*, Institute for Computational and Experimental Research in Mathematics, Providence, RI, 6 September - 9 December 2016.
- Co-organizer, *Foldable, Buildable, and Responsive Materials*, University of Pennsylvania, 22-23 August 2014.
- Chair, 2013 Gordon Research Conference on Liquid Crystals (Vice-Chair 2011).
- Co-organizer, *Knotted Fields*, Kavli Institute for Theoretical Physics, June 2012.

- Co-organizer, *Materials and the Imagination*, Aspen Center for Physics, January 2011.
- Co-organizer, *Geometry and Materials Physics: Making the Connection*, Aspen Center for Physics, June 2004.
- Co-organizer, *2002 Boulder School for Condensed Matter and Materials Physics*, July 2002.
- Co-organizer, *Symposium in Honor of the 65<sup>th</sup> Birthday of A. Brooks Harris*, University of Pennsylvania, 17-18 March 2000.
- Co-organizer, *3<sup>rd</sup> and 4<sup>th</sup> Annual Symposia on the Physics of Soft Materials*, Laboratory for Research on the Structure of Matter, University of Pennsylvania, 2 May 1998 and 9 October 1999.
- Co-organizer, *Ten Years of the TGB Phase: A Workshop*, University of Pennsylvania, 22-24 April 1998.

### Internal Service

#### *Department of Physics and Astronomy*

- Planning Committee, 2000-05 (*ex officio*), 2006-07 (*ex officio*), 2007-08, 2010-16, 2017-18, 2020-21.
- Graduate Committee, 1998-2007, 2010-14, 2017-18.
- Chair of Colloquium Committee, 1999-2000, 2012-14.
- Chair of Bio/Nano Search Committee, 2011-12 (ending in hire of Professor Alison Sweeney).
- Associate Chair for Graduate Affairs and Chair of the Graduate Group in Physics and Astronomy, 2000-05, 2006-07, 2013-14.
- Member of search committees, organizer of seminar series, and chair and member of promotion *ad hoc* committees.
- Awards Committee, 2014-15, 2016-17.

#### *School of Arts and Sciences*

- Chair of Cluster Search Committee in Evolution, 2012-14.
- Personnel Committee, 2003-05.

#### *University of Pennsylvania*

- Deputy Director, Center for Analyzing Evolved Structures as Optimized Products (AESOP), 2015–
- SAS Dean Search Committee, 2012-13.
- Co-Leader, IRG1, Laboratory for Research in the Structure of Matter, 2011-17.
- Middle States Reaccreditation Self Study Team, 2002-03, 2012-13.
- Graduate Council of Faculties, 2005-08.
- Chair, Selection Committee, Penn Prize for Excellence in Teaching by Graduate Students, 2005-08.
- Graduate Education Strategic Planning Committee, 2001.
- Focus Group on Undergraduate Brochure, 1998.

### Teaching

Spring 2021	Physics 528	<i>Introduction to Liquid Crystals</i>
Fall 2020	Physics 611	<i>Statistical Mechanics</i>
Fall 2019	Physics 611	<i>Statistical Mechanics</i>
Fall 2019	Physics 500	<i>Mathematical Methods in Physics I</i>

Fall 2018	Physics 611	<i>Statistical Mechanics</i>
Spring 2018	Physics 528	<i>Introduction to Liquid Crystals</i>
Fall 2017	Physics 500	<i>Mathematical Methods in Physics I</i>
Spring 2017	Physics 696	<i>Introduction to the Renormalization Group</i>
Spring 2016	Physics 612	<i>Advanced Statistical Mechanics</i>
Fall 2015	Physics 500	<i>Mathematical Methods in Physics I</i>
Fall 2014	Physics 611	<i>Statistical Mechanics</i>
Fall 2014	Physics 500	<i>Mathematical Methods in Physics I</i>
Spring 2014	Physics 528	<i>Introduction to Liquid Crystals</i>
Fall 2013	Physics 500	<i>Mathematical Methods in Physics I</i>
Fall 2012	Physics 611	<i>Statistical Mechanics</i>
Spring 2012	Physics 528	<i>Introduction to Liquid Crystals</i>
Fall 2011	Physics 611	<i>Statistical Mechanics</i>