

- to the understanding of soft biomaterials, quantum fields, and superstrings, using geometrical and topological methods.”
- 2001 Ira Abrams Award, highest distinguished teaching honor of Penn’s School of Arts and Sciences.
- 1997 Penn SAS Faculty Research Fellowship.
- 1988–94 NSF Presidential Young Investigator award.
- 1988–91 Young Faculty Award, University of Pennsylvania.
- 1988–91 Alfred P. Sloan Foundation Fellow.
- 1988 Department of Energy Outstanding Junior Investigator.
- 1984–87 Junior Fellow, Harvard University Society of Fellows.
- 1981–84 National Science Foundation graduate fellow.
- 1980-82 Winston Churchill Foundation fellowship.

Past research interests

Biological physics: biopolymers; molecular motors; self-assembly; DNA topology and elasticity; stochastic modeling; neuroscience.

Condensed matter physics: complex fluids; bilayer membranes; dynamical pattern formation; colloidal forces; entropic forces.

Geometrical methods in theoretical physics: classical and quantum fields; monopoles; anomalies; string theories; superspace and supergravity; Bose-Fermi equivalence; conformal field theory; random geometry.

Dissertation

“Global Conflicts”; advisor Prof. S. Coleman.

Teaching experience

Physics 909: Seminar on Extended Objects in Field Theory.

Physics 896: Superstring Theory.

Physics 601: Relativistic Quantum Mechanics.

Seminar on Differential Geometry in Physics.

Physics 503: Geometry, Relativity, Gravitation.

Physics 632–633: Relativistic Quantum Field Theory.

Physics 514: Mechanics, Fluids, Chaos.

Physics 240/250: Einstein’s Century.

Physics 650: Minicourse on Biopolymers and Membranes.

Physics 580: Biological Physics.

Physics 516: Electromagnetic Phenomena.

Physics 280: Physical Models of Biological Systems.

For all of these see <http://www.physics.upenn.edu/~pcn/>

Dissertations supervised

- 1992 Eugene Wong. Wong is on the faculty of the Department of Physics and Astronomy of the University of Western Ontario.
- 1995 Thomas Powers. Powers is currently James R. Rice Associate Professor of Solid Mechanics and Associate Professor of Engineering

- Mechanics of Solids and Structures at Brown University.
1998 J. David Moroz. Moroz works for the International Atomic Energy Agency.
2001 Yi Chen. Chen is an analyst at Goldman Sachs.
2009 John F. Beausang.

Recent
Postdocs

- 1998 Martin Zapotocky; now Group Leader, Dept of Biological Physics, Max Planck Institute for Physics of Complex Systems.
2001–03 Cornelis Storm; now Assistant Professor, Eindhoven Technical Univ.
2006–07 Igor Kulić; now postdoc, Harvard University.
2005–06 Prashant Purohit; now Assistant Professor, Penn MEAM Department.
2007–08 Kevin Towles; now at Boston Consulting Group.
2008– Gasper Tkacik.

Conferences
attended
since 1997

- 2009 Biophysical Society (invited talk).
2009 American Physical Society March Meeting (invited talk).
2009 Single Molecule Biophysics, Aspen (contributed talk).
2008 Invitational Summit on Undergraduate Biology Teaching, Howard Hughes Medical Institute.
2008 SIAM Conference on Mathematical Aspects of Materials Science (invited talk).
2008 Biophysical Society (invited talk).
2007 Biophysical Society (contributed talk).
2006 Molecular Motors: Point Counterpoint, Asilomar.
2006 New Physical Approaches to Molecular and Cellular Machines, Kavli Institute for Theoretical Physics (coorganizer).
2006 Interdisciplinarity and Discipline in Education, Kavli Institute for Theoretical Physics (coorganizer).
2005 Single Molecule Biophysics, Aspen Center for Physics (invited talk).
2005 Biophysical Society (invited talk).
2004 American Chemical Society Meeting, Philadelphia (invited talk).
2004 American Physical Society March Meeting, Montreal (invited talk).
2004 Towards a Predictive Biology, Isaac Newton Institute, Cambridge UK (invited talk).
2004 American Association of Physics Teachers, Miami (invited talk).
2003 FASEB Conference on Mechanism and Regulation of Prokaryotic Transcription (contributed poster).
2003 Frontiers in Biological Physics, Institute for Complex Adaptive Matter, Aspen/Snowmass (invited talk).
2003 Aspen Winter Workshop on Single Molecule Biophysics (contributed talk).
2002 Workshop on Opportunities in Materials Theory, NSF (invited talk).

- 2001 Electrostatic Interactions in Polymers, Colloids, and Biophysics, Theoretical Physics Institute, Minneapolis (invited talk).
- 2001 Principles of Soft Matter, Center for Nonlinear Studies, Los Alamos (invited plenary talk).
- 1999 American Association of Physics Teachers Regional Meeting, Philadelphia (contributed talk).
- 1999 Complex Materials Conference in Honor of Philip Pincus, Santa Barbara (invited talk).
- 1999 European Molecular Biology Organization Conference on Single Molecule Biophysics (Tours, France).
- 1999 Gordon Conference on Condensed Matter Physics (invited lecture).
- 1999 American Physical Society Centennial Meeting (invited talk).
- 1999 Cold Spring Harbor Laboratory Workshop on the Role of DNA Topology, Conformation and Associated Factors in Gene Expression (invited talk).
- 1999 Biophysical Society Meeting (contributed talk).
- 1998 Physics at the Scale of the Cell, Cargèse (invited course of lectures).
- 1998 Dynamics Days, Chapel Hill (invited talk).
- 1997 Biophysics of the Cell, Aspen.
- 1997 American Physical Society March Meeting (one invited talk, one contributed talk).
- 1997 Joint DIMACS/PMMB/MBBC Workshop on DNA Topology (invited talk).

Other invited talks:

Seminars outside Penn, since 1996:

Harvard, Cornell, Princeton, Duke, and the Rockefeller University ($\times 2$).

Department Colloquia, since 1996:

MIT Applied Mathematics, Duke University Physics, Brown University Physics, University of Colorado Physics, University of Chicago Physics, Boston University Physics, Rutgers Physics ($\times 2$), Brandeis Physics, University of Illinois, Harvard University Physics, Emory University Physics, Temple University Physics, Caltech Biophysics, Princeton Physics, Renaissance Technology.

Other professional activities

- 2007 Boulder Summer School in Quantitative Biology (invited lecturer).
- 2006 Co-organizer, workshop on “New Physical Approaches to Molecular and Cellular Devices” at the Kavli Institute for Theoretical Physics, UCSB.
- 2005,09 Visiting Committee of the Harvard University Physics Department.
- 2004 NSF Workshop on the Role of Theory in Biological Physics and Materials, Tempe, AZ (panel participant).
- 1992 NSF NYI Award review panel.

- 1991 Workshop co-organizer, Aspen Center for Physics.
- 1987 Convenor and chair, superunification session, American Physical Society Division of Particles and Fields meeting, Salt Lake City.
- 1987 Consultant to Public Broadcasting Associates for NOVA.

Philip Nelson

Publications since 1994

Book:

- P. Nelson**, *Biological Physics: Energy, Information, Life* (W. H. Freeman and Co., 2004); *Updated edition* (2008).
- P. Nelson**, *Física Biológica: Energía, Información, Vida* (Editorial Reverte, 2005).
- P. Nelson**, *Física Biológica: Energia, Informação, Vida* (Guanabara Koogan, 2006).
- P. Nelson**, *Sheng Wu Wu Li Xue: Neng Liang, Xing Xi, Sheng Ming* (Shanghai Scientific and Technical Publishers, 2006).

Peer-Reviewed Journal Articles (since 1994)

- W. Cai, T.C. Lubensky, **P. Nelson**, and T. R. Powers, *Measure Factors, Tension, and Correlations of Fluid Membranes*, J. Phys. II France **4**, 931–949 (1994).
- T. R. Powers, **P. Nelson**, and U. Seifert, *Dynamical Theory of the Pearling Instability in Cylindrical Vesicles*, Phys. Rev. Lett. **74** 3384–3387 (1995).
- T. R. Powers and **P. Nelson**, *Fluctuating Membranes With Tilt Order*, J. Physique II (France) **5**, 1671–8 (1995).
- R. E. Goldstein, **P. Nelson**, T. R. Powers, and U. Seifert, *Front Propagation in the Pearling Instability of Tubular Vesicles*, J. Physique II (France) **6**, 767–796 (1996).
- U. Seifert, J. Shillcock, and **P. Nelson**, *Role of Bilayer Tilt Difference in Equilibrium Membrane Shapes*, Phys. Rev. Lett. **77**, 5237–5300 (1996).
- U. Seifert, W. Wintz, and **P. Nelson**, *Straightening of Thermal Fluctuations in Semi-Flexible Polymers by Applied Tension*, Phys. Rev. Lett. **77**, 5389–5392 (1996).
- J.D. Moroz, **P. Nelson**, R. Bar-Ziv, and E. Moses, *Spontaneous Expulsion of Giant Lipid Vesicles Induced by Laser Tweezers*, Phys. Rev. Lett. **78**, 386–389 (1997).
- J. D. Moroz and **P. Nelson**, *Dynamically-Stabilized Pores in Bilayer Membranes*, Biophys. J. **72**, 2211–2216 (1997).

- R. Kamien, T. Lubensky, **P. Nelson**, and C. O’Hern, *Direct Determination of DNA Twist-Stretch Coupling*, Europhys. Lett. **38**, 237–242 (1997).
- J. D. Moroz and **P. Nelson**, *Torsional Directed Walks, Entropic Elasticity, and DNA Twist Stiffness*, Proc. Natl. Acad. Sci. USA **94**, 14418–14422 (1997).
- A.D. Dinsmore, D.T. Wong, **P. Nelson**, and A.G. Yodh, *Hard Spheres in Vesicles: Curvature-Induced Forces and Particle-Induced Curvature*, Phys. Rev. Lett. **80**, 409–412 (1998).
- R. D. Kamien, T. C. Lubensky, **P. Nelson**, and C. S. O’Hern, *Elasticity Theory of a Twisted Stack of Plates*, Eur. Phys. J. **B1**, 95–102 (1998).
- P. Nelson**, *New Measurements of DNA Twist Elasticity*, Biophys. J. **74**, 2501–2503 (1998).
- R. Bar-Ziv, E. Moses, and **P. Nelson**, *Dynamic Excitations in Membranes Induced by Optical Tweezers*, Biophys. J. **75**, 294–320 (1998).
- P. Nelson** *Sequence-Disorder Effects on DNA Entropic Elasticity*, Phys. Rev. Lett. **80**, 5810–5812 (1998).
- J.D. Moroz and **P. Nelson**, *Entropic Elasticity of Twist-Storing Polymers*, Macromolecules **31**, 6333–6347 (1998).
- P. Nelson**, *Transport of Torsional Stress in DNA*, Proc. Natl. Acad. Sci USA **96**, 14342–7 (1999).
- H. Aranda-Espinoza, Y. Chen, N. Dan, T.C. Lubensky, **P. Nelson**, L. Ramos, and D.A. Weitz, *Electrostatic Repulsion of Positively Charged Vesicles and Negatively Charged Objects*, Science **285**, 394–397 (1999).
- L. Ramos, T.C. Lubensky, N. Dan, **P. Nelson**, and D.A. Weitz, *Surfactant-Mediated Two-dimensional Crystallization of Colloidal Crystals*, Science **286**, 2325–2328 (1999).
- Y. Chen and **P. Nelson**, *Charge-Reversal Instability in Mixed Bilayer Vesicles*, Phys. Rev. **E62**, 2608–2619 (2000).
- C. Storm and **P. Nelson**, *The Bend Stiffness of S-DNA*, Europhys. Lett., **62**, 760–766 (2003).
- C. Storm and **P. Nelson**, *Theory of High-Force DNA Stretching and Overstretching*, Phys. Rev. **E67**, 051906-(1–12) (2003).
- P. Nelson**, *Comment on “Rotational Drag on DNA: A Single Molecule Experiment” by P. Thomen, U. Bockelmann, and F. Heslot*, Phys. Rev. Lett. **92**, 159801-(1) (2004); highlighted in the Virtual Journal of Biological Physics Research (May 1, 2004 issue).
- P.A. Wiggins, R. Phillips, and **P.C. Nelson**, *Exact Theory of Kinkable Elastic Polymers*, Phys. Rev. **E71**, 021909-(1–19) (2005); highlighted in the March 1, 2005 issue of Virtual Journal of Biological Physics Research.
- D.E. Segall, **P.C. Nelson**, and R. Phillips, *Excluded-Volume Effects in Tethered-Particle Experiments: Bead Size Matters*, Phys. Rev. Lett. **96**, 088306-(1–4) (2006).

- P.A. Wiggins and **P.C. Nelson**, *Generalized Theory of Semiflexible Polymers*, Phys. Rev. E **73**, 031906-(1–13) (2006).
- P.C. Nelson**, C. Zurla, D. Brogioli, J.F. Beausang, L. Finzi, and D. Dunlap, *Tethered Particle Motion as a Diagnostic of DNA Tether Length*, J. Phys. Chem. B **110**, 17260–17267 (2006).
- J. Li, **P.C. Nelson**, and M.D. Betterton, *Entropic Elasticity of DNA with a Permanent Kink*, Macromolecules **39**, 8816–8821 (2006).
- P.A. Wiggins, T. van der Heijden, F. Moreno–Herrero, A. Spakowitz, R. Phillips, J. Widom, C. Dekker, and **P.C. Nelson**, *High Flexibility of DNA on Short Length Scales Probed by Atomic Force Microscopy*, Nature Nanotechnology **1**, 137–141 (2006).
- P.K. Purohit and **P.C. Nelson**, *Effect of Supercoiling on Formation of Protein Mediated DNA Loops*, Phys. Rev. **E74**, 061907-(1–14) (2006).
- J.F. Beausang, C. Zurla, L. Sullivan, L. Finzi, and **P.C. Nelson**, *Elementary Simulation of Tethered Brownian Motion*, Am. J. Phys. **75**, 520–523 (2007).
- J.F. Beausang, C. Zurla, C. Manzo, D. Dunlap, L. Finzi, and **P.C. Nelson**, *DNA Looping Kinetics Analyzed Using Diffusive Hidden Markov Model*, Biophysical Letters section of Biophys. J. **92**, L64–L66 (2007).
- Y. Seol, J. Li, **P.C. Nelson**, T.T. Perkins, and M.D. Betterton, *Elasticity of Short DNA Molecules: Theory and Experiment for Contour Lengths of 0.6–7 μm* , Biophys. J. **93**, 4360–4373 (2007).
- J.F. Beausang and **P.C. Nelson**, *Diffusive Hidden Markov Model Characterization of DNA Looping Dynamics in Tethered Particle Experiments*, Physical Biology **4**, 205–219 (2007).
- Igor M. Kulić and **P.C. Nelson**, *Hitchhiking Through the Cytoplasm*, Europhys. Lett. **81**, 18001-(1–6) (2008).
- I.M. Kulić, A.E.X. Brown, H. Kim, C. Kural, B. Blehm, P.R. Selvin, **P.C. Nelson**, and V.I. Gelfand, *The Role of Microtubule Movement in Bidirectional Organelle Transport*, Proc. Natl. Acad. Sci. USA, **105** 10011–10016.
- L. Han, H.G. Garcia, S. Blumberg, K.B. Towles, J.F. Beausang, **P.C. Nelson**, R. Phillips, *Concentration and Length Dependence of DNA Looping in Transcriptional Regulation*, submitted.
- K. Towles, J.F. Beausang, H.G. Garcia, R. Phillips, and **P.C. Nelson**, *First-principles Calculation of DNA Looping in Tethered Particle Experiments*, Physical Biology, in press.
- J.F. Beausang, H.W. Schroeder III, **P.C. Nelson**, Y.E. Goldman, *Twirling of Actin by Myosins II and V Observed via Polarized TIRF in a Modified Gliding Assay*, Biophys. J. **95**, 5820–5831 (2008).

Reviews, lectures, proceedings, popular articles (since 1994):

- P. Nelson**, *Statistical Mechanics of Membranes*, in *McGraw-Hill Yearbook of Science and Technology 1995* (McGraw-Hill, 1995) pp.395–397.
- S. Gruner, J. Langer, **P. Nelson**, and V. Vogel, *What Future Will We Choose for Physics?* *Physics Today*, **48**:12, 25–30 (December 1995).
- J.D. Moroz and **P. Nelson**, *Dynamically-Stabilized Pores in Bilayer Membranes*, in *Statistical Mechanics in Physics and Biology, MRS Proceedings Vol. 463* ed. D. Wirtz, T.C. Halsey, and J. Van Zanten (Materials Research Society, Pittsburgh, 1997), pp. 161–166 (refereed).
- R.D. Kamien, T.C. Lubensky, **P. Nelson**, and C.S. O’Hern, *Twist-Stretch Elasticity of DNA*, in *Statistical Mechanics in Physics and Biology, MRS Proceedings Vol. 463* ed. D. Wirtz, T.C. Halsey, and J. Van Zanten (Materials Research Society, Pittsburgh, 1997), pp. 43–48 (refereed).
- P. Nelson**, *Deoxyribonucleic Acid*, article in *McGraw-Hill Yearbook of Science and Technology 1999* (McGraw-Hill, 1998) pp. 122–124.
- J.D. Moroz and **P. Nelson**, *Microscopic Elasticity of DNA from Torsionally-Constrained Stretching*, in *Materials Science of the Cell, MRS Proceedings Vol. 489*, edited by B. Mulder, C. Schmidt, and V. Vogel, (Materials Research Society, Pittsburgh, 1998).
- R.E. Goldstein, **P. Nelson**, and T.R. Powers, *Teaching Biological Physics*, *Physics Today*, **58**:3 46–51 (March 2005).
- H.G. Garcia, P. Grayson, L. Han, M. Inamdar, J. Kondev, **P.C. Nelson**, R. Phillips, J. Widom, and P.A. Wiggins, *Biological Consequences of Tightly Bent DNA: The Other Life of a Macromolecular Celebrity*, *Biopolymers* **85**, 115–130 (2007).
- P.C. Nelson**, *Colloidal Particle Motion as a Diagnostic of DNA Conformational Transitions*, *Curr. Op. Colloid Interf. Sci.* **12**, 307–313 (2007).
- L. Han, B.H. Lui, S. Blumberg, J.F. Beausang, **P.C. Nelson**, and R. Phillips, *Calibration of Tethered Particle Motion Experiments*, to appear in *Mathematics of DNA Structure, Function and Interactions* eds. C.J. Benham et al. (Springer, 2008).
- P. Nelson**, *Advanced Theories*, letter to *New Yorker Magazine* (8 September 2008) p. 5.