

Ranjan Mukhopadhyay

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EDUCATION:

- **Ph.D., Physics** June 1998
California Institute of Technology, Pasadena, CA
Thesis: Quantum phase transitions in disordered Bose systems.
Advisor: Dr. Peter Weichman
- **Integrated M.Sc., Physics** May 1991
Indian Institute of Technology, Kanpur

EMPLOYMENT:

- **Assistant Professor, *Clark University*** 2003 to present
- **Postdoctoral Scientist, *NEC Research Institute*** 2001 to 2003
- **Postdoctoral Research Fellow, *University of Pennsylvania*** 1999 to 2001
- **Postdoctoral Research Fellow, *Simon Fraser University*** 1997 to 1999
- **Research Assistant: *California Institute of Technology*** 1993 to 1997
- **Teaching Assistant: *California Institute of Technology*** 1991 to 1996

OTHER APPOINTMENTS:

- **Visiting Scholar, *Princeton University*** 2006 to 2007

FIELDS OF RESEARCH ACTIVITY:

- Theoretical and computational biophysics: Cellular and subcellular organization, bacterial cell shapes, self assembly, biomembranes, and electrostatic effects.
- Modeling of stochasticity in biochemical networks.
- Condensed Matter theory: correlated quantum systems, superconductivity, biomimetic materials, colloidal aggregation.

PUBLICATIONS:

1. K. Daly, Ned S. Wingreen, and Ranjan Mukhopadhyay, "Mechanics of blebbing and antibiotic damage in bacteria," preprint, to be submitted for publication.
2. Hui Wang, Greg Huber, and Ranjan Mukhopadhyay, "Statistical mechanics of coat proteins in intracellular transport," preprint, submitted.
3. Ranjan Mukhopadhyay and Ned S. Wingreen, "Curvature and shape determination of growing bacteria," submitted for publication to *Physical Review E*.
4. K.C. Huang, Ranjan Mukhopadhyay, B. Wen, Z. Gitai, and Ned S. Wingreen, "Cell shape and cell-wall organization in Gram-negative bacteria," *Proceedings of the National Academy of Science* **105**, 19281-19286 (2008).
5. Hui Wang, Ned S. Wingreen, and Ranjan Mukhopadhyay, "Self-organized periodic positioning of protein clusters in growing bacteria," *Phys. Rev. Lett.* **101**, 218101(4 pages), (2008).
6. Gerald Lim, Michael Wortis, and Ranjan Mukhopadhyay, "Mechanical Basis of Shapes and Shape Transformations of Red Blood Cells," 168 pages, article in **Soft Matter: Volume 4: Lipid Bilayers and Red Blood Cells**, by Gerhard Gompper (Editor), Michael Schick (Editor), Wiley VCH (2008).
7. Peter Weichman and Ranjan Mukhopadhyay, "Particle-hole symmetry and the dirty boson problem," *Physical Review B* **77**, 214516 (39 pages), (2008). Selected by Physical Review B for Editor's Suggestion (these are papers selected for particular interest, importance, or clarity).
8. Ranjan Mukhopadhyay, K.C. Huang, and Ned S. Wingreen, "Lipid localization in bacteria through curvature-mediated microphase separation," *Biophysical Journal* **95**, 1034-49 (2008). Paper was selected as Editor's choice by the Journal *Science*.
9. Pankaj Mehta, Ranjan Mukhopadhyay, and Ned S. Wingreen, "Exponential sensitivity of noise-driven switching in genetic networks," *Physical Biology* **16**, 26005 (6 pages), (2008).

10. Fangfu Ye, Ranjan Mukhopadhyay, Olaf Stenull, and T. C. Lubensky, "Semi-soft Nematic Elastomers and Nematics in Crossed Electric and Magnetic Fields," *Physical Review Letters* **98**, 147801 (4 pages), (2007).
11. Peter Weichman and Ranjan Mukhopadhyay, "Revisiting the scaling relation $z = d$ for dirty bosons," *Physical Review Letters*, **98**, 245701 (4 pages), (2007).
12. K.C. Huang, Ranjan Mukhopadhyay, and Ned S. Wingreen, "A curvature-mediated mechanism for localization of lipids to bacterial poles," *Public Library of Science (PLoS) Computational Biology* **2**, e15, 1357- 1364 (2006). Selected for featured research by PLoS.
13. D.M. Roma, R.A. Flanagan, Andrew E. Ruckenstein, Anirvan M. Sengupta, and Ranjan Mukhopadhyay, "Optimal path to epigenetic switching," *Physical Review E* **71**, 011902 (5 pages), (2005).
14. Eldon Emberly, Ranjan Mukhopadhyay, Ned S. Wingreen, and Chao Tang, "Flexibility of β -sheets: Principal component analysis of database protein structures," *PROTEINS: Structure, Function, and Bioinformatics* **55**, 91-98 (2004).
15. Ranjan Mukhopadhyay, Eldon Emberly, Ned S. Wingreen, and Chao Tang, "Statistical Mechanics of RNA folding: importance of alphabet size," *Physical Review E*, **68** 041904 (5 pages), (2003).
16. Eldon Emberly, Ranjan Mukhopadhyay, Ned S. Wingreen, and Chao Tang, "Flexibility of α -helices: Results of a statistical analysis of database protein structures," *Journal of Molecular Biology* **327**, 229-237 (2003).
17. Xianjung Xing, Ranjan Mukhopadhyay, Leo Radzihovsky, and T.C. Lubensky, "Fluctuating Nematic Elastomer Membranes: a New Universality Class," *Physical Review E*, **68**, 021108 (17 pages), (2003).
18. T.C. Lubensky, Ranjan Mukhopadhyay, Leo Radzihovsky, and Xianjung Xing, "Symmetries and Elasticity of Nematic Gels," *Physical Review E* **66**, 011702 (22 pages), (2002).
19. Gerald Lim, Michael Wortis, and Ranjan Mukhopadhyay, "Stomatocyte–Discocyte–Echinocyte Sequence of the Human Red Blood Cell: New Evidence for the Bilayer–Couple Hypothesis from Membrane Biomechanics," *Proceedings of the National Academy of Science*, **99**, 16766-16770 (2002).
20. Ranjan Mukhopadhyay, Gerald Lim, and Michael Wortis, "Echinocyte Shapes: Competition between Bending, Stretching and Shear Determines Spicule Shape and Spacing," *Biophysical Journal* **82**, 1756-1772 (2002).
21. Anand Yethiraj, Ranjan Mukhopadhyay, and John Bechhoefer, "Two experimental tests of a fluctuation-induced first-order phase transition: Intensity fluctuation microscopy at the nematic–smectic-A transition," *Physical Review E* **65**, 021702 (16 pages), (2002).

22. C.L. Kane, Ranjan Mukhopadhyay, and T.C. Lubensky, "The Fractional Quantum Hall effect in an array of quantum wires," *Phys. Rev. Lett.* **88**, 036401 (4 pages), (2002).
23. Ranjan Mukhopadhyay, C.L. Kane, and T.C. Lubensky, "Sliding Luttinger liquid phases," *Physical Review B* **63**, 081103 (18 pages), (2001).
24. Ranjan Mukhopadhyay, C.L. Kane, and T.C. Lubensky "A crossed sliding Luttinger liquid phase," *Physical Review B, Rapid Communications* **64**, 045120 (4 pages), (2001).
25. Ranjan Mukhopadhyay, Anand Yethiraj, and John Bechhoefer, "External-field-induced tricritical point in a fluctuation-driven nematic–smectic-A transition," *Phys. Rev. Lett.* **83**, 4796-4799 (1999).
26. Peter Weichman, Anoop Prasad, Ranjan Mukhopadhyay, and Jonathan Miller, "Trapped Second Sound Waves on a Nonequilibrium Superfluid-Normal Interface," *Phys. Rev. Lett.* **80**, 4923-4927 (1998).
27. Talso P. Chui, David Goodstein, Alexa Harter, and Ranjan Mukhopadhyay, "Heat Capacity Anomalies of Superfluid ^4He under the influence of a counterflow near T_λ ," *Proceedings of the 21st International Conference on Low Temperature Physics, Prague, August 8-14, 1996*.
28. Talso C. P. Chui, Yuri Mukharsky, Ranjan Mukhopadhyay, and David Goodstein, "Heat capacity measurements in rotating helium," *Czech Journal of Physics* **46**, 177 (3 pages) (1996).
29. Talso C. P. Chui, David Goodstein, Alexa Harter, and Ranjan Mukhopadhyay, "Heat Capacity Anomalies of Superfluid ^4He under the influence of a counterflow near T_λ ," *Phys. Rev. Lett.* **77**, 1793-1796 (1996).
30. Ranjan Mukhopadhyay and Peter Weichman, "Role of particle-hole symmetry in the superfluid to Bose glass transition," *Phys. Rev. Lett.* **76**, 2977-2980 (1996).

TEACHING:

- Methods of Physics. New undergraduate course I developed at Clark. Now a required course for Clark Physics majors.
- Discovering Physics. This is an active learning course, organized around experiments and group discussions and offered to non-science majors.
- Advanced Topics in Condensed Matter Physics. New graduate course that I developed at Clark, centering around the ideas of symmetry, symmetry-breaking and Landau-Ginzburg theories.
- Physics of Biomolecular Networks. New undergraduate course I developed at Clark.
- Undergraduate Classical Mechanics, Undergraduate Electricity and Magnetism, Graduate Electromagnetism, Modern Physics.

PROFESSIONAL SERVICE:

- Undergraduate Physics Advisor, 2008-present.
- Clark Undergraduate Academic Board (UAB), 10/08-present.
- Clark Library Committee, 9/04-6/06. Was committee chair from 2005-06.
- Organized, jointly with Professor Kudrolli, the 27th New England Complex Fluids meeting that was held at Clark University on June 9, 2006.
- Chaired (and helped in organizing) focus session on Biomembranes at APS meeting in March 2007.
- Chaired session at the 23rd New England Complex Fluids meeting held at University of Connecticut on June 10, 2005.
- Member of review panel for National Science Foundation.

CURRENT FUNDING:

- National Science Foundation (NSF).

REFeree:

- Journals: Physical Review Letters, Physical Review E, Proceedings of the National Academy of Science, Applied Physics Letters, Physica A, Journal of Chemical Physics, Physical Review B, European Biophysical Journal, and Journal of Theoretical Biology.
- Funding Agencies: National Science Foundation (NSF), Netherlands Foundation for Fundamental Research on Matter (FOM).

INVITED PRESENTATIONS:

- *Physics of protein and lipid organization in bacteria*, May 5, 2009. Seminar at UMass Lowell.
- *Modeling protein and lipid organization in bacterial membranes*, June 26, 2009. Talk at symposium on biomembranes at the 2009 Joint ASCE-ASME-SES Conference on Mechanics and Materials, Blacksburg, Virginia.
- *Cell shape and cell-wall organization in Gram-negative bacteria*, Dec. 9, 2008. Invited talk at conference: "Cells and Materials: At the Interface between Mathematics, Biology and Engineering - Reunion Conference II," Lake Arrowhead, California.
- *Modeling protein and lipid organization in bacteria*, Oct. 30, 2008. Biomath seminar, UCLA.
- *Modeling the Soft Geometry of Biological Membranes*, March, 2007. Seminar, Univ. of Conn. Health Center.
- *Mechanisms for subcellular protein and lipid organization in bacteria*, April 25, 2007. BioMaPS seminar, Rutgers University.

- *Modeling the Soft Geometry of Biological Membranes*, February 26, 2007. Interdisciplinary PICASO Seminar, Princeton University.
- *Protein and lipid organization in bacteria*, December, 2006. Condensed Matter seminar, University of Pittsburgh.
- *Protein and lipid organization in bacteria*, November 17, 2006. Condensed Matter seminar, Brown University.
- *Physics of Red Blood Cell Shapes*, November 30, 2005. Physics Colloquium, Memphis University.
- *Physics of Red Blood Cell Shapes*, October 4, 2005. Physics Colloquium, Colgate University.
- *Mechanics of Red Blood Cell shapes*, September 28, 2005. Department of Mechanical Engineering Seminar, Yale University.
- *The red blood cell membrane: Ultra-structure, mechanics, and red cell shapes*, September 16, 2005. Invited talk at 24th New England Complex Fluids Workshop.
- *Domains in Lipid Mixtures*, August 9, 2005. Presented at workshop in Benasque on “Biological Membranes: Current Challenges”.
- *Physics of Red Blood Cell Shapes*, November 29, 2004. Colloquium at Worcester Polytechnic Institute.
- *Physics of Red Blood Cell Shapes*, June 10, 2004. Presented at Aspen summer workshop on “Materials and Geometry”.
- *Physics of Red Blood Cell Shapes*, January 27, 2004. Physics Colloquium, Virginia Tech.
- *Physics of Red Blood Cell shapes*, October 8, 2003. Squishy Physics Talk, Harvard University.
- *Physics of Red Blood Cell shapes*, September 17, 2003, Condensed Matter Seminar, Brandeis University.
- *Statistical Mechanics of RNA folding*, March 18, 2003. Biomaps Seminar, Rutgers University.
- *Statistical Mechanics of RNA folding: Dependence on alphabet size*, March 7, 2003. Invited talk at the American Physical Society March meeting, Austin. (Press coverage of talk in APS newsletter and Dallas Morning News).
- *Physics of Red Blood Cell Shapes*, January 20, 2003. Physics Colloquium, Mich. Tech. Univ.
- *Designability and RNA folding*, August 10, 2002. Seminar presented at Symposium honoring 65th birthday of Michael Wortis, Vancouver.
- *Designability of RNA secondary structures*, May 22, 2002. Seminar at Bell Labs.

- *Elasticity and broken symmetry in a novel class of polymer networks*, February 2002. Condensed Matter Seminar, Indiana University, Bloomington.
- *Elasticity and broken symmetry in nematic elastomers*, February 2002. Condensed Matter Seminar, UMass Amherst.
- *Elasticity and broken symmetry in nematic elastomers*, January 3, 2002. Invited talk at symposium: “India and abroad: a symposium on Condensed Matter Physics” in Bangalore, India.
- *Sliding phases and Luttinger liquids*, March, 2001, Condensed Matter Seminar, Univ. of Mich. at Ann Arbor.
- *Sliding phases: from DNA-lipid complexes to quantum wires*, January 2001. Physics Colloquium, NJIT, New Jersey.
- *Elasticity and broken symmetry in nematic elastomers*, January, 2001. Seminar at National Institute of Health, Bethesda.

FEATURED RESEARCH:

- “Polar preferences,” *Science* **320**, 719 (2008).
- Paper on dirty bosons selected by Physical Review B for Editor’s Suggestion (these are papers selected for particular interest, importance, or clarity), 2008.
- Paper on lipid localization featured in PLoS, 2006.
- “The search for an RNA Eve,” Physics News Update, March 2003. Also featured in APS News.
- “Why life is a Four-Letter word,” *Science News*, March 2003.
- “Language of life may be spelled out with RNA,” Dallas News, March 2003.