Shiladitya Banerjee, Ph.D.

CONTACT INFORMATION

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ACADEMIC APPOINTMENTS

Carnegie Mellon University, Pittsburgh, USA — 01/2020 -
Department of Physics
Assistant Professor

University College London, London, UK — 09/2019 - 01/2020
Department of Physics & Astronomy
Associate Professor

University College London, London, UK — 05/2019 - 09/2019
Department of Physics & Astronomy
Lecturer

University College London, London, UK — 07/2016 - 04/2019
Institute for the Physics of Living Systems
Junior Group Leader

University of Chicago, Chicago, USA — 08/2013 - 06/2016
James Franck Institute
Postdoctoral Fellow

EDUCATION

Syracuse University, USA — 2008 - 2013
Ph.D. Physics, 2013
Thesis: *Cell Mechanics: From cytoskeletal dynamics to tissue-scale mechanical phenomena*.
Advisor: Prof. M. Cristina Marchetti

Chennai Mathmatical Institute, India — 2005 - 2008
B.Sc. (Honors), Physics, 2008

HONORS AND AWARDS

- Royal Society University Research Fellowship (2018).
- Young Investigator Award, Human Frontiers Science Program (HFSP) (2018).
- New Investigator Award, UK Engineering and Physical Sciences Research Council (EPSRC) (2018).
- UCL Global Engagement Award (2017-2018).
- Strategic Fellowship, UCL Institute for the Physics of Living Systems (2016-2019).
- Kharasch Postdoc Award, Department of Chemistry, University of Chicago (2016).
- American Physical Society Prize for *Outstanding Doctoral Thesis Research* (2014).
- Kadanoff-Rice Postdoctoral Fellowship, University of Chicago (2013-2016).
- *All-Univeristy Doctoral Prize*, The College of Arts and Sciences, Syracuse University (2013).
- Best five student speakers, American Physical Society March Meeting, Group on Statistical and Nonlinear Physics (2012).
- Institute for Complex Adaptive Matter, Junior Travel Award (2010).
- Gold Medal for Excellence, Chennai Mathematical Institute (2008).

PUBLICATIONS *corresponding author; **equal contribution

41. D. Gradeci, A. Bove, A.R. Lowe*, S. Banerjee*, and G. Charras*, "Distinct modes of cell competition are governed by entropic and energetic properties of mixed cell populations", bioRxiv:729731 (2019).

40. L Blackie, M.F. Staddon, S. Banerjee, and F. Pichaud, "Cell-type specific mechanical response and actomyosin dynamics in the developing Drosophila retina", bioRxiv:558593 (2019).

39. S. Banerjee, M.L. Gardel, and U.S. Schwarz, "The actin cytoskeleton as an active adaptive material", Annual Reviews of Condensed Matter Physics, in press (2019).

38. K.E. Cavanaugh, M.F. Staddon, E.M. Munro, S. Banerjee, and M.L. Gardel, "RhoA mediates epithelial cell shape changes via mechanosensitive endocytosis", Developmental Cell, accepted (2019).

37. M.F. Staddon, K.E. Cavanaugh, E.M. Munro, M.L. Gardel, and S. Banerjee*, "Mechanosensitive junction remodelling promotes robust epithelial morphogenesis", Biophysical Journal **117**, 1739 (2019).

36. V. Yadav, D.S. Banerjee, A.P. Tabatabai, D.R. Kovar, T. Kim, S. Banerjee and M.P. Murrell, "Filament nucleation tunes mechanical memory in active polymer networks", Advanced Functional Materials **29**, 1905243 (2019)

35. N. Ojkic, D. Serbanescu, and S. Banerjee*, "Surface-to-volume scaling and aspect ratio preservation in rod-shaped bacteria", eLife **8**, e47003 (2019).

34. R.J. Tetley, M.F. Staddon, D. Heller, A. Hoppe, S. Banerjee, and Y. Mao, "Tissue fluidity promotes epithelial wound healing", Nature Physics **15**, 1195 (2019).

33. V. Ajeti, A.P. Tabatabai, A.J. Fleszar, M.F. Staddon, D.S. Seara, C. Suarez, S. Yousafzai, D. Bi, D.R. Kovar, S. Banerjee and M.P. Murrell, "Wound healing coordinates actin architectures to regulate mechanical work", Nature Physics **15**, 696 (2019).

32. D. Gradeci, A. Bove, G. Charras*, A.R. Lowe*, and S. Banerjee*, "Single cell approaches to cell competition: high-throughput imaging, machine learning and simulations", Seminars in Cancer Biology (2019).

31. S. Banerjee*, and M.C. Marchetti, "Continuum models of collective cell migration", Cell Migrations: Causes and Function, Advances in Experimental Medicine & Biology **1146**, 45-66 (2019).

30. S. Karki**, S. Banerjee**, K. Mclean, A.R. Dinner, and M.R. Clark, "Transcription factories in Igκ allelic choice and diversity", Advances in Immunology **141**, 33-49 (2019).

29. D.S. Seara, V Yadav, I. Linsmerier, A.P. Tabatabai, P.W. Oakes, S.M. Ali Tabei, S. Banerjee* and M.P. Murrell*, "Entropy production rate is maximized in non-contractile actomyosin", Nature Communications **9**, 4948 (2018). *Featured in Nature Collection: "Active Matter"*.

28. M.F. Staddon, D. Bi, A.P. Tabatabai, V. Ajeti, M.P. Murrell, and S. Banerjee*, "Cooperation of dual modes of cell motility promotes epithelial stress relaxation to accelerate wound healing", PLoS Computational Biology **14**, e1006502 (2018). *Featured in PLoS Comp Biol's front page. Highlighted in PLOS Biologue.*

27. E.N. Schaumann, M.F. Staddon, M.L. Gardel, and S. Banerjee*, "Force localization modes in dynamic epithelial colonies", Molecular Biology of the Cell **29**, 2835 (2018). *A 'Highlights from MBoC' selection, Cover article*.

26. S.L. Freedman, G.M. Hocky, S. Banerjee, and A.R. Dinner, "Nonequilibrium phase diagrams for actomyosin networks", Soft Matter **14**, 7740 (2018).

25. S. Karki, D.E. Kennedy, K. Mclean, A.T. Grzybowski, M. Maienschein-Cline, S. Banerjee, H. Xu, E. Davis, M. Mandal, C. Labno, S.E. Powers, M. M. Le Beau, A.R. Dinner, H. Singh, A.J. Ruthenburg, and M.R. Clark, "Regulated capture of V-κ gene topological associating domains by transcription factories", Cell Reports **24**, 2443 (2018).

24. S. Stam, S.L. Freedman, S. Banerjee, K.L. Weirich, A.R. Dinner and M.L. Gardel, "Filament rigidity and connectivity tune the deformation modes of active biopolymer networks", Proc. Natl. Acad. Sci. U.S.A. **114**, E10037-E10045 (2017).

23. A. Bove, D. Gradeci, Y. Fujita, S. Banerjee*, G.T. Charras* and A.R. Lowe*, "Local cellular neighbourhood controls proliferation in cell competition", Molecular Biology of the Cell **28**, 3215 (2017).

22. S.L. Freedman, S. Banerjee, G.M. Hocky and A.R. Dinner, "A versatile framework for simulating the dynamic mechanical structure of cytoskeletal networks". Biophysical Journal **113**, 448 (2017).

21. S. Banerjee, K. Lo, M. Daddysman, A. Selewa, T. Kuntz, A.R. Dinner and N.F. Scherer, "Biphasic growth dynamics control cell division in Caulobacter crescentus". Nature Microbiology **2**, 17116 (2017).

20. K.L. Weirich, S. Banerjee, K. Dasbiswas, T.A. Witten, S. Vaikuntanathan and M.L. Gardel, "Liquid behavior of cross-linked actin bundles". Proc. Natl. Acad. Sci. U.S.A **114**, 2131 (2017).

19. I. Linsmeier, S. Banerjee, P.W. Oakes, W. Jung, T.Y. Kim and M.P. Murrell, "Disordered actomyosin networks are sufficient to produce cooperative and telescopic contractility", Nature Communications **7**, 12615 (2016). *Featured in Nature Collection "Active Matter"*.

18. J. Notbohm**, S. Banerjee**, K.J.C. Utuje, B. Gweon, H. Jang, Y. Park, J. Shin, J. Butler, J.J. Fredberg and M.C. Marchetti, "Cellular contraction and polarization drive collective cellular motions", Biophysical Journal **110**, 2729 (2016).

17. W.G. Liang, C. Triandafillou, D.Y. Hwang, M.M.L. Zulueta, S. Banerjee, A.R. Dinner, S.C. Hung and W.J. Tang, "Structural basis for oligomerization and glycosaminoglycan binding of CCL5 and CCL3", Proc. Natl. Acad. Sci. U.S.A **113**, 5000 (2016).

16. S. Banerjee, N.F. Scherer and A.R. Dinner, "Shape dynamics of growing cell walls", Soft Matter **12**, 3442 (2016).

15. S. Banerjee*, K.J.C. Utuje and M.C. Marchetti, "Propagating stress waves during epithelial expansion", Physical Review Letters **114**, 228101 (2015). *Selected as Editor's suggestions*.

14. C.S. Wright**, S. Banerjee**, S. Iyer-Biswas, S. Crosson, A.R. Dinner and N.F. Scherer, "Intergenerational continuity of cell shape dynamics in *Caulobacter crescentus*", Scientific Reports **5**, 9155 (2015).

13. E.J. Hemingway, A. Maitra, S. Banerjee, M.C. Marchetti, S. Ramaswamy, S.M. Fielding and M.E. Cates, "Active viscoelastic matter: from bacterial drag reduction to turbulent solids", Physical Review Letters **114**, 098302 (2015).

12. P.W. Oakes, S. Banerjee, M.C. Marchetti and M.L. Gardel, "Geometry regulates traction stresses in adherent cells", Biophysical Journal **107**, 825 (2014). *Journal cover article; Selected as "New and Notable"*.

11. S. Banerjee, R. Sknepnek and M.C. Marchetti, "Optimal shapes and stresses in adherent cells on patterned substrates", Soft Matter **10**, 2424 (2014).

10. S. Banerjee and L. Giomi, "Polymorphism and bistability in adherent cells". Soft Matter **9**, 5251 (2013).

9. S. Banerjee and M.C. Marchetti, "Controlling cell-matrix traction forces by extracellular geometry", New Journal of Physics **15**, 035015 (2013). *Selected as 'Highlights of 2013'*.

8. A.F. Mertz, Y. Che, S. Banerjee, J. Goldstein, S. Revilla, C. Niessen, M.C. Marchetti, E.R. Dufresne and V. Horsley, "Cadherin-based intercellular adhesions organize epithelial cell-matrix traction forces", Proc. Natl. Acad. Sci. U.S.A **110**, 842 (2013). *Recommended by F1000 Prime*.

7. S. Banerjee and M.C. Marchetti, "Contractile stresses in cohesive cell layers on finite-thickness substrates", Physical Review Letters **109**, 108101 (2012).

6. G.K. German, W.C. Engl, E. Pashkovski, S. Banerjee, Y. Xu, A.F. Mertz, C. Hyland and E.R. Dufresne, "Heterogeneous drying stresses in *Stratum Corneum*". Biophysical Journal **102**, 2424 (2012).

5. A.F. Mertz, S. Banerjee, Y. Che, G. German, Y. Xu, C. Hyland, M.C. Marchetti, V. Horsley and E.R. Dufresne, "Scaling of traction forces with the size of cohesive cell colonies", Physical Review Letters **108**, 198101 (2012). *Selected as Editor's suggestions.*

4. S. Banerjee, T.B. Liverpool and M.C. Marchetti, "Generic phases of cross-linked active gels: Relaxation, oscillation and contractility", Europhysics Letters **96**, 58004 (2011).

3. S. Banerjee and M.C. Marchetti, "Substrate rigidity deforms and polarizes active gels", Europhysics Letters **96**, 28003 (2011).

2. S. Banerjee, M.C. Marchetti and K.K. Müller-Nedebock, "Motor-driven dynamics of cytoskeletal filaments in motility assays", Physical Review E **84**, 011914 (2011).

1. S. Banerjee and M.C. Marchetti, "Instabilities and oscillations in isotropic active gels", Soft Matter **7**, 463 (2011).

Active Grants

- **PI**, "Physical Determinants of Cellular Fitness for Survival and Proliferation", Royal Society RGF\EA\181044 — 2019-2022
- **Co-I**, "Molecular Control of Cell Polarization", Human Frontiers Science Program (HFSP) RGY0073/2018 — 2018-2021
- **PI**, "Physics of Cytoskeletal Organisation and Cellular Morphogenesis", Royal Society URF\R1\180187 — 2018-2023
- **PI**, "Physics of Bacterial Growth Control and Antibiotic Resistance", EPSRC EP/R029822/1 — 2018-2020

Other Research Support

- Royal Society funded PhD studentship (2019-2022)
- EPSRC funded PhD studentship (2016-2020)
- EPSRC funded PhD studentship (2016-2019)
- UCL Global Engagement Fund (2017-2019)
- UCL IPLS Strategic Fellowship (2016-2019)

Supervision

- Daniel Gradeci, Ph.D. 2019, UCL; Quantitative Analyst, Orbis Investment, London.
- Michael Staddon, Ph.D. expected 2020, UCL.
- Diana Serbanescu, Ph.D. expected 2022, UCL.
- Tin Wai Ng, Ph.D. expected 2023, UCL.
- Nikola Ojkic, Postdoc 2018-2020, UCL.
- Deb Sankar Banerjee, Postdoc 2018-2021, UCL.

Invited Talks

- KITP conference on Active Matter, Santa Barbara, USA 04/2020
- Seminar, Imperial College London, UK 11/2019
- Seminar, University of Heidelberg, Heidelberg, Germany 10/2019
- Seminar, EMBL Heidelberg, Heidelberg, Germany 10/2019
- International symposium on "Cell competition in development & disease", EPFL Lausanne, Switzerland 09/2019
- Warwick Theory Day, IOP Theory of Condensed Matter, UK 06/2019
- British Applied Mathematics Colloquium, Bath, UK 04/2019
- Biophysics Seminar, Center for Theoretical Biophysics, Rice University, USA. 02/2019
- Soft-Bio seminar, University of Warwick, UK. 02/2019
- Systems Biology and Biophysics Seminar, University of California, Irvine, USA. 02/2019
- Physics Colloquium, Carnegie Mellon University, USA. 02/2019
- Soft & Biological Matter Seminar, University of Oxford, UK. 11/2018
- Fluids and Materials Seminar, University of Bristol, UK. 11/2018
- Society of Engineering Sciences (SES) conference, Madrid, Spain. 10/2018
- Physics of Cells: from biochemical to mechanical PhysCell2018, Harrogate, UK. 09/2018
- Kavli Institute for Theoretical Sciences, Beijing, China 08/2018
  Program on *Jamming in Bioloigcal Systems*.
- Applied Mathematics Seminar, University of Southampton, UK 04/2018
- Department of Biology Seminar, University of Maryland, USA. 03/2018
- DGZ Young Scientists' Forum, Berlin, Germany. 02/2018
- Materials Science & Engineering Seminar, University of Illinois at Urbana-Champaign, USA 02/2018
- CUNY Graduate Center, New York, USA 01/2018
  Symposium on *Structure and Dynamics, Control and Evolution*
- Physics Department Seminar, Pennsylvania State University, USA 01/2018
- Physics-Biology Interface Seminar, Universite Paris-Sud, Orsay, France 01/2018
- Mathematical Biology Seminar, University of Edinburgh, UK. 01/2018
- 118th Statistical Mechanics Conference, Rutgers University, USA. 12/2017
- Keynote speaker, UCL cross-disciplinary network on Soft Materials 06/2017
- CECAM workshop on Cell and Tissue Motility, Lausanne, Switzerland. 05/2017
- Biophysics Seminar, University of Sheffield, UK. 11/2016
- Computational Biology Seminar, University of Dundee, UK. 11/2016
- LMCB seminar, University College London, UK. 10/2016
- *Quantitative Biology of Cytoskeletal Mechanics* Workshop, Chicago, USA. 10/2015
- University College London, MRC Laboratory for Molecular Cell Biology. 10/2015
- University of Bristol, Department of Applied Mathematics, Bristol, UK. 07/2015

- *Computations in Science* seminar, University of Chicago, Chicago, USA. 06/2015
- Chennai Mathematical Institute Alumni Conference, Chennai, India. 01/2015
- APS March Meeting, Denver, USA 03/2014
- Program on Active Matter, KITP Santa Barbara, USA 02/2014
- *Dynamics of suspensions, gels, cells and tissues*, 06/2013
  Isaac Newton Institute for Mathematical Sciences, Cambridge, UK.
- APS March Meeting, Baltimore, USA. 03/2013
- Squishy Physics Seminar, Harvard University, USA. 02/2013
- Biophysics Seminar, Lewis-Sigler Institute, Princeton University, USA. 11/2012
- Seminar, TIFR Center for Interdisciplinary Sciences, Hyderabad, India. 07/2012
- GSNP Student Speaker Award talk, APS March Meeting, Boston, USA. 03/2012
- Biological Physics Seminar, Syracuse University, USA. 06/2011
- Theoretical Physics Seminar, Stellenbosch University, South Africa. 03/2010

CONTRIBUTED PRESENTATIONS

- *Quantitative Approaches to Antimicrobial Resistance*, IOP conference, 2017
  Physics of Life Network, Edinburgh, UK (Talk). 2017
- 7th European Cell Mechanics Meeting, Windermere, UK (Talk).
- International conference on Active and Smart Matter, Syracuse, NY (Talk). 2016
- Gordon Research Conference on *Self Assembly and Active Matter*, 2015
  New London, NH, USA. (Poster)
- Workshop on Soft|Meta matter, University of Chicago, USA. 2014
- APS March Meeting, Baltimore, MD, USA. (Talk) 2013
- 13th New York Complex Matter Workshop, Syracuse University, USA. (Talk) 2012
- APS March Meeting, Boston, MA, USA. (Talk) 2012
- Gordon Research Conference, New London , NH, USA. (Poster) 2011
  Soft Matter Far from Equilibrium
- 11th New York Complex Matter Workshop, Syracuse University, USA. (Talk) 2011
- APS March Meeting, Dallas, TX, USA. (Talk) 2011
- Workshop on Active Materials, Stellenbosch, South Africa. (Talk) 2010
- 10th New York Complex Matter Workshop, Cornell University, USA. (Talk) 2010
- 9th New York Complex Matter Workshop, RIT, Rochester, USA. (Talk) 2009
- Boulder School for Condensed Matter Physics, UC Boulder, USA. (Poster) 2009
- Summer school on *Soft Solids and Complex Fluids*, UMass Amherst, USA. 2009
- ICAM Conference on Soft Active Materials, Syracuse University, USA. (Talk) 2009

SERVICE

- **Editorial Board**, *Scientific Reports* (2017 - present)
- **Reviewer and Consultant** for peer-reviewed journals: Nature, Nature Materials, Nature Physics, Nature Reviews Physics, Nature Cell Biology, Nature Communications, Scientific Reports, PNAS, Physical Review Letters, Physical Review E, Current Biology, Biophysical Journal, Soft Matter, Journal of Royal Society Interface, PLOS Computational Biology, New Journal of Physics, Europhysics Letters, Physical Biology, European Physical Journal E, Experimental Cell Research, BBA Molecular Cell Research, Seminars in Cancer Biology.
- **Grant Reviewer**: UK Engineering and Physical Sciences Research Council (EPSRC), Swiss National Science Foundation, Agence Nationale de la Recherche (France).
- **Co-organizer**, *IPLS Seminar*, University College London (2016-); *Computations in Science Seminar*, University of Chicago (2014-2016).
- **Organizer and chair**, APS March Meeting 2015 invited symposium: *From bacteria to eukaryotes: shape organization in living matter*.

TEACHING

University College London

- PHAS0103: Molecular Biophysics (4th Year MSci/1st Year MSc Physics Module) — 2017-2019
- PHAS0097: Physics Projects (4th Year Physics Module) — 2016-2019
- PHASG810: Advanced Biophysical Theories (MSc Biological Physics Module) — 2018

Syracuse University

- PHY 531: Thermodynamics and Statistical Mechanics — Spring 2013
- PHY 360: Vibrations, Waves and Optics — Fall 2012
- PHY 305: Solar Energy Science and Architecture — Fall 2012
- PHY 312: Relativity, Cosmology and Beyond — Spring 2011, 2012
- PHY 221: General Physics I: Mechanics — Spring 2009
- PHY 222: General Physics II: Electricity, Magnetism and Light — Fall 2008