

RAJ KUMAR MANNA

Indian Institute of Technology Kharagpur
School of Medical Science and Technology
319 Life Sciences Building
Kharagpur, WB, India 721302

Email: raj@smst.iitkgp.ac.in
Phone: +91 9339 201 202
Homepage: rkmanna.com

RESEARCH INTEREST

Biological Physics and Soft Matter: Mechanics of three-dimensional organ development and tissue morphogenesis. Collective behavior of cells in confluent and nonconfluent environments. Cell rearrangements in 2D and 3D epithelial tissues. Role of biophysical forces in tumor invasion. Tissue growth in bone-scaffold systems. Effects of gravity on the wound-healing process. Biophysics of host-parasite interactions. Microfluidic models for cardiac and lung tissues. Hydrodynamic modeling of cytoskeletal filaments. Low-Reynolds-number locomotion of microswimmers (parasites, spermatozoa, bacteria).

ACADEMIC BACKGROUND

Indian Institute of Technology Madras 2018
Ph.D., Physics
Thesis: Hydrodynamics of polyelectrolytes and active polymers.
Advisors: Prof. P. B. Sunil Kumar & Prof. Ronojoy Adhikari

Indian Institute of Technology Madras 2011
M.Sc., Physics
Thesis: Interaction between similarly charged surfaces in the presence of counterions.

Ramakrishna Mission Residential College, Narendrapur, Kolkata 2009
B.Sc., Physics (Hons.)

PROFESSIONAL APPOINTMENT

Indian Institute of Technology Kharagpur, 2024-present
School of Medical Science and Technology
Assistant Professor

Northeastern University, Department of Physics 2022-2024
Postdoctoral Associate
Advisor: Prof. Dapeng Bi

Syracuse University, Department of Physics 2022-2024
Postdoctoral Associate
Advisor: Prof. M. Lisa Manning

University of Pittsburgh, Department of Chemical Engineering 2018-2022
Postdoctoral Associate
Advisor: Prof. Anna C Balazs

TEACHING EXPERIENCE

Indian Institute of Technology Kharagpur

Biological Physics	2024-2026
Mathematical Methods in Biomedical Engineering	2024-2026
Thermodynamics and Transport in Biological Systems	2025-2026
Molecular Imaging	2025-2026

Medical Electronics Lab	2025-2026
Introduction to Programming	2025
Teaching assistant at Indian Institute of Technology Palakkad	
Taught: Computational Engineering (undergraduate)	2015-2016
Teaching assistant at Indian Institute of Technology Madras	
Taught: Numerical Methods and Programming (postgraduate)	2012-2015
Physics Lab I (undergraduate)	2014
Introduction to Soft Matter Physics (postgraduate)	2013
Physics-I (undergraduate)	2013

AWARD & ACHIEVEMENTS

- **Best poster award** at CompFlu -2017, Indian Institute of Technology Madras, India. 2017
- **'Soft Matter' poster prize** at 2nd International Conference on Soft Materials, Jaipur, India. 2016
- **Best presentation award** at 2nd International Conference on Soft Materials, Jaipur, India. 2016
- **Travel award** from ICTP, Italy, for attending a workshop on Knots and Links in Biological and Soft Matter Systems. 2016
- **Best poster award** and selected for oral talk at IASBS-ICTP School on Active Matter and Chemotaxis, Zanjan, Iran. 2016
- **Travel award** from ICTP, Italy, for attending a school on Active Matter and Chemotaxis in Zanjan, Iran. 2016
- **Summer research fellowship** from Department of Physics, University of Calcutta. 2010
- **Institute merit-cum-means scholarship** from Indian Institute of Technology Madras during Master of Science. 2010-2011

RESEARCH FUNDING

- **ANRF-PMECRG**: Unveiling the role of biomechanical forces in extracellular matrix remodeling during three-dimensional tumor development (**PI**). Rs. 48,18,450. 2025-2028
- **ISRO-HFSP**: Development of an advanced wound healing patch for microgravity conditions (**co-PI**). Rs. 33,91,968. 2026-2028
- **India-Japan LOTUS Programme**: Understanding the mechanism of fruiting body formation using 3D vertex model and phase-field model" India-Japan LOTUS Programme with Shuji Ishihara, University of Tokyo (**Indian-PI**). 2026-2027

PUBLICATIONS

(* denotes equal contribution)

21. Raj Kumar Manna*, Emma M Retzlaff*, Anna Maria Hinman, Yiling Lan, Osama Abdel-Razek, Mike Bates, Heidi Hehnly, Jeffrey D Amack, M Lisa Manning **Dynamic forces drive cell and organ morphology changes during embryonic development**, *Proc. Natl. Acad. Sci.* **122** (29), e241811122 (2025).
20. Siji S Saju, Raj Kumar Manna, PB Sunil Kumar, **Dry polymer model for a string of pushers: Nontrivial scaling of tumbling time with shear rate**, *Phys Rev Research* **6** (4), 043126 (2024).
19. Oleg E Shklyaev, Raj Kumar Manna, Anna C Balazs, **Multifunctionality of two-dimensional sheets actuated by chemical pumps and motors**, *MRS Bulletin* **49** (11), 1145-1154 (2024).

18. Erin McCarthy*, Raj Kumar Manna*, Ojan Damavandi, and M. Lisa Manning, **Demixing in binary mixtures with differential diffusivity at high density**, *Phys. Rev. Lett* 132 (9) 098301 (2024).
17. Raj Kumar Manna, Oleg E. Shklyaev and Anna C. Balazs, **Chemically driven multimodal locomotion of active, flexible sheets** *Langmuir* 39 (2), 780 (2023).
16. Oleg E. Shklyaev, Raj Kumar Manna, Abhrajit Laskar, Joshua E Kauffman, Benjamin M Tansi, Ayusman Sen, and Anna C. Balazs, **Autonomous photothermally-driven fluid pumping and particle transport and assembly**, *Out-of-Equilibrium Soft Matter*, *The Royal Society of Chemistry*, 296, (2023).
15. Raj Kumar Manna, Oleg E. Shklyaev, Howard A. Stone, and Anna C. Balazs, **Solutal-buoyancy driven intertwining and rotation of patterned elastic sheets**, *PNAS Nexus* 1 (2), pgac072 (2022).
14. Abhrajit Laskar, Raj Kumar Manna, Oleg E. Shklyaev, and Anna C. Balazs, **Computer modeling reveals modalities to actuate mutable, active matter** *Nature Communications* 13, 2689 (2022).
13. Raj Kumar Manna*, Kayla Gentile*, Oleg E. Shklyaev, Ayusman Sen, and Anna C. Balazs, **Self-generated convective flows enhance the rates of chemical reactions**, *Langmuir* 38 (4),1432 (2022).
12. Raj Kumar Manna, Abhrajit Laskar, Oleg E. Shklyaev, and Anna C. Balazs, **Harnessing the power of chemically active sheets in solution**, *Nat. Rev. Phys.* 4 (2), 125 (2022).
11. Joshua E Kauffman, Benjamin M Tansi, Christopher LaSalle, Raj Kumar Manna, Oleg E Shklyaev, Anna C. Balazs, and Ayusman Sen, **Colloidal assembly and separation under UV-induced convective flows and on inclines**, *ChemNanoMat* 7 (7), 805 (2021).
10. Raj Kumar Manna, Oleg E. Shklyaev, and Anna C. Balazs, **Chemical pumps and flexible sheets spontaneously form self-regulating oscillators in solution**, *Proc. Natl. Acad. Sci. U.S.A.*, 118(12) (2021).
9. Benjamin M Tansi*, Raj Kumar Manna*, Oleg E Shklyaev, Matthew L Peris, Anna C. Balazs, and Ayusman Sen, **Achieving Independent Control over Surface and Bulk Fluid Flows in Microchambers**, *ACS Appl. Mater. Interfaces* 13(5), 6870 (2021).
8. Raj Kumar Manna, Oleg E. Shklyaev, Howard A. Stone, and Anna C. Balazs, **Chemically controlled shape-morphing of elastic sheets**, *Mater. Horiz.* 7(9), 2314 (2020).
7. Abhrajit Laskar, Raj Kumar Manna, Oleg E Shklyaev, Anna C Balazs, **Modeling the biomimetic self-organization of active objects in fluids**, *Nano Today* 29, 100804 (2019).
6. Raj Kumar Manna, Oleg E. Shklyaev, Joshua Kauffman, Benjamin Tansi, Ayusman Sen , and Anna C. Balazs, **Light-induced convective segregation of different sized microparticles**, *ACS Appl. Mater. Interfaces* 11(19),18004 (2019).
5. Raj Kumar Manna and P. B. Sunil Kumar, **Emergent topological phenomena in active polymeric fluids**, *Soft Matter*, 15, 477-486 (2019).
4. Bipul Biswas, Raj Kumar Manna, Abhrajit Laskar, P. B. Sunil Kumar, R. Adhikari, and Guruswamy Kumaraswamy, **Linking catalyst-coated isotropic colloids into “active“ flexible chains enhances their diffusivity**, *ACS nano* 11 (10), 10025 (2018).
3. Raj Kumar Manna, P. B. Sunil Kumar and Ronojoy Adhikari, **Colloidal transport by active filaments**, *J. Chem. Phys.* 146, 024901 (2017). Highlighted in AIP News, Materials Today News
2. Kandiledath Jayasree*, Raj Kumar Manna*, Debapriya Banerjee , and P. B. Sunil Kumar, **Dynamics of a polyelectrolyte in simple shear flow**, *J. Chem. Phys.* 139, 224902 (2013)
1. Shyamal Biswas, Debnarayan Jana, Raj Kumar Manna, **Excess energy of an ultracold Fermi gas in a trapped geometry**, *European Physical Journal D* 66, 217 (2012)

CONFERENCE ORAL PRESENTATION

- APS March Meeting 2019, Boston, MA, United States, 4-8 March, (2019)
 - Gordon Research Conference on Complex Active and Adaptive Material Systems, Ventura, CA, United States, 27 Jan - 01 Feb, (2019)
 - CompFlu-2017, Indian Institute of Technology Madras, India, 18-20 December, (2017)
 - 26th International Conference on Discrete Simulation of Fluid Dynamics, Erlangen, Germany, 10-14 July, 2017
 - 2nd International Conference on Soft Materials, Jaipur, 12-16 December, (2016)
 - IASBS-ICTP School on Active Matter and Chemotaxis, IASBS, Zanjan, Iran, 14-25 May, (2016)
 - CompFlu-2016, Indian Institute of Science Education and Research, Pune, India, 02-04 January, (2016)
 - New Colloids Discussion Meeting, Raman Research Institute, India, 19-21 July, (2015)
-

CONFERENCE POSTER PRESENTATION

- Physics of Morphing Matter, Princeton University, 12-14 December, (2022)
 - CompFlu-2017, Indian Institute of Technology Madras, India, 18-20 December, (2017)
 - 10th Liquid Matter Conference, Ljubljana, Slovenia, 17-21 July, (2017)
 - 2nd International Conference on Soft Materials , Jaipur, India, 12-16 December, (2016)
 - Workshop on Knots and Links in Biological and Soft Matter Systems, ICTP, Trieste, Italy, 26-30 September, (2016)
 - IASBS-ICTP School on Active Matter and Chemotaxis, IASBS, Iran, 14-25 May, (2016)
 - Indian Statistical Physics Community Meeting, ICTS Bangalore, India, 12-14 February, (2016)
 - 3rd Soft Matter Young Investigator Meet, Pondicherry, India, 17-20 December, (2015)
-