Brato Chakrabarti

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RESEARCH INTERESTS

Fluid dynamics	Fluid-structure interaction	Biophysics
Soft-matter physics	Scientific computing	Slender structures
Active matter	Biological transport	Mathematical modeling

EMPLOYMENT

Reader — March 2024-Present
International Center for Theoretical Sciences
Tata Institute of Fundamental Research
Bengaluru, India

Flatiron Research Fellow — March 2020-January 2024
Center for Computational Biology (CCB)
Flatiron Institute, Simons Foundation
Mentor: Professor Michael J. Shelley

EDUCATION

Doctor of Philosophy, Applied Mechanics — Fall 2015-Fall 2019
Department of Mechanical and Aerospace Engineering (MAE)
University of California, San Diego
Thesis: Problems on Viscous Dynamics of Passive and Active Microfilaments
Advisor: Professor David Saintillan

Master of Science, Engineering Mechanics — Fall 2013-Spring 2015
Biomedical Engineering and Mechanics
Virginia Tech
Thesis: Catenaries in Viscous Fluid
Advisor: Professor James Hanna

Bachelor of Engineering, Mechanical Engineering — 2009-2013
Jadavpur University, India

PUBLICATIONS (* denotes equal contribution)

1. Dipanjan Ghosh, **Brato Chakrabarti**, and Xiang Cheng "Breathe in, breathe out: Bacterial density determines collective migration in aerotaxis", bioRxiv, 2025.04.02.646741, (2025).
2. Olenka Jain, **Brato Chakrabarti**, Reza Farhadifar, Elizabeth R. Gavis, Michael J. Shelley, and Stanislav Y. Shvartsman "Geometric Effects in Large Scale Intracellular Flows", arXiv:2409.06763, (To appear in *PRX Life*) (2025).
3. **Brato Chakrabarti**, Manas Rachh, SY Shvartsman, and Michael J. Shelley "Cytoplasmic stirring by active carpets", *Proceedings of the National Academy of Sciences*, **121** (2024).
4. Chenji Li, **Brato Chakrabarti**, Pedro Castilla, Achal Mahajan, and David Saintillan, "Chemomechanical model of sperm locomotion reveals two modes of swimming ", *Physical Review Fluids*, **8** 113102 (2023).
5. **Brato Chakrabarti**, Michael J. Shelley, and Sebastian Fürthauer "Collective Motion and Pattern Formation in Phase-Synchronizing Active Fluids", *Physical Review Letters* **130**, 128202 (2023).

6. Francesco Bonacci, **Brato Chakrabarti**, David Saintillan, Olivia du Roure, and Anke Lindner "Dynamics of semiflexible polymers in oscillatory shear flows ", *Journal of Fluid Mechanics*, **955** A35 (2023).
7. A. C. Quillen, A. Peshkov, **Brato Chakrabarti**, Nathan Skerrett, Sonia McGaffigan, and Rebeca Zapiach "Fluid circulation driven by collectively organized metachronal waves in swimming T. aceiti nematodes", *Physical Review E*, **106** 064401 (2022).
8. **Brato Chakabarti**, Sebastian Fürthauer and Michael J. Shelley, "A multiscale biophysical model gives quantized metachronal waves in a lattice of cilia", *Proceedings of the National Academy of Sciences of the USA* **119** (2022).
9. **Brato Chakabarti**, Yanan Liu, Olivia du Roure, Anke Lindner, and David Saintillan, "Signatures of elastoviscous buckling in the dilute rheology of stiff polymers", *Journal of Fluid Mechanics*, **919** A12 (2021).
10. **Brato Chakrabarti**, and David Saintillan, "Shear-induced dispersion in peristaltic flow", *Physics of Fluids*, **32** 11302 (2020). **Invited:** "Contributions from Early Career Researchers 2020" and selected as a **featured** article.
11. **Brato Chakrabarti**, Charles Gaillard, and David Saintillan, "Trapping, gliding, vaulting: Transport of semiflexible polymers in periodic post arrays", *Soft Matter*, **16** 5534 (2020).
12. **Brato Chakrabarti**, Yanan Liu, John Lagrone, Ricardo Cortez, Lisa Fauci, Olivia du Roure, David Saintillan, and Anke Lindner, "Flexible filaments buckle into helicoidal shapes in strong compressional flow", *Nature Physics*, (2020).
13. **Brato Chakrabarti** and David Saintillan, "Hydrodynamic synchronization of spontaneously beating filaments", *Physical Review Letters*, **123** 208101 (2019).
14. **Brato Chakrabarti** and David Saintillan, "Spontaneous oscillations, beating patterns and hydrodynamics of active filaments", *Physical Review Fluids*, **4** 043102 (2019).
15. Roberto Alonso Matilla, **Brato Chakrabarti** and David Saintillan, "Transport and dispersion of active particles in periodic porous media", *Physical Review Fluids*, **4** 043101 (2019).
16. Yanan Liu*, **Brato Chakrabarti***, David Saintillan, Anke Lindner and Olivia du Roure, "Tumbling, buckling, snaking: Morphological transitions of flexible filaments in shear flow", *Proceedings of the National Academy of Sciences of the USA*, **115** 9438 (2018).
17. **Brato Chakrabarti** and James Hanna "Catenaries in Viscous Fluid", *Journal of Fluids and Structure*, **66** 490–516 (2016).

CONFERENCE ARTICLES AND PRESENTATIONS (presenter underlined)

1. Francesco Bonacci, Brato Chakrabarti, Olivia du Roure, Anke Lindner, and David Saintillan, *Reversible to chaotic transitions in the dynamics of fluctuating elastic filaments in oscillatory shear flow*, at the 77th Annual Meeting of the APS Division of Fluid Dynamics, November 2024, Salt Lake City, USA.
2. Brato Chakabarti, and Michael J Shelley, *A coarse-grained model for cytoplasmic streaming*, at the 76th Annual Meeting of the APS Division of Fluid Dynamics, November 2023, Washington DC, USA.
3. Brato Chakabarti, and Michael J Shelley, *A coarse-grained model for cytoplasmic streaming*, at the APS March Meeting, 2023, Las Vegas, USA.
4. Brato Chakabarti, Sebastian Fürthauer and Michael J Shelley, *Self-organized flows in phase-synchronizing active fluids*, at the APS March Meeting, 2022, Chicago, USA.
5. Brato Chakabarti, Sebastian Fürthauer and Michael J Shelley, *A multiscale biophysical model gives quantized metachronal waves in a lattice of cilia*, at the APS March Meeting, 2022, Chicago, USA.
6. Francesco Bonacci, Brato Chakrabarti, Olivia du Roure, Anke Lindner, and David Saintillan, *Dynamics of semiflexible filaments in oscillatory shear flows*, at the Annual European Rheology Conference, Sevilla, 2022.
7. Brato Chakabarti, Sebastian Fürthauer and Michael J Shelley, *A multiscale biophysical model gives quantized metachronal waves in a lattice of cilia*, at the 74th Annual Meeting of the APS Division of Fluid Dynamics, November 2021, Phoenix, USA.
8. David Saintillan, Chenji Li, Brato Chakrabarti, Pedro Castilla, and Achal Mahajan *An integrated chemomechanical model of sperm locomotion reveals two fundamental swimming modes*, at the 74th Annual Meeting of the APS Division of Fluid Dynamics, November 2021, Phoenix, USA.

9. David Saintillan, Yanan Liu, John Lagrone, Ricardo Cortez, Lisa Fauci, Olivia du Roure, Anke Lindner, and Brato Chakrabarti *Viscous dynamics of elastic filaments: from buckling instabilities to rheology*, at the APS March Meeting, 2021 (online).
10. Brato Chakabarti, Yanan Liu, Olivia du Roure, Anke Lindner, and David Saintillan, *Signatures of elastoviscous buckling in the dilute rheology of stiff polymers*, at the 73rd Annual Meeting of the APS Division of Fluid Dynamics, November 2020 (online).
11. David Saintillan, and Brato Chakrabarti, *Hydrodynamic synchronization of spontaneously beating filaments*, at the 72nd Annual Meeting of the APS Division of Fluid Dynamics, November 2019, Seattle, USA.
12. Brato Chakrabarti, Yanan Liu, John Lagrone, Ricardo Cortez, Lisa Fauci, Olivia du Roure, David Saintillan, and Anke Lindner *Helical buckling of flexible filaments in viscous flow*, at the 72nd Annual Meeting of the APS Division of Fluid Dynamics, November 2019, Seattle, USA.
13. Anke Lindner, Brato Chakrabarti, Yanan Liu, Olivia du Roure and David Saintillan, *The dynamics of flexible Brownian fibers in viscous flows* at The Annual European Rheology Conference, Slovenia, April 8-11, 2019.
14. Brato Chakrabarti and David Saintillan, *Spontaneous oscillations and hydrodynamics of active micro-filament* at the 71st Annual Meeting of the APS Division of Fluid Dynamics, November 2018, Atlanta, USA.
15. Roberto Alonso Matilla, Brato Chakrabarti and David Saintillan, *Asymptotic transport and dispersion of active particles in periodic porous media* at the 71st Annual Meeting of the APS Division of Fluid Dynamics, November 2018, Atlanta, USA.
16. Brato Chakrabarti, Yanan Liu, David Saintillan, Anke Lindner and Olivia du Roure, *The dynamics of flexible and Brownian filaments in viscous flows* at the 71st Annual Meeting of the APS Division of Fluid Dynamics, November 2018, Atlanta, USA.
17. Brato Chakrabarti, Yanan Liu, David Saintillan, Anke Lindner and Olivia du Roure, *Buckling and migration of semi-flexible filaments* at the 70th Annual Meeting of the APS Division of Fluid Dynamics, November 2017, Denver,USA.
18. David Saintillan and Brato Chakrabarti, *Shear dispersion in peristaltic pumping* at the 70th Annual Meeting of the APS Division of Fluid Dynamics, November 2017, Denver,USA.
19. James Hanna and Brato Chakrabarti, *Catenaries in viscous fluid*. 24^{th} ICTAM, Montreal, August 2016.
20. Brato Chakrabarti and David Saintillan. *Drift, Mixing and Diffusivity in Stokes Flow*. Presented at the Southern California (SoCal) Fluids X, April 2016, UC Irvine, California, USA.
21. Brato Chakrabarti and James Hanna. *Catenaries in viscous fluid*. At the 68th Annual Meeting of the APS Division of Fluid Dynamics, November 2015, Boston, USA.
22. Brato Chakrabarti and James Hanna. *Catenaries in Drag*. Presented at the 67th Annual Meeting of the APS Division of Fluid Dynamics, November 2014, San Francisco, USA.

INVITED TALKS

1. 'Active carpet model for intracellular flows', CompFlu, Indian Institute of Technology, Hyderabad, 2024.
2. 'From one to many: two problems in fluid-structure Interactions at low Reynolds number', LadHyX, Ecole Polytechnique, France, 2024.
3. 'Problems and puzzles in intracellular flows', PMMH-ESPCI, Paris, France, 2024.
4. 'Self-organized intracellular flows: coarse-grained theory and the role of geometry', Symposium on Nonequilibrium and Active Matter Physics Meeting, Indian Institute of Science, 2024.
5. 'Self-organized intracellular flows: coarse-grained theory and the role of geometry', Symposium on Nonequilibrium and Active Matter Physics Meeting, Indian Institute of Science, 2024.
6. 'Self-organized intracellular flows: computational methods and coarse-grained theory', International Workshops on Advances in Computational Mechanics - IV, Kitakyushu, Japan, 2024.
7. 'Cytoplasmic streaming by active carpets', 9th Indian Statistical Physics Community Meeting, ICTS-TIFR, 2024.
8. 'Cytoplasmic streaming by active carpets', Mechanical Science Young Investigator Meeting (MSYIM), IIT Kanpur, 2024.
9. 'The waves within us: hydrodynamics of passive and active filaments', Indian Association for the Cultivation of Science, Kolkata, India, 2024.
10. 'The waves within us: hydrodynamics of passive and active filaments', University of California, Riverside, 2023.
11. 'Quantized metachronal waves in arrays of cilia', BPPB seminar (online), 2023.

12. 'Beat, sync, and wave: nonlinear dynamics of flagella and cilia', Department of Mechanical Engineering, IIT Bombay, 2023.
13. 'The waves within us: hydrodynamics of passive and active filaments', Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, 2023.
14. 'The waves within us: nonlinear dynamics of passive and active filaments', Tata Institute of Fundamental Research, Hyderabad, 2023.
15. 'A continuum theory for cytoplasmic streaming in the *Drosophila* oocyte', International Center for Theoretical Sciences (ICTS), Bengaluru, 2022.
16. 'Beat, sync, and wave: nonlinear dynamics of cilia and flagella', Colloquium, International Center for Theoretical Sciences (ICTS), Bengaluru, 2022.
17. 'Problems on nonlinear dynamics of filaments in viscous fluids', Department of Applied Mechanics, Indian Institute of Technology, Madras, 2022.
18. 'From buckling to streaming: problems on fluid-structure interaction in viscous flows', Department of Mathematics, Princeton University, Analysis of Fluids Seminar, 2022.
19. 'The waves within us: problems on dynamics of passive and active filaments', International Center for Theoretical Sciences (ICTS), Bengaluru, 2022.
20. 'Problems on viscous dynamics of passive and active filaments: from one to many', Raman Research Institute (RRI), Bengaluru, 2022.
21. 'The waves within us: from single cilium to the formation of metachronal waves', Institute of Mathematical Sciences (IMSc), Madras, 2022.
22. 'The waves within us', Simons Foundation Lecture Series, Flatiron Institute, 2022.
23. 'A multiscale biophysical model gives quantized metachronal waves in a lattice of cilia', Frontiers in Applied & Computational Mathematics, New Jersey Institute of Technology, 2022.
24. 'Hydrodynamics of Active Matter', Jadavpur University, 2021.
25. 'Metachronal waves in ciliary arrays', Brown Bag Seminar, Center for Computational Biology, Flatiron Institute, 2020.
26. 'Helical buckling of actin filaments in compressional flow', Biophysical Modeling group, Center for Computational Biology, Flatiron Institute, 2019.
27. 'Viscous dynamics of active and passive microfilaments', Department of Physics, University of California, Santa Barbara, 2019.
28. 'Spontaneous oscillations and hydrodynamic synchronization of active filaments', ESPCI, Paris, France 2019.

OUTREACH

1. **ICTS summer course, 2024:** Dynamics of biological systems (together with Prof. Akshit Goyal)
2. **Physics of Life, NCBS monsoon school, 2024:** Biological fluid flows and active matter
3. **Beyond Boundaries: A Day of Interdisciplinary Exploration**, ICTS, 2024

AWARDS AND HONORS

1. **Scientific High-Level Visiting Fellowships** from the French Institute of India, 2024.
2. **Early Career Researcher** awarded by the journal *Physics of Fluids*, 2020.
3. **Powell Fellow, UCSD** by Jacobs school of Engineering, 2015.
4. **Awarded Gold Medal** for best performance in Fluid Mechanics in Bachelor of Engineering (Mechanical Engineering, Jadavpur University), 2013.
5. **National Merit Scholarship** for performance in school leaving examination, 2009.

REVIEWER OF ARCHIVED JOURNALS

1. Journal of Fluid Mechanics
2. Physical Review Letters
3. Physical Review Fluids
4. Physical Review E
5. Soft Matter
6. Journal of Computational Physics

7. Physica D
8. New Journal of Physics
9. Journal of Mathematical Fluid Mechanics
10. Proceedings of the Royal Society A
11. Proceedings of the National Academy of Science
12. Nature Communications

TEACHING EXPERIENCE

ICTS-TIFR

- Fall 2024: Fluid dynamics and elasticity
- Spring 2025: Biological fluid mechanics and active suspensions

Virginia Tech

- Fall 2013: Teaching Assistant, Statics (ESM 2104)
- Spring 2014: Teaching Assistant, Dynamics (ESM 2204)
- Fall 2014: Teaching Assistant, Anaytical mechanics (ESM 3214)
- Spring 2015: Teaching Assistant, Vibrations (ESM 3134)

UCSD

- Winter 2017: Teaching Assistant, Fluid mechanics (MAE 210 A)
- Fall 2018: Teaching Assistant, Introduction to mathematical physics (MAE 105).
- Spring 2019: Teaching Assistant, Hydrodynamic stability (MAE 210 C)