

Sumitabha Brahmachari, Ph.D.

Post-doctoral Associate
Center for Theoretical Biological Physics
Rice University, Houston, TX, US 77005

Email: sb95@rice.edu
Homepage: <https://s-brahmachari.github.io>
Cell: +1 224 410 9449

RESEARCH INTERESTS

Computational and theoretical modeling (Machine Learning, Molecular Dynamics, Statistical Mechanics),
Genome organization, Transcription regulation, DNA supercoiling, Chromosome biophysics.

RESEARCH EXPERIENCE

- **Post-doctoral Associate**, Rice University 2018 - present
Supervisor: Prof. José N. Onuchic
Summary: Developed simulation force-fields for chromosomes using Hi-C-derived information; Built machine learning models to learn statistical correlations between structure and epigenetics; Built numerical models exploring the role of DNA mechanics in transcription; Mentored graduate and undergraduate students; Collaborated with experimental labs.
- **Graduate Researcher**, Northwestern University 2013-2018
Supervisor: Prof. John F. Marko
Summary: Built statistical mechanical models of DNA elucidating the role of mechanical forces and DNA structure in influencing in vivo processes; Collaborated with experimentalists.

EDUCATION

Ph. D. Physics , Department of Physics and Astronomy, Northwestern University	2013-2018
M. Sc. Physics , Department of Physics, Indian Institute of Technology Mumbai	2011-2013
B. Sc. Physics , Hindu College, University of Delhi	2008-2011

PUBLICATIONS (* indicates shared authorship)

- [1] [Preprint] [S Brahmachari](#), S Tripathi, JN Onuchic, H Levine. Regulation of chromatin transcription dynamics by DNA supercoiling. *BioRxiv* (2023) doi.org/10.1101/2023.11.06.565891
- [2] [Preprint] [S Brahmachari](#), T Markovich, FC MacKintosh, JN Onuchic. Temporally correlated active forces drive chromosome structure and dynamics. *BioRxiv* (2023) doi.org/10.1101/2023.04.23.528410
- [3] E Dodero-Rojas, MF Mello, [S Brahmachari](#), et al. PyMEGABASE: Predicting cell-type-specific structural annotations of chromosomes using the epigenome. *J. Mol. Biol.* 435 (15), p168180 (2023). doi.org/10.1016/j.jmb.2023.168180
- [4] BS Ruben, [S Brahmachari](#), VG Contessoto, et al. Structural reorganization and relaxation dynamics of axially stressed chromosomes. *Biophys. J.* 122 (9) p1633-1645 (2023). doi.org/10.1016/j.bpj.2023.03.029
- [5] [S Brahmachari](#) VG Contessoto, M Di Pierro, and JN Onuchic. Shaping the genome via lengthwise compaction, phase separation, and lamina adhesion. *Nucl. Acids Res.* 50, p4258-4271 (2022). doi.org/10.1093/nar/gkac231
- [6] S Tripathi, [S Brahmachari](#), JN Onuchic, and H Levine. DNA supercoiling-mediated collective behavior of co-transcribing RNA polymerases. *Nucl. Acids Res.* 50 (3), p1269-1279 (2022). doi.org/10.1093/nar/gkab1252

- [7] C Hoencamp*, O Dudchenko*, AMO Elbatsh*, S Brahmachari* et al. 3D genomics across the tree of life reveals condensin II as a determinant of architecture type. **Science** 372, p984-989 (2021). doi.org/10.1126/science.abc221
- [8] PR Desai, S Brahmachari, JF Marko, et al. Coarse-grained modelling of DNA plectoneme pinning in the presence of base-pair mismatches. **Nucl. Acids Res.** 48 (19), p10713-10725 (2020). doi.org/10.1093/nar/gkaa836
- [9] S Brahmachari and JF Marko. Chromosome disentanglement driven via optimal compaction of loop-extruded brush structures. **Proc. Natl. Acad. Sci. USA.** 116, p24956-24965 (2019). doi.org/10.1073/pnas.1906355116
- [10] S Brahmachari, A Dittmore, Y Takagi, et al. Defect-facilitated buckling in supercoiled double-helix DNA. **Phys. Rev. E** 97 (2), p022416 (2018). doi.org/10.1103/PhysRevE.97.022416
- [11] A Dittmore, S Brahmachari, Y. Takagi, J. F. Marko, and K. C. Neuman. Supercoiling locates mismatches. **Phys. Rev. Lett.** 119, 147801 (2017). doi.org/10.1103/PhysRevLett.119.147801
- [12] S Brahmachari*, KH Gunn*, RD Giuntoli, et al. Nucleation of multiple buckled structures in intertwined DNA double helices. **Phys. Rev. Lett.** 119, 188103 (2017). doi.org/10.1103/PhysRevLett.119.188103
- [13] S Brahmachari and JF Marko. Torque and buckling in stretched intertwined double-helix DNAs. **Phys. Rev. E** 95 (5), p052401 (2017). doi.org/10.1103/PhysRevE.95.052401
- [14] [Book chapter] S Brahmachari and JF Marko. DNA mechanics and topology. **Biomechanics in Oncology**, Advances in Experimental Medicine and Biology, vol 1092. p11-39 Springer, Cham. (2018). doi.org/10.1007/978-3-319-95294-9_2

MANUSCRIPTS IN PREPARATION

- [1] S Brahmachari, S Tripathi, JN Onuchic, H Levine. DNA supercoiling-mediated stabilization of R-loops as a mechanism of transcription control. (2023)
- [2] S Brahmachari, AB Oliveira Jr., VG Contessoto, JN Onuchic. Bacterial chromosomes inferred from entropy maximization reveal structural nuances of chromosome segregation. (2023)

AWARDS AND FELLOWSHIPS

- | | |
|---|-----------|
| • Robert A. Welch Postdoctoral Fellow, Rice University | 2018-2022 |
| • Shirley Chan student travel grant sponsored by DBIO, APS | 2017 |
| • Molecular Biophysics Training Program Fellow, Northwestern University | 2014-2016 |
| • Innovation in Science Pursuit for Inspired Research (INSPIRE) scholarship, sponsored by the Department of Science and Technology, Government of India | 2008-2013 |

PROFESSIONAL SERVICE

- Proposed and co-organized a DBIO-sponsored focus session: DNA Mechanics and Gene Expression, at the American Physical Society March Meeting 2023. Also organizing the session in the 2024 meeting.
- Organized workshop on Quantitative Approaches to Modeling Biological Systems (January 2023) hosted by the Center for Theoretical Biological Physics, Rice University.
- Member of the American Physical Society (2017 to present).
- Peer-reviewed for PLOS One, iScience, Journal of Royal Society Interface, Clinical and Translational Medicine, and eLife.

TEACHING EXPERIENCE

- 2023 Mentoring Rice University graduate students Esteban Doderro-Rojas and Matheus F. Mello
- 2022 Mentored Rice University graduate student Esteban Doderro-Rojas
- 2021 Mentored Rice University graduate student Shubham Tripathi
- 2020 Mentored Frontiers in Science Summer Internship student Kyle Lare
- 2019 Mentored Rice University undergraduate student Benjamin Ruben
- 2017 Teaching Assistant (Northwestern University) for Quantitative Biology (IBiS-410)
- 2016 Teaching Assistant (Northwestern University) for Quantum Mechanics II (Phys 412-2)
- 2015 Teaching Assistant (Northwestern University) for Quantum Mechanics III (Phys 412-3)
- 2014 Teaching Assistant (Northwestern University) for General Physics Laboratory (Phys 136-1)

SELECTED PRESENTATIONS

- 2023 Invited talk at the International Plant and Animal Genome Conference, Perth, Australia (September)
- Invited talk at Indian Institute of Technology Bombay (IITB), Mumbai, India (September)
- Invited talk at Jawaharlal Nehru Center for Advanced Scientific Research, Bengaluru, India (Sep)
- Invited talk at International Center for Theoretical Sciences (ICTS), Bengaluru, India (September)
- Invited talk at National Center for Biological Sciences (NCBS), Bengaluru, India (September)
- Invited talk at the American Physical Society (APS) March Meeting, Las Vegas, US (March)
- 2022 Contributed talk at the American Physical Society March Meeting, Chicago, US (March)
- 2020 Contributed talk at the Genome Organization Workshop, held virtually at MIT, US (June)
- 2019 Contributed talk at APS March meeting, Boston, US (March)
- Poster at Gordon Research Conference on Chromosome Dynamics, Newry, US (June)
- Poster at Genome Architecture Meeting, Varna, Bulgaria (July)
- 2018 Contributed talk at the APS March meeting, Los Angeles, US (March)
- 2017 Contributed talk at the APS March meeting, New Orleans, US (March)
- Poster at Chromosome segregation and structure meeting, Cold Spring Harbor Lab, US (June)