

Sumitabha Brahmachari, PhD

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Summary

- Theoretical/Computational Biophysicist with 8 years of experience in genome research
- Author of 10 research articles in peer-reviewed journals with 7 first-authored articles
- Inter-disciplinary collaborator: experience working with theorists and experimentalists

Research Experience

Rice University, Post-doctoral Scholar

2018 - Present

Robert A. Welch Postdoctoral Fellow (2018-2022)

Center for Theoretical Biological Physics, Supervisor: Prof. José N. Onuchic

Molecular Dynamics Simulations

- Proposed a simple, elegant model for the genome that explains the species-wide genome-architecture variants as a competition between three fundamental genome organizing forces
- Hypothesizing novel force fields, elucidated the mechanism of SMC protein (condensin II) activity and how it counteracts phase segregation of centromeres
- Developing a stochastic integrator for non-equilibrium simulations that incorporates the effect of temporally correlated noise, an emergent characteristic of coarse-grained active systems
- Collaborated with a team of international, inter-disciplinary scientists to verify theoretical predictions
- Supervised graduate/undergraduate researchers, and volunteered to mentor summer interns through a Science Outreach program

Analytical/Numerical Modeling

- Modeled coupling of DNA supercoiling and transcription to explain observations of a strong cooperation between co-transcribing RNA-polymerases
- Building analytical models for torque response of chromatin fibers to explore mechanics of eukaryote transcription
- Supervised graduate researcher in building numerical simulations of the transcription process using the Doob-Gillespie algorithm

Northwestern University, Doctoral Researcher

2013-2018

Molecular Biophysics Training Program Fellow (2014-2016)

Department of Physics and Astronomy, Supervisor: Prof. John F. Marko

- Built statistical mechanical models of DNA as a polymer to elucidate the torque response of base-mismatched DNA and braided DNAs
- Worked closely with experimentalists: built software for real-time analysis of magnetic tweezer data and analyzed raw data to verify theoretical predictions
- Built scaling models of chromosomes that identifies the structural role of loops in minimizing entanglements between chromosomes

Indian Institute of Technology Mumbai, Graduate Researcher

2011-2013

Department of Physics, Supervisor: Prof. K. G. Suresh

- Analyzed magnetocaloric properties of intermetallic compound SmMn_2Ge_2 that features multiple magnetic phase transitions (reentrant magnetism)

Education

Northwestern University

Ph.D. Physics: Department of Physics and Astronomy 2018

Indian Institute of Technology Mumbai

M.Sc. Physics: Department of Physics 2013

University of Delhi, Hindu College

B.Sc. Physics: Department of Physics 2011

Technical Skills

- Molecular Dynamics: GROMACS, OpenMM
- Python, C++, MATLAB, Git

Awards and Fellowships

- Robert A. Welch Postdoctoral Fellow, Rice University (2018-2022)
- 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)

Selected Publications (5 out of 10; * indicates shared authorship)

- C. Hoencamp*, O. Dudchenko*, A.M.O. Elbatsh*, S. Brahmachari*, et al. 3D genomics across the tree of life reveals condensin II as a determinant of architecture type. *Science* **372**, 984-989 (2021)
- S. Tripathi, S. Brahmachari, J. N. Onuchic, and H. Levine. DNA supercoiling-mediated collective behavior of co-transcribing RNA polymerases. *Nucl. Acids Res.* gkab1252 (2021)
- S. Brahmachari and J. F. Marko. Chromosome disentanglement driven via optimal compaction of loop-extruded brush structures. *Proc. Natl. Acad. Sci. USA*. **116**, 24956-24965 (2019)
- A. Dittmore, S. Brahmachari, Y. Takagi, J. F. Marko, and K. C. Neuman. Supercoiling locates mismatches. *Phys. Rev. Lett.* **119**, 147801 (2017)
- S. Brahmachari*, K. H. Gunn*, R. D. Giuntoli, A. Mondragon, and J. F. Marko. Nucleation of multiple buckled structures in intertwined DNA double helices. *Phys Rev Lett.* **119**, 188103 (2017)

Selected Conference Presentations

- Oral presentation titled “Plasticity of genome structure and organization governed by the differential activity of SMC complexes” at virtual American Physical Society March Meeting (March, 2021)
- Oral presentation titled “Inter-chromosomal organization via lengthwise compaction” at the NSF-sponsored Genome Organization Workshop, held virtually at MIT (June 2020)
- Poster presentation titled “Interplay of self-adhesion and lengthwise compaction in inter-chromosomal organization” at Genome Architecture Meeting, Varna, Bulgaria (July, 2019)
- Oral presentation titled “Optimizing chromosome disentanglement via chromatin loop organization” at American Physical Society March Meeting, Boston, MA (March 2019)
- Oral presentation titled “Statistical Mechanics of Double-Helix DNA” at the Theoretical Biophysics Summer School, Cargese, France (June, 2017)
- Oral presentation titled “Torque and Buckling in Stretched Intertwined Double-Helix DNAs” at the American Physical Society March Meeting 2017, New Orleans, LA (March, 2017)