Kiran Kumari

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INC consortium talk

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Research training and interests:

I am a post-doctoral fellow at the Max Planck Institute for Infection Biology. My training is in chemical engineering (B. Tech, M. Tech.), computational biology, soft-matter physics, and biophysics (PhD). I do data-driven integrative modelling, combining different experimental datasets and biophysical simulations.

My expertise is in broadly three areas: (i) epigenetics and chromatin organization, (ii) data-driven modelling, and (iii) self-assembly in soft matter systems. I use this expertise to investigate biological systems in healthy/diseased states. I have been studying the 3D organization of chromatin in cancer cells and how the folding of DNA and epigenetics influence gene transcription and cell proliferation. I have investigated the role of multi-way enhancer-promoter interactions for the transcription in cancer cells.

I have gained expertise in different types of computer simulation methods and data analysis. I have been doing Brownian dynamics simulations of chromatin polymers. I developed an Inverse Brownian Dynamics method to extract information from chromosome conformation capture experiments and studied the statics and dynamics of chromatin at the length scale of a few genes. With a chemical engineering background, I have training in theoretical/computational studies of soft-matter systems. Apart from Brownian dynamics simulations, I am also trained to do Monte Carlo and kinetic Monte Carlo simulations.

I have gained expertise in using experimental data sets, analyzing them using statistical and AI/ML methods and modelling them using computational and biophysical tools. I have used Hi-C and ChIP-Seq datasets to study chromatin states. I have worked in collaboration with experimental groups studying genome organization.

Publications:

Research papers under preparation

1. **K. Kumari**, S. Shin, X. Li, D. Thirumalai, *Unlocking gene transcription in cancer cells: the central role of multi-way enhancer-promoter interactions*
   Under preparation (To submit in 2024)
2. **Kiran Kumari**, *Time-dependent replication influences the formation of chromatin domains*
   Under preparation (To submit in 2024)
3. A. Jairam, S. Dutta, S. Kadam, **K. Kumari**, R. Padinhateeri, *Predicting statistics of translocation events: role of chromatin compaction and double-strand DNA break*
   Under preparation (To submit in 2024)

Research papers published in peer-reviewed journals

1. S. Kadam, **K. Kumari**, V. Manivannan, S. Dutta, M. Mitra, R. Padinhateeri, *Predicting scale-dependent chromatin polymer properties from systematic coarse-graining*
   Nat. Commun. 14, 4108 (2023), doi: 10.1038/s41467-023-39907-2

2. **K. Kumari**, J. R. Prakash, R. Padinhateeri, *Heterogeneous interactions and polymer entropy decide organization and dynamics of chromatin domains*
Biophys J. 121, 1-19 (2022), doi: 10.1101/2021.02.17.431616.
3. L. Sreekumar, **K. Kumari**, A. Bakshi, N Varshney, Bhagya C., Thimmappa, K. Guin, L. Narlikar, R. Padinhateeri, R. Siddharthan, K. Sanyal, *Orc4 spatiotemporally stabilizes centromeric chromatin*,
Genome Research, 31, 607-621 (2021), doi: 10.1101/gr.265900.120.
4. **K. Kumari**, B. Duenweg, R. Padinhateeri, J. R. Prakash, *Computing 3D chromatin configurations from contact probability maps by Inverse Brownian Dynamics*,
Biophys J. 118, 2193-2208 (2020), doi: 10.1016/j.bpj.2020.02.017.
5. A. Santra, **K. Kumari**, R. Padinhateeri, B. Duenweg, J. R. Prakash, *Universality of the collapse transition of sticky polymers*,
Soft Matter, 15, 7876-7887 (2019), doi: 10.1039/C9SM01361J.

Education:

- **Post-Doctoral Fellow, Department of Chemistry, 2021-2024**
University of Texas at Austin, USA.
- **Ph.D., Computational Biophysics, 2021**,
IITB-Monash Research Academy (IIT Bombay and Monash University)
  - Joint PhD program of IIT Bombay, India and Monash University, Australia
  - Worked in Department of Chemical Engineering Monash University and Biosciences and Bioengineering, IIT Bombay
  - Thesis advisors : Prof. Ranjith Padinhateeri & Prof. Ravi Jagadeeshan
  - Thesis: *Computing the spatial organization and dynamics of chromatin domains*
  - CPI: **9.53/10**
- **M. Tech. Chemical Engineering, 2016**
Indian Institute of Technology Dhanbad, Jharkhand, India.
  - CPI: **9.54/10**
- **B. Tech., Chemical Engineering, 2014**
BIT Sindri, Dhanbad, India
  - CPI: **8.08/10**

Computer skills:

- **Programming:** Matlab, C, C++, Fortran, R, Python.
- **Operating Systems :** Unix, GNU/Linux, Mac OS X, MS Windows.
- **Packages :** LAMMPS, VMD.

Honors/Awards:

- **Best postgraduate talk award:** for my presentation in *Statistical Mechanics of Soft Matter* conference 2020.
- **Best paper award:** awarded by the Department of Bioscience and Bioengineering, IIT Bombay.
- **Best 3-minutes-thesis-talk:** awarded by the Department of Chemical Engineering, Monash University.

Selected conferences:

- American Physical Society, held at Las Vegas, Nevada, 05-10 March, 2022 (Talk).
- Statistical Mechanics of Soft Matter organized jointly by the Griffith University and the University of Queensland, Brisbane, Australia (held virtually) 14-15 December, 2020 (Talk).

- 3D Genomics 2020: Interdisciplinary school in 3D genomics: from experiments to models and back, Lyon, France (held virtually) from 23-26 November 2020.
- Biophysics Paschim, CSIR-NCL, Pune, India (held virtually) 3 October 2020 (Poster).
- EMBO Symposium: Regulatory epigenomics: From large data to useful models organized by IMSc Chennai, India from 10-13 March 2019 (Poster).
- International Union of Theoretical and Applied Mechanics held at IIT Kanpur, India from 17-20 December 2018 (Poster).
- 7th Meeting of the Asian Forum of Chromosome and Chromatin Biology held at JNCASR, Bangalore, India from 15-17 November 2018 (Poster).
- Chemical Engineering Postgraduate Association conference held at Monash University, Australia on 26 October 2017. (Talk)

Teaching:

- Teaching Assistant for Transport Phenomenon at Monash University,Australia and for Mathematical Methods for Biologists at IIT Bombay, India.
- Mentored post-graduate students (4) in computational methods.

Relevant courses completed and workshops attended:

- *Post Graduate Program in Artificial Intelligence and Machine Learning*: Business Applications by McCombs School of business, The University of Texas at Austin.
- HarvardX course PH125.8x: *Data Science: Machine Learning*.
- *Intellectual Property Rights Fundamentals Workshop 2019* at IIT Bombay.

References:

Available upon request.