

Abhishek Kumar Sharma, PhD

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Research Experience

- Postdoctoral Scholar, de Pablo Group, Pritzker School of Molecular Engineering, UChicago (July 2021-present)
- Visiting Scientist, Escobedo Research Group, Cornell University (June 2021)
- Graduate Research Assistant, Escobedo Research Group, Cornell University (2017-2021)
- Undergraduate Researcher, Bioseparations and Bioprocessing Lab, IIT Delhi (2014-2016)
- Research Intern, Mammalian Downstream Lab, Biocon Research Limited, India (Summer 2015)

Scientific Communication and Art Experience

Contributor, [STAGE Lab](#)

Pritzker School of Molecular Engineering, The University of Chicago (2022-present)

- Curriculum Innovation Team: Development of an undergraduate course aimed at interactions between science and film. Working with a team of scientists and artists to cater the course content to both audiences. The course explores the use of scientific objects, concepts, and scientists as a part of their narratives, characters, and techniques. Presented poster at 2023 Symposium for Entertainment and Engineering at Purdue University.
- Science-inspired Theater: Scriptwriting, improvisation, and ideation over a play that conveys quantum mechanics through the lens of multicultural experience. Working within a group of 15 people from diverse backgrounds in art and science – including actors, retired physicists, and even high school teachers!

Producer, [Science Blender Podcast](#)

Smith School of Chemical and Biomolecular Engineering, Cornell University (2018-2020)

- Helped produce, edit, and host three episodes that blended the personal journey with scientific pursuits for Ph.D. students with diverse backgrounds to humanize scientists to the broader public.
- Episodes Produced:
 - [Dave Gnopo: Can bacteria prevent disease?](#): Growing up in Ivory Coast, Dave witnessed death caused by preventable diseases, which led him on a life mission to protect people from getting sick. Through an incredible journey, today Dave has developed a novel method to produce vaccines using outer membrane vesicles from bacteria with hopes of helping his home country.
 - [Laura Sinclair: Art Blender](#): The graphic artist of the podcast shares her experiences as both a chemical engineer and an artist, and how her two identities influence the other.
 - [Arna Pálsdóttir: Value from Waste](#): Coming from Iceland, Arna made her way to the US to work on science useful for geothermal operations back home. At Cornell, she developed a new method to extract lithium out of geothermal wastewater.

Scientific Outreach

- *Acoustic Bandgap and Wave Transmission*: A new outreach demo that directly translated cutting-edge research for a striking demonstration of wave transmission. Well received at [South Side Science Festival, 2023](#)

- *Martians vs. Machine Learning*: A new outreach demo that gamifies the concept of machine learning through a robotic arm and a narrative of space exploration and climate change. Demonstrated for elementary schoolers ([South Side Science Festival](#), September 2022) and middle schoolers ([No Small Matter](#), April 2023). Developed at UChicago Molecular Engineering with a team of graduate students and postdocs.
- *DNA Extraction from Strawberries*: Ideation and lab demonstration for the bioengineering portion of the annual [WOMEN outreach](#) at Cornell aimed at woman-identifying students in upstate New York. (2019)
- *Pattern Recognition and Crystallization*: Original demo aimed to teach the concept of crystal ordering to middle schoolers at WOMEN Outreach (2019)
- *Outreach Volunteering*: [Expanding Your Horizons](#) (2017), [CURIE](#) (2018), [Catalyst](#) (2019).

Teaching and Mentoring Experience

Teaching Experience

- Teaching Assistant, CHEME 7130: Advanced Chemical Engineering Thermodynamics (Fall 2018)
 - Lecturing (5 lectures on Information Entropy, new module), developing new homework problems, grading, and office hours.
- Teaching Assistant, CHEME 4320: Unit Operations Laboratory (Fall 2019)
 - Facilitation of experiments in process control, distillation, heat exchangers, and membrane separations.

Mentoring Experience

- Fabian Bylehn, PhD Candidate in Molecular Engineering, The University of Chicago (2021-present)
- Daryna Safarian, PhD Candidate in Molecular Engineering, The University of Chicago (2022-present)
- Cesar Castro Rubio, PhD Student in Molecular Engineering, The University of Chicago (2023-present)
- Ge Sun, PhD Candidate in Molecular Engineering, The University of Chicago, (2021-2022)
- Allen Yang, M.S. Student in Chemical Engineering, Cornell University, (2020)

Teaching Interests

- Pure Science Courses:
 - Thermodynamics (both classical and statistical varieties)
 - Fluid Mechanics
 - Molecular Simulations
 - Chemical Kinetics
 - Introduction to Soft and Active Matter
- Interdisciplinary Courses:
 - Patterns in Nature and Art: this course explores the origins of various natural patterns, their mathematical and physical basis, and how they have been utilized for artistic expression
 - Ethics and Engineering: This course will be at the intersection of the philosophy of engineering and what ethical dilemmas may arise in the work of an engineer.
 - Architecture and Novel Materials: This course would explore instances where material innovation led to the creation of novel architectures, and where novel architectural concepts motivated material discoveries.
 - Film and Science: this course that explores the technological, sociological, and narrative aspects of film and science. Including chemical aspect of film, and use of computer-generated imagery.
 - Computer Simulations and Simulacrum: This course would expose students to the practice of computer simulation prevalent ever since the advent of computers. Then philosophical explorations are pursued regarding the nature of reality, epistemology and whether nature is computing or not.

Education

Doctor Of Philosophy | 2016-2021 | Cornell University, USA

- Major: Chemical & Biomolecular Engineering | Minor: Applied Mathematics

Bachelor Of Technology | 2012-2016 | IIT Delhi, India

- Major: Chemical Engineering | Minor: Biochemical Engineering and Biotechnology

Journal Publications

- Sharma, A.K.; Bylehn, F.; de Pablo, J. Directed Ageing for Phononic Bandgaps in Networked Materials. *In preparation*.
- Sharma, A.K.*; Bylehn, computer-generated Learning Allostery in Charged Mechanical Networks via Tuning of Charges. *In preparation*. *equal contribution
- Safarian, D.; Sharma, A.K.; de Pablo, J. Graph Neural Networks for Design of Networked Metamaterials. *In preparation*.
- Sharma, A.K.; Singh, A.; Pablo, J.; Shear Driven Ordering and Disordering of Frictional Spheres Suspensions in 2D. *In preparation*
- Shen, M.; Reyes-Martinez, M.; Powell, L.; Iadicola, M.; Sharma, A.K.; Bylehn, F.; Pashine, N.; Chan, E.; Soles, C.; Jaeger, H.; et al. Three-Dimensional Auxetic Materials from Disordered Networks by Global Node Optimization. *Mater Horiz* 2023, *Submitted*.
- Singh, A.; Ness, C.; Sharma, A.K.; de Pablo, J.; Jaeger, H. Rheology of Bidisperse Non-Brownian Suspensions. *Physics Review Letters* 2023, *Submitted*.
- Sharma, A. K., & Escobedo, F. A. (2023). Effect of Particle Anisotropy on the Thermodynamics and Kinetics of Ordering Transitions in Hard Faceted Particles. *The Journal of Chemical Physics*. 158, 044502.
- Mohamed, Z., Shin, J. H., Ghosh, S., Sharma, A. K., Pinnock, F., Bint E Naser Farnush, S., ... & Daniel, S. (2021). Clinically relevant bacterial outer membrane models for antibiotic screening applications. *ACS Infectious Diseases*, 7(9), 2707-2722. Supplementary Cover
- Sharma, A. K., & Escobedo, F. A. (2021). Low Interfacial Free Energy Describes the Bulk Ordering Transition in Colloidal Cubes. *The Journal of Physical Chemistry B*, 125 (19), 5160-5170. Supplementary Cover.
- Sharma, A. K., & Escobedo, F. A. (2018). Disorder Foreshadows Order in Colloidal Cubes. *The Journal of Physical Chemistry B*, 122(39), 9264-9273.
- Sharma, A. K., & Escobedo, F. A. (2018). Nucleus-size pinning for determination of nucleation free-energy barriers and nucleus geometry. *The Journal of Chemical Physics*, 148(18), 184104.
- Sharma, A. K., Thapar, V., & Escobedo, F. A. (2018). Solid-phase nucleation free-energy barriers in truncated cubes: interplay of localized orientational order and facet alignment. *Soft Matter*. 14, 1996-2005, Cover Article.
- Hadpe, S. R., Sharma, A. K., Mohite, V. V., & Rathore, A. S. (2017). ATF for cell culture harvest clarification: mechanistic modeling and comparison with TFF. *Journal of Chemical Technology and Biotechnology*, 92(4), 732-740. Cover Article,
- Sharma, A.K, Agarwal, H., Pathak, M., Nigam, K.D.P., Rathore, A.S. (2016) Continuous refolding of a biotech therapeutic in a novel coiled flow inverter reactor, *Chemical Engineering Science*, 140, 153-160.
- Rathore, A., Kateja, N., Agarwal, H., & Sharma, A. K. (2016). Continuous processing for the production of biopharmaceuticals. *Biopharm International*, 29(4), 14-19.
- Rathore, A.S., Agarwal, H., Sharma, A. K., Pathak, M., & Muthukumar, S. (2015). Continuous processing for production of biopharmaceuticals. *Prep. Biochem. & Biotechnology*, 45(8), 836-849.

Patent

- A coiled flow inverter reactor for continuous refolding of denatured recombinant proteins and other mixing operations, WO2016116947A1

Oral Presentations

- Nucleus-Size Pinning for Determination of Nucleation Free-Energy Barriers and Nucleus Geometry (476e), AIChE 2018
- Engineering Entropic Self-Assembly of Faceted Nanoparticles (74e), AIChE 2018
- Disorder Foreshadows Order in Colloidal Cubes (C58.00007), APS Meeting 2019
- Role of Interfacial Free Energy in Non-classical Nucleation of Polyhedral Nanoparticles (F07.00001), APS 2021
- Effect of Particle Anisotropy and Rotational Symmetry on the Kinetics of Disorder-to-Order Phase Transitions (525c), AIChE 2021
- Diffusionless rotator-crystal transitions in colloidal truncated cubes: lattice distortion and kinetic pathways (M25. 00003), APS 2022
- Shear thickening and jamming of bidisperse dense suspensions (Y25.00002), co-author, APS 2022
- Shear-Driven Ordering and Disordering of 2D Frictional Sphere Suspensions (242f), AIChE 2022
- Kinetics of Diffusionless Transitions of Colloidal Truncated Cubes (244b), AIChE 2022
- Shear-driven ordering and disordering of frictional sphere suspensions in 2D (S01.00008), APS 2023
- Understanding the Role of Water Molecules and Ion Transport Mechanisms in Anion Exchange Membranes (Z15.00006), co-author, APS 2023

Professional Memberships and Service

American Physical Society | 2019-present

- Advisory Board Member, APS Inclusion Diversity Equity Alliance (IDEA) | 2022-23
- Divisions: Computational Physics (DCOMP), Soft Matter (DSOFT)
- Forums: Diversity and Inclusion, Early Career Scientists, Outreach and Education

American Institute of Chemical Engineers | 2018-present

- Member, Computational Molecular Science and Engineering Forum
- Session Co-chair: Modeling and Simulation of Complex Molecules, AIChE 2022 and 2023

Technical Skills

Programming Languages & Utilities

- High Proficiency: MATLAB, Python
- Basic Proficiency: FORTRAN, BASH, COMSOL, LaTeX
- Utilities: UNIX, VMD, Ovito, Adobe Photoshop, Divi Builder, Pro Tools

Lab Skills

- Spectroscopy: UV-Vis, Fluorescence, Circular Dichroism
- Dynamic and Static Light Scattering, Biolayer Interferometry
- Ligand chemical immobilization, Liquid chromatography, Filtration (UF, DF, ATF)

Initiatives

- Inclusion Advocate, Diversity and Inclusion Program: 2019-2021
- Member, CBE Graduate Reunion Committee 2018, Cornell University

- Member, Chemical Engineering Graduate Students Association 2018-19
- Webmaster, CBE Women 2018-2020
- Producer, Science Blender Podcast 2018-2021
- Lab Demonstrator, CBE WOMEN Outreach Event 2019
- Organizing Committee, CBE Graduate Research Symposium 2019
- Student Journalist, Board for Student Publications, IIT Delhi, 2013-14

Awards & Honors

- 1st Prize, FOMMS Movie Competition 2022
- [Austin Hooey Graduate Research Excellence Award](#), 2020
- National Winner, [7th GE Edison Challenge 2014](#)
- Summer Undergraduate Research Award 2014, IIT Delhi
- 1st Prize, Undergraduate Projects, [Open House 2014](#), IIT Delhi
- Letter of Appreciation from Biocon Research, 2015
- IIT Delhi Merit Semester Scholar; 2013, 2015
- G.S. Bhasin Chemical Engineering Scholar, 2014