

Nikhil R. Agrawal - Curriculum Vitae

Ph.D. Candidate

Department of Chemical and Biomolecular Engineering
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EDUCATION

Ph.D. in Chemical Engineering

August 2018 - August 2024

University of California, Berkeley, USA

Advisor: Prof. Rui Wang

Thesis title: *Modified Gaussian Renormalized Fluctuation Theory for Electrolytes at Interfaces*

Thesis committee: David T. Limmer, Kranthi K. Mandadapu, and Clayton J. Radke

B.S. and M.S. (Dual Degree) in Chemical Engineering

July 2013 - July 2018

Indian Institute of Technology (IIT), Delhi, India

Master's thesis title: *Minkowski Tensors to Characterize Particle Packings in Packed Bed Reactors*

Master's thesis advisor: Prof. Shantanu Roy

Institute medal for highest GPA in the program

RESEARCH EXPERIENCE

Statistical physics of concentrated electrolytes at interfaces

Aug '18 - Present

Ph.D. Candidate | Mentor: Prof. Rui Wang

Pitzer Center for Theoretical Chemistry, UC Berkeley, California, USA

Deep Gaussian Processes for uncertainty quantification of machine-learned free energies Mar '24 - June '24

Research Intern | Mentor: Dr. Amit Samanta

Physics & Materials Science Division, Lawrence Livermore National Laboratory, California, USA

Hybrid Kinetic Monte-Carlo and MD simulations to study mitotic spindle formation

June '23 - Aug '23

Summer Predoctoral Researcher | Mentor: Dr. Adam R. Lamson and Prof. Michael J. Shelley

Center for Computational Biology, Flatiron Institute, New York, USA

Microscopic characterization of particle packings in packed bed reactors

Jan '17 - July '18

Master's Candidate | Mentor: Prof. Shantanu Roy

Department of Chemical Engineering, IIT Delhi, India

Sequential Particle Deposition to simulate overdamped granular systems

May '17 - July '17

Visiting Researcher | Mentor: Prof. Dr. Thorsten Pöschel

Institute of Multi-scale Simulations (MSS), University of Erlangen-Nuremberg, Germany

Image processing and pore network modeling for multiphase flows in porous media

May '16 - July '16

Summer Research Associate | Mentor: Dr. Paul Duru

Institut de Mecanique des Fluides de Toulouse (IMFT), Toulouse, France

Design and characterization of visible light photo-catalysts for CO₂ reduction

May '15 - April '16

Undergraduate Researcher | Mentor: Prof. Suddhasatwa Basu

Department of Chemical Engineering, IIT Delhi, India

JOURNAL PUBLICATIONS AND PREPRINTS

1. Electrostatic correlation augmented self-consistent field theory and its application to polyelectrolyte brushes
Chao Duan, **Nikhil R. Agrawal**, and Rui Wang, *under review*, [arXiv:2404.09103](https://arxiv.org/abs/2404.09103).

2. Nature of overcharging and charge inversion in electrical double layers
Nikhil R. Agrawal, Chao Duan, and Rui Wang, *The Journal of Physical Chemistry B*, 2024, 128, 1, 303–311
3. Ion correlation-driven like-charge attraction and reentrant condensation in multivalent salt solutions
Nikhil R. Agrawal, Ravtej Kaur, Carlo Carraro and Rui Wang, *The Journal of Chemical Physics* 159, 244905 (2023)
4. Non-monotonic salt concentration dependence of inverted electrokinetic flow
Nikhil R. Agrawal and Rui Wang, *AIChE Journal*, e18269, 2023.
5. Self-consistent description of vapor-liquid interface in ionic fluids
Nikhil R. Agrawal and Rui Wang, *Physical Review Letters* (2022), 129, 228001.
6. Electrostatic correlation induced ion condensation and charge inversion in multivalent electrolytes
Nikhil R. Agrawal and Rui Wang, *Journal of Chemical Theory and Computation* (2022), 18, 6271-6280
7. A first-order segregation phenomenon in fluid-immersed granular systems
 Prapanch Nair, LAT Cisneros, CRK Windows-Yule, **Nikhil R. Agrawal**, Shantanu Roy, and Thorsten Pöschel, *Powder Technology* 373 (2020): 357-361.
8. Isotropy of sphere packings in a cylindrical confinement
Nikhil R. Agrawal, Prapanch Nair, Thorsten Pöschel and Shantanu Roy, *Chemical Engineering Journal* 377 (2019): 119820.
In preparation:
9. Long-range opposite-charge repulsion in multivalent salt solutions
Nikhil R. Agrawal, Carlo Carraro and Rui Wang.
10. Sturm–Liouville theory inspired approach to solving Gaussian ion-ion correlation functions
Nikhil R. Agrawal, Carlo Carraro and Rui Wang.

COURSEWORK AND CERTIFICATIONS

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|---|---|
| • Bayesian Data Analysis and Machine Learning for Physical Sciences | • Fundamentals of Deep Learning (NVIDIA) |
| • Machine Learning, Statistical Models, and Optimization for Biological and Chemical Problems | • Data Parallelism: How to Train Deep Learning Models on Multiple GPUs (NVIDIA) |
| • Statistical Mechanics & Transport Phenomena | • Model Parallelism: Building and Deploying Large Neural Networks (NVIDIA) |
| • Finite Element Methods | • Partial Differential Equations |
| • Numerical Methods in Chemical Engineering | • Fundamentals of Computational Fluid Dynamics |

SELECTED PRESENTATIONS

1. Beyond mean-field Poisson-Boltzmann: A self-consistent theory for electrical double layers
Energy Conversion Group, Lawrence Berkeley National Laboratory, Invited Presentation, Feb 2023
2. Modified Gaussian Renormalized Fluctuation theory: A self-consistent electrolyte solution theory
Pitzer Center for Theoretical Chemistry, Invited Presentation, Jan 2023

3. Self-consistent theory to describe charge inversion and like-charge attraction in multivalent electrolytes
2023 American Physical Society March Meeting, Oral Presentation
4. A self-consistent theory for complex electrostatic phenomena at interfaces
2022 American Chemical Society Colloid and Surface Science Symposium, Oral Presentation
5. Vapor-Liquid interface in ionic fluids
2022 American Physical Society March Meeting, Oral Presentation
6. Ion correlation induced non-monotonic height change and microphase separation of polyelectrolyte brushes
2024 American Physical Society March Meeting, Oral Presentation
7. Correlation Induced Electrostatic Wetting and Charge Inversion
2020 American Institute of Chemical Engineers Annual Meeting, Oral Presentation

AWARDS AND HONOURS

- Langmuir Graduate Student Oral Presentation Awards Finalist, American Chemical Society 2022
- *Institute Silver Medal* from IIT Delhi for highest GPA in the dual degree program in Chemical Engg. 2018
- IIT Delhi *Semester Merit Award* for 9 out of 10 semesters for being among *top 7%* meritorious students across the dual degree program, *consecutively for 8 semesters* 2013-2017
- *Significant Contribution to Research Activities Award* by Chemical Engineering Society, IIT Delhi 2017
- *Kishore Vaigyanik Protsahan Yojana (KVPY) Fellowship* by Department of Science and Technology, Govt. of India 2013
- Was among the *Nation's Top 1%* merit holders in National Standard Examination in Physics (NSEP) conducted by the Indian Association of Physics Teachers (IAPT) 2013

ACADEMIC ADVISING

- Julien Kehon, Undergraduate majoring in Chemical Engg. at UC Berkeley (Jan 2022 - May 2022)
- Ravtej Kaur, Undergraduate majoring in Chemical Engg. at UC Berkeley (Jan 2023 - August 2023)

SERVICE & OUTREACH

Secretary, SPIC MACAY, IIT Delhi

April '15 - April '16

SPIC MACAY: *Society for Promotion of Indian Classical Music And Culture Amongst Youth*

Led a team of 13 to organize marketing, publicity, and hospitality of club events like dance workshops and music concerts for eminent artists including Grammy Awardee Pt. Vishwa Mohan Bhatt.

SKILLS

Domain Knowledge	Computational Modeling, Thermodynamics, Transport Phenomena, Applied Machine Learning, Finite Difference, Finite Element, and Spectral Methods
Programming Skills	Python, C++, PyTorch, GPyTorch, TensorFlow, Scikit Learn, Bash
Technical software	ParaView, MATLAB, COMSOL, FLUENT, Autodesk Inventor
Languages	English and Hindi

HOBBIES AND INTERESTS

Sociology, Psychology, listening to classical music, and a keen interest in philosophical discussions