Ashveed A

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Education

2019–2024 **BS-MS Dual Degree in Physics (Minor - Mathematics)**.
Indian Institute of Science Education and Research (IISER), Thiruvananthapuram
CGPA: 7.62/10

2016–2018 **Higher Secondary Education**.
BJSM Madathil VHSS, Kerala, India
CGPA: 98.25/100

Research Interests

- Statistical Mechanics and Disordered Systems
- Mathematical Foundations of Machine Learning
- Information Theory and Statistical Inference
- Non-equilibrium Dynamics, Large Deviations, and Rare Events
- Optimization and Combinatorics

Experience

April 2025 – Present **Visiting Student Researcher**, *Raman Research Institute, Bangalore, India.*

Supervisor Dr. Rituparno Mandal

Title *Inferring Interaction Potential from Stochastic Trajectories*

- Developing Graph Neural Network (GNN)-based model to infer interaction potentials from stochastic trajectories of particles governed by overdamped Langevin dynamics.
- Formulating the inference task as an inverse problem, leveraging the structure of particle interactions and trajectory data within a machine learning framework

February 2025 – Present **Visiting Student Researcher**, *Raman Research Institute, Bangalore, India.*

Supervisor Dr. Rituparno Mandal

Title *Odd Elasticity and Crack Propagation in Soft Materials*

- Working on theoretical and computational models to explore the effects of odd elasticity on crack propagation in soft materials.
- Utilizing statistical physics and numerical simulations to study emergent behaviors in these non-equilibrium elastic systems.

Aug 2024 – Feb 2025 **Research Intern**, *GITAM University, India.*

Supervisor Dr. S.S. Ashwin

Title *Dynamical Large Deviation Generators: An efficient technique to sample exponentially rare trajectories*

- Exponentially rare fluctuations in dynamical systems and stochastic processes are shaped by large deviation theory, but sampling these rare event trajectories is computationally demanding.
- This neural network approach utilizes Normalizing Flows to efficiently generate statistically independent rare event trajectories.
- This generative method employs volume-preserving transformations dependent on positional, temporal, and conjugate parameters linked to low-probability dynamical quantities, offering a 'one-shot' solution for tackling these computationally intensive sampling tasks.

July 2023 – June 2024 **Master's Thesis**, *Indian Institute of Science Education and Research, Thiruvananthapuram.*

Supervisor Dr. Souvik Paul

Title *Atomistic Spin Dynamics Simulations of Skyrmions in Transition Metal Ultrathin Films*

- The project reveals the significant role played by the Dzyaloshinskii-Moriya Interaction(DMI), Heisenberg exchange interactions, and anisotropic interactions in stabilizing skyrmions on transition-metal interfaces.
- The ultra-thin film system considered was the fcc-Rd/Co bi-layer on Re(0001).
- The size (radius) of single skyrmion was precisely calculated. The variation of the radius and stability of skyrmions with several parameters has been studied.

March 2023 – June 2023 **Summer Intern**, *Indian Institute of Science Education and Research, Thiruvananthapuram.*

Supervisor Dr. Souvik Paul

Title *Investigating Topological Spin Structures in Thin Films*

- Numerical simulation of the Landau–Lifshitz–Gilbert(LLG) was done and spin dynamics was studied to understand interactions like Heisenberg Exchange interaction, Dzyaloshinskii-Moriya (DMI), Zeeman, and magnetic anisotropy.
- Started learning Quantum ESPRESSO for DFT calculations and POV-Ray for visualizing spin structures.

Skills

Programming	Python (NumPy, Matplotlib, Pandas, SciPy), Pytorch, Linux, Bash, Fortran, LaTeX
Machine Learning	Generative AI, Normalizing Flows, Bayesian Neural Networks, Graph Neural Networks
HPC	Experience with Padmanabha Cluster (IISER TVM) and HPC Cluster (GITAM) for multi-scale and parallel simulations
Simulations	Monte Carlo Techniques-Markov Chain Monte Carlo & Diffusion Monte Carlo and Molecular Dynamics (MD) Simulations
Softwares	Quantum ESPRESSO & Wein2K for DFT Calculations, POV-Ray for visualization
Advanced Characterization	Experience in Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM) for analyzing thin-film materials (2 years in advanced MS lab).
Physics & Mathematics	Strong foundation in Statistical Physics, Large Deviations, Condensed Matter Physics

Teaching Assistantship

- Quantum Mechanics for Computer Science B-Tech (2nd year)
- Mathematical Physics for Physics MS (1st year)

Achievements

- Cleared GATE Physics (For PhD in India) (93.06 percentile, 2024).
- Qualified JEE-Advanced (For Undergrad)(Top 0.1% in India, 2019).
- Scored 98.25% in 12th grade (Top 1% in state(Kerala, India)).

Conferences and Workshops

Nov 2024 Presented 'Dynamical Large Deviation Generators' at the discussion meeting on *"Glasses and related disordered systems"* at JNCASR, Bangalore - organized by Dr. Srikanth Sastry

Oct 2024 Lecture series on 'Reinforcement Learning' at International Center for Theoretical Science (ICTS), Bangalore - by Dr. Hugo Touchette

June 2024 SERB Workshop on AI in Energy Materials (NITK) - Among 25 candidates selected.

Feb 2024 International conference on Latest Advances in Applied and Computational Mathematics (LACAM-24), at IISER Thiruvananthapuram

2024 Frontier Symposium in Physics, Thiruvananthapuram

2024 Frontier Symposium in Mathematics, Thiruvananthapuram

2023 Quantum Computing Workshop by Qkrishi held at IISER Thiruvananthapuram

Publications

- *Dynamical Large Deviation Generators: An efficient technique to sample exponentially rare trajectories* (manuscript under preparation).

References

- **Dr. S.S. Ashwin**
  Associate Professor
  School of Physics, GITAM University
  asampang4@gitam.edu

- **Dr. Rituparno Mandal**
  Associate Professor
  Soft Condensed Matter, Raman Research Institute
  rituparno@rri.res.in

- **Dr. Geetha Thangavelu**
  Associate Professor
  School of Mathematics, IISER Thiruvananthapuram
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