

Md Aquib Molla

Curriculum Vitae

Makalhati T.M.Lane, P.O. Bidhangarh
, P.S. Rabindranagar, Kolkata-700066, India

+91 8479827706

✉ mollaaquib@gmail.com; aquib.cu.phys@gmail.com

📞 0000-0003-0416-1349

🌐 AquibMolla

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Objective

I am a researcher in theoretical physics, specializing in statistical physics and emergent dynamics in complex systems. My current work focuses on adaptive foraging in stochastic environments, investigating how inertia, memory, and local resource conditions shape survival and movement patterns. Using tools from statistical mechanics and nonlinear dynamics, I study strategy switching, phase transitions, and efficiency trade-offs in forager behavior. My broader research includes modeling electrical signal propagation in heart-like systems via percolation theory, and exploring transport phenomena through quantum random walks, linking analytical models to real-world complex systems.

Education

2018–2020 **M.Sc. in Physics**, University of Calcutta, CGPA: 7.150

2015–2018 **B.Sc. in Physics**, University of Calcutta, 66.75%

2015 **Higher Secondary**, WBCHSE, 79.00%

2013 **Secondary**, WBBSE, 61.86%

Academic Supervisor

Supervisor **Dr. Sanchari Goswami**, Department of Physics, Vidyasagar College under the University of Calcutta

Email sg.phys.caluniv@gmail.com

Research Interests

My research focuses on the intersection of statistical mechanics, quantum theory, and complex systems, with an emphasis on both theoretical modeling and real-world applications. I am particularly interested in how **collective behavior, symmetry, and geometry** give rise to emergent dynamics in a variety of physical contexts.

- **Statistical Physics and Complex Systems:** I explore stochastic processes such as random walks, directed percolation, and phase transitions in interacting particle systems, with applications ranging from biological transport and foraging behavior to socio-economic dynamics. My approach combines analytical methods with numerical simulations to understand universality and critical behavior.
- **Quantum Mechanics and Information Theory:** I study quantum walkers, decoherence, and their implications for quantum computation and information processing. My interest also extends to how quantum entanglement, topological effects, and generalized symmetries play a role in organizing quantum systems, bridging ideas from quantum foundations to condensed matter physics.
- **Forager Dynamics in Lattice Models:** I develop theoretical frameworks to model partial resource consumption, inertial effects, and survival strategies in spatially distributed environments. These models reveal how local interactions and resource limitations lead to rich spatio-temporal patterns, often exhibiting

transitions reminiscent of critical phenomena.
This broader framework naturally connects with current developments in topological phases of matter, symmetry-protected phenomena, areas I am keen to explore more deeply.

Seminars, Conferences, and Workshops

Organized

- 2024 **Infinitesimal to Infinite**, *Co-Organizer, Department of Physics, Vidyasagar College, IQAC and CITP, Kolkata*
- 2024 **Celebrando La Fisica**, *Member, Department of Physics, Vidyasagar College, IQAC, and University of Calcutta, Kolkata*

Attended

- 2025 **Decisions, Games and Evolution**, *ICTS TIFR, Bengaluru*
- 2024 **Infinitesimal to Infinite**, *Department of Physics, Vidyasagar College, IQAC and CITP, Kolkata*
- 2024 **Celebrando La Fisica**, *Department of Physics, Vidyasagar College, IQAC and Department of Physics, University of Calcutta, Kolkata*
- 2024 **Discrete Integrable Systems: Difference Equations, Cluster Algebras, and Probabilistic Models**, *ICTS TIFR, Bengaluru*
- 2024 **Data Dynamics Summit**, *IISER Pune, Pune*
- 2023 **Molecular Simulation Design Framework (MoSDeF): Capabilities and Applications**, *UK (online)*
- 2023 **One Day Student Seminar**, *Dept. of Physics, Behala College*
- 2023 **Bangalore School on Statistical Physics – XIV**, *ICTS Bengaluru, Bengaluru*
- 2023 **Decode & Design: Discussing Different Areas of Physics and Computer Science & Related Career Opportunities**, *Vidyasagar College, Kolkata*
- 2023 **Steady State Phenomena in Soft Matter, Active and Biological Systems**, *S. N. Bose National Centre for Basic Sciences, Kolkata*
- 2022 **First-Passage Percolation and Related Models**, *ICTS Bengaluru, Bengaluru*
- 2022 **StatPhys Kolkata XI**, *Kolkata (online)*
- 2022 **Statistical Physics: Recent Advances and Future Directions**, *ICTS Bengaluru (online)*

Talks and Posters

Talks

- 2025 **Cardiac Dynamics through Percolation and Nonequilibrium Physics**, *Leuven school: Basics of nonequilibrium statistical mechanics, KU Leuven, Belgium*
- 2024 **Heartbeats and Flow: Exploring Percolation Theory in Cardiac Cells**, *Discrete Integrable Systems: Difference Equations, ICTS TIFR, Bengaluru*
- 2023 **Study of Heart and Brain-like Cells in the Light of Percolation Theory**, *One Day Student Seminar, Behala College, Kolkata*
- 2022 **Directed LPP in Traffic Model (Joint talk)**, *First-Passage Percolation and Related Models, ICTS Bengaluru, Bengaluru*

Poster

- 2025 **Strategic Foraging: Role of Inertia in Survival**, *Decisions, Games and Evolution, ICTS TIFR, Bengaluru*

- 2024 **Forager Survival: How Threshold and Starving Time Affect Their Lifespan**, *Celebrando La Fisica*, Department of Physics, Vidyasagar College, Kolkata
- 2024 **Study of Heart and Brain-like Systems with Percolation Theory**, *Data Dynamics Summit*, IISER Pune, Pune
- 2022 **Quantum Walk and a Hopping Detector**, *StatPhys Kolkata XI*, Kolkata (online)

Publications

- 2023 **M. A. Molla, S. Goswami**, *Quantum Walker in Presence of a Moving Detector*, *Physica A: Statistical Mechanics and its Applications*, 620, 128775
- 2024 **M. A. Molla, S. Goswami**, *An Insight into Heart-like Systems with Percolation*, *Physics Letters A*, 518, 129695
- 2024 **M. A. Molla, S. Goswami, P. Sen**, *Forager with Inertia: Better for Survival?*, In preparation for submission
- 2024 **M. A. Molla, S. Goswami**, *Modeling Forager Behavior: Partial Consumption and Energy Depletion*, Work in Progress
- 2025 **M. A. Molla**, *Does Selfishness Help?*, Work in Progress

Honors and Awards

- 2019 **Junior Research Fellow (JRF)**, *National Eligibility Test (NET)*
- 2020 **Graduate Aptitude Test in Engineering (GATE)**, *Qualified*
- 2022 **Excellent Academic Performance**, *Award from Metiabruz Garments Manufacturers Association*, Kolkata

Skills

- **Programming Languages:** C, C++, Fortran, Python, Julia, HTML, CSS.
- **Tools:** MATLAB, LaTeX, Mathematica