

# Ankit Kumar Jha

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Graduate Student in Computer Science  
Masters in Physics | Minor in Mathematics and Computing

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## EDUCATION

Graduate Student, Computer Science, University of Massachusetts Amherst, GPA: 4.00/4.00	Sep'24 - Aug'25
Integrated Bachelor and Master of Science, Physics, Indian Institute of Technology, Kharagpur, CGPA: 9.42/10.00	Jun'19 - Apr'24
Intermediate (ISC), Srikrishna Public School, Percentage : 97.75%	Apr'17 - Apr'19
Matriculation (ICSE), Srikrishna Public School, Percentage : 96.60%	Apr'03 - Apr'17

## PUBLICATIONS


-  Bhattacharya, J., Das, D., Das, S. K., **Jha, A. K.**, Kundu, M., "Numerical bootstrap in quantum mechanics", *Physics Letters B*, 2021
-  **Jha, A. K.**, Nechita, I., "On Random Classical Marginal Problems with Applications to Quantum Information Theory", *Journal of Physics A: Mathematical and Theoretical*, 2025
-  **Jha, A. K.**, Dutta, P., Shukla, V., "Prethermalization in Continuously Driven Classical Spin Systems", *manuscript in preparation*

## RESEARCH PROJECTS



- Post Selection in Concatenated Bosonic Error Correcting Codes** Sept'24 — Present  
supervised by Dr. Filip Rozpedek, University of Massachusetts Amherst  Amherst, USA
- Developed an efficient GPU based Monte Carlo simulator from scratch to simulate performance of concatenated codes using CUDA.
  - Integrated post-selection in concatenated bosonic and discrete error correcting codes to obtain higher entanglement rates.
  - Demonstrated improved entanglement rate in resource-efficient quantum repeater architectures for long-distance networks.
  - Working on incorporating measurement-based quantum computing (MBQC) inspired decoding in concatenated architecture.
- Entanglement Generation in Pair of Qubits coupled to Environmental Spin Chains,** Dec'21 — Jan'22  
supervised by Dr. Shashi Srivastava, Variable Energy Cyclotron Centre  Kolkata, India
- Studied the dynamics of Fermionic Systems under Quadratic Hamiltonians and its diagonalization using Bogoliubov transformation.
  - Learnt mapping of Spin- $\frac{1}{2}$  Pauli operators onto creation/annihilation operators of fermionic systems using Jordan-Wigner method.
  - Simulated the generation of Wootters' concurrence in qubits coupled to an environmental Transverse Field Ising Chain systems.
  - Explored the effects of quenching on the system using the covariance matrix to analyze the evolution of Loschmidt echos.
- Bootstrapping Quantum Mechanical Systems,** Apr'21 — Oct'21  
supervised by Dr. Jyotirmoy Bhattacharya, High-Energy Physics Group  Kharagpur, India
- Examined the convergence of spectra of various potentials using the Bootstrap approach to demonstrate exponential convergence.
  - Illustrated method's efficacy in capturing instanton splitting in double-wells and energy correlations in supersymmetric systems.
  - Integrated multiprocessing in python with Numba's jit compiler to obtain speed-up of >100x in obtaining spectra of complex systems.
  - Studied bootstrap's feasibility by converting brute-force search into a semidefinite programme for a Linear Matrix Inequality (LMI).

## MASTER'S THESIS

[LINK]

- Dynamics of Classical and Quantum Spin Chains** Aug'23 — Apr'24  
supervised by Dr. Vishwanath Shukla, StatFluid Lab  Kharagpur, India
- Simulated spin diffusion in classical Heisenberg spin chains to show super and sub-diffusive behaviour in different coupling regimes.
  - Demonstrated prethermalization and emergence of novel phases in periodically driven spin-systems using Floquet Engineering.
  - Deployed multiprocessing using Message Passing Interface (MPI) in C++ to simulate 10K+ ensembles upto large time periods.
  - Incorporated GPU programming using CUDA to develop highly efficient device kernels to simulate dynamics of spin chains in C++.

## RESEARCH INTERSHIPS

- Random Classical Marginal Problems and Quantum Information Theory,** Charnpak Summer Scholar May'23 — Nov'23  
supervised by Dr. Ion Nechita, Laboratoire de Physique Théorique  Toulouse, France
- Investigated the extent of nonlocality of Quantum and Supra-Quantum Correlations in Bell Games and Quantum Networks.
  - Learnt the geometry of classical/quantum probabilities using Correlation and Cut polytopes and other non-convex objects.
  - Quantified volume ratios of the local and no-signalling correlation slices associated with fixed marginals for various graphs.
  - Derived facet structure of local polytope for graphs with small tree-widths studying changes on removing edges or gluing graphs.
- Bell Non-Locality in the context of No-Signalling Behaviours and Negative Probabilities,** DAAD-WISE Intern May'22 — Aug'22  
supervised by Prof Dr. Otfried Gühne, Theoretical Quantum Optics Group  Siegen, Germany
- Studied Bell Inequalities and nonlocality witnesses like CHSH and GHZ tests in Classical, Quantum and Post-Quantum regimes.
  - Analyzed the hidden-variable realizations (joint probabilities) for non-classical correlations by allowing negative probabilities.
  - Evaluated the negativity of these joint probability mappings on perturbations to standard models using semidefinite programming.
  - Examined symmetries in correlations to impose constraints on joint probabilities to separate quantum and post-quantum regions.

## AWARDS AND ACHIEVEMENTS

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- 🏆 Awarded a \$5,000 Non-working Fellowship by Manning College of Information and Computer Sciences for graduate studies.
- 🏆 Conferred the 70th Convocation Endowment Prize 2024 at IIT Kharagpur for the best Master's thesis in the Physics Department.
- 🏆 Part of the Gold Winning Team representing IIT Kharagpur at the Inter-IIT Tech Meet for the event Mphasis - Quantum Optimization.
- 🏆 One of the 31 students in India awarded France Excellence Charpak Lab Scholarship-2023 by Ambassade de France en Inde.
- 🏆 One of the 15 students to receive the IIT KGP Foundation Grant-2023 to undertake summer research in a foreign university.
- 🏆 One of the 150 students in India selected for the DAAD-WISE Scholarship-2022 by Deutscher Akademischer Austauschdienst.
- 🏆 Awarded the Innovation in Science Pursuit for Inspired Research (INSPIRE) scholarship (2019-2024) by DST, Government of India.
- 🏆 One of the top-10% students in IIT Kharagpur offered Department Change due to exceptional performance in 1st year.
- 🏆 Ranked Top-2% (in 1.2million students) in JEE Mains-2019 and Top-5% (in 0.2million students) in JEE Advanced-2019.

## TEACHING AND COURSE DEVELOPMENT EXPERIENCE

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**Game Playing AI Platform for CS 683** May'25 — Aug'25  
For the course Artificial Intelligence

- Built a modular framework supporting multiple games (Chess, Checkers, etc.) with extensible AI agent design and integrated GUI.
- Implemented minimax, alpha-beta pruning and MCTS, and enabled Human vs AI and AI vs AI battles for students to test their agents.

**Course Development for Undergraduate Research Volunteer Programme** May'25 — Aug'25  
Course Material for prerequisite course to Undergraduate Research Volunteer Programme at UMass Amherst

- Designed lecture slides on effective research practices, how to read research papers, and quantitative and qualitative methods.
- Recorded the material into lecture videos tailored for undergraduate students preparing to participate in the URV programme.

**Teaching Assistant for CICS 119** Sept'24 — Dec'24  
For the course Introduction of Programming in Python

- Conducted weekly office hours to assist students debug programming assignments, and clarify doubts on projects and quizzes.
- Designed quiz questions, pre-evaluated coding projects before release, graded assignments, and led an interactive activity class.

**Rebuilding the Password Game in Python** Oct'24 — Nov'24  
Reusable Learning Object created as a part of CICS 879 : Teaching Assistants as Tomorrow's Faculty for CICS 119

- Designed a hands-on guided activity for students to learn key coding concepts and practices by recreating the password game.
- Integrated response tracking to monitor student progress and reinforce debugging and test-driven development skills.

## COURSE PROJECTS

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**Effect of Customer Interactions in M/G/1 Queues** Nov'24 — Dec'24  
course project for Performance Evaluation

- Simulated customer behaviour for local and global interactions under different service time distributions in multi-class M/G/1 queue.
- Demonstrated the dependence of final type of service customer on arrival/departure rates, system flushing rate and group arrivals.

**Determination of Critical Exponents for 2D Ising Model** Oct'23 — Nov'23  
course project for Statistical Physics - II

- Deployed the Metropolis algorithm to obtain equilibrium states of the nearest neighbour 2D Ising model at different temperatures.
- Calculated the magnetization, susceptibility and specific heat near critical temperature to obtain critical exponents using numerics.

**Chaotic Dynamics of orbits around Pseudo Newtonian Schwarzschild compact objects** Mar'23 — Apr'23  
course project for Order and Chaos

- Simulated dynamics of an off-equatorial test particle around Black Hole with an accretion disk using a pseudo-Newtonian potential.
- Visualized system behavior in relativistic and non-relativistic limits via Poincaré Maps, identifying chaos through disorderly patterns.

**Comparative study of Algorithms for Matrix equation solving on Supercomputer** Mar'21 — Apr'21  
course project for High-Performance Scientific Computing

- Utilized the Finite Difference Method to formulate Laplace equations as a matrix equation. Studied and implemented various algorithms, including Jacobi, Gauss-Seidel, Gradient Descent, CGS, BCG, and BICGSTAB, for solving matrix equations.
- Achieved super-linear speedup due to effective cache size expansion by parallelizing the algorithms with OpenMP and MPI, running them on large matrices ( $[10000 \times 10000] \approx 1\text{GB}$ ) on a local HPC Cluster (Paramshakti) for performance comparison.

## TERM PAPERS

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- 📖 **Short and Long time prediction of stocks using Monte Carlo Methods**, for Stochastic Processes [\[link\]](#)
  - 📖 **Feynman's Path Integral Formulation of Quantum Mechanics**, for Classical Mechanics - II [\[link\]](#)
  - 📖 **Scattering in Quantum Chromodynamics**, for REYES-2021 [\[link\]](#)
  - 📖 **Bouncing Droplets in Vibrating Reservoirs**, for Fluid Mechanics and Elasticity [\[link\]](#)
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## SUMMER SCHOOLS AND WORKSHOPS

- Quantum Networking Workshop: Modeling, Applications, Design**, UMass Amherst, USA Jun'25
  - Gave a joint talk on All-photon Quantum Networks with GKP qubits
- Center of Quantum Networks Annual All Member Retreat**, UoA Tucson, USA Mar'25
  - Presented Poster on Post-Selection in Concatenated Bosonic and Discrete Variable Codes [link]
- Remote Experience for Young Engineers and Scientists (REYES)**, ODU, USA (remote) [link] Jul'21 - Aug'21
- Introductory Summer School in Astronomy and Astrophysics (ISSAA)**, IUCAA Pune (remote) [link] May'21 - Jun'21

## SKILLS

<b>Programming</b>	C/C++   Python   Java   Bash   MATLAB   Mathematica   HTML   CSS
<b>Libraries</b>	OpenMP   MPI   YALMIP   CUDA   gurobi   mosek   numpy   sympy   scipy   pandas   matplotlib   cdd   tensorflow (quantum)   cirq   keras   astropy   scikit-learn   PICOS   Numba   concurrent   networkx   polytope   qiskit
<b>Softwares</b>	Miktex   Texmaker   Overleaf   VS Code   slurm   WinSCP   Vim   Windows   Ubuntu   sed   Jupyter

## COURSEWORK INFORMATION

<b>Physics</b>	Atomic, Molecular, and Quantum Information Theory   Statistical Physics-I, II   Quantum Many-Body Theory   Advanced Concepts in Field Theory and Gravitation   General Theory of Relativity   Physical Cosmology   Introduction to Quantum Field Theory-I   Nuclear and Particle Physics*-I, II   Quantum Mechanics-I, II   String Theory   Order and Chaos   Atomic and Molecular Physics   Random Matrix Theory   Electrodynamics-I, II   Electromagnetism and Optics Lab-I, II, III   Fluid Mechanics and Elasticity   Thermal Physics   Condensed Matter Physics*-I, II   Computational Physics*   Optics   Physics-I : Vibrations and Waves*   Classical Mechanics-I, II   Thermal Physics Lab   Physics-II : Quantum Physics and Spectrometry   Experimental Methods   Basic Electronics and Electronics for Physicists*
<b>Mathematics</b>	Mathematics-I, II (Multivariable Calculus, Analysis, ODE, Vector Calculus)   Transform Calculus   Linear Algebra   Probability and Statistics   Real Analysis   Mathematical Methods-I (Complex Analysis, Orthogonal Polynomials, Tensors), II(PDE, Group Theory)   Numerical Techniques Lab   Stochastic Processes   Group Theory and its Application
<b>Computer Science</b>	Programming and Data Structures*   Advanced Algorithms   Performance Evaluation   Quantum Information Theory   Design and Analysis of Algorithms*   High-Performance Scientific Computing   Essentials of Scientific Computing   Accelerated Data Sciences   Data-driven Astronomy(MOOC)
<b>Others</b>	Electrical Technology*   Chemistry* (Organic and Inorganic)   Introduction to Manufacturing Processes*   Mechanics   Engineering Drawing and Computer Graphics   Science of Living System   Economics   Science and Humanism   Cryogenics and Superconductivity for Particle Accelerator   Teaching Assistants as Tomorrow's Faculty

courses with \* had both theory and laboratory components

## POSITION OF RESPONSIBILITIES

- Master of Ceremony**, Rozpedek and Vardoyan Research Group Jan'25 — May'25
  - Managed research meetings, handling room bookings, coordinating with speakers, and ensuring participation for remote attendees.
  - Oversaw technical and administrative tasks, including setting up presentation equipment and managing meeting logistics.
- Research Assistant**, Manning College of Information and Computer Sciences Jan'25 — May'25
  - Investigating novel decoding strategies for the concatenation of bosonic and discrete-variable quantum codes in quantum networks.
  - Developing fast Monte Carlo solvers using High-Performance techniques to study error rates in various quantum network settings.
- Founding Member**, Kharagpur Quantum Information and Computing Club Jan'24 — Jun'24
  - Led the establishment of theory, web, and design teams, overseeing development of organized structure for research and outreach.
  - Managed public engagement, designing and publicizing the onboarding process, creating entrance tests and organizing interviews, hosting talks and seminars by researchers in the field, and formulating an action plan for the club's long-term growth.
- Advisor**, Phy Society - Department of Physics May'21 — Jul'23
  - Organized various events, introducing 2 new events, Assimilation Programme for freshers and Project Dissemination seminars.
  - Delivered speeches during events to encourage scientific scrutiny and foster a sense of brotherhood in the student community.
- Student Mentor**, Student Welfare Group - IIT Kharagpur Oct'21 — Jul'22
  - Provided guidance to 5 first-year undergraduate students of the Department of Physics to adapt and navigate their college life.
  - Delivered DePhy lecture sessions on Quantum Information Theory attended by 30+ first and second year undergraduate students.
- Associate Member**, Spring Fest - IIT Kharagpur Jul'19 — Aug'20
  - Published 10+ articles in newspapers in Jharkhand and undertook university visits to increase participation of the region by 12%.
  - Led a team of 23 campus ambassadors from 18 colleges across Jharkhand to increase awareness and promote cultural exchange.