

Mathew Alex

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[LinkedIn](#) | [Google Scholar](#)
[Website](#) | [GitHub](#)

EDUCATION

Brock University

M.Sc. Theoretical Physics (GPA: 86/100)

Relevant Coursework: General Relativity (90%), Partial Differential Equations (88%)

Thesis: [Nonlinear Wave Equation for an Elastic String: Derivation, Symmetries, and Conserved Quantities.](#)

St. Catharines, ON

2023 – 2025

Cochin University of Science and Technology

M.Sc. Physics (First Class)

Thesis: *Lattice Boltzmann Method.* Awarded Best Master's Thesis.

Kochi, India

2017 – 2019

Mahatma Gandhi University

B.Sc. Physics (A Grade)

Graduated top of class in Physics and Mathematics.

Kottayam, India

2014 – 2017

Note: [WES Verified](#) North American Equivalency confirms these as equivalent to a 4-year Bachelor's degree and a Master's degree.

RESEARCH & PROFESSIONAL EXPERIENCE

Graduate Researcher, Brock University

2023 – Present

- Computed the symmetries and conservation laws (computed by Noether's theorem to variational symmetries) admitted by the exact equations of motion governing elastic strings.
- Working on extending the work to model the motion of elastic membranes, the 2-dimensional analogue of strings.

Research Engineer, Relecura Technologies

2020 – 2022

- Authored a comprehensive review analyzing patenting trends in quantum technologies ([arXiv:2102.04552](#), 14+ citations) aimed at a general audience.
- Fine-tuned transformer-based architectures and trained machine learning models to classify patents and for Named Entity Recognition (NER) to extract domain-specific technical entities from patent claims.

TECHNICAL & COMPUTATIONAL PROJECTS

Differentiable Physics & Multi-Agent RL Soccer Environment [Github coming soon, [video demo](#)]

2026

- Engineered a batched, fully differentiable 2D multi-agent physics simulation from scratch in native PyTorch, eliminating external physics engine dependencies.
- Formulated vectorized dynamics, achieving numerically stable gradients across contact discontinuities to support Back-propagation Through Time (BPTT).

Independent Research: Statistical Mechanics & Tensor Networks [Github]

- Architected an arbitrary-topology graph tensor network contraction engine from first principles in Python/NumPy (zero external tensor libraries), implementing dynamic multigraph leg rerouting and tensor trace evaluation.
- Applied this engine to independent graduate research, calculating the 2D periodic Ising model partition function and analytically verifying thermodynamic observables against Onsager's solution.

Computational Physics Solvers

2018 – Present

- Programmed numerical PDE solvers for the Schrödinger equation (Finite Difference) and Navier-Stokes equations (Finite Difference, Fourier spectral, and Lattice Boltzmann methods).
- Built numerical schemes stemming from kinetic theory using discretized Boltzmann equations to model fluid behavior at low Reynolds numbers (e.g., the driven lid cavity problem).
- Executed cosmological N-body simulations to model large-scale structural evolution using Gadget-2 and custom Python scripts.

Airplane Design Project

2017

- Designed and built a functional RC airplane for under \$50 using RF-transmitted PWM signals to drive the BLDC motor controller; achieved aerodynamic stability through airframe design rather than onboard stabilization electronics ([photo](#)).

TEACHING EXPERIENCE

Teaching Assistant & Exam Invigilator, Brock University

2023 – Present

- Instruct undergraduate seminars for Introduction to University Science (SCIE 1P00), guiding cohorts through scientific methodology, data analysis, and interdisciplinary problem solving.

- Instructed foundational physics with laboratory sections ([PHYS 1P90](#), [1P91](#)); delivered weekly lab lectures, facilitated help desks, and managed grading administration.
- Developed Python scripts to generate personalized free-body diagrams from student lab data to provide targeted grading feedback.

Guest Teacher, Cochin University of Science and Technology

2019

- Delivered post-secondary curriculum to science students, focusing on numerical methods, differential equations, and scientific data visualization.

PUBLICATIONS

- [1] M. Alex, “[Quantum Technologies: A Review of the Patent Landscape](#)”, [arXiv:2102.04552](#) (2021). 14 citations including *Nature Scientific Reports* and IEEE.
- [2] *In Preparation*: Nonlinear Wave Equations for Elastic Strings and Membranes: Derivations, Symmetries, and Conserved Quantities.

AWARDS & HONORS

- **CSIR Junior Research Fellowship (NET JRF)** — Awarded national doctoral fellowship in Physical Sciences; ranked **89th nationwide out of 30,000+ candidates (top 0.3%)**. Grants 5 years of independent government funding for Ph.D. research (India’s equivalent to the US NSF GRFP / Canada NSERC CGS-D) (2020).
- **Doctoral Admission Offer — Indian Institute of Science (IISc)**. Offered admission to the Ph.D. in Physics program at India’s #1 ranked research university, following national screening exam percentiles and a departmental faculty technical interview (2022).
- **INAT (IUCAA-NCRA Admission Test) Top 50** — Qualified among the top 50 students nationwide for the astrophysics PhD program at India’s top astrophysics institute (2019).
- **Best Master’s Thesis Award** — Cochin University of Science and Technology (2019).
- **Physics Teachers Association Award** — Received for academic excellence during undergraduate studies (2017).

SKILLS

Programming & Tools: Python, C++, CUDA (in PyTorch), MATLAB, Mathematica, Maple, Git, Linux, LaTeX, Assembly (8085)

Data Science & ML: Statistical Modeling, NLP, Semantic Search, Transformers, Reinforcement Learning, PyTorch, NumPy, SciPy, pandas, scikit-learn

Mathematical & Physical Modeling: PDEs, Monte Carlo, N-body Simulations, Tensor Networks, Renormalization Group (RG), Lattice Boltzmann Methods (LBM)

Languages: Fluent English (TOEFL iBT: 111/120, IELTS: 8.0/9.0)