

# Arnav Menon

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## EDUCATION

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**Georgia Institute of Technology**, Atlanta, GA May 2022 - May 2025  
Bachelor of Science in Physics (Astrophysics Concentration), Minor in Mathematics Cumulative GPA: 3.9/4.0  
**Organizations:** Society of Physics Students, Astronomy Club, Quantum Computing Association

## RESEARCH INTERESTS

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Machine learning applications in radiation therapy, Radiation therapy dose optimization, Radiation transport simulation, Radiation effects on biological systems, Monte Carlo simulation for treatment planning, Computer vision applications in radiotherapy, Medical image segmentation, AI-driven treatment verification systems

## RESEARCH EXPERIENCE

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**Emory Proton Therapy Center** Atlanta, GA  
*Research Assistant* — Advisor: Dr. Liyong Lin July 2025 - Present

- Particle Track Image Classification: Implemented transfer learning techniques to train and fine-tune a biomedical segmentation AI model for particle track classification images collected from experimental data, achieving a 97% accuracy and demonstrating the effectiveness of computer vision applications in proton radiation therapy.
- Monte-Carlo Radiation Transport Simulations: Developed a high-performance Monte-Carlo simulation of proton radiation beams with GPU multithreading, utilizing the box-sorting algorithm to enhance computational efficiency by a factor of 2,000x while accurately simulating particle interactions at the micrometer scale.

**Georgia Tech Soft Matter Physics Lab** Atlanta, GA  
*Undergraduate Research Assistant* — Advisor: Dr. Itamar Kolvin May 2024 - August 2024

- Logarithmic Nanoparticle Diffusion: Developed an empirical model for nanoparticle diffusion in bacterial flagella mediums by collecting data using fluorescence microscopy and implementing Python-based particle-tracking analysis, uncovering a logarithmic relationship governing diffusion in this particular soft matter system.
- Microtubule Depletion Measurement Technique: Designed and executed a lab protocol leveraging dextran-induced depletion forces for microtubule immobilization on acrylamide slides, standardizing filament lengths for nematic liquid crystal formation in non-equilibrium media supporting self-assembly of nanomachines.

**Georgia Tech Center for Relativistic Astrophysics** Atlanta, GA  
*Undergraduate Research Assistant* — Advisor: Dr. Nepomuk Otte August 2023 - May 2024

- Telescope Data Collection: Automated the extraction and analysis of signals from over 300,000 telescope events by developing Python and C++ scripts to process individual pixel traces, fitting results against Monte Carlo-simulated ideal profiles for accurate detection of ultra-high energy neutrino events.
- CNN-Based Particle Classification: Trained a convolutional neural network on simulated Cherenkov telescope images to distinguish genuine neutrino signatures from noise with a 95% accuracy, advancing data-driven validation of the Trinity Demonstrator's astrophysical performance.

**Johns Hopkins Applied Physics Laboratory** Laurel, MD  
*Machine Learning Intern* — Mentor: Dr. Vicki Toy-Edens June 2023 - August 2023

- Data Collection Pipeline Creation: Engineered an end-to-end data pipeline to process 20 years of NASA's ACE spacecraft data in a continuous particle flux format, automating the web scraping, cleaning, and structuring of over 1,500 events while characterizing and labeling time-series data for predictive model training.
- Interplanetary Shock Arrival Forecasting: Developed an interplanetary shock onset detection algorithm and trained deep learning forecasting models (LSTM, CNN) in TensorFlow to predict shock arrival, achieving a 30% accuracy improvement over previous benchmarks and predicting arrival dates 2-5 days in advance.

### Georgia Tech VIP Program - Quantum Chemistry

Atlanta, GA

Research Course — Professor: Dr. Andrew Medford

January 2023 - May 2024

- Molecular Simulations on Supercomputers: Leveraged SLURM-managed, parallelized Python workflows on Georgia Tech's supercomputing cluster to run Density Functional Theory (DFT) catalysis simulations of ammonia adsorption on a platinum crystal surface, achieving < 5% deviation from Q-Chem benchmarks.
- Graph Neural Network Surrogate Modeling: Designed, trained, and validated GNN architectures to emulate DFT simulation outputs, cutting computation time from 3-5 hours to about 2 seconds while maintaining < 1% error against full quantum calculations for rapid identification of novel catalyst candidates.

## PUBLICATIONS

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**In Preparation:** S. Mardhekar, D. Dacosta, **A. Menon**, S. Aguirre, X. Yang, L. Lin. Automated Particle Track Segmentation in Mixed-Particle Microdosimetry Using nnU-Net. *SPIE Medical Imaging*.

**Published:** M. Bagheri, A. Barletta, J. Bogdan, A.M. Brown, L. Cedeno, M. Fedkevych, S. Gadamsetty, E. Gazda, J. Holder, E. Judd, D. Kieda, E. Kuznetsov, N. Lew, O. Romero Matamala, **A. Menon**, A.N. Otte, M. Potts, W. Springer, S. Stepanoff, A. Wilcox, A. Zhang. (2025). Commissioning and performance of the Trinity Demonstrator. *Nuclear Instruments and Methods in Physics Research Section A*, 1080, 170769.

## CLINICAL EXPERIENCE

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### Grady Radiation Oncology Center

Atlanta, GA

Clinical Observer/Shadow — Medical Physicist: Krista Burton

- Observed stereotactic body radiation therapy (SBRT) treatments and daily clinical workflows in a busy radiation oncology department, gaining firsthand understanding of patient care and treatment delivery processes.
- Gained hands-on exposure to Varian linear accelerator systems, including daily quality assurance procedures and patient-specific QA protocols essential for safe radiation delivery.
- Observed medical physicists performing beam commissioning, treatment plan reviews, and comprehensive safety checks, developing appreciation for the critical role of physics in patient safety.

## TEACHING EXPERIENCE

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### Mathematics Tutor - Knack

Atlanta, GA

Linear Algebra and Multivariable Calculus

August 2023 - December 2024

- Provided individualized instruction to engineering students in fundamental mathematics courses, helping them gain an appreciation for mathematical problem-solving and thinking.
- Designed personalized lesson plans in collaboration with course professors to align with curriculum objectives, prepare students for term exams, and ease student workload and stress.
- Created interactive visual demonstrations using Desmos to illustrate multivariable calculus and linear algebra problems/concepts, fostering deeper conceptual understanding and enhanced mathematical intuition.

## TECHNICAL SKILLS

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**Programming & Scripting:** Python, C++, JavaScript, MATLAB, CUDA, Bash

**Software Development & Tools:** Git, CMake, GitHub Actions, Google Test, Doxygen, YAML/JSON, MLOps

**Machine Learning & Data Science:** PyTorch, TensorFlow, Scikit-Learn, Deep Learning, Computer Vision, Image Segmentation, Transfer Learning, Time Series Analysis, Signal Processing

**Computational Physics & Modeling:** Monte Carlo Simulation, Radiation Transport Modeling, GEANT4, TOPAS, gMicroMC, Density Functional Theory (DFT), Graph Neural Networks

**Data Engineering & High-Performance Computing:** Pandas, Numpy, HDF5, SQL, Parallelization, SLURM, AWS, Docker, Linux

## PROJECTS

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### Orbital Mechanics Simulation of Saturn's Rings

- Orbital Mechanics Simulation Library: Designed and implemented a high-performance, modular C++17 simulation library for orbital mechanics, featuring efficient numerical integrators and scalable data handling (CSV, HDF5) for reproducible, large-scale scientific computations; integrated automated testing, Docker-based deployment, and AWS support to enable portable, scalable, and collaborative simulation workflows.
- Software Development Best Practices: Established best practices in software engineering by implementing comprehensive automated testing (Google Test), rigorous CI/CD workflows (CMake, GitHub Actions), detailed developer and API documentation (Doxygen), and reproducible configuration management (YAML/JSON), ensuring robust, production-quality code with consistent results and easy onboarding for contributors.

### Azalea - AI Fitness Assistant for Seniors

- Integrated AI Application Development: Engineered and launched an AI-powered senior fitness/health platform using React and Node.js from concept to deployment, implementing a personalized recommendation engine that boosted user satisfaction by 50% compared to other fitness apps, all accessible through an NLP-driven SMS interface and managed with robust MLOps practices for versioning and monitoring.
- Enhanced AI Reliability and Trust: Minimized AI hallucinations by 26% and increased user trust by architecting a Retrieval-Augmented Generation (RAG) pipeline that grounds the conversational assistant in a curated vector database of 100+ documents from authoritative sources like the National Institute on Aging and Mayo Clinic.