ARASH DEV AHLAWAT

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EDUCATION

Degree	University/Board	Institute/School	Year	CPI / %
B. Tech in **Engineering Physics**	IIT Bombay	IIT Bombay	2027	7.86
Intermediate	CBSE	Delhi Public School, Karnal	2023	93.80%
Matriculation	CBSE	St. Theresa's Convent School, Karnal	2021	96.80%

Pursuing a Minor in **Artificial Intelligence and Data Science** at the Centre for Machine Intelligence and Data Science with **CPI: 10.00**

SCHOLASTIC ACHIEVEMENTS

- Secured **99.90** percentile in the Joint Entrance Examination (JEE) - Main among **1.1 million+** candidates [2023]
- Attained AIR **1655** in the Joint Entrance Examination (JEE) - Advanced among **0.18 million+** candidates [2023]
- Secured an AIR of **426** in the **Kishor Vaigyanik Protsahan Yojana (KVPY)** Scholarship, out of **50k+** students [2022]
- Achieved an AIR of **111** in the esteemed **IISER** Aptitude Test **(IAT)**, among over **34k+** candidates nationwide [2023]
- Received a **Certificate of Merit** in the prestigious Indian Olympian Qualifier in Mathematics **(IOQM)** [2022-23]
- Awarded Certificate of Merit for ranking **top 1%** statewide in the National Standard Examination in Physics **(NSEP)** [2022]

RESEARCH EXPERIENCE

Self-Organizing in Genome & Polymer Dynamics [Aug 2025 - Nov 2025]

Course Project | PH303: Supervised Learning Project | Guide: ***Prof. Mithun Mitra***

- Investigated scaling contradictions between **Hi-C structure** and **chromatin MSD dynamics** in live cells by studying **Kardar**'s polymer physics treatment of crumpled globules and **Mistelli**'s view of self-organizing genome architecture
- Analyzed **Rouse** versus **Reptation** models to interpret constrained polymer diffusion in dense nuclear environments
- Derived the center-of-mass fluctuation (**COM**) correction ($D_{\mathrm{COM}} \propto 1/s$) and showed that the corrected segment dynamics follow a robust **crumpled globule** scaling exponent ($\alpha \approx 0.77$), successfully reconciling structure with stochastic motion
- Connected polymer-driven **genome organization** to emergent long-term stability of chromosome territories in nuclei

KEY PROJECTS

Binary Black Holes from Scratch [May 2024 - Jul 2024]

Krittika Summer Project | Krittika - The Astronomy Club, IIT Bombay

- Analyzed binary system interactions such as **Roche lobe overflow**, stellar mergers and **common envelope evolution**
- Simulated **100,000+** stellar structures and **Compact Binary Objects** (binary black holes/neutron stars) using Compact Object Mergers: Population Astrophysics and Statistics **(COMPAS)** a rapid stellar/binary population synthesis code
- Parallelized simulations by splitting runs through batch processing via **bash** scripting, reducing large-scale runtime by **90%**
- Illustrated stellar evolution and compact object formation using scatter plots, **HR diagrams**, and **chirp mass** distribution
- Investigated the evolution of **gravitational wave** emissions from binary systems, rigorously comparing simulated data to real observations, and iteratively adjusting parameters to achieve a **29%** match with observational data from **LIGO-Virgo**

MCMC Fitting of Isochrones to Determine the Age of a Primordial Cluster Pair [Sept 2025 - Nov 2025]

Course Project | PH556: Astrophysics | Guide: ***Prof. Varun Bhalerao***

- Used **MCMC-based isochrone fitting** on open clusters **ASCC 19** and **ASCC 21** to determine cluster age and metallicity
- Stacked and observed **20 exposures** (**30 s** each) of the star clusters across **g** and **i** bands, ensuring complete spatial coverage and adequate photometric depth within the Growth India Telescope's (GIT) **0.7°** × **0.7°** field of view
- Modeled **HR diagrams** and implemented both **least-squares** and **Markov Chain Monte Carlo (MCMC)** fitting routines to estimate cluster age and [Fe/H], performing convergence checks and benchmarking results against **Gaia DR3** parameters
- Compared derived parameters (**age ≈ 10 Myr**, **metallicity ≈ 0.75 $Z_\odot$**) to validate the **primordial cluster pair** hypothesis

Neuronal Dynamics [Sept 2025 - Oct 2025]

Course Project | PH567: Non-linear Dynamics | Guide: ***Prof. Punit Parmananda***

- Modeled neurons using a simplified **Hodgkin-Huxley** model, analyzing feedback-driven dynamics across **0-50 pA** input
- Created **30-60 s Manim** animations, to demonstrate **Saddle-node**, **SNIC**, supercritical and subcritical **Hopf bifurcations**
- Simulated threshold manifolds and frequency preference **(100-1000 Hz)** using **MATLAB**, illustrating temporal response curves and the distinction between **Class 1** and **Class 2** excitability, and visualizing **integrator-resonator** transitions
- Connected observed bifurcation dynamics to their implications in **neuromorphic computation** and spiking neural models

How to Train Your Dinosaur [Nov 2024 - Dec 2024]

Course Project | PH227: AI and Data Science | Guide: ***Prof. Alok Shukla***

- Developed a clone of the Chrome T-Rex game using **Pygame**,incorporating personalized hand-drawn sprite animations
- Collected gameplay data by logging 6 key features (e.g., time, object distance, object height) in **CSV** as training data
- Trained a **Convolutional Neural Network (CNN)** on the collected data and integrated it with a **Reinforcement Learning** system using Fitness function and **Genetic Algorithms**, evolving over **50** generations to achieve a peak score of **40,000+**
- Managed a collaborative **GitHub** repository for version control and seamless coordination across the development team

RAVEDM 4X4X4 [Programmable LED Cube with Dynamic Visualizations] [Apr 2025 - May 2025]
Course Project | *PH222: Digital Electronics and Microprocessors* | *Guide:* ***Prof. Pradeep Sarin***

- Designed and built a fully-functional 4x4x4 LED cube using **shift registers, Arduino MEGA**, and a layered circuit design
- Engineered visually dynamic and interactive 3D light animations using the **Arduino IDE**, including **firefly synchronization** through the **Kuramoto model**, and wave propagation effects based on distance-dependent mathematical functions
- Implemented efficient **state-machine logic** and **multiplexing** using Pulse Width Modulation (**PWM**) for smooth animation
- Achieved smooth 3D animations of up to **80 FPS** using **70** μ**s** per-LED PWM and real-time multiplexing across **64** LEDs
- Integrated **microphone input** to perform real-time audio visualization, with **beat detection** and amplitude control

Song Classification using Machine Learning [Oct 2024 - Nov 2024]
Course Project | *DS203: Programming in Data Science* | *Guide:* ***Prof. Vinay Kulkarni***

- Built a **CNN-RNN** based audio classifier using the **PyTorch** library to identify song patterns from their feature vectors
- Reconstructed Mel-frequency cepstral coefficient **MFCC** files into **.wav** audio for manual classification and validation
- Analyzed **116** MFCC samples using heatmaps, **PCA**, scatter plots, and elbow curves to study feature distribution
- Constructed a custom-labeled dataset of **180** external songs, achieving a model training accuracy of over **90%**
- Trained the model using **Adam optimizer** and **Cross-Entropy** loss functions and achieved testing accuracy of over **50%**

POSITIONS OF RESPONSIBILITY

Convener | *Krittika - The Astronomy Club* | *IIT Bombay* [Apr 2024 - Mar 2025]
Selected among **8** out of **150+** applicants to promote **Astronomy** among a strong community of over **12,000** students and staff

- Developed proficiency in processing astrophotographs using **Siril**, and **GIMP**, gained hands-on experience to use **Dobsonian** and **Equatorial** Telescopes and created a detailed inventory for the astronomical observatory under construction
- Planned and led a **2-day** astronomy trip to **Udaipur** and **Mount Abu**, visiting the **PRL** Solar and Infrared Observatories; also organized a stargazing camp to **Bhandardara**, successfully managing **50+** participants across both events
- Coordinated a **3-day** Astrophotography Exhibition on **National Space Day 2024**, promoting public engagement in astronomy; also conducted an **Introduction to Astrophotography Workshop** during **PG Tech Week**
- Ideated, planned and organized **Astromania** - The Annual Astronomy Quiz, which was attended by **150+** students
- Headed the design team, responsible for creating designs for **club merchandise** such as t-shirts and hoodies through software like **Illustrator** and **Figma**; created one of the most viewed posts on the official club page with **10k+** views

Observation Round Evaluator | *International Olympiad of Astronomy and Astrophysics (IOAA)* [Aug 2025]
Selected as a member of the **Academic Team** of **IOAA 2025**, conducted from August 10th-21st in Mumbai by **HBCSE**

- Invited as a member of a panel that assessed the observation skills of **300+ students** representing **63+ countries**
- Evaluated proficiency in **telescope operations**, **instrument handling** in the observation component of the Olympiad

Football Coordinator | *Aavhan - Sports Fest* | *IIT Bombay* [Feb 2023 - Mar 2023]

- Experienced organizing a large-scale tournament overseeing schedules, team **coordination**, and match **logistics**
- Improved **communication** and **negotiation skills** by securing multiple college participation throughout **Maharashtra**
- Enhanced **leadership** by coordinating volunteers to ensure smooth execution while fostering a competitive environment

OTHER PROJECTS

Customized Linux Desktop Configuration [May 2025 - Jul 2025]
Self Project | *Custom Dotfile Configuration for Personalized Experience*

- Configured an **Arch Linux** environment with **Hyprland compositor**, tailored for performance and aesthetic consistency
- Implemented **dynamic theming** using **pywal**, integrating it across terminal, VS Code, Firefox, Eww bar, and **Glava**
- Customized window management behavior, gaps, animations, and keybindings for an efficient tiling experience
- Automated environment setup using **shell scripts and dotfile versioning** with Git for seamless portability
- Integrated media tools like **spotify-player**, and real-time audio visualizations with **GLava** synced to system theming

Personal Website Development [May 2025 - Aug 2025]
Self Project | *Front-End Development with a creative UI design*

- Created a personal website using **GitHub Pages** to display my portfolio and projects with an **artsy**, street-inspired design
- Employed **HTML**, **CSS**, and **JavaScript** for developing interactive features and achieving **mobile-responsive** functionality
- Customized an **interactive UI** reflecting personal branding while balancing between **creative expression** and usability
- Integrated version control using **Git**, organized code for modularity and enhanced site efficiency using **code refactoring**

Accurate Low-Level Signal Measurement using Dithering [Oct 2025 - Nov 2025]
Course Project | *EE616: Electronic System Design* | *Guide:* ***Prof. Siddharth Tallur***

- Studied **sub-LSB** signal distortion in ADCs, showing deterministic quantization error suppresses low-amplitude signals
- Simulated ADC **dithering** in Python, demonstrating sub-LSB signal reconstruction through noise addition and averaging
- Designed analog summer circuit combining sine and white noise for hardware validating dithering on an STM32 ADC
- Implemented Python-based acquisition and moving-average post-processing to suppress distortion and improve **ENOB**

Phonon Dispersion Measurements using Neutron Scattering [Oct 2025 - Nov 2025]
Course Project | *PH 436 : Condensed Matter Physics* | *Guide:* ***Prof. Hridis Kumar Pal***

- Derived neutron scattering conditions using energy and crystal momentum conservation for phonon spectroscopy
- Explained zero, one, and multi-**phonon scattering** processes and methods to reconstruct phonon dispersion spectra

- Reviewed experimental neutron scattering studies on nickel, interpreting dispersion curves using **Born-von Kármán** model

Universal Testing Machine [Sep 2023 - Nov 2023]

Course Project | MS101: Introduction to MakerSpace | Guide: ***Prof. Joseph John, Prof. Krishna Jonnalagadda***

- Worked in a team of 6 to build a **Universal Testing Machine**, measuring **tensile strength** of material using an **Arduino**
- Used tools such as **dremel**, **lathe** to create a fully-functional semi-automated machine after designing through AutoCAD
- Utilized software such as **Fracktory**, and **LaserCAD** in order to optimize the project and ensure high-end performance
- Designed a **horizontal UTM** system, recognized as one of the best designs for its **minimalist** approach and **efficiency**

Dynamic Obstacle-Avoiding Gesture-Guided Operator 1.0 (DOGGO 1.0) [Dec 2024 - Feb 2025]

Electronics and Robotics Club | IIT Bombay

- Designed a quadruped robot's mechanical structure with dog-like leg geometry using **SolidWorks**
- Simulated motion and leg coordination using **ROS Gazebo**, refining inverse kinematics and locomotion strategies
- Implemented a camera-based gesture recognition system using **OpenCV** to interpret human hand gestures in real-time
- Developed **reinforcement learning algorithms** enabling the robot to **autonomously** adapt to navigate dynamic terrain
- Manufactured and Assembled **3D-printed parts**, electrical components, connected **actuators** and sensors for control and implemented basic coding for standing and walking, ensuring motor control and sensor feedback are functional

Remote Controlled Bot XLR8 [Sep 2023]

Electronics and Robotics Club | Institute Technical Council

- Collaborated in a four-member team to design an RC bot and successfully navigate a competition-grade obstacle course
- Built a wireless **gyroscopic controller** using the **MPU-6050** and connected it to the bot via **ESP-32 microcontroller**
- Integrated **L298N motor driver** with bot's drive system using **PWM-based speed control** for precise maneuvering

Stop-Motion Animation [Mar 2023 - Apr 2023]

Course Project | DE109: Introduction to Design | Guide: ***Swati Agarwal***

- Created a stop motion animation by illustrating over **50 detailed sketches**, showcasing strong artistic skills
- Utilized a range of software tools, including **Adobe Premiere Pro**, along with various online resources, to compile, edit, and refine the animation, showcasing advanced proficiency in **video editing** and post-production workflows

TECHNICAL SKILLS

Programming Languages	Python (NumPy, Matplotlib, Scikit-learn, SciPy, PyTorch, Pygame), C/C++, HTML, CSS, JS
Softwares	Git, SolidWorks, AutoCAD, Hyprland, VS Code, Illustrator, GIMP, Siril, ROS, OpenCV, LaTeX
Others	Adobe Fresco, Figma, Fractory, Op-Amps, Digital Storage Oscilloscopes, MOSFETs, Krita

KEY COURSES

Physics	Classical Mechanics, Thermal Physics, Oscillations and Waves, Physics Lab, Statistical Mechanics, Quantum Mechanics, Electromagnetic Theory, General Physics Lab, Astrophysics, Non-linear Dynamics, Condensed Matter Physics, Nuclear Physics Lab
Computer Science	Computer Programming, Programming for Data Science, AI and Data Science, Numerical Analysis
Electronics	Analog Electronics, Digital Electronics and Microprocessors, Electronics System Design
Mathematics	Calculus, Linear Algebra, Differential Equations, Complex Analysis and Integral Transforms
Miscellaneous	Makerspace, Introduction to Design, Introduction to Psychology, Economics, Biology, Design Thinking, Computational Multinomics, Decision Analysis & Game Theory

EXTRA-CURRICULAR ACTIVITIES

Sports	• Secured the **Silver Medal** in the **Institute Football League 2023-24** with **100+** participants	[2024]
	• Won the **Gold Medal** with **Hostel 16A** in the **Freshiesta Football Tournament 2023**	[2023]
	• Represented **Hostel 5** as a core team member in the **Inter-Hostel General Championship**	[2025]
	• Emerged as **Champion** in the institute-wide **FIFA Open**, competing against **30+** participants	[2025]
	• Completed a year-long intermediate football course under the **National Sports Organization**	[2024]
	• Participated in the Aavhan Half Marathon, completing **21 KM** in less than **150 minutes**	[2023]
	• Underwent one year of training with the **Karnal District Football Team**	[2019]