

KSHITIJ DURAPHE

Boston, MA

kshitijduraphe5@gmail.com | +1 (314) 886-3066 | ksd3.github.io | github.com/ksd3 | LinkedIn

EDUCATION

Boston University

Boston, MA

Master of Science in Electrical and Computer Engineering

Sep 2022 – May 2024

Advisor: Prof. Joshua Semeter

GPA: 3.8/4.0

College of Engineering Pune

Pune, India

B.Tech. in Electrical Engineering with Minor in Computer Science and Engineering

Aug 2018 – June 2022

Advisors: Prof. Archana Thosar, Prof. Suhas Kakade

GPA: 9.11/10.0

RESEARCH INTERESTS

Astrophysics, Plasma Physics, Scientific Machine Learning, Remote Sensing

THESES

Data Driven Techniques to Advance Our Understanding of the STEVE Phenomenon

Kshitij Duraphe, Joshua Semeter

Master's Thesis, Electrical and Computer Engineering, Boston University, 2024

Design of an Automated Radio Telescope for Observing the 21 cm Hydrogen Line

Kshitij Duraphe, Archana Thosar

Bachelor's Thesis, Electrical Engineering, College of Engineering Pune, 2021

RESEARCH EXPERIENCE

University of Zielona Góra

Zielona Góra, Poland

Research Assistant (Remote)

Mar 2025 – Sep 2025

Advisor: Prof. Gopal Bhatta

- Analyzed a decade of NuSTAR hard X-ray observations of Cygnus X-1, employing spectral-timing analysis and fitting techniques to investigate accretion flow properties — *The Astrophysical Journal* (under review)

- ▶ Characterizing the system's behavior in different spectral states to advance the understanding of accretion physics near stellar-mass black holes, revealing a failed state transition

UniverseTBD Collaboration

Researcher

Advisors: Dr. Ioana Ciucă, Dr. Michael Smith, Dr. John Wu

Jul 2024 – Present

- ▶ Led the first empirical test of the **Platonic Representation Hypothesis** in astronomy, showing foundation models converge on shared representations with scale — **NeurIPS ML4PS 2025**
- ▶ Engineered a cross-modal framework to evaluate foundation models on premier astronomical surveys, validating the use of general-purpose architectures for computationally-efficient AI

Space Physics Lab, Boston University

Boston, MA

Graduate Research Assistant

Advisor: Prof. Joshua Semeter

Oct 2022 – May 2024

MS Thesis

Jul 2023 – May 2024

- ▶ Characterized STEVE morphology and kinetics using high-resolution citizen science imagery, developing computer vision tracking methods to quantify fine-scale dynamics, revealing distinct westward velocities for columnar (13 km/s) and picket fence (1 km/s) features
- ▶ Investigated STEVE's impact on the ionosphere by analyzing Total Electron Content (TEC) variations using high-cadence GNSS data processed via custom ETL pipelines, identifying potential two-stage TEC increases linked to STEVE passage distinct from typical substorm
- ▶ Developed automated STEVE detection capabilities for noisy All-Sky Imager data by adapting faint-source astronomical algorithms and evaluating deep learning models (ConvNeXt), enhanced by custom image superresolution, inpainting, and time-series classification modules

Hariri Center for Computing, Boston University

Jul 2023 – Jan 2024

- ▶ Developed GPS propagation models for ionospheres of Mars for the NASA Life on Mars initiative
- ▶ Developed classical and deep learning models for spatiotemporal interpolation of sparse Total Electron Content (TEC) data of the Martian ionosphere

MS Project

Oct 2022 – May 2023

- ▶ Investigated ionospheric plasma dynamics conducive to STEVE formation by configuring and executing 3D forward modeling simulations using the GEMINI3D fluid-electrodynamic model
- ▶ Analyzed simulation outputs to identify key plasma parameter variations (density structures, temperature enhancements, flow shears) and dynamical features driven by modeled STEVE-like conditions

College of Engineering Pune

Pune, India

Undergraduate Research Assistant

Jan 2021 – May 2022

Advisors: Prof. Archana Thosar, Prof. Suhas Kakade

B.Tech. Thesis

Aug 2021 – May 2022

- ▶ Developed a high-gain (20dB) pyramidal horn radio telescope for 21cm line observations, including waveguide/feed design simulated and verified using Ansys HFSS

- ▶ Integrated COTS hardware (RTL-SDR, LNA) and created C++/Python spectral analysis software (implementing WOLA FFT based on VIRGO) to detect galactic 21cm emission and derive a partial rotation curve

Signal Processing Lab

Jan 2021 – May 2021

- ▶ Developed machine learning models to predict optimal photovoltaic panel tilt angles for maximum power generation by incorporating environmental and seasonal factors, achieving predicted output increases of 8.44%-11.8% and validating results against the SMARTS2 analytical model. **Presented** at GPECOM-21

IIT Bombay

Mumbai, India

Research Intern

May 2021 – Aug 2021

- ▶ Performed Bayesian analysis of the eclipsing binary QX Cas, using PHOEBE/MCMC for light curve fitting and developing a custom 3-body dynamics simulator with a differential evolution solver to investigate variability drivers and constrain parameters of a hypothesized tertiary companion

Naxxatra Equinox Initiative

Bangalore, India

Research Intern

Jul 2020 – Oct 2020

- ▶ Derived the equations of stellar structure incorporating hydrostatic equilibrium and relativistic electron degeneracy pressure; numerically solved the resulting ODEs using a 4th-order Runge-Kutta method in Python to compute the white dwarf mass-radius relationship and determine the Chandrasekhar limit

INDUSTRY EXPERIENCE

Absentia Technologies

Boston, MA

Machine Learning Engineer

Jan 2025 – Present

- ▶ Implemented distributed training pipelines (PyTorch FSDP) for deep learning models applied to astronomical image denoising and real-time scene understanding using content-aware architectures
- ▶ Configured and managed automated CI/CD workflows (Docker, Jenkins, AWS) for model versioning, integration, and deployment

Spatialise

Noordwijk, The Netherlands (Remote)

Geospatial Machine Learning Engineer

Feb 2025 – May 2025

- ▶ Developed a multimodal spatiotemporal foundation model using multispectral satellite data, informed by statistical modeling (GPR, clustering) of soil properties for remote sensing predictions and soil health monitoring
- ▶ Engineered a scalable cloud pipeline (GCP, DVC, Dask) for processing large geospatial datasets and training foundation models

The KeelWorks Foundation

Oak Harbor, WA

Software Engineer (Machine Learning Applications)

Jul 2024 – Jan 2025

- ▶ Architected complex agentic LLM systems (LangChain, Idefics-3) and optimized RAG pipelines (Pinecone) for QA, contextual summarization, and efficient information retrieval over large document corpora (85% QA accuracy, under 500ms retrieval)

- Engineered a synthetic data generation framework by fine-tuning language models (Mistral) using techniques like back-translation and sequential style representation for specific data augmentation tasks

Halo AI (Stealth startup incubated at Columbia University)

New York, NY

Founding AI Engineer

Dec 2023 – Aug 2024

- Developed and optimized (via pruning, distillation, quantization) on-device federated/ensemble LLMs for real-time, multimodal agentic assistants, leveraging TF LiteRT and ONNX for deployment (latency cut by 27%, inference under 1.5s)
- Engineered cloud data pipelines (AWS) and a microservice-based MLOps framework (Kubeflow) to support distributed federated learning experiments and continuous integration (reducing data preparation time by 70%)

PAPERS

- K. Duraphe, R. Baviskar, S. Shingade, A. Thosar, *Optimizing Solar Panel Tilt using Machine Learning Techniques*, [GPECOM 2021](#)
- N. Servan-Schreiber, J. Semeter, K. Duraphe, et al., *Smartphone Carrier Phase TEC: A Study Across Ionospheric Spatio-Temporal Scales*, [ESS Open Archive \(2024\)](#)
- K. Duraphe et al., *The Platonic Universe: Do Foundation Models See the Same Sky?*, [NeurIPS ML4PS 2025 - Spotlight Paper \[arXiv\]](#)
Investigates if foundation models see the same underlying astrophysical phenomena and develops custom foundation models to better learn underlying astrophysics
- G. Bhatta, S. Markowitz, K. Duraphe et al., *Hard X-ray Variability from Cygnus X-1: Spectral-Timing Analysis with NuSTAR*, [The Astrophysical Journal \(under review\)](#)

SELECTED PROJECTS

Using high-rate dual-frequency cellphones to study the April 8th total solar eclipse Ogunquit, ME 2024 [Poster](#) | [Paper](#)

Comparative Optimization of Photonic QGANs using Quandela Perceval 2024 [MIT iQuHack 2024](#) [Code](#)

BeatQraft: QCBM-Based Rhythmic Pattern Generation 2023 [MIT iQuHack 2023](#) [Code](#)

TALKS AND PRESENTATIONS

- *The Platonic Universe: Do Foundation Models See the Same Sky?* (long version) [AstroAI, 2025](#)
- *The Platonic Universe: Do Foundation Models See the Same Sky?* [NeurIPS ML4PS Workshop, Dec 2025](#)
- *Using high-rate dual-frequency cellphones to study the April 8th total solar eclipse* [CEDAR Workshop, Jun 2024](#)
- *Optimizing Solar Panel Tilt using Machine Learning Techniques* [GPECOM, Dec 2021](#)

REVIEW EXPERIENCE

- United States Research Software Engineer Conference (US-RSE)

2025

SELECTED AWARDS AND HONORS

- MS Ambassador, Boston University ECE Department 2024
- 2nd out of 100+ international teams at MIT iQuHack-2023, IBM x Covalent Challenge 2023
- 3rd in class of 81 at College of Engineering Pune 2022

KEY SKILLS

Programming: Python, C, C++, SQL, MATLAB, Octave

ML Libraries & Frameworks: PyTorch, TensorFlow, scikit-learn, pandas, NumPy, Matplotlib, AstroPy

ML Techniques: Deep Learning, Statistical & Bayesian Modeling (MCMC), Spectral Analysis, Time-Series Analysis, Computer Vision (Scientific Data), LLM Applications (RAG, Fine-tuning)

Astrophysics & Simulation: GEMINI3D, PHOEBE, Ansys HFSS, HEASoft, Numerical Methods

Cloud, MLOps & Tools: AWS, GCP, Docker, Kubeflow/MLflow, CI/CD (Jenkins), SQL/NoSQL DBs, Dask/PySpark, Git

TEACHING EXPERIENCE

Computational Research Access NEtwork (CRANE) Physics

Winter 2024

TA/Mentor

- Topics: Signal Processing, Introduction to Python, Numerical Methods, Machine Learning, PIC Simulations

ASTRONOMY SCHOOLS AND WORKSHOPS ATTENDED

Inter-University Center for Astronomy and Astrophysics (IUCAA)

Pune, India

Introductory Summer School in Astronomy and Astrophysics

May – Jun 2020

- Daily lectures on different introductory topics in astronomy and astrophysics

OUTREACH AND VOLUNTEERING

COEP Astronomy Club

Pune, India

Project Head

2018 – 2022

- Led projects on antenna design for low-frequency observations of the universe, deep learning methods to detect neutral hydrogen galaxies, telescope operation
- Gave talks at schools for autistic children on identifying constellations in the night sky

- Mentored 30 undergraduates on how to process astronomical data and build reflector telescopes

COEP Mathematics Club

Member

Pune, India

2018 – 2020