Youssef Abdulghani

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solar.physics.montana.edu/youssef/ | No Sponsorship Required/Global Talent Visa

Education

Doctor of Philosophy in Physics — **August 2025**
Montana State University — Bozeman, MT
Thesis: The Galactic Black Hole Low-Mass X-Ray Binaries: An Observational Study

Graduate Certificate in AI — **May 2024**
Montana State University — Bozeman, MT
Coursework included: Advanced ML, QML Project, Time Series Analysis, Methods of Data Analysis

Master of Science in Physics — **May 2022**
Montana State University — Bozeman, MT

Bachelor of Science in Physics with Concentration in Astrophysics — **February 2019**
University of Science and Technology at Zewail City — Cairo, Egypt

Technical Skills

Statistical Methods: GLM, Mixed Effects, Hypothesis Testing, Time Series Analysis (SARIMA), Experimental Design
AI/ML Concepts: Supervised Learning, Unsupervised Learning, Neural Networks, Random Forest, Decision Trees, kNN, Ensemble Methods, LSTM, GRU, Predictive Modeling, Monte Carlo, Bootstrapping, Uncertainty Quantification
Programming Languages: Python, R, Mathematica, MATLAB, SQL, OOP, and C++
Python Packages: NumPy, Matplotlib, SciPy, pandas, astropy, Scikit-learn, TensorFlow, and PyTorch
Software Tools: Jupyterlab, VS Code, Linux Systems, Slurm, Postman/API testing, Docker, Apptainer, Git, Github, and LaTeX

Work Experience

Research Fellow – Human-centric AI — **September 2025 – Present**
University of Nottingham — Nottingham, UK

• Exploring how information aggregation operators can be used to model the human decision process

Researcher: Physics/AI — **June 2021 – August 2025**
Montana State University: Department of Physics — Bozeman, MT, USA

• Evaluated and trained the performance of GRU and CNN models on augmented time series data in TensorFlow to infer black hole accretion disk parameters, demonstrating advanced AI modeling techniques in limited data scenarios
• Leveraged smart data augmentation techniques to artificially increase limited dataset size by 190x, improving trainability and generalization
• Implemented an SQLite database routine to access the simulations which resulted in reducing data loading by 60x, streamlining the simulation analysis process
• Optimized code for an HPC environment (MSU-Tempest), achieving a 100x acceleration in data synthesis, demonstrating the ability to deliver efficient hardware performance, a key requirement for high-performance AI applications
• Conducted comprehensive population statistical analysis on black hole X-ray binaries using hypothesis testing and data synthesis using simulations in the order of 10^7, providing critical insights into astrophysical phenomena
• Deployed an online tool for rapid estimation of transient black hole X-ray binaries, facilitating real-time data analysis and decision-making

• Created a Python pipeline with multiprocessing capabilities for the X-ray binary distance project, achieving a 700% runtime speedup and greatly enhancing statistical framework efficiency
• Developed a Bayesian statistical framework using MCMC modeling to accurately constrain the distance of 26 black hole X-ray binaries, improving the precision of astrophysical measurements

Teaching Assistant: Physics I with Calculus Lab **Fall 2019, Spring 2020, Fall 2021, Spring 2023, Fall 2024**
Teaching Assistant: College Physics I Lab **Summer 2020, Fall 2022**
Montana State University Bozeman, MT, USA

• Delivered personalized support to students, significantly improving their lab skills and academic performance.
• Implemented innovative online learning tools to enhance student engagement and facilitate remote education
• Provided approximately 300+ hours of tutoring support at the Physics Help Center

Physics Content Developer **February 2019 - June 2019**
Nagwa Limited Cairo, Egypt
• Designed and developed more than 100 physics problems and answer keys for K-12 and college levels, enhancing educational content quality and accessibility while working in a multi-national team
• Led strategic meetings with upper management, including the CEO, to propose and implement technical enhancements in content presentation, driving innovation and quality improvements

Publications & Products

In preparation:

Abdulghani Y., Lohfink A.M., Sheppard J, Maccarone T.J. , Chauhan J. "Inferring Disk Inclination in Black Hole Low-Mass X-ray Binaries using Machine Learning"
- Contribution: Led the project including analysis and writing

Refereed:

Abdulghani Y., Lohfink A.M., and Chauhan J. "A new independent look at the galactic black hole low-mass X-ray binary distribution", doi:10.1093/mnras/staf979
- Contribution: Led the project including analysis and writing

Abdulghani Y., Lohfink A.M., and Chauhan J. "A Dependable Distance Estimator to Black Hole Low-Mass X-ray Binaries", MNRAS, vol. 530, no. 1, OUP, pp. 424–445, 2024. doi:10.1093/mnras/stae767
- Contribution: Led the project including analysis and writing

Chauhan J., Bharali P., Lohfink A., **Abdulghani Y.**, and Davidson E. "A spectral study of GRS 1915+105 during its March 2017 NuSTAR observations" MNRAS, vol. 527, no. 4, pp. 11801–11811, 2024
- Contribution: Manuscript writing and spectral data analysis

Software:

LMXBDq Tool – Rapid distance estimator for transient black hole binaries: solar.physics.montana.edu/youssef/lmxbd/
Bayesian Distance Calculator - *Python* - github.com/ysabdulghani/lmxbd
K-means Clustering of Black Hole Spectral States – *Python* - github.com/ysabdulghani/lmxb-states-kmeans
Bayesian Time Series Analysis of Eagle Counts – *R* – Team Project - github.com/ysabdulghani/stat436-BayesTS
Statistical Study on Detected Exoplanets' Distance – *R* - github.com/ysabdulghani/stat512-exoplanets-distance

Grants & Outreach

***NASA*'s Swift Guest Investigator Cycle 19: Awarded grant ($15,000) for a proposal on X-ray binaries** **July 2023**
American Astronomical Society (AAS) 243rd Meeting: Speaker - Research Contributed Talk **January 2024**