Prajita Bhattarai, Ph.D.

Experimental Particle Physics, Data Science & Applied Machine Learning
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Menlo Park, CA

About Me

Ph.D. in Experimental Particle Physics with **6+ years of research experience** in large-scale data analysis, machine learning, and silicon detector development. Experienced in developing and deploying ML models for data reconstruction and event classification, with a focus on robustness and interpretability. Strong background in statistical methods, software development, detector development and collaborative research in high-energy physics.

Technical Skills

- **Programming Languages:** Python, C++, ROOT, UNIX
- **Machine Learning Frameworks & Architecture:** Pytorch, Tensorflow, Deep Neural Networks, Transformers, and Boosted Decision Trees
- **Data Analysis & Visualization:** NumPy, SciPy, Pandas, Matplotlib, Seaborn
- **Statistical Methods:** Regression, Uncertainty Quantification, Hypothesis Testing, Log-likelihoods
- **Tools & Platforms:** Git, Jupyter Notebooks, CERN Gitlab, SLAC Computing Resources

Research Experience

SLAC National Accelerator Laboratory & Stanford University 2023 – Present
Research Associate — ATLAS Experiment, Large Hadron Collider (CERN)

Role overview: Develop and evaluate machine learning methods for data reconstruction and analysis in the ATLAS experiment, with an emphasis on robustness, interpretability, and performance under realistic experimental constraints.

- Developed transformer-based machine learning models for event classification, yielding an **expected ∼20% sensitivity improvement** in high-impact physics analyses.
- Contributed to the development of a centralized ML-based regression algorithm for physics object calibration, intended for reuse across multiple analyses.
- Prepared, curated, and optimized large-scale datasets for ML training and evaluation, including feature engineering and data-quality validation.
- Collaborated with cross-functional engineering and physics teams on the assembly and integration of large-scale silicon detector systems, contributing to quality control and performance validation.
- Investigating quantum-inspired tensor network architectures for hardware-efficient edge ML, targeting real-time anomaly detection in high-rate data environments.

Brandeis University 2017 – 2023
Graduate Researcher — ATLAS Experiment, Large Hadron Collider (CERN)

- Designed and implemented end-to-end data analysis pipelines operating on large, heterogeneous datasets.
- Applied Bayesian unfolding techniques to correct for detector effects and extract underlying physical quantities from observed data.
- Led analysis efforts from problem formulation through final publication, including validation, documentation, and internal peer review.

Leadership & Collaboration

- **Leadership:** Led detector assembly and integration efforts involving cross-functional teams, and contributed to internal reviews of multiple large-scale analyses.
- **Coordination:** Coordinated development of shared ML tools and research frameworks, and helped organize seminars, conferences, and machine learning workshops.
- **Mentorship:** Mentored undergraduate and graduate researchers on detector performance and analysis projects.
- **Communication:** Presented complex technical work to diverse audiences through collaboration meetings, seminars, and international conferences.

Education

Ph.D. in Experimental High Energy Physics 2023
Brandeis University, USA

B.S. in Physics *(Summa Cum Laude)* 2017
Southeast Missouri State University, USA

B.S. in Physics *(Distinction)* 2014
Tribhuvan University, Nepal

Honors & Awards

2023 ATLAS Thesis Award, CERN *2024*
Awarded for outstanding doctoral contributions to the ATLAS Collaboration.

ATLAS Ph.D. Grant, CERN *2020*
Competitive two-year fellowship funded through the Fundamental Physics Breakthrough Prize.

David L. Falkoff Graduate School Prize in Physics, Brandeis University *2020*
Awarded for excellence in teaching.

Selected Publications

Full list of publications available at ORCID. Below are a few selected works.

- Search for $H \to c\bar{c}$ and measurement of $H \to b\bar{b}$ in vector-boson fusion production with the ATLAS Detector, ATLAS Collaboration, submitted to PRL, arXiv:2511.21911
  — *Contributed to background estimation, analysis framework development, and coordination of internal collaboration review.*
- Transformer networks for constituent-based b-jet calibration with the ATLAS detector, ATLAS Collaboration, ATL-PHYS-PUB-2024-015
  — *Designed and developed transformer-based architecture for b-jet energy calibration, demonstrating improved performance over traditional methods.*
- Differential cross-section measurements of the production of four charged leptons in association with two jets using the ATLAS detector, ATLAS Collaboration, JHEP 01 (2024) 004
  — *Key analyst; contributed to the analysis framework and Bayesian unfolding methodology.*
- Software Performance of the ATLAS Track Reconstruction for LHC Run 3, ATLAS Collaboration, Comput. Softw. Big Sci. 8, 9 (2024)
  — *Contributed to performance validation and large-scale reconstruction studies.*