

Haoyi (Kenny) Jia

+1 (617)-949-0048 | hjia625@stanford.edu | [Google Scholar](#)

RESEARCH INTEREST

Beyond Standard Model Physics, Self-supervised/Unsupervised machine learning (ML), Fast/“edge” ML, Foundation Models, Anomaly Detection, Future Colliders.

EDUCATION

Stanford University

Ph.D. candidate in Physics,

- Advisors: Dr. Julia L. Gonski, Dr. Dong Su

Stanford, CA

Sep. 2023 – Present

University of Wisconsin-Madison

B.Sc. in Mathematics and Physics (Honors in Major)

- Senior Honor Thesis: “*Prospects for the Measurement of the Standard Model Higgs Boson Pair Production at the Muon Colliders*”. Advisor: Dr. Sridhara R. Dasu

Madison, WI

Sep. 2019 – May. 2023

EXPERIENCE

Research Assistant

SLAC National Accelerator Laboratory

ATLAS experiment at the LHC

- **Interpretable anomaly detection for new physics searches:** Developed an interpretable two-stages framework combining supervised/self-supervised contrastive learning with a downstream anomaly detection task for event-level anomaly scoring. Introduced a factorized-likelihood interpretation enabling statistically rigorous signal extraction — a capability absent from existing AD methods. Demonstrated significant gains in sensitivity over baselines across diverse signatures on the COLLIDE-2V dataset.
- **ORCA for dedicated new physics searches:** Applied the ORCA framework for long-lived particle searches, using contrastive learning to detect extremely rare decay anomalies that standard physics algorithms miss.
- **Real-time anomaly detection at the L0Global calorimeter trigger:** Adapted ORCA to calorimeter-tower images via a lightweight MLP-Mixer backbone for FPGA deployment under stringent resource budgets. Improves performance over existing trigger-level baselines while inheriting ORCA’s interpretability, enabling post-hoc diagnostics of trigger decisions in real-time AD systems.
- **Ultra-fast ML on FPGAs at the ATLAS experiment:** Led the design and deployment of the experiment’s first operational, unsupervised anomaly detection trigger (VAE-GAN) on custom FPGAs. Processing **40 MHz data streams** within strict **<25 ns latency**, the system leverages pure-data training to capture novel physics signals previously discarded by standard algorithms.
- **ML Deployment Infrastructure:** Stationed at **CERN**, Genève (Summer 2025), to developed a C++ framework for **hls4ml** (High Level Synthesis for ML) to deploy models into the ATLAS real-time data filter simulation. It generates wrappers around ML model and produces pre-compiled shared libraries to automate data preprocessing and interface between the detector response and the neural network.

Hardware-aware AI/ML and Microelectronics

- **Embedded Sensor Intelligence:** Collaborated with electrical engineers to embed ML directly onto pixel sensors (eFPGAs) to manage bandwidth constraints. Optimized a Boosted Decision Tree (BDT) for extreme power budgets (milliwatt level) with single-clock cycle latency ($\mathcal{O}(10)$ ns).

June. 2023 – Present

Menlo Park, CA

- **Data Compression & Detector Monitoring:** Evolved the system to use a Variational Autoencoder (VAE) at the sensor edge. This architecture reduces data transmission by 80–90% while simultaneously effectively identifying sensor defects (e.g., dead or “loud” pixels) via anomaly scoring.

Undergraduate Research Assistant

May. 2020 – May. 2023

Department of Physics, University of Wisconsin-Madison

Madison, WI

- Worked under Dr. Sridhara Dasu on feasibility studies of measuring di-Higgs production and Dark Matter Searches at the future Muon Collider. Both papers are included in the Snowmass 2021 proceedings, part of the U.S. particle physics planning process held every decade.
- Proposed a novel approach of simulating the background noise induced from beam effect at the future Muon Collider within a fast Monte Carlo simulation framework.

SELECTED PUBLICATIONS (ATLAS COLLABORATION AUTHOR SINCE MARCH 2026)

- H. Jia, A. Dave, J. Gonski, and R. Herbst. Analysis of hardware synthesis strategies for machine learning in collider trigger and data acquisition, 2024. URL <https://arxiv.org/abs/2411.11678>
- A. Yue, H. Jia, and J. Gonski. Variational autoencoders for at-source data reduction and anomaly detection in high energy particle detectors. *Machine Learning: Science and Technology*, 6(3):035017, jul 2025. doi: 10.1088/2632-2153/adf0c0. URL <https://dx.doi.org/10.1088/2632-2153/adf0c0>
- J. Gonski, A. Gupta, H. Jia, H. Kim, L. Rota, L. Ruckman, A. Dragone, and R. Herbst. Embedded fpga developments in 130 nm and 28 nm cmos for machine learning in particle detector readout. *Journal of Instrumentation*, 19(08):P08023, 8 2024. URL <https://doi.org/10.1088/1748-0221/19/08/P08023>
- K. Black et al. Muon Collider Forum report. *Journal of Instrumentation*, 19(02):T02015, feb 2024. URL <https://dx.doi.org/10.1088/1748-0221/19/02/T02015>
- K. Black et al. Prospects for the Measurement of the Standard Model Higgs Pair Production at the Muon Colliders. *Proceedings of the US Community Study on the Future of Particle Physics (Snowmass 2021)*, 8 2023. URL <https://arxiv.org/abs/2203.08874>
- T. Bose et al. Report of the Topical Group on Physics Beyond the Standard Model at Energy Frontier for Snowmass 2021. *Proceedings of the US Community Study on the Future of Particle Physics (Snowmass 2021)*, 10 2022. URL <https://arxiv.org/abs/2209.13128>
- A. Boveia et al. Summarizing Experimental Sensitivities of Collider Experiments to Dark Matter Models and Comparison to Other Experiments. *Proceedings of the US Community Study on the Future of Particle Physics (Snowmass 2021)*, 6 2022. URL <https://arxiv.org/abs/2206.03456>
- K. Black et al. Prospects for Heavy WIMP Dark Matter Searches at Muon Colliders. *Proceedings of the US Community Study on the Future of Particle Physics (Snowmass 2021)*, 5 2022. URL <https://arxiv.org/abs/2205.10404>

TALKS AND PRESENTATIONS

Fast Machine Learning for Science 2025

Sep. 2025

GELATO: A Generic Event-Level Anomaly detection Trigger for ATLAS.

Zürich, Schweiz

ATLAS & CMS ML Operations Workshop

Jun. 2025

Firmware:ML integration into Athena.

Genève, Suisse

ATLAS Trigger and Data Acquisition (TDAQ) Week <i>Integrating HLS4ML into Athena.</i>	Mar. 2025 <i>Genève, Suisse</i>
US Higgs Factory Planning 2024 <i>eFPGA-based ML Implementation on Future Collider Detector Readout.</i>	Dec. 2024 <i>Menlo Park, CA</i>
US LHC Users Association Annual Meeting <i>eFPGA-based ML Implementation on Future Collider Detector Readout.</i>	Dec. 2024 <i>Menlo Park, CA</i>
Bridging the Farm: AI for Science at SLAC and Stanford <i>Edge Machine Learning for Smart Detectors in Future Colliders.</i>	Oct. 2024 <i>Stanford, CA</i>
US ATLAS Summer Workshop 2024 <i>EFPGA Developments in 130/28 nm CMOS for ML in Detector Readout.</i>	July. 2024 <i>Seattle, WA</i>
UW-Madison Physics Board of Visitors Meeting <i>Physics Prospects at the Muon Colliders.</i>	May. 2023 <i>Madison, WI</i>

HONORS AND AWARDS

Affiliated Trainee , A3D3 Institute (NSF Harnessing the Data Revolution Program)2024–Present	
Violet Higgitt Frank Scholarship , UW-Madison Department of Mathematics	Dec. 2022
Hilldale Undergraduate Research Fellowship , UW-Madison	Apr. 2022
Albert Augustus Radtke Scholarship , UW-Madison Department of Physics	Jul. 2021
Ralph B. Abrams Scholarship , UW-Madison College of Letter and Science	May. 2021
UW-Madison Undergraduate Scholarship for Summer Study , UW-Madison	Apr. 2021
Dean’s List , UW-Madison	2019-2022

TEACHING

Physics 43 Teaching Assistant <i>Stanford University</i> • Electricity and Magnetism.	Apr. 2024 – Jun. 2025 <i>Stanford, CA</i>
Physics 46 Teaching Assistant <i>Stanford University</i> • Light and Heat Laboratory.	Sep. 2024 – Dec. 2024 <i>Stanford, CA</i>
Physics 43 Teaching Assistant <i>Stanford University</i> • Electricity and Magnetism.	Apr. 2024 – Jun. 2024 <i>Stanford, CA</i>