Oz Amram

Postdoctoral Researcher at Fermilab

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Research Interests

Experimental Particle Physics
LHC, CMS, model-agnostic searches for new particles, jet substructure, fast calorimeter simulations, hardware-level trigger

Machine Learning
Anomaly detection, unsupervised learning, generative models, statistical inference, foundation models

Education

2016-2022 **Johns Hopkins University**, *M.A., Ph.D*
Thesis: Searching for Anomalies in Proton-Proton Collisions at the Large Hadron Collider. Advisors: Morris Swartz and Petar Maksimovic

2012-2016 **Carnegie Mellon University**, *B.S. Physics*

Positions

2024– Co-Convener of the CMS analysis group dedicated to exotic searches for new particles with jets (EXO Jets+X L3). Reviewing and managing ∼15 active analyses

2021-2022 Co-Convener of the CMS pixel offline software and reconstruction subgroup (Tracker DPG L3)

2019– Regular writer of outreach articles for Particle Bites, "The high energy physics reader's digest"

2020-2021 JHU Physics and Astronomy Graduate Student Diversity & Inclusion Co-Chair

Selected Publications

Below is a list of publications for which I made a significant contribution. As a member of the CMS collaboration I am an author of 400+ publications.

Highlighted works

1. CMS Collaboration. Machine-learning techniques for model-independent searches in dijet final states. *CMS-PAS-MLG-23-002.* https://cds.cern.ch/record/2938054 (July 2025).

2. CMS Collaboration. A method for correcting the substructure of multiprong jets using the Lund jet plane. *Sub. to JHEP.* arXiv: 2507.07775 (July 2025).

3. Amram, O. & Szewc, M. Data-Driven High-Dimensional Statistical Inference with Generative Models. *Sub. to JHEP.* arXiv: 2506.06438 (June 2025).

4. CMS Collaboration. Model-agnostic search for dijet resonances with anomalous jet substructure in proton-proton collisions at $\sqrt{s} = 13$ TeV. *Rept. Prog. Phys.* **88.** arXiv: 2412.03747 (Dec. 2024).

5. Amram, O. & Pedro, K. Denoising diffusion models with geometry adaptation for high fidelity calorimeter simulation. *Phys. Rev. D* **108.** arXiv: 2308.03876 (Aug. 2023).

6. CMS Collaboration. Measurement of the Drell-Yan forward-backward asymmetry at high dilepton masses in proton-proton collisions at $\sqrt{s} = 13$ TeV. *JHEP* **2022.** arXiv: 2202.12327 (Feb. 2022).

7. Amram, O. & Suarez, C. M. Tag N' Train: a technique to train improved classifiers on unlabeled data. *JHEP* **01.** arXiv: 2002.12376 (Feb. 2021).

Other works

8. CMS Collaboration. Search for resonances decaying to an anomalous jet and a Higgs boson in proton-proton collisions at $\sqrt{s} = 13$ TeV. *Sub. to EPJ C.* arXiv: 2509.13635 [hep-ex] (Sept. 2025).

9. Brennan, L. *et al.* Weakly supervised anomaly detection with event-level variables. *Sub. to PRD.* arXiv: 2504.13249 [hep-ph] (Apr. 2025).

10. Amram, O. & Cummings, G. *United States Early Career Researchers in Collider Physics input to the European Strategy for Particle Physics Update* in (Mar. 2025). arXiv: 2503.22834.

11. Amram, O. *et al.* Aspen Open Jets: unlocking LHC data for foundation models in particle physics. *Mach. Learn. Sci. Tech.* **6**, 030601. arXiv: 2412.10504 [hep-ph] (Dec. 2024).

12. CMS Collaboration. Search for t-channel scalar and vector leptoquark exchange in the high-mass dimuon and dielectron spectra in proton-proton collisions at $\sqrt{s} = 13$ TeV. *Sub. to JHEP.* arXiv: 2503.20023 (Mar. 2025).

13. Krause, C. *et al.* CaloChallenge 2022: A Community Challenge for Fast Calorimeter Simulation. arXiv: 2410.21611 (Oct. 2024).

14. Kasieczka, G. *et al.* The LHC Olympics 2020 a community challenge for anomaly detection in high energy physics. *Rept. Prog. Phys.* **84**. arXiv: 2101.08320 (2021).

15. Lambrides, E. *et al.* Merger or Not: Accounting for Human Biases in Identifying Galactic Merger Signatures. *The Astrophysical Journal* **919**. arXiv: 2106.15618 (Sept. 2021).

Teaching

2024-	Founding organizer of annual 'Machine Learning for Fundamental Physics' school hosted in Berkeley with ∼40 in person and ∼100 virtual participants. Introduces graduate students and advanced undergraduates to applications of AI in particle physics research. Co-planned scope of week long curriculum. Gave a lecture and ran a tutorial on anomaly detection.
2023-5	Worked with UChicago Data Science Institute to develop research project on AI particle physics as part of undergraduate data science course. Instructed several groups of students (four per quarter) on this project.
Oct. 2024	Guest lecture at Purdue university for course 'Introduction to ML for physicists', discussed applications of anomaly detection and generative models in particle physics
2023-5	Lead facilitator for yearly CMS 'Data Analysis School' at Fermilab. Led a multi-day exercise introducing group of 10 graduate students to LHC data science methods used at the LHC
2017-2021	Head Teaching Assistant, General Physics I, Johns Hopkins University. Taught weekly recitation section of ∼25 students focused on hands-on problem solving practice. Organized and oversaw all homework and exam grading and other course logistics. Contributed to design of exam problems.
2016-2017	Teaching Assistant, General Physics Lab, Johns Hopkins University. Sole instructor of weekly lab course of 25 students. Guided students through lab experiments, graded weekly lab reports.

Invited Seminars

2024-5	*Treasure Hunting without a Map: First Anomaly Detection Results from CMS* UChicago, LBNL, Fermilab Wine & Cheese, Purdue, Michigan, TRIUMF, Texas A&M

Conference Presentations

Aug. 2025	*Data-driven, optimal, interpretable measurements with generative models* Machine Learning for Jets Conference (ML4Jets). Caltech. Pasadena, CA
Aug. 2025	*Anomaly Detection Searches from CMS* Machine Learning for Jets Conference (ML4Jets). Caltech. Pasadena, CA
July 2025	*Experimental Introduction (invited)* BOOST. Brown University. Providence, RI
June 2025	*Data-driven, optimal, interpretable measurements with generative models* LHC Physics Center EFT Workshop. Fermilab, IL

June 2025	*Results from Anomaly Detection Searches in CMS (invited)* Anomaly Detection in HEP Workshop. Columbia, NY
Oct 2024	*Fast Simulation of Particle Physics Calorimeters* Fast Machine Learning for Science. Purdue, IN
May 2024	*Introduction to Anomaly Detection in HEP (invited)* Fundamental Physics in the Era of Big Data and Machine Learning, Summer Workshop. Aspen, CO
Dec. 2023	*Techniques for ML-based Model Agnostic Searches in CMS* Lightning Talk, Award Winner. US LHC Users Association Meeting. Fermilab, IL
Nov. 2023	*Boosted Jet Tagging and Calibration in CMS* Machine Learning for Jets Conference (ML4Jets). DESY, Germany
Aug. 2023	*Boosted Jet Tagging and Calibration in CMS 13 TeV Data* BOOST. LBNL, CA
May 2023	*Fast & Accurate Calorimeter Simulation with Diffusion Models (invited)* Fast Calorimeter Simulation (CaloChallenge) Workshop. Rome, Italy
May 2023	*Fast & Accurate Calorimeter Simulation with Diffusion Models* Computing in High Energy Physics (CHEP). Norfolk, VA
Mar. 2023	*Standard Model W, Z(+Jets) at CMS and ATLAS* Rencontres de Moriond : QCD & High Energy Interactions. La Thuile, Italy
Nov. 2022	*Searches with boosted objects and ML in CMS* Machine Learning for Jets Conference (ML4Jets). Rutgers, NJ
Apr. 2022	*Recent Z boson Results from the LHC* Standard Model at LHC Workshop. CERN
Sep. 2021	*Machine Learning Based Anomaly Detection at the LHC (invited)* Rising Stars in Experimental Particle Physics Symposia. UChicago, IL
Jul. 2020	*Anomaly Searches with Tag N' Train (invited)* Anomaly Detection Workshop, LHC Summer Olympics 2020. Virtual
Jan. 2020	*Tag N' Train : Combining Autoencoders and CWoLa for Better Unsupervised Searches* Machine Learning for Jets Conference (ML4Jets). NYU
April 2018	*Measurement of the forward-backward asymmetry of high mass Drell-Yan lepton pairs at 13 TeV* APS April Meeting. Columbus, OH

Service

2025	Organized US Early Career input to 2025 European Strategy Update detailing preferences for future collider options
2023-	Journal referee for papers in SciPost Physics (2 papers), PRD (1), PLB (1), Scientific Reports (1)
2024-	Reviewer for conference papers. ACAT (2024) and NeurIPS Machine Learning for Physical Sciences workshop (2025)

Mentorship

2023-	Mentoring UCSB graduate student on project developing new anomaly detection method for the LHC. Student had no prior AI experience
2020-5	Mentor in US CMS mentoring program. Provided career advice to younger graduate students at Ohio State (2) and UCSD (1)
2019-2022	Mentored younger graduate students at JHU on projects related to CMS pixel detector and data analysis

Awards and Honors

2021   Rising Star in Experimental Particle Physics, University of Chicago
2016   Richard E. Cutcosky Award, Carnegie Mellon
2016   Phi Beta Kappa, Carnegie Mellon
2015   Phi Kappa Phi, Carnegie Mellon