Oz Amram

Postdoctoral Researcher at Fermilab

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Research Interests

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

Machine Learning.
Anomaly detection, unsupervised learning, generative modeling, 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` (2025).
2. CMS Collaboration. A method for correcting the substructure of multiprong jets using the Lund jet plane. *Sub. to JHEP*. arXiv: 2507.07775 (2025).
3. Amram, O. & Szewc, M. Data-Driven High-Dimensional Statistical Inference with Generative Models. *Sub. to JHEP*. arXiv: 2506.06438 [hep-ph] (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 (2024).
5. Amram, O. & Pedro, K. Denoising diffusion models with geometry adaptation for high fidelity calorimeter simulation. *Phys. Rev. D* **108.** arXiv: 2308.03876 (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 (2022).
7. Amram, O. & Suarez, C. M. Tag N' Train: a technique to train improved classifiers on unlabeled data. *JHEP* **01.** arXiv: 2002.12376 (2021).

Other works

8. Brennan, L. *et al.* Weakly supervised anomaly detection with event-level variables. *Sub. to PRD.* arXiv: 2504.13249 [hep-ph] (Apr. 2025).
9. Search for resonances decaying to a Higgs boson in the bb final state and an anomalous jet. *CMS-PAS-B2G-24-015.* https://cds.cern.ch/record/2928202 (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. 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).

Invited Seminars

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

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 SciPost Physics (2 papers), PRD (1 paper), PLB (1 paper), Scientific Reports (1 paper)

2024-5 Organizer of 'Machine Learning for Fundamental Physics' School. An annual week long school introducing students to ML topics in HEP, hosted in Berkeley with $\sim$40 in person and $\sim$ 100 virtual participants

2023-5 Lead facilitator for yearly CMS 'Data Analysis School' at Fermilab. Led a multi-day exercise introducing group of 10 students to LHC analysis methods

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

Mentoring & Teaching

2020- Mentor in USCMS mentoring program. Advised younger graduate students at Ohio State (2) and UCSD (1)

2023-5 Mentored several groups of UChicago undergraduate students on a project related to ML for calorimeter simulation as part of data science course

2019-2022 Mentored younger graduate students at JHU on projects related to CMS pixel detector and data analysis

2017-2021 Head Teaching Assistant, General Physics I, JHU

2016-2017 Teaching Assistant, General Physics Lab, JHU