

Research Interests

Experimental Particle Physics.

Model-agnostic searches for new physics, jet substructure, precision standard model measurements, calorimeter simulations, silicon pixel trackers

Machine Learning.

Anomaly detection, weakly supervised learning, generative modeling, diffusion, semi-supervised learning, unsupervised learning

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.*

Projects

Measurement of the Drell-Yan Forward-Backward Asymmetry at High Dilepton Masses.

Main analyzer for CMS Run-II measurement. Measured in various bins of dilepton mass up to 1 TeV. Employed a novel template fitting technique that improves sensitivity compared to counting based methods. Measurement used to set limits on the existence of a new heavy Z' that are complementary to direct searches.

Tag N' Train.

Developed a novel technique for training machine learning classifiers on collider data called Tag N' Train that combines unsupervised and weakly supervised approaches. Demonstrated its applicability in a dijet anomaly search. Successfully able to find the hidden signal in the LHC Olympics anomaly detection challenge.

CMS Pixel Detector Calibration and Software.

Was directly involved in various aspects of offline calibration and reconstruction using the CMS pixel detector and co-convener the group from 2021-2022. Projects included developing novel reconstruction techniques suitable for high levels of radiation damage, producing calibrations to account for radiation damage, testing candidate designs for the Phase-2 upgrade, and overseeing the first calibrations and performance studies of Run3 data.

Positions

2019- Regular Writer for Particle Bites, "The high energy physics reader's digest"

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

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

Selected Publications

Primary Author

Oz Amram and Cristina Mantilla Suarez. Tag N' Train: a technique to train improved classifiers on unlabeled data. *JHEP*, 01:153, 2021. arXiv:2002.12376.

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(08):063, 2022.

Contributor

Gregor Kasieczka et al. The LHC Olympics 2020: A Community Challenge for Anomaly Detection in High Energy Physics, January 2021. arXiv:2101.08320.

Erini Lambrides et al. Merger or Not: Accounting for Human Biases in Identifying Galactic Merger Signatures, June 2021. arXiv:2106.15618.

Awards and Honors

- 2016 Richard E. Cutcosky Award, Carnegie Mellon
- 2016 Phi Beta Kappa, Carnegie Mellon
- 2015 Phi Kappa Phi, Carnegie Mellon

Presentations

- May 2023 "Fast & Accurate Calorimeter Simulation with Diffusion Models". Computing in High Energy Physics
- Mar. 2023 "Standard Model W, Z(+Jets) at CMS and ATLAS". Rencontres de Moriond : QCD & High Energy Interactions
- Nov. 2022 "Recent ML-usage in searches with boosted objects in CMS". ML4Jets 2022
- Apr. 2022 "Recent Z boson Results from the LHC". SM@LHC Workshop
- Sep. 2021 "Machine Learning Based Anomaly Detection at the LHC". UChicago Rising Stars in Experimental Particle Physics Symposia. Virtual
- Jul. 2020 "Anomaly Searches with Tag N' Train". Anomaly Detection Workshop, LHC Summer Olympics 2020. Virtual
- Jan. 2020 "Tag N' Train : Combining Autoencoders and CWoLa for Better Unsupervised Searches". ML4Jets 2020. New York, NY
- April 2018 "Measurement of the forward-backward asymmetry of high mass Drell-Yan lepton pairs at 13 TeV" APS April Meeting. Columbus, OH

Mentoring & Teaching

- 2019-2022 Mentored younger graduate students at JHU on projects related to CMS pixel detector and data analysis
- 2020-2022 Mentored a younger graduate student at Ohio State through USCMS mentoring program
- 2017-2021 Head Teaching Assistant, General Physics I at JHU
- 2016-2017 Teaching Assistant, General Physics Lab JHU