

APPOINTMENTS & EDUCATION

PostDoctoral Fellow

LAWRENCE BERKELEY NATIONAL LABORATORY

FEBRUARY 2022-PRESENT

NSSC Fellow

UNIVERSITY OF CALIFORNIA, BERKELEY

MAY 2019 - MARCH 2021

PhD, Physics

UNIVERSITY OF CALIFORNIA, BERKELEY

AUGUST 2016 - DECEMBER 2021

B.S. Physics Honors

STONY BROOK UNIVERSITY

AUGUST 2012 - MAY 2016

RESEARCH EXPERIENCE

AI Codesign - Generative Modeling for Calorimeter Simulation

Lawrence Berkeley National Lab | February 2022 - Present

- Used state of the art score based diffusion models to generate calorimeter showers.
- Investigated optimal representation of calorimeter data for machine learning.
- Compared models made up of CNNs trained on images to models consisting of DeepSets trained on Point Clouds.
- Chosen representation lead to 150x reduction in disk space, and a 300% reduction in sampling time, all while maintaining cutting-edge performance.
- Ground work to generate differentiable simulations for end-to-end differentiable detector design.

H1 - Machine Learning Assisted Unfolding for Lepton-Jet Asymmetry measurements

Lawrence Berkeley National Lab | February 2022 - Present

Postdoctoral Fellow | Lawrence Berkeley National Lab | February 2022 - Present

- Use ML-based deconvolution (called "unfolding" in particle/nuclear physics) to measure moments defining properties of electron-proton collisions
- Measurement of moments of lepton-jet asymmetry angle, probes contribution of soft gluon radiation to asymmetry measurements. Vital reference for future TMD studies at the EIC.
- Iteratively reweighted a set of simulated events with deep learning, correcting entire datasets for detector effects
- Repurposed a classifier as a likelihood-ratio estimator to reweight synthetic data to match real data
- Ran thousands of models in High Performance Computing environment, both for robustness of results and for visualizing progression of iterative models.

AI Codesign - Optimal Use of Detector Segmentation

Postdoctoral Fellow | Lawrence Berkeley National Lab | February 2022 - Present

- Optimize the design for a hadronic calorimeter to be used in the upcoming Electron Ion collider, to be built at Brookhaven National Laboratory
- Training surrogate models on detector simulation that are conditional on the parameters of the detector geometry
- Translated data into Point-Cloud representation for use in deep sets and graph neural network models
- Used surrogate models to provide the optimal reconstruction of the high-dimensional point-cloud calorimeter dataset, acquiring the best experimental design suited for detector reconstruction
- Large scale production of simulation using High Performance computing infrastructure at Lawrence Berkeley and Lawrence Livermore national lab
- Distilled methods into easy to run Jupyter Notebooks for engaging students
- Optimal reconstruction conditioned on detector parameter values for differentiable design process
- Influenced hadronic calorimeter after sharing results of optimal detector design. Methods were transferred to optimize additional detector, the zero-degree calorimeter (ZDC). Results indicated expensive pre-shower material could be eliminated.

ALICE - Deep Photons for Photon-Jet Correlations

Graduate Researcher | July 2021 - December 2021 | University of California, Berkeley

- Developed deep neural network classifier to identify prompt vs. non-prompt photons in PbPb
- Trained model on PYTHIA embedded into PbPb data.

- Tuned neural network over wide parameter space using keras tuner.
- Experimented with convolution layers, dropout layers, and ResNet architecture.
- Analyze results, plotting ROC curves and obtained an accuracy of 70% or greater.
- Model currently outperforms standard σ_{long}^2 variable based on cluster shower shape.

ALICE – Isolated Photon-Hadron Correlations

Graduate Researcher | June 2018 – May 2020 | University of California, Berkeley

- First photon-tagged fragmentation measurement at the LHC in p-Pb.
- Analyzed isolated, single photon-hadron correlations in ALICE pp and p-Pb data.
- Thorough comparison of proxy fragmentation functions in two collision systems.
- Showed no observable modification in p-Pb compared to pp, constraining cold nuclear matter effects on parton fragmentation.

EIC - Jet Resolution and Lepton Jet Correlations

Graduate Researcher | November 2020 - June 2021 | University of California, Berkeley

- Ran large scale electron-proton simulations using the PYTHIA and sPHENIX Fun4All framework inside a Singularity container at NERSC.
- Helped implement All-Silicon tracker in Fun4All for GEANT4 full simulation.
- Created NTuple framework with full e-proton event information, including all jets and particles at truth and reconstructed level, vastly reducing the need to re-run simulation.
- Analyze simulation results: charged jet momentum response as well as momentum and angular resolutions.
- Produced Lepton Jet Correlations and Charged Jet fragmentation analysis, propagating uncertainties using relevant resolutions, and scaling statistical error bars according to expected EIC luminosity.

High Performance Computing for Event Mixing

Graduate Researcher & NSSC Fellow | June 2018 – Present | University of California, Berkeley

- Created novel event mixing framework for pairing similar collision events based on Gale-Shapely stable pairing algorithm often used in the field of economics.
- Characterized detector acceptance affects and combinatorial background in ALICE γ -hadron and γ -jet analysis.
- Parallelized framework to run on NERSC KNL and Haswell high performance nodes with fast, random access I/O implemented with HDF5.
- Decreased required time of mixed event correlations from several days through the ALICE analysis train system to 30 minutes on a single high performance interactive node.

sPHENIX – Jet Energy Scale Calibration

NSSC Fellow & Lab Intern | June 2019 - March 2020 | Livermore National Lab

- Analyze simulation results to develop and optimize jet calibration methods in order to improve jet energy scale and accuracy to probe jet energy loss mechanisms in Quark Gluon Plasma.
- Contributed to NSSC meetings comprised of nuclear engineers, political scientists, data analysts, and physicists.
- Present results in jet substructure topical group on jet reconstruction performance.
- Run simulation on Livermore Computing clusters as well as RACF at BNL.
- Apply numerical inversion technique to correct reconstructed jet energy scale.

Alice - Upgraded Pixel Detector Testing

Berkeley Lab Undergraduate Intern (BLUR) | June 2015 – Aug 2015 | Berkeley National Lab

- Characterized latch-up cross section of prototype next generation Monolithic Active Pixel Sensor for the upgrade to ALICE Inner Tracking System.
- Read data from data acquisition card and check linear energy transfer of ALPIDE silicon pixels.
- Took measurements of linear energy transfer in real time during beam test at 88" Cyclotron.

PHENIX - Muon-Piston Calorimeter Extension

Undergraduate Researcher | April 2013 - February 2015 | Stony Brook University

- Helped simulate electromagnetic showers from incident photons or π_0 's in PHENIX, to help identify the impact of a pre-shower detector
- Assisted in the construction of a Tungsten-Silicon pre-shower detector with high position resolution to separate direct and π_0 decay photons.

Radiation Damage in Lead-Glass Calorimeter

SULI Intern | Summer 2014 | Thomas Jefferson National Accelerator Facility

Fernando Torales Acosta

- Worked to reduce radiation damage in lead glass by thermal annealing
- Modeled the optical transparency and the electrical conductivity of lead glass as a function of temperature, used to predict the impact of thermal annealing

Ring Imaging Cherenkov Detector

Undergraduate Researcher | February 2012- March 2013 | Stony Brook University

- Helped develop a prototype 1-meter long compact Ring Imaging Cherenkov detector (RICH).
- Tested and optimized the appropriate bias for a five layer stack of Gas Electron Multipliers, a 'quintuple GEM stack', used to detect the Cherenkov radiation at the end of the RICH.
- Successfully tested the detector using beam tests at Fermi National Accelerator Laboratory.

CONFERENCES & TALKS

NeurIPS

December 2023 | New Orleans, USA

- Contribution on Fast Generative Models for EIC calorimeters

AI4EIC

November 2023 | Washington D.C., USA

- Talk on Optimal Use of segmentation for sampling calorimeters

International Workshop on DIS March 2023 | Michigan, USA

- Talk on data deconvolution for measuring soft gluon radiation contribution to lepton jet asymmetry measurement

Quark Matter

November 2019 | Wuhan, China

- Contribution on Isolated γ -hadron correlations in pp and p-Pb Collisions

ALICE Physics Week

July 2019 | Prague, Czech Republic

- Overview on Isolated γ -hadron analysis given to ALICE collaboration

APS Quarks to Cosmos

July 2019 | Boulder, CO

- Description of Isolated γ -hadron analysis in pp and p-Pb collisions

ALICE-USA Meeting March 2019 | Knoxville, TN

- Talk on Isolated γ -hadron analysis in pp and p-Pb collisions

Hard Probes

September 2018 | Savoie, France

- Isolated γ -hadron and γ -jet correlations preliminary [contribution]

NSSC University Program Review 2018

June 2018 | Ann Arbor, MI

- Upgrade to the ALICE Inner Tracking System

Talking Science SCIENCE COMMUNICATION TO THE PUBLIC

Jan 2016 – May 2016 | Stony Brook, NY

- Discussion oriented school of journalism course on effectively communicating science to the public

PUBLICATIONS

COMPARISON OF POINT CLOUD AND IMAGE-BASED MODELS FOR CALORIMETER FAST SIMULATION

<https://arxiv.org/abs/2307.04780>

ARTIFICIAL INTELLIGENCE FOR THE ELECTRON ION COLLIDER

<https://arxiv.org/abs/2307.08593>

THE OPTIMAL USE OF SEGMENTATION FOR SAMPLING CALORIMETERS

<https://arxiv.org/abs/2310.04442>

EIC PHYSICS FROM AN ALL-SILICON TRACKING DETECTOR

<https://arxiv.org/abs/2102.08337>

ISOLATED PHOTON HADRON CORRELATIONS IN 5.02

TeV PP AND P-PB COLLISIONS AT ALICE

DOI:10.1103/PhysRevC.102.044908

PERFORMANCE OF A QUINTUPLE-GEM BASED RICH

DOI:10.1109/TNS.2015.2487999

AWARDS/APPOINTMENTS

LLBNL Posdoctoral Fellow	2022-2025
NSSC Fellow	2019-2021
NSSC Fellow	2017-2019
NSF Fellow Honorable Mention	2016
SUNY LSAMP Fellowship	2015-2017
NASA NY Undergraduate Space Grant	2014