ALI EREN SIMSEK

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PROFESSIONAL RESPONSIBILITIES & OUTREACH

CMS NPS (SUS/SUSY) L3 MC&I,T Convener — *Trigger*
TFPX Assembly Huddle Coordinator — *CMS Phase-II Inner Tracker*
Simulation Expert and Key Contact — *CERN SPS H2 & H4 Beamline*
2025 DC Trip Organization for HEP Advocacy — *Co-Organizer*
Science Mission Co-Chair — *Fermilab Users and Associates Executive Committee (UAEC)*
Government Relations Co-Chair — *Fermilab Users and Associates Executive Committee (UAEC)*
QuarkNet Program — *Ph.D. Physicist & Faculty Member*
Fermilab CMS Data Analysis School (DAS) — *Facilitator/Educator*
Fermilab PURSUE Program — *Final Reviewer*

SELECTED PUBLICATIONS

[1] "Search for dijet resonances with data scouting in proton-proton collisions at $\sqrt{s} = 13$ TeV," 2025. arXiv: 2510.21641.
[2] "Timing performance of the CMS High Granularity Calorimeter prototype," *JINST*, vol. 19, 2024, ISSN: 1748-0221. DOI: 10.1088/1748-0221/19/04/p04015. arXiv: 2312.14622.
[3] "Performance of the CMS High Granularity Calorimeter prototype to charged pion beams of 20-300 GeV/c," 2023. DOI: 10.1088/1748-0221/18/08/P08014. arXiv: 2211.04740 [physics.ins-det].
[4] "Response of a CMS HGCAL silicon-pad electromagnetic calorimeter prototype to 20–300 GeV positrons," *JINST*, vol. 17, 2022, ISSN: 1748-0221. DOI: 10.1088/1748-0221/17/05/p05022.
[5] "The DAQ system of the 12,000 channel CMS high granularity calorimeter prototype," *JINST*, vol. 16, 2021, ISSN: 1748-0221. DOI: 10.1088/1748-0221/16/04/t04001.
[6] "Construction and commissioning of CMS CE prototype silicon modules," *JINST*, 2020. arXiv: 2012.06336.
[7] "Search for dijet resonances using events with three jets in proton-proton collisions at $\sqrt{s} = 13$ TeV," *Physics Letters B*, vol. 805, 2020, ISSN: 0370-2693. DOI: 10.1016/j.physletb.2020.135448.
[8] "Search for high mass dijet resonances with a new background prediction method in proton-proton collisions at $\sqrt{s} = 13$ TeV," *JHEP*, 2020, ISSN: 1029-8479. DOI: 10.1007/jhep05(2020)033.

Full Publication List & Citation: *link to Inspire-HEP*

SELECTED SEMINARS, COLLOQUIUMS, & TALKS

Phenomenology Symposium at University of Pittsburgh (USA) — *19-21 May 2025*
Probing new physics with dedicated data streams at CMS

Physics Colloquium at Catholic University of America (USA) — *11 Oct 2023*
CERN CMS Experiment: Revealing Exotic Physics through Dijet Resonance Search

Seminar at the University Of Alabama (USA) — *31 Mar 2022*
Dijet Resonance Searches & CMS Phase-II Upgrades

Seminar at the University Of Virginia (USA) — *06 Jan 2021*
Dijet Resonance Searches & CMS Phase-II Upgrades

APS April 2021 Meeting *18 Apr 2021*
Dijet Resonance Search with Calo-Scouting technique

8th Beam Telescopes and Test Beams Workshop Georgia (co-author) *27-31 Jan 2020*
SPS H2 Beam Line Simulation: Energy Loss and Material Impact at HGCAL Test Beam

INTERNAL PAPER REVIEWS (CMS ARC/IRC)

EXO-24-039 (ARC):	Search for paired dijets with b-jets in the final state
HIG-24-003 (IRC):	Search for VVH(bb) production through Vector Boson Scattering
SUS-23-016 (IRC):	Search for new physics in the monophoton final state
EXO-22-026 (IRC):	Searching for new physics detecting anomalies in jets

FELLOWSHIPS, GRANTS & AWARDS

Turkish Energy, Nuclear and Mining Research C. [TENMAK] Fellowship - CERN
TUBITAK 2214A Fellowship Program for PhD Students - Fermilab
CMS HGCAL Group Fellowship - CERN
Turkish Atomic Energy Authority [TAEK] Fellowship - CERN
Turkish Atomic Energy Authority [TAEK] Fellowship - CERN

PROFESSIONAL EXPERIENCE

Postdoctoral Research Assoc. at the Catholic University of America, USA	*2022–*
Graduate Researcher at CERN, Switzerland	*2020-2022*
Graduate Researcher at Fermilab, USA	*2019-2020*
Graduate Researcher at CERN, Switzerland	*2016-2019*
Mathematics Teacher at the Ministry of Education, Turkiye	*2014*
Software Developer at the 2 Adam Software & Technology, Turkiye	*2009-2011*

EDUCATION

Ph.D. in Applied High-Energy and Particle Physics — Cukurova University, Turkiye
M.Sc. in Applied High-Energy and Particle Physics — Cukurova University, Turkiye
B.Sc. in Physics — Cukurova University, Turkiye
Associate Degree in Finance — Anadolu University, Turkiye
Youth Software Engineering Program (4-years) — Nurten Yetimoglu, Turkiye

RESEARCH EXPERIENCE

L3 Convener of the NPS MC&IT Group
*As the L3 Trigger Convener for the **N**ew **P**hysics with **S**tandard Objects (NPS) group, I lead the design, optimization, and validation of trigger strategies to support a wide range of new physics searches. I work in close coordination with analysis teams to ensure trigger coverage aligns with physics goals and detector constraints. I also developed a robust, scalable trigger monitoring system—applicable across CMS groups (e.g., EXO, NPS, HIG) — The final goal is to run autonomously using effective ML techniques for real-time performance evaluation.*

CMS Inner Tracker Silicon Module Production for CMS Phase II Upgrades
Played a central role in the production of silicon sensor modules in CUA's ISO-8 cleanroom for the Inner Tracker Forward Pixel (TFPX) detector, a key deliverable of the CMS Phase II upgrades aimed at sustaining detector performance under high-luminosity conditions. Responsibilities included coordinating day-to-day assembly workflows, enforcing quality-control procedures, and supervising a multidisciplinary team consisting of a lab technician, two graduate students, and several undergraduate interns. In addition, coordinated the TFPX Assembly Meetings between 2023–2025 and helped facilitate module production across five U.S. institutions: Catholic (CUA), Purdue, Nebraska–Lincoln (UNL), Boston, and Vanderbilt.

CalVision Data Acquisition (DAQ) Framework
I developed a Python-based Data Acquisition (DAQ) system from scratch for CalVision BGO crystal testing that consistently monitors and records crystal test campaigns. It streamlines how different instruments and test setups feed data into a common workflow, making it easier for students and collaborators to run measurements, document results, and compare results across studies. The framework is designed to be maintainable and expandable.

Advancement in CMS Tracker Monitoring Tool
I contributed to the development of the CMS Tracker Data and Performance Monitoring tool by extending its capabilities and improving its usability for day-to-day detector operations. In particular, I introduced new functionalities such as real-time monitoring of auto-masked channels to assess the status of individual channels and diagnose the origin of issues quickly.

Dijet Resonance Search with the Calo-Scouting Technique Using 117 fb^{-1} at $\sqrt{s} = 13$ TeV
Performed a dijet resonance search targeting new phenomena such as dark-matter mediators, Grand Unified Theory (GUT) states, or models with extra dimensions, using the CMS calo-scouting data stream to access lower-mass regions with high statistical precision. The analysis set the most stringent CMS limits to date on the universal coupling g'_q of a leptophobic Z' boson to quarks, achieving expected sensitivities comparable to those of ATLAS and slightly stronger observed limits in the relevant mass range. The results were presented at major international conferences (Moriond 2025, Pheno 2025) and submitted to JHEP.

SPS H2 Beamline Simulation – HGCAL Test-Beam
This work addressed the energy loss observed in the October 2018 HGCAL test-beam data by combining on-site measurements with a high-fidelity Geant4-based simulation of the SPS H2 beamline. The study examined the impact of vacuum and air sections, as well as material interactions with beamline instrumentation such as scintillators and wire chambers. This detailed modeling improved agreement between test-beam data and Monte Carlo (MC) simulations, supported a more reliable HGCAL calibration, and prompted beamline adjustments that enabled cleaner beam delivery by the H2 experts. The same realistic beamline description was later incorporated into the FASER MC, improving its simulation accuracy by about 20%.

SPS H4 Beamline Simulation – CMS ECAL Test-Beam
Building on the techniques developed for the HGCAL test-beam program, this study extended the beamline modeling to the SPS H4 line used for mostly CMS ECAL tests. A comprehensive treatment of material effects, Bremsstrahlung, synchrotron radiation, multiple scattering, and even environmental conditions (humidity and temperature) was included. Using data collected during in-situ visits, a detailed and realistic H4 beamline configuration was implemented, resulting in a highly accurate Monte Carlo (MC) description of the test-beam conditions and a more reliable interpretation of ECAL performance studies.

High Granularity Calorimeter (HGCAL) Muon/MIP Calibration with Test Beam Data
The goal of this work was to calibrate each HGCAL channel using the Minimum Ionizing Particle (MIP) constant, which maps raw ADC counts to a common MIP-based energy scale and allows the energy deposited in the calorimeter to be expressed in MIP equivalents. By suppressing noise contributions in the ADC spectra, the procedure improved the stability and uniformity of the electronic response at the module, chip, and channel levels. In addition to the standard muon-based approach, the study also showed that a comparable MIP calibration can be derived from hadronic particles (e.g., pions), providing a practical alternative when dedicated muon beams are limited.

High Granularity Calorimeter (HGCAL) Test-Beam Data Analysis
HGCAL is a new CMS sub-detector designed to measure both electromagnetic and hadronic particles. In this study, I worked on identifying and separating these two particle populations in test-beam data by constructing beam profiles from the calorimeter response. This approach also allowed us to detect and isolate performance issues in specific regions of the detector and trace the reason to nearby electrical components present during the test beam. Based on these findings, the HGCAL team decided to take corrective actions in the affected area and to relocate or shield the nearby electronics to improve the performance and stability of the impacted modules, chips, and channels in future test beams.

Troubleshooting Power Module Issues in the CMS Back-End Electronics
I worked on resolving temperature-related issues that arose in the power modules of the CMS backend electronics during the proton-proton collisions at the CMS experiment. We've developed a Raspberry Pi-based system to collect temperature readings from the modules for further analysis. The "NATview" and "Telnet" frameworks are used for management and configuration of the Schroff and Vadatech microTCA crates. Various strategies were developed and implemented to reduce the heat generated by the power modules during Run-2 data-taking! Ultimately, the HCAL group agreed on a special configuration that was applied as the solution for these temperature problems. The solution has been remarkably successful during the Run-3 data taking.

Performance and Background Noise Analysis of Hadronic Forward (HF) Calorimeter with 2016 CMS Data
During a major maintenance and upgrade period for the CMS experiment at CERN between 2013 and 2015 (Long Shutdown 1), necessary improvements were made to acquire data at an energy level of 13 TeV. In 2016, the CMS detector began collecting data from proton-proton collisions at this enhanced energy level for the first time. This project focused on analyzing the performance and stability of a particular sub-detector of the CMS Experiment called the Hadronic Forward (HF) Calorimeter, which is crucial for detecting certain types of particles. Specifically, I assessed the efficiency of noise filters in the HF Calorimeter using the data collected from proton-proton collisions at 13 TeV in 2016.

MENTORING & OUTREACH PROJECTS

Search for High-Mass Dijet Resonances in Proton-Proton Collisions at $\sqrt{s} = 13.6$ TeV
I mentored a graduate student undertaking a comprehensive investigation into dijet resonance in proton-proton collision data collected from the CMS Detector operating at a collision energy of $\sqrt{s} = 13.6$ TeV. My role involves providing guidance from the initial phases of research design through to the eventual publication, ensuring rigorous data analysis and interpretation within the high-energy physics domain.

Silicon PhotoMultiplier (SiPM) Performance Analysis of the CMS Hadronic End-Cap
I mostly mentored a graduate student to analyze the performance of Silicon Photomultipliers (SiPMs) that are used in Hadronic calorimeters of the CMS Experiment. Initial studies focused on a specific

part of the detector, where these new sensors were first used, and found everything to be working well. However, we spotted minor technical issues in some eta-phi regions of the detector due to a power supply failure (2018). After the investigation, the impact of this problem on the actual physics data was found to be minimal. Eventually, the problem is fixed by replacing the faulty equipment during the LS2.

Cosmic Ray Detector for Educational Outreach and Muon Lifetime Studies
I built a cosmic ray detector utilizing four photomultiplier tubes (PMTs) to identify and measure the lifetime of cosmic muons. This project served a dual purpose: to conduct high-precision measurements of muon decay and to engage high school and undergraduate students in hands-on research within high-energy physics, fostering a deeper interest in the field and cultivating the next generation of physicists.

Development of a Basic Particle Detector with Visual Tracking for Educational Outreach
I designed and 3D-modeled a compact detector system that combines Geiger tubes (LND-712) with a cloud-chamber-style visual component to detect and simultaneously display alpha, beta, and gamma particle activity. Data from the tubes were digitized with an MCP3008 ADC and read out via a Raspberry Pi, allowing students to record and analyze radiation signals while also seeing particle tracks in real time. This setup was intentionally built for high school and undergraduate outreach, giving students a tangible way to connect detector principles with actual measurements and fostering a deeper understanding of particle interactions.

Training, Outreach, and Mentoring within the TFPX Module Production Program
In parallel with the production activities at CUA, I contributed to the onboarding and day-to-day mentoring of students and interns involved in the TFPX assembly work. I provided hands-on guidance on cleanroom practices, documentation, and basic detector concepts, enabling undergraduate and early-stage graduate students to participate in CMS hardware tasks in a structured manner. By helping define clear, achievable tasks, I supported broader student participation in the CMS Phase II activities at CUA and contributed to building a steady pool of trained personnel for ongoing module production.