

# Hichem Bouchamaoui

HIGH ENERGY PHYSICS EXPERIMENTALIST

Princeton, NJ, USA

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## Education

### Princeton University

PHD IN HIGH ENERGY PHYSICS EXPERIMENT

• Committee: Jim Olsen (advisor), Isobel Ojalvo, Mariangela Lisanti.

Princeton, NJ

July. 2019 - Exp. May. 2025

### Boston University

B.A. IN PHYSICS WITH HONORS AND ECONOMICS, *Summa Cum Laude*

• Advisors: Tulika Bose, David Sperka.

Boston, MA

Sep. 2015 - May. 2019

## Conferences & Invited Talks

### APS April Meeting, Oral Presentation

**DEEPCORE 2.0: CONVOLUTIONAL NEURAL NETWORK FOR TRACKING IN JETS WITH HIGH TRANSVERSE MOMENTUM**

Sacramento, CA

April 2024

### CMS Week, Plenary Talk

**TRACKING IN DENSE ENVIRONMENTS**

Geneva, Switzerland

February 2024

### The 6th Inter-experiment Machine Learning Workshop (IML), Poster

**DEEPCORE 2.0: CONVOLUTIONAL NEURAL NETWORK FOR TRACKING IN THE CORE OF HIGH-ENERGY JETS**

Geneva, Switzerland

January 2024

### CMS Machine Learning Town Hall, Oral Presentation

**PIXEL CLUSTER SPLITTING WITH A CONVOLUTIONAL NEURAL NETWORK**

Remote

July 2020

### Boston University Undergraduate Research Opportunities Program Symposium, Poster

**EVALUATION OF THE PERFORMANCE OF A BOOSTED DECISION TREE (BDT) IN THE CMS SEARCH FOR A  $W'$  BOSON**

Boston, MA

October 2017

## Honors & Awards

2021 **Physics Department Teaching Award**, Princeton University

Princeton, NJ

2019 **College Prize for Excellence in Physics**, Boston University College of Arts and Science

Boston, MA

2017 **Phi Beta Kappa Award**, Boston University Epsilon of Massachusetts Chapter

Boston, MA

2017 **UROP Scholarship**, Boston University Undergraduate Research Opportunities Program

Boston, MA

## Schools & Academic Training

2024 **The CMS Data Analysis School (CMSDAS)**, CMS and Fermilab

Batavia, IL

2023 **The IAIFI PhD Summer School**, Institute for Artificial Intelligence and Fundamental Interactions

remote

2022 **Business Skills for Ph.D.s in Academia & Beyond**, GradFutures, Princeton University

Princeton, NJ

2022 **Hadron Collider Physics School 2022 (HASCO)**, CERN and University of Goettingen

Goettingen, Germany

2022 **CMS course: Machine Learning**, Prof. Sergei Gleyzer, University of Alabama

remote

2021 **CMS course: Statistics in Particle Physicists**, Prof. Harrison B. Prosper, Florida State University

remote

2020 **CMS course: The Science and Lore of Instrumentation for Particle Physics**, Prof. Roger Rusack, The University of Minnesota

remote

## Teaching Experience

SU 2021 **PHY 110 Lab (Accelerated Intro E&M)**, Princeton University

Princeton, NJ

SP 2021 **PHY 103 Lab (Intro E&M)**, Princeton University

Princeton, NJ

FA 2020 **PHY 101 Lab (Intro Mechanics)**, Princeton University

Princeton, NJ

SP 2019 **PY 451 (Quantum Mechanics)**, Boston University

Boston, MA

## Research Projects & Relevant Experience

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### DeepCore 2.0: Convolutional Neural Network for Tracking in Jets with High Transverse Momentum (CMS-DP-2024/003)

Princeton, NJ

JIM OLSEN (ADVISOR), SLAVA KRUTELYOV AND MARCO MUSICH (TRACKING POG CONVENERS)

Aug. 2021 -

- Updated DeepCore to DeepCore 2.0, which include big fixes, updated training, Run 3 configuration and more, leading to a significant tracking performance improvement compared to the original iteration of DeepCore (DeepCore 1.0).
- Overcame the limitation of the DeepCore 1.0, which has significantly lower tracking performance on displaced tracks, by optimizing a hybrid of DeepCore 2.0 and the legacy algorithm JetCore (DeepCore 2.0 Hybrid).
- DeepCore 2.0 Hybrid results in a  $\sim 10\%$  increase in the total CMS tracking efficiency relative for tracks with  $p_T > 100$  GeV and a  $\sim 1\%$  reduction in CPU time of the overall CMS tracking reconstruction.
- DeepCore 2.0 Hybrid is implemented in CMSSW as of 2024 for data taking/MC and future (re)processing, with validation ongoing.

### CMS Service Work

Princeton, NJ

JIM OLSEN (ADVISOR)

Feb. 2020 -

- Took 20+ DQM shifts during 2022.
- Tracking POG Machine Learning Liaison since May 2023.

### Pixel Cluster Splitting with a Convolutional Neural Network (Master's Thesis)

Princeton, NJ

JIM OLSEN (ADVISOR)

Feb. 2020 - Aug. 2021

- Optimized a CNN to identify and split merged pixel clusters in the first layer of the Compact Muon Solenoid (CMS) pixel detector.
- Presented preliminary results to the CMS Pixel Offline group and Tracking POG, who suggested I work on the DeepCore project since they shared many similarities and my experience could lead a working version of DeepCore that can be implemented in the CMS track reconstruction.

### Evaluation of the performance of a Boosted Decision Tree (BDT) in the context of the CMS Search for a $W'$ Boson (Senior Thesis)

Boston, MA

TULIKA BOSE AND DAVID SPERKA (ADVISORS)

June. 2017 - May. 2019

- Optimized a BDT in the context of the CMS sensitivity to a  $W'$  boson relative to the cut-based analysis.
- Improved the CMS sensitivity to mass points 1, 2, 3 and 4 GeV in both electron and muon channels, relative to the  $W'$  cut-based analysis.

### Lab Technician at the Boston University Electronics Design Facility

Boston, MA

ERIC HAZEN (SUPERVISOR)

Jan. 2016 - May. 2017

- Wrote a program (C++) that reads and decrypts events payloads from the "AMC 13" (CMS data) .
- Assembled several high voltage boards for the G-2 experiment as well as clock injector boards for the LHC.
- Designed a micro-controller (circuit board), assembled it and wrote an Arduino program using the I2C protocol (C) that monitors a micro-TCA, and includes a user interface (Python).

## Leadership & Outreach

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### Princeton Physics Ambassadors Program

Princeton, NJ

TREASURER 2021- , OPEN HOUSE LIAISON IN 2021 & 2022, AMBASSADOR OF THE NEW ENGLAND REGION AND INTERNATIONAL

Sep. 2020 -

AMBASSADOR FOR EUROPE AND AFRICA 2021 & 2022, FOUNDING MEMBER 2020

- Reached out to state schools and universities with underrepresented minorities to invite them to our events about physics graduate school.
- Held office hours to answer students' questions about physics graduate school application and graduate life at Princeton University.
- Helped organize the 2021 Princeton Physics Open House as ambassador liaison in the open house committee, by answering prospective students' questions, reaching out to them individually and putting together the Equity, Diversity and Inclusion (EDI) panel, resulting in the highest ever recorder admission rate among female identifying students - close to 40% of the 2026 Princeton physics admitted students.
- First and current treasurer of the executive board, in charge of overseeing the budget of the Princeton Physics Physics Preview (P4) program, webinar series and future initiatives.
- Contributed to the Princeton Physics Ambassadors Program's talk at [APS April meeting 2022](#).

### Princeton University Physics Equity, Diversity and Inclusion Initiative

Princeton, NJ

MEMBER OF THE GRADUATE RECRUITMENT GROUP, MEMBER OF THE SOCIAL MENTORING GROUP, COORDINATOR OF RESPECT IS

June. 2020 - May. 2023

PART OF RESEARCH

- Founded the Princeton Physics Ambassadors program that aims to reach out to underrepresented minorities in physics.
- Improved the admission process by having one of the students from Graduate Recruitment sit on the admission committee and review all applications from underrepresented minorities.
- Boosted Princeton Physics' attendance in major conferences for underrepresented minorities like SACNAS (Society for Advancement of Chicanos/Hispanics and Native Americans in Science) and NCBPS (National Conference of Black Physics Students).
- Founding member of the Princeton Physics Social Mentoring group, which aims to support physics graduate students during their first year, particularly underrepresented minorities, and make them feel welcome in the department.
- Made and lead a workshop called "Respect is Part of research" that aims to improve the work environment and prevent sexual harassment/sexual violence in the physics department, by making use of case studies inspired from real stories. This workshop is inspired from the workshop of the same name that is offered in the physics department at UC Berkeley.

## Princeton Women in STEM Leadership Council

Princeton, NJ

TREASURER 2021-2022, MEMBER 2020-2021, 2022-

Feb. 2020 -

- Organized events that promotes women participation in STEM fields, like social networking events with women identifying faculties in Princeton.
- Planned and led the organization committee of a hybrid workshop about responding to systemic racism in class and academic settings, directed to first year and second year graduate students in STEM fields at Princeton.
- Organized a discussion panel demystifying the reporting process with Title IX and Title VI representatives.
- Won Princeton University's **Best of Access, Diversity, and Inclusion (BADI) Award** for "Outstanding Programming" as part of the executive board of the Women in STEM Leadership Council.

## Boston University Student Physics Society

Boston, MA

PRESIDENT 2018, CO-PRESIDENT 2017, VICE-PRESIDENT 2016, MEMBER 2015

Sep. 2015 - May. 2019

- Helped Physics majors to get into research and provided them with weekly free tutoring sessions.
- Gave a talk about my research project at the 2018 Greater Boston Society of Physics Student Conference.

## Boston University College of Arts and Science Student Government

Boston, MA

BUDGET COMMITTEE REPRESENTATIVE OF NATURAL SCIENCES

Sep. 2015 - May. 2019

- Supports funding of Boston University organizations related and help them put together their budget.
- Collaborated with other representatives to efficiently allocate our \$ 60,000 yearly budget across more than 30 student organizations.

## Technical Skills and Languages

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- **Programming Languages:** C/C++, Python, Mathematica, MATLAB, VHDL, Turbo Pascal, Stata.
- **Software Packages:** ROOT, PyROOT, TensorFlow, Keras, Scientific Python.
- **Physics Tools:** Pythia 8, Madgraph5, CMSSW, CRAB3, Condor.
- **Other Tools:** GitHub/GitLab, Jupyter, Vim, ExpressSCH/PCB.
- **Languages:** Fluent in French, Arabic and English. Beginner in Japanese, Turkish and Spanish.