Rikab Gambhir

Curriculum Vitae

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Center for Theoretical Physics, MIT
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Education

2020-Present **PhD Candidate (Expected 2025)**, *Center for Theoretical Physics*, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA.

Advisor Jesse Thaler

2016-2020 **Bachelor of Science**, *Majors in Physics, Applied Science Engineering, and Mathematics*, Rutgers University Honors College - New Brunswick, New Jersey, USA.
GPA : 4.00/4.00, Graduated with Highest Honors, Ranked 1/992

Advisor Stephen Schnetzer

Thesis A Search for Fully Hadronic Final State Vector-Like Quark Pair Production in 13TeV pp Collisions using CMS Data

Honors

2022 **MIT Open Data Prize**, *Honorable Mention*.
Prize awarded by MIT for use of open data tools

2020 **Weidner Award**.
Prize awarded by the Rutgers Physics Department for academic performance

2019 **Barry Goldwater Scholar**.
Selected by the Barry Goldwater Scholarship and Excellence in Education Foundation and the Department of National Defense Education Program for research

2019 **Mary Wheeler Wigner Memorial Scholarship**.
Scholarship awarded by the Rutgers Physics Department for academic performance

2018 **Herman Y. Carr Scholarship**.
Scholarship awarded by the Rutgers Physics Department for academic performance

2018 **Kuhl Memorial Engineering Scholarship**.
Scholarship awarded by the Rutgers Engineering Department for academic performance and leadership

2017 **Aresty Summer Science Fellowship**.
Fellowship awarded to rising sophomores for conducting research over the summer

Publications

February 2023 **SHAPER: Can You Hear the Shape of a Jet?**, *Rikab Gambhir, Benjamin Nachman, and Jesse Thaler*, arXiv:2302.12266, J. High Energ. Phys. 2023, 195 (2023).

May 2022 **Bias and Priors in Machine Learning Calibrations for High Energy Physics**, *Rikab Gambhir, Benjamin Nachman, and Jesse Thaler*, arXiv:2205.05084, Phys. Rev. D 106, 036011.

May 2022 **Learning Uncertainties the Frequentist Way: Calibration and Correlation in High Energy Physics**, *Rikab Gambhir, Benjamin Nachman, and Jesse Thaler*, arXiv:2205.03413, Phys. Rev. Lett. 129, 082001.

December 2020 **A search for bottom-type, vector-like quark pair production in a fully hadronic final state in proton-proton collisions at $\sqrt{s} = 13$ TeV**, *CMS Collaboration*, arXiv:2008.09835, Phys. Rev. D 102, 112004.

Works In Progress

Muon Beam Dump Phenomenology.
Calculations relevant for muon beam dump and muon collider searches for new physics

Moment Pooling: Gaining Performance and Interpretability Through Physics Inspired Product Structures, *Rikab Gambhir, Athis Osathapan, and Jesse Thaler*.
We develop new architectures, based on the Energy Flow Network [1810.05165], with built-in product structures to improve both the performance and interpretability of learned observables though a simple factorization.

Presentations

11 July 2023 **How Do I Take My Cup of CMS Open Data**.
Invited Talk, Fermilab Open Data Workshop, 11 July 2023, Batvaria, Illinois

17 April 2023 **Moment Pooling: Gaining Performance and Interpretability Through Physics Inspired Product Structures**.
APS April 2023, 17 April 2023, Minneapolis, Minnesota

3 December 2022 **Learning Uncertainties the Frequentist Way: Calibration and Correlation in High Energy Physics**.
Poster, 3 December 2022, NeurIPS (Virtual)

12 November 2022 **Learning Uncertainties the Frequentist Way: Calibration and Correlation in High Energy Physics**.
Invited Seminar Speaker, 12 November 2022, ATLAS (Virtual)

13 September 2022 **Learning Uncertainties the Frequentist Way: Calibration and Correlation in High Energy Physics**.
Invited Seminar Speaker, 13 September 2022, University of California, Irvine (Virtual)

15 August 2022 **Can You Hear the Shape of a Jet?**.
BOOST 2022, 15 August 2022, University of Hamburg, Germany

10 April 2022 **Can You Hear the Shape of a Jet?**.
APS April 2022, 10 April 2022, New York, NY

7 July 2021 **Learning Uncertainties the Frequentist Way: Calibration and Correlation in High Energy Physics**.
ML4Jets2021, 7 July 2021, University of Heidelberg (Virtual)

19 April 2020 **A Search for Fully Hadronic Final State Vector-Like Quark Pair Production in 13 TeV pp Collisions using CMS Data**.
APS April 2020, 19 April 2020, Washington D.C (Virtual)

29 July 2019 **A Search for Fully Hadronic Final State Vector-Like Quark Pair Production in 13 TeV pp Collisions using CMS Data**.
2019 Meeting of the Division of Particles & Fields of the American Physical Society, 29 Jul-2 Aug 2019, Boston, MA

4 August 2017 **How Can We Model Insect Flight Quickly and Accurately?**.
2017 Rutgers Summer Aresty Symposium, 4 Aug 2017, New Brunswick, NJ

Mentorship

Summer 2023 **Xinyue Wu**, *Undergraduate MIT Independent Research, Supervised by Jesse Thaler.*

Summer 2022 **Sergio Diaz**, *Undergraduate MIT Independent Research, Supervised by Jesse Thaler.*

Summer 2021 - Present **Athis Osathapan**, *Undergraduate MIT Independent Research, Supervised by Jesse Thaler.*

Summer 2021 **Pedro Rivera-Cardona**, *Undergraduate MIT Summer Research Program, Supervised by Jesse Thaler.*

Teaching

Fall Spring 2023 **MIT 8.011**, *Physics I: Mechanics*, Teaching Assistant.

Fall 2021 **MIT 8.03**, *Physics III: Vibrations and Waves*, Teaching Assistant.

Leadership

2016 - 2020 **Director of the Rutgers Machine Learning & AI Club**.
I gave weekly lectures on deep learning topics, ranging from basic statistics to advanced network architectures, and led students in building and designing their own neural network projects

Technical skills

Programming C++, Python, Java, Android, Bash, LaTeX, Qiskit

Data Analysis Mathematica, Matlab, ROOT, Keras, Pytorch, Tensorflow, Numpy, Scipy, CMSSW

Machine Learning Implementation & Design of CNN's, RNN's, GAN's, Bayesian Networks, Autoencoders, Neural ODE's, Deep Set Networks