Rikab Gambhir

Curriculum Vitae

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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

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

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. We search for the production of a pair of bottom-type, vector-like quarks (VLQ's) each decaying into a b quark and either a Higgs or a Z boson using data from 13 TeV center-of-mass proton-proton collisions recorded by the CMS Experiment, and significantly extend previous exclusion limits.

Works In Progress

Learning Uncertainties the Frequentist Way: Calibration and Correlation in High Energy Physics, *Rikab Gambhir, Benjamin Nachman, and Jesse Thaler*.
We present a machine learning framework for performing frequentist inference with manifest uncertainty extraction in a single training using an information-theoretic loss functional, apply the framework to improve jet energy resolutions in the CMS detector

Manifold Learning Hadron Jet Distributions Via x-KDS, *Demba Ba, Akshunna S. Dogra, Rikab Gambhir, and Jesse Thaler*.
We apply the KDS framework for clustering simplices developed in [2012.02134] to the context of jet physics in order to develop new observables probing the geometric structure of jets.

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.

Talks

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

Teaching

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