"Beyond Classification:

Using Machine Learning to Probe New Physics with the ATLAS Experiment in "Impossible" Final States

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Abstract

Although the discovery of the Higgs Boson is often referred to as the completion of the Standard Model of Particle Physics, the many outstanding mysteries of our universe indicate that some unknown new physics is awaiting discovery. Experiments at the Large Hadron Collider (LHC), including the ATLAS Experiment, offer an exciting opportunity to search the highest reachable energy regimes to directly search for such new physics. At the same time, the large volume of complex data recorded by the ATLAS Experiment make it an especially prime candidate for taking advantage of the artificial intelligence and machine learning revolution. Thus far, one major application of machine learning in ATLAS has been for better separating a physical process of interest (signal) from other Standard Model processes producing similar detector signatures (background). However, we can also cleverly utilize machine learning beyond simply classifying signal versus background, for example better modeling these background processes or better identifying particles within particle collision data. In this talk, I will present examples of how using machine learning in such ways can open up "impossible" regions of data for analysis. I will also discuss how future advances in artificial intelligence and machine learning will continue to open new avenues for probing for new physics.

Biography

Rachel Hyneman is currently a Research Associate with the ATLAS group at SLAC National Accelerator Laboratory in California. Her primary research pursuits include: studying the properties of the Higgs Boson to search for hints of new physics; developing machine learning techniques to improve data analyses at the ATLAS experiment; and developing construction procedures for the upgraded ATLAS Inner Tracker system. Concurrently with her research, she has committed to leading multiple Diversity, Equity, and Inclusion efforts to improve the climate at the lab. Prior to joining SLAC, she completed her doctoral studies in 2020 at the University of Michigan, also as part of the ATLAS experiment.