The Higgs Boson: Improving the Detection of Fundamental Particles Using Neural Networks

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It's of scientific interest to develop techniques to analyze the large amounts of data generated by particle accelerators such as the LHC in order to complete the standard model. We've developed an automated method of analyzing data from the ATLAS detector to detect the Higgs boson using machine learning techniques. We've constructed a neural network to classify Higgs to Tau-Tau decays based on simulated data from the ATLAS detector. The network was found to be able to show the existence of the Higgs with a certainty of 99.94% after 5 positive predictions which is at least as accurate as the winning model of the Kaggle competition ($p<1e-13$). Furthermore, we show how the network may be generalized to classify other elementary particles using transfer learning, and how we may find, and selectively isolate a transferable distribution between two domains using Generative Adversarial Networks, and some domain knowledge which wouldn’t be possible using the architecture from the competition.