Abstract

Lawrence Livermore National Laboratory

Improving High-Energy Particle Detectors with Machine Learning

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Microseconds after the Big Bang, the universe existed in a state called the quark-gluon plasma (QGP). To experimentally study its properties, the QGP is recreated in high-energy nuclear collisions at the LHC, and the particles produced from the QGP are reconstructed from their energy deposition in the calorimeter. This requires both classifying the particles and calibrating their deposited energy. The objective of this project is to improve the reconstruction by using machine learning techniques, where the energy depositions of clusters of cells, formed by ATLAS topo-clustering methods, are treated as three-dimensional images when inputted to the neural networks. This approach significantly improves the calibration of deposited energies when cross-validating while training. Additionally, models trained on idealized data predict the calibrated energies of particles in more complex data sets well. This work illustrates that using machine learning methods for both classification and calibration has the potential to significantly improve particle reconstruction.