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How to Apply Machine Learning to  
Experimental & Theoretical  
**PHYSICS**

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## Machine Learning for Calorimetry Physics: Classification and Anomaly Detection

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FoCal-H is a hadronic calorimeter currently under development and is intended as a part of an upgrade to the ALICE experiment at the LHC at CERN. As part of an Applied Machine Learning course, we looked at real data from FoCal-H and used machine learning techniques on it. Data was collected during testbeams where particle type and energy are selected and fired at the device. With labelled data we were able to do supervised learning as well as unsupervised learning. Our approach was to compute features for all the events, and in particular, we computed Hu Moments, which are moments that are invariant under certain transformations. We were able to train models to predict particle type with around 98% accuracy, and less successful with other labels like energy. We also did anomaly detection by hand-picking good events and translating, rotating and mirroring them into new events to augment the original hand-picked set. This method showed promise.

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