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Studying Hadronic Shower Development in HERD CALO with Machine Learning

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The High Energy cosmic-Radiation Detection (HERD) facility will be installed as a space astronomy payload on the China Space Station in 2028. The three-dimensional imaging calorimeter (CALO) of HERD comprises about 7500 lutetium yttrium oxy-orthosilicate (LYSO:Ce) cubes, where the topological development of hadronic showers can be measured. Over the years, advancements in deep learning, particularly Convolutional Neural Networks (CNNs) and Transformers, have demonstrated state-of-the-art performance in high energy physics. These deep learning architectures are designed to exploit large datasets to reduce complexity and find new features in data. In this seminar, I will discuss the application of the CNN and Transformer techniques to precisely reconstruct the parameters of a hadronic shower initiated in HERD CALO. Both models are optimized using isotropic proton simulations and demonstrate superior performance over a wide energy range from 30 GeV up to 1 TeV. After some adaptation, these architectures could be applied for different types of calorimeters.

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