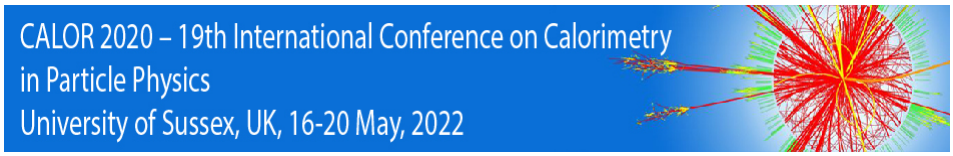

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Graph Neural Networks and the reconstruction of pions and electrons in the CMS HGCAL

As part of the development of the CMS High Granularity Calorimeter (HGCAL), a series of beam tests have been conducted using prototype segmented silicon detectors. In a test conducted at the CERN SPS H2 beam line in 2018, the performance of a prototype calorimeter equipped with ≈12,000 channels of silicon sensors (for the 28-radiation-length, one interaction length electromagnetic section and an additional four-interaction-length hadronic section), supplemented with the CALICE AHCAL (Analogue Hadronic Calorimeter) prototype scintillator+SiPM sampling calorimeter. Together this configuration is close to the final design of the HGCAL. Data were taken with beams of high-energy electrons, pions and muons with momenta ranging from 20 to 300 GeV/c. The measured performance is compatible with the HGCAL design specifications.

The reconstruction of the events observed has been carried out using both a traditional weights-based methods and an advanced deep-learning algorithm based on detailed low-level hit information. The deep-learning method uses dynamic graph neural networks (GNN) and effectively images the shower development in three spatial dimensions, while also measuring the corresponding energy deposition in the active elements. The results obtained with the GNN show a significant improvement in the relative energy resolution for pions compared to the weights-based reconstruction technique.

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