

Digital Electromagnetic Calorimetry with Extremely Fine Spatial Segmentation

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The CALICE Digital Hadron Calorimeter, the DHCAL, utilizes Resistive Plate Chambers, RPCs, as active media. The readout is provided by 1 cm x 1 cm pads with the front-end electronics directly coupled to the RPCs. The chambers including the readout are housed within a cassette structure with steel and copper front and back planes. The cassettes are interleaved with iron or tungsten absorber plates to incite hadronic and electromagnetic interactions.

In special tests, the active layers of the DHCAL were exposed to low energy particle beams, without being interleaved by absorber plates. The thickness of each layer corresponded approximately to 0.29 radiation lengths or 0.034 nuclear interaction lengths. Here we report on the measurements performed with this device in the Fermilab test beam with positrons in the energy range of 1 to 10 GeV. The measurements provide unprecedented spatial detail of low energy electromagnetic interactions with a factor of approximately 5000 finer granularity compared to conventional electromagnetic calorimeters. The results are compared to simulations based on GEANT4 and a standalone program to emulate the detailed response of the active elements.

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