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Performance of segmented lead glass absorber calorimeter prototype

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Sampling calorimeter is essential for physics measurements in high-energy frontier collider experiments using Particle Flow Algorithm (PFA). In order to separate the particles in a jet incident on the calorimeter, three-dimensional detailed information is required. Therefore, in calorimeters optimized for PFA, not only energy information but also position information is very important. Location information can be improved by creating a very fine granulated detection layer. However, energy resolution is principally determined by the sampling ratio.

Energy resolution can be dramatically improved if energy information can be read using lead glass as the absorption layer. In order to independently observe the energy in the narrow area required to use PFA, it is necessary to divide the lead glass into small pieces that are independent of each other. A small optical sensor is required to read out the Cherenkov light from a small lead glass block. To read a lot of small lead glass blocks, the dead volume between layers can be reduced by using MPPC, this optical sensor thickness is very thin. This sampling calorimeter using lead glass blocks as the absorption layers is useful for experiments that require the high energy resolution in the future.

We are developing a prototype of a calorimeter with a segmented lead glass absorption layer that takes PFA into account. The prototype absorber layer size is 9x9x4cm^3 and consists of nine 3x3x4cm3 lead glass blocks. The detection layer can read position information of 1x1cm^1 using a plastic scintillator with a width of 1cm. Backward energy leakage is measured with a tail catcher using a single 12x12x25cm^3 lead glass block. All detectors are optically read out using MPPCs.

We tested this prototype using the positron beam at Research Center for ELectron PHoton Science, Tohoku University. First, a positron beam was injected into each lead glass block channel for calibration. Then, the performance of the whole prototype was evaluated by injecting the beam.

As a result of the beam injection test of the prototype with three segmented lead glass absorption layers, the overall energy resolution is 13%. We will report on the performance of this prototype.

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