

Study on Granularity Optimization for ILD Hadron Calorimeter

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The Analogue Hadron CALorimeter (AHCAL) at the International Linear Collider (ILC) is a high granularity hadron calorimeter based on scintillator tiles readout by MPPCs. Toward the construction of ILC, it is necessary to make a more realistic design of ILD detector. The optimization of AHCAL granularity is, therefore, now revisited, and we study the mixed granularity with larger scintillator tile at outer layers. However, the performance of the larger tile than standard $30\times 30\text{mm}^2$ tile has not ever been demonstrated. We tested the performance such as light yield and uniformity by using the prototype with a $60\times 60\text{mm}^2$ tile. Light yield of $60\times 60\text{mm}^2$ tile is found to be about a half of $30\times 30\text{mm}^2$ tile, while $60\times 60\text{mm}^2$ tile has excellent uniformity in tile response. Since the performance of the single tile was demonstrated, a detection layer composed of 144 tiles of $60\times 60\text{mm}^2$ was constructed. MPPCs with a twice larger active area ($2\times 2\text{mm}^2$) than that for the standard detection layer are used to recover light yield reduction. It was added to the large technological prototype of AHCAL composed of 38 detection layers with the $30\times 30\text{mm}^2$ tiles.

A test beam experiment was carried out at May and June/July 2018. The detection layer with $60\times 60\text{mm}^2$ tiles worked properly. The peak of single photoelectron is clearly resolved and $60\times 60\text{mm}^2$ tiles on HBUs have good enough light yield. We report in details the performance of the larger scintillator tile and the detection layer with $60\times 60\text{mm}^2$ tiles.

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