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Highly granular scintillator-strip electromagnetic calorimeter for future Higgs factories

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Several future Higgs factories based on the electron-positron collider are planned for precision Higgs physics to search for the new physics beyond the Standard Model. The calorimeters with the high granularity play a crucial role on the precision Higgs measurement. Especially the high granularity of the cell size of the $5\text{ mm} \times 5\text{ mm}$ is required for the electromagnetic calorimeter.

The Scintillator Electromagnetic CALorimeter (Sc-ECAL) is one of the technology options for the ECAL at the future Higgs factories. It is based on a scintillator strip readout by a Silicon Photomultiplier (SiPM) to realize the $5\text{ mm} \times 5\text{ mm}$ cell size by aligning the strips orthogonally in x-y configuration. In order to demonstrate the performance of the Sc-ECAL and the scalability to the full-scale detector, the technological prototype has been developed with the full 30 layers.

The commissioning of the prototype is based on long-term tests with LED and cosmic-ray. The per-channel calibrations are successfully done for the key parameters of the Sc-ECAL. It is found that the Sc-ECAL can be properly calibrated and operated.

The performance of the Sc-ECAL is evaluated. The key parameters are successfully monitored and it is found that most of the parameters show excellent stabilities over a long period. The efficiency and position resolution are found to be consistent with the Monte Carlo simulation, and the position resolution meets the requirement of the cell size of $5\text{ mm} \times 5\text{ mm}$. The shower analysis is performed using the cosmic-ray. The showers induced by the cosmic-ray are successfully measured as expected in the simulation.

In conclusion, the Sc-ECAL is found to be a promising and mature technology for the highly granular calorimeter to achieve the precision physics at the future Higgs factories.

Collaboration

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