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Advancing Timing Resolution of Strip Scintillators for Electromagnetic Calorimeters

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In the upcoming generation of collider experiments, such as the proposed Linear Collider Higgs Factory, precise measurement of particle flow (PF) is pivotal for enhancing the energy resolution of jets, which consist of numerous hadrons observed in the final state. To achieve this, we focus on equipping fine-segmented electromagnetic calorimeters with high-precision time measurement capabilities, thereby facilitating improved discrimination of particles within jets and aiding in cluster reconstruction within the jet calorimeter.
In our research, we emphasize the essential role of electromagnetic calorimeters with highly-segmentation, necessitating a cell size of 5 mm x 5 mm. By enhancing each cell with high-precision time measurement, we aim to advance the accuracy of energy measurements and improve the identification of parent particles within jets. Furthermore, our approach holds promise for exploring Beyond the Standard Model (BSM) physics, particularly in the detection of long-lived particles.
To achieve these objectives, we have developed a novel configuration for the electromagnetic calorimeter, employing scintillator strips arranged orthogonally to ensure both positional resolution and a reduced number of readout channels. The scintillator strips have been read out the scintillation light at the both end edges by serially connected silicon photo-sensors. This configuration increase the photons and improve the time resolution. Various configurations are tested at the beam test at KEK. Moreover, our measurements are anticipated to refine the accuracy of time measurements within electromagnetic showers. Through electron beam tests, we have demonstrated significant improvements in time resolution performance. In this presentation, we will showcase the results of our efforts to enhance the optical readout method of the current strip scintillator for electromagnetic showers, thereby advancing the capabilities of linear collider Higgs Factory collider experiments.

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