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Electronic readout system for Belle II imaging Time of Propagation detector

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Content

The imaging Time of Propagation (iTOP) detector is a new quartz Cherenkov radiation detector to work at the Belle II experiment. The iTOP will identify, with high precision, charged hadrons created in electron-positron collisions at the SuperKEKB collider. With its timing resolution of less than 50 ps, the iTOP will help searching for rare and previously unobserved physics events while minimizing effects of SuperKEKB beam backgrounds on the reconstructed data. The iTOP is built as a 16-module barrel detector placed at Belle II between the Central Drift Chamber and the Electromagnetic Calorimeter. In the iTOP, Cherenkov photon signals are collected by microchannel plate photomultiplier tubes. Sixty four (four per each iTOP module) 128-channel electronic Subdetector Readout Modules (SRMs) sample the collected photon signals, digitize them, read out the digitized data, and then forward them to the Belle II back-end data acquisition system. Every SRM is composed of five boards. Four of those boards carry application-specific integrated circuits (ASICs) that perform sampling and digitization; every board (the ASIC carrier board) has four 8-channel ASICs mounted on it. Sampling and digitization in each channel is done by a 16 x 32 (x 64) switched capacitor array using Wilkinson method. The ASIC carrier board, in addition, has a field-programmable gate array that reads out the digitized data from the on-board ASICs. The fifth board of the SRM, named as Standard Control Readout Data (SCROD) board, collects data from the four ASIC carrier boards, then buffer and forward them through an optical link to the back-end data acquisition system. The field-programmable gate array mounted on the SCROD board formats the data collected from the ASIC carrier boards. The iTOP 8192-channel front-end electronic readout system was built and integrated at Belle II. In situ commissioning of the system is underway. Performance studies of the calibration laser data acquisition, with and without magnetic field of 1.5 T, demonstrate that the iTOP channels collect data with the timing resolution of less than 50 ps.

Summary

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