

Belle II Electromagnetic Calorimeter

Tuesday, 17 May 2016 17:20 (20 minutes)

At present new SuperKEKB collider is under commissioning at KEK (Japan) while the Belle II detector for experiments at this collider is at the final stage of the construction. This new experiment will continue and widen the studies began at the previous experiments with the Belle detector. The luminosity of this collider will exceed the previous one by about 40 times, amounting to $8 \times 10^{35} \text{cm}^{-2} \text{s}^{-1}$. However, high luminosity is unavoidably accompanied by the high event rate and background. Then the detector should be drastically upgraded. The electromagnetic calorimeter is a very important component of the BELLE II detector. This calorimeter is described in this report. A core part of the calorimeter, 8736 counters based on CsI(Tl) crystals read out by PIN photodiodes, is reused from the Belle detector which operated at the KEKB asymmetric energy collider from 1999 to 2010. Since the project luminosity of the SuperKEKB is 40 times higher than that of the previous collider, much more severe background conditions are expected. Therefore all readout electronics is replaced to a new one that will be able to cope with high event rate.

Signals from preamplifiers attached to the crystals are transmitted to the Shaper Digitizer Boards (SDB). In this board a signal after shaping with a time constant of 0.5us is digitized by 18 bit ADC with 1.8 MHz sampling rate and sent to pipeline buffer in FPGA where waveform fitting is performed to extract energy and timing information. Amplitude and timing data obtained by fit are collected by the Collector Board (CB). The CB sends this information to backend DAQ system. By now all calorimeter DAQ electronics including 576 (432 barrel+144 endcap) SDB and 52 CB are installed to the detector. The barrel part of the calorimeter is tested with cosmic rays.

A second step of the upgrade when the crystals in the end caps are replaced by the fast pure CsI crystals is under study. Since the photon emission of undoped CsI crystal is roughly 10 times smaller than that of doped one, the photosensors with amplification should be used. Current baseline option is vacuum photopentodes, their characteristics and performance study is presented. An option of a read out with the large area APD is also under study.

Summary

The electromagnetic calorimeter of the BELLE II detector for experiments at Super B-factory SuperKEKB is described. This calorimeter is based on the CsI(Tl) scintillation crystals inherited all crystals, mechanical structure, PIN diodes for light readout and preamplifiers from the previous Belle experiment. But new signal processing and DAQ electronics were developed and produced. An option with fast pure CsI crystals in end caps is under development now. This is discussed in this report as well.

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Session Classification: Calorimeters for future accelerator experiments