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128 channel waveform sampling digitizer/readout in the TOP counter for the Belle II upgrade

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Extremely fast timing from Micro-Channel Plate PhotoMultiplier Tubes (MCP-PMTs) and multi-gigasample per second (GSa/s) waveform sampling ASICs will allow precision timing to play a pivotal role in the next-generation of Ring Imaging Cherenkov (RICH) detectors. We have developed a second prototype of the electronics to instrument the Time of Propagation (TOP) counter for the Belle II detector at KEK in Tsukuba, Japan. The front-end electronics modules consist of an array of waveform sampling / digitizing ASICs controlled by FPGAs with embedded microprocessor cores. The ASICs digitize amplified signals from an array of multi-anode MCP-PMTs coupled to a quartz radiator bar. Unwanted artifacts in the data are corrected with digital signal processing and feature-extraction on the front-end. Readout and control are done via multi-gigabit per second fiber optic links to a custom back-end.

A previous generation of these modules has been running in a prototype Focusing Detection of Internally Reflected Cherenkov (fDIRC) counter mounted in a Cosmic-Ray Stand (CRT) at SLAC continuously for over 12 months. The most recent version was taken to a beam test at SPring-8/LEPS in Japan in mid-2013. These experiences have influenced the design of the next set of ASICs and PCBs for the front-end, and we will present details on the latest generation.

Summary

We will present details on the latest generation of the front-end electronics (amplifiers, ASIC, FPGA/SoC, PCBs) in the TOP counter for the Belle II upgrade at KEK in Tsukuba, Japan.

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