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The Level 1 Trigger System for Belle II CDC

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The Belle II experiment at the SuperKEKB collider at KEK is aiming at high precision measurements in B physics. To select the interested physics events at high luminosity peak at 8x10ˆ35/cmˆ2/s, a multi-layer trigger system is developed for the central drift chamber detector (CDC). The CDC is a multi-wire drift chamber for charged particle tracking. It comprises of 14 thousand sense wires in 9 super-layers, 5 in axial direction and the other 4 with stereo angles.

The CDC trigger system first collects the wire hit information from all super-layers and finds the track segments in each super-layer. The identified track segments are passed to various tracking stages. The 2-dimensional tracking applies a Hough transformation on axial super-layers to perform a track pattern recognition. To further remove tracks from the beam background, a sophisticated 3-dimentional tracking is developed, which uses all available hit information to achieve a z-vertex trigger at 1 cm precision. In addition, a complementary neural-network tracking runs in parallel to ensure the total efficiency. The results from all tracking stages are fed to a global decision logic module (GDL) to make a final trigger decision. Two types of FPGA based electronics boards, merger and universal trigger board (UT3), are designed for this trigger system. The trigger data flow is pipelined through gigabit optical serial links at 32 MHz data rate. Three types of serial transceiver ports of the FPGA, GPT, GTX, and GTH, at bandwidth from 3 Gbps to 11 Gbps are used in the trigger chain. To conclude a trigger decision within 5 microseconds, a user defined protocol is developed to reduce the latency for optical transmission. A set of transmission rules is defined for data flow control and synchronization among all stages. The design detail, current status, and performance studies will be presented.

Index Terms—Belle II, CDC, real time trigger, FPGA, optical transceiver

Author: Dr SHIU, Jing-Ge (National Taiwan University)

Presenter: Dr SHIU, Jing-Ge (National Taiwan University)

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