PROCEEDINGS OF SCIENCE

Commissioning of Belle II data acquisition

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The Belle II experiment operates at the SuperKEKB e^+e^- energy-asymmetric collider on or near the $\Upsilon(4S)$ resonance energy. The Belle II experiment has completed the "Phase 2" run, in which the Belle II operation without the vertex detector system has been tested. The main focus of the Phase 2 run is on the search for new physics related with dark sector, axion-like particles, etc. with an intermediate luminosity on the way to reach the challenging target. To accomplish these physics goals of Phase 2, a new trigger menu for the single photon and low multiplicity events is essential. With the luminosity design goal, it is crucial to cope with a high trigger rate for data acquisition (DAQ). In this presentation, we describe the DAQ system of Belle II, focusing on the successful commissioning in Phase 2 and the performance of the system.

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1. Overview

The Belle II experiment[1] is designed to search for new physics beyond the Standard Model[2] using high-statistics sample of B, charm, and τ which are generated by SuperKEKB[3] e^+e^- collider. The target luminosity of SuperKEKB is 8×10^{35} cm^{-2}s^{-1}, and integrated luminosity goal is 50 ab^{-1}. Accordingly, the DAQ system is designed[4, 5] to cope with the high luminosity data which is taken from 7 sub-detector components. DAQ read out all detector signals upon L1 trigger and build event in multiple steps [6] with High Level Trigger (HLT)[7].

One of the important concept of the Belle II DAQ is unification. We unify the firmware interface in frontend electronics (FEE) boards for trigger-timing distribution (TTD/FTSW)[8] and data flow (Belle2link)[9]. Data flow from FEE to HLT is also unified. This unification allows to reduce costs and resources for managing and maintaining system.

2. Phase 2 Result and Phase 3 Plan

From April to July, 2018, Belle II phase 2 data taking was performed. During phase 2 run, our DAQ was successfully commissioned as designed. First, full event process chain was working well. Second, capability to handle up to 30 kHz with dummy trigger and limited sub-detector systems was confirmed. In actual data taking, L1 trigger rate was kept up to 500 Hz due to phase 2 beam, background status and trigger condition.

For phase 3 full data taking, we need to include full PXD and SVD readout system and prepare frontend firmware for 30 kHz L1 trigger rate. Also, more stable DAQ operation is required. For the stability, comprehensive error reporting system and faster, more automated recovery procedures will be prepared. These reduce downtime and deadtime fraction.

References

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