Development of Trigger Circuit for Forward Vertex Detector at PHENIX

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The motivation of the PHENIX experiment is to search the origin of proton spin. The proton spin is 1/2, however, it cannot be explained by valence quarks only. The other fraction of the proton spin can be carried by gluons, sea quarks, and their orbital angular momentum. The existing gluon polarization measurements indicate a small contribution. However, the present measurement region is limited in the relatively high-x region, where gluons are less populated. A newly installed detector, Forward Silicon Vertex Detector (FVTX), has the potential to extend the measurements to low-x region where gluons exist with higher probability. Moreover, heavy meson production is advantageous for the measurement of gluon spin as it produces a high gluon purity in its subprocesses. Thus, the detection of heavy mesons at forward rapidity region is an ideal probe to measure gluon polarization. FVTX distinguishes muons decayed from heavy quarks by measuring the distance of the closest approach using its precise position measurement near the vertex.

However, the existing high-momentum muon trigger does not provide sufficient rejection power to detect muons from heavy flavor origin efficiently because one needs to lower the momentum threshold. Thus our motivation is to improve the rejection power by adding the trigger capability to FVTX as an additional matching requirement on the existing high momentum trigger provided by Muon Tracking Chambers. The FVTX trigger can be formed by pattern matching between the observed hits and preprogrammed hit patterns to be a track within the FVTX readout electronics (FPGA).

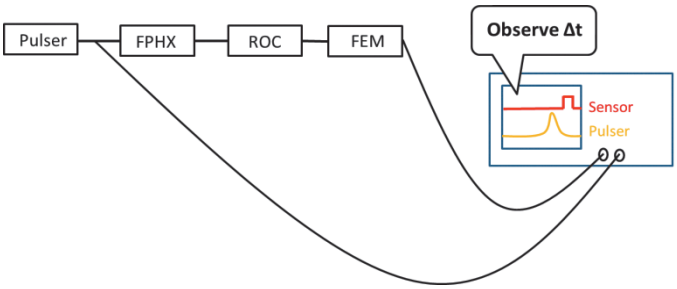

Fig.1 Setup of the timing measurement using a scope and FVTX readout devices[1)]

An FVTX detector and its readout system have been set up at the test bench in RIKEN. It is important to measure the present FVTX readout time to know how much time window allowed (latency) for the new trigger in order to process signals before the trigger decision. The actual latency constraint is known to be 17 Beam Clocks (BCLKs) for all the trigger signals to be received by the Local Level-1 trigger system. As the first step of the trigger development, the signal process time in the readout system was measured using the setup shown in figure 1. As shown in figure 2, the time difference was 2.8μs. Since 13 additional BCLK delay was inserted in the readout system for some purpose, the true time difference is expected to be about 15 BCLKs.

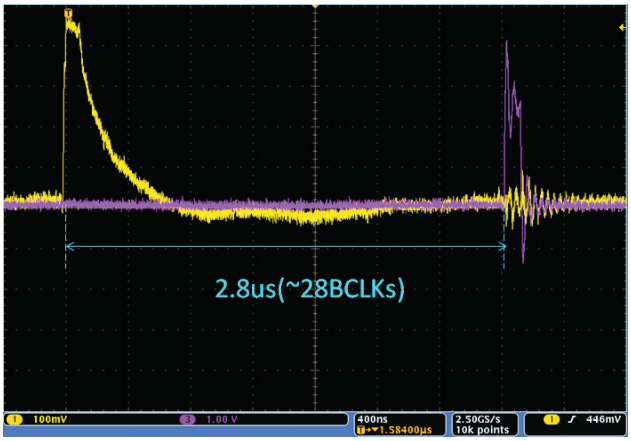

Fig.2 Coincidence between calibration pulse (yellow) and trigger signal (pink)

As the next step, the timing measurement using a radiation source is being conducted to measure the latency, including the FVTX sensor.

References

1) arXiv:1311.3594, to be published from NIM.

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