Upgrade of End-cap TOF Trigger system on BESIII

Jingzhou ZHAO, Zhen-An LIU, Wenzuan GONG, Fang DENG, Libo CHENG, Zhi WU, Ke WANG, Jie HUANG

In the ETOF(End-cap TOF) upgrade of BESIII, MRPC(Multi-gap Resistive Plate Chamber) detectors are used. ETOF is designed with 72 MRPCs. 24 channels signals are generated from each MRPC, in which 6 neighbouring channels OR together in Front-End Electronic(FEE) side. So 288 channel hit signals are sent to ETOF trigger system for trigger logic. The MRPC hit signal is about 30 ns width after FEE. Hit signals are stretched and trigger data are stored by TDPP (Trigger Data Pre-Processor) and then sent to ETOFT (End-cap TOF Trigger) through 10 high speed fiber links. Trigger data are aligned and stored in FIFO in ETOFT. Trigger logic in the center FPGA counts hits signals and Back to Back events and gives out ETOF trigger conditions: NETOF.GE.1, NETOF.GE.2 and NETOF.BB. ETOF trigger conditions are integrated with other detector trigger conditions by SIF2(Signal Integrate and Fan-out Version2) to Global Trigger to generate L1 signal.

ETOF detector module: 36 MRPCs on each side. MRPCs are staggered in two layers to make sure its area detect percent is more than 99%.

ETOF trigger system consists of TDPP, ETOFT and SIF2 boards.

ETOF trigger system upgrade system

Trigger system in the lab. Now trigger system has been installed on BESIII in Sept.2015 and already run stable for half a year.

Data Alignment Protocol:
- Data Layer: Trigger data transmission and error rate check.
- Protocol layer: Match system clock and RocketIO Reference Clock.
- Link Layer: Consists of RocketI0, optical transceiver and fiber cable.

Trigger Simulation parameter:
- Magnetic field intensity B = 1 Tesla;
- Semimajor of BTOF a=1.33m;
- Radius of ETOF: R0=0.454m, R1=0.649m, R2=0.844m.
- Pt range: Pt>660Mev/C;
- φ0 range: 0≤φ0<2π;

Data after Deserial on ETOFT, viewed by Chipscope.

Data after alignment protocol on ETOFT, viewed by Chipscope.

ETOF trigger efficiency checked by Bhabha event selected online. NETOGE.1 is used for Physics data taking.