CMS iRPC Backend and Front-End Electronics joint test

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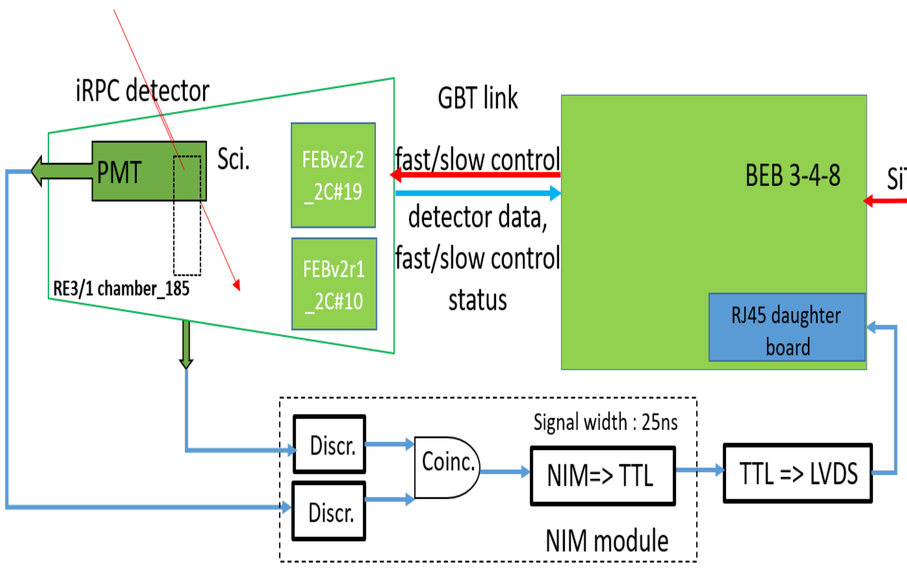
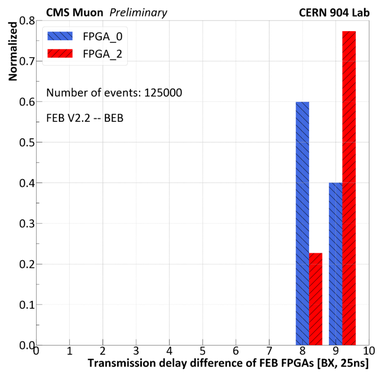
Abstract

CMS has started Phase 2 upgrade to prepare for the High-Luminosity LHC (HL-LHC). The improved Resistive Plate Chambers (iRPC) will be installed in the challenging forward region with new Front-End Electronics (FEE) to read each strip from both ends. The Backend Electronics(BE) provides fast/slow control for the FEB and performs trigger primitives, data acquisition, and readout. The slow control based on IPbus was developed to realize functions like powering up and TDC correction for the FEE and configuration for the BE. A joint test system was set up to study the data transmission mechanism between the front and backend, and verify the backend functions. The system efficiency was measured ensuring that the whole system works normally.

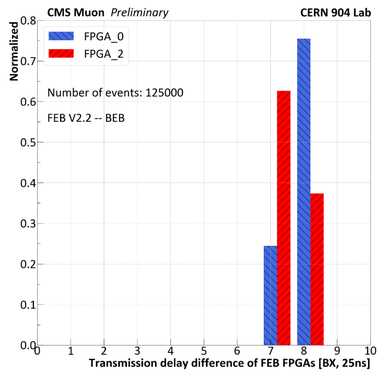
Joint test system setup in CERN 904 lab



Transmission delay difference of FEB



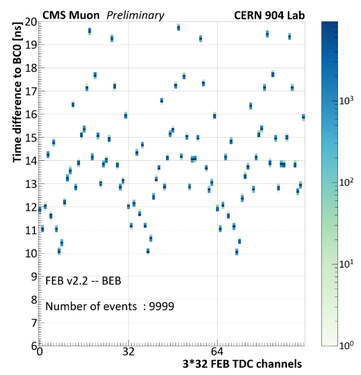
The distribution changes after each powering up.



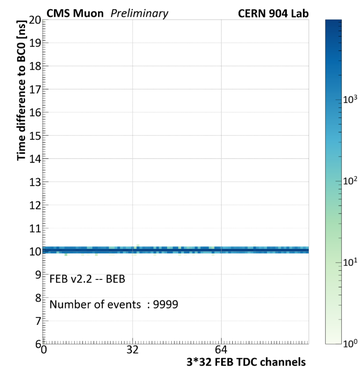
The transmission delay difference of FEB FPGA0/2 compared to FEB FPGA1 (0 BX point position) . The data from FEB FPGA0/2 comes 7-9 BX later than FPGA1. It was caused by the serial links used for communication between three FPGAs and can be solved by implementing the IHEP proposal “Check-Sort-Push” mechanism.

FEB TDC difference correction

A correction module was created on FEB and all the TDC data will minus its correction value. The result shows that the difference between different TDC channels is corrected.

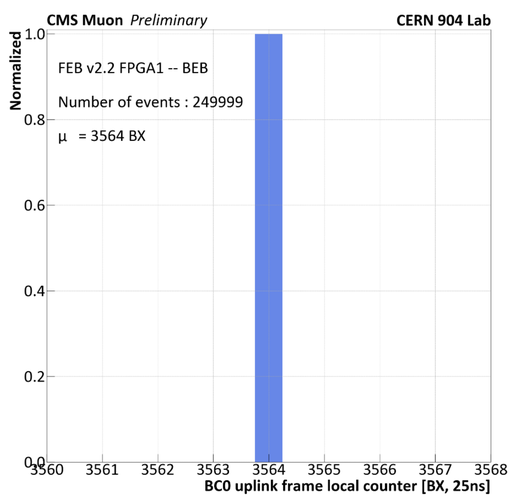


Before correction



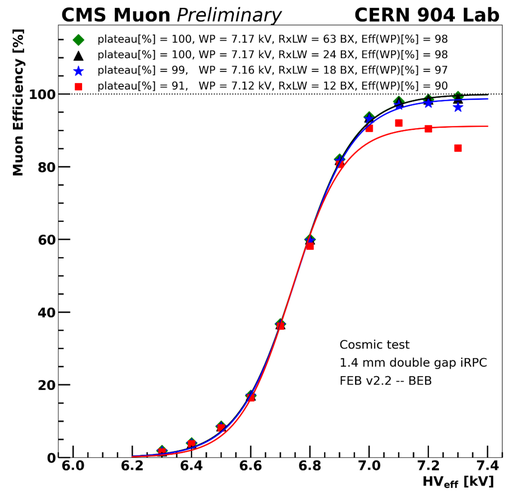
After correction

BC0 distribution



The FEB was connected to BEB via optical links and the fast control signal “BC0” need to be transmitted to FEB every 3564 BX. Then the FEB will perform TDC function on BC0 channel and reply the BEB with its timestamp. The time interval between two BC0 timestamp was measured 3564*25ns (BX) as expected by the local counter in BEB.

High voltage efficiency scan



High voltage efficiency scan is a powerful way to verify the whole system efficiency When RxLW = 12 BX, the efficiency was not high. And it increases to 100% when the RxLW is 63 BX (test situation, at the cost of 1 link per BEB). This will be improved by implementing Check-Sort-Push mechanism (sorting in time sequence before sending) in FEB.

Acknowledgements

Thanks our colleagues from the FEB team for helping us finish the cosmic test. Thanks everyone who participates in the RPC upgrade project.