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Simulation of the ATLAS New Small Wheel Trigger System

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The instantaneous luminosity of the Large Hadron Collider (LHC) at CERN will be increased up to a factor of seven with respect to the original design value to explore higher energy scale. In order to benefit from the expected high luminosity performance, the first station of the ATLAS muon end-cap Small Wheel system will be replaced by a New Small Wheel (NSW) detector. The NSW provide precise track segment information to the muon Level-1 trigger to reduce fake triggers. This contribution will summarize a detail simulation of the NSW trigger decision system, track reconstruction algorithm implemented into the trigger processor and results of performance studies on the trigger system.

Summary
The instantaneous luminosity of the LHC will be increased up to a factor of seven with respect to the present design value by undergoing an extensive upgrade program over the coming decade. In order to benefit from the expected high luminosity performance, the first station of the ATLAS muon end-cap Small Wheel system will need to be replaced by a New Small Wheel (NSW) detector, which is used for trigger and precision measurement. The NSW provides precise track segment information to the muon Level-1 trigger to reduce fake triggers arising from particles that are not high pT muons originating from the Interaction Point (IP). The NSW consists of Micromegas (MM) and small-strip Thin Gap Chambers (sTGC). Both systems find a track segment independently and provide a two-dimensional position, ( ), as well as the angle deviation of the NSW track-segment with respect to an infinite momentum track from IP. Eventually, a coincidence by ( ) between the NSW and outer muon system is required to suppress the fake trigger rate.

A detailed study of the final design and validation of the readout electronics for the trigger system that are able to work at high rates with excellent real-time spatial resolution has been performed. A dedicated parametric digitization model based on the exhaustive standalone MC studies and experimental test beam results has been developed to simulate the response of the NSW trigger system. This contribution will summarize a detail simulation of the NSW trigger decision system, track reconstruction algorithm implemented into the trigger processor and results of performance studies of the DAQ trigger logic.

The NSW simulation has been developed to model the actual response of the detector and its fast electronics. The simulation has been used to get a deep understanding of the trigger logic timing, the tracking-segment finding efficiency, track rate and track-pointing resolutions at the high background hit rate expected during the next phases of operation of ATLAS at the LHC. The results of these performance studies will be presented to show that the NSW trigger system is capable of working with good performance compared to the foreseen requirements.

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