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Performance of the ALICE PHOS trigger and improvements for RUN 2

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This paper will discuss the performance of the PHOS level-0 trigger and planned improvements for RUN 2. Due to hardware constraints the Trigger Region Unit boards are limited to an operating frequency of 20 MHz. This has led to some ambiguity and biases of the trigger inputs. The trigger input generation scheme was therefore optimized to improve the performance. Proposed actions to further improve the performance and possibly eliminate the impact of the biased trigger inputs will also be presented. A level-1 trigger input is currently also being developed and tested.

Summary

The Photon Spectrometer (PHOS) is one of the sub-detectors of the ALICE experiment, which shall generate level-0 and level-1 trigger inputs to the Central Trigger Processor (CTP). The PHOS level-0 trigger system consists mainly of two parts, 40 Trigger Region Unit (TRU) boards and 1 Trigger-OR (TOR) board. Local level-0 trigger inputs are generated by the TRUs according to the analog-sum singles, which represent the energy of the detected photons, and further processed by the TOR from which the final level-0 trigger input is sent to the CTP.

Ideally, level-0 trigger inputs should be issued at the peak point of the analog-sum signals, last for 25 ns (bunch spacing), and arrive at the CTP at a fixed time within the trigger input time window of 400-800 ns. However, due to hardware constraints the TRU operating frequency is limited to 20 MHz. As a result the level-0 trigger input pulses are wider than the bunch spacing, and furthermore, a phase shift of 25 ns can be induced between different TRUs due to the variation in the stabilization time of PLL clock outputs. This can lead to some ambiguity as the arriving time of the level-0 trigger input to the CTP may vary depending on which TRU generated the initial signal.

To reduce the impact of the TRU phase shift two trigger input generation schemes, short trigger scheme and long trigger scheme, were proposed. According to a performance comparison, the latter scheme was selected. It keeps the trigger input active as long as the corresponding analog-sum signal is above threshold, which results in a common time slot that can be aligned with trigger inputs from other sub-detectors.

The PHOS level-0 trigger system has been working with an acceptable efficiency and purity. This paper will discuss the performance of the PHOS trigger in light of the issues mentioned above, and look at possible actions for LS1 aiming to further improve the performance. For example, one suggested approach that can be implemented in the TOR to eliminate the phase shift between the TRUs and reduce the length of the trigger input, is to measure the average distance, at the beginning of a run, from the generated level-0 trigger input to the confirmed level0 trigger from the CTP, and then re-synchronize the TRU trigger inputs accordingly.

In addition, a level-1 trigger input is being developed and tested in the lab. It will provide a more robust cluster energy estimate which allows to derive three level-1 trigger signals simultaneously for different energy thresholds. It is planned to be commissioned at Point 2.

Primary author: ZHAO, Chengxin (University of Oslo (NO))

Presenter: ZHAO, Chengxin (University of Oslo (NO))

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