Status of the NA62 liquid krypton electromagnetic calorimeter level 0 trigger processor

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The NA62 experiment at the CERN SPS aims to measure the Branching Ratio of the very rare kaon decay K+ -> pi+ nu nubar collecting ˜100 events with a 10% background in two years of data taking. To reject the K+ -> pi+ pi0 background the NA48 liquid krypton calorimeter will be used in the 1-10 mrad angular region. A vertical slice of the trigger processor has been assembled and tested in the laboratory and is currently being installed at CERN SPS. Test results of a vertical slice of the NA62 liquid krypton electromagnetic calorimeter Level 0 trigger processor are presented.

Summary

The NA62 experiment at the CERN SPS aims to measure the Branching Ratio of the very rare kaon decay K+ -> pi+ nu nubar collecting ˜100 events with a 10% background in two years of data taking. One of the main background to the proposed measurement is represented by the K+ -> pi+ pi0 decay. To suppress this background an efficient photo veto system is foreseen. The NA48 liquid krypton high-performance electromagnetic calorimeter is used in the 1-10 mrad angular region.

The Level 0 electromagnetic calorimeter trigger identifies electromagnetic clusters in the liquid krypton calorimeter and sends to the Level 0 trigger processor a time-ordered list of reconstructed clusters together with the arrival time, position, and energy measurements of each cluster.

The main parameters of the trigger are the high expected hit rate (30 MHz) and the required single cluster time resolution (1.5 ns).

The liquid krypton electromagnetic calorimeter trigger is based on the energy deposits in tiles of 16 calorimeter cells (super-cells) which are available from the main calorimeter readout boards. Digitized data are transmitted from the readout boards to the liquid krypton front-end boards over shielded copper twisted pair cables.

The trigger processor is a three layer parallel system (divided in front end and concentrator boards) based on the custom TEL62 cards developed for the NA62 experiment.

The first layer (front-end) boards receive 864 digital signals, each corresponding to a 16 calorimeter cells tile. The photon arrival times are calculated on-line in the FPGAs performing a parabolic fit to obtain an accurate estimate of the peak amplitude, and then applying a constant-fraction discriminator to measure the cluster arrival time. Digital data processed on the front end boards are transmitted to the concentrator boards with a custom high speed link (4.8 Gbps).

The second layer (concentrator) boards receive data on a custom mezzanine, combine peaks detected by different front-end boards in a single cluster, and send the time ordered list of reconstructed clusters to the third layer concentrator board.

The third layer concentrator board sends the time ordered list of reconstructed cluster to the Level 0 Trigger Processor.

Beside its trigger functionalities the processor provides a fast coarse-grained Gigabit Ethernet readout of the liquid krypton calorimeter that is used in on-line high level software triggers and off-line as a cross-check for the high-granularity readout.

In total, the system will be composed of 36 TEL62 boards, 108 mezzanines and 215 high-performance FPGAs. A vertical slice of the trigger processor composed of two Front-End boards and a Concentrator board, together with a complete Timing Trigger and Control distribution system was assembled in the laboratory and is currently being installed at CERN SPS.

Test results of a vertical slice of the NA62 liquid krypton electromagnetic calorimeter Level 0 trigger processor are presented.

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