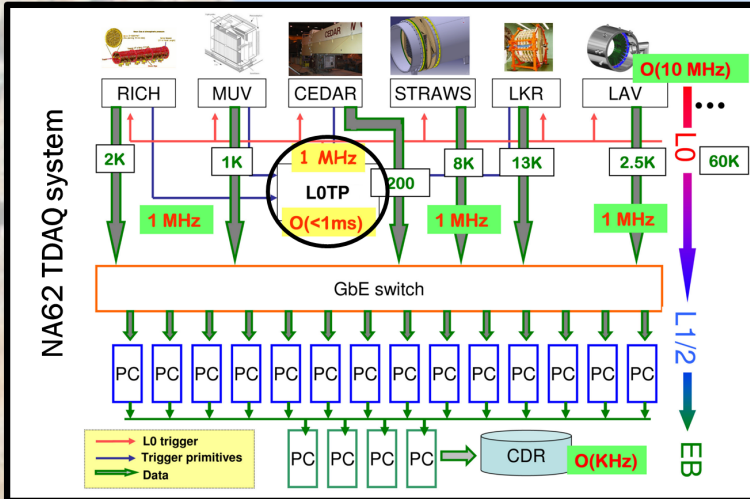


# The Level 0 Trigger Processor for the NA62 Experiment

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The NA62 experiment at CERN SPS is devoted to the measurement of the very rare kaon decay  $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ . The expected branching ratio has been recently estimated within the Standard Model to be of the order of  $10^{-10}$  thus requiring a high intensity kaon beam. The high rate of incident particles affects the design of the trigger and data acquisition of the experiment. Thus, the performance of Level 0 (L0) trigger is crucial to reduce and appropriately select the large amount of data produced by detectors.



## NA62 Trigger Levels:

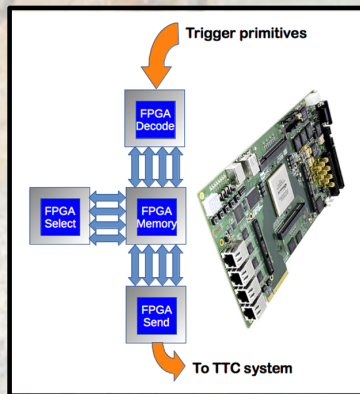
- ✓ L0: Hardware synchronous level. 10 MHz to 1 MHz. Max latency: 1 ms.
- ✓ L1: Software level. "Single detector". 1 MHz to 100 kHz. Max latency: O(1 s).
- ✓ L2: Software level. "Complete information". 100 kHz to O(kHz). Max latency: spill period.

## L0TP Features:

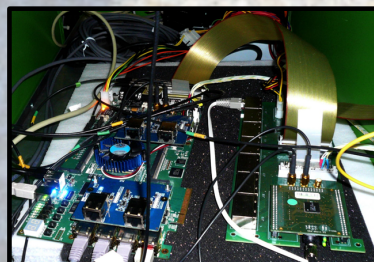
- ✓ Asynchronously receive trigger primitives from 4 to 7 detectors.
- ✓ Time align and match primitives with programmable masks.
- ✓ Synchronously send selected triggers to the Timing Trigger and Control (TTC) system with fixed latency.

## Two approaches for the trigger processor

### FPGA-based L0TP



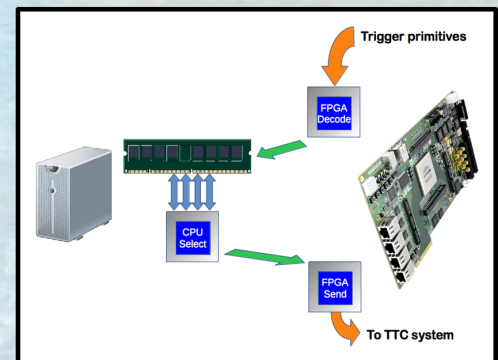
- ✓ FPGA receives L0 data and performs trigger selection.
- ✓ Fully real-time processing with guaranteed constant latency.
- ✓ Trigger matching algorithms embedded in firmware.
- ✓ FPGA limited resources.



- ✓ Time granularity: 3.125 ns.
- ✓ Trigger granularity common for all detectors.

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### PC-based L0TP



- ✓ FPGA receives L0 data and CPU performs trigger selection.
- ✓ Not real-time processing, 1 ms constant latency assured.
- ✓ Trigger matching algorithms software programmed.
- ✓ Large memory available.



- ✓ Full time granularity: 97.5 ps.
- ✓ Online selectable time granularity for each detector.

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