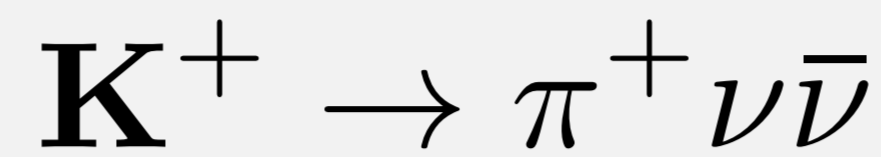


# The Level 0 Trigger Processor - NA62 Experiment

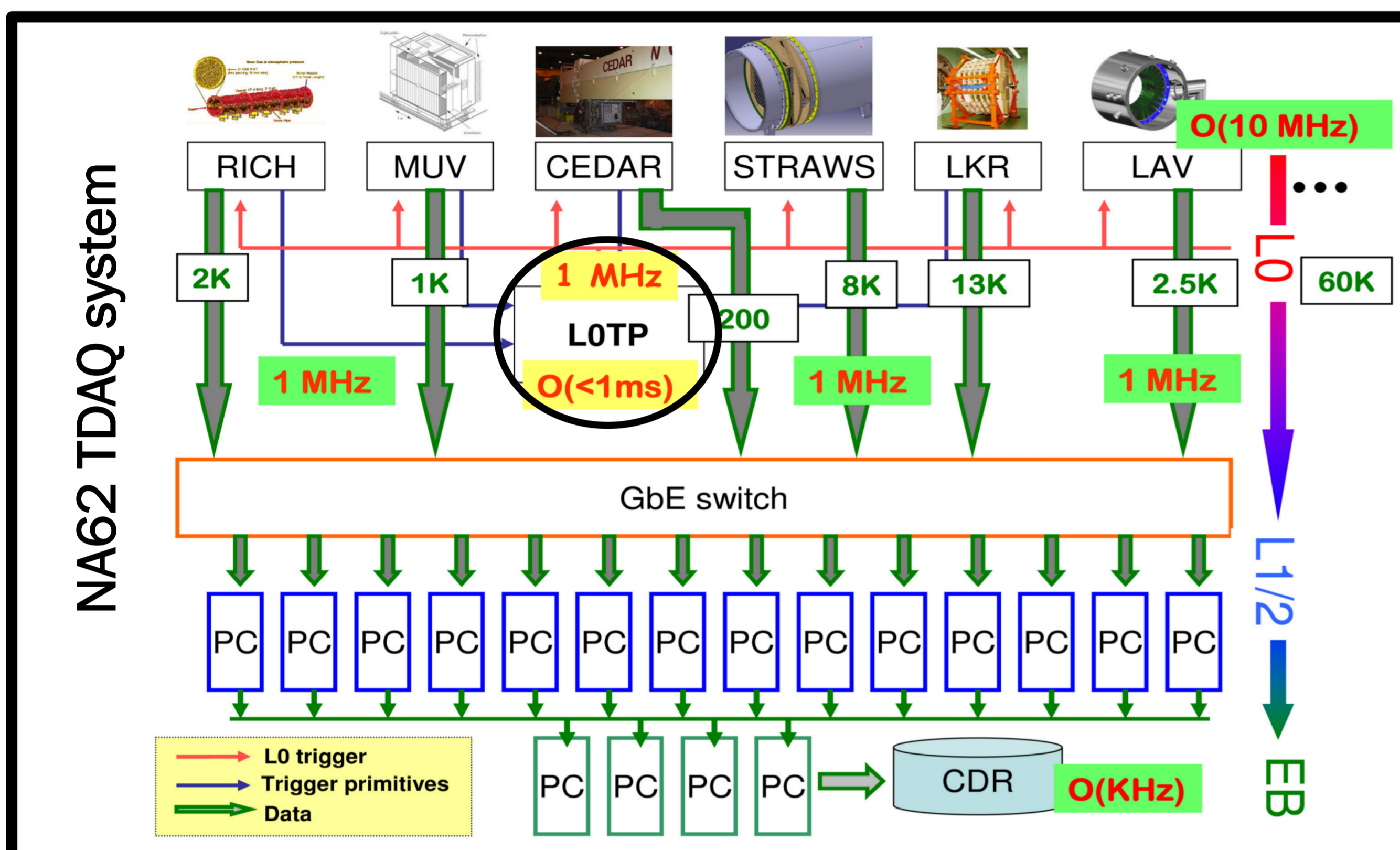
Stefano Chiozzi <sup>(a)</sup>, Enrico Gamberini <sup>(a, b)</sup>, Alberto Gianoli <sup>(a)</sup>, Giorgia Mila <sup>(c)</sup>, Ilaria Neri <sup>(a, b)</sup>, Ferruccio Petrucci <sup>(a, b)</sup>, Dario Soldi <sup>(c)</sup>

(a) INFN, Ferrara (Italy) - (b) University of Ferrara - (c) INFN, Torino (Italy)

The main purpose of the experiment NA62 at CERN - SPS is to measure the branching ratio of the (ultra) rare decay



The expected value, according to the Standard Model, is of the order of  $10^{-10}$  thus requiring a high intensity kaon beam. The intense flux of particles requires a high-performance trigger and data acquisition system. The Level 0 (L0) trigger applies cuts to select particular event types and should be flexible to allow for requirements in later stages of the experiment.

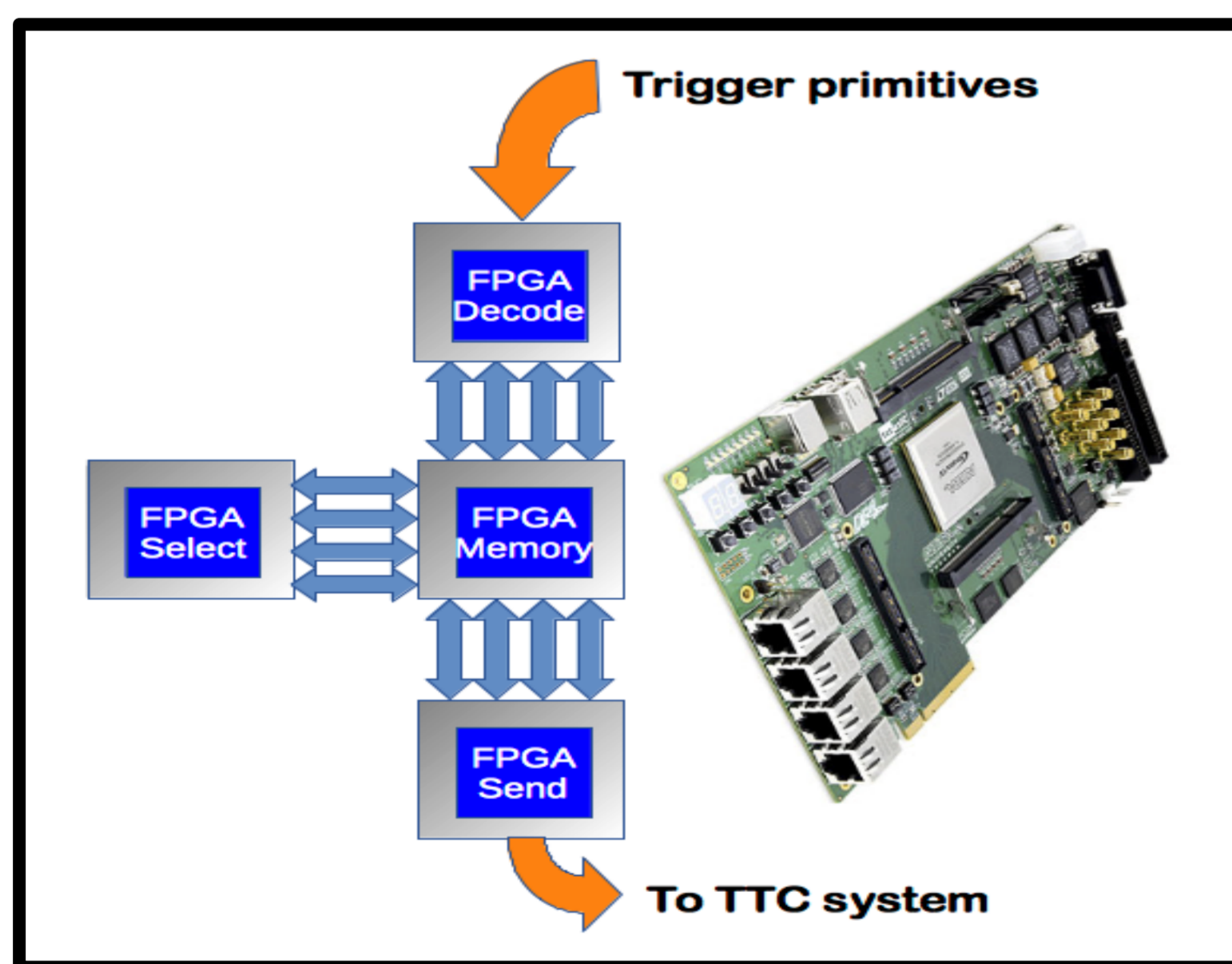


- ### NA62 Trigger Levels:
- L0: Hardware level. 10 MHz to 1 MHz. Max latency: 1 ms.
  - L1: Software level. "Single detector". 1 MHz to 100 kHz. Max latency: O(1 s).
  - L2: Software level. "Complete information". 100 kHz to O(kHz). Max latency: spill period O(10 s).

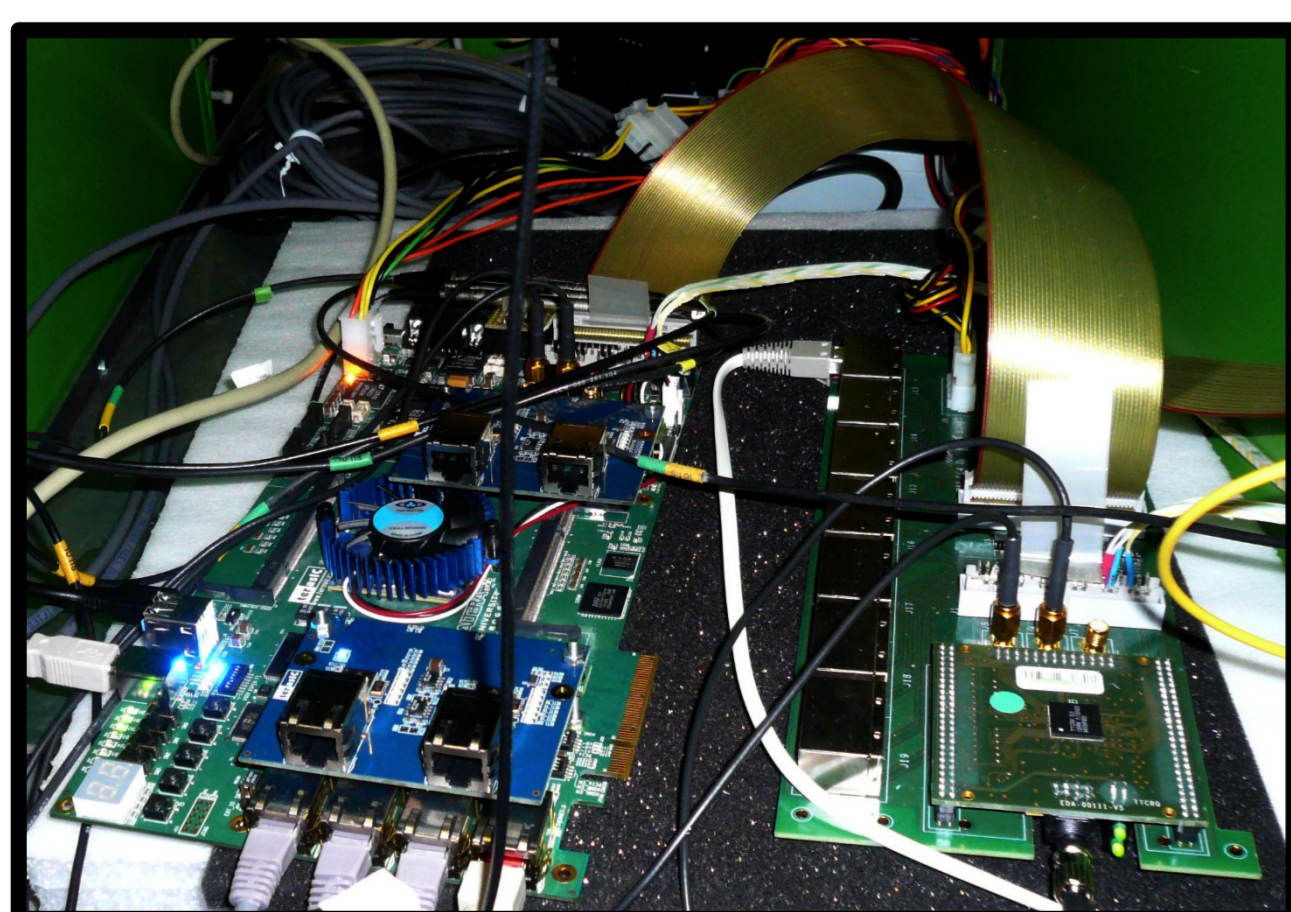
- ### L0TP Features:
- Data asynchronously sent from detector to L0TP via Ethernet using UDP protocol (primitives).
  - 7 Input detectors.
  - Time align and match primitives with programmable masks.
  - Synchronously send selected triggers to the Timing Trigger and Control (TTC) system with fixed latency.

## L0 Trigger Processor – two different solutions

### FPGA-based L0TP

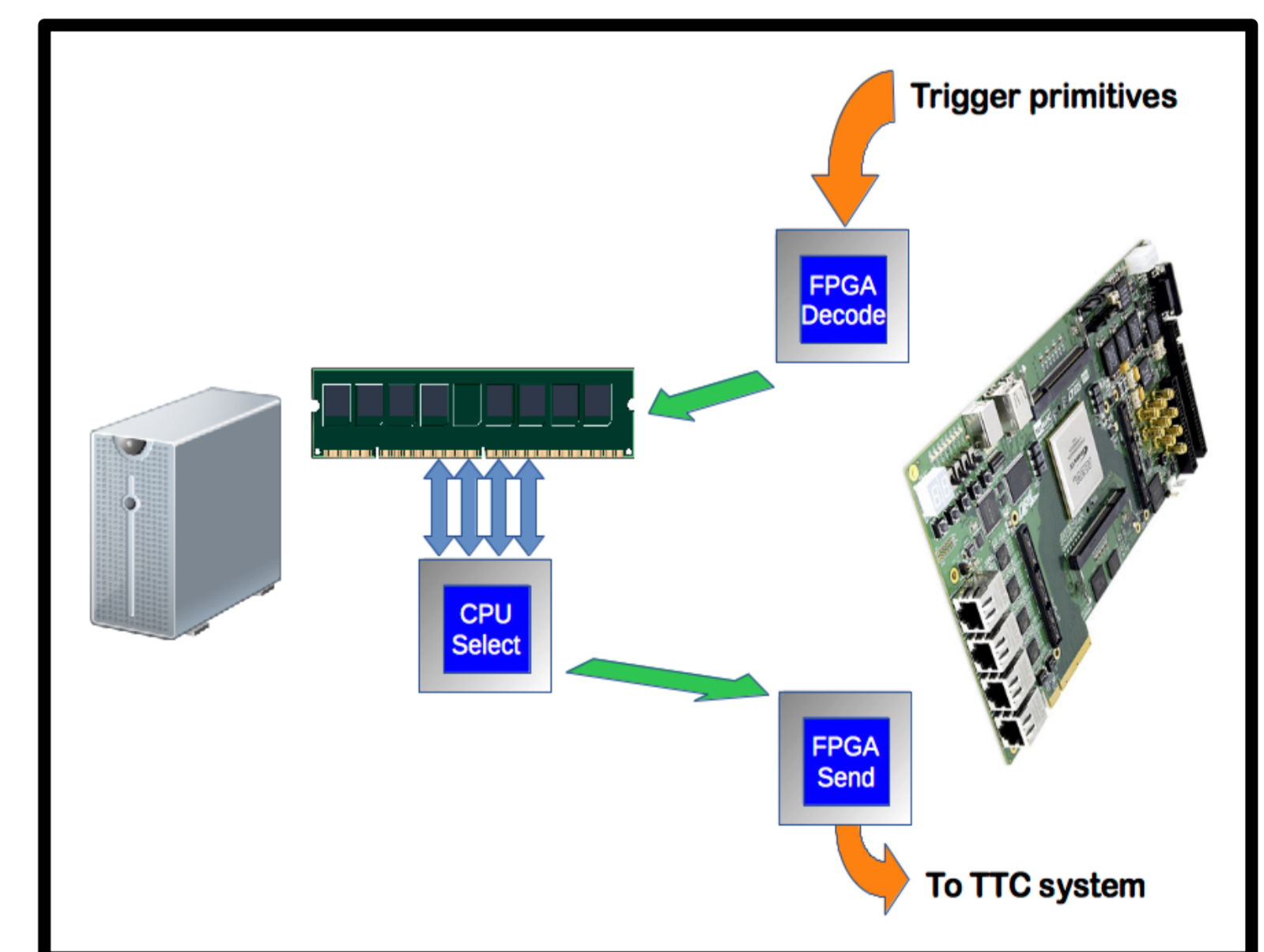


- L0-Trigger selection directly on the FPGA.
- Fully real-time processing with constant latency.
- Trigger matching algorithms embedded in firmware.
- Very powerful with limitations that derive from the bounded FPGA resources.



- Time granularity: 3.125 ns.
- Used in 2014 and in the current data taking
- Installed @ NA62 experiment at CERN

### PC-based L0TP



- FPGA receives L0 data while CPU performs trigger selection.
- 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.
- Designed for an upgrade of the experiment