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The new hardware trigger processor at NA62 experiment: Status of the System and First Results

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The NA62 experiment is designed to study kaon's rare decays using a decay-in-flight technique. Its Trigger and Data Acquisition (TDAQ) system is multi-level, making it critically dependent on the performance of the inter-level network.

To manage the enormous amount of data produced by the detectors, three levels of triggers are used. The first level L0TP, implemented using an FPGA device, has been in operation since the start of data taking in 2016.

To increase the efficiency of the system and implement additional algorithms, an upgraded system (L0TP+) was developed starting in 2018. This upgrade utilizes a high-end FPGA available on the market, offering more computing power, larger local memory, and higher transmission bandwidth.

We have planned tests for a new trigger algorithm that implements quadrant-based logic for the veto systems. This new approach is expected to improve the main trigger efficiency by several percent.

Extensive tests were conducted using a parasitic setup that included a set of Network TAPs and a commodity server, allowing for proficient comparison of trigger decisions on an event-by-event basis. The experience gained from this parasitic mode operation can be leveraged for the next data-taking period as a development setup to implement additional features, thereby accelerating the TDAQ upgrade.

After the testing period, the new system has been adopted as the online processor since 2023. Preliminary results on the efficiency of the new system will be reported. Integration with the new AI-based FPGA-RICH system, which performs online partial particle identification, will also be discussed.

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