A Triggerless readout system for the PANDA electromagnetic calorimeter

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The future PANDA (antiProton Annihilations at Darmstadt) experiment at the FAIR (Facility for Antiproton and Ion Research) in Darmstadt, Germany, will study the decay of hadrons in the energy regime where the fundamental theory of Quantum Chromo Dynamics behaves strongly non-perturbatively. One of the physics highlights is to search for exotic states that have been predicted by theory, and whose properties are governed by the presence of valence gluons. Such exotic states can be formed directly and copiously in proton-antiproton annihilations. The challenge lies in reducing the enormous background yield while preserving a high efficiency for the detection of exotic hadrons. As the detector response of background events is very similar to that of the decay of the exotic states, the use of a conventional triggered readout scheme, where a limited number of subdetectors generates a trigger signal that engages the readout of the complete detector, is ruled out. Therefore, a new type of intelligent readout is being developed, where kinematical constraints are imposed online on reconstructed events. This technique is dubbed as “triggerless readout” [1].

![Figure 1: The readout chain for the PANDA electromagnetic calorimeter](image)

The triggerless readout concept consists of several stages, which will be discussed for the electromagnetic calorimeter [2]. These stages consist of the following parts (see also Fig. 1):

- front-end modules (performing amplification and digitisation of the signal, timestamping, energy extraction and pile-up detection),
- data concentration (combining output from several front-end modules, performing pile-up recovery, time-ordering and synchronisation of front-end modules), and
- event building (electromagnetic shower and event reconstruction, event selection).

A data reduction factor of \(\sim 10^3\) is expected to be achieved by employing this technique for the whole detector, resulting in a data rate of \(\sim 10^4\) events/s (or, equivalently, 200 MB/s) that will then be sent to storage for offline processing and analysis.

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References