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Free-running data acquisition system for the AMBER experiment

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Triggered data acquisition systems provide only limited possibilities of triggering methods. In our paper, we propose a novel approach that completely removes the hardware trigger and its logic. It introduces an innovative free-running mode instead, which provides unprecedented possibilities to physics experiments. We would like to present such system, which is being developed for the AMBER experiment at CERN. It is based on an intelligent data acquisition framework including FPGAs modules and advanced software processing. The system provides the triggerless mode that allows to gain more time for the data filtration and implement more complex algorithms. Moreover, it utilises a custom data protocol optimized for needs of the free-running system. The filtration procedure takes place in a server farm playing the role of the high-level trigger. For this purpose, we introduce a high-performance filtration framework providing optimized algorithms and load balancing to cope with excessive data rates. Furthermore, this paper also describes the filtration pipeline as well as the simulation chain that is being used for production of artificial data, for testing, and validation.

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