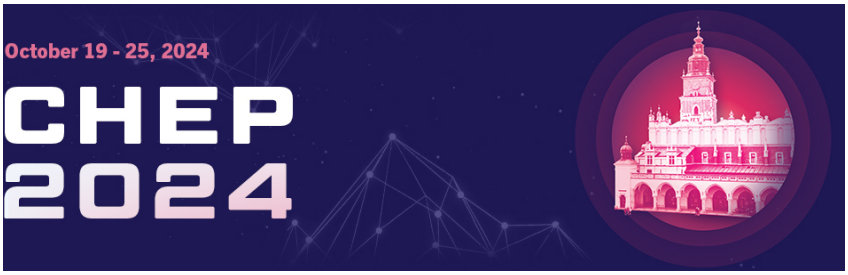

Contribution ID: **502** Type: **Talk**

An optimized C++ software for the management of Timepix4 data acquisition and analysis

Monday 21 October 2024 14:06 (18 minutes)

Timepix4 is an innovative multi-purpose ASIC developed by the Medipix4 Collaboration at CERN for fundamental and applied physics detection systems. It is composed by a ~7cm^2 area matrix with about 230k independent pixels, each one with a charge integration circuit, a discriminator and a time-to-digital converter that allows to measure Time-of-Arrival with 195 ps width bins and Time-over-Threshold with 1.56 ns width bins. Timepix4 can produce up to 160 Gbps of output data, so a strong software counterpart is needed for fast and efficient data processing.

We developed an open-source multi-thread C++ framework to manage the Timepix4 ASIC, regardless of which control board is used for communication with the server. The software can configure Timepix4 through low and high level functions, depending on the final user's expertise and his need for customization. Those methods also allow the user to easily perform complex routines, like pixel matrix equalization and calibration, with user-friendly C++ scripts.

When the acquisition starts, some read-out threads can safely store Timepix4 data on disk. Offline post-acquisition classes can be used to analyze the data, using a custom clustering algorithm that can process more than 1M events/s and, if needed, an ad-hoc convolutional neural network for particle track identification. If the acquisition rate is lower than 1M events/s, clustering can be performed online, exploiting a dedicated thread, connected to read-out ones, that runs the same algorithm. Moreover, an online monitor thread can be connected to clustering object to view up to O(100)kEvents/s, showing a hit-map and real-time statistics like cluster dimension and energy.

In this contribution we will present the software architecture, its performances and some results obtained during acquisitions using radioactive sources, X-ray tubes and monochromatic synchrotron X-ray beams.

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