# Smart Fast-Digitizer system for astro-particle detectors

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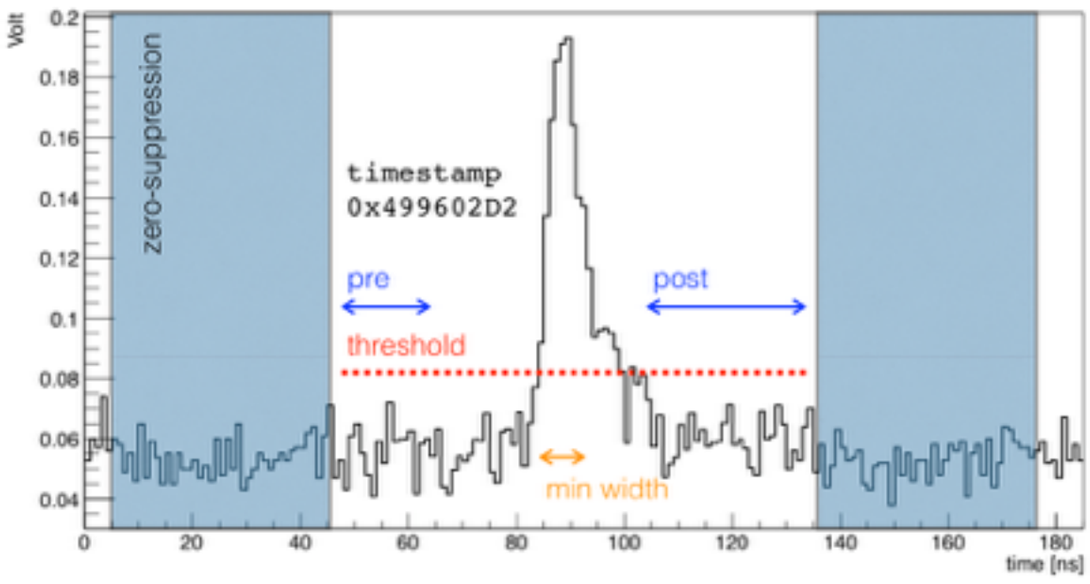
We developed a Fast-Digitizer based zero-suppression algorithm which supports single channel self-triggering, TDC and ADC functionalities, and detector triggering capabilities.
We implemented and successfully tested the system in the DarkSide experiment for the search of dark matter. The system can be used as it is for any next generation dark matter or neutrino experiments which use photo-detectors and is scalable up to thousands of channels.

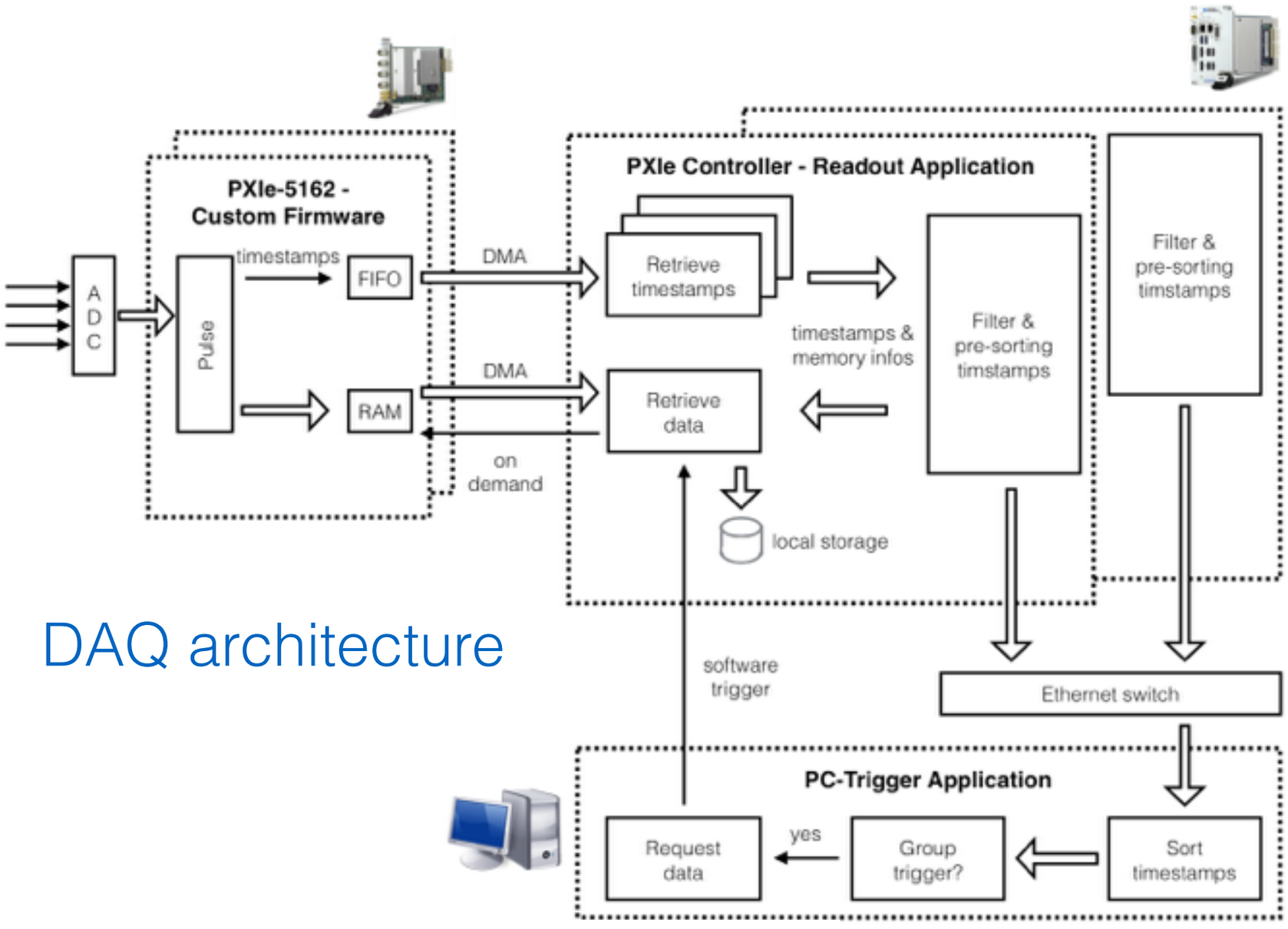
Experiments in astroparticle physics require the acquisition of high-speed signals from a large number of photo-multipliers tubes (PMT). The signal of interest of a single PMT is limited to short pulses (10 to 20 ns) generated by specific events. The detector requires continuos acquisition, but only the data (sampled data and time of the pulse) associated with these pulses is of interest.

This contribution presents the implementation and performances of a novel system for data reduction and software group trigger to satisfy these needs.

The system is based on NI PXIe-5162 waveform digitizers (4 channels, 1.25 GSample/s/ch).




Each channel of the waveform digitizer is able to identify pulses and perform zero suppression. When a pulse is identified, a 64 bit time-stamp, that encodes the time of a pulse, is generated.
*Timestamps can be read independently from the waveform data of the pulses.*



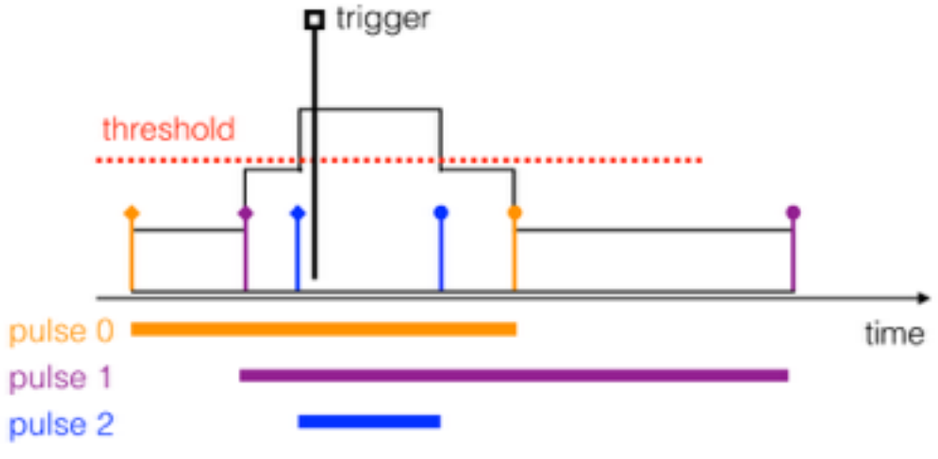

DAQ architecture

The trigger of the system is entirely generated by software, that reads the time-stamps and evaluate a group trigger condition.

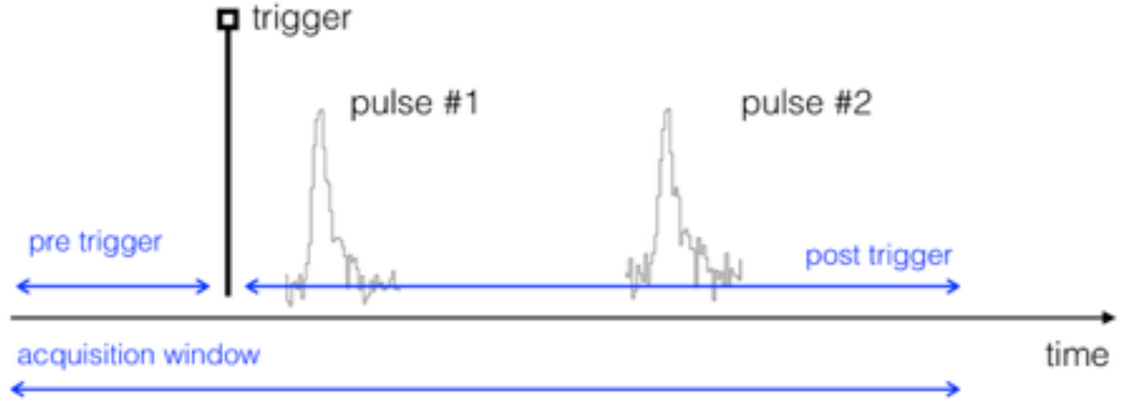
**The waveform data of the pulses are only read by the DAQ when the software group trigger is issued.**

Tests shows that the system is scalable to thousands of channels.

**This DAQ system supports the needs of next-gen dark matter or neutrino experiments**




group trigger condition




waveform of pulses requested on demand