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Using ultra fast analog memories for fast photo-detector readout.

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The recent progresses in the field of photo-detection have pushed the performances of the detectors toward the picosecond scale. Currently existing electronics dedicated to precise charge and time measurement is mainly based on the use of high-end oscilloscopes. Numerous test benches are also based on both Charge-to-Amplitude Converters and Constant Fraction Discriminators (CFD) associated with Time to Digital Converters (TDC). The time resolution obtained with some commercial modules is very good (Time to Analog Converters ˜ 5 ps rms after amplitude correction), but said modules house very few channels. Some TDC boards offer a higher number of channels, based on a coarse measurement performed by a digital counter associated with a fine measurement (interpolation) using Delay Line Loops, but their overall resolution is only of the order of 30 ps rms.

Recently, alternative methods based on digital treatment of the analogue sampled then digitized detector signal have been developed. Such methods permit an easy calculation of the charge and amplitude, and achieve a timing resolution far better than the sampling frequency. Digitization systems have followed the progress of commercial ADCs, but the latter have prohibitory drawbacks like their huge output data rate and power consumption. Conversely, high speed analog memories now offer sampling rates far above 1GHz at low cost and with low power consumption.

The new 16-channel WaveCatcher board has been designed to provide high performances over a short time window. It houses sixteen 12-bit 500-MHz-bandwidth digitizers sampling between 400 MS/s and 3.2 GS/s. It is based on the patented SAMLONG ASIC, a high-performance low-power analog circular memory designed in a cheap pure CMOS 0.35µm technology. The board offers a lot of functionalities like smart trigger configurations and embedded charge integration. It houses 480 Mbits/s USB and 1.5Gbits/s optical link interfaces.

The board will soon been tested in different test benches dedicated to the characterization of fast MCP-PMTs or SiPMs, but a reproducible time precision better than 10 ps rms has already been demonstrated.

The WaveCatcher board thus seems to be a powerful tool for photo-detector characterization and high-scale readout.

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