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A Compact Tiled Readout for Hamamatsu H13700 PMTs with 256 Pixels

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Recent advances in light detectors has led to the introduction of a number of highly pixelated but compact photomultiplier tubes. These PMTs require compact readout electronics that directly couple to the PMTs, are high performance and can provide timing resolution on par with the PMT. In this paper we propose a compact readout device for the Hamamatsu H13700 PMT with 256 pixels. The design is based on the TARGETX waveform sampling chip developed at the University of Hawaii. The proposed electronics allow for tile assembly and operation for multiple of such PMTs.

Summary

One of the factors that impacts the accuracy of tracking particles is the number of detector channels. Higher channel count and larger area coupled with good timing accuracy are some of the proposed specifications for new detectors or upgrades to existing detectors. Recent advances in light detectors such as MCP-PMTs show promising performance in high speed photon detection while providing a dense array of pixels. The main problem with the new detectors is developing compact readout electronics that can match the high channel density of the PMTs in a form factor that allows tiling and abutting of the PMTs to cover a larger area. One traditional approach is to attach pre-amp boards to the PMT, amplify and condition the signal and then send analog signals via special cables to legacy crate based readout electronics in an electronics hut. This solution quickly adds to the cost, power draw and will create thermal issues.
We propose a full waveform sampling compact readout electronics that attaches directly to such PMTs. The H13700 PMT is a 256 channel device with a ˜2"x2"footprint. The readout electronics are based on the already developed TARGETX waveform sampling ASIC developed at the University of Hawaii. We used 16 TARGETX chips to readout 256 channels of the PMT. The TARGETX is has an internal storage of 16384 samples equivalent to ˜16us of memory when operating at 1GSa/s. This long buffer will allow operation in long latency large detector operations. The analog signal is brought into the readout chip directly eliminating the need for preamps and impedance matching which leads to tremendous power savings. The form factor of the readout PCB and vertical integration allows for abutting the PMTs and operation in tile configuration. Use of full waveform sampling and built in feature extraction in the front end electronics makes this design attractive for large detectors. Potential applications include the particle identification (PID) detector for Electron Ion Collider.

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