Front-end electronics for EIC - PID

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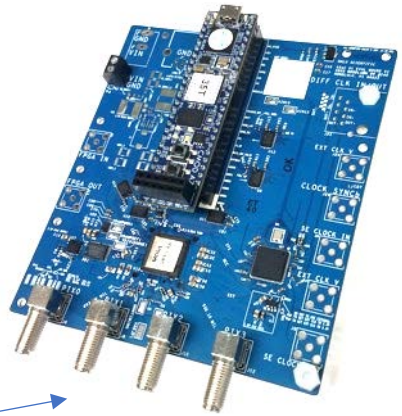
Data Acquisition Systems

Next Generation Photosensor Readout

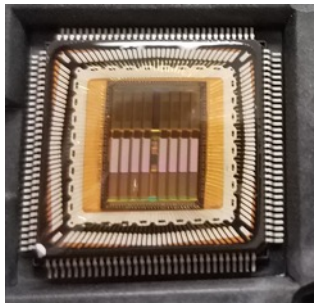
- Building upon lessons learned from the development of photosensor readout for the Belle II upgrade (picosecond timing, low-cost, large muon system) and CTA SCT cameras ($1.40/channel)
- ASIC development important, but firmware and support have been the most critical issues
- UH has partnered with Nalu Scientific team to develop commercial variants (with functional extensions), to provide engineering support
- UH can then focus on strengths of an academic institution for innovation, testing and data analysis

Current Nalu's SoC-ASIC Projects

Project	Sampling Frequency (GHz)	Input BW (GHz)	Buffer Length (Samples)	Number of Channels	Timing Resolution (ps)	Available Date
ASoC	3-5	0.8	32k	8	35	Rev 2 avail
SiREAD	1-3	0.6	4k	64	80-120	Rev 1 avail
AARDVARC	6-10	2.5	32k	4-8	4-8	Rev 2 avail
AODS	1-2	1	8k	1-4	100-200	Nov 2019

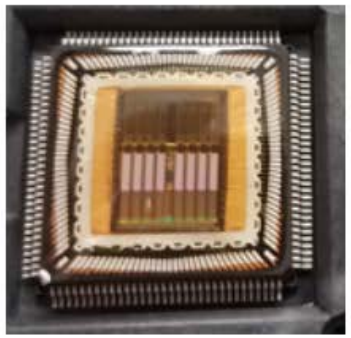


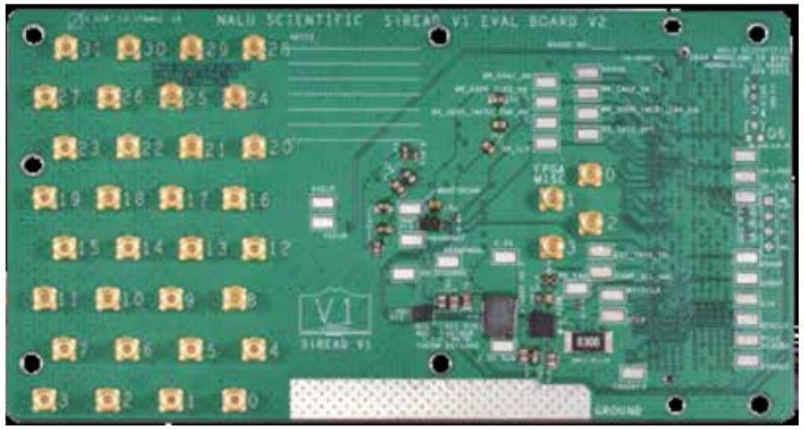
- **ASoC**: Analog to digital converter System-on-Chip
  - Rev 1 under test – **Funded Phase II - Eval card available**
- **SiREAD**: SiPM specialized readout chip with bias and control
  - Rev 1 under test
- **AARDVARC**: Variable rate readout chip for fast timing and low deadtime
  - Rev 1 under test – **Funded Phase II**

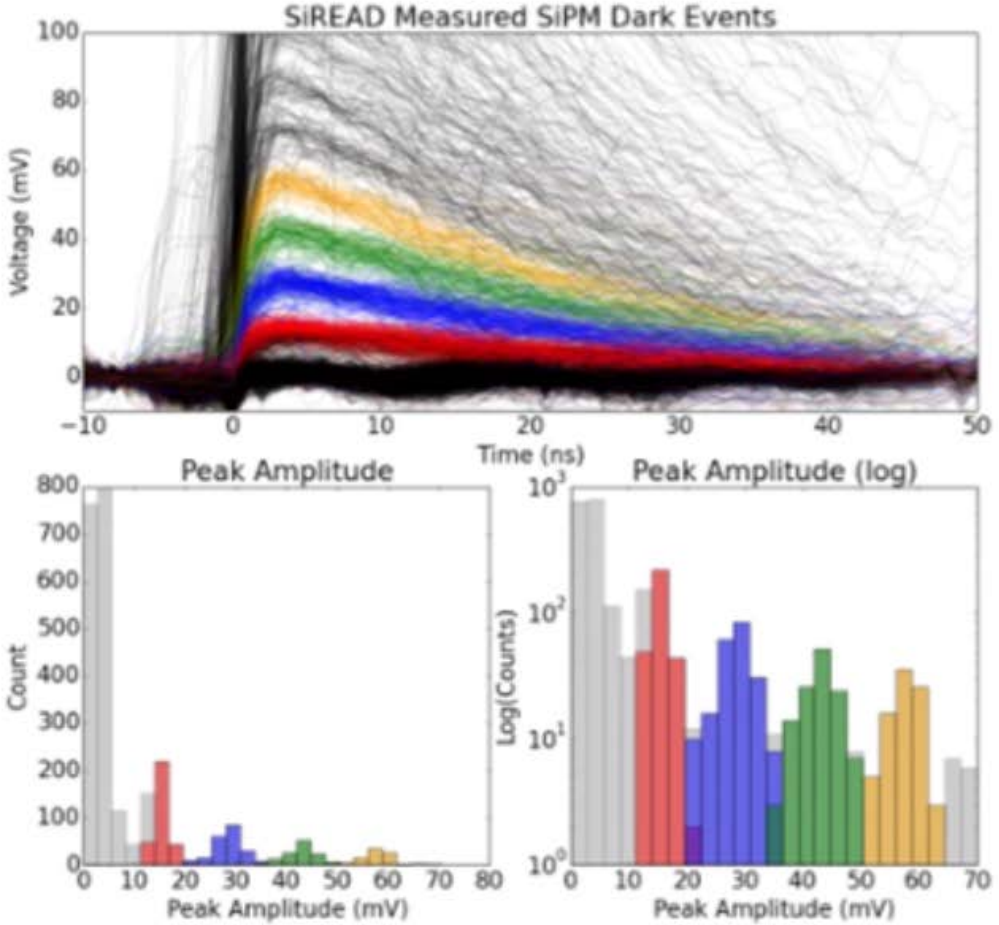


All chips, are designed with commercial grade tools and licenses and can be sold once commercialized.

SiREAD Electronics Evaluation

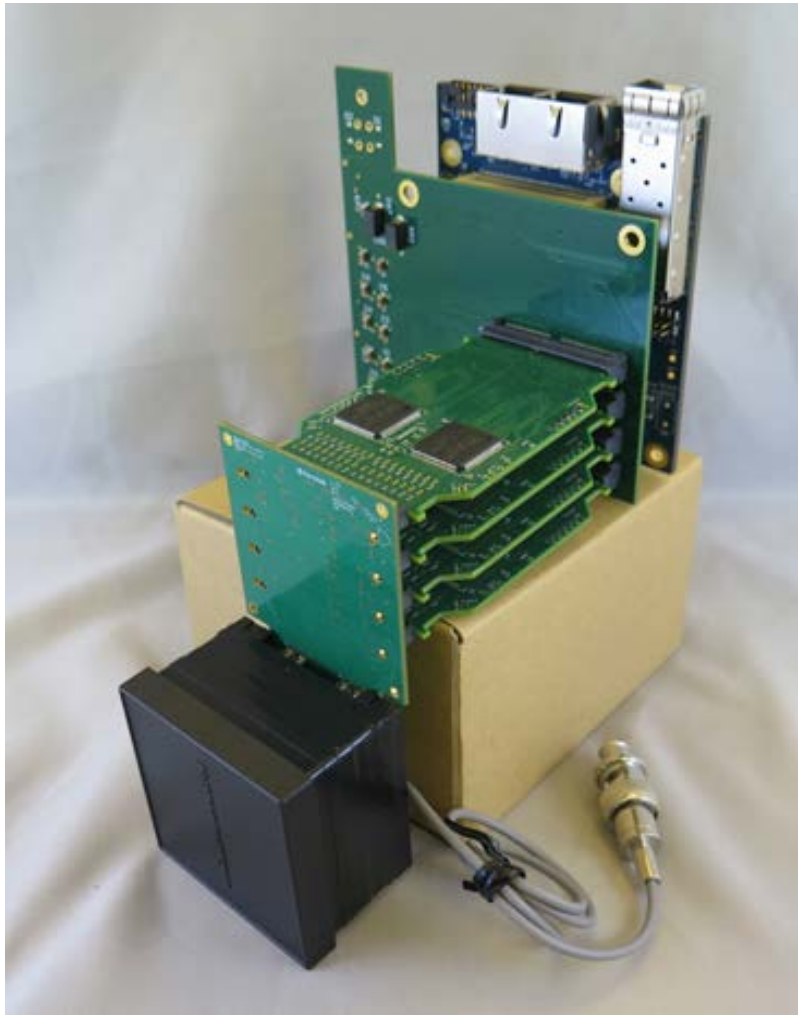




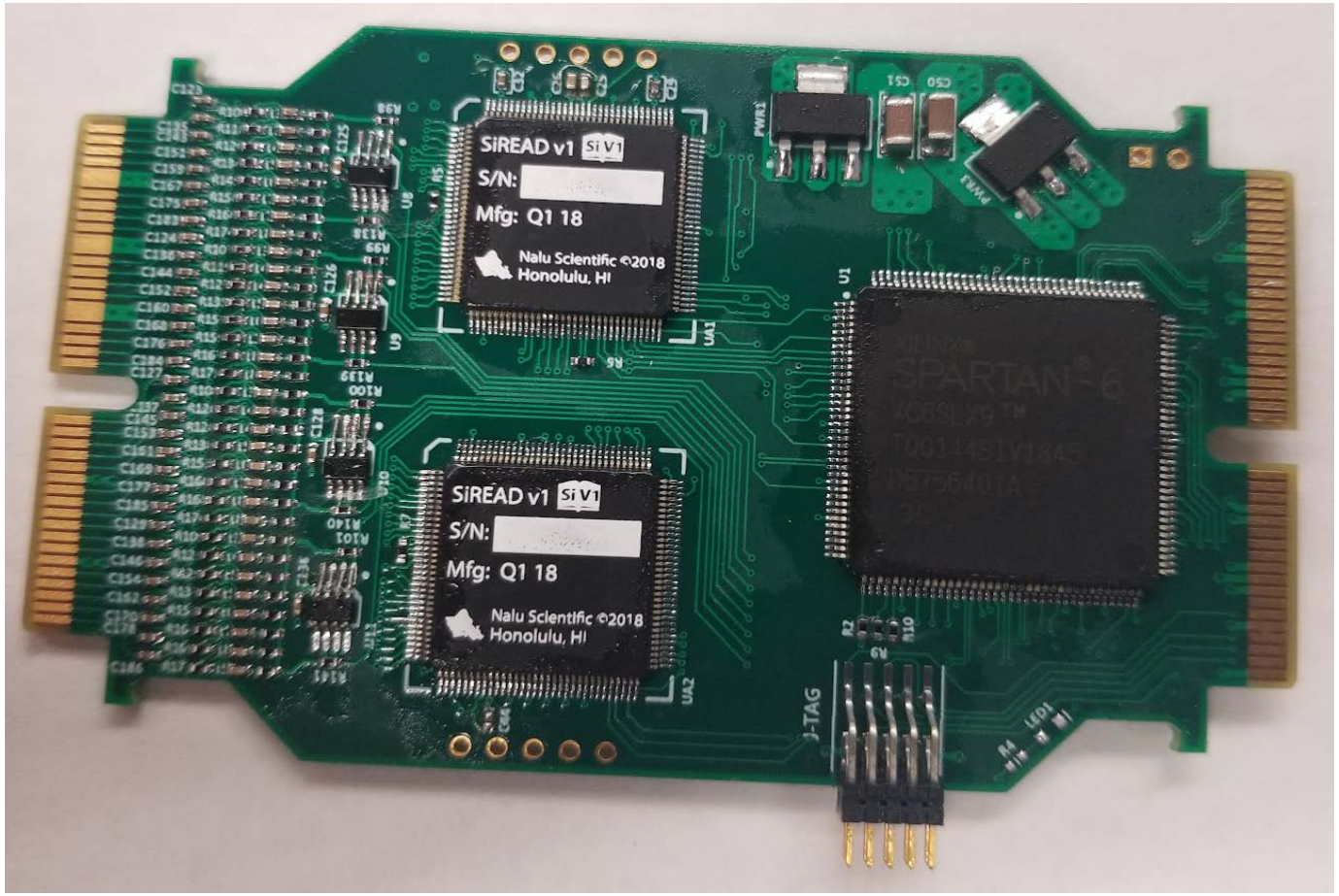


- Micrograph of the fabricated prototype SiREAD (**top left**). Prototype SiREAD on the evaluation PCB (**top middle**). Superimposed dark count waveforms recorded from a SiPM using the SiREAD operating at 1 Gsa/s (**right**). High channel count evaluation PCB for SiREAD with 32 dedicated MMCX connectors (**bottom left)**.

PMT Readout



Photograph of the first generation of 256-anode 2" PMT readout for use with mRICH prototype in the Fermilab beam test facility.



Photograph of the 64 channel SiREAD based (2x SiREAD rev.1) readout card as a building block for the 256 MA-PMT readout.

HW/FW development

- Need for robust firmware development
- Nalu Scientific team provides in-house FW development, with institutional memory
- UH provides comprehensive bench, environment and picosecond laser/photosensor testing
- UH hiring new EE post doc on July 3rd (pending hiring paperwork)
- Immediate push is to get SiREAD version of 256 anode PMT readout working; evaluate performance; design more compact version