Flashtalks
Photodetectors
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interface between photon detectors and readout is large, in some cases non trivial when integration is possible

	Neutrino Frontier	Cosmic Frontier	Energy Frontier	Rare & Precision
Sensors hiE		●		
Sensors UV	●	●		●
Sensors VIS	●	●	●	●
Sensors IR		●		
Sensors μwave/Radio		●		
Large Area	●			●
Low Background				●
Fast Timing	●	●	●	
Light collection	●	●		●

At least all these areas need to be associated with significant readout developments.

Large arrays of SIPM, and imagers

Highly multiplexed readout for SC detectors

Fast timing readout

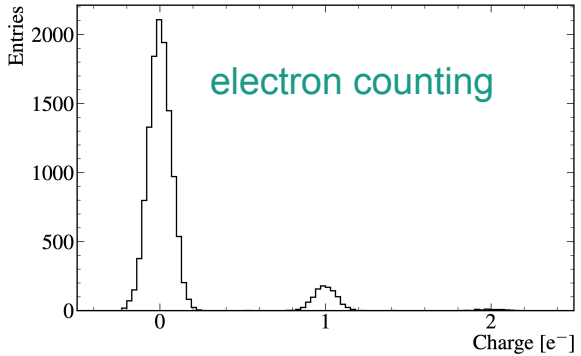
now I will focus on one specific need as an example
(obviously the one closer to my needs…)

What?

Readout systems for large arrays of CCDs and skipper-CCDs.

CMOS pixel detectors with non-destructive readout (sensor and readout integration).

On chip intelligence.



Why?

Science need

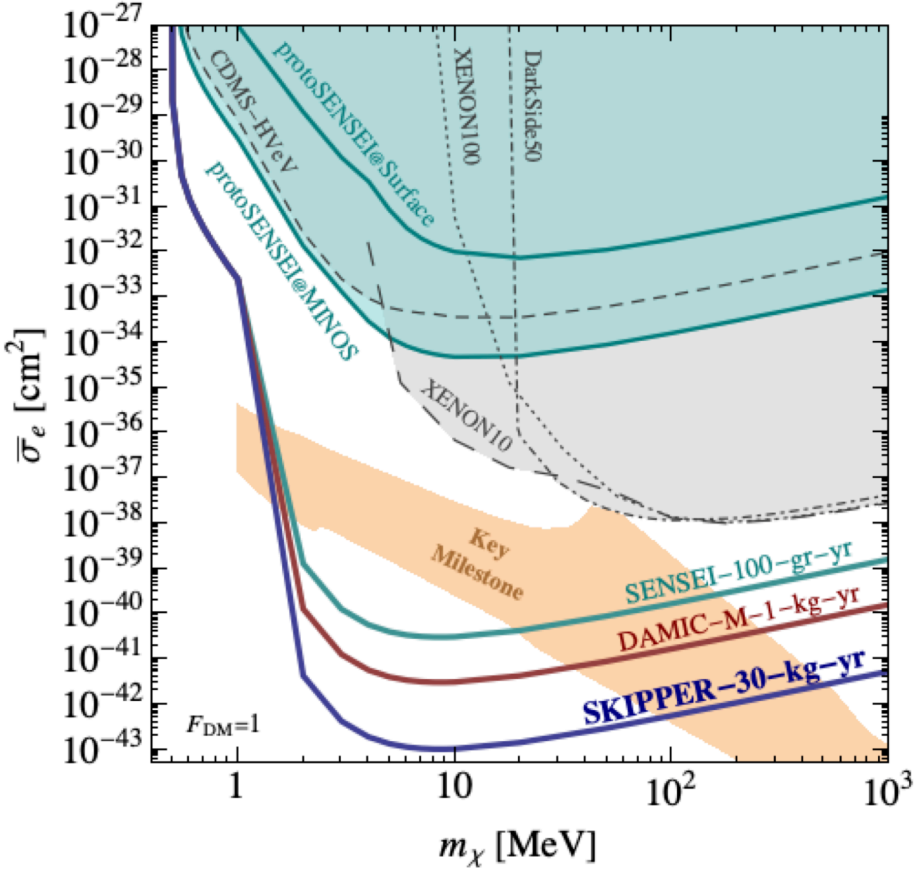
We are currently planning experiments with ~20k CCDs for direct dark matter and neutrino detection (for example https://astro.fnal.gov/science/dark-matter/oscura/) . This needs significant development on readout (low background cold ASIC front end, discrete components for backend) .

Technology opportunity

At the same time, we are facing the challenge of foundries discontinuing standard CCD processing… and this presents the opportunity to move the fabrication of these sensors into “CMOS compatible” processes. With this opportunity, we can also integrate more readout features and even some processing (intelligence) .

Maintaining / training / developing technical expertise.

Keep our ability to build the experiments with large array of low noise silicon pixel imagers, using new technology and even adding new on chip capabilities.



How?

Technological path

- ASIC developments building on experience of LSST (Paris/DAMIC-M team) and starting new efforts optimized for the non-destructive readout.
- CCD production in “CMOS compatible” processing. We are looking at 2 or 3 possibilities with companies and national labs for the fab of the new type of sensors… with some integrated electronics. Some of these sensors live in the interface between photodetectors, and readout.

Team

- collaborators for Dark Matter effort (U.Chicago, U. Washington, FNAL, LBNL, PNNL + international partners)
- QIS effort (SLAC)

Synergies?

I focused on the needs for large arrays of detectors for DM and neutrinos, but these readout developments are also needed for large arrays imagers with non-destructive readout for QIS (FNAL/ LBNL effort) and Astronomical Instruments (Alex Drilica-Wagner).

Also significant synergy with BES (we are collaborating with SLAC on this)

Conclusion

Success in scientific results produced with sensors using non-destructive readout has open new opportunity for developing large arrays of pixel sensors with non-destructive readout. Strong science drivers (DM, neutrinos) and very large synergy with other field.

Because of the technological landscape new ideas are needed for the sensors, which could allow better integration with the readout.

Comments welcomed…