Prototype announcement

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Compact, fast and distortion free SiPM detector

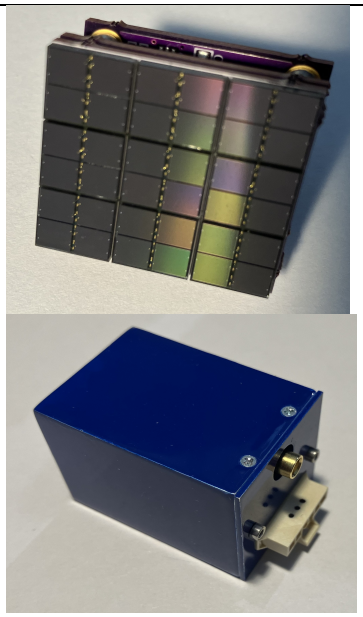
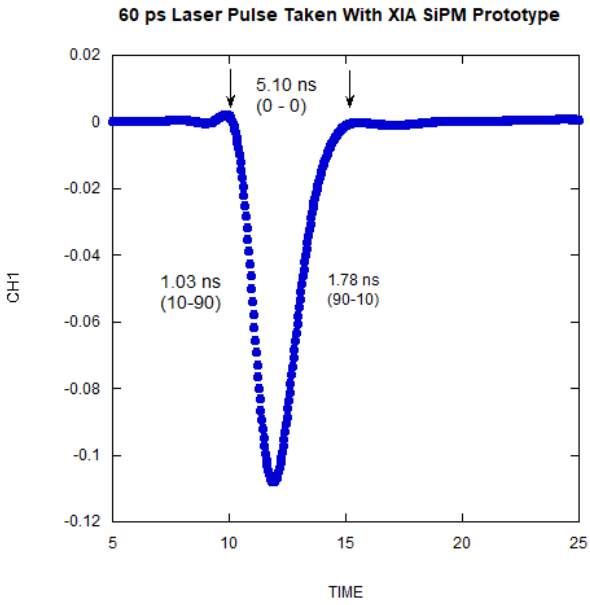


Fig. 1: 6x6 SiPM on prototype board and placed in 1" enclosure



Time scale: 30 ns

Fig. 2: Time response to 60ps laser pulse.

The SiPMs are densely mounted on their carrier board so that they may be close packed in both directions. The backside has an MCX connector for signal out and a 6 pin connector to supply +/-5V to the electronics, 35-45V for the SiPM, and ground. Fig. 1 shows both the SiPM array and packaged in an enclosure with a 1" cube of BSO-100 scintillator. While the prototype shown is 1" x 1", board layouts are readily changed to accommodate different scintillator shapes. The SiPMs do not have to be densely packed, if cost is a consideration. Fig. 2 shows the SiPM array's response to a 60 ps laser pulse at 405nm. This intrinsic response is sufficiently fast (1.03 ns 10-90 risetime, 1.78 ns fall times) to not distort even the fastest scintillator responses. While this array has a single readout, layouts with more readouts of its sub-arrays are in development..

Array features (SiPM building block)

- High PDE: 63% at 420 nm.
- Micro Cell Pitch: 40 µm
- Dark Count/Unit Area: 125 kcps/mm^2
- Peak Sensitivity: 420 nm
- Convenient Pitch: 8.26 mm x 8.26 mm
- Cells Per Block: 4 * 8334
- Recharge time constant < 50 ns
- Spectral Range: 250 – 900 nm

Array Uses

- Nuclear Physics Detectors
- Homeland Security Applications
- Nuclear Medicine
- Positron Emission Tomography
- Decontamination Instruments
- Analytical Instruments
- X-ray & Gamma-ray Detection
- Cherenkov Radiation Detection

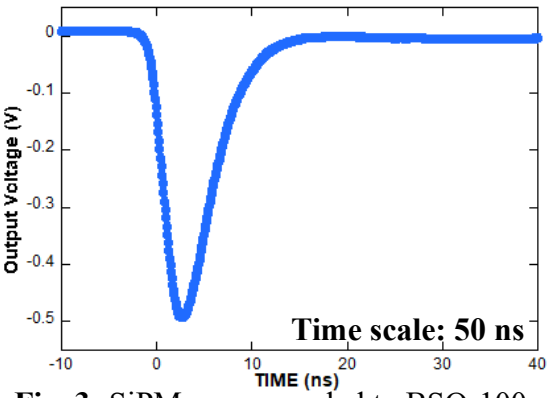


Fig. 3: SiPM array coupled to BSO-100.

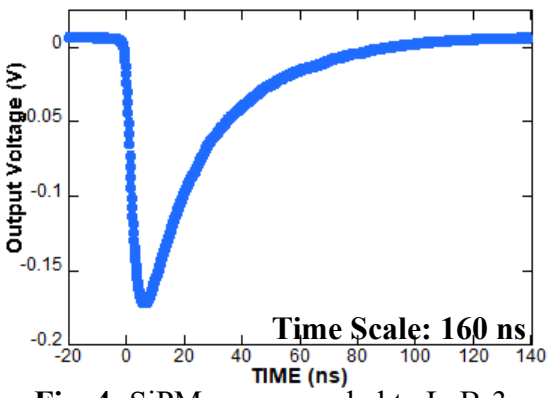


Fig. 4: SiPM array coupled to LaBr3.

These four figures show the output response when the array is coupled to BSO-100 (Fig. 3), to LaBr3 (Fig. 4), and to NaI in regular (Fig. 5A) and expanded (Fig. 5B) time scales.

The BSO-100 trace shows that the SiPM array works very well with scintillators that show a pulse shape distribution for distinguishing neutrons from gamma-rays. In particular, the region from 5 to 50 ns is not distorted, showing the same shape as a fast PMT. The SiPM array is much more compact, however, operates at lower voltages, and is also immune to magnetic fields. This is advantageous both in hand held survey instruments and in large research instruments. In the latter case the SiPM array can be tailored to directly fit the scintillator bar, or cluster of bars.

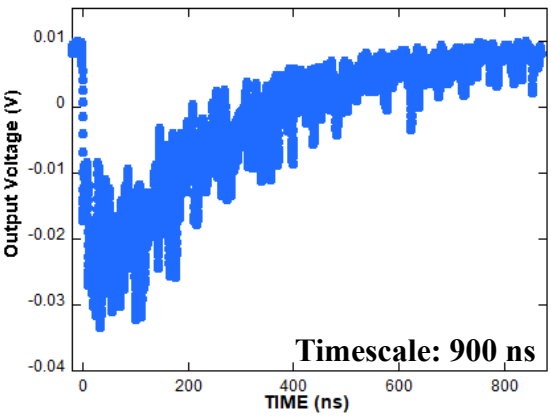


Fig. 5A: SiPM array with NaI, long timescale.

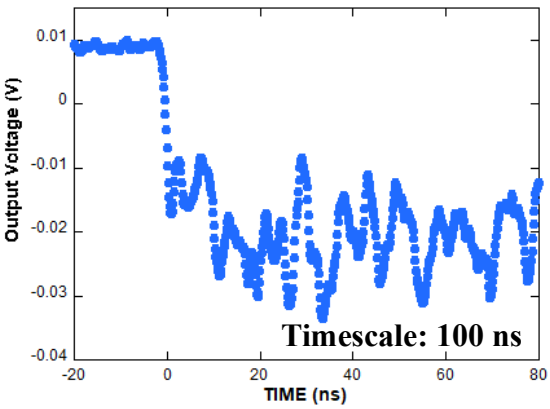


Fig. 5B: SiPM array withNaI, short timescale.

Fig. 4 (LaBr3) shows that even with a very bright and fast scintillator, the SiPM array can follow the output trace and give both timing and amplitude information.

Fig. 5A shows the array coupled to a NaI detector, with Fig. 5B showing an expanded view of the same trace. The figure shows why NaI is not generally used for precision timing measurements since it's output is a series of micro-bursts, rather than a continuous decay. It is, however, cheap and gives good energy resolution, which the SiPM array preserves.