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Performance of Large-Area 1D CRL Position Sensitive Silicon Photomultiplier Array

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The applications of previously reported two-dimensional (2D) Cap Resistive Layer (CRL) Position Sensitive (PS) SiPM were limited due to their small 6.14×6.14 mm² active area and position distortions at corner due to interaction between adjacent strip metal electrodes. In this study, we developed a 4×4 array of 1D CRL PS SiPMs with total active area of 24.6×24.6 mm². By employing a cathodes and anodes multiplexing technology based on resistors network, its readout channels are greatly reduced into two anodes and two cathodes. The coarse 1D position coordinate, i.e., which row of the array is impinged by photons, is determined from two cathode signals based on charge division mechanism of external resistors. Meanwhile, the fine 1D position coordinate, i.e., the relative position of incident light relative to the anode readout channels of pixel 1D CRL PS SiPM, is derived from the two anode signals utilizing the charge division mechanism facilitated by the intrinsic cap resistor of the 1D CRL PS SiPM. In this way, large active area of the array, high position and timing resolution can be achieved while retain less readout channel.
The preliminary results will be presented in this talk. Under a mean photoelectron number of approximately 130 and bias voltage of 32 V, the position measurement error was 54.8 ± 38.3 μm, about 0.23% of the edge length of the array, position resolution was 392.9±58.3 μm, and time resolution was 205.3±22.3 ps. Additionally, by perpendicularly arranging two 1D CRL PS SiPM arrays at the end of a scintillator, a novel 3D scintillation detector is proposed for precise acquiring the X, Y and Z interaction coordinates.

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