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Capacitively Coupled LAPPDs with 2D Pixelated Readout Planes for Ring Imaging Cherenkov Applications in High Energy and Nuclear Physics Experiments

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Large Area Picosecond Photodetectors (LAPPDs) are micro-channel based photosensors featuring hundreds of square centimeters of sensitive area in a single package and timing resolution on the order of 50 ps for a single photon detection. However, LAPPDs currently do not exist in finely pixelated 2D readout configurations that in addition to the high-resolution timing would also provide the high spatial resolution required for Ring Imaging CHerenkov (RICH) detectors. One of the recent LAPPD models, the so-called Gen II LAPPD, provides the opportunity to overcome the lack of pixellation in a relatively straightforward way. The readout plane of Gen II LAPPD is external to the sealed detector itself. It is a conventional inexpensive capacitively coupled printed circuit board (PCB) that can be laid out in a custom application-specific way for 1D or 2D sensitive area pixellation. This allows for a much shorter readout-plane prototyping cycle and provides unprecedented flexibility in choosing an appropriate segmentation that then could be optimized for any detector needs in terms of pad size, orientation, and shape. We fully exploit this feature by designing and testing a variety of readout PCBs with conventional square pixels and interleaved anode designs.

Data acquired in the lab with the LAPPD tile 97 provided by Incom will be shown using a laser system to probe the response of several interleaved and standard pixelated patterns. Results from a beam test at Fermilab Test Beam Facility will be presented as well, including world's first Cherenkov ring measurement with this type of a photosensor. 2D spatial resolutions well below 1 mm will be demonstrated for several pad configurations. Future plans, including a direct demonstration of e/p/K/p separation by a proximity focusing RICH detector prototype with a LAPPD as a photosensor in a forthcoming beam test at Fermilab in summer 2022, will be discussed.

Collaboration

Primary author: KISELEV, Alexander (Brookhaven National Laboratory)

Presenter: KISELEV, Alexander (Brookhaven National Laboratory)

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