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Characterisation of LAPPD

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This study presents a comprehensive characterization of Large Area Picosecond Photodetectors (LAPPD) of Generation II, developed by Incom Inc., with a focus on their applicability in high-performance timing and imaging systems such as RICH detectors (e.g., Belle II ARICH, LHCb RICH) and time-of-flight PET imaging. LAPPDs combine single-photon sensitivity, ~30 ps time resolution, millimeter-scale spatial resolution, and a large active area (20×20 cm^2), making them suitable for advanced particle detection applications.

The investigation centers on the effects of capacitive coupling between the monolithic ground-plane anode and the external readout pads, particularly examining how signal spread and timing performance depend on geometrical factors and pad segmentation. Using a pulsed diode laser system, spatial and timing characteristics were probed with fine granularity. Measurements confirm that signal distribution is dominantly governed by induced charge spread rather than electron diffusion, with signal confinement significantly affected by pad size and MCP-to-anode and anode-to-pad distances. A model was used to understand the observed signal spread and to find optimal system parameters.

Time resolution analyses show a primary timing peak ($\sigma \approx 27$ ps) and secondary structures consistent with backscattering effects, with resolution improving with increased photocathode-to-MCP potential, all in agreement with a simple model. The study also evaluates integration with two readout systems: PETSYS TOFPET2 ASIC, which showed effective photon detection and spatial clustering, and FastIC ASIC, which delivered excellent timing precision with low-power consumption and integrated TDC/ADC features.

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