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Simulation studies of a novel, charge sharing, multi-anode MCP detector

The next generation Ring Imaging Cherenkov (RICH) detectors for particle ID applications, at CERN, PANDA, and others place stringent requirements on photon detectors, with potentially high magnetic fields unaligned with the detector's optical axis, high event rates challenging detector lifetime, high density multi-anode readout and a high time resolution requirement typically less than 50 ps.

We are undertaking an R&D project for the TORCH collaboration, a proposed LHCb upgrade, to develop a novel multi-anode Microchannel Plate detector, with 128×8 effective pixels in a 5.3×5.3 cm^2 active area each with 50 ps RMS timing resolution. The proposed design utilises charge sharing across multiple readout anodes to i) improve spatial resolution beyond the defined anode pitch, ii) provide a well-defined charge footprint for readout even in high magnetic fields and iii) reduce the impact of manufacturing issues when producing high-density multi-anode devices.

Simulations of this hybrid multi-anode detector will be presented, covering the expected charge footprint on each readout anode and the impact of utilising charge sharing between anodes to improve the detector's spatial resolution. This includes simulating the impact of the TORCH project current readout solution using the NINO amplifier/discriminator ASIC and the HPTDC, a 25 ps resolution time-to-digital converter.

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