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Robust photocathodes and spatial resolution studies of resistive PICOSEC Micromegas precise-timing detectors

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The PICOSEC Micromegas precise-timing detector concept, combining a Cherenkov radiator, semi-transparent photocathode and double stage amplification stage, has demonstrated a time resolution below 20ps for minimum ionising particles. To extend the versatility of PICOSEC Micromegas detectors for various applications, specific developments of robust detector elements including carbon-based photocathodes and resistive Micromegas as well as detector variants targeting improved spatial resolution and rate-capability are presented.

Photocathodes made on thin layers of diamond-like carbon (DLC) or boron-carbide (B4C) were evaluated as an alternative to CsI for improved stability under prolonged ion back flow. Time resolution values better than 40 ps were achieved and the optimal thicknesses of semi-transparent photocathodes of the two materials were determined.

PICOSEC prototypes based on resistive Micromegas technology have previously been shown to achieved comparable spatial resolution to non-resistive prototypes. Multi-pad detectors can provide spatial information of detected particles and resistive or capacitive charge sharing may be exploited to increase spatial resolution. Prototypes with higher readout granularity down to 2.5 mm pitch are presented and compared for achievable spatial resolution and the impact of sharing signals across multiple readout pads on achievable timing precision.

While resistive Micromegas are favourable for challenging operating conditions, high anode resistivity limits the achievable rate capability. A resistive PICOSEC Micromegas prototype using vertical charge evacuation with double DLC layers is presented to combine protection from discharges with improved rate capability. The presented developments target specific optimisation of the PICOSEC Micromegas concept and highlight the versatility of this precise-timing concept.

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