

PICOSEC Micromegas precise-timing gaseous detectors and studies on robust photocathodes

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The PICOSEC Micromegas (MM) detector is a precise-timing gaseous detector based on a Cherenkov radiator coupled with a semi-transparent photocathode and a MM amplifying structure, targeting a time resolution of tens of picoseconds for minimum ionising particles. The first single-pad prototypes demonstrated a time resolution below 25 ps and several developments are being pursued to make the concept suitable for physics applications. The objective is to build robust multi-channel detector modules for large-area detection systems requiring good time resolution. Intense R&D activities within PICOSEC have covered all areas from simulations, design, production and assembly to measurements in laboratory conditions as well as with 150 GeV/c muon beams. One of the project's milestones was scaling up the prototype to a 100-channel detector with an active area of 10x10 cm². The optimised device showed a time resolution below 18 ps for individual pads, proving that the excellent timing performance of the single-channel proof of concept can be transferred to the 100-channel prototype. Regarding robustness, a 10x10 cm² area resistive PICOSEC MM of 20 M Ω /□ was produced and a time resolution of 20 ps for individual pads was obtained. Furthermore, detailed measurements of carbon-based photocathode samples, including Diamond Like Carbon (DLC) and Boron Carbide (B4C) are ongoing to find an alternative to Cesium Iodide. Preliminary results from single- and multi-channel detectors equipped with DLC and B4C photocathodes showed a time resolution below 35 ps. Finally, complete read-out chain measurements using RF pulse preamplifiers and a SAMPIC digitiser were successfully performed, confirming the system to be appropriate for studying multi-channel detector response. Efforts dedicated to scale up the detector, improve the robustness and integrate scalable electronics make the PICOSEC MM concept more suitable for large experiments requiring enhanced endurance while maintaining good timing properties.

Collaboration

PICOSEC Micromegas Collaboration

Role of Submitter

I am the presenter

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