

## A large area 100 channel PICOSEC Micromegas detector with sub 20 ps time resolution

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The PICOSEC Micromegas precise timing detector is based on a Cherenkov radiator coupled to a semi-transparent photocathode and a Micromegas amplification structure. The first proof of concept single-channel small area prototype was able to achieve time resolution below 25 ps. One of the crucial aspects in the development of the precise timing gaseous detectors applicable in high-energy physics experiments is a modular design that enables large area coverage. The first 19-channel multi-pad prototype with an active surface of approximately 10 cm<sup>2</sup> suffered from degraded timing resolution due to the non-uniformity of the preamplification gap. A new 100 cm<sup>2</sup> detector module with 100 channels based on a rigid hybrid ceramic/FR4 Micromegas board for improved drift gap uniformity was developed. Initial test beam measurements with 80 GeV muons showed large improvements in timing response over measured pads and a time resolution below 25 ps. More recent measurements with a new thinner drift gap detector module and newly developed RF pulse amplifiers show that the resolution can be enhanced to a level of 16 ps. This work will present the development of the detector from simulations, design, production, and test beam commissioning with a focus on the timing performance of a thinner drift gap detector module in combination with new electronics using an automated timing scan method.

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