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Picosec Micromegas detector for precise muon timing in the Muon Collider detector

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Picosec is a novel micropattern gaseous detector (MPGD) proposed by the RD51 Picosec MicroMegas collaboration to overcome the limitations of classical MPGDs regarding timing performance. The concept is based on detecting Cherenkov light emitted by an impinging particle in a proper radiator. A photocathode converts such light into electrons, and a double amplification stage MicroMegas detector detects them. The Picosec RD51 collaboration has already demonstrated the functionality of this technology reaching, in the best operating conditions, a time resolution of 16.7ps. In particular, a prototype with an area of 100cm² with 100 readout channels reached an average time resolution over the whole area of 18ps.

This technology opens the timing sector on tens of picoseconds to gaseous detectors, making them competitive with other fast-timing technologies but with the traits of MPGD.

Picosec technology is currently proposed for the Muon Collider detector as a muon timing station where it can enhance the quality of the muon tracks. We aim to build and develop a robust and reliable standard for this detector technology capable of operating in next-generation facilities. This goal can be reached by searching for radiation-hard photocathodes, new eco-friendly gas mixtures and robust Cherenkov radiators.

This technology well fits the requirements of a Muon Collider Detector. In this contribution, we will use results from detailed simulations of the expected beam-induced background to motivate the use of this detector technology. We will also present results from 2022 test beams showing time resolutions with different combinations of Cherenkov radiators and photocathodes, followed by the more recent measurements of the rate capability of the detector and early tests on new eco-friendly gas mixtures.

Primary author: FIORINA, Davide (INFN Pavia)

Presenter: FIORINA, Davide (INFN Pavia)