

Test-beam performance of a TORCH prototype module

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The TORCH time-of-flight detector is designed to provide a 15 ps timing resolution for charged particles, resulting in K/pi (p/K) particle identification up to 10 (15) GeV/c momentum over a 10 m flight path. Cherenkov photons, produced in a quartz plate of 10 mm thickness, are focused onto an array of micro-channel plate photomultipliers (MCP-PMTs) which measure the photon arrival times and spatial positions. A half-scale (660 x 1250 x 10 mm³) TORCH demonstrator module instrumented with customised MCP_PMTs has been tested in a 5 GeV/c mixed proton-pion beam at the CERN PS. The MCP-PMTs with the active area 53 x 53 mm² and granularity 64 x 8 pixels have been developed in collaboration with an industrial partner (Photek). With 30 photons per particle detected, the 15 ps per particle time resolution requires single-photon resolution of 70 ps. The timing performance and photon yields have been measured as a function of beam position in the radiator, giving measurements which are consistent with expectations. A possible TORCH design of the particle identification system in the LHCb experiment has been simulated and the potential for particle identification performance for high luminosity running has been evaluated.

Secondary track (number)

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