

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 π/K particle identification up to 10 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 ($660 \times 1250 \times 10 \text{ mm}^3$) TORCH demonstrator module has been tested in a 5 GeV/c mixed proton-pion beam at the CERN PS. Customised MCP-PMTs of active area 5 cm^2 and granularity 64×64 pixels have been employed, which have been developed in collaboration with an industrial partner. The single-photon timing performance and photon yields have been measured as a function of beam position in the radiator, giving measurements which are consistent with expectations. The expected performance of TORCH for high luminosity running of the LHCb upgraded experiment has been simulated.

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