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Performance studies of the TORCH detector

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The Time Of internally Reflected Cherenkov detector (TORCH) is a proposed large-area time-of-flight detector, which aims to enhance the particle identification performance of the LHCb experiment in the 2–10 GeV/c momentum range. A TORCH module consists of a 10 mm thick quartz plate in which the positions and arrival times of Cherenkov photons from a charged track are detected by highly segmented MCP-PMTs. A general overview of TORCH and its operating principles will be presented, which will then be highlighted by the excellent performance of a 1.25 m length TORCH prototype module (Proto-TORCH). This was equipped with two MCP-PMTs and exposed to an 8 GeV/c test-beam at CERN. Single-photon timing resolutions of between 70-110 ps have been measured, dependent on the beam position in the plate, and photon yields agree with expectations. Another test-beam period has been scheduled for autumn 2022 when the existing TORCH optics will be equipped with a full complement of MCP-PMT detectors and readout, allowing a full system test to be made. Finally, the projected PID performance of TORCH at the LHCb experiment will be shown.

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