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A large-area detector for precision time-of-flight measurements at LHCb

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The TORCH (Time Of internally Reflected CHerenkov light) detector is an innovative high-precision time-of-flight system which is suitable for large areas, up to tens of square metres, and is being developed for the upgraded LHCb experiment. The TORCH provides a time-of-flight measurement from the imaging of photons emitted in a 1 cm thick quartz radiator, based on the Cherenkov principle. The photons propagate by total internal reflection to the edge of the quartz plane and are then focused onto an array of Micro-Channel Plate (MCP) photon detectors at the periphery of the detector.

The goal is to achieve a timing resolution of 15 ps per particle, over a flight distance of 10 m. This will allow particle identification in the challenging intermediate momentum region, up to 20 GeV/c. Commercial MCPs have been tested in the laboratory and demonstrate the required timing precision. An electronics readout system based on the NINO and HPTDC chipset is being developed to evaluate an 8x8 channel TORCH prototype in a testbeam. The expected performance of the TORCH detector at LHCb in full simulation will also be presented.

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