Contribution ID: **245**   Type: **Talk**

Test-beam and laboratory characterisation of the TORCH prototype detector

Tuesday 16 February 2016 14:25 (20 minutes)

The TORCH time-of-flight (TOF) detector is being developed to provide particle identification between 2-10 GeV/c momentum for a flight distance of 10 m. It has been proposed for the upgrade of the LHCb experiment to complement the particle identification capabilities of the RICH detectors. TORCH is designed for large-area coverage, up to 30m^2, and has a DIRC-like construction with 10 mm thick synthetic amorphous fused-silica plates as a radiator. Cherenkov photons propagate by total internal reflection to the plate periphery and there are focused onto an array of position-sensitive micro-channel plate detectors, customised in industry. The goal is to achieve a 15 ps time-of-flight resolution per incident particle by combining arrival times from multiple photons. The photon detectors will provide a spatial resolution of 0.4 mm by 6.6 mm in the vertical and horizontal directions, respectively, by incorporating a novel charge-sharing technique to improve the spatial resolution to be better than the pitch of the readout anodes. Prototype photon detectors and readout electronics have been tested and calibrated in the laboratory. These tests, together with the construction of a prototype TORCH detector and its first test beam measurements, will be presented.

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Session Classification: Cherenkov

Track Classification: Cherenkov Detectors