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Feasibility studies of LAPPD as a timing layer for the Upgrade-2 of LHCb calorimeter

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The Upgrade-2 of the LHCb experiment aims to operate with an instantaneous luminosity a factor seven higher than the current one to reach ultimate precision in several domains of its physics program. This objective challenges the development of subdetectors able to cope with the foreseen high-occupancy regime.
The measurement of the time of hits in the detector will be a crucial new feature. Simulation studies show that a resolution between 10 and 20 ps is essential to exploit the time separation of the primary proton-proton collisions and mitigate the pileup.

The "Large Area Picosecond Photo Detector" technology (LAPPD) is a candidate to constitute a timing layer placed between the front and back sections of the electromagnetic calorimeter of LHCb Upgrade-2 (PicoCAL). The LAPPD is the largest microchannel-plate photomultiplier ever built, all made with inexpensive materials. The high charged-particle multiplicity at shower maximum permits efficient operations even without the photocathode, avoiding the issues related to its ageing. This presentation reports the status of the art of the ongoing R&D campaign. Four models have been characterized so far: the Gen-I with stripline readout and the Gen-II with external pixelated readout, both with either 10- or 20-μm pore size. A time resolution close to the target was measured with electrons from 1 to 5.8 GeV at DESY and from 20 to 100 GeV at SPS. The radiation hardness of the MCP tiles was verified up to 10^{16} protons/cm^2 at IRRAD and 300 C/cm^2 with a UV lamp in the laboratory. The performances at high rates were tested with a laser ($\lambda = 405$ nm). They will be crucial for the upcoming development steps.
As a spin-off of the project, the concept of a new radiation-resistant photocathode was proposed. Its design will be described, including details on the construction and operation of prototypes.

Collaboration

INFN Bologna, LHCb

Role of Submitter

The presenter will be selected later by the Collaboration

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