Silicon Photomultiplier based dual-readout fibre calorimeter: firsts results and the pathway beyond the proof-of-concept

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Detectors for future experiments in high energy physics will need to allow for extreme precision in reconstructing trajectories and energies of both isolated particles and jets produced in the particle collisions. The energy resolutions obtained for hadronic showers are typically worse than the ones for electromagnetic showers, mainly because of event-by-event fluctuations in the electromagnetic fraction. The dual-readout calorimetric technique reconstructs the event by event electromagnetic fraction through the simultaneous measurement of the scintillating (S) and the Cherenkov (C) light produced in the shower development. Using this technique, a first calorimeter module with Silicon PhotoMultiplier (SiPM) readout was designed, constructed and tested on beam.

In the module, S and C fibres were alternately positioned, within the converter matrix, with a pitch of 1.5 mm and individually connected to a SiPM. This provided an unprecedented readout granularity. Since the S and C light yields differed by about 2 orders of magnitude, minimizing the optical crosstalk represented a significant challenge to the exploitation of the dual-readout principle.
An overview of the latest test beam results (i.e. crosstalk, linearity response and particle separation capability) and the R&D program required to move towards a prototype of a building block for a calorimeter that could be used in detectors at future accelerators will be discussed.