Because of the challenging conditions in which they will be operated, future calorimeters will need to improve their energy and timing resolutions as well as their ability to distinguish particles. We proposed earlier an approach based on crystal fibers to form a fully homogeneous calorimeter [1]. These extrinsic scintillators can also be used undoped and act as very efficient Cherenkov radiators. Both undoped and doped crystal fibers can thus be assembled so that homogeneity, dual readout and particle identification can be achieved simultaneously. The recent progress in shaped growth of inorganic single crystals [2,3] now allows conceiving projective designs and tracker-like capabilities. In case a fully homogeneous design cannot be afforded, sampling designs having a first homogenous layer were demonstrated to yield the best performances [4]. To keep an overall unity, crystal fibers are excellent candidates since they fit both in homogenous and sampling configurations [5].

From the point of view of timing resolution, they are also dense enough to be able to extract from very tiny layers enough light to generate a fast time stamp, as in [6], directly from the inside of the calorimeter. This latter advantage will become decisive for pileup mitigation at higher luminosities.

This contribution presents the results obtained with crystal fibers of lutetium aluminium garnet (LuAG, Lu₃Al₅O₁₂) based on beam tests both at CERN and Fermilab. We also present Geant4 simulations which allowed studying different configurations of a fiber-based detector and discuss possible implementations into a real calorimeter.

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References