Proof-of-principle of a new geometry for sampling calorimetry using inorganic scintillator plates

Francesca Nessi-Tedaldi*, Günther Dissertori, Qinhua Huang, David Luckey#, W. Lustermann, Sebastian Lutterer, Felicitas Pauss, Milena Quittnat, Rainer Wallny

Institute for Particle Physics, ETH Zurich, Otto-Stern Weg 5, CH - 8093 Zurich, Switzerland

Sampling calorimeters are being considered as an option for detector upgrades at CERN, for running after the planned High-Luminosity upgrade (HL-LHC). There, proton-proton collisions will produce energetic hadron fluences up to $5 \times 10^{14}$ cm$^{-2}$ in the large-rapidity regions of the calorimeters. Some inorganic scintillators have been identified, that are likely to perform adequately in the strong radiation field and high particle fluences present during HL-LHC running. A sampling calorimeter employing them might offer an interesting option in terms of costs and short light path. Inorganic crystalline materials however present mechanical challenges compared to plastic scintillators. This talk describes an innovative light collection geometry that minimizes the mechanical processing complexity, and presents first test results demonstrating a successful signal extraction.

![Figure 1: Concept drawing for an innovative sampling calorimeter geometry using inorganic scintillator plates as an active material.](image)

The geometry (Fig. 1) consists of a sampling calorimeter made of passive absorber layers (W or Pb e.g.) interleaved with layers of an active medium made of inorganic scintillating crystals. Wavelengthshifting (WLS) fibers run along the four long, few mm wide chamfers of the stack, transporting the light to photodetectors at the rear. To maximize the amount of scintillation light reaching the WLS fibers, the scintillator chamfers are depolished. The simplicity of the design minimizes the mechanical processing complexity, compared to other geometries with grooves or holes machined through the stack. It is shown herein that this concept is working for Cerium Fluoride [1] as a scintillator. Coupled to it, several different types of materials are tested as WLS medium. In particular, materials that might be sufficiently resistant to the HL-LHC radiation environment, such as LYSO:Ce and Cerium-doped quartz, are compared to conventional plastic WLS fibers. Finally, an outlook is presented on the further possible optimization of the different components.

* Corresponding author e-mail: Francesca.Nessi-Tedaldi@cern.ch
# Also at Massachusetts Institute of Technology, Cambridge, Massachusetts, USA

References