

FoCal - a high-granularity electromagnetic calorimeter for forward direct photon measurements at LHC

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The measurement of direct photon production at forward rapidity ($y \sim 3-5$) at the LHC provides access to the structure of protons and nuclei at very small values of fraction momentum ($x \sim 10^{-5}$). FoCal, an extremely-high-granularity Forward Calorimeter covering $3.5 < \eta < 5.3$ is proposed as a detector upgrade to the ALICE experiment. To facilitate the design of the upgrade and to perform generic R&D necessary for such a novel calorimeter, a compact high-granularity electromagnetic calorimeter prototype has been built. The corresponding R&D studies will be the focus of this presentation. The prototype is a Si/W sampling calorimeter. It was instrumented with 24 layers of Monolithic Active Pixel Sensors, a total of 39M pixels. We will report on performance studies of the prototype with test beams at DESY and CERN in a broad energy range. The results of the measurements demonstrate a very small Molière radius (~ 11 mm) and good linearity of the response. Unique results on the detailed lateral shower shape, which are crucial for the two-shower separation capabilities, will be presented. We will compare the measurements to GEANT-based MC simulations, which additionally include a modeling of charge diffusion. The studies demonstrate the feasibility of this high-granularity technology for use in the proposed detector upgrade. They also show the extremely high potential of this technology for future calorimeter development.

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